



**REQUEST FOR PROPOSAL
FOR THE PROVISION OF CONSULTANT SERVICES FOR
HIGH SCHOOL INTERSECTION DESIGN STUDY**

PROPOSAL CALL: June 13, 2023

PROPOSALS DUE: July 4, 2023, 3:00 PM EST

2023-RFP-050

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1. PROJECT OVERVIEW

The City is seeking to retain a Consultant for the High School Intersection Design Study project. The Consultant's team will be retained to provide technical and professional services for the Project.

The City invites individual firms or consortiums of firms to submit Proposals for the above-referenced Project in accordance with the terms and conditions of this Request for Proposal document.

1.1 Background

1.1.1 Location

Iqaluit is the capital of the Nunavut Territory and is located at the south end of Baffin Island near the end of Frobisher Bay (63°45'N latitude and 68°31'W longitude). Access to Iqaluit is provided by regular scheduled commercial aircraft year-round, snowmobile trails from other Baffin Island communities in the winter, and sealift from the port of Montreal and Valleyfield in the summer.

1.1.2 Geology and Terrain

Iqaluit's location is above the tree line and within the permafrost zone of Canada. The region generally consists of glacially scoured igneous/ metamorphic terrain. In some locations, a thin layer of organic material is found.

1.1.3 Climate

Iqaluit has an Arctic climate with an average January temperature of -21.5°C and July average temperature of 8°C. The annual precipitation is made up of 19.2 cm of rainfall and 255.0 cm of snowfall for a total of 43.0 cm of precipitation. The prevailing winds are northwest at 16.7 km/hr.

1.1.4 City Growth and Population

The City is the newest Capital City in Canada and as a result has experienced a period of rapid development and growth. Iqaluit is the seat of government for the Territory of Nunavut and is the home base of many federal and territorial government departments. The City is rapidly developing into a regional center for the territory with many northern businesses in Inuit organizations making it their base of operations. The current population of Iqaluit is estimated at about 7,000 people with an average annual growth rate between three and four percent.

1.1.5 Land Ownership System

Iqaluit has a unique land ownership system. The major land owners in Iqaluit are the Commissioner of Nunavut, the City and the regional Inuit associations. These entities in turn lease land to individuals, corporations and other government departments. The

City land is administered by a land acquisition by-law and by a Territorial Statute. Generally speaking, there is no private ownership of land.

1.2 Definitions

The following terms and definitions listed shall apply within this RFP:

| | |
|------------------------------|---|
| <i>City/ Client/ Owner</i> | means the Municipal Corporation of the City; means the entity as defined in the Supplementary Conditions, which may be the same entity as the City as defined herein. |
| <i>City Representative</i> | means the individual, assigned to the Project, who will be representing the City. |
| <i>City Website</i> | means www.iqaluit.ca . |
| <i>Class A Estimate</i> | means an estimate that is accurate to +/- 10% that is used to establish cost for the construction of the Project and is based on 99% complete design package which is ready for tender. |
| <i>Class B Estimate</i> | means an estimate that is accurate within +/- 15% and is based on a 66% design development. |
| <i>Class C Estimate</i> | means an estimate that is accurate within +/- 20% and is based on a 33% design development. |
| <i>Class D Estimate</i> | means an estimate that is accurate within +/- 30% and is based on conceptual design sketches. |
| <i>Closing Time</i> | means the time set out in paragraph 4.1. |
| <i>Contractor</i> | means the entity who will be providing construction services to perform the work. |
| <i>Construction Contract</i> | means the executed agreement between the City and the Contractor for the work. |
| <i>Evaluation Committee</i> | means a committee appointed by the City in order to evaluate all submitted proposals in order to determine a preferred proponent. |
| <i>Preferred Proponent</i> | means the company or firm that has been selected by the City's Evaluation Committee and who will initially discuss the contract arrangements based upon acceptance of the proponent's proposal. |

| | |
|---------------------------------|--|
| <i>Consultant</i> | means the Consultant who will provide the technical and professional services defined in the Request for Proposal. |
| <i>Professional Services</i> | means the technical and professional services to be provided by the Consultant for this contract. |
| <i>Project</i> | means the High School Intersection Design Study . |
| <i>Project Manager</i> | means the Project Manager assigned by the City, who will be responsible for managing the execution of the Project. |
| <i>Project Team</i> | means the group of people which includes the City Representative, the Project Manager, the Discipline Design Leaders and any other person invited from time to time by the City Representative of the Project Manager. |
| <i>Proponent</i> | means a company or firm intending to submit a Proposal and from whom a Proposal submission was received. |
| <i>Proposal</i> | means the document submitted in response to the Request for Proposal. |
| <i>Supplementary Conditions</i> | means the Supplementary Conditions forming APPENDIX B. |
| <i>This contract</i> | means the Consultant contract for which this Request for Proposal is issued. |
| <i>User group</i> | means the City or the users of the facility for which the City is responsible. |

1.3 Project Scope

The City is seeking a consultant to provide stakeholder engagement and engineering concept design services for improving vehicle and pedestrian traffic at the High School Intersection and high school entrance/exit loop. The City would like the consultant to further analyze previous recommendations made related to this area and consult the appropriate City and external stakeholders in order to develop a final recommendation and development plan as it relates to improving and managing vehicle and pedestrian traffic in this area.

It is the City's intent to have the study completed before the end of 2023.

Below is a screenshot taken from the City's GIS tool that shows the area to be studied under this scope. For clarity, the scope area has been identified by a purple box.



2. INSTRUCTIONS TO PROPONENTS

2.1 Submission

Proponents must submit their proposals by electronic submission (PDF format), through MERX before July 4, 2023, 3:00 PM EST. MERX can be accessed via the following website link – <https://www.merx.com/>. Proponents must address proposals to:

City of Iqaluit
 Tami Adeleke
 Project Officer of Engineering and Capital Planning
 901 Nunavut Drive, P.O. Box 460
 Iqaluit, Nunavut, X0A 0H0

Proponents will be required to submit a Technical and Financial Submission as part of their offer, in separate files. Files should be labeled as follows:

Technical Submission: ***“TECHNICAL PROPOSAL – 2023-RFP-050 / High School Intersection Design Study – Proponent Name”***



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Financial Submission: ***“FINANCIAL PROPOSAL – 2023-RFP-050 / High School Intersection Design Study – Proponent Name”***

It is the Proponent’s responsibility to confirm successful submission of the proposal to MERX prior to the deadline.

The final decision on whether to accept late Proposals is at the City’s discretion.

2.2 Inquiries

All inquiries concerning this RFP are to be directed by email only to:

Jared Wright
Colliers Project Leaders
Email: jared.wright@colliersprojectleaders.com

Shuyue Wang
Colliers Project Leaders
Email: shuyue.wang@colliersprojectleaders.com

To ensure consistency and fairness to all Proponents, all firms who have received the RFP will receive information with respect to significant inquiries in the form of written addenda or clarifications. Verbal explanations or instructions will not be binding.

The deadline for submitting inquiries will be on June 27, 2023, 3:00 PM EST.

2.3 Addenda

If it is determined that an amendment is required to this RFP, a written addendum will be posted via Merx and the City’s website. It is the Proponents responsibility to check Merx and the City’s website to confirm whether an addendum has been posted. The only way this RFP may be added to or amended in any way is by a formal written addendum. No other communication whether written or oral from any person will affect or modify the terms of this RFP or may be relied upon by any Proponent.

The City may amend, supplement or otherwise modify this RFP at any time and from time to time prior to the Proposal submission date, only by written addenda.

2.4 Proponent Requirements

The successful Proponent must have a valid City of Iqaluit Business License prior to commencement of the Project. The Preferred Proponent shall apply for a license immediately upon notification of award, should they not hold a valid license.

2.5 Opening of the Proposals

There will be no public opening of the Proposals.

2.7 Validity of Offer

The proposals shall remain open for acceptance for a period of not less than sixty (60) calendar days from the closing date of this Request for Proposal.

2.8 Intended RFP Process Schedule

The City estimates the schedule for the Request for Proposal process milestones will be as follows:

Table 1 – RFP Process Schedule

| Milestone | Date |
|----------------------------------|----------------------------|
| Issue RFP | June 13, 2023 |
| Last Day for Proponent Questions | June 27, 2023, 3:00 PM EST |
| Last Date for Issue of Addendum | June 28, 2023 |
| RFP Closes – Submission Deadline | July 4, 2023, 3:00 PM EST |
| Contract Award | July 28, 2023 |
| Project Kick-Off Meeting | August 4, 2023 |

3. PROPOSAL REQUIREMENTS

Proponent submissions should be prepared in sections, with the content of each section as specified below. Concise submissions which address the section requirements are encouraged. Where a maximum number of pages are specified, each page is based on a single-side of an 8 ½ x 11 sheet, with text no smaller than size 11 Arial font. The technical submission will be limited to twenty (20) pages single-sided with three (3) additional 11" x 17" pages for schedule and level of effort table. There are no page limits or restrictions to the financial submission.

The technical submission must not have any financial details included. If aspects of the financial offer are included in the technical submission, the City may choose to disqualify the Proponent.

3.1 Technical Submission Requirements

3.1.1 Section A – Understanding of the Project (10 points)

Provide a written statement demonstrating the Proponent's understanding of the overall Project, the goals and objectives of this assignment, and its relevance to the overall delivery of the Project. Identify any risks and challenges, based on the Proponents

understanding of the Project, based on the information presented in this RFP, and provide mitigation measures which will ensure successful project delivery.

Provide a description of the Proponent's vision for the assignment by comparison and contrast to reference projects which are similar examples of the Proponent's work. The details of each project should be included at Section B. The Evaluation Committee is interested in understanding how these reference projects responded to the project requirements and how these relate to the Proponent's understanding of the requirements for this assignment.

3.1.2 Section B – Reference Projects (15 points – 5 points per project)

Provide information for Projects completed in the last 10 years that are relevant to this project. Provide three (3) reference projects. The projects listed should illustrate experience in the following areas:

- .1 Preparing concept sketches for intersection improvements
- .2 Preparing concept sketches and phasing plans for road or civil projects located in Iqaluit or a similar northern region
- .3 Engaging internal and external stakeholders from different entities in order to prepare a solution that has been deemed successful for the direct client as well as external stakeholders

The Proponent should describe their roles and responsibilities on each of the projects, whether the projects were joint ventures along with the names of the other parties of the joint venture, and a brief description of the project/ assignment. For each project, identify a Client contact and provide contact information (email and phone number). The Evaluation Committee may consult with the persons indicated as references by the Proponents in order to obtain feedback on the Proponent's performance on previous Projects and to understand the relationship between the Client and the Proponent. The technical ratings may be adjusted, based on the interviews and feedback from reference consultations. Proponents must ensure that phone numbers and e-mail addresses of references are accurate and still valid.

When identifying a reference project, the Proponent should consider how their project relates to the assignment described in this RFP, along with the goals and objectives of the overall Project. Photographs representing each reference project are encouraged.

3.1.3 Section C – Work Plan (25 points)

Provide a work plan detailing the methodology and approach to be taken to deliver the assignment, reflecting the schedule outlined in this Request for Proposal. Identify the proposed schedule along with key milestones for meetings with the City group. Include in this section a schedule for the provision of services, identifying the time required for the Proponent's work and a breakdown of the time (number of hours) allocated for each task and Consultant (if applicable) during the work identified in the Request for

Proposal. Include a description of major tasks, sub-tasks, methods/ systems and personnel that the firm proposes to use for all components of the project.

The Proponent shall describe what Inuit, local and Nunavut content, if any, shall be utilized.

3.1.4 Section D – Corporate Qualifications and Experience (5 points)

Provide a statement of qualifications for the Proponent and other major consultant firms included in the Design Team (civil, structural, mechanical, electrical, and process control engineers) including:

- .1 Year founded as current corporate entity;
- .2 Permanent office address; and
- .3 List a maximum of 5 reference Projects (do not provide Project details as these should be listed in Section B.

3.1.5 Section E – Qualifications and Experience (15 points)

Provide an organizational chart describing the Proponent's Project Team for the assignment, which includes all positions involved in the project. Proponent to include key Sub-Consultant's (if applicable) along with their position within the Project Team. Provide a summary of key Project Team personnel, and include the information below:

- .1 Name;
- .2 Corporate affiliation;
- .3 Role and title on the Project, including the period for which the individual is to be associated with the Project, and the extent of the individual's time that will be devoted to the Project during that period; and
- .4 List any reference Projects provided in Section B (do not provide Project details) and describe the individual's role on each of the Projects.

Include the individual's resume immediately after the individual's summary. It is the City's understanding that the Project Team proposed by the Proponent in this section will be committed to the full delivery of the assignment. Changes to the Proponent's Project Team must be approved by the City.

3.1.6 Section F – List of Sub-consultants

Provide a list of all consultants the Consultant will be looking to engage as "Sub-Consultants" for the execution of the Project.

3.1.7 Section G – Mandatory Submission Requirements (pass/fail)

Provide all mandatory requirements, as identified in Section 4.3. Proponents who fail to submit mandatory items will not proceed to the next phase of evaluation.

3.2 Financial Submission Requirements

3.2.1 Consultant's Professional Fees (30 points)

Submit a completed and unqualified Cost Submission Form, included in Appendix A, along with a Consultant's corresponding level of effort fee table, complete with positions, hours, rates, and fee breakdown, based on the work being requested under this RFP for a fixed fee. The level of effort table must be broken up based on major project tasks/ phases (i.e. detailed design phase, tender support, contract administrator/ site inspection, etc.).

The fee table must also include a breakdown on expenses/ disbursements, based on the requirements described in the Terms of Reference. The Proponent must use per diem rates established by the National Joint Council for the Territory of Nunavut. Accommodations will be provided by the City of Iqaluit at a City owned residence. The Proponent will be responsible for transportation requirements and must include this in their fee proposal for expenses/ disbursements. All expenses/ disbursements will be invoices at cost with no mark-up.

The completed Cost Submission Form and level of effort fee table shall form part of the contract document to be used between the City and the Preferred Proponent. The rates included in the fee table will be used in the event the scope of work is changed and provisions of the contract value to be changed during the project period.

The Financial Submission will not be opened until after the evaluation of the technical submission has been completed and satisfied per the required criteria.

4. EVALUATION

4.1 Evaluation Committee

The evaluation of Proposals will be undertaken by an Evaluation Committee appointed by the City. The Evaluation Committee may consult with technical, financial and other advisors, as the Evaluation Committee, in its sole discretion, may decide. The Evaluation Committee will reach a consensus through discussions internal to the Committee.

4.2 Evaluation Stages

Proposals will be evaluated in four stages:

4.2.1 Evaluation of Mandatory Criteria

Proposals that do not meet the mandatory criteria will be rejected (Refer to Section 4.3 below).

4.2.2 Technical Evaluation – Total Value 70 Points

Subject to the Evaluation Committee's right to reject an unacceptable Proposal under Section 4.4, the Evaluation Committee will evaluate and score the Proposal information provided using Table 2 in Section 4.5 as a guide to assign scores. For each criterion, each Proposal will be assessed, and points will be awarded on the basis of the extent to which the requirements of the Request for Proposal documents are satisfied, and the comparative merit of the individual Proposal as compared to other Proposals.

Proposals will be ranked from highest to lowest in terms of meeting the City's requirements and containing technical merit. Proponents are required to achieve a minimum score of 70% (49/70 points) on the Technical Evaluation, in order to qualify for review of the Financial Submission.

4.2.3 Financial Evaluation – Total Value 30 Points

Financial evaluation of cost criteria will be conducted after evaluation of the technical criteria and reference checks.

A total of 30 points will be awarded on the basis of the Financial Proposal, and the distribution of fees to each phase of the Project.

The points for price will be awarded as follows:

The score for the Financial Submission will be in accordance with the following formula:

$$\text{Proponent Score} = \frac{\text{Lowest Financial Offer}}{\text{Proponent Financial Offer}} \times 30 \text{ points}$$

4.2.4 Selection

The Evaluation Committee will rank the Proponents, using the combined Technical and Financial score, from which it will select the Preferred Proponent. The Preferred Proponent's Proposal will be recommended to the City for the award of a contract for Consultant services based on the Proponents standing in the evaluation review process.

4.3 **Mandatory Requirements**

As indicated in Section 1 of this Request for Proposal, Proponents may be individual firms, or consortia of firms. In order for Proponent's Proposals to be considered for further evaluation they must demonstrate in their Proposals that the following mandatory requirements can be met.

Proponents must:

- .1 Provide evidence satisfactory to City from the Proponent's insurer that the Proponent is able to obtain the insurance coverage as specified in APPENDIX E City's Standard Service Agreement;
- .2 Include the submission of the Proponent's latest valid WSCC/ WSIB Certificate of Clearance;
- .3 Include a completed sign-off of Proposal submission, as per the requirements in APPENDIX F; and

4.4 Rejection of Unacceptable Proposals

The Evaluation Committee may at any time reject a Proposal without completing a full evaluation (including a Proposal from a Proponent that complies with the Mandatory Requirements), if in the judgment of the Evaluation Committee further consideration of the Proposal would not be acceptable as the basis for a contract considering the evaluation criteria indicated in Section 4.5 below.

The City reserves the right without liability, cost or penalty, in its sole discretion to disqualify any Proposal before its full evaluation if the Proposal reveals a conflict of interest, incorrect information, or misrepresentation by the Proponent of any information provided in its Proposal. The City further reserves the right without liability, cost or penalty, in its sole discretion to disqualify any Proposal where there is evidence that the Proponent, its employees, agents or representatives colluded with one or more other Proponents or any of their respective employees, agents or representatives in the preparation of the Proposal.

4.5 Evaluation Criteria

The Evaluation Committee will evaluate eligible Proposals to determine the Proposal which best meets the needs of the City, using the weighting criteria indicated in Table 1 below as a guideline.

Table 2 – RFP Evaluation Criteria

| EVALUATION CRITERIA | WEIGHTING |
|---|------------------|
| Technical Submission | |
| Section A – Understanding of the Project | 10 points |
| Section B – Reference Projects | 15 points |
| Section C – Work Plan | 25 points |
| Section D – Corporate Qualifications and Experience | 5 points |
| Section E – Qualifications and Experience | 15 points |
| Technical Score Sub-Total: | 70 points |

| Financial Submission | |
|--|-------------------|
| Consultant Fees – Cost Submission Form | 30 points |
| Financial Score Sub-Total: | 30 points |
| Total RFP Evaluation Score: | 100 points |

5. TERMS AND GENERAL CONDITIONS

5.1 Terms and Conditions

- 5.1.1 Submission of a Proposal constitutes acknowledgement that the Proponent has read and agrees to be bound by all the terms and conditions of this Request for Proposal.
- 5.1.2 The City will not make any payments for the preparation of a response to this Request for Proposal. All costs incurred by a Proponent will be borne by the Proponent.
- 5.1.3 This is not an offer. The City does not, by virtue of this Proposal call, commit to an award of this Proposal, nor does it limit itself to accepting the lowest price or any Proposal submitted, but reserves the right to award this Proposal in any manner deemed to be in the City's best interest.
- 5.1.4 Proponents may not amend their proposal after the closing date and time but may withdraw their proposal at any time prior to acceptance by the City and issuing a Letter of Intent.
- 5.1.5 The City has the right to cancel this Request for Proposal at any time and to reissue it for any reason whatsoever, without incurring any liability and no Proponent will have any claim against the City as a result of the cancellation or reissuing of the Request for Proposal.
- 5.1.6 The City will not be responsible for any Proposal that does not indicate the Request for Proposal reference, and the Proponent's name.
- 5.1.7 The City will not be responsible for any Proposal that is delivered to any address or in any manner other than that provided in Section 2.1 of this Request for Proposal.
- 5.1.8 If a contract is to be awarded as a result of this Request for Proposal, it will be awarded to the Proponent whose Proposal for each service, in the City's opinion, provides the best potential value to the City and is capable in all respects to perform fully the contract requirements and has the integrity and reliability to assure performance of the contract obligations.
- 5.1.9 If the City decides to award a contract based on a submission received in response to this Request for Proposal, the Successful Proponent will be notified of the intent to award in writing, and the subsequent execution of a written agreement shall constitute the making of a Contract. Proponents will not acquire any legal or equitable rights or privileges whatsoever until a Contract is signed by both parties. In the event of any

inconsistency between this Request for Proposal, and any ensuing contract, the contract shall govern.

- 5.1.10 The contract will be in the form of the City's standard "City of Iqaluit Services Agreement" and it will contain the relevant provisions of this Request for Proposal, the accepted Proposal as well as such other terms as may be mutually agreed upon, whether arising from the accepted Proposal or as a result of any negotiations prior or subsequent thereto. The City reserves the right to negotiate modifications with any Proponent who has submitted a Proposal.
- 5.1.11 A copy of the Services Agreement is included as APPENDIX E.
- 5.1.12 Any amendment made by the City to the Request for Proposal will be issued in writing and sent to all who have received the documents.
- 5.1.13 An Evaluation Committee will review each Proposal. The City reserves the exclusive right to determine the qualitative aspects of all Proposals relative to the evaluation criteria.
- 5.1.14 Proposals will be evaluated as soon as practicable after the closing time. No detail of any Proposal will be made public except the names of all parties submitting Proposals.
- 5.1.15 The proposal and accompanying documentation submitted by the proponents are the property of the City and will not be returned.
- 5.1.16 Proponents must acknowledge receipt of any addenda issued by the City in their Proposal.
- 5.1.17 Proponents shall disclose in its Proposal any actual or potential conflicts of interest and existing business relationships it may have with the City, its elected or appointed officials or employees. The City may rely on such disclosure.
- 5.1.18 Proponents and their agents will not contact any member of the City Council, City Staff or City Consultants with respect to this Request for Proposal, other than the City Representative named in section 2.6, at any time prior to the award of a contract or the cancellation of this Request for Proposal.

5.2 No Collusion

By submitting a Proposal, the Proponent, and each firm, corporation or individual member associated with the Proponent's Proposal submission, represents and confirms to the City, with the knowledge and intention that the City may rely on such representation and confirmation, that its Proposal has been prepared without collusion or fraud, and in fair competition with Proposals from other Proponents. Include confirmation of this under Item 3.1.8 of the Proposal submission.

5.3 Conflict of Interest

Proponents shall disclose any potential conflicts of interest and existing business relationships they may have with Colliers Project Leaders, the City, its elected officials or employees, or any known participants in the Project. The City may rely on such disclosure.

Under Item 3.1.8 of the Proposal submission, include confirmation of the Proponent's agreement to conform to the conflict-of-interest requirements and disclosures as indicated in Supplementary Conditions SC2 – CONFLICT OF INTEREST.

5.4 Accuracy of Information

While the City has used considerable efforts to ensure an accurate representation of information in the Request for Proposal, the information contained in this Request for Proposal is supplied solely as a guideline for Proponents. The City gives no representation whatsoever as to the accuracy or completeness of any of the information set out in this Request for Proposal, or any other background or reference information or documents prepared by third parties and made available to Proponents. Proponents will make an independent assessment of the accuracy and completeness of such information and will have no claim whatsoever against the City or its representatives, agents, consultants and advisors, with respect to such information.

5.5 Confidentiality

Proponents shall treat all information received through this Request for Proposal process and subsequent contract award as confidential and will not disclose such information to any person except with the prior written consent of the City.

Under Item 3.1.8 of the Proposal submission, include confirmation of the Proponent's agreement to conform to the confidentiality requirements as indicated in Supplementary Conditions SC1 – CONFIDENTIALITY. The Consultant shall ensure that all drawings, specifications and other documentation prepared for the Project and designated as confidential by the Owner, are prominently stamped on each page or sheet of each document with the word "CONFIDENTIAL" prior to release for construction bidding purposes or during the course of the Work.

5.6 Working Language

All Proposals must be written in English.

5.7 Terms of Payment

The Proponent shall be reimbursed monthly for works completed for each service provided. Invoices are to be submitted on a monthly basis, and shall include:

- .1 the project title.

- .2 the service contract number.
- .3 a description of the work completed.
- .4 billing summary, which includes the tasks as set forth in the costing submission, the proposed costs, cost to date, percentage invoiced to date, and the percentage of work completed to date for each task.
- .5 backup for all disbursements (time sheets may be requested).

The monthly invoice should be reviewed as a draft by the Consultant and the Project Manager in order to validate the fee and services being claimed. The Proponent is to update the invoice (as required), as per comments/ feedback received from the Project Manager. The Project Manager and Proponent are to determine at the Project Kick-Off meeting the date which draft monthly invoices are to be reviewed.

The final invoice is to be submitted to the Project Manager for processing with the City. Invoices that are issued directly to the City's Accounts Payable Department will not be processed. Invoices must be submitted for payment by the 15th of every month, for previous months work (e.g. invoice must be submitted by February 15th for work completed up to January 31st).

No payment will be made for the cost of work incurred to remedy errors or omissions for which the contractor is responsible. No additional invoicing will be accepted above and beyond what the City has agreed to as per the contract. At no time shall the contract upset limit be exceeded without prior written authorization from the City.

5.8 Cash Flow Expenditure Forecast

The Proponent is to submit a cash flow expenditure forecast identifying how the Proponent anticipates invoicing the City on a monthly process, based on the established schedule. An update cash flow expenditure forecast is to be submitted with every monthly invoice.

5.9 WSIB/ WSCC Certificate

Under Item 3.1.8 of the Proposal submission, include submission of the Proponent's latest WSIB or WSCC Certificate of Clearance (failure to submit a certificate or letter of exemption from coverage with the Proposal may result in disqualification of the Proposal). Proponents with no WSCC coverage must apply to the Government of Nunavut with 10 working days of starting operations.

5.10 Health and Safety

The successful Proponent shall provide the City a copy of its Health and Safety plan within 5 calendar days of execution of the contract. The successful Proponent shall comply at all times with the City's health and safety requirements while working in Iqaluit.

5.11 Project Reporting

The Consultant will be required to provide monthly status reports, which must communicate the following: assignment status, work completed to date, work remaining, schedule progress (baseline and approved changes), and financial status (original contract value, current contract value, % complete vs. % spent). The report is to be submitted to the City's Project Manager.

6. CONSULTANT SCOPE OF WORK

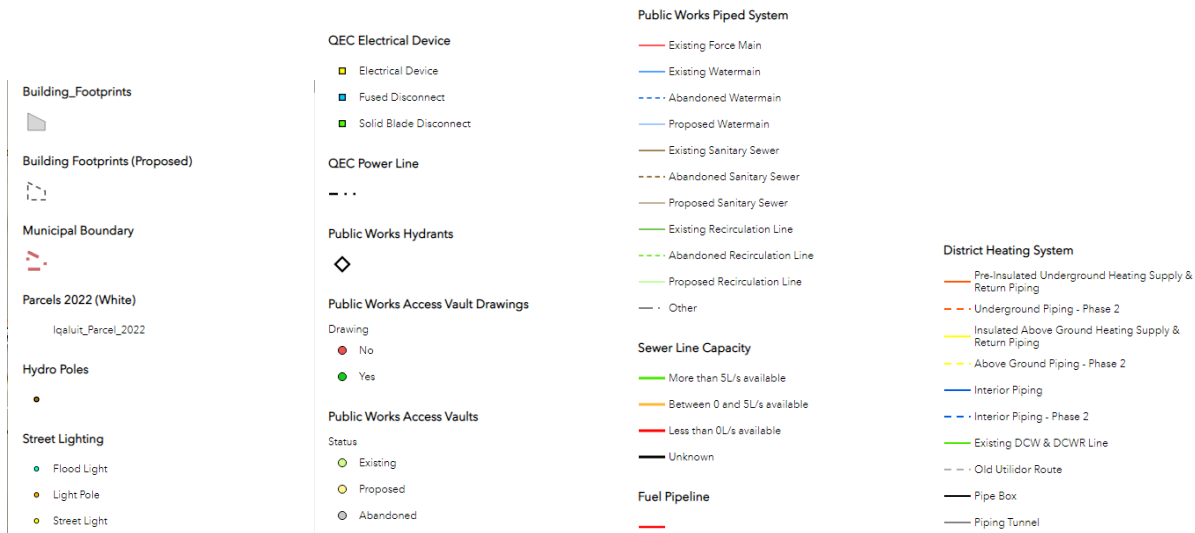
The City is seeking a consultant to provide stakeholder engagement and engineering concept design services for improving vehicle and pedestrian traffic at the High School Intersection.

The recently completed Transportation Master Plan notes that this intersection is operating near capacity for its current arrangement. The Plan recommends the immediate implementation of a southbound left turn lane on Saputi Road and that the entrance and exits to the high school loop be improved with respect to functionality and signage. The Plan also recommends the medium-term implementation of an eastbound left-turn lane on Niaqunngusiariaq Road and an all-way traffic light. The City is interested in having the consultant study these recommendations further and consult the City and external stakeholders that would be directly impacted by any changes in the area in order to develop a final recommendation and development plan for improving and managing vehicle and pedestrian traffic at the intersection of Saputi Road and Niaqunngusiariaq Road ("High School Intersection") as well as the High School Loop.

The High School Loop has been included in this scope as the City has identified vehicle and pedestrian traffic issues in this area. During school drop-off, lunch start, lunch end, and pick-up, there is a significant backup of vehicles due to school buses and individual vehicles needing to wait for significant amounts of time to turn left into the western end of the loop. Similarly, when buses and vehicles are leaving the eastern end of the loop, there are significant traffic impacts due to the space buses take up, in particular buses that are turning left towards the west. As such, the City is looking to implement a solution for the loop that is consistent with the High School Intersection to be prepared under this scope.

At this time, the City has prepared the following comments for consideration. It should be noted that these are based on preliminary high-level internal discussions and are being provided to the consultant as background information only. These comments do not define the project requirements. As part of this scope, the consultant shall be responsible for consulting the City and reviewing available background information to establish the project requirements, which may include adjustments or changes to these comments.

- Saputi Road would benefit from implementing a separate left- and right-turn lane but the road would likely need to be widened or modified



6.1 Background Information Review and Stakeholder Engagement

Purpose: To establish the requirements necessary in order to inform the subsequent phase, which will be used as a basis for future detailed design by other and eventual construction.

The Consultant shall:

- .1 Conduct a desktop study of all relevant background information made available with this RFP or that may be provided following contract award as it relates to any elements of road, sidewalk, crosswalk, and intersection considerations, previous studies in the area, and other as-built or existing conditions documents for infrastructure that will be temporarily or permanently impacted by the work.
- .2 Lead consultations with the relevant City stakeholders and any external parties at the City's request to gain an understanding of inherent challenges and ultimate goals to inform the current and future phases of the work. Assume up to three (3) meetings will be required to carry out this task, which shall be chaired and minuted by the consultant. External parties that are currently identified as stakeholders include, but are not limited to, Qulliq Energy Corporation, Iqaluit District Education Authority, Community and Government Services, and Nunavut Arctic College.
- .3 Prepare a Background Information and Stakeholder Engagement Report in both draft and final format, which includes at a minimum any findings, discussions, and recommendations related to:
 - Understanding of existing conditions within and adjacent to the area being studied under this scope

- Desktop study of all relevant background information that inform the current and future phases of the work
 - Relevant municipal, territorial, and federal design guidelines, standards, and best practices that inform the current and future phases of the work
 - Summary of stakeholder engagements, including but not limited to meeting agendas and minutes
 - Recommendations from previous reports and discussion as to whether they should be pursued further
 - Other recommendations by the consultant (if any) that should be pursued further following their own analysis of the scope area as well as input from stakeholders
 - Proposed elements and inclusions for future intersection improvements
 - Provisional: site survey report
- .4 Present the Background Information and Stakeholder Engagement Report to the City in a virtual meeting in draft format for incorporation of any feedback when preparing the final report.
- .5 Provisional: Complete a site survey:

The Consultant will be required to complete topographical surveying as specified within this RFP. The Consultant shall provide results of all investigations and coordinate its work with the City for incorporation into the final design. Although the Consultant shall ultimately determine the scope and level of survey required for this assignment, the following minimum requirements are anticipated:

The Consultant will:

- Carry out on-site reviews and field work required for, and to complete, the design of this project including survey work required to locate / identify existing features, utilities, obstructions, etc. and as required to provide measurements for tender quantities.
- Carry out total area survey as necessary to inform and define the work.
- Verify the accuracy and correctness of any digital mapping and control points provided by the City or publicly available.
- Verify elevation and position data to confirm all potential conflicts and surface features potentially affecting the proposed works.
- Identify all existing features, including watercourses, which may affect the work.

- Perform detailed inventory of existing infrastructure and features to ensure that construction reinstatement will closely match existing conditions.
- Coordinate with the City for access to the Site.
- Prepare a traffic control plan for any work affecting the roadway in accordance with this RFP.

A non-exhaustive list of required deliverables for this phase is provided below:

- .1 Background Information and Stakeholder Engagement Report (draft and final)
- .2 Agendas and minutes for all meetings required to successfully complete this phase of the work, including but not limited to three (3) stakeholder engagement meetings and one (1) draft Background Information and Stakeholder Engagement Report review meeting
- .3 Provisional: Topographic Survey Plan (PDF and CAD format)

6.2 Concept Sketch and Project Phasing

Purpose: To prepare a concept sketch and project implementation schedule that shows the proposed layout and timelines for improvements at the noted area to serve as a basis for the future detailed design phase by other.

The Consultant shall:

- .1 Prepare an Engineering Schematic Design that shows the proposed layout and typical sections of the intersection and loop including any existing, new, or relocated signage, water, sewer, heating, or fuel utilities, sidewalks, ditches, drainage considerations, and other infrastructure that may be relevant to the final implementation of the road. Tie-in to existing connecting roads and utilities that are affected by the work must also be considered for this task.
- .2 Prepare a Project Phasing Schedule that recommends what study, design, and construction efforts should be carried out and when as it relates to previous or new immediate, medium-term, and ultimate recommendations for the work. The Schedule must identify all necessary design and construction activities with realistic timelines and durations while also considering internal reviews, Council reviews, procurement efforts, and long-lead items.
- .3 Prepare a Class D Cost Estimate for the construction of the final recommended improvements, broken down into the recommended phased approach.

- .4 Present the Engineering Schematic Drawing, Class D Cost Estimate, and Project Phasing Schedule to the City in a virtual meeting in draft format for incorporation of any feedback when preparing the final drawing.

A non-exhaustive list of required deliverables for this phase is provided below:

- .1 Engineering Schematic Design – PDF and CAD format (draft and final)
- .2 Project Phasing Schedule (draft and final)
- .3 Class D Cost Estimate (draft and final)
- .4 Agenda and minutes for draft Engineering Schematic Design and Project Phasing Schedule review meeting

7. SCHEDULE

7.1 Timelines

The Proponent must satisfy the general timelines identified below for the work.

Table 3 – Project Schedule

| Milestone | Date |
|---|--------------------|
| Project Kick-Off Meeting | August 4, 2023 |
| Submission of draft Background Information and Stakeholder Engagement Report | September 22, 2023 |
| Submission of final Background Information and Stakeholder Engagement Report | October 13, 2023 |
| Submission of draft Engineering Schematic Design, Class D Cost Estimate, and Project Phasing Schedule | November 17, 2023 |
| Submission of final Engineering Schematic Design, Class D Cost Estimate, and Project Phasing Schedule | December 8, 2023 |
| Project Completion | December 31, 2023 |

7.2 Submission Requirements

Proponent to prepare project schedule in the form of a Gantt chart. The schedule is to include dates for the commencement and completion of each major element of the work, as per the requirements of Table 3. The key elements of the schedule will detail the various assignment milestones. The schedule will form the baseline for assignment.

The schedule will form part of the contract documents. Changes to the project schedule must be approved by the Project Manager by means of a change order. A revised schedule must be submitted describing the approved changes.



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APPENDIX A – COST SUBMISSION FORM

Proponent's Name: _____

Proponent's Address: _____

Proponent Email/ Telephone: _____

Provide the following cost breakdown for the services detailed herein that the Proponent is proposing to offer the City of Iqaluit.

Table A1 Fee Table

| Item | Description | Qty | Unit | Unit Price | Total |
|------|--|-----|------|------------|-------|
| 1. | General, project management, administration, and coordination | 1 | LS | \$ | \$ |
| 2. | Background Information and Stakeholder Engagement Report | 1 | LS | \$ | \$ |
| 3. | Provisional: Site Survey (incl. site activities, disbursements, expenses, and reporting) | 1 | LS | \$ | \$ |
| 4. | Engineering Schematic Design | 1 | LS | \$ | \$ |
| 5. | Class D Cost Estimate | 1 | LS | \$ | \$ |
| 6. | Project Phasing Schedule | 1 | LS | \$ | \$ |

Sub-Total: \$ _____

GST: \$ _____

TOTAL: \$ _____

Fees for changes to the work shall be as agreed upon prior to the commencement of services for the change as set out under the contract. For additional work, the proponent shall use the rates detailed below.

| POSITION | TEAM MEMBER | Hourly Rates (\$/hr.) |
|----------------------------|-------------|-----------------------|
| Principle/ Project Sponsor | | |
| Project Manager | | |



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| | | |
|---------------------------|--|--|
| Project Engineer | | |
| <i>Insert Position(s)</i> | | |
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Consultant to add positions as necessary. Each discipline shall provide names for each position as necessary.

END OF APPENDIX A

APPENDIX B – SUPPLEMENTARY CONDITIONS

Amend the General Conditions as follows:

Add SC1 Confidentiality

SC 1 Confidentiality

- .1 The Consultant and the Consultant's employees and sub-Consultants shall not use, copy, disclose or otherwise communicate and information not available to the general public that was gained by them in the course of their duties related to this Contract, except as is necessary in the proper discharge of those duties. This obligation survives the Contract.
- .2 All information provided by the Consultant is subject to the disclosure and protection provisions of applicable freedom of information and privacy legislation. Such Act allows any person a right of access to records in the Client's custody or control, subject to limited and specific exceptions.

Add SC2 Conflicts of Interest

SC 2 Conflicts of Interest

The Consultant and the Consultant's employees:

- .1 shall conduct their duties related to this Contract with impartiality and shall, if they exercise inspection or other discretionary authority over others in the course of those duties, disqualify themselves from dealing with anyone with whom a relationship between them could bring their impartiality into question;
- .2 shall not influence, seek to influence, or otherwise take part in a decision of the Client, knowing that the decision might further their private interests. Any communication with the City's elected officials before contract award shall result in disqualification of the Proponent.
- .3 shall not accept any commission, discount, allowance, payment, gift, or other benefit that is connected, directly, or indirectly with the performance of their duties relating to this Contract, that causes, or would appear to cause, a conflict of interest, and
- .4 shall have no financial interest in the business of a third party that causes, or would appear to cause, a conflict of interest in connection with the performance of their duties related to this Contract, and if such financial interest is acquired during the term of this Contract, the Consultant shall promptly declare it to the Client.

Add SC3 Project History File

SC 3 Project History File

- .1 All project documentation shall be considered deliverables and shall form the core of the Project History File. A project history file is to be submitted to the Client prior to project closeout. It is the Consultants responsibility to ensure that the requirements for all deliverables be applied to all sub-consultants and vendors.
- .2 All supporting and originating data (calculations, graphs, data, pictures, drawings checks, tables, etc.) that are developed and incorporated into the deliverable documentation shall be included in Project history file.
- .3 All data collected as part of the Project and relating to the deliverables that have been organized into database tables and spreadsheets shall be included electronically as supporting data for the deliverable. This information will be incorporated into the project history file
- .4 The project history file will be submitted electronically in a logical file folder structure.

END OF APPENDIX B



APPENDIX C – SUB-CONSULTANT LIST

The Proponent will engage and fully coordinate the work of the following sub-consultants listed to deliver the work:

Table C1 List of subconsultants

| Consultant Name | Project Office Address | Discipline |
|-----------------|------------------------|------------|
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END OF APPENDIX C

APPENDIX D – INFORMATION PROVIDED BY THE CITY

This schedule forms part of the contract for consulting services for **2023-RFP-050 / High School Intersection Design Study**. The City will provide the following information to the Consultant:

- .1 Municipal Design Guidelines, City of Iqaluit – 2015
- .2 Good Building Practices Guideline, Government of Nunavut – 2020
- .3 City of Iqaluit Transportation Master Plan, 2022
- .4 Traffic Light Signal Controls Final Report, 2009
- .5 Traffic Light Signal Controls PIC Boards, 2009
- .6 Traffic Study Nunavut Arctic College Iqaluit Campus, 2017
- .7 QEC District Heating System Mapping
- .8 Fuel Pipeline Saputi Replacement As-Built, 2018
- .9 Nunavut Arctic College Site Development Drainage Plan
- .10 Nunavut Arctic College Site Development Site Plan

END OF APPENDIX D



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APPENDIX E – CITY OF IQALUIT SERVICES AGREEMENT

BETWEEN: THE MUNICIPAL CORPORATION OF THE CITY OF IQALUIT
(hereinafter referred to as the "CITY OF IQALUIT")
OF THE FIRST PART

AND: <INSERT CONSULTANT NAME>
(hereinafter referred to as the "Consultant")
OF THE SECOND PART

WHEREAS the CITY OF IQALUIT has requested the Consultant to provide engineering services for the
<insert project name/ contract title>;

AND WHEREAS the Consultant has agreed to provide such services to the CITY OF IQALUIT in its proposal
dated <insert proposal date>;

AND WHEREAS the CITY OF IQALUIT and the Consultant wish to set out the terms and conditions relating
to the provision of such services;

THEREFORE the CITY OF IQALUIT and the Consultant agree as follows:

1. SERVICES AND PAYMENT

- 1.1 The Consultant agrees to provide to the CITY OF IQALUIT those services set out in the job description and scope of work provided on <insert proposal date>. A copy of the proposal is attached as Appendix "A".
- 1.2 The CITY OF IQALUIT agrees to pay for the services described above, a total amount not greater than <insert proposal amount>, for the provision of professional services based on the Proposal dated <insert proposal date>.

2. TERM

- 2.1. This Contract shall commence on the <insert contract start date> and terminates on the <insert contract termination date> unless otherwise terminated in accordance with the provisions of this Contract.

3. NOTICE AND ADDRESS

- 3.1 Any notice required to be given herein or any other communication required by this contract shall be in writing and shall be personally delivered, sent by facsimile, or posted by prepaid registered mail and shall be addressed as follows:



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i) If, to the CITY OF IQALUIT:

Rod Mugford
Chief Administrative Officer
City of Iqaluit
P.O. Box 460 Iqaluit, NU X0A 0H0

Reference: 2023-RFP-050

ii) If to the Consultant at:

<Insert Consultant Representative Name>
<Insert Consultant/ Company Name>
<Insert Address>

3.2 Every such notice and communication, if delivered by hand, shall be deemed to have been received on the date of delivery or if sent by prepaid registered mail shall be deemed to have been received on the seventh day after posting, or if by facsimile, 48 hours after the time of transmission, excluding from the calculation weekends and statutory holidays.

4. COMPLETE AGREEMENT

4.1 This Contract and its attachments constitute the complete Contract between the parties. Except as provided herein, it supersedes and shall take effect in substitution for all previous agreements. It is subject to change only by an instrument executed in writing by the City.

4.2 If this Contract arises from a request for proposals or tender call, the provisions of the request for proposals or tender call and the Consultant's bid or proposal submission are incorporated into this Contract and may be used to clarify, explain or supplement this Contract, but shall not be used to contradict any express terms of this Contract.

4.3 In the event of a conflict between this Contract, the Consultant's bid or proposal submission, and the City's original tender bid instructions or Request for Proposals, the more recently prepared document shall govern to the extent of such inconsistency.

5. GENERAL TERMS

5.1 Any information obtained from or concerning any department of the CITY OF IQALUIT or clients of any department of the CITY OF IQALUIT, by the contractor, its agents or employees in the performance of any contract shall be confidential. The Consultant shall take such steps as are necessary to ensure that any such information is not disclosed to any other person and shall maintain confidential and secure all material and information that is the property of the CITY OF IQALUIT and in the possession of or under the control of the Consultant. This clause survives the termination of this contract.

5.2 Time shall in every respect be of the essence. The Consultant shall deliver the services specified in the contract and according to the project schedule on costs. The CITY OF IQALUIT may grant reasonable extensions to the Consultant for delays, if the Consultant can show those delays were caused by circumstances beyond the control of the Consultant.



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- 5.3 The Consultant is an independent Consultant with the CITY OF IQALUIT and nothing in this contract shall be construed or deemed to create the relationship of employee and employer or of principal and agent between the CITY OF IQALUIT and the Consultant. The Consultant is solely responsible for payments of all statutory deductions or contributions including but not limited to pension plans, unemployment insurance, income tax, workers' compensation and the Nunavut Payroll Tax.
- 5.4 This contract shall be interpreted and governed in accordance with the laws of Nunavut and the laws of Canada as they apply in Nunavut.
- 5.5 No waiver by either party of any breach of any term, condition or covenant of this contract shall be effective unless the waiver is in writing and signed by both parties. A waiver, with respect to a specific breach, shall not affect any rights of the parties relating to other or future breaches.
- 5.6 The failure of either party at any time to require the performance of any provision or requirement of this contract shall not affect the right of that party to require the subsequent performance of that provision or requirement.
- 5.7 Title to any report, drawing, photograph, plan, specification, model, prototype, pattern, sample, design, logo, technical information, invention, method or process and all other property, work or materials which are produced by the Consultant in performing the contract or conceived, developed or first actually reduced to practice in performing the contract (herein called "the Property") shall vest in the CITY OF IQALUIT and the Consultant hereby absolutely assigns to the CITY OF IQALUIT the copyright in the property for the whole of the term of the copyright. The Consultant shall not be responsible for any loss or damage suffered by the City of Iqaluit or any third parties resulting from any unauthorized use or modification of the property, errors in transmission of the property, changes to the Property by others, the consequences of design defects due to the design of others, or defects in contract documents prepared by others, and the City of Iqaluit agrees to defend, indemnify, and hold the Consultant harmless from and against all claims, demands, losses, damages, liability and costs associated therewith. Subject to the foregoing, the Property may be relied by the City of Iqaluit for design and construction work undertaken by other parties with respect to the Services provided that such parties verify the accuracy and completeness of the Property to their satisfaction.
- 5.8 It is intended that all provisions of this agreement shall be fully binding and effective between the parties, but in the event that any particular provision or provisions or a part of one is found to be void, voidable or unenforceable for any reason whatever, then the remainder of the agreement shall be interpreted as if such provision, provisions, or part thereof, had not been included.
- 5.9 This contract may be extended by the written consent of the parties.
- 5.10 The CITY OF IQALUIT may delegate any of its authority and undertaking pursuant to this contract to any employee or contractor the CITY OF IQALUIT by notice in writing to the Consultant.
- 5.11 This contract shall ensure to the benefit of and be binding on the respective administrators, successors and assignment of each of the parties hereto.
6. CONSULTANT RESPONSIBILITIES
- 6.1 The Consultant shall indemnify and hold harmless, the CITY OF IQALUIT, its officers, employees, servants and agents from and against all claims, actions, causes of action, demands, losses, costs,



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damages, expenses, suits or other proceedings by whomsoever made, brought or prosecuted in any manner based upon or related to the negligent acts, errors, or omissions of the Consultant under this contract.

- 6.2 The Consultant shall be liable to the CITY OF IQALUIT for any loss or damage to property or equipment that is supplied to or placed in the care, custody or control of the Consultant for use in connection with the contract if such loss or damage is attributable to the negligence or deliberate acts of the Consultant or its employees or agents.
- 6.3 If, in the opinion of the CITY OF IQALUIT acting reasonably, the Consultant is in default in respect of any obligation of the Consultant hereunder, the CITY OF IQALUIT may rectify such default and pursue a claim against the Consultant for any direct costs associated with any such remediation, including a reasonable allowance for the use of the CITY OF IQALUIT's own employees or equipment.
- 6.4 The Consultant may not assign or delegate work to be done under this contract, or any part thereof, to any other party without the written consent of the CITY OF IQALUIT. In the case of a proposed assignment of monies owing to the Contractor under this contract, the consent in writing of the CITY OF IQALUIT must be obtained.
- 6.5 The Consultant shall keep proper accounts and records of the services for a period of 3 years after the expiry or termination of this agreement. At any time during the term of this contract or during the three years following the completion or termination of this agreement, the Consultant shall produce copies of such accounts and records upon the written request of the CITY OF IQALUIT.
- 6.6 The Consultant shall notify the CITY OF IQALUIT immediately of any claim, action, or other proceeding made, brought, prosecuted or threatened in writing to be brought or prosecuted that is based upon, occasioned by or in any way attributable to the performance or non-performance of the services under this contract.
- 6.7 If at any time the Consultant considers their estimates indicate costs will exceed the project budget, they will immediately advise the City of Iqaluit. If in the opinion of the City of Iqaluit, acting reasonably, the excess is due to design, costs factors or matters under the control or reasonably foreseeable by the Consultant, the CITY OF IQALUIT may require the Consultant to do everything by way of revision of the design to bring the cost estimate within the project budget. Costs of completing such revisions shall be based upon a level of compensation reasonably appropriate to the circumstances, including the reason for the revisions.
- 6.8 Except as required in the performance of services set out in this agreement, the Consultant must maintain as confidential all data and information made available to the Consultant, the CITY OF IQALUIT, or any other parties which is generated by or results from the Consultant's performance of the Services described in this Contract. All such data and information is the property of the City of Iqaluit. This clause shall survive the termination of the Contract.

7. TERMINATION

- 7.1 The CITY OF IQALUIT may terminate this contract at any time upon giving written notice to this effect to the Consultant if, in the opinion of the CITY OF IQALUIT, the Consultant is unable to deliver the service as required, the Consultant's performance of work is persistently faulty, in the event that the

Consultant becomes insolvent or commits an act of bankruptcy, in the event that any actual or potential labor dispute delays or threatens to delay timely performance of the contract or the (Consultant Contractor) defaults or fails to observe the terms and conditions of the contract in any material respect.

- 7.2 This contract shall terminate as of the day for termination set out in the written notice and the Consultant shall forthwith invoice the CITY OF IQALUIT for work performed to the date of termination.
- 7.3 Any invoice submitted by the Consultant pursuant to clause 7.2 shall be reviewed by the CITY OF IQALUIT to assess the amount which is properly due and owing for work done by the Contractor prior to termination.

8. FINANCIAL

- 8.1 The CITY OF IQALUIT, having given written notice of a breach, may withhold or hold back in whole or in part any payment due the Consultant without penalty, expense or liability, if in the opinion of the Contracting Authority, the Consultant has failed to comply with or has in any way breached an obligation of the consultant. Any such hold back shall continue until the breach has been rectified to the satisfaction of the CITY OF IQALUIT.
- 8.2 The CITY OF IQALUIT may set off any payment due the Consultant against any monies owed by the Consultant to the CITY OF IQALUIT.
- 8.3 The City of Iqaluit will pay the Goods and Services Tax (GST).
- 8.4 Provided all terms and conditions on the part of the Consultant have been complied with, each invoice will be paid thirty (30) calendar days after receipt of the invoice, or thirty (30) calendar days after delivery of the services, whichever is later.
- 8.5 The CITY OF IQALUIT may, in order to discharge lawful obligations or to satisfy lawful claims against the Consultant or a Subconsultant arising out of the execution of work, pay any amount, which is due and payable to the Consultant under the contract, if any, directly to the obligee of and the claimants against the Consultant or Subconsultant.

9. INSURANCE AND LIABILITY

- 9.1 The Consultant's liability to the City of Iqaluit for claims arising out of this Agreement, or in any way relating to the Services, will be limited to direct damages and to the re-performance, without additional compensation, of any Services not meeting a normal professional standard of care and such liability will, in the aggregate, not exceed the amount of \$1,000,000.00. The limitations of liability will apply, to the extent permitted by law, whether Consultant's liability arises under breach of contract or warranty; tort, including negligence; strict liability; statutory liability; or any other cause of action, and will extend to and include Consultant's directors, officers, employees, insurers, agents and sub-consultants.
- 9.2 In no event will either party be liable to the other party for indirect or consequential damages including without limitation loss of use or production, loss of profits or business interruption.

9.3 The Consultant shall, without limiting his obligations or liabilities hereto, obtain, maintain and pay for during the period of this agreement, the following insurance with limits not less than those shown:

- a) Workers' Compensation insurance covering all employees engaged in the work in accordance with the statutory requirements of the Territory or Province having jurisdiction over such employees. If the Consultant is assessed any additional levy, extra assessment or super-assessment by a Workers' Compensation Board as a result of an accident causing injury or death to an employee of the Consultant or any sub-consultant, or due to unsafe working conditions, then such levy or assessment shall be paid by the Consultant at its sole cost and is not reimbursed by the CITY OF IQALUIT.
- b) Employer's liability insurance with limits not less than \$500,000 for each accidental injury to or death of the Consultant's employees engaged in the work. If Workers' Compensation insurance exists, then in such event, the aforementioned Employer's Liability insurance shall not be required but the Comprehensive General Liability policy referred to in item (d) herein shall contain an endorsement providing for Contingent Employers' Liability insurance.
- c) Motor Vehicle, water craft and snow craft standard liability insurance covering all vehicles and/or craft owned or non-owned, operated and/or licensed by the Consultant and used by the Consultant in the performance of this agreement in an amount not less than one million dollars (\$1,000,000.00) per occurrence for bodily injury, death and damage to property; and with respect to busses limits of not less than one million dollars (\$1,000,000.00) for vehicle hazards and not less than one million dollars (\$1,000,000.00) for Bodily Injury to or death of one or more passengers and loss of or damage to the passengers property in one accident.)
- d) Comprehensive General Liability Insurance with limits of not less than two million dollars (\$2,000,000.00) (inclusive) per occurrence for bodily injury, death and damage to property including loss of use thereof. Such insurance shall include but not be limited to the following terms and conditions:
 - Products & Completed Operations Liability *
 - Consultant's Protective Liability
 - Blanket Contractual Liability
 - Broad Form Property Damage
 - Personal Injury Liability
 - Cross Liability
 - Medical Payments
 - Non-owned Automobile Liability *
 - Contingent Employers Liability *
 - Employees as Additional Insureds *

**WHERE APPLICABLE*

- e) Professional Liability Insurance with limits of not less than two hundred fifty thousand dollars (\$250,000.00) per claim and five hundred thousand dollars (\$500,000.00) in the annual aggregate, to cover claims arising out of the rendering of or failure to render any professional service under this contract or agreement.



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All policies shall provide that thirty days written notice be given to the CITY OF IQALUIT prior to any cancellations of any such policies.

The Comprehensive General Liability Insurance policies shall name the CITY OF IQALUIT and any permitted sub-consultants as additional insureds only with respect to the terms of this contract and shall extend to cover the employees of the insureds hereunder.

The Consultant shall be responsible for any deductibles, exclusions and/or insufficiency of coverage relating to such policies.

The Consultant shall deposit with the CITY OF IQALUIT prior to commencing with the work a certificate of insurance evidencing the insurance(s) required by this clause in a form satisfactory to the CITY OF IQALUIT and with insurance companies satisfactory to the CITY OF IQALUIT.

IN WITNESS WHEREOF the parties hereto have set their hand and seals as of the date and year entered below.

FOR THE CITY OF IQALUIT:

FOR THE CONSULTANT:

Name/Title

Name/Title

Signature

Signature

Date

Date

Witness

Witness

END OF APPENDIX E



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APPENDIX F – SIGNING SHEET

I/We, agree that we have received addenda ____ to ____ inclusive, and the Proposal Pricing includes provisions set out in such addenda.

I/We confirm agreement to conform to the confidentiality requirements as indicated in Supplementary Conditions SC1 – Confidentiality.

I/We confirm agreement to conform to the conflict-of-interest requirements and disclosures as indicated in Supplementary Conditions SC2 – Conflict of Interest.

Signer must have authority to bind the company.

Signed, and delivered at this _____ day of _____ 2023.

Signature of Name (Authorized official or principal who has authority to bind the company)

Legal Company Name

Address: # Street, Municipality, Province/ Territory, Postal Code

Name: Print or Type

Title

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Telephone #

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CITY OF IQALUIT

MUNICIPAL DESIGN GUIDELINES

JANUARY 2005

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A WATER DISTRIBUTION SYSTEM

A-1 GENERAL

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the water system is designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

These Guidelines only apply in areas where underground water servicing is specified.

A-2 ORGANIZATIONS ISSUING STANDARDS:

ASTM-American Society for Testing and Materials

AWWA-American Water Works Association

CSA-Canadian Standards Association

NFPA-National Fire Protection Association

NSF-National Sanitation Foundation

Fire Underwriter's Survey

A-3 WATER MAINS

A.3.1 Flow Requirements

- | | | |
|--|---|-----------------------|
| 1. Average Daily Demand | - | 400 L/person/day |
| 2. Population Density (residential) | - | 3.5 persons/residence |
| 3. Maximum Daily Demand | - | 2 × Average Demand |
| 4. Peak Hourly Demand | - | 4 × Average Demand |
| 5. Minimum Residual Water Pressure During Peak Hour Flow | - | 350 kPa (50 psi) |
| 6. Minimum Residual Water Pressure During Maximum Day + Fire Flow | - | 140 kPa (20 psi) |
| 7. Minimum Residual Water Pressure Maximum Day Flow (for operation of residential fire sprinklers) | - | 350 kPa (50 psi) |

A.3.2 Pipe Sizing

1. Sizing of water mains shall be determined by hydraulic network analysis. Results shall be submitted to the City Engineer for approval.
2. The minimum size for a distribution main shall be 200mm. Lines must be sized to accommodate the anticipated land use.
3. The minimum size for a recirculation line shall be 50mm. Lines must be sized to accommodate the anticipated land use.
4. The maximum velocity under normal operating conditions shall not exceed 3.0 m/s.
5. Hazen-Williams “C” value shall be 120 for H.D.P.E. pipe.
6. Analysis shall be made to ensure that there is a minimum residual pressure of 350 kPa (50 psi) under Peak Hour Demand conditions.
7. Separate analysis shall be made to ensure that there is a minimum residual pressure of 140 kPa (20 psi) under Maximum Day Demand plus Fire Flow Conditions.

A.3.3 Water Main Alignment and Location

1. Water mains shall be located within the road right-of-way and outside the carriageway.
2. Water mains shall be located a minimum of 230mm outside of insulation to outside of insulation horizontally and 300mm from invert to obvert vertically from any sewer line.
3. Public Utility Lot (PUL) widths shall be at least 6.0m for a single utility and 8.0m for two utilities.
4. Water distribution and transmission systems in new subdivisions shall be looped.

A.3.4 Required Depth for Water Mains

1. The water main shall have a minimum depth of cover of 2.5m measured from finished grade to the top of pipe.
2. Water mains shall cross above sewer where ever possible. Water mains crossing below sewers shall require special approval from the City Engineer.
3. Water mains crossing above the sewer with sufficient clearance to allow for proper bedding and structural support of the pipes. Pipe clearance when passing over any sewer shall be a minimum of 300mm separation between the top of the sewer pipe and the bottom of the water main.
4. Water mains crossing under sewers shall be a minimum of 500mm separation between the bottom of the sewer pipe and the top of the water main. Efforts shall be made to pass over the sewer when possible.

A.3.5 Water Pipe Material

General

1. Approved materials shall be as per City of Iqaluit standards.
2. Only new materials shall be deemed acceptable. All materials found to be defective or damaged shall be replaced at the no cost to the City. The pipe shall not be more than two years old at the time of installation.
3. Records of quality control testing performed by the manufacturer shall be made available upon request.
4. All pipe and joint lubricants must be certified for potable water use in accordance with N.S.F. Standards.

Polyethylene

1. All pipe materials and fabrication shall conform to AWWA C901 or C906, as applicable
2. Polyethylene pipe shall conform to CSA B137.1 and ASTM F714, D3035, D3350
3. Water main shall be HDPE DR11 (Series 160, 1100 kPa)
4. All pipe to have a 50mm thickness shop cast polyurethane insulation and black jacket.
5. Moulded fittings shall conform to ASTM D2683 or D3261
6. Fabricated fittings shall be manufactured from pipe of the same series as that used in the piping system.
7. Pipe shall be joined by thermal butt-fusion, flange assemblies or compression type fittings.
8. Compression couplings shall be used with stainless steel inserts.
9. Couplers shall be Victaulic Type 995 for use with HDPE piping or approval equal.
10. Valves shall be cast iron gates valves with flanged connections.
11. Each pipe length shall be marked for use with potable water, the manufacturer's name, nominal pipe size, dimension ratio, material grade, manufacturing standard, and a code indicating the date and place of manufacture.

Steel Fittings

1. Fittings for H.D.P.E pressure pipe shall conform to AWWA C200 and C208 with a minimum working pressure of 1035 kPa and a yield point strength of 207 Mpa.
2. Slip-on flanges of forged steel shall conform to AWWA C207, Class D and flat faced or weld-neck flanges shall conform to ANSI B16.1, Class 125.
3. Use stainless steel double threaded studs with two nuts, ASTM A307, Grade B.
4. Full-faced rubber gaskets shall be used with 1035 kPa working pressure.

5. Weldolets and threadolets of forged steel shall comply with ASTM A105.
6. Welding of shop-fabricated fittings shall conform to CSA Z662.
7. The exterior of all fittings shall be factory coated with an epoxy coating conforming to AWWA C213.

A.3.6 Water Main Installation

1. The pipe installation shall be conducted in compliance with the pipe manufacturer's specifications.
2. Align pipes carefully from access vault to access vault. Keep joints free of mud, gravel and foreign material and ensure that the joint is complete as outlined in the manufacturer's specifications. Deflections shall not exceed those permitted by the manufacturer.
3. The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete.
4. The alignment of pipes less than 900mm in diameter shall not be more than 150mm of the designated alignment.
5. The invert of pipe shall not deviate from the design grade by more than 40mm.

A-4 VALVES

A.4.1 Materials

1. All water valves shall be certified to National Sanitation Foundation (NSF) Standard 61 – Drinking Water System Components: Health Effects and Standard 14 – Plastics and Plumbing System Components.

Pressure Reducing Valves

1. Valves 200mm and smaller shall be of single diaphragm type. Valves 250mm and larger shall be double diaphragm type.
2. Valves shall be globe style, hydraulically operated, pilot controlled with flanged cast iron body to ANSI B16.1, Class 125. Valves shall have type 304 stainless steel seat and stem.

Flow Control Valves

1. Valves shall be diaphragm type, globe or angle style with cast iron body and bronze trim.
2. Provide an "O" ring seat seal on main valve and strainer and needle valve on pilot inlet lines.

Air Valves

1. All air valves shall conform to AWWA C512 with cast iron body and stainless steel float. Minimum working pressure shall be 1035 kPa.

A.4.2 Valve Location and Spacing

1. The location and spacing of valves should be such that when the system is in operation:
 - No more than two hydrants will be put out of service by a water main shutdown
 - No more than four valves are required to effect a shutdown
 - No more than 20 lots are out of service due to a water main shutdown
2. Valves should be no greater than 250m apart.
3. Valves shall be located in access vault.
4. Valves shall be located at both ends of a main passing through a utility lot or easement and shall be placed 500mm from the property line.
5. Valves shall be the same size as the corresponding main.
6. All valves locations shall be reviewed and approved by the City Engineer and the Fire Department.

A.4.3 Valve Installation

1. Valves, valve casings and fittings shall be installed in accordance with the manufacturer's specifications.
2. Upon completion, all valve casings must be checked to ensure that they are plumb and that the operating nut can be turned properly.

A-5 HYDRANTS

A.5.1 Materials

1. All hydrants shall be 200mm Crane McAvity M-67 inline fire hydrants unless otherwise approved by the City Engineer.
2. All hydrants shall be certified to NSF Standard 61 – Drinking Water System Components: Health Effects and Standard 14 – Plastics and Plumbing System Components.
3. Compression type hydrants shall be supplied conforming to AWWA C502 for dry barrel fire hydrants.
4. Hydrant shall be designed for 1035 kPa working pressure.

5. Hydrants shall have one pumper connection, 146mm outside diameter, and two hose connections (63.5mm) with MPSH thread at least 415mm above the ground flange. Nipples shall be provided with caps without chains or cables. The hose and pumper caps and hydrant valve shall open clockwise.
6. Hydrants shall consist of a minimum 2.45m barrel with 300mm extension.
7. Hydrants shall have a 200mm cast iron outside diameter inlet elbow with bell end and harnessing lugs. Elbow shall be flanged to the barrel.
8. Valve stem in hydrant head to have “O” ring seals.
9. Operating nut shall be three sided, each side being a 36.5mm long arc.
10. Hydrants shall have stainless steel bolt assemblies throughout.
11. External paint shall conform to AWWA C550 – corrosion resistant fluorescent red.

A.5.2 Hydrant Location and Spacing

1. The maximum spacing between hydrants shall be 120m for residential areas
2. For school, industrial or commercial areas hydrant spacing shall be such as to provide complete coverage to the building from a maximum distance of 90m.
3. For sprinkled buildings, a hydrant shall be located within 45m of the building siamese connection.
4. All hydrants to be placed inside access vaults as per City of Iqaluit standards.
5. Hydrants and access vaults shall be located at the projection of the property lines where possible.
6. Hydrant spacing shall be approved by the Fire Department.

A.5.3 Hydrant Installation

1. Hydrants shall be installed in accordance with the manufacturer’s specifications and AWWA M17.
2. Upon completion, all hydrants must be checked to ensure that they are plumb and that the operating nut is functioning properly.

A-6 COUPLINGS AND ADAPTORS

1. Bolted sleeve couplings shall conform to AWWA C219 with ductile iron or carbon steel bodies with epoxy coating conforming to AWWA C213 or AWWA C550 as applicable. Coupling shall have a minimum operating pressure of 1035 kPa. Linings shall be in accordance with AWWA C210, C213 or C550 and be suitable for use with potable water.
2. Flange adapters shall conform to AWWA C219 with ductile iron or carbon steel bodies with epoxy coating conforming to AWWA C210, C213 or C550 as applicable.

The minimum operating pressure shall be 1035 kPa. Flanges shall conform to AWWA C207, Class D. Linings shall be in accordance with AWWA C210, C213 or C550 and be suitable for use with potable water.

3. Couplings for grooved and shouldered joints shall conform to AWWA C606 and shall have operating pressures, coatings and linings as above.

A-7 TRENCHING BEDDING AND BACKFILLING

1. All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.
2. If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the design drawings or as a brief report to the City Engineer prior to construction.
3. Modified Granular C pipe bedding shall be utilized in suitable soil conditions. Bedding sand shall have minimum depth of 100mm below the pipe, shall extend up both sides to the trench wall and provide a minimum cover of 300mm above the pipe.
4. Test pits are to be excavated every 15m to a depth of 450mm below the invert of the pipe to check for the presence of silt. Subexcavate 450mm below the invert of the pipe when silt is found and backfill with Granular B compacted to 95% Standard Proctor Density.
5. The minimum trench width measured at the pipe springline shall be the pipe outside diameter plus 450mm. The maximum trench measured at the pipe springline shall be the pipe outside diameter plus 600mm. The City Engineer must be notified if the trench must be excavated deeper or wider than specified.
6. Excavated material shall be stockpiled at a safe distance from the edge of the trench.
7. The Design Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.
8. Trench excavations shall be kept free of water.
9. Utility trenches shall be adequately compacted.

Native backfill under existing or proposed roads or laneways shall be compacted to:

- 98% standard proctor density from subgrade to 1.5m below subgrade or original ground, whichever is lower;
- 95% standard proctor density greater than 1.5m from the subgrade or original ground, whichever is lower;

to a distance equal to the trench depth past the shoulder.

Granular backfill under existing or proposed roads or laneways shall be compacted to 95% of standard proctor density throughout the entire trench depth below subgrade to a distance equal to the trench depth past the shoulder.

Backfill in all other areas shall be compacted to 95% standard proctor density.

Subgrade and base course compaction for roadway construction shall be as specified in Section D – Roadways, Walking Trails and Snow Mobile Trails.

If the above standards cannot be achieved due to a large variation in soil types throughout the development, the City Engineer may at his sole discretion, establish a more appropriate standard on an individual case basis.

10. If the minimum compaction standards cannot be met due to abnormal weather or wet ground conditions, the City Engineer may establish a more suitable standard on a site-specific basis provided adequate justification is presented.
11. All landscaping, pavement structures, sidewalks, curb and gutter damaged or removed during trenching shall be restored or replaced unless otherwise directed by the City Engineer.
12. All debris, surplus fill and unused materials must be removed from the site.

A-8 INSPECTION AND TESTING

1. All water installations shall be subject to inspections by the City Engineer prior to issuance of the Substantial Certificate of Completion and Final Certificate of Completion.
2. Visual inspections of all lines are required prior to Substantial Certificate of Completion. Any deflections, sags obstructions and other defects affecting the performance of the line shall be corrected and the line re-inspected prior to Substantial Certificate of Completion.
3. All material testing (backfill densities and concrete testing) shall be performed by an accredited agency and certified by a Professional Engineer. All test results shall be submitted to the City Engineer with a report indicating any deficiencies and remediation.

A.8.1 Testing

1. The Fire Department shall be responsible for pressure and flow testing of the entire water system. If discrepancies are found, the Design Engineer shall indicate the corrective action that must undertake to remedy the deficiency.

A-9 DISINFECTION

1. Water mains are to be disinfected and flushed in accordance with AWWA C651.
2. Fill section of main to be disinfected with a chlorine solution, and measure the starting residual.
3. Disinfect for 24 hours and measure residual. If no chlorine is measured repeat the disinfection procedure.

4. When disinfection is completed, test for bacteria.
5. When the City Engineer has approved the bacteria test, flush water mains and safely discharge the water so that no downstream damage occurs.
6. If repairs are made on any section of pipe, disinfection shall be repeated.
7. The mains shall not be commissioned and put into use until the bacteriological sample results are approved by the City Engineer.

A-10 OPERATION OF BOUNDARY VALVE & EXISTING HYDRANT

1. City representatives shall be notified at least 24 hours in advance of valve operation requirements. City personnel shall operate the boundary valves.
2. Use of fire hydrants, tap faucets or the like, connected to the City's treated water supply is strictly forbidden. Any violations will result in appropriate fines as stipulated in the bylaws. All water used in the performance of the work must be obtained from truck fill stations as directed by the City.

B SANITARY SEWER SYSTEM

B-1 GENERAL

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the sanitary sewer system is designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

These Guidelines only apply in areas where underground sanitary servicing is specified.

B-2 ORGANIZATIONS ISSUING STANDARDS:

ASTM – American Society for Testing and Materials

CSA – Canadian Standards Association

B-3 SANITARY SEWERS

B.3.1 Flow Generation Rates

The sanitary system shall be of sufficient capacity to carry peak flows plus an inflow and infiltration allowance. The flow and factors listed below shall be used as minimum requirements in the design of the sanitary sewer systems.

- | | | |
|-------------------------------------|---|---|
| 1. Average Sewage Flow | - | 400 L/person/day |
| 2. Population Density (residential) | - | 3.5 persons/residence |
| 3. Peak Sewage Flow | - | Average Flow x Peaking Factor |
| 4. Peaking Factor | - | $1 + 14/(4+P^{1/2})$ (residential) |
| | | (Harmon's Formulas) where P = the contributing design population in thousands |
| | | where $P < 1$, a peaking factor of 4.5 shall be used |
| | | 3.0 (non-residential) |

The total design peak flow rates for the sanitary sewer shall be the sum of the peak flow rates plus all extraneous flow allowances.

B.3.2 Gravity Sewer Pipe Sizing

The following design factors shall be used in determining the sanitary sewer pipe sizes:

1. Minimum pipe size - 200mm diameter
2. Manning's Formula "n" - 0.013
3. Required sewer capacity - $\frac{\text{Estimated Peak Design Flow}}{0.86}$
4. Minimum flow velocity - 0.6 m / sec (during average flow)
5. Maximum flow velocity - 3.0 m / sec
9. Minimum design slopes

| Sewer Diameter (mm) | Minimum Design Slope |
|---------------------|----------------------|
| 200 | 0.40% |
| 250 | 0.28% |
| 300 | 0.22% |
| 375 | 0.15% |
| 450 | 0.12% |
| 525 and greater | 0.10% |

9. Minimum slopes shall be increased by 50% on all curved sections.
9. The minimum grade of the first upstream leg shall not be less than 1.0%.
9. It is recommended that all sanitary sewers be designed with a slope of 0.5% or greater, wherever possible.

B.3.3 Sanitary Sewer Alignment and Location

1. Sewer mains shall be located within the road right-of-way and outside the carriageway.
2. Sanitary sewers shall be located a minimum of 230mm outside of insulation to outside of insulation horizontally and 300mm from obvert to invert vertically from any waterline.
3. Public Utility Lot (PUL) widths shall be at least 6.0m for a single utility and 8.0 for two utilities.
4. Curved sewers shall run parallel to the road centre line.

B.3.4 Required depth for sanitary sewers

1. Sanitary sewers shall be installed at a sufficient depth to meet the following requirements:
2. The main shall have a minimum depth of cover to ensure the mains are in permafrost. No main shall be installed with less than 3.0m of cover measured from finished grade to the top of the pipe.
3. Gravity mains shall have sufficient depth to allow all buildings to drain by gravity to the sewer. Service lines shall have a minimum cover of 2m from the finished lot surface to the top of pipe at the property line.
4. Sanitary Sewers shall cross below water mains where ever possible. Sewers crossing above water mains shall require special approval from the City Engineer.
5. Sanitary sewer crossing above the water main with sufficient clearance to allow for proper bedding and structural support of the pipes. Pipe clearance when passing over any sewer shall be a minimum of 300mm separation between the top of the sewer pipe and the bottom of the water main.
6. Sanitary sewers crossing above water mains shall be a minimum of 500mm separation between the bottom of the sewer pipe and the top of the water main. Efforts shall be made to pass under the water main when possible.

B.3.5 Sanitary Sewer Materials

1. Only new materials shall be deemed acceptable. All materials found to be defective or damaged shall be replaced at no cost to the City.
2. Where specific products are specified, it is intended that approved equals are also acceptable. Approval must be obtained by the City Engineer prior to installation.
3. Polyethylene pipe and fitting shall conform to the following:
 - DR11 Polyethylene pipe shall conform to CSA B137.1 and ASTM D3035, D3350
 - Minimum pressure rating of 1100 kPa (series 160)
 - Moulded fittings shall conform to ASTM D2683 or D3261
 - Fabricated fittings shall be manufactured from pipe of the same series as that used in the piping system.
 - Pipe shall be joined by thermal butt-fusion, flange assemblies or compression type fittings.
 - Flanges shall be stainless steel or epoxy coated ductile iron conforming to ASTM A536-80 with stainless steel nuts, bolts and washers.
 - Compression couplings shall be used with stainless steel inserts.
 - Outlet sleeve saddle shall be Robar type 6626 or approved equal.

- Valves shall be cast iron gates valves with flanged connections.
- Each pipe length shall be marked with the manufacturer's name, nominal pipe size, dimension ratio, material grade, manufacturing standard, and a code indicating the date and place of manufacture.

B.3.6 Sewer Installation

1. The pipe and gasket installation shall be conducted in compliance with the pipe manufacturer's specifications. Installation of HDPE pipe and fittings shall conform to CSA-B137.1.
2. Pipe installation shall start at an access vault and work upstream to the next access vault.
3. Align pipes carefully when jointing. Keep joints free of mud, gravel and foreign material and apply sufficient pressure to ensure that the joint is complete as outlined in the manufacturer's specifications. Complete each joint before laying the next length of pipe. Deflections shall not exceed those permitted by the manufacturer.
4. The pipe must be thoroughly flushed of all dirt, stones and pipe lubricant when complete.
5. The alignment of pipes shall not be more than 150mm off the designated alignment.
6. The invert of the pipe shall not deviate from the design grade by more than 6mm plus 20mm per metre of diameter of sewer pipe.

B-4 SANITARY CLEANOUT DESIGN AND LOCATION

1. Clean outs shall be located at the end of each line, at all changes in pipe size, grade and alignment.
2. Clean outs shall be located in all access vaults.
3. The maximum distance between clean outs shall not exceed 120m.
4. The drop across access vaults should be of sufficient magnitude to account for any energy losses in the access vault.
5. Pipe deflections of less than 45° require a drop of at least 30mm
6. Pipe deflections of 45° to 90° require a drop of at least 50mm
7. Invert drops for pipes larger than 600mm or for high flow situations shall be assessed on an individual basis
8. The obvert elevation of a sewer entering a manhole shall not be lower than the obvert elevation of the outlet pipe.
9. Pipe deflection in the manhole shall not be greater than 90°.
10. Risers for service lines shall be required when sewer mains exceed 4 metres in depth.

B-5 TRENCHING, BEDDING AND BACKFILLING

1. All trenching and backfilling shall be completed in strict accordance with Occupational Health and Safety Guidelines.
2. If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the design drawings or as a brief report to the City Engineer prior to construction.
3. Modified Granular C pipe bedding shall be utilized in suitable soil conditions. Bedding sand shall have minimum depth of 100mm below the pipe, shall extend up both sides to the trench wall and provide a minimum cover of 300mm above the pipe.
4. Test pits are to be excavated every 15m to a depth of 450mm below the invert of the pipe to check for the presence of silt. Subexcavate 450mm below the invert of the pipe when silt is found and backfill with Granular B compacted to 95% Standard Proctor Density.
5. The minimum trench width measured at the pipe springline shall be the pipe outside diameter plus 450mm. The maximum trench measured at the pipe springline shall be the pipe outside diameter plus 600mm. The City Engineer must be notified if the trench must be excavated deeper or wider than specified.
6. Excavated material shall be stockpiled at a safe distance from the edge of the trench.
7. The Design Engineer shall identify areas where the trench excavation requires sheathing, shoring or bracing in order to protect workers, property or adjacent structures.
8. Trench excavations shall be kept free of water.

Native backfill under existing or proposed roads or laneways shall be compacted to:

- 98% standard proctor density from subgrade to 1.5m below subgrade or original ground, whichever is lower;
- 95% standard proctor density for depths greater than 1.5m from the subgrade or original ground, whichever is lower;

to a distance equal to the trench depth past the shoulder.

Granular backfill under existing or proposed roads or laneways shall be compacted to 95% of standard proctor density throughout the entire trench depth below subgrade to a distance equal to the trench depth past the shoulder.

Backfill in all other areas shall be compacted to 95% standard proctor density.

Subgrade and base course compaction for roadway construction shall be as specified in Section D.

If the above standards cannot be achieved due to a large variation in soil types throughout the development, the City Engineer may at his sole discretion, establish a more appropriate standard on an individual case basis.

9. If the minimum compaction standards cannot be met due to abnormal weather or wet ground conditions, the City Engineer may establish a more suitable standard on a site-specific basis provided adequate justification is presented.
10. All landscaping, pavement structures, sidewalks, curb and gutter damaged or removed during trenching shall be restored or replaced unless otherwise directed by the City Engineer.
11. All debris, surplus fill and unused materials must be removed from the site.

B-6 INSPECTION AND TESTING

1. All sewer installations shall be subject to inspections by the City Engineer prior to issuance of the Substantial Certificate of Completion and Final Certificate of Completion.
2. Visual inspections of all lines are required prior to Substantial Certificate of Completion. Any deflections, sags obstructions and other defects affecting the performance of the line shall be corrected and the line re-inspected prior to Substantial Certificate of Completion.
3. All material testing (backfill densities and concrete testing) shall be performed by an accredited agency and certified by a Professional Engineer. All test results shall be submitted to the City Engineer with a report indicating any deficiencies and remediation.

B-7 SANITARY WASTEWATER PUMPING SYSTEMS

B.7.1 General

1. Wastewater pumping systems shall only be installed where site constraints restrict the gravity collection system from tying to an existing sanitary trunk line. The requirement must be justified in an initial subdivision design report taking the development plans for the surrounding area into account.

B.7.2 Standards and Approvals

1. The design and construction of the pumping system must meet the requirements of other governmental authorities and regulations including Federal, Territorial and Municipal. The Design Engineer is responsible for all submissions and applications required for approval.

B.7.3 Location

1. The pumping station shall be located in such a manner as to minimize the impact to adjacent development in terms of visibility, odour and noise.

2. Pumping stations shall not be located in areas subject to flooding during a major rainfall event.
3. Pumping stations shall always be accessible by road.

B.7.4 Configuration

1. A wet well configuration with submersible pump or above ground suction head pump is preferred.
2. A wet well/dry well configuration may be considered for larger facilities.
3. A building will be required for all pumping stations.
4. A collection access vault shall intercept flow from all incoming sewers before discharge to the pumping station. The station shall receive flow from one inlet only.
5. Provision shall be made to shut off flow from the collection manhole if required.

B.7.5 Pumping Station Design

1. The pumps shall be sized to accommodate the maximum expected flow as determined by accepted engineering practice and according to the requirement specified in Section B.3.1 - Flow Generation Rates.
2. Pumping stations shall be equipped with two or more pumps sized such that if one pump is out of service, the remaining pump(s) is/are capable of pumping the design capacity flow rate. Pumps shall be identical and interchangeable for a duplex pumping station. Pumps starts shall alternate between pumps.
3. Pumps shall be provided by a well-recognized manufacturer.
4. Submersible pumps shall have a non-clog impeller design and flush valves.
5. Pump motors shall operate on 3-phase power wherever possible. This requirement may be relaxed by the City if 3-phase power cannot be supplied at a feasible cost.
6. Dead storage shall be minimized while meeting minimum depth requirements specified by the pump manufacturer.
7. Wet wells shall be sized based on accepted engineering practice. Storage shall be provided to minimize the frequency of pump starts but maximum retention time in the wet well should not exceed 30 minutes. The design shall meet pump manufacturer's specifications.
8. Wet wells shall be sized and equipped to accommodate operator access, maintenance and safety requirements.

B.7.6 Valves and Piping

1. The minimum diameter for all pump suction and discharge piping shall be 100mm.

2. Pipe sizing shall allow for minimum and maximum flow velocities of 0.75m/s to 3.5m/s respectively within the station.
3. The minimum pressure rating of piping within the station shall be determined based on calculated operating pressures but shall not be less than 900 kPa.
4. Pumps shall be connected in parallel to a common discharge header located within the station. Check valves and isolation valves shall be installed on the discharge line between each pump and the discharge header.
5. A forcemain isolation valve shall be installed on the main discharge pipe outside the wet well.

B.7.7 Water Supply

1. Water supply must be provided to the facility for washing/cleaning purposes.
2. The design shall ensure that the connection between the potable water supply and the wastewater pumping station does not cause contamination of the potable water supply. The design shall comply with the conditions stipulated in the Environment “Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems” for Water Supply and Wastewater Facilities.
3. Where a potable water supply is to be used for washing/cleaning purposes, a break tank, pressure pump and pressure tank shall be provided. In-line backflow preventers are not acceptable. The potable water shall be discharged to the break tank through an air gap at least 150mm above the maximum flood line or the spill line of the tank.

B.7.8 Alarms and Emergency Backup

1. Stations shall be equipped with or provided with the feature for future connection of remote sensing and telemetry equipment enabling operators to monitor the alarms.
2. Power must be supplied from two independent sources. In the event of a power failure, secondary power must automatically engage through a diesel generator or direct-coupled motor.
3. Special consideration shall be made to control any possible overflow in a manner acceptable to the City and the Department of Environment.

B.7.9 Access and Maintenance

1. Permanent hoist equipment and access hatches of sufficient size and capacity shall be provided for removal of station equipment.
2. All access points shall have locking devices.
3. Ladders shall be non-skid and shall comply with Occupational Health and Safety requirements.
4. Stations shall have adequate interior and exterior lighting.

5. An Operating and Maintenance manual shall be provided for the facility. The manual shall include a complete parts list for all mechanical and electrical components including control diagrams, schematics and manufacturer's operation, maintenance, service and repair specifications. Five (5) copies along with all commissioning and testing results shall be submitted to the City prior to issuance of the Substantial Certificate of Completion.

B.7.10 Heating and Ventilation

1. Forced mechanical ventilation is required for dry wells below ground level and for wet wells containing screens or mechanical equipment requiring maintenance or inspection.
2. Equipment shall be able to provide at least six air changes per hour. Provision shall be made for ventilation of the wells with portable equipment in case of system failure. Ventilation failure alarms are required.
3. There shall be no interconnection between wet well and dry well ventilation systems.
4. Multiple air inlets and outlets are recommended for dry wells over 5m deep. Air intakes and outlets shall be designed to function year round and screen openings should be sized to avoid frost build-up or clogging.
5. Air shall be forced into the dry well at a point 150mm above the pump floor and into the wet well at a point 150mm above water level.
6. Automatic heating and dehumidification equipment shall be provided in all dry wells.

B.7.11 Building Requirements

1. All lift stations shall be provided with a building to house all electrical and control equipment and to provide a workspace for pump maintenance.
2. Buildings shall be of an adequate size to allow for the required access hatches, hoist equipment, ventilation and control equipment while allowing for an appropriate workspace for pump maintenance.
3. Access to the wet well shall not be from within the building.
4. Building layout and access shall be designed to facilitate the removal of any equipment that may require off-site maintenance.
5. Structural members shall be masonry, concrete or structural steel. Wood frame buildings are not permitted. Buildings shall comply with the National Building Code.
6. The design shall incorporate measures to reduce the noise and odour impact on the surrounding development.
7. Buildings shall be designed to blend architecturally with the surrounding development.
8. Windows shall not be permitted in lift station buildings.

B.7.12 Forcemains

1. System head curves shall be developed for each forcemain to be submitted to the City Engineer upon request.
2. The minimum forcemain diameter shall be 100mm.
3. The pressure rating of the pipe shall be twice the operating pressure or 690 kPa, whichever is greater.
4. The velocity shall be within 0.9 m/sec to 3.5 m/sec. The minimum velocity for pipes larger than 300mm shall be 1.1 m/sec. Special design provisions in order to stabilize the line shall be incorporated when design velocities exceed 3.0 m/sec.
5. The forcemain design pressure shall allow for the normal static and dynamic operating pressures including water hammer effects.
6. A series of 45° bends shall be used in lieu of 90° bends.
7. Air release valves shall be installed in access vaults at all relative high points. Forcemain grades should be designed in order to avoid the requirement for an air release valve wherever possible.
8. Blow-off valves shall be provided at all low points.
9. Vacuum relief valves shall be installed wherever necessary in lines designed to drain by gravity between pumping cycles.
10. The forcemain invert at the receiving manhole shall be a maximum of 300mm above the highest invert. The outlet invert of a lagoon inlet manhole shall always be above the high water level.
11. When forcemain length exceeds 1000 metres, cleanouts should be installed in concrete access chambers complete with isolation valves and adaptor coupling for line flushing.

C ACCESS VAULTS

C-1 GENERAL

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the access vaults are designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

C-2 ACCESS VAULT DESIGN

C.2.1 Fabrication

Steel access vaults (AVs) shall be prefabricated, complete with all piping, fittings, and accessories.

Fabricator to provide shop drawing, to be approved by the Design Engineer.

Access vaults are to be finished, inspected and tested in the prefabrication shop prior to shipping. A certificate of testing shall be provided for each access vault. The certificate shall include the date of testing, method of testing and test results, and shall be signed by the inspector.

All piping and fittings shall be set horizontally and vertically as shown on the detail drawing and in approved shop drawings.

C.2.2 Materials

1. Access vault to be constructed of steel plate:
 - Sides (interior and exterior) – 6 mm thick steel plate
 - Cover – 6 mm thick steel plate
 - Bottom – 10 mm thick steel plate
2. Urethane foam insulation shall be injected from above to prevent the formation of voids. Urethane foam insulation to have the following properties:

| | |
|---|--------|
| ♦ Density (kg per cubic metre core) (ASTM D-1622): | 35 |
| ♦ Compressive Strength kPa @ 25°C 10% Deflection measured axially (ASTM D-1621-64): | 240 |
| ♦ Thermal Conductivity W/m°C @ 25°C (ASTM D-2326-64T): | 0.0187 |
| ♦ Operating temperature range °C Cryogenic to +: | 93 |
| ♦ Closed cell content % (ASTM D-2856): | 90 min |
| ♦ Water absorption gm/1000cc (ASTM D-2856): | 12 |

- ♦ Dimensional Stability, % (ASTM D2126 Procedure B & E): 3
- 3. Pipe Fittings shall be constructed from “Tube Turn”, or approved equal standard wall welding fittings and 1,030 kPa (150 psi) flanges). All fitting shall be hot dipped galvanized inside and outside after fabrication.
- 4. Flanged cast iron fittings shall be “Grinnell” 1,030 kPa (150 psi), standard fittings, coated inside and outside with asphaltic coat tar epoxy paint, or approved equal.
- 5. Fabricated steel pipe supports shall be hot dipped galvanized.
- 6. Styrofoam insulation shall be Dow Chemical Company HI 410 kPa Styrofoam or approved equal.
- 7. All bolts and washers shall be cadmium plated.

C-3 ACCESS VAULT CONSTRUCTION

1. Access Vaults shall be constructed to a size to allow the required piping and fitting to be installed and maintained, and shall have a minimum inside dimension of 1830 millimetres.
2. Interior piping and fittings to be set horizontally and vertically as specified on Access Vault Design Drawings. Where an access vault has both water mains and sanitary sewers and unless otherwise specified, the water main and sanitary sewer shall be grade separated through the access vault.
3. All interior and exterior surfaces of the access vault, with the exception of the access vault top plate, lid and ladder shall be sandblasted and epoxy coated after fabrication as follows:
 - ♦ Surface Preparation: steel surfaces shall be prepared in accordance to the Steel Structures Painting Council specification SSPC #10 near white blast condition.
 - ♦ Painting: Access vault to be painted with two coats of epoxy paint, 8mils dry film thickness. Interior colour to be off white and exterior colour to be grey. Floors painted with Indurall Ruff Stuff 3300 or equal.
4. Access vault top plate, lid and ladder shall be hot dipped galvanized after fabrication. Galvanizing to conform to CSA G164 (minimum 610 g/m²).
5. The access vault cover shall have the words “Confined Space, Entry by Permit Only” stencilled on the exterior cover in red epoxy paint.

C-4 ACCESS VAULT INSTALLATION

C.4.1 Access Vault Location

1. Access vaults to be located at alignment or grade changes.
2. Access vaults shall be spaced at a maximum of 120 metres.

C.4.2 Installation

1. All work to be carried out in a dry excavation.
2. Access vaults shall be placed on 300 mm of Modified Granular 'C' bedding compacted to 95% standard proctor, and 38 mm thick Styrofoam insulation base. Bedding and Styrofoam to extend 300 mm beyond the base plate.
3. Base plate to be covered with 38 mm Styrofoam insulation, to extend 300 mm beyond the edge of the base plate. 10 mm thick filler piece to be installed between insulation below and above base plate.
4. Access vault to be backfilled with 300 mm modified granular 'C', 300 mm above insulation and adjacent to access vault.
5. Access vault shall be installed to maintain design alignments and grades.
6. Access vault shall extend above grade between 150 to 450 mm.
7. Damaged to exterior finish shall be repaired by repainting with epoxy paint to match manufactured finish.

C-5 INSPECTION AND TESTING

1. All materials are subject to inspection and testing at the discretion of the Engineer. Any materials found to be flawed or defected shall be rejected and shall be removed from the site and replaced.
2. The Contractor shall provide sufficient notice to the Engineer to allow the Engineer to witness and approve the test.
3. Written certificates shall be issued to the Contractor by the Engineer verifying successful completion of testing.

C.5.1 Static Leakage Test

1. Upon completion of the fabrication of the inner shell and the installation of the piping, and prior to the installation of the exterior shell the access vault shall have a static leakage test preformed. The inner shell shall be support above the floor, conduit entries capped and the access vault filled with water. There shall be no signs of leakage after 4 hours.

C.5.2 Water Pressure Test

1. Water main piping shall be water pressure tested at 1,380 kPa for four hours. There shall be no leakage or signs of leakage during the testing period.

C.5.3 Air Pressure Test

1. Sanitary sewer piping shall be air pressure/bubble tested at 100 kPa for two hours. There shall be no leakage or signs of leakage during the testing period.
2. Water pressure testing shall be an accepted alternative.

D SERVICE CONNECTION

D-1 GENERAL

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the water system is designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

These Guidelines only apply where service connections are specified.

D-2 WATER SERVICE

D.2.1 General

1. Separate water service connections shall be provided for each separately titled lot.
2. The minimum size of a residential water service shall be a 25mm supply and a 25mm return placed inside a 100mm insulated carrier pipe. Non-residential service connections shall be sized according to anticipated demand.
3. Carrier Pipe for all water services shall be installed to the property line at the time of initial subdivision development.
4. Water services complete with service saddles and associated connection kit shall be installed at the time of house construction.
5. The minimum allowable distance between services shall be 1000mm.
6. Water services greater than 50mm shall be connected and valved inside an access vault.
7. Services shall be located such that they do not conflict with driveway locations.

D.2.2 Materials

1. Water service pipe shall be Series 160 SDR9. Polyethylene tubing conforming to AWWA C901 and CSA B137.1.
2. Compression connections with stainless steel inserts are required for all materials.
3. All fittings shall be designed for and operating pressure of 1035 kPa.
4. Water service saddles shall be stainless steel type 304, bronze or a combination. Bronze components shall conform to ASTM B62. Single or double band design.
5. Service saddles for use on polyethylene pipe shall be Romac type 101, 202, 305 or 306 series, Robar 2706 or approved equal for use on polyethylene pipe.
6. Operating rods shall be Type 304 stainless steel with brass cotter pins.

D.2.3 Service Installation

1. Residential water services shall be installed in common trench with the sanitary sewer services.
2. Tapping for residential service connections shall be done with full operating pressure in the main. The tap shall be made within 30° of the pipe crown and graded to service trench level.
3. A tapping valve and sleeve must be used for services 100mm and larger.

D-3 SANITARY SERVICE

D.3.1 General

1. Separate sanitary sewer connections shall be provided for each separately titled lot.
2. The minimum size of a residential gravity sanitary sewer service shall be 100mm.
3. Non-residential service connections shall be sized according to anticipated user requirements.
4. The sanitary services including sewer saddles shall be installed to property line at the time of the initial subdivision development.
5. The minimum grade for gravity sanitary sewer service line shall be 2.0% for 100mm diameter lines and 1% for 150mm diameter lines and larger.
6. Services shall be located such that they do not conflict with driveway locations.

D.3.2 Materials

1. Water service pipe shall be Series 160 SDR9. Polyethylene tubing conforming to AWWA C901 and CSA B137.1.
2. Sanitary sewer service saddle to be Robar No. 6626 outlet sleeve saddle – sized to fit main and service lateral.

D.3.3 Service Installation

1. Residential sanitary services shall be installed in common trench with the water services.

E ROADWAYS, WALKING TRAILS, SNOW MOBILE TRAILS

E-1 GENERAL

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the transportation system is designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

For each new subdivision development, the appropriate roadway classifications and design designation shall be determined during the planning stages in consultation with City officials.

Where conflicts or inconsistencies with the General Municipal Servicing Standards arise due to adoption of other transportation planning documents, the more stringent requirements shall be satisfied.

These Guidelines only apply in areas where roadway construction is specified.

E-2 DESIGN CRITERIA

1. The trip generation rate for single detached housing in the City of Iqaluit shall be 9 one-way trips per household. Trip generation rates for other types of development shall be justified by the Design Engineer and approved by City Engineer.
2. The City of Iqaluit uses the following design designations for subdivision roads. The cross section elements for each of these design designations are shown in drawings at the back of this section.

Local Undivided

Collector undivided

Gravel surfaced

Gravel Surfaced

3. For the purpose of these servicing standards, all roadways within The City of Iqaluit will be considered collector roads or local roads. Although some may perform minor collector functions, local road design designations should apply to most roadways.
4. The roadway design shall be prepared considering the future requirements, economic factors, safety considerations, staging, and other road users not associated with the development.
5. The design speed selected should relate to the expected operating speed on the road after improvement. It should reflect public expectations and include an allowance for safety. The design speed is typically 10 km/hr higher than the anticipated posted speed limit.

E-3 ROAD STRUCTURE

1. Roadway structures shall be based on results of a geotechnical investigation. A report shall be submitted specifying the required structure and all design factors including design traffic loading and the design life. The road structures specified in the Municipal Standards are intended as minimum standards only.

E-4 CUL-DE-SACS

1. The maximum length for any cul-de-sac without a Public Utility Lot (PUL) is 120m from the centreline of the intersecting street to the start of the bulb. Cul-de-sacs in excess of 120m shall require a 6.0m minimum wide PUL allowing emergency vehicle access and water main looping.
2. PUL's provided to allow for emergency access shall be properly graded to ensure positive drainage and gravelled to prevent erosion.
3. Cul-de-sacs should be graded to drain towards the intersection unless a PUL is provided to allow drainage to escape to other drainage courses.
4. The minimum cul-de-sac bulb radius for residential areas is measured to the face of the curb or shoulder. Minimum radius shall be 14 metres.

E-5 INTERSECTIONS

1. Intersections shall be designed at 90° wherever possible. The minimum angle of intersection for two roadways shall be 75° unless otherwise approved by the City Engineer.
2. Intersection design shall incorporate accepted sight distances based on the roadway classification and good engineering practice.
3. Minimum intersection spacing shall be 60m measured from centreline to centreline.

E-6 WALKING TRAILS AND SNOW MOBILE TRAILS

1. Walking and snowmobile trail alignments and locations within any development must allow for adequate public access to Nuna, parks, recreational areas and environmental and municipal reserves.
2. Where trails cross drainage swales, ditches or natural drainage courses, culverts or footbridges shall be designed to accommodate a 1:25 year storm without overtopping.
3. Wherever possible, trails should be centered within the right-of-way. Trails may be offset from the centreline in situations where this will prevent conflicts with utilities sharing the same right-of-way.
4. Trail grading shall ensure positive drainage with a minimum grade of 0.5%. Grading shall be designed in order to incorporate the overall drainage pattern of the development.

5. Where the trail right-of-way is not shared with other utilities, it shall be a minimum of 6m wide.
6. The subgrade must be compacted to a minimum 95% Standard Proctor Density (SPD) for a depth of 150mm.
7. For granular trail, the excavation may require geotextile fabric liner prior to placement of the granular material depending on the type of in-situ material. The granular material shall be spread uniformly and compacted to 95% SPD.
8. Trail surfacing material must be approved by the City prior to installation. Walkway materials shall be selected to minimize the maintenance and replacement costs.

E-7 DRIVEWAYS

1. Driveways shall have a minimum clearance of 1.5 metres from any surface feature such as hydrants, power poles, curb cocks, etc...
2. Driveways shall not be situated on intersection turning radius.
3. For corner lots, the driveways should access the road with the lesser traffic volume, wherever possible. Wherever possible, driveways should not be located within 100m of an intersection with the exception of multi-lot subdivision.
4. For industrial lots, the selection of the driveway location may be delayed until parking lot configurations are determined. A caveat on title will be required to inform future owners of their responsibility to pay for the installation while adhering to design recommendations.
5. Residential driveways shall be between 7.5 and 9.0 metres in width. Industrial driveways shall be between 10.0 and 12.0 metres in width.
6. All driveways shall have the same structure as the adjoining roadway and be constructed up to the property line.

E-8 SIGNAGE

1. Traffic control signs shall be manufactured and installed in accordance with the latest edition of "Uniform Traffic Control Devices for Canada".
2. Street addressing signs shall be located within 10.0m of the intersection in the direction of the nearside approaching traffic. Signs shall be offset at least 1.0m from the edge of the road and mounted 3.0m to 3.5m above the finished road surface. Street addressing signs shall be a minimum size of 15cm x 60cm and a maximum of 15cm x 90cm. The lettering shall be 10cm high. If the address does not fit on the maximum size, two signs may be joined with an end bracket and H-clip. Signs shall have silver lettering with a blue background.
3. All signs shall be placed so as not to obstruct the view of oncoming vehicles.

4. Material for temporary signs, such as subdivision layout signs, shall be approved by the City prior to installation.

E-9 DRAINAGE AND CULVERTS

1. Drainage systems shall meet the flow requirements outlined in Section G for both local and collector cross sections.
2. Ditches for roadways shall have back slopes no steeper than 3H:IV.
3. Swale and ditch grades shall match the road grades wherever possible.
4. Swale and ditch grades shall have a minimum grade of 0.5% wherever possible. Grades less than 0.5% shall be subject to review and approval by the City Engineer.
5. Drainage channels shall be provided with ditch checks and/or other means of erosion control as necessary.
6. Ditches shall have a flat bottom, width as per applicable design standard.
7. Culvert sizing is the responsibility of the Design Engineer. Culverts and ditches shall be designed to accommodate a 1:25 year rainfall event. Ditches shall be allowed to back up during such an event to the height of the subgrade.
8. Culverts shall be new galvanized corrugated steel pipe with a minimum wall thickness of 1.6mm or as required to meet the design loading criteria.
9. Minimum pipe sizes for various uses are as follows;

| | |
|----------------------------------|----------------|
| 10. Residential Driveway Culvert | 400mm diameter |
| 11. Industrial Driveway Culvert | 450mm diameter |
| 12. Roadway Centreline Culverts | 450mm diameter |
13. All culverts shall have appropriate end treatments depending on application. Inverts shall be extended to the toe of the side slope.
14. The culvert grade shall not be less than the ditch grades at the inlet and outlet.
15. Culverts shall have a sufficient amount of cover to protect against damage from the expected traffic loading. Minimum cover shall be 300mm or one-half the diameter of the culvert, whichever is greater as measured from the finished shoulder grade to the top of the culvert.

E-10 QUALITY ASSURANCE

Quality control testing related to the roadway construction shall include but not necessarily limited to sieve analysis, densities, mix design, core sampling and concrete testing. Quality control shall be performed by an independent party and certified by a professional engineer licensed to practice in the Territory of Nunavut.

F TRUCKED WATER AND SANITARY SERVICES

F-1 GENERAL

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the water system is designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

These Guidelines only apply in areas where trucked water and sewer servicing is specified.

F-2 WATER SERVICES

1. All single family residential water storage tanks shall be a minimum of 5,000 litres.

F-3 SANITARY SERVICES

1. All single family residential sanitary storage tanks shall be a minimum of twice the size of the water storage tanks.

F-4 SERVICE INSTALLATION

1. All installations must exceed applicable Nunavut, National Building and Canadian plumbing codes

G AGGREGATE

G-1 GENERAL

The following granular classifications will be used for City of Iqaluit projects.

G-2 GRANULAR CLASSIFICATIONS

| ASTM Sieve Designation | Percent Passing | | | |
|------------------------|-----------------|------------|------------|---------------------|
| | Granular A | Granular B | Granular C | Modified Granular C |
| 200mm | - | - | 100 | - |
| 100mm | - | 100 | - | - |
| 75mm | - | 95-100 | - | - |
| 50mm | - | - | - | - |
| 38.1mm | - | - | - | - |
| 25mm | 100 | 45-100 | 50-100 | - |
| 19mm | 85-100 | - | - | - |
| 12.5mm | 65-90 | - | - | - |
| 9.5mm | 50-73 | - | - | 100 |
| 4.75mm | 35-55 | 25-70 | 20-100 | 55-100 |
| 1.8mm | 15-40 | - | 10-100 | 30-100 |
| 0.425mm | - | 4-50 | - | - |
| 0.300mm | 5-22 | - | 2-65 | 10-50 |
| 0.075mm | 2-8 | 0-8 | 0-8 | 0-10 |

1. Gradations to be within the limits specified when tested to ASTM C136-84a and ASTM C117-84 and are to have a smooth curve without any sharp breaks when plotted on a semi-log grading chart.
2. Granular A and Granular B to be crushed stone or crushed gravel and shall be free of clay lumps, cementation, organic material, frozen material and other deleterious materials.
3. Granular C to be crushed stone or gravel or screened stone or gravel and shall be free of clay lumps, cementation, organic material, frozen material and other deleterious materials.

4. Modified Granular C to be crushed stone or gravel or screened stone, gravel or sand and shall be free of clay lumps, cementation, organic material, frozen material and other deleterious materials.

H STORMWATER MANAGEMENT SYSTEM

H-1 GENERAL

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the water system is designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

The stormwater management system should be designed with major and minor drainage systems. In general, a minor system consists of swales, ditches and culverts that have been designed in order to avoid property damage and flooding due to runoff generated by a 1 in 5 year rainfall event. When the capacity of the minor system is exceeded, the major system must provide a continuous overland flow route allowing the excess runoff to reach the designated ponding areas or water body.

H-2 ORGANIZATIONS ISSUING STANDARDS:

ASTM – American Society for Testing and Materials

CSA – Canadian Standards Association

H-3 MINOR SYSTEM

H.3.1 Flow Rates

1. The stormwater management system shall be designed as a separate system. Effluent from sanitary sewers or any potentially contaminated drainage shall not be discharged in the ditches or swales.
2. The Minor System shall be designed to accommodate the runoff generated from a 1:5 year or more frequent rainfall event without overflowing swales or ditches.
3. The Rational Method shall be used in estimating flows for the design of storm ditches and swales for areas less than 65 hectares.

$$Q = \frac{CIA}{360}$$

where Q = the design peak flow rate in cubic metres per second

I = the intensity of rainfall in millimetres per Hour

A = the contributing area in hectares

C = the runoff coefficient

4. Minimum runoff coefficients shall be according to the following table:

| Land Use/Surface Characteristics | Runoff Coefficient, C |
|----------------------------------|-----------------------|
| Residential Lots | 0.2 |
| Undeveloped Land | 0.1 |
| Pavement, concrete, buildings | 0.9 |
| Gravel Roadways | 0.3 |

5. Due to the large variation in lot sizes for commercial and industrial areas, a weighted runoff coefficient for these types of developments can be calculated using the following formula:

$$C = \frac{(0.9 \times \text{Impervious Area}) + (0.15 \times \text{Pervious Area})}{\text{Total Area}}$$

6. The intensity for the rational formula is selected from the available rainfall data using the time of concentration (T_c). T_c is the sum of inlet time and travel time. The inlet time is the time for the overland flow to reach the ditch. The maximum inlet time for residential areas shall be 10 minutes. Inlet times for commercial or industrial areas shall be calculated on a site-specific basis.
7. For areas larger than 65 hectares, acceptable computer modeling of the area must be submitted for review.

H-4 MAJOR SYSTEM

H.4.1 General

The major conveyance system accommodates flows not intercepted by or beyond the capacity of the minor drainage system through planned surface flow routes and storage facilities. The intent of the major system is to provide surface flow management in order to minimize flooding and property damage from a 1:100 year rainfall event. The design of the major drainage system must not be limited to the immediate development area but must consider overland flows that may enter the area from adjacent land as well as down stream effects on adjacent development and receiving water bodies.

H.4.2 Lot Grading

Proper lot grading is the first step towards a well-planned major drainage system. The goal of the lot grading shall be to ensure that water flows away from the building. Flow from lots shall always have an escape route to a public right-of-way. The lot-grading plan shall develop a proper balance between the road elevation, proposed building elevations, surrounding development and existing topography.

Generally, the lots shall be designed to drain to adjacent laneways or public right of ways without crossing adjacent lots. An overall drainage plan will be required for all subdivisions.

H.4.3 Swales

1. Drainage swales on municipal or private property shall be constructed prior to any development of subdivision lots. Complete swale construction shall be a prerequisite to the issuance of the Substantial Certificate of Completion.
2. Drainage swales located on private property shall be covered by an easement in favour of the City. A minimum clearance of 200mm should be provided between the edge of the swale and the property line. Major rainfall event flows shall be contained within the easement.
3. Drainage swales crossing several properties for the collection of runoff shall not be permitted unless special circumstances warrant.
4. The minimum design slope for swales is 1%.

H.4.4 Roadways

Grading of streets comprising the major drainage system shall follow the guidelines listed below:

1. Continuity of over flow routes between adjacent developments shall be maintained.
2. Collectors shall have at least one lane that is not inundated.

Local roads should not have a depth of water more than 50mm above the crown of the road.

I STREET LIGHTING

I-1 STANDARD AND GUIDELINES

These guidelines are intended as a guide only. The Design Engineer is responsible to ensure that the water system is designed and constructed according to accepted engineering practice.

These Guidelines shall not be considered as a substitute for a detailed material and construction specification prepared by the Design Engineer.

The street lighting design shall be in accordance with the “Guide for the Design of Roadway Lighting” published by the Transportation Association of Canada (TAC) as well as applicable standards published by the Illuminating Engineering Society of North America (IES).

All roadway lighting systems shall be installed in strict compliance with the Canadian Electrical Code.

These Guidelines only apply in areas where street lighting is specified.

I-2 ENGINEERING DRAWINGS AND APPROVAL

1. The Design Engineer is responsible for the preparation and submission of design drawings prepared by a qualified professional engineer showing the layout, pole spacing, types and heights and luminaire wattages. The street lighting plan shall include all surface features and utilities. The layout, products and materials are subject to approval by the City.

I-3 DESIGN AND OPERATIONS

1. The Design Engineer shall be responsible to work with the local wires owner for the design, supply and installation of the street lighting system.
2. The responsibility for energizing the street lighting system shall be the responsibility of the City.

I-4 SAFETY

1. The lighting design shall ensure the proper illumination of conflict areas such as intersections and crosswalks. The design shall be prepared with public safety in mind.

I-5 ENERGY USAGE

1. The Street lighting design should be optimized to allow for the least possible energy consumption while still maintaining acceptable safety standards. The City of Iqaluit encourages the use of the highest efficiency lamps available at the time of installation.

I-6 POLE LOCATION

1. In some cases, the road and lot configuration will dictate the pole layout. Wherever possible, poles should be located at the projection of lot lines. Pole locations shall not conflict with other utilities or approaches. Spacing shall be selected by the Design Engineer and the City Engineer based on the optimum spacing/height/light distribution combination but shall not exceed the minimum standards published by the TAC.
2. Pole setbacks shall be as outlined in the TAC guidelines. Where roadways are designated for widening within five years of pole installation, the pole setback shall allow for said widening.

I-7 TYPE OF POLE

1. Pole types shall be consistent with adjacent developments. All poles within a new development shall be of the same type and height in order to obtain continuity.
2. All poles shall be resistant to all climatic and environmental conditions encountered within The City of Iqaluit.

I-8 AESTHETIC


1. Street lighting design shall be compatible with the type of development and proposed buildings.
2. The use of decorative poles shall be subject to approval by the City. Proposed decorative poles and luminaries should share common optical systems and components as other decorative items found in existing developments within the City.

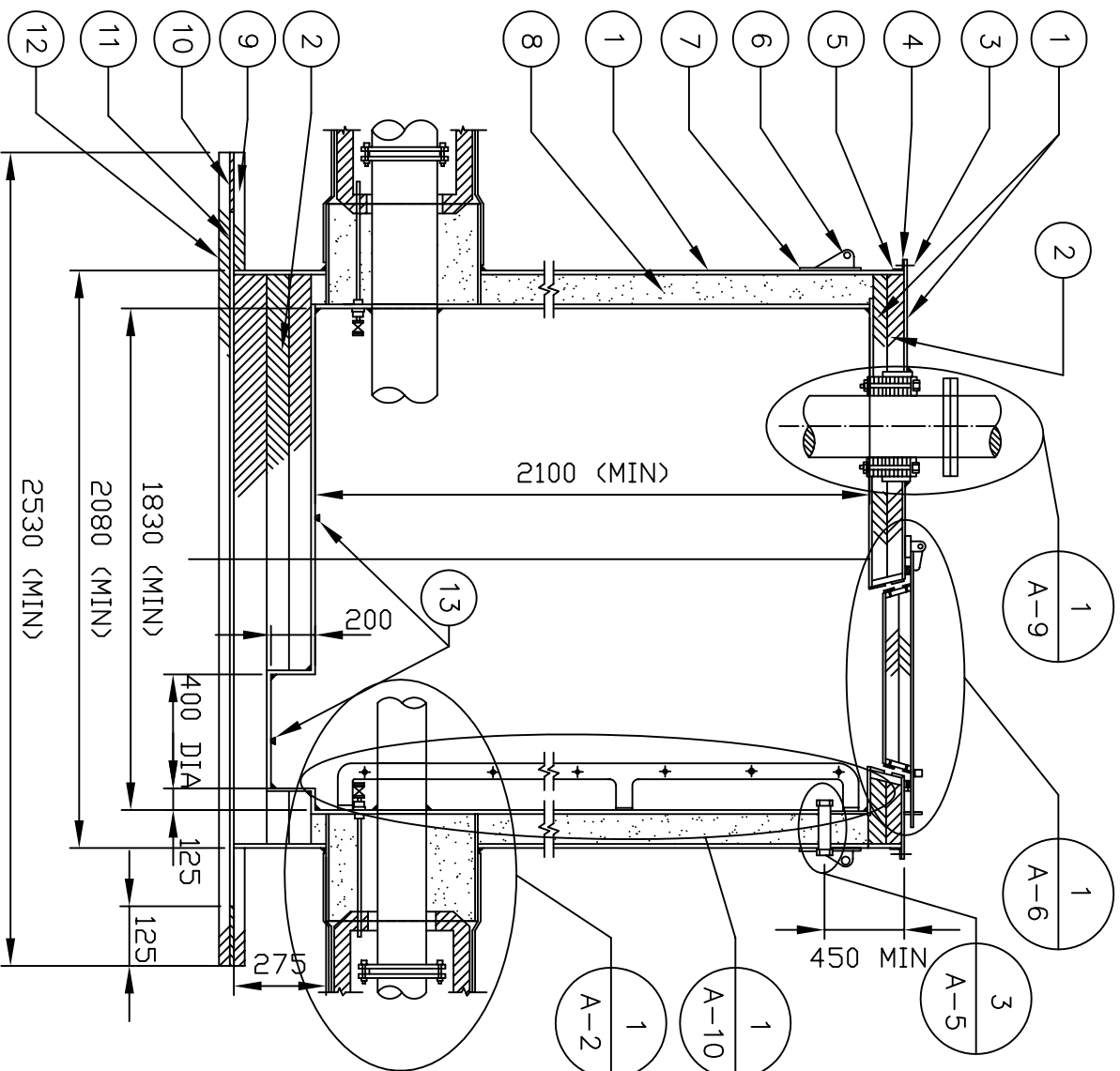
I-9 FOUNDATIONS

1. Foundations shall be designed based on the specific soil conditions on site. The foundations shall be designed to withstand all loading, wind loading in particular.

ACCESS VAULT – GENERAL NOTES

- 1) CONSTRUCT ACCESS VAULTS FROM 6mm STEEL PLATE WITH CONTINUOUS (FULLY) WELDED CONSTRUCTION. FABRICATE COMPLETELY PRIOR TO EPOXY COATING. WELDING AND FABRICATION TO CSA W59-1977 & W47-1-1973
- 2) ALL STEEL TO BE CSA G40.21 TYPE 260W OR ASTM A36-62T.
- 3) ALL PIPING INSIDE THE ACCESS VAULT TO BE PREFABRICATED TO THE LIMITS SHOWN ON THE TYPICAL SECTION AND AS SHOWN ON THE LAYOUT PLANS.
- 4) PROVIDE PIPE ENTRY SPOOL PIECES, LADDER MOUNTING STUDS & ALL OTHER ACCESS VAULT PARTS, ETC. AS REQUIRED, PREWELDED IN PLACE PRIOR TO SANDBLASTING AND EPOXY COATING.
- 5) ALL PREFABRICATED STEEL PARTS OF THE ACCESS VAULT (EXCEPT TOP PLATE HATCH AND LADDER) SHALL BE SANDBLASTED AND EPOXY COATED INSIDE AND OUTSIDE AS PER SPECIFICATIONS.
- 6) TOP PLATE, HATCH, HINGE, & LADDER SHALL BE HOT DIPPED GALVANIZED TO CSA G164 MINIMUM 610g/m².
- 7) ALL NUTS, BOLTS, WASHERS, SCREWS ETC. SHALL BE ZINC PLATED OR CADMIUM PLATED.
- 8) FLANGE INSULATION KITS AND STYROFOAM ACCESS VAULT BASE INSULATION SUPPLIED AS PART OF THE ACCESS VAULT.
- 9) HYDRANT, AND LINK SEAL JOINT TO BE SHIPPED SEPARATELY (INSIDE ACCESS VAULT).
- 10) PRIOR TO SHIPPING, ALL FACES OF FLANGES PROJECTING OUTSIDE THE ACCESS VAULT SHALL PROTECTED BY 5/8" THICK PLYWOOD COVER FIXED BY 4 BOLTS.
- 11) PROVIDED WITH EACH ACCESS VAULT SHALL BE 4 200mm DIA STEEL BUMPER POST, 1 TO INCLUDE SIGN.
- 12) PAINT SPECIFICATIONS:
 - SANDBLAST SSPC SP10
 - 2 COATS OF INTERGARD EX HB FROM INTERNATIONAL, 16 MILS DRY THICKNESS.
 - COLOURS: OUTSIDE – GREY
 INSIDE – BEIGE

| | | | |
|---|--------------------------------------|--------------------|---------------------|
|  | TITLE: ACCESS VAULT GENERAL NOTES | | DWG NO.: A-1 |
| | SCALE: NTS | DATE: MAR. 2004 | |



KEY TO NUMBERED PARTS:

- 1 6 THICK STEEL PLATE ACCESS VAULT CONSTRUCTION
- 2 URETHANE SHEET INSULATION CUT TO SIZE
- 3 12 CAD. PLATED STEEL BOLT, NUT, WASHER 32 MIN AT EQUAL SPACING
- 4 3 X 5 COMPRESSIBLE NEOPRENE RUBBER GASKET
- 5 10 THICK 50 X 50 MIN. ANGLE WELDED FULL LENGTH
- 6 LIFTING LUGS – TWO PER ACCESS VAULT, 150 X 75 X 12 THICK WITH 38 DIA LIFTING EYE
- 7 REINFORCING PLATE 200 X 200 X 12 CURVED TO EXTERIOR WALL RADIUS
- 8 FORMED IN PLACE INSULATION (URETHANE)
- 9 38 THICK STYROFOAM CUT TO MATCH EXTERIOR WALL RADIUS
- 10 FILLER PIECE – 10 THICK INSULATION
- 11 10 THICK STEEL BASE PLATE
- 12 38 THICK INSULATION
- 13 FROST PLUG

NOTES:

1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.



TITLE:

ACCESS VAULT
DETAIL

DWG NO.:

A-2

SCALE:

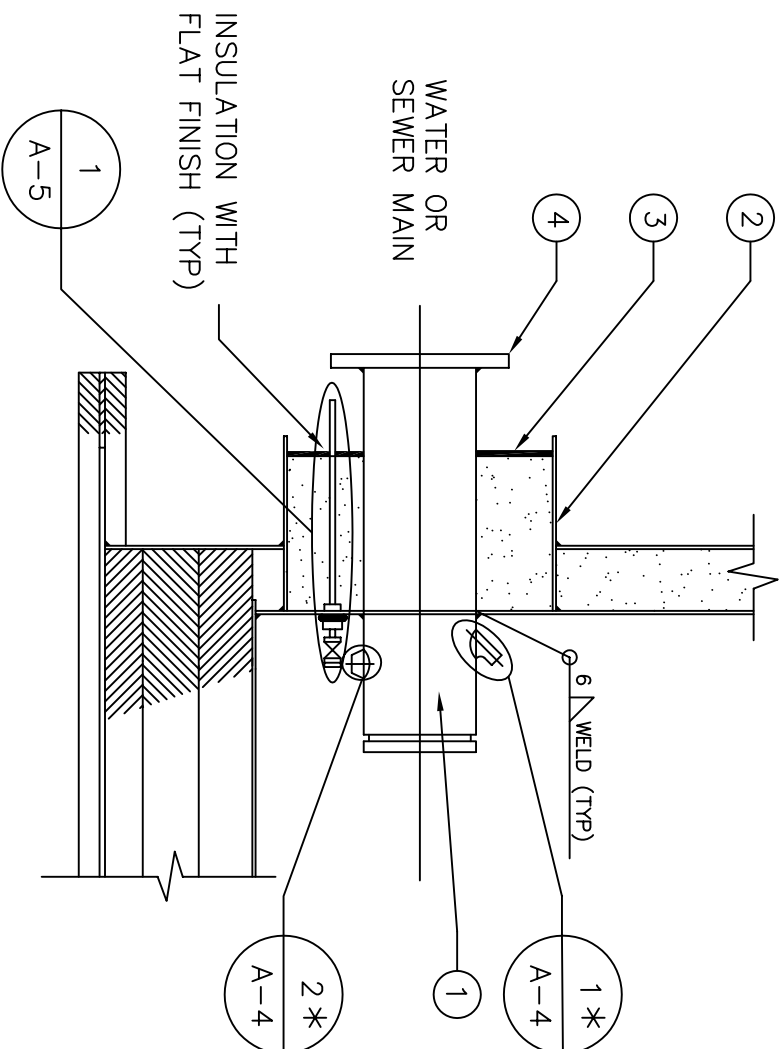
NTS

DATE:

MAR. 2004

KEY TO NUMBERED PARTS:

- ① SCHEDULE 80 STEEL PIPE SPOOL PIECE
- ② STEEL RING SECTION WELDED TO ACCESS VAULT OUTER WALL – 6mm TH x 407mm O.D. FOR 150 DIA, 470mm O.D. FOR 200 DIA, 535mm O.D. FOR 250 DIA
- ③ APPLY SILICONE CAULKING AT ALL PIPE ENTRY LOCATIONS.
- ④ WELDED STEEL SLIP-ON FLANGE, SIZED TO FIT



* REQUIRED ONLY ON WATER MAINS

1 WALL PENETRATION DETAIL

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.
- 2) AFTER INSTALLING DRAINS, TEST VALVE ASSEMBLY PRIOR TO INSTALLING FLANGE INSULATION



TITLE:

ACCESS VAULT
WALL PENETRATION
WATER OR SEWER MAINS

DWG NO.:

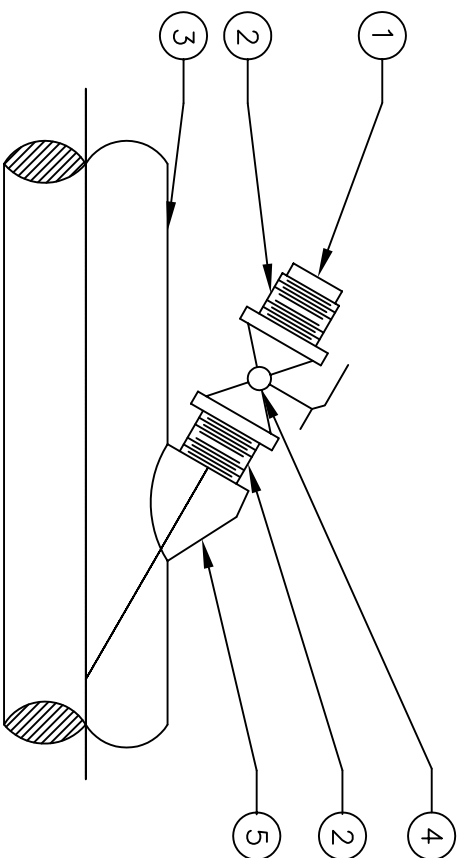
A-3

SCALE:

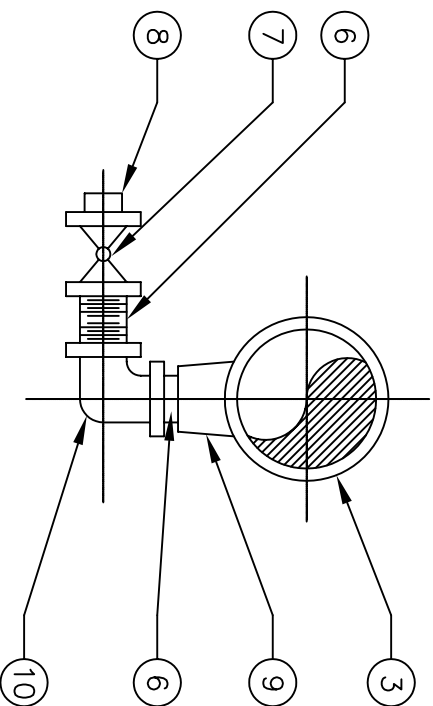
NTS

DATE:

MAR. 2004



1) LATEROLET CONNECTION



2) WATER MAIN DRAIN

KEY TO NUMBERED PARTS:

- ① 50mm DIA. N.P.T. PLUG
- ② 50mm DIA. N.P.T. NIPPLE
- ③ WATER MAIN – HOT DIPPED GALV. STEEL PIPING
- ④ 50mm DIA. BALL VALVE
- ⑤ 50mm DIA. LATEROLET
- ⑥ 25mm DIA. N.P.T. SHORT NIPPLE
- ⑦ 25mm DIA. BALL VALVE
- ⑧ 25mm DIA. N.P.T. PLUG
- ⑨ 25mm DIA. N.P.T. THEODOLET
- ⑩ 25mm DIA. 90 DEGREE ELBOW N.P.T. FEMALE

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES



TITLE:

LATEROLET & DRAIN DETAILS

DWG NO.:

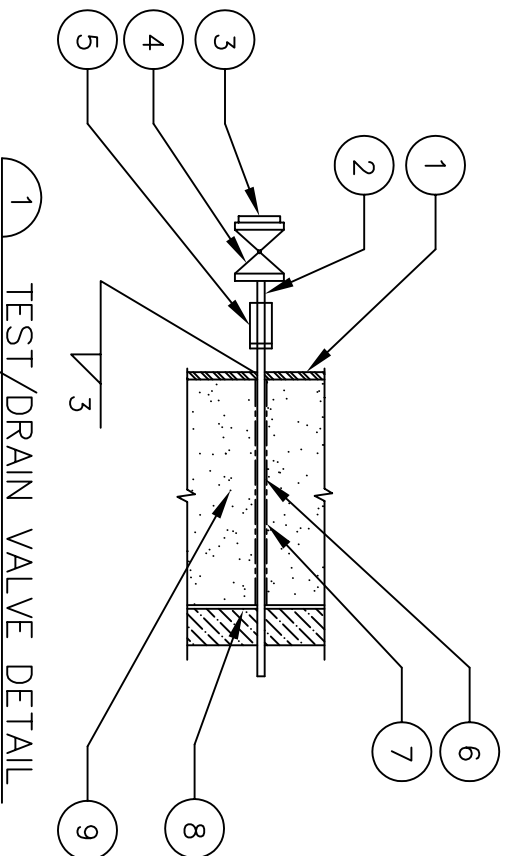
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SCALE:

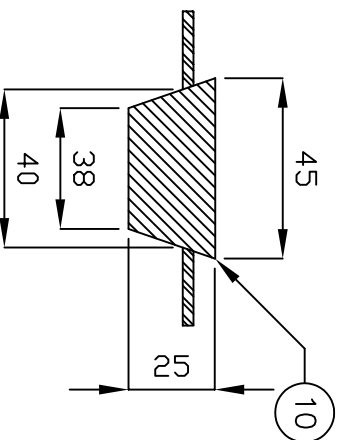
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DATE:

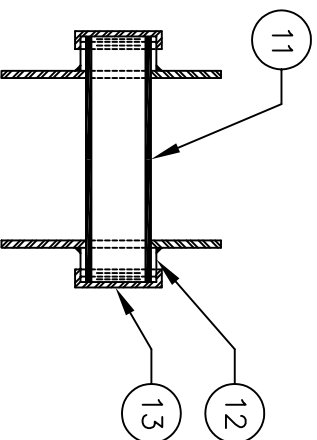
MAR. 2004



1 TEST/DRAIN VALVE DETAIL



2 FROST PLUG DETAIL



3 WALL SLEEVE DETAIL

KEY TO NUMBERED PARTS:

- ① 6 THICK STEEL PLATE ACCESS VAULT WALL
- ② 12 DIA. GALV. ST. NIPPLE
- ③ 12 DIA. PLUG
- ④ 12 DIA. SCREWED BALL VALVE
- ⑤ 12 DIA. GALV. ST. COUPLING
- ⑥ 12 DIA. GALV. ST. PIPE
- ⑦ DRILL THROUGH SHOP CAST POLYURETHANE INSULATION
- ⑧ FLANGE INSULATION KIT BY OTHERS
- ⑨ SHOP CAST POLYURETHANE INSULATION
- ⑩ FROST PLUG TO BE MADE FROM SOLID BLACK RUBBER DRIVEN TIGHTLY INTO HOLE.
- ⑪ 37 DIA RIGID PVC – OIL COAT SURFACE PRIOR TO INSULATING
- ⑫ 50 DIA. SCHEDULE 40 NIPPLE
- ⑬ 50 DIA. CAP

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.
- 2) PROVIDE FROST PLUG IN FLOOR PLATE AND SUMP HOLE.
- 3) PLUG TO HAVE A 10mm PROJECTION ABOVE FLOOR AFTER BEING PLACED TIGHTLY INTO HOLE.
- 4) 2 WALL SLEEVES REQUIRED PER ACCESS VAULT.



TITLE:

MISCELLANEOUS
ACCESS VAULT DETAILS

DWG NO.:

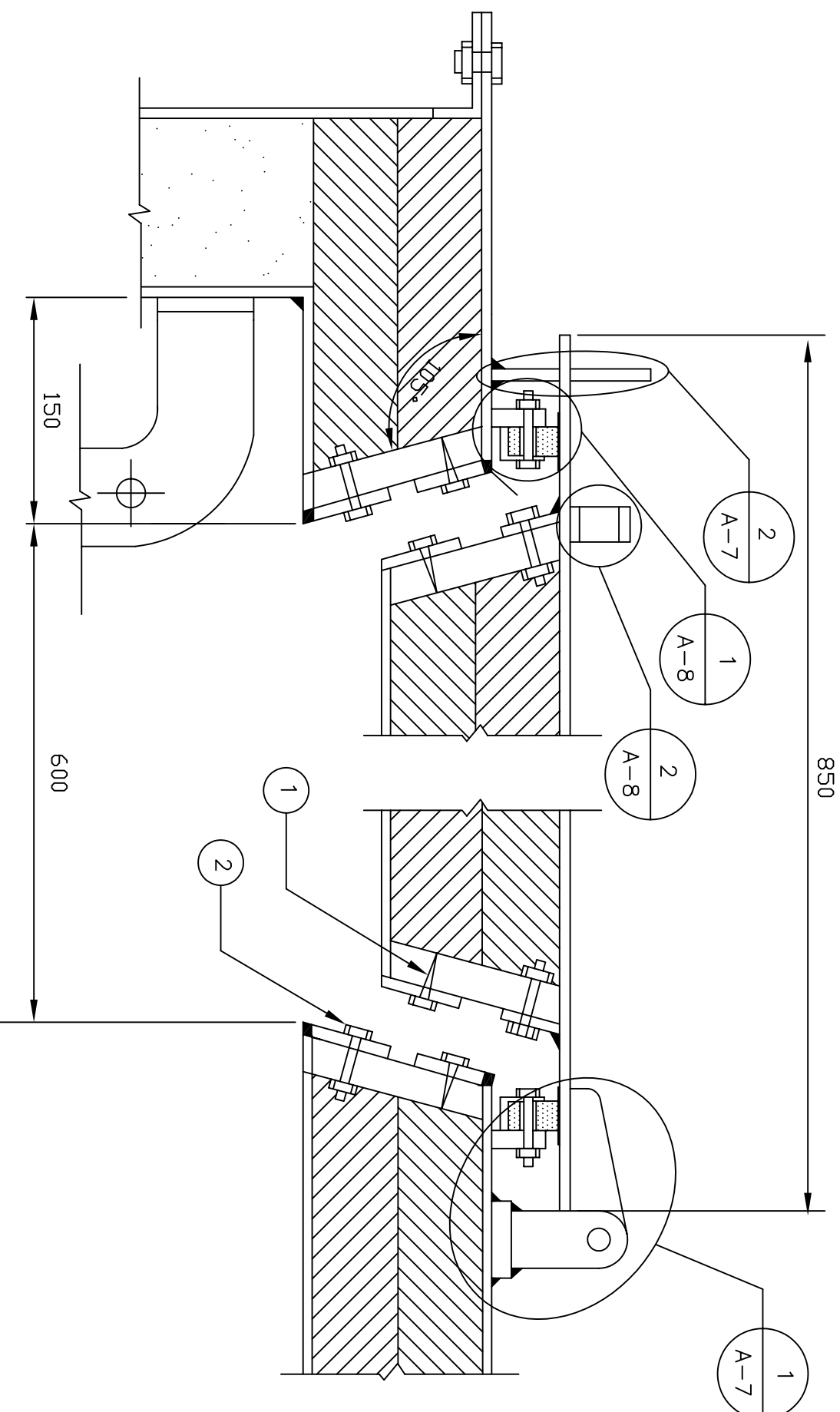
A-5

SCALE:

NTS

DATE:

MAR. 2004



KEY TO NUMBERED PARTS:

- ① #12-30 PAN HEAD SHEET METAL SCREWS AT 100 SPACING
- ② 6 GALV. BOLTS, NUT, & WASHER AT 100 SPACING

NOTES:

1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.

1 ACCESS VAULT COVER

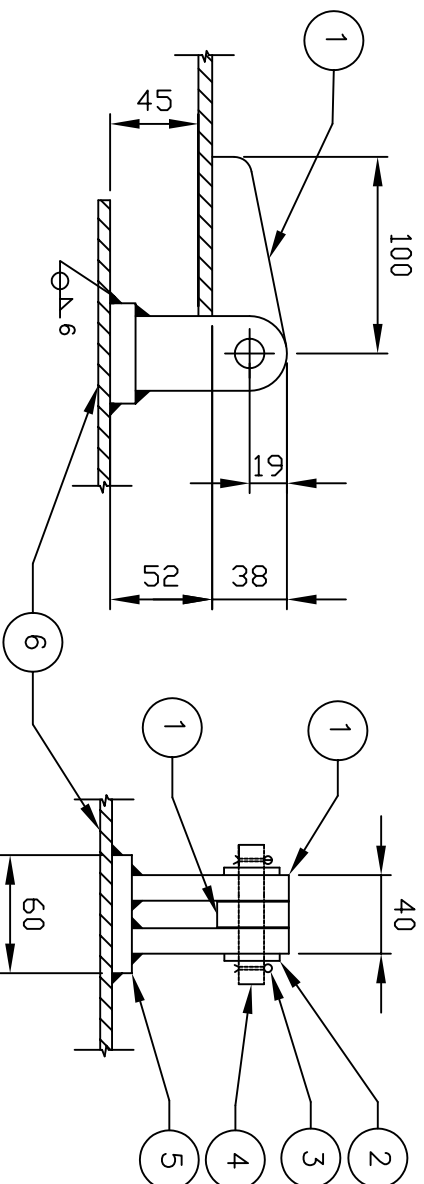


TITLE: ACCESS VAULT COVER
DETAIL

SCALE: NTS
DATE: MAR. 2004

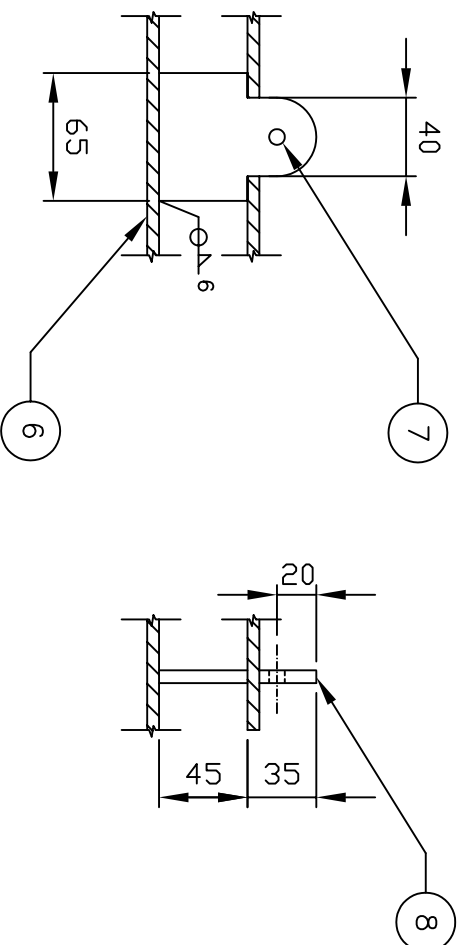
DWG NO.:

A-6



1 COVER HINGE DETAIL

- KEY TO NUMBERED PARTS:
- 1 13 HOT DIPPED GALV. STEEL PLATE
 - 2 CAD. PLATED WASHER (TYP.)
 - 3 COLLAR PIN (TYP.)
 - 4 12.7 DIA. CAD. PLATED PIN
 - 5 12 TH STEEL BAR UNDER HINGES
 - 6 6 TH STEEL PLATE ACCESS VAULT CONSTRUCTION
 - 7 8mm DIA. HOLE DRILLED FOR PADLOCK
 - 8 6 TH GALV. STEEL STAPLE



2 LOCK HASP DETAIL

- NOTES:
- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES
 - 2) TWO HINGES ARE REQUIRED PER COVER.
 - 3) HINGES TO BE SPACED AT 400mm APART



TITLE:

ACCESS VAULT COVER
MISC. DETAILS

DWG NO.:

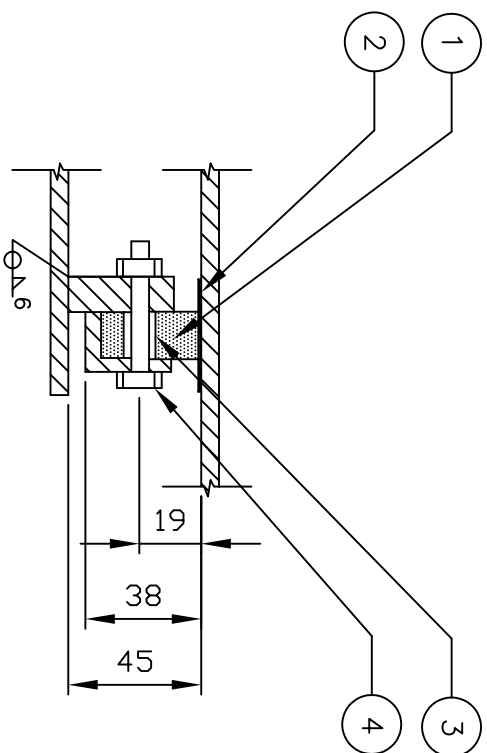
A-7

SCALE:

NTS

DATE:

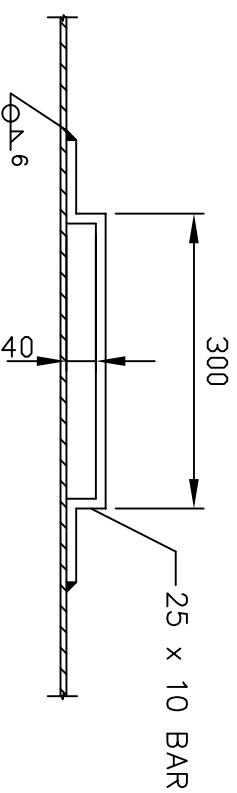
MAR. 2004



KEY TO NUMBERED PARTS:

- ① 37 DIA METKA IND. TG-155 GASKET
- ② 25 WIDE TEFLON TAPE APPLIED TO DOOR
- ③ 6.5 X 17 SPACER
- ④ 6 X 31 CAD. PLATED STEEL BOLT 150 SPACING

1 COVER SEAL DETAIL



2 COVER HANDLE DETAIL

NOTES:

1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.



TITLE:

ACCESS VAULT COVER
MISC. DETAILS

DWG NO.:

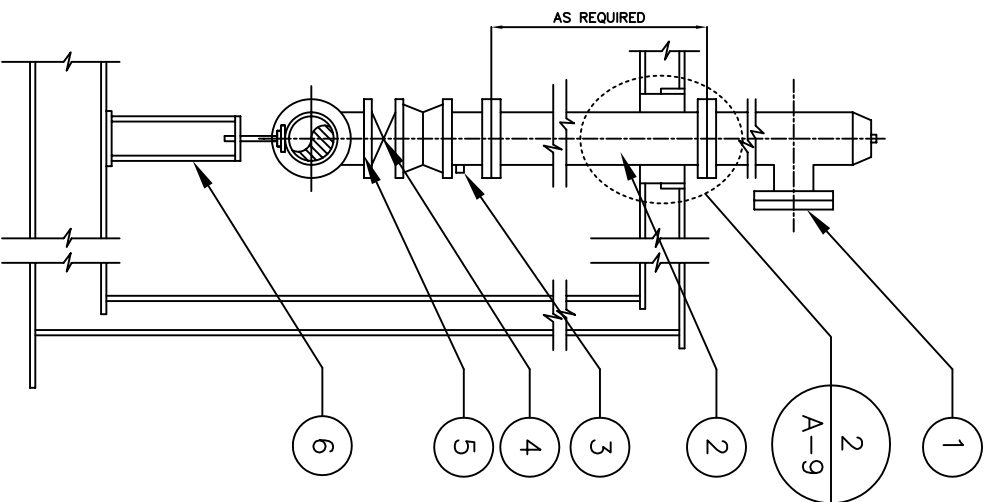
A-8

SCALE:

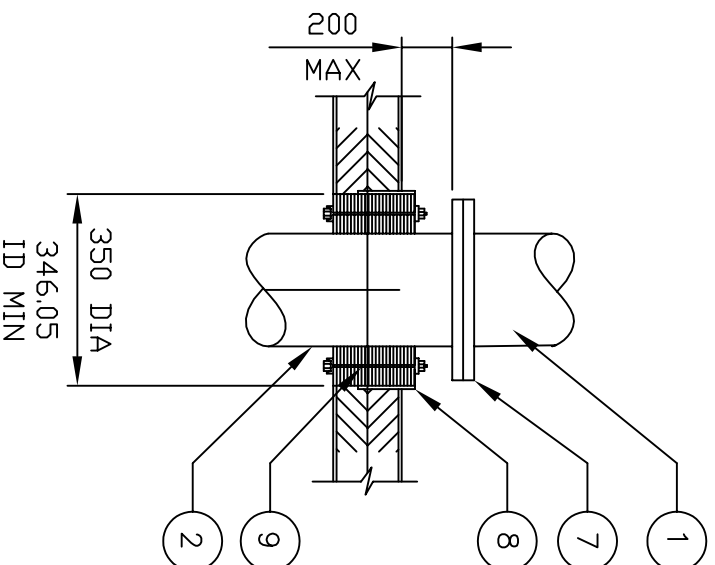
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DATE:

MAR. 2004



1 FIRE HYDRANT DETAIL



2 HYDRANT PENETRATION DETAIL

KEY TO NUMBERED PARTS:

- ① 200mm CRANE McAVITY M-67 "IN-LINE" FIRE HYDRANT
- ② FIRE HYDRANT BARRELL
- ③ VALVE & CAP TO MATCH HYDRANT DRAIN PORT
- ④ 200 mm LUG TYPE BUTTERFLY VALVE COMPLETE WITH OPERATOR
- ⑤ FLANGE TEE 1080 KPA - DIA. TO MATCH MAIN AND HYDRANT SIZE
- ⑥ PIPE SUPPORT, SEE DETAIL DWG A-15
- ⑦ HYDRANT FLANGE
- ⑧ 350 DIA SCHEDULE 10 (364 I.D.) STEEL PIPE x 100 LONG WELDED TO ACCESS VAULT TOP PLATE
- ⑨ THUNDER-LINE CORP LINK-DEAL MODEL LS-500-C (200X350) OR APPROVED EQUAL

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.



TITLE:

FIRE HYDRANT
DETAILS

DWG NO.:

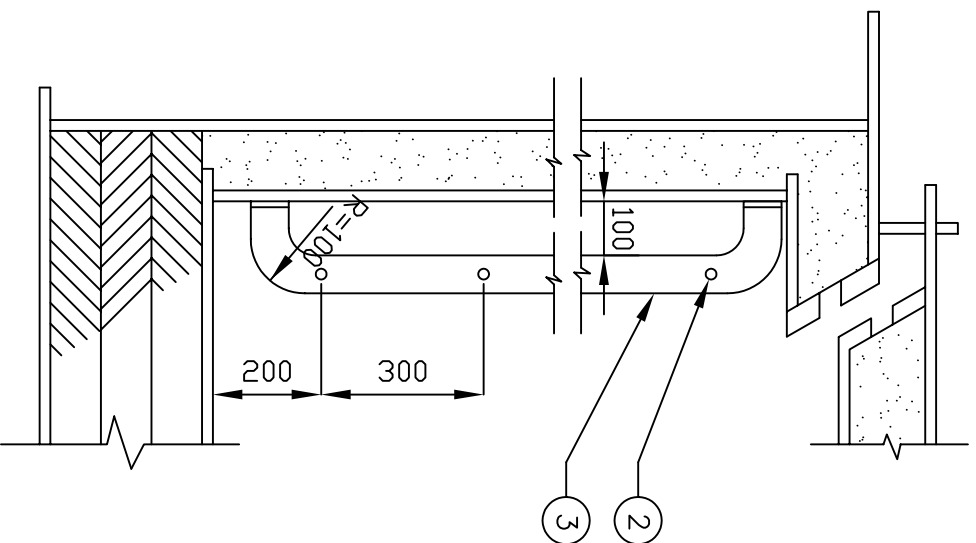
A-9

SCALE:

NTS

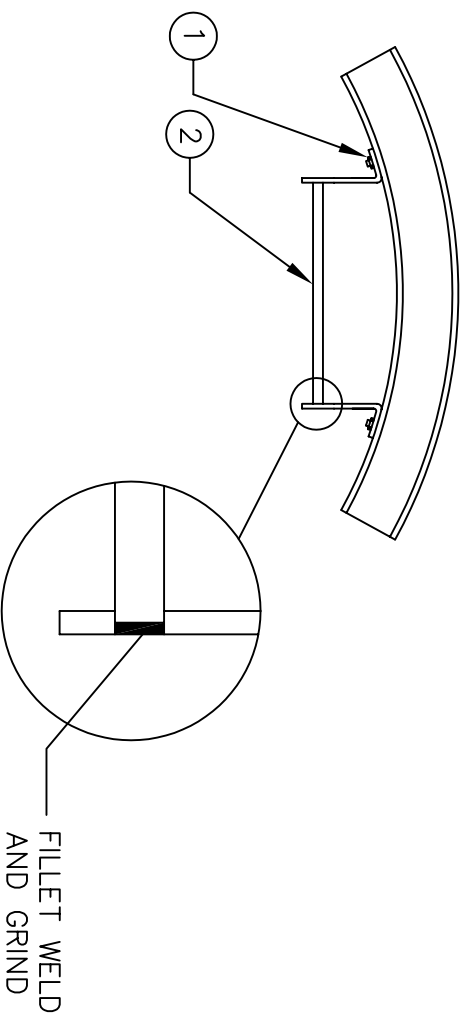
DATE:

MAR. 2004



ELEVATION

1 LADDER DETAIL



PLAN

KEY TO NUMBERED PARTS:

- ① 12 DIA STUD WELDED TO INNER WALL C/W FASTENING NUTS
- ② 20 DIA RUNGS INSERTED HALFWAY THROUGH HOLES IN STRINGER, FILLET WELD REMAINDER OF HOLE AND GRIND SMOOTH – SEE DETAIL PLAN VIEW
- ③ 63.5 x 9.5 FLAT BAR STRINGER, BENT TO MAKE SUPPORTS AND DRILLED THROUGH FOR RUNGS

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.
- 2) LADDER TO BE HOT DIPPED GALV. AFTER FABRICATION.



TITLE:

LADDER DETAIL

DWG NO.:

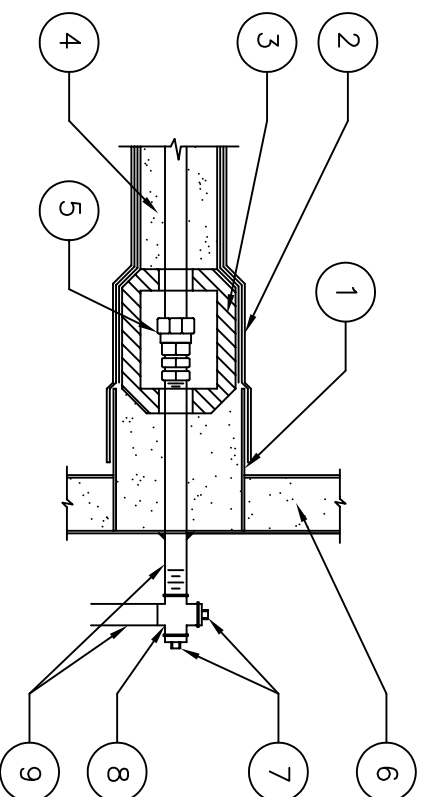
A-10

SCALE:

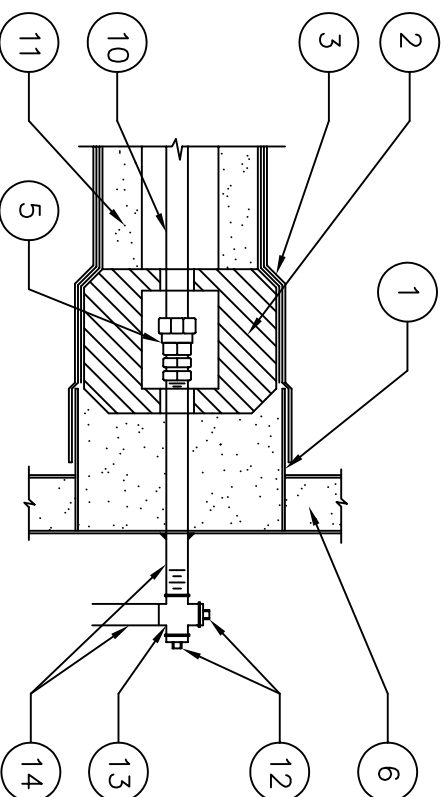
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DATE:

MAR. 2004



1 50mm WALL PENETRATION



2 25mm WALL PENETRATION

KEY TO NUMBERED PARTS:

- ① STEEL RING SECTION WELDED TO ACCESS VAULT INNER WALL – 6mm TH x 300 O.D. FOR 50mm DIA. , 275mm O.D. FOR 25mm DIA
- ② 2 LAYERS OF HEAT TRACE (0.09" THICK BLACK POLYETHYLENE SELF ADHESIVE)
- ③ INSULATED HALF SHELLS
- ④ 50mm DIA HDPE PIPE, c/w 50mm URETHANE INSULATION & 2 LAYER OF POLYETHYLENE BLACK JACKET
- ⑤ COMPRESSION FITTING, c/w SLEEVE AND INSERT – 2 REQUIRED – SIZED TO FIT
- ⑥ ACCESS VAULT WALL
- ⑦ 50mm DIA. N.P.T PLUG
- ⑧ 50 x 50 x 50 x 50 mm CROSS
- ⑨ 50mm SCH. 80 IPS
- ⑩ 25mm DIA HDPE SERIES 160 TUBING
- ⑪ 100mm DIA. HDPE SERIES 100 PIPE, c/w 50mm URETHANE INSULATION AND POLYETHYLENE BLACK JACKET
- ⑫ 25mm DIA. N.P.T. PLUG
- ⑬ 25 x 25 x 25 x 25 mm CROSS
- ⑭ 25mm DIA. SCH. 80 IPS

NOTES:

1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.



TITLE:

25mm & 50mm WALL
PENETRATION DETAILS

DWG NO.:

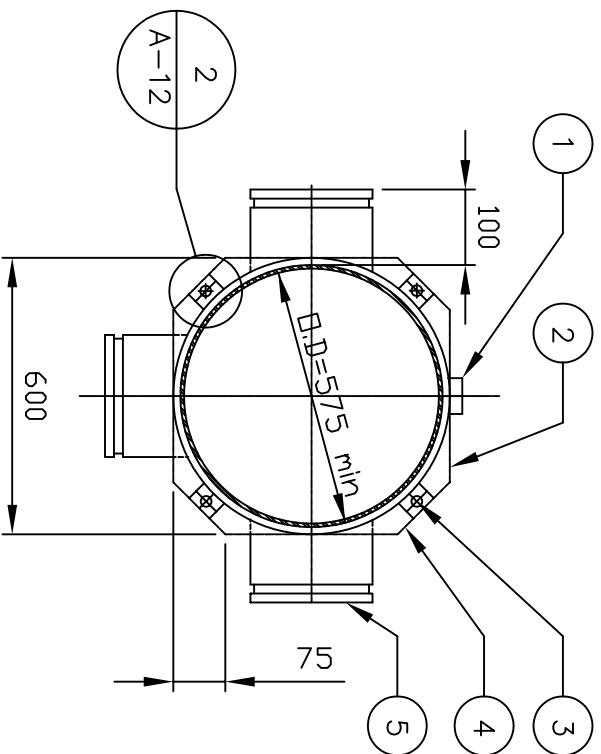
A-11

SCALE:

NTS

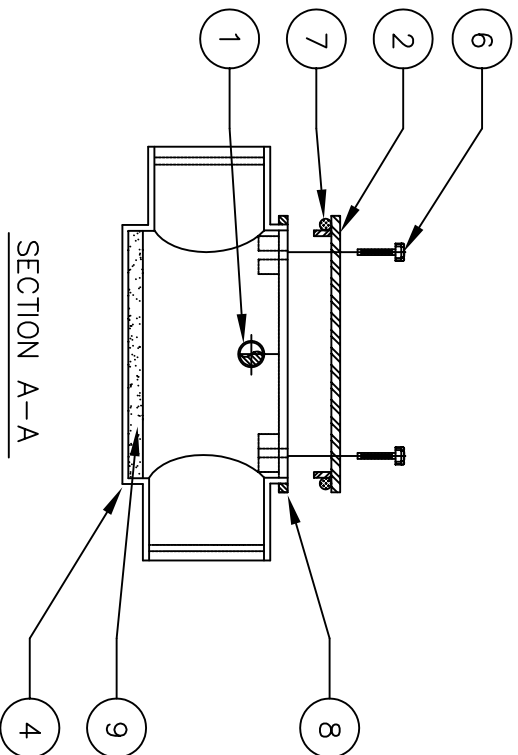
DATE:

MAR. 2004



NOTE:
1. O.D. TO BE SIZED BY CONTRACTOR

PLAN

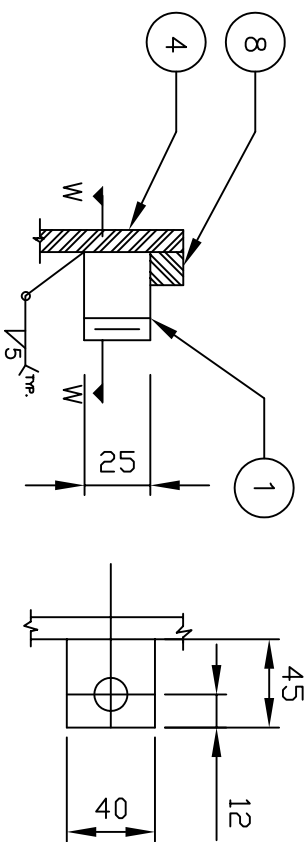


SECTION A-A

1 TYPE 1 CLEANOUT - TEE

KEY TO NUMBERED PARTS:

- 1 25 N.P.T. HALF COUPLING AND PLUG
- 2 FABRICATED CLEANOUT COVER FROM 6 TH PLATE CONTINUOUS BUTT WELDED AND HOT DIPPED GALV. AFTER FABRICATION
- 3 BOLT LUGS TAPPED 12 NC
- 4 FABRICATED CLEANOUT BODY FROM 6 TH PLATE CONTINUOUS BUTT WELD AND HOT DIPPED GALV. AFTER FABRICATION
- 5 SCHEDULE 40 STEEL - NIPPLE VICTAULIC GROOVED (SIZE TO MATCH PIPE SIZE)
- 6 12 NC X 73 LONG CAD PLATED HEX HEAD SCREW AND WASHER TO FIT COVER
- 7 20K ONE PIECE SOFT RUBBER GASKET O RING STRETCH TO FIT COVER
- 8 12 SQ. ROD RIM
- 9 CEMENT MORTAR BENCHING SUPPLIED AND INSTALLED BY INSTALLING CONTRACTOR



SECTION W-W

2 BOLT & LUG DETAIL

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.



TITLE:

CLEANOUT

DWG NO.:

TYPE 1 - TEE

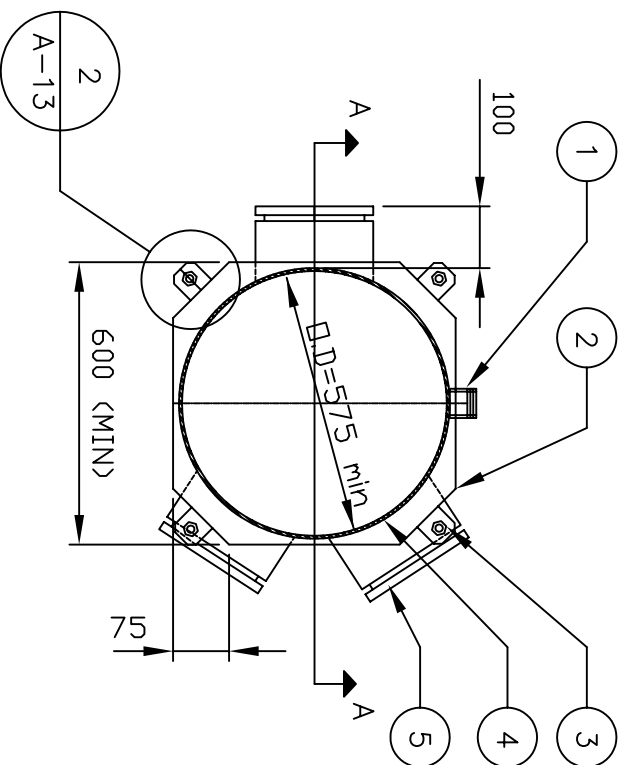
A-12

SCALE:

NTS

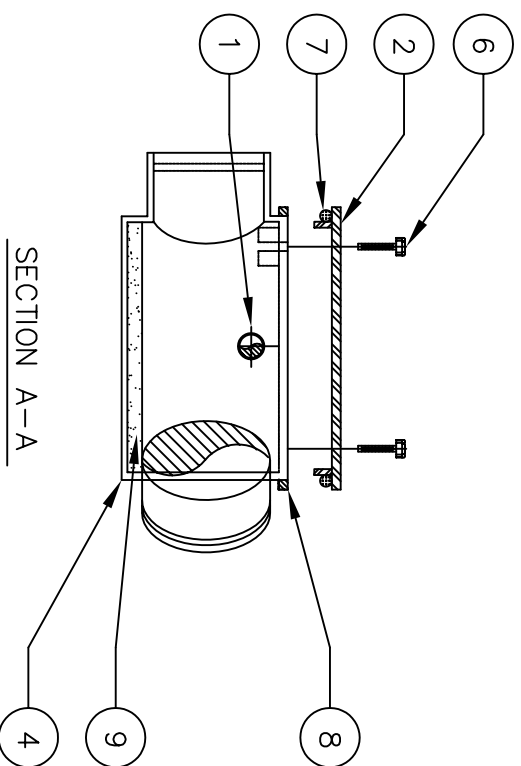
DATE:

MAR. 2004



NOTE:
1. O.D. TO BE SIZED BY CONTRACTOR

PLAN

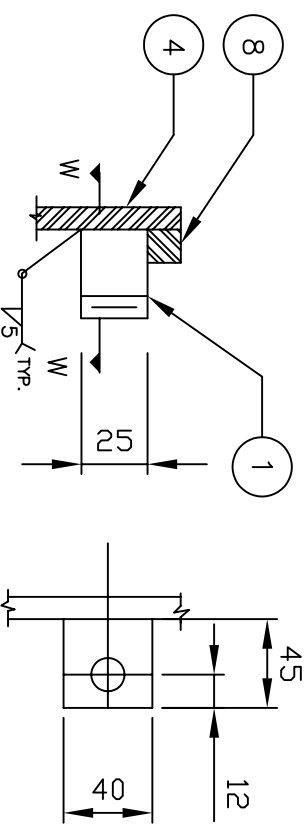


SECTION A-A

1 TYPE 1 CLEANOUT - WYE

KEY TO NUMBERED PARTS:

- 1 25 N.P.T. HALF COUPLING AND PLUG
- 2 FABRICATED CLEANOUT COVER FROM 6 TH PLATE CONTINUOUS BUTT WELDED AND HOT DIPPED GALV. AFTER FABRICATION
- 3 BOLT LUGS TAPPED 12 NC
- 4 FABRICATED CLEANOUT BODY FROM 6 TH PLATE CONTINUOUS BUTT WELD AND HOT DIPPED GALV. AFTER FABRICATION
- 5 SCHEDULE 40 STEEL - NIPPLE VICTAULIC GROOVED (SIZE TO MATCH PIPE SIZE)
- 6 12 NC X 73 LONG CAD PLATED HEX HEAD SCREW AND WASHER
- 7 20K ONE PIECE SOFT RUBBER GASKET O RING STRETCH TO FIT COVER
- 8 12 SQ. ROD RIM
- 9 CEMENT MORTAR BENCHING SUPPLIED AND INSTALLED BY INSTALLING CONTRACTOR



SECTION W-W

2 BOLT & LUG DETAIL

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.



TITLE:

CLEANOUT

TYPE 2 - WYE

DWG NO.:

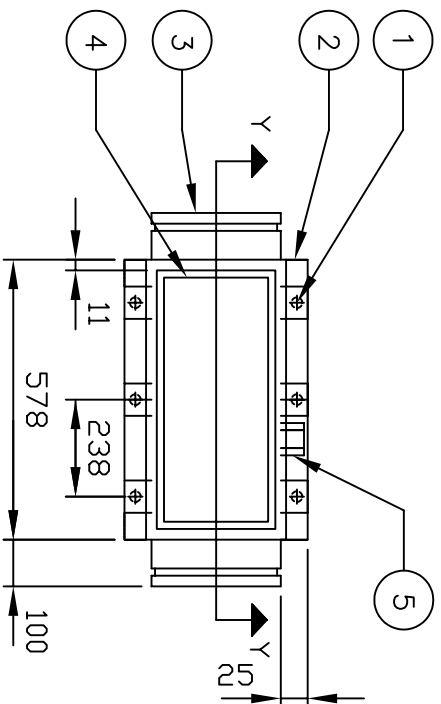
A-13

SCALE:

NTS

DATE:

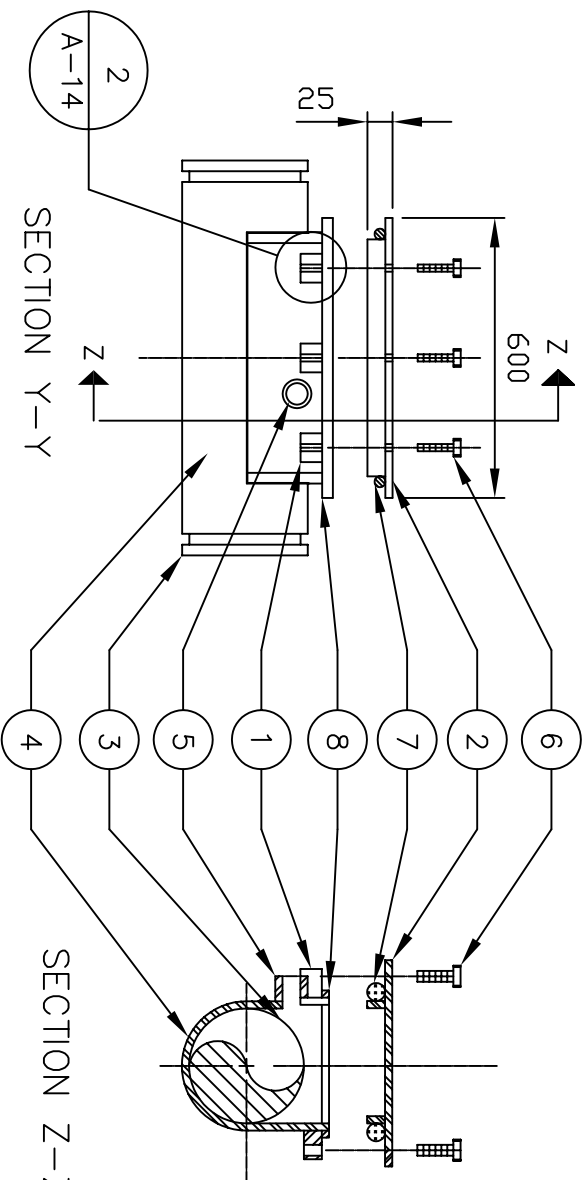
APR. 2005



PLAN

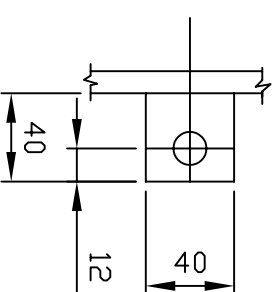
KEY TO NUMBERED PARTS:

- ① BOLT LUGS TAPPED 12 NC
- ② FABRICATED CLEANOUT COVER FROM 6 TH PLATE CONTINUOUS BUTT WELDED AND HOT DIPPED GALV. AFTER FABRICATION
- ③ SCHEDULE 40 STEEL - NIPPLE VICTAULIC GROOVED (SIZE TO MATCH PIPE SIZE)
- ④ FABRICATED CLEANOUT BODY FROM 6 TH PLATE CONTINUOUS BUTT WELD AND HOT DIPPED GALV. AFTER FABRICATION
- ⑤ 25 N.P.T. HALF COUPLING AND PLUG
- ⑥ 12 NC X 73 LONG CAD PLATED HEX HEAD SCREW AND WASHER
- ⑦ 20K ONE PIECE SOFT RUBBER GASKET O RING STRETCH TO FIT COVER
- ⑧ 12 SQ. ROD RIM

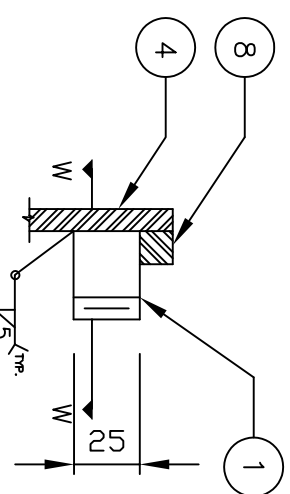


SECTION Y-Y

SECTION Z-Z



SECTION W-W



② BOLT & LUG DETAIL

① TYPE 2 CLEANOUT

NOTES:

1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES.



TITLE:

CLEANOUT - TYPE 2

DWG NO.:

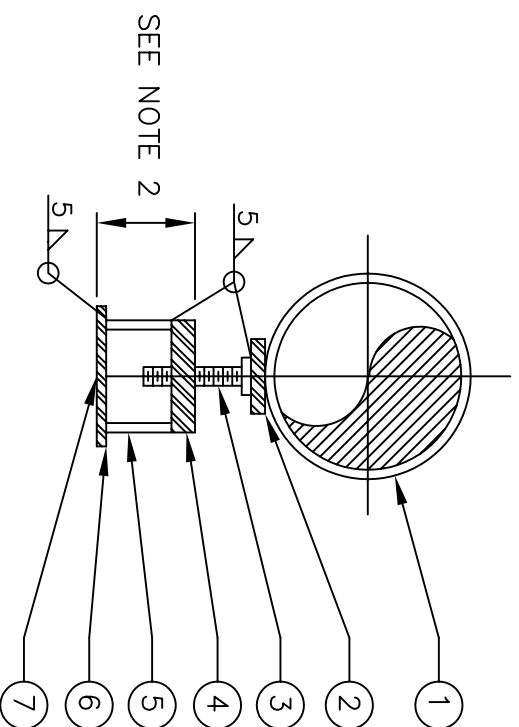
A-14

SCALE:

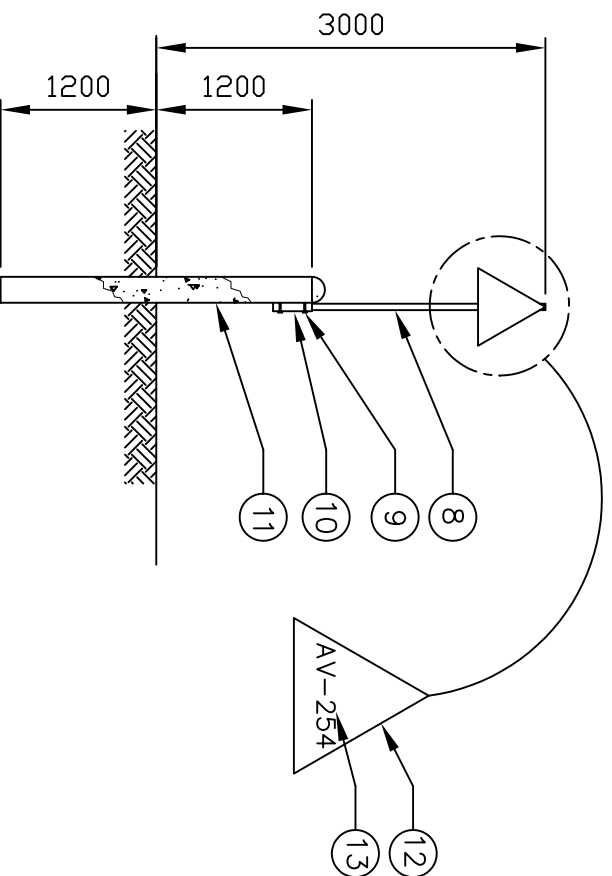
NTS

DATE:

MAR. 2004



1 PIPE SUPPORT DETAIL



2 BUMPER POST DETAIL

KEY TO NUMBERED PARTS:

- 1 WATER MAIN – HOT DIPPED GALV. STEEL PIPING
- 2 75mm DIA x 12 TH PLATE
- 3 20mm x 15 'O' BOLT
- 4 20 TH THICK PLATE DRILLED & TAPPED
- 5 100mm DIA. SCHEDULE 40 STEEL PIPE
- 6 150 x 150 x 12 TH PLATE
- 7 2 – 15mm DIA. HOLES
- 8 50mm DIA. GALV. STEEL PIPE MAST – 4 – 11mm DIA. BOLT HOLES.
- 9 2 – 9mm DIA. x 89mm LONG GALV. BOLTS THROUGH SLEEVE AND MAST.
- 10 65mm DIA. STEEL SLEEVE WELDED TO POST, c/w 2 – 11mm DIA. DRILLED HOLES
- 11 200mm DIA. STEEL PIPE POST EPOXY COATED AND FILLED WITH CONCRETE.
- 12 3mm TH STEEL PLATE SIGN PAINTED RED c/w 2 – 11mm DIA DRILLED BOLT HOLES. SIGN SECURED TO MAST WITH 2 – 9mm DIA x 76 LG. GALV. BOLTS.
- 13 WHITE LETTERING, 100mm HIGH. LETTERING TO MATCH ACTUAL ACCESS VAULT NUMBERING.

NOTES:

- 1) SEE DRAWING A-1 FOR GENERAL ACCESS VAULT NOTES
- 2) HEIGHT TO BE 100mm FOR SANITARY OR WATER IN SEPARATE AV, 500mm FOR WATER IN COMMON AV.
- 3) POST, SLEEVE AND MAST TO BE PAINTED RED AFTER FABRICATION
- 4) 4 BOLLARDS REQUIRED PER ACCESS VAULT. ONE BOLLARD PER ACCESS VAULT TO INCLUDE MAST AND SIGN.



TITLE:

MISCELLANEOUS
ACCESS VAULT DETAILS

DWG NO.:

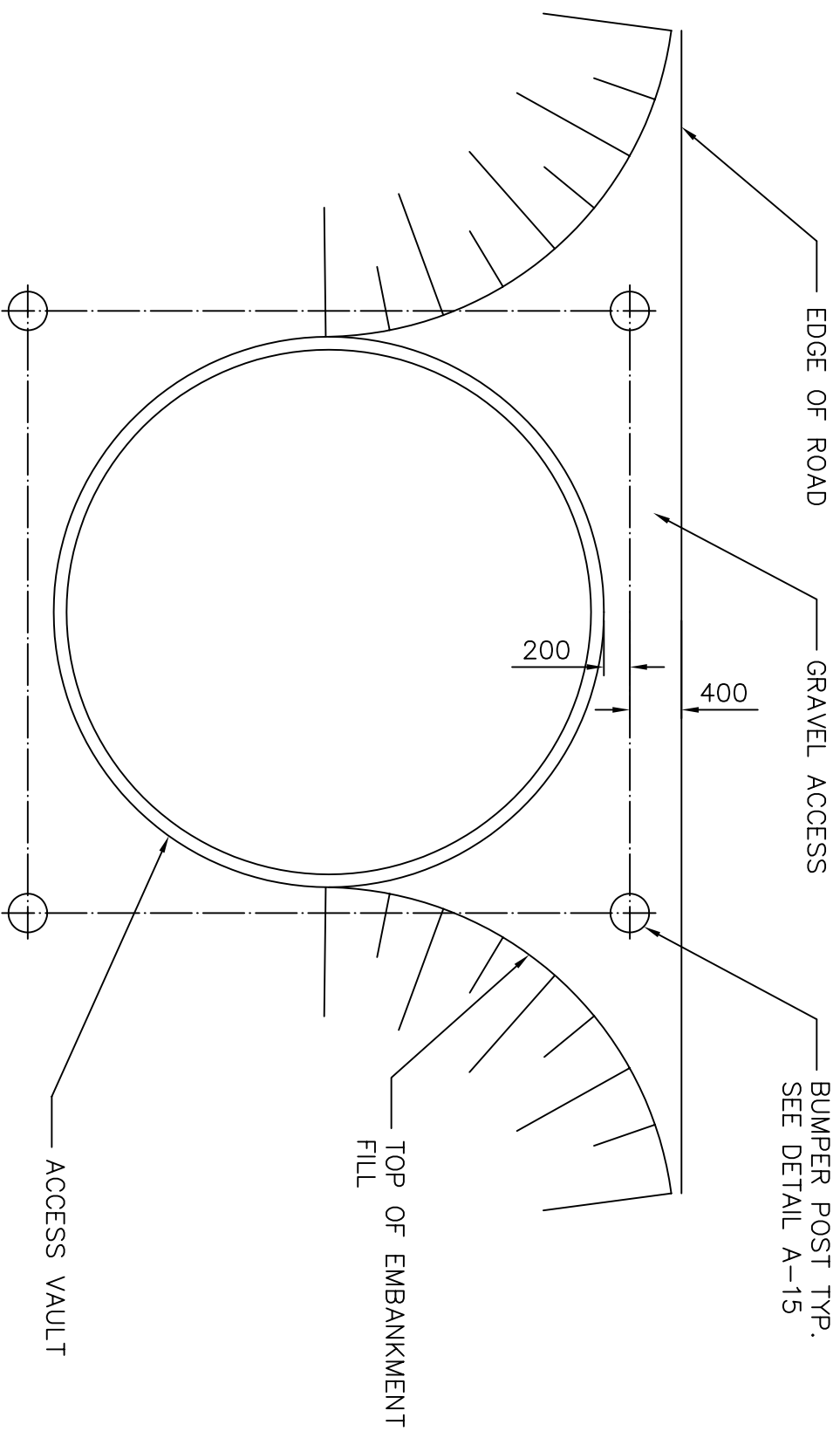
A-15

SCALE:

NTS

DATE:

MAR. 2004



| | | |
|--|--------------------|----------------------|
| TITLE: ACCESS VAULT BUMPER POST LOCATION DRAWING | | DWG NO.: A-16 |
| SCALE: NTS | DATE: APR. 2005 | |

| Building Type | Water Supply | Water Return | Sanitary Sewer | Carrier Pipe |
|---------------|--------------|--------------|----------------|--------------|
| Single family | 25 mm | 25 mm | 100 mm | 100 mm |
| 2-plex | 25 mm | 25 mm | 100 mm | 100 mm |
| 3-plex | 25 mm | 25 mm | 100 mm | 100 mm |
| 4-plex | 25 mm | 25 mm | 100 mm | 100 mm |
| 6-plex | 38 mm | 25 mm | 150 mm | 150 mm |
| 8-plex | 38 mm | 25 mm | 150 mm | 150 mm |
| 10-plex | 38 mm | 25 mm | 150 mm | 150 mm |



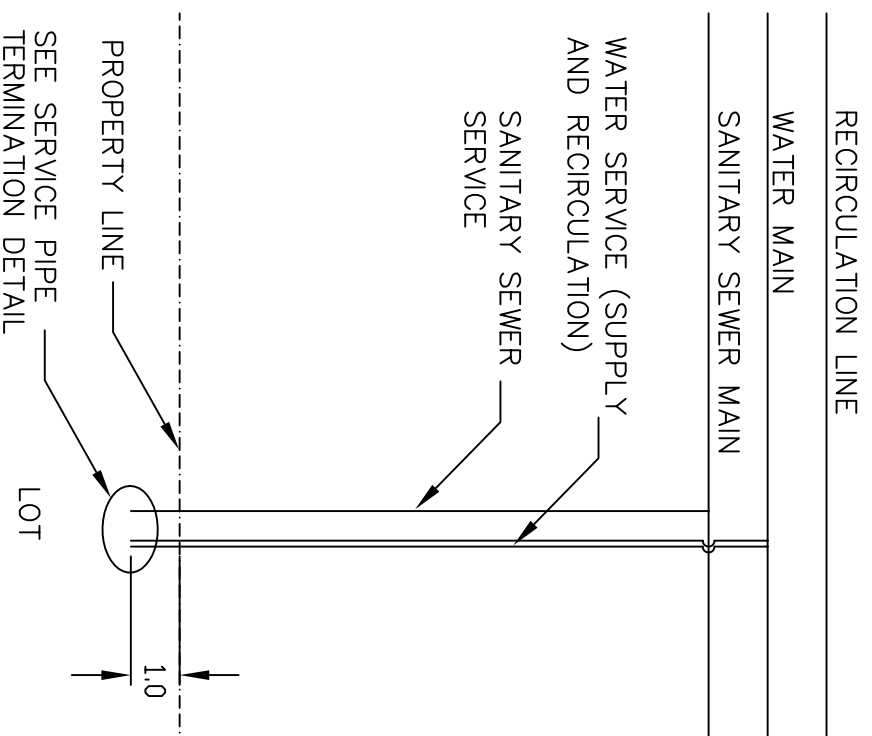
TITLE: SERVICE LATERAL
SIZING TABLE

SCALE:
NTS

DATE:
MAR. 2004

DWG NO.:

S-1



PLAN

NOTES:

1. MINIMUM SLOPE OF SANITARY SERVICE TO BE 2%
2. CAP ENDS OF SERVICE USING A BLIND FLANGED CONNECTION FOR FUTURE TIE-IN BY LOT OWNER.
3. MARK END OF SERVICE WITH 100mm x 100mm WOODEN STAKE, FROM PIPE INVERT TO A MINIMUM OF 500mm ABOVE THE GROUND. EXPOSED STAKE TO BE PAINTED RED AND MARKED TO INDICATE EITHER WATER OR SEWER.



TITLE:

TYPICAL RESIDENTIAL
SERVICE CONNECTION

DWG NO.:

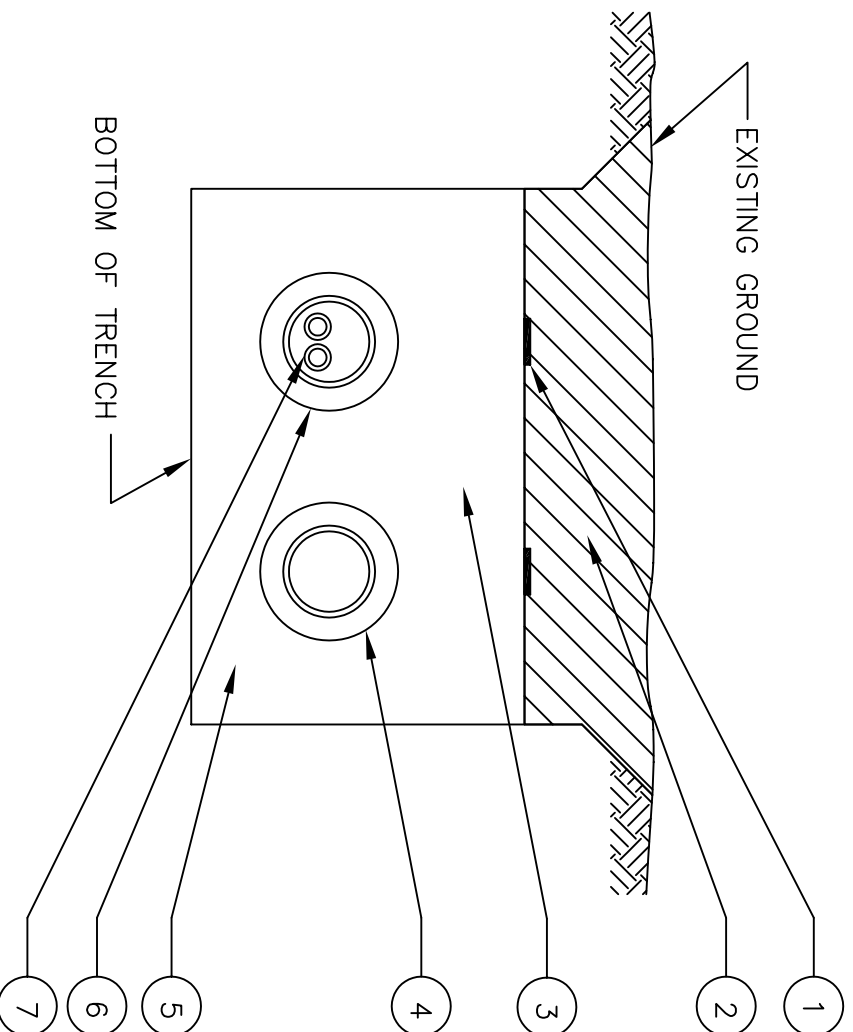
S-2

SCALE:

NTS

DATE:

MAR. 2004



KEY TO NUMBERED PARTS:

- ① WARNING TAPE.
- ② SELECT NATIVE BACKFILL MATERIAL, OR ENGINEERED BACKFILL WHERE DIRECTED BY ENGINEER.
- ③ SAND BACKFILL, COMPACTED TO 90% STANDARD PROCTOR, MINIMUM 300mm COVER OVER SERVICE PIPES.
- ④ 100mm DIA SANITARY SERVICE – DR17 HDPE PIPE c/w 50mm APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑤ SAND BEDDING COMPACTED TO 90% STANDARD PROCTOR, 150mm (IN ROCK) DEEP.
- ⑥ 100mm DIA CARRIER PIPE – DR17 HDPE PIPE c/w 50mm APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑦ 25mm SUPPLY AND 25mm RECIRCULATION WATER SERVICE, COILED DR11 HDPE PIPE INSIDE CARRIER PIPE.

NOTES:

1. PIPES TO BE SPACED AT 230mm, OR GREATER, FROM TRENCH WALL AND OTHER PIPES TO ALLOW COMPACTION.
2. TEST PITS TO BE DUG EVERY 15m TO A DEPTH OF 500mm BELOW PIPE INVERT TO CHECK FOR PRESENCE OF SILT. SUBEXCAVATE TO A DEPTH OF 450mm BELOW PIPE INVERT AND BACKFILLED WITH GRANULAR B COMPACTED TO 90% STANDARD PROCTOR.
3. SERVICE PIPES TO HAVE A MINIMUM OF 600mm OF COVER TO TOP OF INSULATION.



TITLE:

SERVICE TRENCH DETAIL

DWG NO.:

S—3

SCALE:

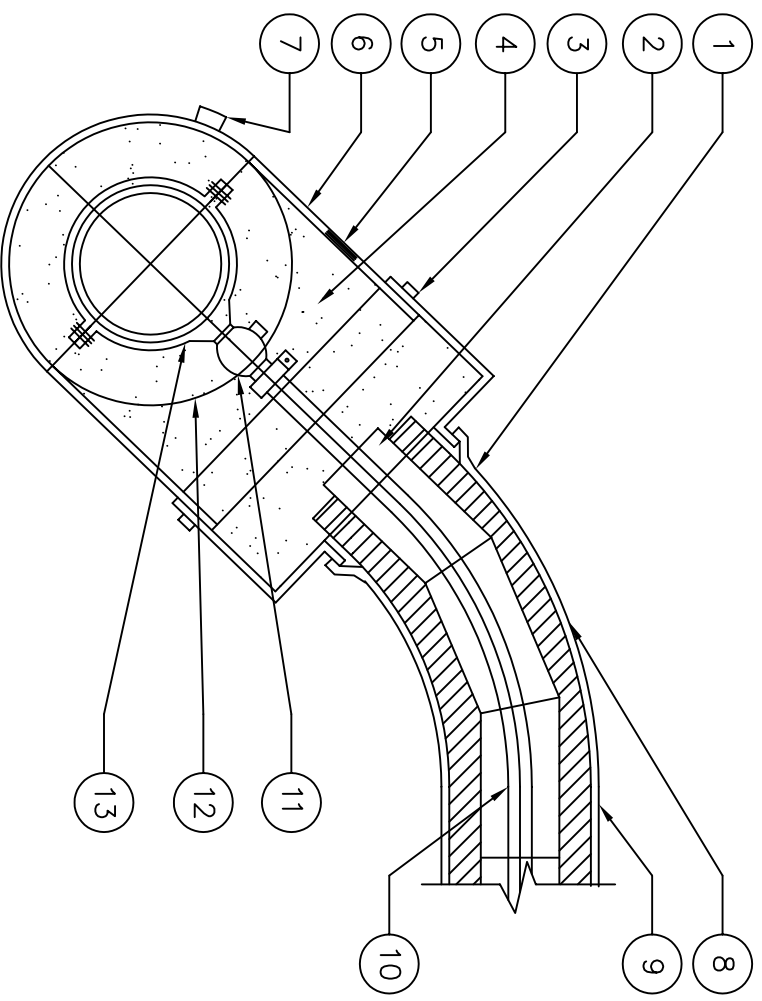
NTS

DATE:

MAR. 2004

KEY TO NUMBERED PARTS:

- ① HEAT SHRINK SLEEVE, MIN. 100mm LAP ON BLACK JACKET.
- ② POLYURETHANE FOAM PLUG
- ③ GALV. SHEET METAL SCREWS
- ④ FIELD POURED POLYURETHANE INSULATION FOAM (207 kPa COMPRESSIVE STRENGTH).
- ⑤ HOLES FOR FOAM INJECTION – TO BE MASTIC COATED AFTER FOAM INJECTION.
- ⑥ INSULATION FORM (SEE DETAIL S-14), SIZED TO FIT WATER MAIN O.D. AND SERVICE LATERAL O.D., 25mm LAP REQUIRED ON EACH SIDE.
- ⑦ STAINLESS STEEL GEAR CLAMPS.
- ⑧ FACTORY FABRICATED DR17 HDPE 45 DEGREE BEND c/w 50mm FACTORY APPLIED POLYURETHANE INSULATION, FRP JACKET AND MASTIC COATED ENDS.
- ⑨ DR17 HDPE PIPE c/w 50mm FACTORY APPLIED POLYURETHANE INSULATION, FRP JACKET AND MASTIC COATED ENDS.
- ⑩ DR11 CTS HDPE (MIN. DIA 25mm – MAX. DIA 50mm) SUPPLY & RETURN WATER SERVICE PIPE CONTINUOUS LENGTH FROM COIL STOCK.
- ⑪ BRONZE BALL CORPORATION STOP (SIZED TO FIT) – MIP T INLET x CTS DR11 HDPE – JOINT OUTLET c/w STAINLESS STEEL INSERTS STIFFENERS. 2 REQUIRED PER SERVICE.
- ⑫ WATER MAIN – DR11 HDPE PIPE c/w 50mm APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑬ ROBAR 2706 TAPPING SADDLE, DOUBLE STRAP.



NOTES:

- 1) ALL EXPOSED SURFACES OF POLYURETHANE TO BE FIELD COATED WITH MASTIC.
- 2) METAL SURFACES IN CONTACT WITH FIELD POURED POLYURETHANE INSULATION SHALL BE COATED WITH OIL SEPARATING AGENT.



TITLE:

WATER SERVICE
CONNECTION AT MAIN

DWG NO.:

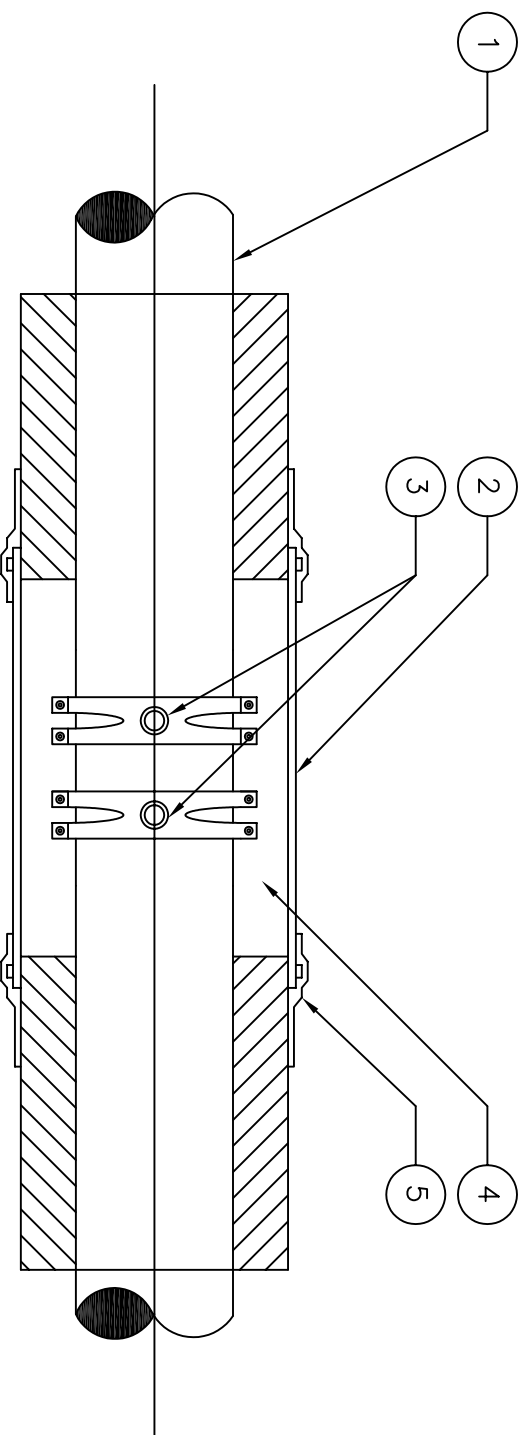
S-4

SCALE:

NTS

DATE:

MAR. 2004



KEY TO NUMBERED PARTS:

- ① WATER MAIN – DR11 HDPE PIPE c/w 50mm APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ② INSULATION FORM (SEE DETAIL S-14), SIZED TO FIT WATER MAIN O.D. AND SERVICE LATERAL O.D., 25mm LAP REQUIRED ON EACH SIDE.
- ③ ROBAR 2706 TAPPING SADDLE, DOUBLE STRAP.
- ④ FIELD POURED POLYURETHANE INSULATION FOAM (207 kPa COMPRESSIVE STRENGTH).
- ⑤ HEAT SHRINK SLEEVE, MIN. 100mm LAP ON BLACK JACKET.

NOTES:

- 1) ALL EXPOSED SURFACES OF POLYURETHANE TO BE FIELD COATED WITH MASTIC.
- 2) METAL SURFACES IN CONTACT WITH FIELD POURED POLYURETHANE INSULATION SHALL BE COATED WITH OIL SEPARATING AGENT.



TITLE: WATER SERVICE
CONNECTION AT MAIN
PLAN

DWG NO.:

S-5

SCALE: NTS

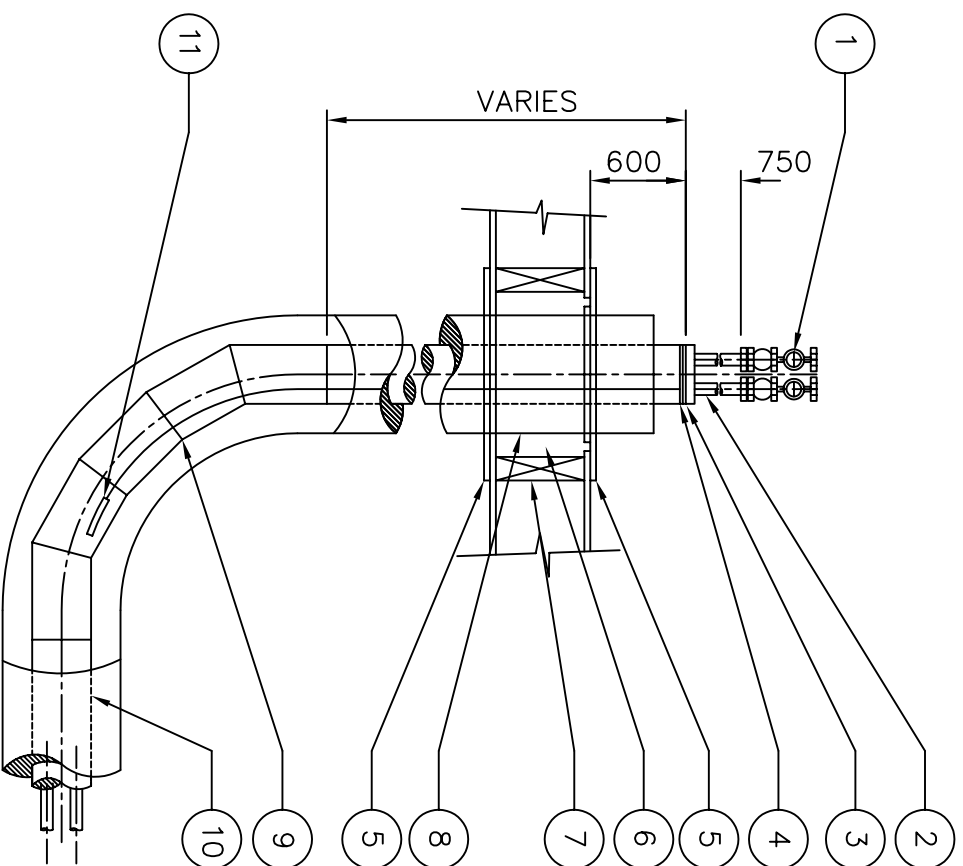
DATE: MAR. 2004

KEY TO NUMBERED PARTS :

- ① 25mm BALL VALVES, COMPRESSION WITH SEAMLESS STAINLESS STEEL INSERT – MULLER H-15219 OR EQUAL.
- ② FIELD INSTALLED 25mm OR 38mm CTS HDPE DR11 SUPPLY & RETURN WATER SERVICE PIPE – CONTINUOUS LENGTH FROM COIL STOCK.
- ③ SECURITY CAP.
- ④ STAINLESS STEEL GEAR CLAMP HOLDING SECURITY CLAMP IN PLACE.
- ⑤ 20mm PLYWOOD GLUED AND SCREWED TO JOIST/STUDS AND HEADERS. CAULK WITH SILICON ALL AROUND.
- ⑥ POLYURETHANE INSULATION FROM PORTABLE FOAM PACK TO FILL VOID.
- ⑦ FLOOR JOIST.
- ⑧ FIBREGLASS REINFORCED PLASTIC THIMBLE.
- ⑨ LONG RADIUS 90 DEGREE BEND – HDPE DR11 C/W FACTORY APPLIED 50mm POLYURETHANE INSULATION AND FRP JACKET.
- ⑩ 100mm OR 150mm CARRIER PIPE – HDPE DR11 C/W FACTORY APPLIED 50mm POLYURETHANE INSULATION AND FRP JACKET.
- ⑪ THERMOSTAT BULB.

NOTES:

1. ALL EXPOSED SURFACES OF POLYURETHANE TO BE FIELD COATED WITH MASTIC.
2. THE INSIDE SURFACE OF METAL TO BE IN CONTACT THE FIELD POURED POLYURETHANE INSULATION SHALL BE COATED WITH OIL SEPARATING AGENT.



TITLE:

WATER SERVICE
RISER AT HOUSE

DWG NO.:

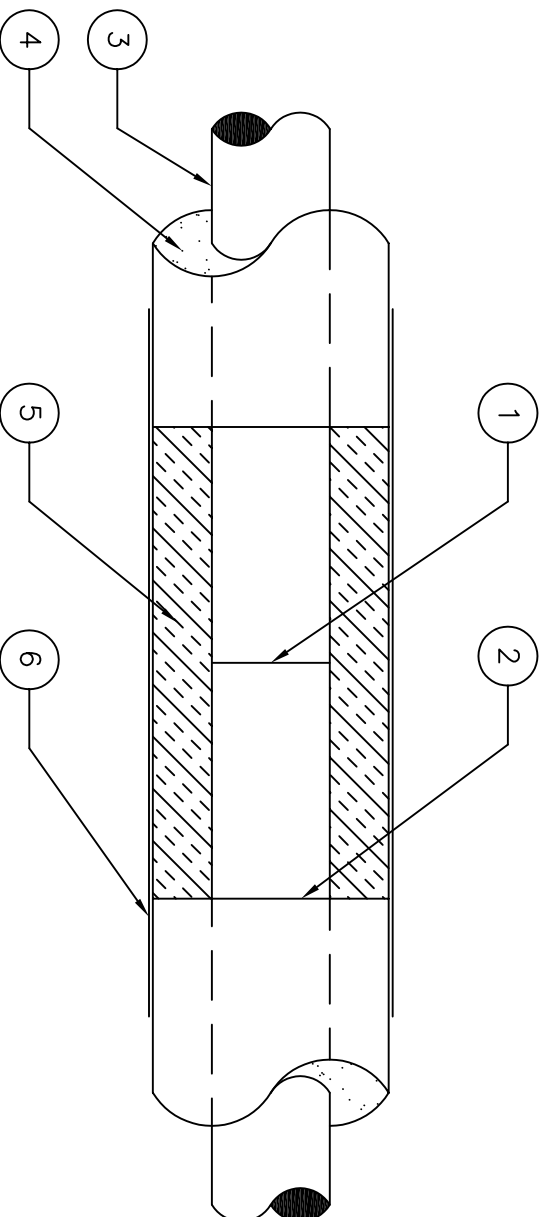
S-6

SCALE:

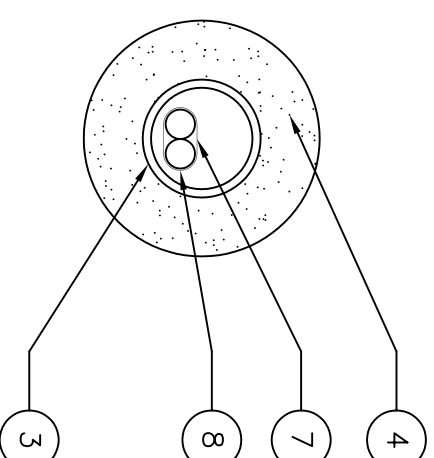
NTS

DATE:

MAR. 2004



PLAN



CROSS SECTION

KEY TO NUMBERED PART:

- ① FIELD BUTT FUSION JOINT MADE BY A QUALIFIED AND LICENSED TECHNICIAN.
- ② FIELD COAT ALL EXPOSED POLYURETHANE WITH MASTIC.
- ③ HDPE SERIES DR 17 SANITARY SEWER SERVICE
- ④ 50mm NOMINAL THICKNESS SHOP CAST POLYURETHANE INSULATION c/w BLACK JACKET.
- ⑤ POLYURETHEAN HALF SHELLS CUT TO FIT AND COATED WITH MASTIC.
- ⑥ MASTIC LINED HEAT SHRINK TAPE – 100mm OVERLAP ON SHELLS AND PIPE JACKET.

- ⑦ TWO FULL TURNS OF POLYESTER PACKAGING TAPE APPLIED EVERY 2m MIN.
- ⑧ FIELD INSTALL 25mm, 38mm OR 50mm CTS HDPE DR 11 SUPPLY AND RETURN WATER SERVICE PIPE (SEE S-1 FOR PIPE SIZING) – CONTINUOUS LENGTH FROM COILED STOCK.



TITLE:

JOINT DETAIL
WATER SERVICE

DWG NO.:

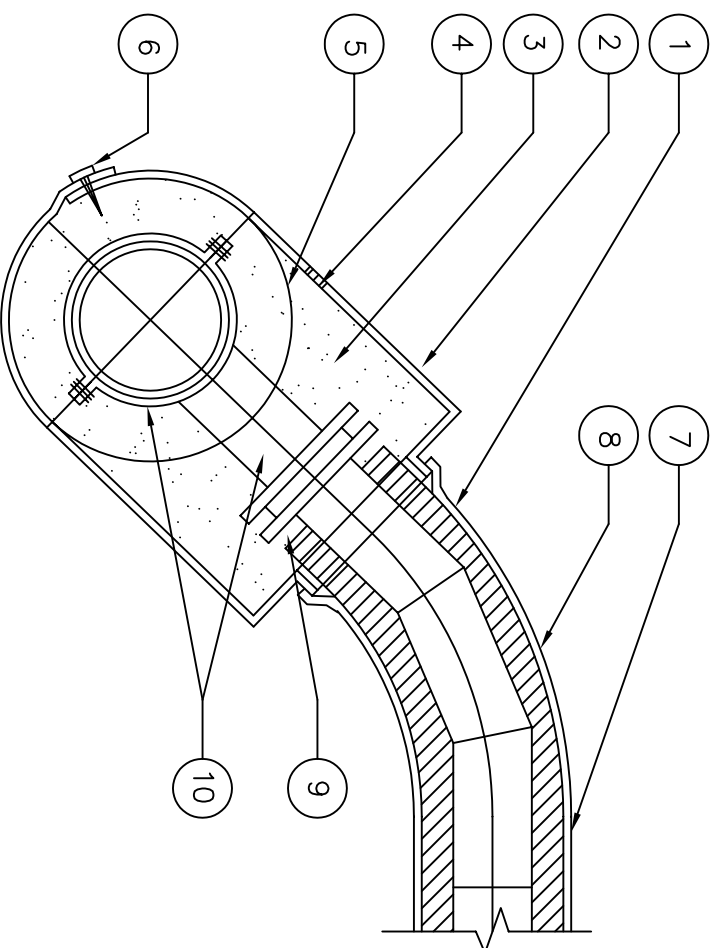
S-7

SCALE:

NTS

DATE:

MAR. 2004



KEY TO NUMBERED PARTS:

- ① HEAT SHRINK SLEEVE, MIN. 100mm LAP ON BLACK JACKET.
- ② INSULATION FORM (SEE DETAIL S-14), SIZED TO FIT WATER MAIN O.D. AND SERVICE LATERAL O.D., 25mm LAP REQUIRED ON EACH SIDE.
- ③ FIELD POURED POLYURETHANE INSULATION FOAM (207 kPa COMPRESSIVE STRENGTH).
- ④ HOLES FOR FOAM INJECTION – TO BE MASTIC COATED AFTER FOAM INJECTION.
- ⑤ SANITARY SEWER – DR11 HDPE PIPE c/w 50mm APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑥ GALV. SHEEL METAL SCREWS
- ⑦ DR17 HDPE PIPE c/w 50mm FACTORY APPLIED POLYURETHANE INSULATION, FRP JACKET AND MASTIC COATED ENDS.
- ⑧ FACTORY FABRICATED DR17 HDPE 45 DEGREE BEND c/w 50mm FACTORY APPLIED POLYURETHANE INSULATION, FRP JACKET AND MASTIC COATED ENDS.
- ⑨ FLANGE STUB END, c/w BACKUP RING, BUTT FUSED TO END OF SERVICE LATERAL.
- ⑩ ROBAR No. 6626 OUTLET SLEEVE SADDLE – SIZED TO FIT MAIN AND SERVICE LATERAL.

NOTES:

- 1) ALL EXPOSED SURFACES OF POLYURETHANE TO BE FIELD COATED WITH MASTIC.
- 2) METAL SURFACES IN CONTACT WITH FIELD POURED POLYURETHANE INSULATION SHALL BE COATED WITH OIL SEPARATING AGENT.



TITLE:

SANITARY SERVICE
CONNECTION AT MAIN

DWG NO.:

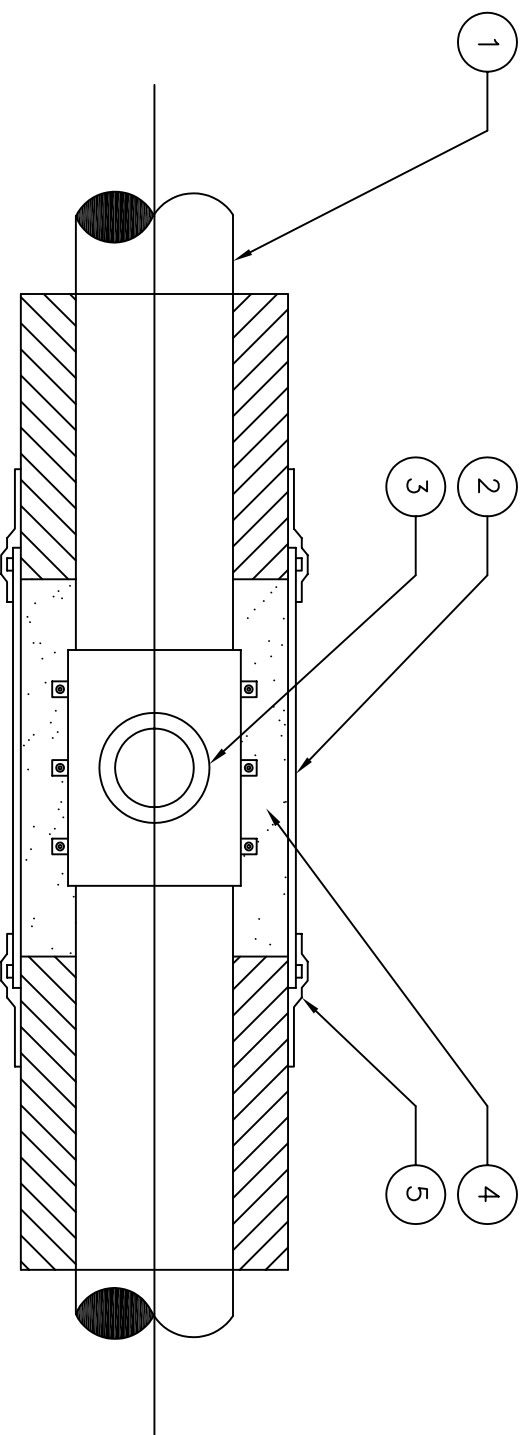
S-8

SCALE:

NTS

DATE:

MAR. 2004



KEY TO NUMBERED PARTS:

- ① SANITARY SEWER – DR11 HDPE PIPE c/w 50mm APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ② INSULATION FORM (SEE DETAIL S-14), SIZED TO FIT SANITARY SEWER O.D. AND SERVICE LATERAL O.D., 25mm LAP REQUIRED ON EACH SIDE.
- ③ ROBAR No. 6626 OUTLET SLEEVE SADDLE – SIZED TO FIT MAIN AND SERVICE LATERAL.
- ④ FIELD POURED POLYURETHANE INSULATION FOAM (207 kPa COMPRESSIVE STRENGTH).
- ⑤ HEAT SHRINK SLEEVE, MIN. 100mm LAP ON BLACK JACKET.

NOTES:

- 1) ALL EXPOSED SURFACES OF POLYURETHANE TO BE FIELD COATED WITH MASTIC.
- 2) METAL SURFACES IN CONTACT WITH FIELD POURED POLYURETHANE INSULATION SHALL BE COATED WITH OIL SEPARATING AGENT.



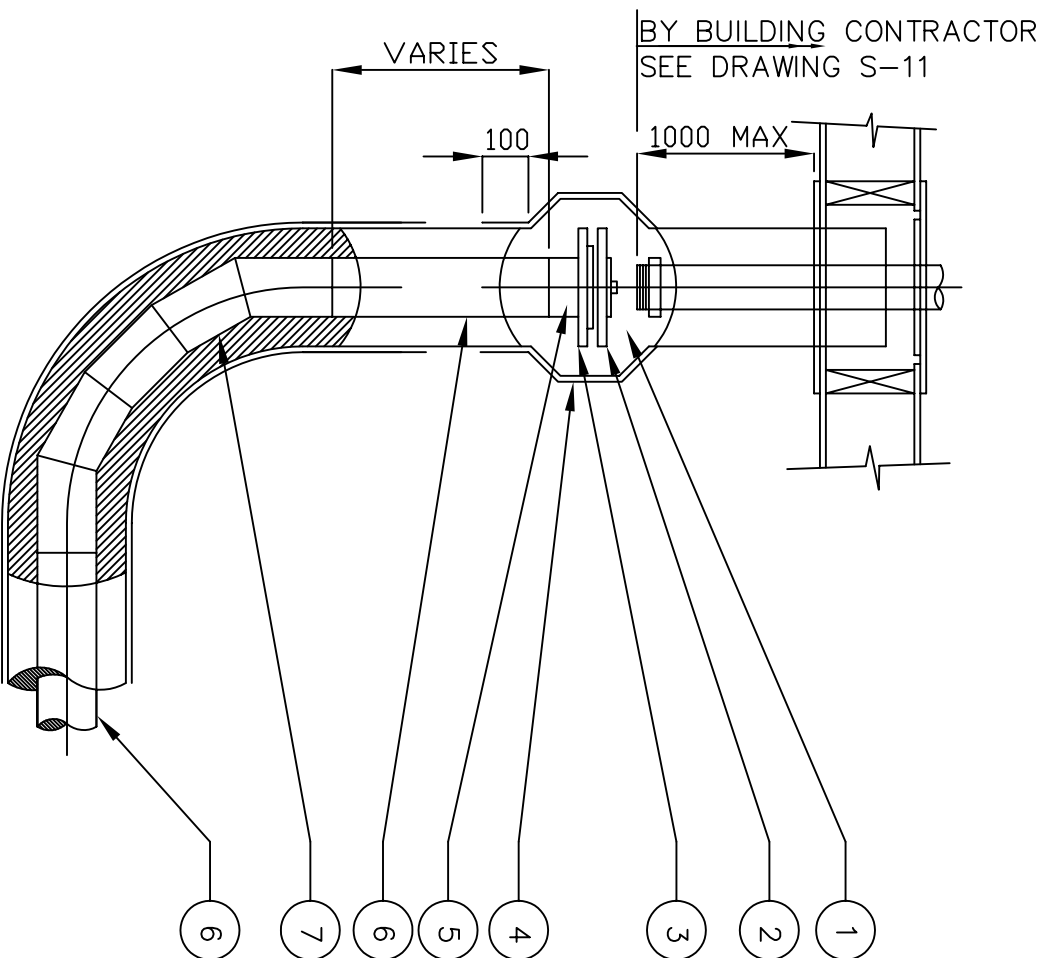
TITLE: SANITARY SERVICE
CONNECTION AT MAIN
PLAN

DWG NO.:

S-9

SCALE: NTS

DATE: MAR. 2004



KEY TO NUMBERED PARTS:

- ① INSULATION KIT FOR FLANGE ASSEMBLY
- ② COMPANION FLANGE (SIZED TO FIT PIPE DIA.), WITH RUBBER GASKET AND BOLTS DRILLED AND TAPPED, c/w PVC TEMP. PLUG (SIZED TO FIT).
- ③ BACKUP RING FOR FLANGE ASSEMBLY.
- ④ HEAT SHRINK TO FIT OVER INSULATION KIT.
- ⑤ HDPE STUB END FUSED TO SANITARY SERVICE PIPE (SIZED TO FIT).
- ⑥ SANITARY SERVICE PIPE, HDPE DR17 c/w 50mm FACTORY APPLIED POLYURETHANE INSULATION, FRP JACKET AND MASTIC COATED ENDS.
- ⑦ FACTORY FABRICATED DR17 HDPE 45 DEGREE BEND c/w 50mm FACTORY APPLIED POLYURETHANE INSULATION, FRP JACKET AND MASTIC COATED ENDS.

NOTES:

- 1) ALL EXPOSED SURFACES OF POLYURETHANE TO BE FIELD COATED WITH MASTIC.
- 2) SURFACES OF METAL TO BE IN CONTACT WITH FIELD POURED POLYURETHANE INSULATION SHALL BE COATED WITH OIL SEPARATING AGENT.
- 3) INSULATION FORMS AND METAL COVER PARTS TO BE 1.6mm TH. STEEL CONTINUOUS WELDED SEAMS, HOT DIPPED GALV. AFTER FABRICATION.



TITLE:

SANITARY SERVICE RISER

DWG NO.:

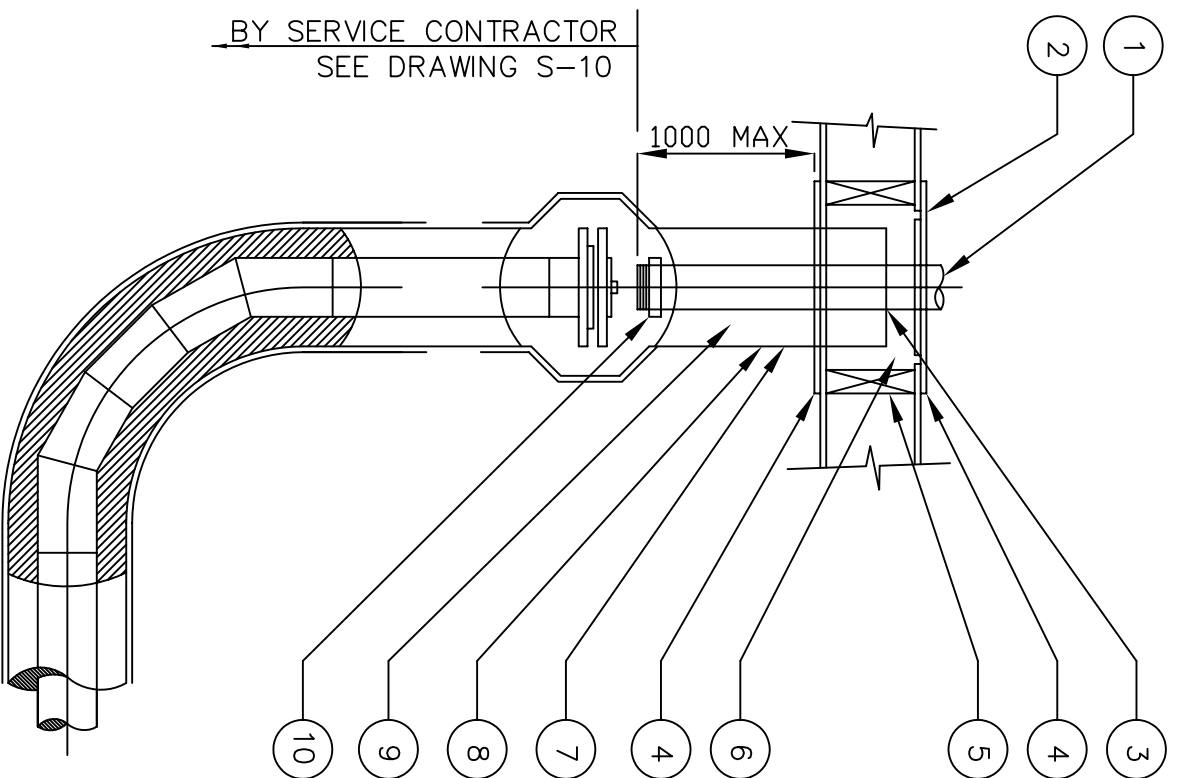
S-10

SCALE:

NTS

DATE:

MAR. 2004



KEY TO NUMBERED PARTS:

- 1) 75mm DIA. PVC OR ABS PIPE
- 2) 200mm CHIMNEY CLEANOUT PLUG. CUT HOLE TO FIT O.D. OF PIPE
- 3) SILICON SEALER APPLIED TO THIS SECTION BEFORE INSERTING INSULATED PIPE INTO OPENING.
- 4) 20mm PLYWOOD – GLUED AND SCREWED TO JOIST/STUDS AND HEADERS.
- 5) FLOOR JOIST.
- 6) FIELD APPLIED POLYURETHANE INSULATION TO FILL VOID.
- 7) 290mm GALV. THIMBLE, 22 GA. TOP AND BOTTOM SCREWED TO PLYWOOD.
- 8) HEAT SHRINK – TO SUIT.
- 9) POLYURETHANE HALF SHELLS, CUT TO LENGTH AND COATED WITH FIELD APPLIED MASTIC.
- 10) ADAPTER SOCKED (SIZED TO FIT) X MPT TO SUIT BUILDING PLUMBING MATERIALS.

NOTES:

- 1) ALL EXPOSED SURFACES OF POLYURETHANE TO BE FIELD COATED WITH MASTIC.
- 2) SURFACES OF METAL TO BE IN CONTACT WITH FIELD POURED POLYURETHANE INSULATION SHALL BE COATED WITH OIL SEPARATING AGENT.
- 3) INSULATION FORMS AND METAL COVER PARTS TO BE 1.6mm TH. STEEL CONTINUOUS WELDED SEAMS, HOT DIPPED GALV. AFTER FABRICATION.



TITLE:

SANITARY SERVICE HOUSE
CONNECTION DETAIL

DWG NO.:

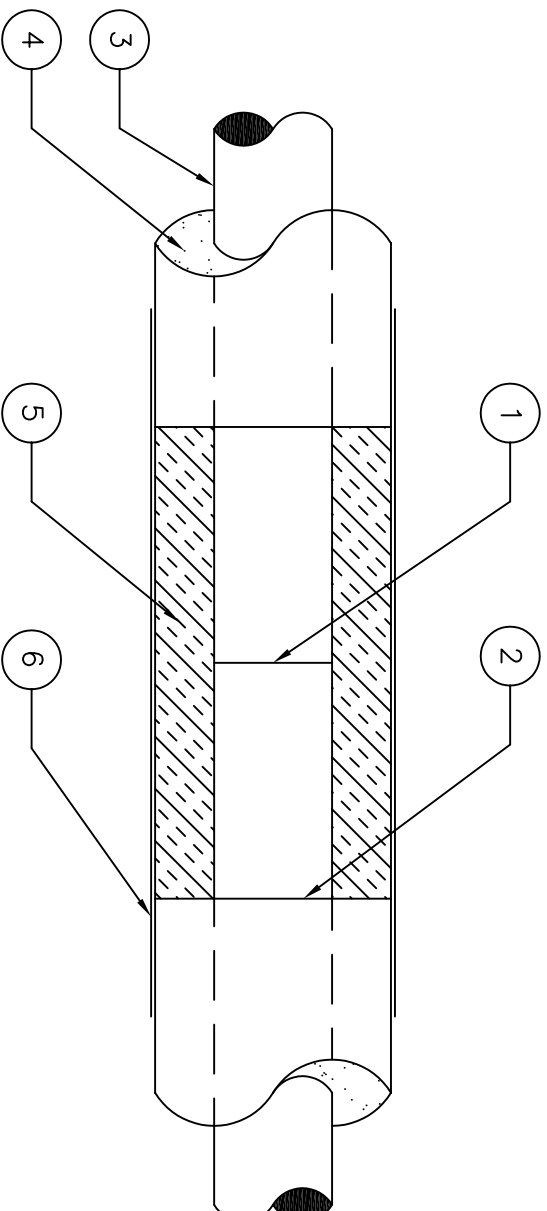
S-11

SCALE:

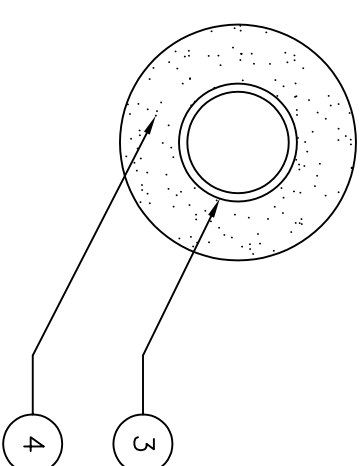
NTS

DATE:

MAR. 2004



PLAN



CROSS SECTION

KEY TO NUMBERED PART:

- ① FIELD BUTT FUSION JOINT MADE BY A QUALIFIED AND LICENSED TECHNICIAN.
- ② FIELD COAT ALL EXPOSED POLYURETHANE WITH MASTIC.
- ③ HDPE SERIES DR 17 SANITARY SEWER SERVICE
- ④ 50mm NOMINAL THICKNESS SHOP CAST POLYURETHANE INSULATION c/w BLACK JACKET.
- ⑤ POLYURETHANE HALF SHELLS CUT TO FIT AND COATED WITH MASTIC.
- ⑥ MASTIC LINED HEAT SHRINK TAPE – 100mm OVERLAP ON SHELLS AND PIPE JACKET.



TITLE:

JOINT DETAIL
SANITARY SERVICE

DWG NO.:

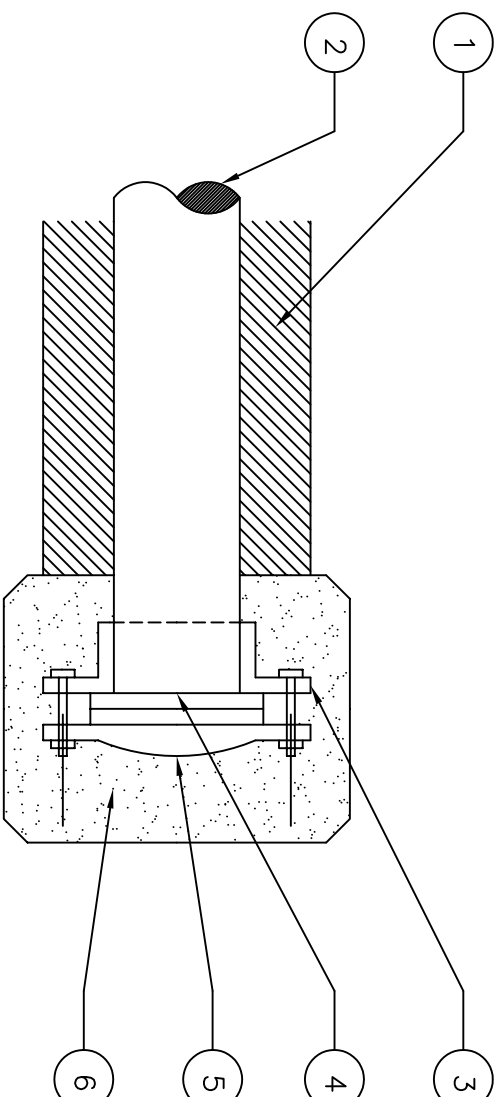
S-12

SCALE:

NTS

DATE:

MAR. 2004



KEY TO NUMBERED PARTS:

- ① 50mm FACTORY APPLIED POLYURETHANE INSULATION, FRP JACKET AND MASTIC COATED ENDS.
- ② DR17 HDPE PIPE c/w 50mm FACTORY APPLIED POLYURETHANE INSULATION
- ③ SLIP ON COLLAR – HDPE (TYP.)
- ④ HDPE STUB END, BUTT FUSED
- ⑤ HDPE BLIND FLANGE
- ⑥ FLANGE INSULATION KIT



TITLE:

PIPE TERMINATION DETAIL

DWG NO.:

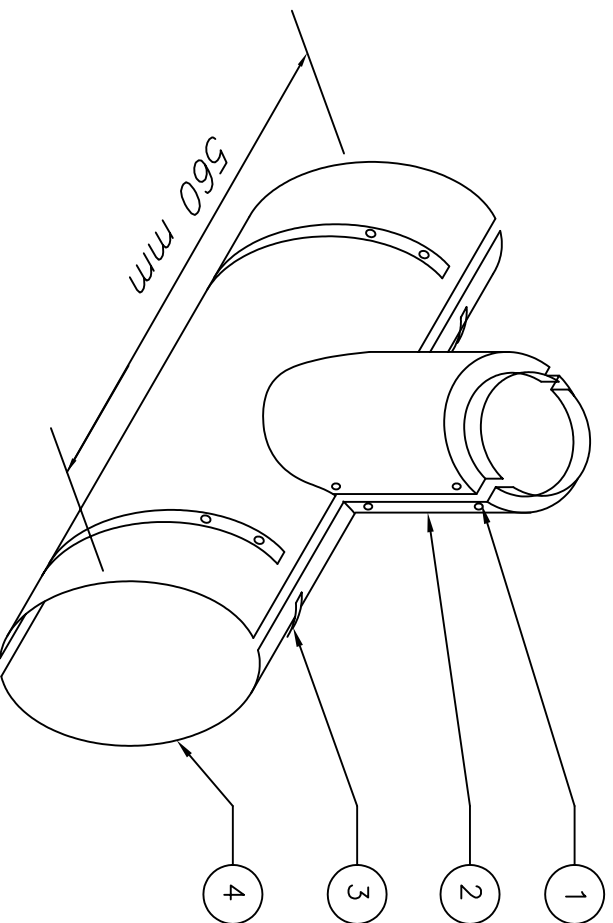
S-13

SCALE:

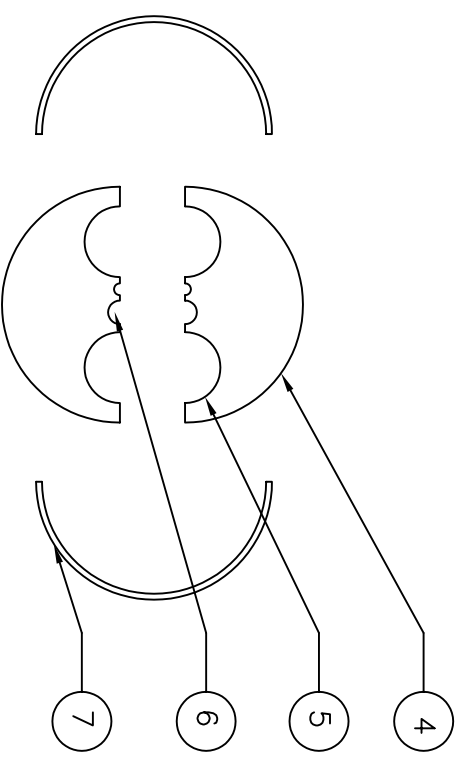
NTS

DATE:

MAR. 2004



1 STEEL INSULATION FORM



2 SECURITY CAP DETAIL

KEY TO NUMBERED PARTS:

- ① HOLES TO BE DRILLED IN FIELD TO SUIT, FOR GALVANIZED SHEET METAL SCREWS.
- ② DIA. TO SUIT INSULATED MAIN O.D. AND REQUIRED 25mm LAP ON EACH SIDE.
- ③ STAINLESS STEEL GEAR CLAMPS.
- ④ 20mm PLYWOOD TO FIT PIPE O.D.
- ⑤ HOLES TO FIT HPDE SUPPLY AND RETURN LINES.
- ⑥ HOLE FOR THERMOSTAT BULB AND HEAT TRACE CABLE.
- ⑦ 22 GAUGE SHEET METAL GALVANIZED.



TITLE:

MISC. DETAILS
SERVICE CONNECTIONS

DWG NO.:

S-14

SCALE:

NTS

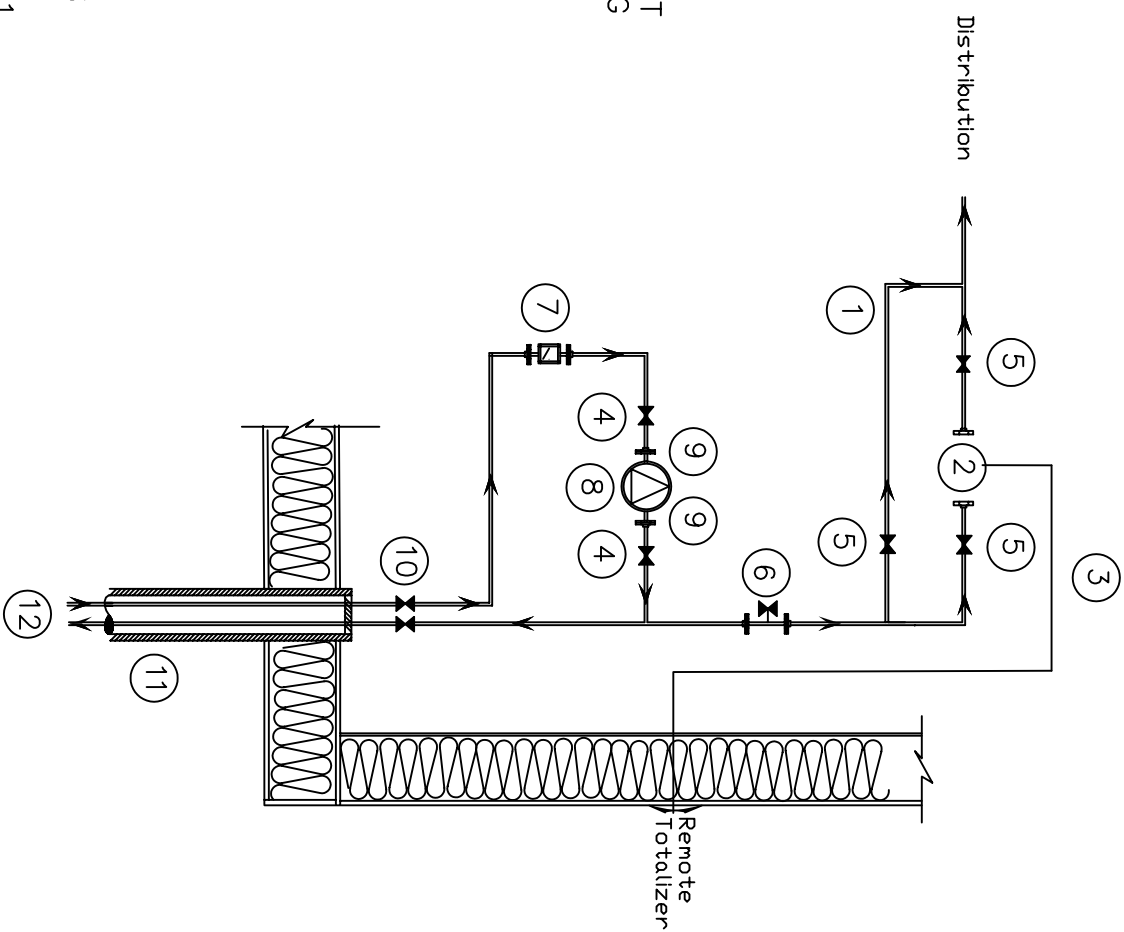
DATE:

MAR. 2004

KEY TO NUMBERED PARTS:

- ① BYPASS REQUIRED FOR ALL METERS 19mm AND LARGER.
- ② METER SIZES / SPOOL PIECE SPACING:

| | | |
|------|-------|-------|
| 10mm | ----- | 191mm |
| 19mm | ----- | 191mm |
| 25mm | ----- | 273mm |
| 38mm | ----- | 330mm |
| 51mm | ----- | 431mm |
| 64mm | ----- | 489mm |
| 76mm | ----- | 489mm |
- ③ METERS TO BE LOCATED 90 TO 120mm FROM THE FLOOR IN A HORIZONTAL POSITION.
- ④ ISOLATION GATE VALVES.
- ⑤ SEALABLE ISOLATION GATE VALVES – SEALED BY MUNICIPALITY.
- ⑥ PRESSURE REDUCING VALVE.
- ⑦ FLOW SWITCH – ACTIVATE FLOW ALARM.
- ⑧ CIRCULATION PUMP
- ⑨ UNION FITTING ON BOTH SIDES OF THE SERVICEABLE EQUIPMENT.
- ⑩ SYSTEM MAIN VALVE MIN. 300mm FROM FLOOR – BRONZE BALL CURB STOP – COMPRESSION FITTING WITH SEAMLESS S.S. INSERT. MULLER H-15219 OR EQUAL.
- ⑪ WATER SERVICE CARRIER PIPE, 100mm DIA MIN, HDPE DR11 WITH 50mm NOMINAL POLYURETHANE INSULATION AND FACTORY APPLIED JACKET.
- ⑫ FIELD INSTALLED CTS HDPE DR11 WATER SUPPLY AND RETURN. CONTINUOUS LENGTH COIL STOCK FROM MAIN TO INTERIOR OF BUILDING.



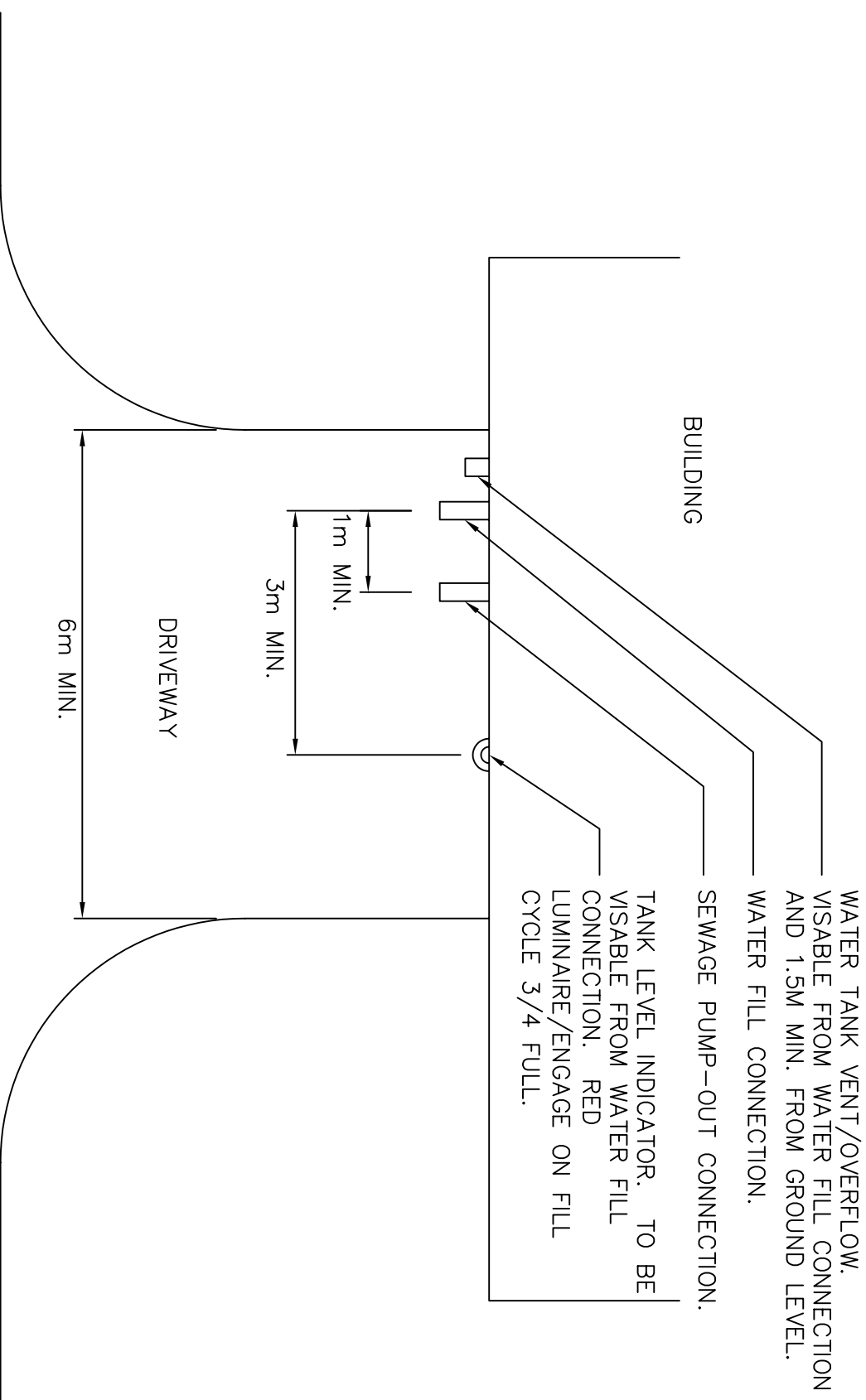
TITLE: WATER METER AND
RECIRCULATION PUMP
SCHEMATIC


DWG NO.:

S-15

SCALE: NTS

DATE: MAR. 2004



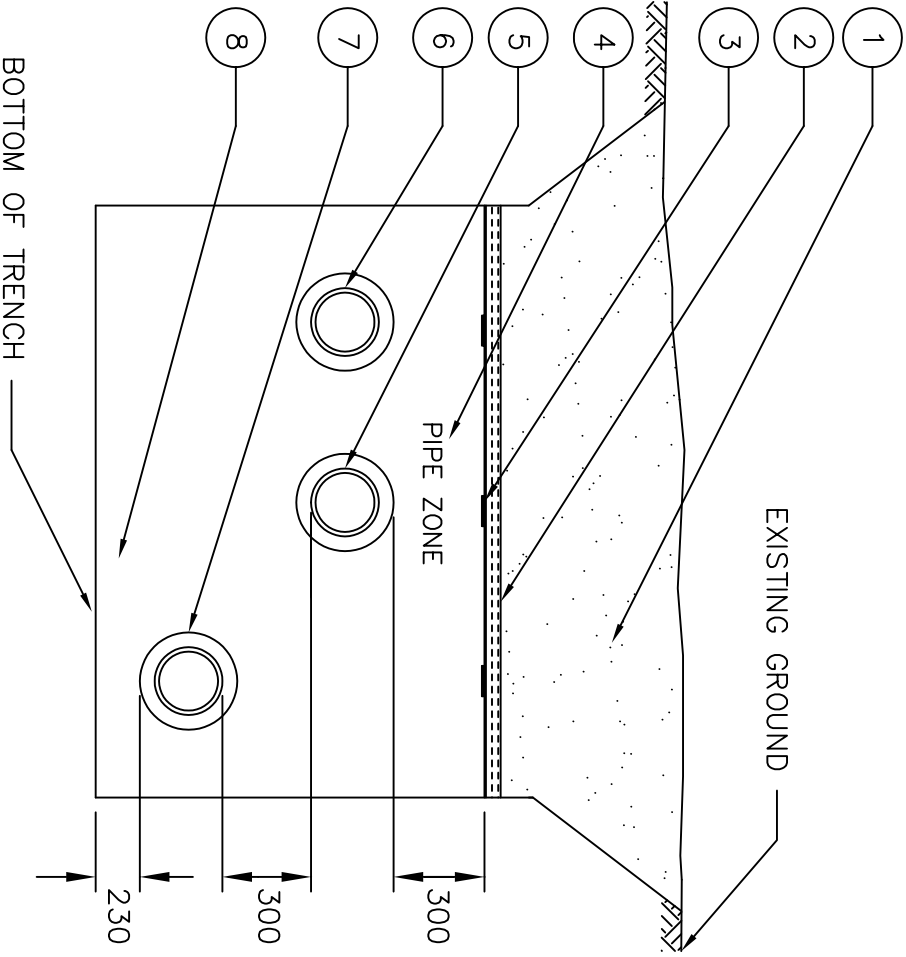
| | | |
|---|------------------------|----------------------|
| TitlE: TRUCKED SERVICE DRIVEWAY LAYOUT DETAIL | | DWG NO.: S-16 |
| SCALE: NTS | DATE: MAR. 2004 | |
|  | | |
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KEY TO NUMBERED PARTS:

- 1 SELECT NATIVE BACKFILL MATERIAL, OR ENGINEERED BACKFILL WHERE DIRECTED BY ENGINEER.
- 2 50mm TRENCH INSULATION – STYROFOAM HI 40, 2440mm WIDE. ADDITIONAL TRENCH INSULATION AS DIRECTED BY ENGINEER.
- 3 WARNING TAPE.
- 4 SAND BACKFILL, COMPACTED TO 90% STANDARD PROCTOR, MINIMUM 300mm COVER OVER PIPES.
- 5 WATER MAIN – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- 6 RECIRCULATION LINE – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- 7 SANITARY SERVICE – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- 8 SAND BEDDING COMPACTED TO 90% STANDARD PROCTOR, 150mm (230mm IN ROCK).

NOTES:

- 1. PIPES TO BE SPACED 230mm, OR GREATER, FROM FROM TRENCH WALL AND OTHER PIPES TO ALLOW COMPACTION.
- 2. TEST PITS TO BE DUG EVERY 15m TO A DEPTH OF 500mm BELOW PIPE INVERT TO CHECK FOR PRESENCE OF SILT. SUBEXCAVATE AS REQUIRED, TO A DEPTH OF 450mm BELOW PIPE INVERT AND BACKFILLED WITH GRANULAR B COMPACTED TO 95% STANDARD PROCTOR.
- 3. SANITARY SEWER TO HAVE A MINIMUM 3.0m COVER. IF COVER IS LESS THAN 3.0m, THE THICKNESS OF THE TRENCH INSULATION TO BE INCREASED.



| EXISTING SURFACE | REINSTATEMENT |
|------------------|--|
| ASPHALT | 2 X 37mm ASPHALT 150mm GRANULAR 'A' 300mm GRANULAR 'B' |
| GRAVEL ROAD | 100mm GRANULAR 'A' 300mm GRANULAR 'B' |



TITLE:

TRENCH DETAIL
W/M, RECIRC & SAN

DWG NO.:

U—1

SCALE:

NTS

DATE:

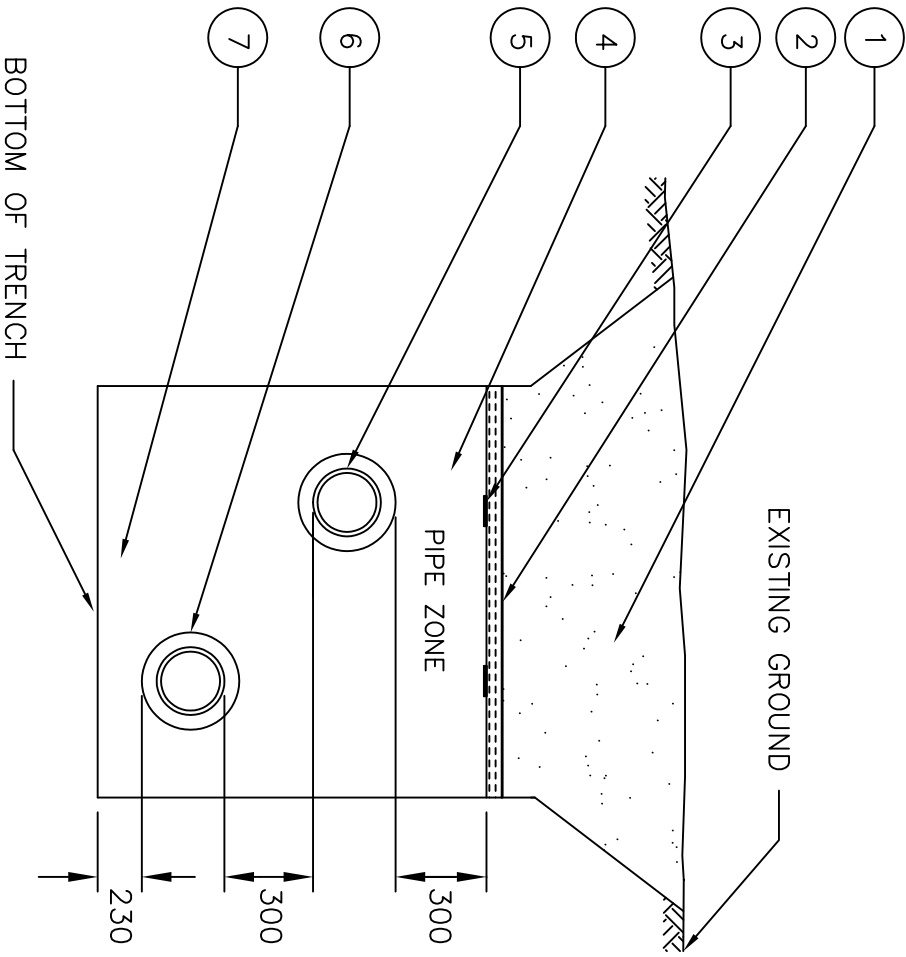
MAR. 2004

KEY TO NUMBERED PARTS:

- ① SELECT NATIVE BACKFILL MATERIAL, OR ENGINEERED BACKFILL WHERE DIRECTED BY ENGINEER.
- ② 50mm TRENCH INSULATION – STYROFOAM HI 40, 2440mm WIDE. ADDITIONAL TRENCH INSULATION AS DIRECTED BY ENGINEER.
- ③ WARNING TAPE.
- ④ SAND BACKFILL, COMPACTED TO 90% STANDARD PROCTOR, MINIMUM 300mm COVER OVER PIPES.
- ⑤ WATER MAIN – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑥ SANITARY SERVICE – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑦ SAND BEDDING COMPACTED TO 90% STANDARD PROCTOR, 150mm (230mm IN ROCK).

NOTES:

1. PIPES TO BE SPACED 230mm, OR GREATER, FROM TRENCH WALL AND OTHER PIPES TO ALLOW COMPACTION.
2. TEST PITS TO BE DUG EVERY 15m TO A DEPTH OF 500mm BELOW PIPE INVERT TO CHECK FOR PRESENCE OF SILT. SUBEXCAVATE AS REQUIRED, TO A DEPTH OF 450mm BELOW PIPE INVERT AND BACKFILLED WITH GRANULAR B COMPACTED TO 95% STANDARD PROCTOR.
3. SANITARY SEWER TO HAVE A MINIMUM 3.0m COVER. IF COVER IS LESS THAN 3.0m, THE THICKNESS OF THE TRENCH INSULATION TO BE INCREASED.



| EXISTING SURFACE | REINSTATEMENT |
|------------------|--|
| ASPHALT | 2 X 37mm ASPHALT 150mm GRANULAR 'A' 300mm GRANULAR 'B' |
| GRAVEL ROAD | 100mm GRANULAR 'A' 300mm GRANULAR 'B' |



TITLE:

TRENCH DETAIL
W/M, SANITARY

DWG NO.:

U-2

SCALE:

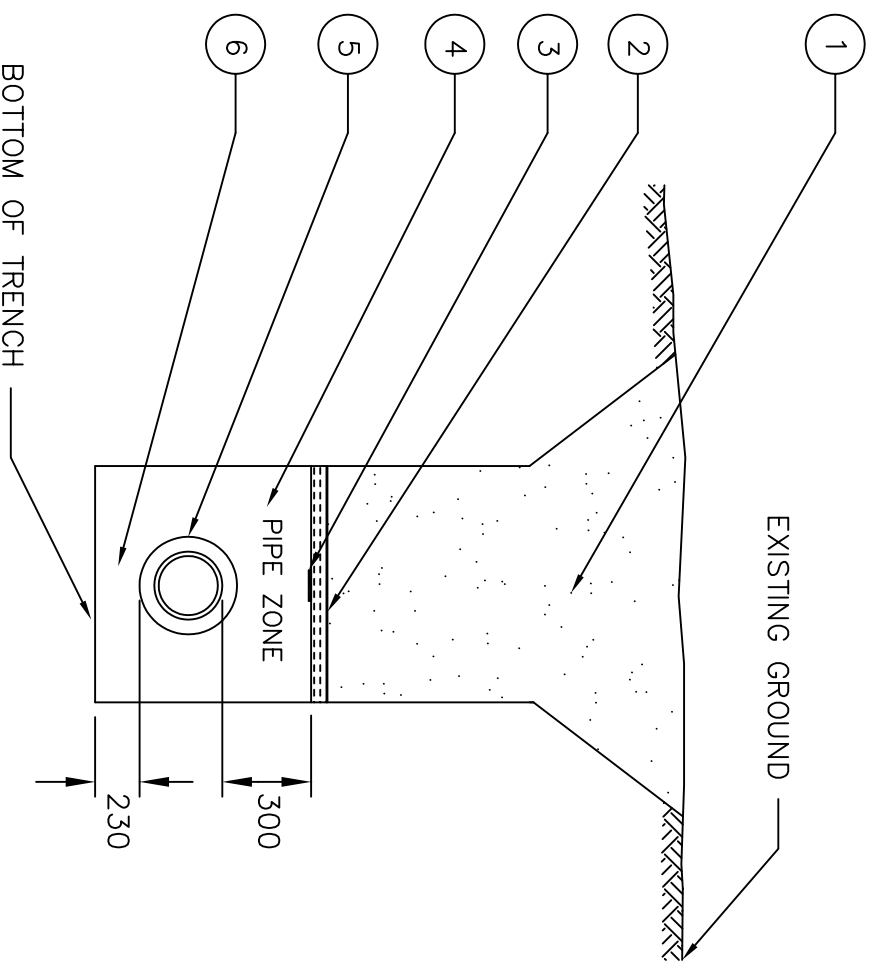
NTS

DATE:

MAR. 2004

KEY TO NUMBERED PARTS:

- ① SELECT NATIVE BACKFILL MATERIAL, OR ENGINEERED BACKFILL WHERE DIRECTED BY ENGINEER.
- ② 50mm TRENCH INSULATION – STYROFOAM HI 40, 1220mm WIDE. ADDITIONAL TRENCH INSULATION AS DIRECTED BY ENGINEER.
- ③ WARNING TAPE.
- ④ SAND BACKFILL, COMPACTED TO 90% STANDARD PROCTOR, MINIMUM 300mm COVER OVER PIPES.
- ⑤ WATER MAIN OR SANITARY SWER – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑥ SAND BEDDING COMPACTED TO 90% STANDARD PROCTOR, 150mm (230mm IN ROCK).



NOTES:

1. TEST PITS TO BE DUG EVERY 15m TO A DEPTH OF 500mm BELOW PIPE INVERT TO CHECK FOR PRESENCE OF SILT. SUBEXCAVATE AS REQUIRED, TO A DEPTH OF 450mm BELOW PIPE INVERT AND BACKFILLED WITH GRANULAR B COMPACTED TO 95% STANDARD PROCTOR.
2. SANITARY SEWER TO HAVE A MINIMUM 3.0m COVER. IF COVER IS LESS THAN 3.0m, THE THICKNESS OF THE TRENCH INSULATION TO BE INCREASED.

| EXISTING SURFACE | REINSTATEMENT |
|------------------|--|
| ASPHALT | 2 X 37mm ASPHALT 150mm GRANULAR 'A' 300mm GRANULAR 'B' |
| GRAVEL ROAD | 100mm GRANULAR 'A' 300mm GRANULAR 'B' |



TITLE:

TRENCH DETAIL
W/M OR SANITARY

DWG NO.:

SCALE:

NTS

DATE:

APR. 2005

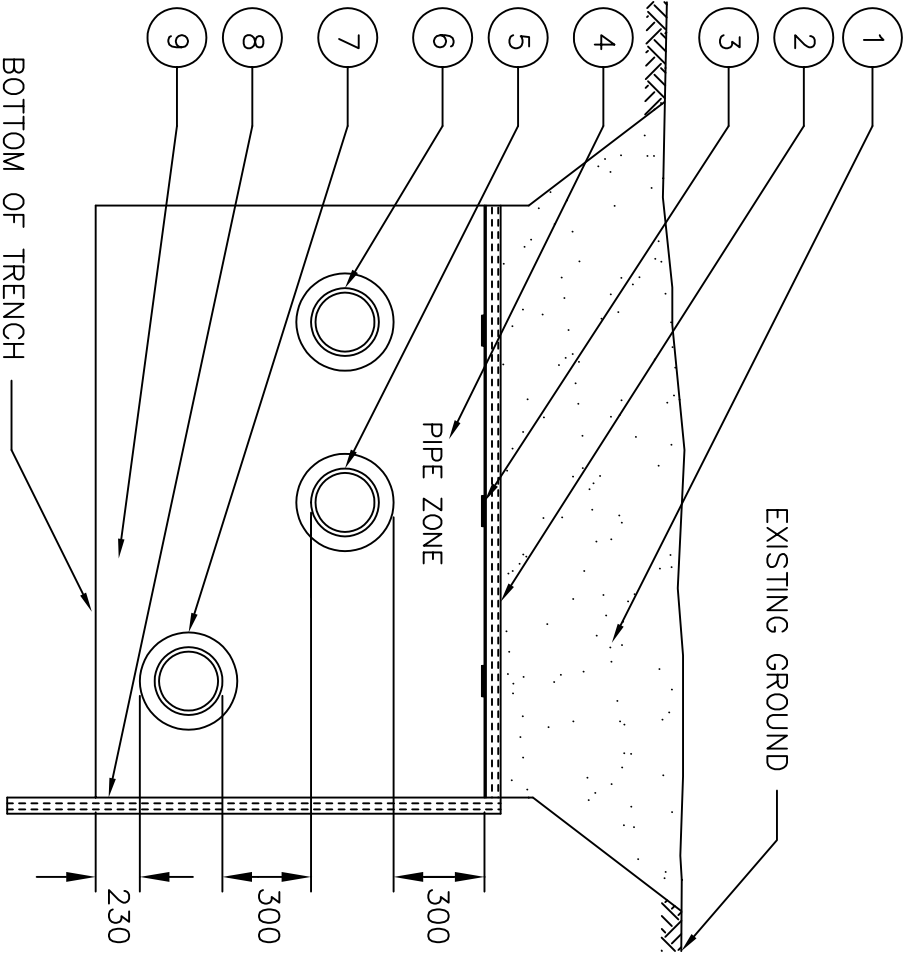
U-3

KEY TO NUMBERED PARTS:

- ① SELECT NATIVE BACKFILL MATERIAL, OR ENGINEERED BACKFILL WHERE DIRECTED BY ENGINEER.
- ② 50mm TRENCH INSULATION – STYROFOAM HI 40, 2440mm WIDE. ADDITIONAL TRENCH INSULATION AS DIRECTED BY ENGINEER.
- ③ WARNING TAPE.
- ④ SAND BACKFILL, COMPACTED TO 90% STANDARD PROCTOR, MINIMUM 300mm COVER OVER PIPES.
- ⑤ WATER MAIN – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑥ RECIRCULATION LINE – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑦ SANITARY SERVICE – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑧ VERTICAL TRENCH INSULATION – 50mm STYROFOAM HI 40, TO EXTEND FROM TRENCH INSULATION TO 450mm BELOW PIPE INVERT. TO BE INSTALL PARALLEL TO CULVERTS OR AS DIRECTED BY ENGINEER.
- ⑨ SAND BEDDING COMPACTED TO 90% STANDARD PROCTOR, 150mm (230mm IN ROCK).

NOTES:

1. PIPES TO BE SPACED 230mm, OR GREATER, FROM FROM TRENCH WALL AND OTHER PIPES TO ALLOW COMPACTION.
2. TEST PITS TO BE DUG EVERY 15m TO A DEPTH OF 500mm BELOW PIPE INVERT TO CHECK FOR PRESENCE OF SILT. SUBEXCAVATE AS REQUIRED, TO A DEPTH OF 450mm BELOW PIPE INVERT AND BACKFILLED WITH GRANULAR B COMPACTED TO 95% STANDARD PROCTOR.
3. SANITARY SEWER TO HAVE A MINIMUM 3.0m COVER. IF COVER IS LESS THAN 3.0m, THE THICKNESS OF THE TRENCH INSULATION TO BE INCREASED.



| EXISTING SURFACE | REINSTATEMENT |
|------------------|--|
| ASPHALT | 2 X 37mm ASPHALT 150mm GRANULAR 'A' 300mm GRANULAR 'B' |
| GRAVEL ROAD | 100mm GRANULAR 'A' 300mm GRANULAR 'B' |



TITLE: TRENCH DETAIL

DWG NO.:

W/M, RECIRC & SAN
VERTICAL TRENCH INSUL.

U-4

SCALE:

NTS

DATE:

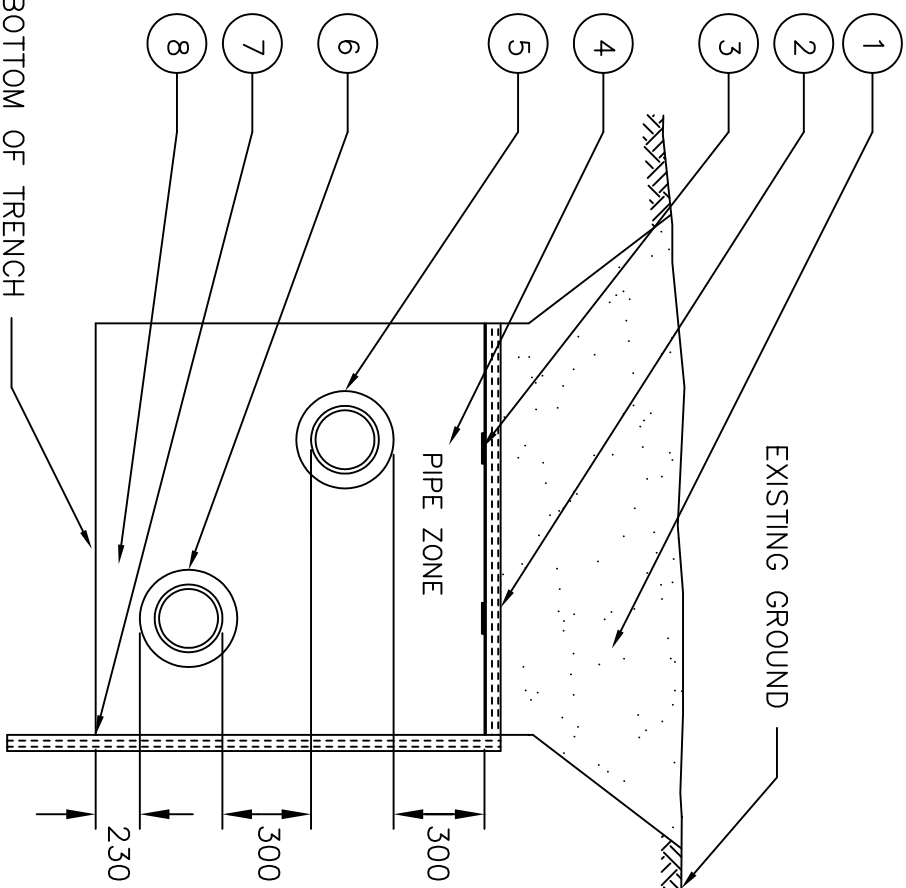
MAR. 2004

KEY TO NUMBERED PARTS:


- ① SELECT NATIVE BACKFILL MATERIAL, OR ENGINEERED BACKFILL WHERE DIRECTED BY ENGINEER.
- ② 50mm TRENCH INSULATION – STYROFOAM HI 40, 2440mm WIDE. ADDITIONAL TRENCH INSULATION AS DIRECTED BY ENGINEER.
- ③ WARNING TAPE.
- ④ SAND BACKFILL, COMPACTED TO 90% STANDARD PROCTOR, MINIMUM 300mm COVER OVER PIPES.
- ⑤ WATER MAIN – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑥ SANITARY SERVICE – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑦ VERTICAL TRENCH INSULATION – 50mm STYROFOAM HI 40, TO EXTEND FROM TRENCH INSULATION TO 450mm BELOW PIPE INVERT. TO BE INSTALL PARALLEL TO CULVERTS OR AS DIRECTED BY ENGINEER.
- ⑧ SAND BEDDING COMPACTED TO 90% STANDARD PROCTOR, 150mm (230mm IN ROCK).

NOTES:

- 1. PIPES TO BE SPACED 230mm, OR GREATER, FROM FROM TRENCH WALL AND OTHER PIPES TO ALLOW COMPACTION.
- 2. TEST PITS TO BE DUG EVERY 15m TO A DEPTH OF 500mm BELOW PIPE INVERT TO CHECK FOR PRESENCE OF SILT. SUBEXCAVATE AS REQUIRED, TO A DEPTH OF 450mm BELOW PIPE INVERT AND BACKFILLED WITH GRANULAR B COMPACTED TO 95% STANDARD PROCTOR.
- 3. SANITARY SEWER TO HAVE A MINIMUM 3.0m COVER. IF TRENCH INSULATION TO BE INCREASED.



| EXISTING SURFACE | REINSTATEMENT |
|------------------|--|
| ASPHALT | 2 X 37mm ASPHALT 150mm GRANULAR 'A' 300mm GRANULAR 'B' |
| GRAVEL ROAD | 100mm GRANULAR 'A' 300mm GRANULAR 'B' |

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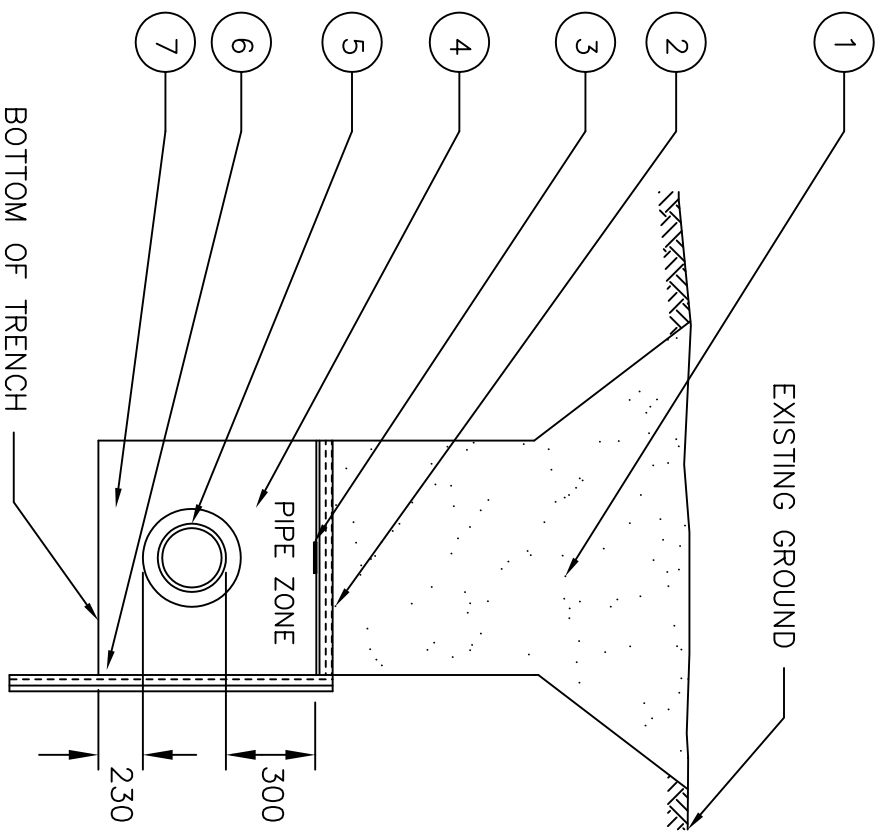
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W/M & SANITARY
VERTICAL TRENCH INSUL.

DWG NO.: U-5

SCALE: NTS
DATE: MAR. 2004

KEY TO NUMBERED PARTS:

- ① SELECT NATIVE BACKFILL MATERIAL, OR ENGINEERED BACKFILL WHERE DIRECTED BY ENGINEER.
- ② 50mm TRENCH INSULATION – STYROFOAM HI 40, 2440mm WIDE. ADDITIONAL TRENCH INSULATION AS DIRECTED BY ENGINEER.
- ③ WARNING TAPE.
- ④ SAND BACKFILL, COMPACTED TO 90% STANDARD PROCTOR, MINIMUM 300mm COVER OVER PIPES.
- ⑤ WATER MAIN OR SANITARY SEWER – DR11 HDPE PIPE c/w 50mm SHOP APPLIED POLYURETHANE INSULATION & FRP JACKET.
- ⑥ VERTICAL TRENCH INSULATION – 50mm STYROFOAM HI 40, TO EXTEND FROM TRENCH INSULATION TO 450mm BELOW PIPE INVERT. TO BE INSTALL PARALLEL TO CULVERTS OR AS DIRECTED BY ENGINEER.
- ⑦ SAND BEDDING COMPACTED TO 90% STANDARD PROCTOR, 150mm (230mm IN ROCK).



NOTES:

1. TEST PITS TO BE DUG EVERY 15m TO A DEPTH OF 500mm BELOW PIPE INVERT TO CHECK FOR PRESENCE OF SILT. SUBEXCAVATE AS REQUIRED, TO A DEPTH OF 450mm BELOW PIPE INVERT AND BACKFILLED WITH GRANULAR B COMPACTED TO 95% STANDARD PROCTOR.
2. SANITARY SEWER TO HAVE A MINIMUM 3.0m COVER. IF COVER IS LESS THAN 3.0m, THE THICKNESS OF THE TRENCH INSULATION TO BE INCREASED.

| EXISTING SURFACE | REINSTATEMENT |
|------------------|--|
| ASPHALT | 2 X 37mm ASPHALT 150mm GRANULAR 'A' 300mm GRANULAR 'B' |
| GRAVEL ROAD | 100mm GRANULAR 'A' 300mm GRANULAR 'B' |



TITLE: TRENCH DETAIL

DWG NO.:

W/M OR SANITARY
VERTICAL TRENCH INSUL.

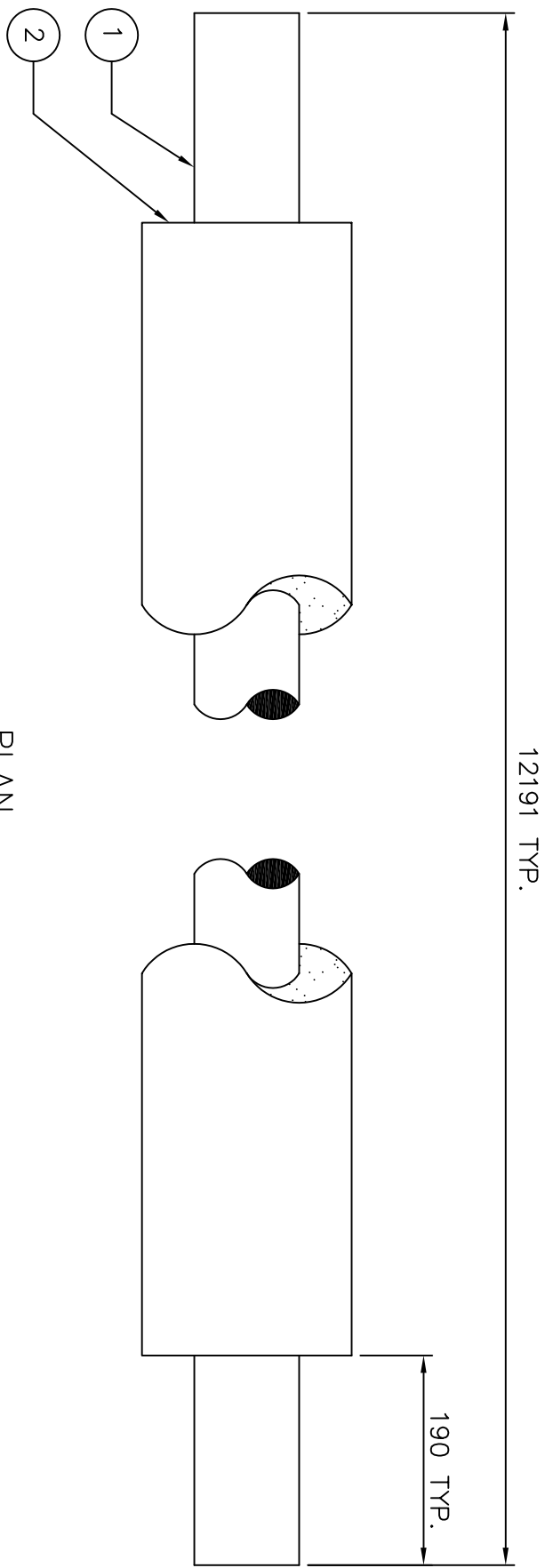
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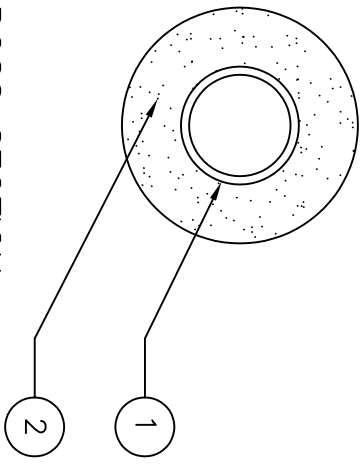
APR. 2005

U—6




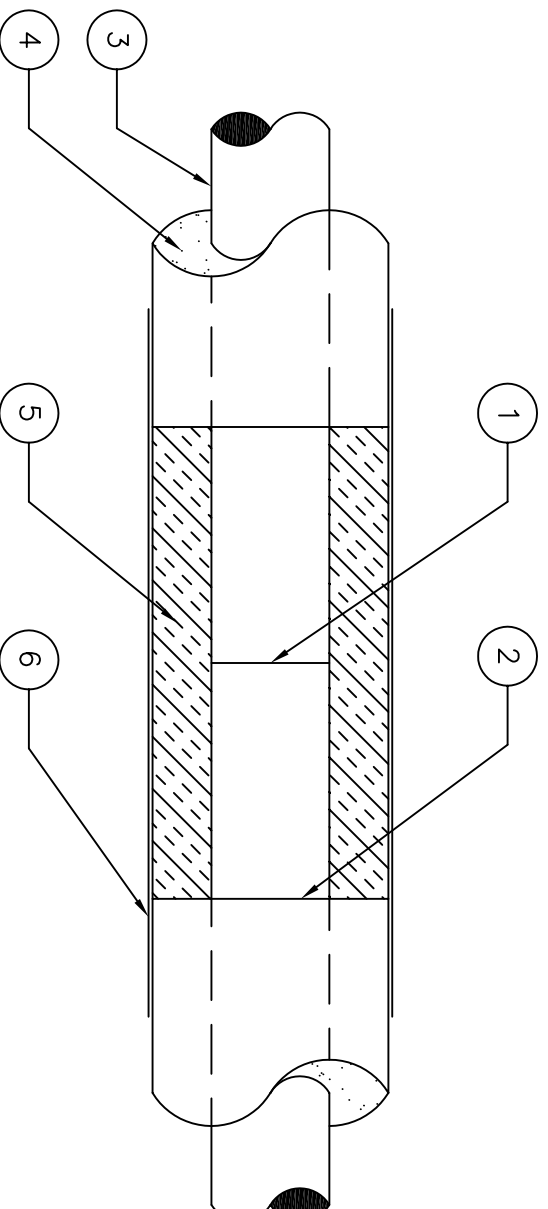
PLAN

- KEY TO NUMBERED PART:
- ① HDPE SERIES DR 11 WATER OR SANITARY SEWER MAIN.
 - ② 50mm NOMINAL THICKNESS SHOP CAST POLYURETHANE INSULATION c/w BLACK JACKET.



CROSS SECTION

| | | | |
|---|------------------------------|---------|----------|
|  | TITLE: | TYPICAL | DWG NO.: |
| | SANITARY SEWER OR WATER MAIN | | |
| SCALE: | DATE: | U-7 | |
| NTS | MAR. 2004 | | |



KEY TO NUMBERED PART:

- ① FIELD BUTT FUSION JOINT MADE BY A QUALIFIED AND LICENSED TECHNICIAN.
- ② FIELD COAT ALL EXPOSED POLYURETHANE WITH MASTIC.
- ③ HDPE SERIES DR 11 WATER OR SANITARY SEWER MAIN.
- ④ 50mm NOMINAL THICKNESS SHOP CAST POLYURETHANE INSULATION c/w BLACK JACKET.
- ⑤ POLYURETHANE HALF SHELLS CUT TO FIT AND COATED WITH MASTIC.
- ⑥ MASTIC LINED HEAT SHRINK TAPE – 100mm OVERLAP ON SHELLS AND PIPE JACKET.



TITLE: JOINT DETAIL
SANITARY SEWER
OR WATER MAIN

SCALE:
NTS

DATE:
MAR. 2004

DWG NO.:

U—8



Third Edition **January 2020**

Good Building Practices

GUIDELINES



FOREWORD

Building in the North is indeed different than building in more temperate climates. The *Good Building Practices Guideline* is intended to illustrate those differences. It is aimed at providing architects, engineers, building contractors, suppliers, facility administrators and operators with a comprehensive set of guidelines for building in the North.

The *Good Building Practices Guideline* assumes an advisory role, while renewing the challenge to builders to be innovative in applying the practices. Builders are encouraged to present alternatives to the suggestions detailed in the *Good Building Practices Guideline*, or to present new or innovative ways of resolving technical problems or of reducing building life-cycle costs.

The *Good Building Practices Guideline* incorporates years of experience in northern construction practices. The *Good Building Practices Guideline* was refined through input from architectural and engineering consultants, building contractors, suppliers, facility operators, Community and Government Services and client department staff, who worked together to achieve a consensus regarding northern building practices that are appropriate, economic and realistic. Simple, straightforward examples are used to illustrate and validate the practices.

The guidelines are not intended to replace mandatory codes or regulations, but to supplement the *National Building Code of Canada*, specifically where the GN believes that:

- More stringent practices should be applied relative to those of the *National Building Code of Canada* or the local municipality
- Code requirements should be clarified
- Its experience has demonstrated that conditions particular to remote northern communities require an approach different from typical Canadian building industry practice
- Its proven preferences for specific products, systems or methods should be employed

We are confident that all northern builders will find the *Good Building Practices Guideline* to be an indispensable guidebook, and challenge users to contribute towards its improvement in the next edition.

Constance Hourie, Deputy Minister
Community and Government Services

ACKNOWLEDGEMENTS

In preparing the *Good Building Practices Guideline* (Third Edition), the Technical Services Division of the Department of Community and Government Services, Government of the Nunavut, has drawn upon the assistance of numerous individuals from within the Department and from private sector agencies. Many of them contributed technical writing and comments to this guidebook. The *Good Building Practices Guideline* became a reality because of their participation.

We would like to express our appreciation to the many northern architectural and engineering firms, including AD Williams Engineering, Park Sanders Adam Vikse Architects, Ferguson Simek Clark Engineers and Architects, Pin-Matthews Architects, and Thorn Engineering for their important contributions to the production of this document.

Moreover, our appreciation also extends to SNC-Lavalin and EVOQ for recent updates and revisions to the third edition as well as the Arctic Energy Alliance and Envirovest Energy Ventures Inc. for providing beneficial information related to energy-saving initiatives.

Community and Government Services in-house technical staff have played a key role in contributing to and coordinating the development of this guidebook.

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PREAMBLE

INTRODUCTION

The Good Building Practices Guideline (GBPG) contains performance guidelines, preferred materials or methods, and logistical considerations for the design and construction of northern facilities. Over time, certain products or approaches to construction have proven successful and have been adopted by property developers, design consultants and builders working in Nunavut. It is hoped that your comments and opinions will lead to further revisions and additions that will keep the document current and relevant.

Criteria for Good Building Practices Guideline

These technical guidelines do not replace any mandatory Codes or Regulations. Rather, they cover the following areas:

- a) Where more stringent requirements should apply than the National Building Code of Canada or local municipal requirements
- b) Where there is a need to augment or clarify a code requirement
- c) Where conditions peculiar to a remote northern community require an approach different from typical Canadian building industry practice
- d) Where specific products, systems or methods have been developed and have been found to be superior for northern conditions

Detailed studies or reference materials are provided in the Appendix or noted within GBPG for interest only, and unless otherwise stated, do not constitute a part of the GBPG.

Application of Guidelines

The GBPG has been prepared as suggested guidelines for obtaining good value and quality buildings. The GBPG may be applicable for renovations to existing buildings, tenant improvements in leased facilities, or utility buildings.

These guidelines come from studying buildings typical of many buildings found in most communities in the Nunavut, which are small-scale low-rise structures designed to accommodate people. The GBPG may be less applicable to unusual or highly specialized buildings, or unusually large buildings.

Development of the Good Building Practices Guideline

The GBPG incorporates collected observations obtained from builders, designers, building operators and users. A substantial portion of the information was collected by staff of the Technical Services Division and Regional Project Management, in consultation with other stakeholders in the construction industry.

REVISIONS

Periodic reviews will be undertaken to reconfirm, revise or update the content of the Good Building Practices Guideline. Your comments and suggestions are invited. Proposed changes or additions should be submitted to:

Director, Technical Services,
Technical Services Division,
Department of Community and Government Services,
Government of Nunavut,
P.O. Box 1000, Station 620
Iqaluit, Nunavut X0A 0H0

Phone: (867) 975-5440

Fax: (867) 975-5378

Referenced Section # and Section Name:

A brief description of your proposed change or addition:

Rationale (relate experiences that have led you to make this recommendation):

Name:

Occupation/Position:

Organization/Firm/Department:

Phone:

Fax:

E-mail:

Date:

Mailing Address:

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- G.1.3 EQUIPMENT
- G.1.4 SUPPLIERS
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CHAPTER G – GENERAL BUILDING OBJECTIVES

The primary objective of this publication is to provide a technical reference handbook to help builders produce the best value in their respective buildings for the North. Buildings should be designed specifically for the northern climate and other physical parameters of the site, as well as for the minimum capital cost consistent with lowest life cycle costs. The objective is to encourage improvement over time based on proven methods and materials, while supporting improved building performance and new technology.

G.1 LOCAL RESOURCES

Promoting and actively assisting communities to take on greater responsibility for their economic and social well-being is an important objective of the GN. Construction projects provide important opportunities for communities to become involved in their own development.

G.1.1 BUILDING USERS

Residents of a community can provide valuable information related to site conditions such as snow drifting patterns, preferred orientations, anticipated use patterns and examples of successful materials or methods.

G.1.2 LABOUR

To facilitate maximum local involvement materials and methods used in building construction should be suitable for broad application that will permit training that will be applicable to future projects and avoid the use of specialized products or installations.

G.1.3 EQUIPMENT

The use of existing equipment benefits the community and can reduce construction costs, as bringing equipment into most communities is extremely expensive. Building design and construction methods should be suitable for available equipment.

G.1.4 SUPPLIERS

Specifications should not unduly restrict local or northern suppliers, and consideration should be given to incorporating any locally available products in new buildings.

G.1.5 OPERATIONS AND MAINTENANCE

Given the growing number of building projects and the limited numbers of experienced trades people in Nunavut, there is both a need and an opportunity to train and develop building maintainers in every community.

G.2 LIFE CYCLE COSTS

Wherever alternative designs are considered, the alternative representing the lowest life cycle cost should be selected. Wherever alternatives are shown to have the same life cycle cost, the alternative with the lowest capital cost should be selected. The life cycle costing should be based on the expected design life of the building and its systems. For comparative purposes a 40-year design life should be used for architectural components and a 20-year design life for electromechanical systems. In some circumstances other considerations may overrule: for example, where direct benefits to the community will be realized (e.g., incorporating locally available materials); or where a product preference is stated in these guidelines.

G.3 ENERGY MANAGEMENT

Minimizing the energy consumption of public buildings is important in Nunavut where energy costs are extremely high: electricity is usually diesel generated and fuel is transported annually to remote locations. Where practical and economically feasible, every attempt should be made to implement systems that reduce energy consumption.

To implement energy efficiency measures that bring about an actual reduction in energy costs, an overall energy cost budget must be evaluated. The energy cost budget is typically based on a reference building where minimal energy code efficiencies are met for various types of space usage. Energy reduction options can then be compared to the reference to evaluate financial feasibility.

Typically, and especially for new buildings, reference building energy cost budgets are created by generating an energy simulation model. These simulations can be developed with various software. Each software has its own limitations and should be chosen based on the required application.

When used properly and with the adequate level of detail, energy simulations provide an accurate way of evaluating the future cost of operations and provide useful information in helping to make system choices during design.

See G6 for comments on the *National Energy Code*.

G.3.1 HEATING AND VENTILATION

Recommendations for energy efficiency have been integrated in the applicable sections of the GBPG.

G.3.2 LIGHTING

Recommendations for energy efficiency have been integrated in the applicable sections of the GBPG.

G.4 APPROPRIATE TECHNOLOGY

To achieve the previously described goals and produce buildings that perform well and keep occupants comfortable, several basic principles have evolved. These principles can help guide building choices to ensure they are appropriate for conditions in Nunavut.

G.4.1 SIMPLICITY AND EFFICIENCY

Available funding dictates "lean" buildings that minimize extraneous volumes and non-habitable space, apart from necessary building service spaces.

In terms of concepts all building design solutions should strive to:

- Produce the minimum gross area necessary to accommodate the stated net program
- Minimize the enclosed volume and building perimeter required to accommodate the program
- Facilitate expansion as simply as possible without major disruption to building use

In terms of detailed development, the building design solutions should:

- Be kept simple to improve the speed of erection in a limited construction season and to offer greater opportunity for employment of local skills
- Incorporate materials and methods that will permit quality construction under adverse environmental conditions in a limited construction season
- Limit the variety of materials to minimize the number of specialized trades required on the project
- Ensure O&M procedures can be easily understood and carried out using readily available maintenance products and equipment.

G.4.2 RELIABILITY

Essential building systems like heating, ventilation and fire protection must be reliable in the harsh winter conditions of Nunavut. Standby equipment and installations that facilitate quick repairs are an essential characteristic of building systems. Building components, including interior and exterior finishes, must also be rugged enough to withstand the conditions to which they are exposed without the need for frequent or specialized repairs. Any equipment or system that needs servicing by specialized trades people or parts that are difficult to obtain, is not desirable, though at times necessary.

G.4.3 STANDARDIZATION

The intent of the GBPG is to standardize system elements based on proven successes, so that the final product is cost effective, energy efficient, readily operable and maintainable by local people. Given the vast size and regional variation within Nunavut, buildings must respond to differences in:

- Community settings
- Climatic zones
- Transportation systems
- Site conditions

G.5 OTHER DESIGN CONSIDERATIONS

G.5.1 ARCHITECTURAL STYLE

It is not the intent of the GBPG to prescribe a 'style' of northern building. It is hoped that the rational application of basic design principles in response to program, climate and political imperatives will, in time, come to represent a practical style. Finding or creating a particular architectural style appropriate for public buildings in Nunavut today is an interesting challenge to designers. Generally, and understandably, many of the older, and indeed some of the newer vernacular buildings clearly exhibit a straightforward expediency. Directions may be found in building forms that respond demonstratively to all aspects of the environment and that are also enriched by culturally inclusive details.

Previous suggestions were that buildings should "fit into the immediate site unobtrusively, with the massing and finishes related to the context of the community". Although this can be a justifiable design approach, it is nearly impossible to achieve in many small communities in Nunavut when adding large new buildings. It should be recognized then, that other approaches are also valid, as long as the design successfully addresses the following:

The design must communicate the function of the building

- The design should incorporate recognizable local symbols appropriate to the design
- Colours, materials and forms are selected to support and enhance other design decisions
- Massing is consistent with function and context
- Whether it blends in, contrasts with or dominates a site, the relationship of the building to the site should be consistent with its function and local traditions
- Whether it is private, public, friendly or decorous, the relationship of the building to the street should be consistent with the function and local traditions
- Whether they contrast with or are like adjacent buildings, the relationship between buildings should be clear and consistent with the building functions

Finally, the design of public sector buildings, while being stylistically appropriate in small communities, should satisfy the demand for buildings that are energy efficient, simple to build and to maintain.

G.5.2 OTHER RELATED DOCUMENTS

"Design" is a word that encompasses a number of activities within the fields of Architecture and Engineering. During the design phase of any project several documents are usually produced, each with a specific objective - the distinctions between them however can be confusing. The GBPG is meant to document performance criteria, preferred materials or methods and logistical considerations and should not be confused with other related documents such as functional programs, specifications or design documents. The following are examples of the distinctions that can be made between the documents:

| <u>Document</u> | <u>Example of contents</u> |
|-------------------------------------|---|
| <i>Functional Program</i> | <ul style="list-style-type: none">• a coffee maker and small appliances such as a toaster and microwave oven will be used |
| <i>GBPG anticipated</i> | <ul style="list-style-type: none">• recommends use of split receptacles wherever coffee making is anticipated |
| <i>Specifications GBPG</i> | <ul style="list-style-type: none">• flooring to be 4.5 mm thick Mondoflex by Mondo Rubber• sports flooring may be either PVC or rubber |
| <i>Submission requirements GBPG</i> | <ul style="list-style-type: none">• provide consumption estimates for heating and electricity• energy consumption targets |

The interrelationship of all of these design considerations is as important to understand as the distinction between them: complete functional/program information is required before the correct technical requirement is applied, right material specified, adequate documentation submitted, and installation completed satisfactorily.

G.6 CODES AND REGULATIONS

G.6.1 NATIONAL BUILDING AND PLUMBING CODES OF CANADA

The latest version of the "National Building Code of Canada" adopted by the Nunavut Building Code Act and Regulations by the Authority having Jurisdiction must be used. The Authority having Jurisdiction is the Office of the Chief Building Official (OCBO).

The OCBO is under the GN Department of Community and Government Services – Safety Services Division. For further information on the building permit application process please contact the OCBO by email, building@gov.nu.ca

G.6.2 MUNICIPAL BYLAWS

All municipal bylaws and ordinances must be observed in the design and construction of facilities for the GN.

G.6.3 DESIGN

G.6.3.1 Professionals

Engineering

The practice of Engineering is regulated by the "Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists" and under the authority of the "Engineering and Geoscience Professions Act of the Northwest Territories".

Architecture

The practice of Architecture in Nunavut is unregulated. No legislation exists to regulate the design of buildings other than the requirements outlined in the *National Building Code*. However, architects must be members in good standing of any Canadian provincial or territorial architectural organization and be a registered professional of such organizations.

G.6.4 SI METRIC REQUIREMENTS

All new construction for the GN must be designed in SI metric units: the actual materials may be designated in metric or imperial, and soft conversion to metric is acceptable.

Note that this requirement may be relaxed when these guidelines are applied to renovation projects and where the original documents are in imperial measures: either metric or imperial may be used in this case. See notes in the Application of Guidelines section of the Preamble.

G.6.4.1 Soft conversion

Physical size remains unchanged, products are described to the nearest metric unit. For example, a 24 x 48 (inches) ceiling tile is 610 mm by 1220 mm (actual size).

G.6.4.2 Hard conversion

Physical sizes are changed, and products designated in metric. For example, a 24 x 48 (inches) ceiling tile is changed slightly in size to become 600 mm x 1200 mm (actual size).

END OF SECTION

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CHAPTER L - LANDSCAPE AND SITEWORK

INTRODUCTION

Reasonable site development conditions include a site that:

- is well drained and not subject to periodic flooding
- Is not too steeply sloped
- Does not require excessive fill or levelling
- Has dimensional proportions suitable to accommodate the shape and size of the proposed building with ample setbacks and space for expansion
- Does not disrupt historical community use patterns

Site work includes all work required to:

- Prepare the site for building foundations
- Grade the site to promote drainage away from the foundation and to direct spring runoff to a suitable drainage course
- Provide access to the site and building for staff, visitors and services (pedestrian and vehicular traffic)
- Provide sufficient on-site parking
- Create outdoor activity areas such as playgrounds
- Create suitable settings for buildings through landscaping
- Remediation of any contaminated soil

L.1 CODES, STANDARDS AND REGULATIONS

- Water and sewer: Refer to local municipality.
- Garbage removal: Refer to local municipality.
- Parking: Refer to local municipality.
- Fuel delivery: Refer to local distributor.
- Zoning bylaws: Refer to local municipality.
- Power: See Section E 1.
- Telephone: See Section E 1.
- Soil Contamination: See Guidelines for Site Remediation & Hazardous Waste Management.
- Asbestos: See Health & Safety Act, Worker's Compensation Board.
- *CSA S501:14 - Moderating the effects of permafrost degradation on existing building foundations*
- *CSA S503:15 - Community drainage system planning, design, and maintenance in northern communities*
- *CSA Plus 4011:19 - Technical guide: Infrastructure in permafrost: A guideline for climate change adaptation*

L.2 INSTALLATION AND MAINTENANCE

L.2.1 INSTALLATION CONSIDERATIONS

L.2.1.1 Schedule

In communities above the tree line, there is a very limited period of time when site work can be done. Buildings are often completed in the late winter or spring before the site work can be finished, meaning that interim or temporary installations must be planned.

L.2.1.2 Granular Materials

Local equipment for hauling, spreading and compacting fill is often limited in small communities. It is generally desirable to ensure that fill and grading work can be completed by the local municipality or contractors. This benefits the local economy and minimizes the cost.

L.2.1.3 Local Equipment

Site work should be designed to ensure work can be completed using existing local equipment and operators.

L.2.2 MAINTENANCE CONSIDERATIONS

L.2.2.1 Snow Clearing

The presence of snow and the need to clear snow from a site is the norm in all communities in Nunavut. Any aspect of a site that does not function well when covered in snow is unacceptable.

Consider:

- How the snow must be removed (hand or machine).
- Where removed snow will be piled and the snow drifting patterns that may be affected by the snow pile
- Protection of building, vegetation and fixed site improvements from snow removal equipment

L.2.2.2 Spring Runoff

In most of the communities in Nunavut the spring melt occurs suddenly. This water must be directed away from the building and into acceptable drainage courses to avoid:

- Flooding of tank rooms
- Water or sewage holding tanks floating and connections breaking
- Granular pads being severely eroded by water seeping under or through the pad, resulting in structural damage

L.2.2.3 Planted Areas

Skills and interest in maintaining vegetation will vary depending on staff and location, and although it should be generally accepted that little effort will be put into maintaining planted areas, it is also a fact that once established, indigenous arctic plants and grasses only require some protection from concentrated traffic. Successful examples include timber framed raised beds defining walks or vehicular uses. Where appropriate, planting can play an important role in protecting slopes from erosion, as well as much needed relief from the ever-present gravel pad.

L.3 ACCESS

L.3.1 PEDESTRIAN ACCESS

Public buildings should be easily identifiable, with prominent, clearly visible entrances. All pathways, ramps and stairs leading to entranceways should be easy to keep clear of snow and be protected from vehicle traffic.

N.B.C. 3.8.1.2 may require more than one ramp depending on the number of exits from a building. Discuss this item with the Office of the Fire Marshal on an individual basis.

Recommendation

Rationale

L.3.1.1 Walkways

Finished walkways should be provided; leading from the edge of the roadway and all parking areas, to all regularly used building entrances. Surfaces should be well drained and finished with contained, finely crushed granular material, or pavement.

This minimizes mud tracked into buildings during spring and fall. This is particularly important for facilities with high public uses such as schools, health centres and community recreation facilities.

All walkways and using material for containment, concrete or pavement should be level with surrounding grade with proper drainage.

The intention is to avoid damage during snow removal with heavy equipment. Timbers and concrete curbs commonly used for containment of walkways are generally destroyed by heavy equipment when above the surrounding grade.

Concrete, paving or grating surfaces should be considered at entrances.

Clean hard surfaces intercept dirt before it is tracked into the building.

Avoid walkways that are immediately adjacent to walls of buildings.

Traffic near the building face can increase the incidence of damage to building finishes.

L.3.1.2 Ramps and Stairs

Whenever possible, eliminate the need for ramps and stairs by shaping the site. Grade elevation at the entrance should be as close to finished floor elevation as possible.

Sloped grade often permits removal of snow with equipment rather than by hand, as is normally the case with stairs and ramps.

One ramped path of travel to the building entrance is preferred to provide both stairs and a ramp. Wherever possible, a ramp with a straight run should be provided. Where space dictates that a ramp must be 'dog-legged', then stairs may be provided in addition to the ramp.

Stairs and ramps are often installed independently, though they lead to a common landing. This creates two paths of travel. A single access route can reduce costs, reduce snow-clearing requirements and reduce the perception that providing ramped access is wasteful.

Recommendation**Rationale**

Note that NBC 3.8.1.2 requires that 50% of all pedestrian entrances to a barrier free building must have ramps. This should be negotiated with the Office of the Fire Marshal on an individual basis.

Areas of fill leading to or from exits must be level and contained.

This controls erosion from normal use.

Open metal or fibreglass grating is the preferred surface material for exterior ramps, stairs and landings. Gratings should meet the requirements of NBC 3.8.1.3 and CSA B651 M90 "Barrier Free Design".

This allows snow to pass through, diminishing accumulations at entranceways. CSA and NBC set a standard for the size of grate openings.

Wood surfaces are acceptable only where traffic is light.

Wood is easily damaged by snow clearing and promotes snow and ice build-up and slippery surfaces.

Concrete stairs and ramps are acceptable.

Where available, concrete can provide a durable, easily cleaned surface. The cost of long ramps and high stairs made of concrete may be prohibitive.

Steel stairs. If steel pipe railings with wire mesh infill are used, ensure that the mesh is minimum 6 mm diameter in a maximum 50mm grid and held in place by spot welds at maximum 150mm o/c.

Lighter wire and larger grid openings have not resisted abuse.

L.3.1.3 Snow Drifting

Locate entrances and major windows where snowdrifts will not normally form. If there are none, find another means of reducing the accumulated snow.

Entrances are typically located so that predominant winds scour the area. Certain building configurations are also prone to snow accumulation, such as inside corners.

Avoid locating entrances and exits at the inside corners of buildings.

Inside corners are prone to snow accumulations.

L.3.2 VEHICULAR ACCESS

In many small communities there are no municipal requirements for parking or service vehicle access to buildings. In general, requirements should be determined by:

- Vehicles commonly in use in the community; may include cars, trucks, snowmobiles or all-terrain vehicles
- The requirement for users of Nunavut buildings is to be provided, and where location of exterior electrical outlets may be required
- Type and size of service vehicles and personnel that must be able to approach connection points year-round with a minimum of difficulty, i.e., no obstruction by snow, standing water or steep slopes.

Recommendation**Rationale****L.3.2.1 Routes and Parking**

Fire and regular vehicle access routes and parking must accommodate the turning radius of local vehicles, including service vehicles and fire fighting equipment.

Normal mode of transportation and type of service vehicles vary from community to community.

Vehicle routes and parking areas on site should be clearly marked, using physical barriers that remain visible in winter conditions if necessary.

This is done to identify and control vehicle traffic around buildings and to provide some protection for pedestrians, landscaping, slopes of building pads or buildings. Boulders, logs, heavy timber or fencing can all be considered.

L.3.2.2 Parking Stalls

Minimum dimensions for car or truck parking stall is 2.5 m x 6 m.

Use standard parking stall dimensions, especially in communities where no area requirements exist.

Minimum dimensions for an ATV or snowmobile-parking stall are 2 metres x 2 meters. Consider drive-through parking spaces.

ATVs are the most common vehicle in many communities - not all are able to back up.

L.3.2.3 Plug-ins

See Electrical Section E6.3.6.

L.3.3 SERVICES AND UTILITIES ACCESS

With winter conditions lasting from 6 to 8 months of the year, it is important that building service points are easily accessed by trucks and personnel and protected from snow and ice build-up. Most municipal services in Nunavut are delivered by vehicle. Water and sewer systems in any given community can range in service. Fuel (primarily heating oil) is delivered exclusively by truck. Power and telephone are generally provided by overhead services.

Recommendation**Rationale****L.3.3.1 Delivery Vehicles**

Provide adequate space for delivery vehicles to pull completely off main roadway when they are servicing a building.

This keeps service vehicles from blocking traffic. (This is a municipal requirement in some communities.)

It is preferable that roads are designed so that they are able to do so without reversing.

Exhaust in winter blocks vision when reversing.

Recommendation**Rationale****L.3.3.2 Service Connection Access**

Provide stairs and platforms wherever people must access fill points or connect to services located more than 1.5 m above ground level.

This allows delivery people to connect to building service points easily and safely.

Ladders are not acceptable.

L.3.4 BUILDING ORIENTATION

Snowdrifts can impede access and exits from buildings, cause excessive structural loads on roofs, block windows, and provide easy access to the building roof by unauthorized persons.

Recommendation**Rationale****L.3.4.1 Snow drifting**

Snow drifting around buildings shall be managed through careful siting and design so that problems can be avoided. Wind control devices, such as scoops or accelerators, will should be avoided unless there is absolutely no alternative.

Although such devices have proven effective, they are an expensive alternative to proper siting to take advantage of natural wind scouring. In certain communities, wind frequently shifts directions, making it difficult to rely on scouring by predominant winds.

L.4 FILL AND GRADING**L.4.1 FILL**

Granular materials can be quarried from suitable local land sites or transported from a remote source and stockpiled near the community. Where local supplies have been identified, the contractor or the subcontractor must obtain permission to quarry from the appropriate authority:

- The Government of Nunavut (Department of Community and Government Services)
- The Government of Canada (Indigenous and Northern Affairs Canada)
- And in many cases ownership may have recently been transferred through the Nunavut Land Claims Agreement.

Recommendation**Rationale****L.4.1.1 Built-up Granular Pads**

Provide an impermeable liner on slopes of pads that lie in the path of runoff in permafrost areas.

This is done to divert water around the pad, rather than allowing it to seep under or through it, potentially degrading permafrost.

See also S3 "Foundations"

L.4.1.2 Excavation

Avoid cutting into existing soils where permafrost is present.

This exposes frozen soil causing degradation of permafrost.

See also S3 "Foundations".

L.4.2 GRADING

Although frozen for much of the year, building sites can be susceptible to significant damage during spring runoff or as a result of ponding:

- Flooded crawl spaces have caused sewage holding tanks to float
- Structural integrity of foundations has been jeopardized by degrading permafrost
- Access to building by users or services has been impeded

Recommendation

Rationale

L.4.2.1 Finished Grades

Finished grades should have a minimum 4% slope away from the building.

This provides drainage away from the foundation without promoting erosion by runoff

Finish the area under the building before construction begins

To allow proper drainage and better working conditions. Rough surface conditions and puddling water make it difficult to work when installing plumbing, utilidettes, insulation and soffit under the building. Poor working conditions often lead to inferior quality when insulating and sealing the floor system, which can lead to cold floors and freezing pipes.

L.4.2.2 Retaining Walls

Where slopes of less than 1:4 cannot accommodate grade differences, because of site constraints or limited fill materials. Heavy timber retaining walls may be considered or gabions (caged riprap).

Using retaining walls can reduce the total amount of fill required; however, is generally a more labour intensive and expensive means of stabilizing slopes.

L.4.2.3 Drainage Channels

Drainage channels/paths must be in place on site before spring runoff: this may require temporary installation of swales or berms.

Construction schedules dependent on barge delivery generally result in winter construction: the building is usually ready for occupancy by spring or early summer, but site work cannot be completed until mid to late summer.

L.5 SITE REHABILITATION AND LANDSCAPING

A comprehensive landscaping plan must incorporate requirements noted in the sections above. Landscaping using lawns, flowerbeds, however, is not a practical consideration in the communities in Nunavut. Nonetheless, care needs to be taken in finishing sites around GN buildings for appearance, public safety and erosion control.

Recommendation

Rationale

L.5.1 EXISTING VEGETATION

Maintain as much existing vegetation on site as possible and protect from vehicular traffic.

This protects the soil from erosion, insulates permafrost and generally improves appearance of site.

L.5.2 VEGETATION – NEW/ADDED

Any plant material added to the site must be hardy, suitable for the locality and requires little or no maintenance - transplanting of local species is encouraged where an acceptable source can be found in the community.

Growing conditions are too harsh for most southern plant species commonly used elsewhere in Canada. There is little or no tradition of 'gardening' in Inuit communities. Resources are currently unavailable for extensive maintenance programs.

Also see Maintenance Considerations (L.2.2).

L.5.3 SOIL

If soil or topsoil is required, it must be available within the community, along with any necessary additives (sand, lime, etc.).

Mixed, prepared topsoil is simply not available in most communities. If required in any quantity, costs can be high.

L.5.4 PLAYGROUNDS

Soft, sandy surfaces should be provided wherever play structures are installed. Play structures should be constructed to applicable standards.

To provide a safe play area

L.5.5 LANDSCAPING

Definition of landscape versus pedestrian and vehicular areas is important. Timbers and rocks have been successfully used for this but must be designed with large snow clearing equipment in mind. If concealed by snow, these elements will be damaged or relocated. (See 3.2.1)

Counteracts the tendency for the site and the community in general to be a continuous gravel surface used universally by pedestrians and vehicular traffic

Recommendation

Edge slopes of gravel pads can be stabilised and made more aesthetically pleasing by the addition of boulders 150 to 200mm diameter, (if economically available).

Rationale

Boulders discourage pedestrian traffic thus promoting the natural re-establishment of native arctic plants, either by transplanting or natural seed migration.

END OF SECTION

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CHAPTER A - ARCHITECTURAL

INTRODUCTION

A.1 SITE DEVELOPMENT

Analyzing site conditions is key in establishing the principle guidelines of a project. The placement and orientation of the building on site has to be planned to benefit from maximum natural light and passive solar gain, and to respect its immediate natural and built environment. It should be positioned strategically in consideration to the existing topography and take advantage of the natural drainage of the site, while oriented to minimize snow accumulation at entrances.

Geotechnical and topographical surveys should be obtained prior to the design phase of the project. A geotechnical study will give information on the type of soil which will influence the foundation system of the building. Permafrost, for instance, must be kept from defrosting because of heat transfer from the projected buildings. The topographical survey will permit to understand the exact shape and slopes of the site. The location of the building should avoid areas of natural water accumulation. A gentle slope should let water drift away from building foundations when on grade.

A preliminary wind and snow accumulation study, along with a sun trajectory analysis at different times of the years are tools used to establish the optimal placement of the building. A final wind and snow accumulation study should be done after preliminary design to verify the building's volume response to snow and wind in order to mitigate unwanted impact. At entrances, methods such as wind deflectors or cold porches can help minimize snow accumulation effects.

Accesses to the building entrances or services (water, sewage, oil) should be practical, safe, easy to maintain, enjoyable for the users and linked to the general circulation scheme of the building. Pathway and driveways should have a minimal slope of 2% to drain properly. Protecting entrances permits to minimize snow removal and allows for easier access to the building during snow events. All entrances, vehicular or pedestrian pathways, along with parking areas should be well light to discourage vandalism and increase security.

Zoning bylaws must be considered when choosing a site and verified during the design of the building.

A.2 INSTALLATION AND MAINTENANCE

A.2.1 INSTALLATION CONSIDERATIONS

The minimum possible number of different trades should be involved in construction and maintenance, in order to reduce travel costs and coordination inefficiencies. Each sub trade on a job should have responsibility for a reasonably large portion of work. Small specialty contracts involve little financial incentive for the sub trades involved, and tend to result in poor workmanship and little attention to correction of post construction deficiencies

A.2.2 OPERATION AND MAINTENANCE CONSIDERATIONS

Four primary O&M cost considerations are:

1. Fuel and power consumption

Consumption is largely dependent on operating practices; however, the shape, layout, and the quality of the exterior envelope of a building can have a significant effect on fuel and power consumption. The most efficient exterior envelope shall have the lowest possible surface area enclosing the lowest possible volume with the least amount of unusable space, in accordance with the functional program of the building.

2. Operation and maintenance of equipment

The planning and layout of a building must ensure adequate access to mechanical and electrical equipment. Accesses for the replacement of major equipment during the life of the building should be provided. Standardization of mechanical and electrical equipment within the building and the community should be coordinated to reduce the amount of skills and parts needed to maintain this equipment.

3. Maintenance of building finish materials

Choose building materials and finishes that are durable, will reduce the effort required for maintenance, and that can be easily repaired or replaced.

4. Custodial services

The choice of building finishes and floor layout, as well as convenience and adequate size of storage for janitorial supplies, will affect regular care taking operations.

A.2.3 MAINTENANCE MATERIALS

The Project Manager should determine, in consultation with Technical Officers and design consultants, what maintenance materials and what quantity should be supplied under the construction contract, how such materials should be delivered and stored, and how such materials should be accepted into inventory for use in the newly completed building.

Recommended maintenance materials include

- Flooring material
- Pre-finished wall covering materials such as plywood, plastic laminate or veneer-faced materials, sheet vinyl
- Custom-tinted paint to match installed paint
- Custom-coloured exterior wall cladding materials
- Replacement parts for door hardware
- Pre-cut replacement glass for exterior and interior windows
- Plastic laminates and cabinet hardware
- Mouldings and fittings for window systems
- Replacement hardware for operable windows
- Spare keys

A.3 BUILDING ENVELOPE

The envelope of a building separates the interior environment from the exterior climate. In Nunavut temperatures can range from about -45° Celsius in the winter to +35° Celsius in the summer. Hourly wind pressures can range from 0.30 kilopascal to 0.80 kilopascal. The climate is generally very dry with precipitation mainly in the form of snow. Total annual rainfall in Iqaluit is 200 mm (as compared to 1,935 mm in Vancouver or 846 mm in Ottawa). Climatic variations within the Nunavut Territory must be recognized in building design and construction. Special attention should be given to major differences in climate from Kugluktuk in the west to Pangnirtung in the east and Grise Fiord in the north to Sanikiluaq in the south. These differences include snow drifting patterns, wind, seasonal temperatures and sunlight.

Careful design and construction are required to ensure airtight, energy efficient building envelopes. Suggested minimum standards in GBPG should be followed unless the designer can show that less demanding standards will provide savings over the life cycle of the building. The suggestions in this section are intended to augment the requirements of NBC Part 5, and NBC9.25.

A.3.1 AIR MOVEMENT, WATER AND VAPOUR PROTECTION

Project managers, designers, and constructors of northern buildings need a clear understanding of air, vapour and A/V barriers. The requirements of the *National Building Code* are intended to apply to buildings in all parts of Canada. Northern application of the *National Building Code* requirements can be clarified with further reading and study. All aspects of construction in this climate could require some specialized adaptations to meet or exceed the requirements stated in the NBC. These adaptations are to be based on the climatic data provided in NBC. A suggested reading list is included in Appendix A.

Recommendation

Rationale

A.3.1.1 Control of Rain and Snow Penetration

The requirements of NBC Division B Section 5.6.1 "Protection from Precipitation" apply.

A.3.1.2 Control of Moisture from Ground

The requirements of NBC Division B Section 5.8 "Moisture in Ground" apply.

A.3.1.3 Control of Condensation and vapour diffusion within the Building Envelope

The requirements of NBC Division B Section 5.5 apply.

Locating the vapour barrier on the warm interior side of the insulation is recommended. Any moisture that accumulates in the wall assembly should be allowed to evacuate and dry by natural ventilation and drainage of the envelope.

The objective is to ensure that any water vapour that does pass through the vapour barrier is not trapped in the envelope. Water vapour that migrates toward the exterior can be deposited in the envelope as frost over the winter months. The moisture must be able to drain or evaporate during the summer when the frost melts. Limiting the amount of vapour and condensation and allowing for evacuation of the moisture in the building envelope is critical. Water should be allowed to drain if accumulated.

Recommendation**Rationale****A.3.1.4 Air Leakage Rates**

The maximum recommended air leakage rate for air barrier systems in the north are: is 1.5 ACH@50pa.

Although the NBC Div. B Sec. 5.4 and Div. B Sec. 9.25 require all buildings to have an effective air barrier system, the maximum leakage criteria provided of 0.02 l/s/m² in NBC Div. B Sentence 5.4.1.2 (1) applies to buildings in all part of Canada. Theoretically, this amount of air leakage will not introduce more vapour into an envelope assembly than can be 'managed' on an annual cycle. See Architectural A3.1.3.

A.3.1.5 Applicable Building Envelope Design Principles in Nunavut

The exterior wall assembly should be designed to be the most efficient possible in consideration to the project context, such as building function, maintenance, construction and operational budget, climate, etc.

Building envelopes are to be designed in accordance with the Rain screen principles for efficient control of moisture infiltration in exterior walls due to wind forces. A range of options can be applied to the principle to obtain improved techniques such as the Pressure Equalized Rain screen principle (PER) or the Pressure Equalized Rain Screen Insulated Structure Technique (PERSIST).

The objective of the Rain screen, PER and PERSIST Principles is to ensure that wetted exterior surfaces of walls are not subjected to constant air pressures. Constant air pressure can force water on the exterior surface of the wall to move into the interior portions of the wall materials through construction joints or other fissures. Refer to CBD-40: "Rain Penetration and its Control."

To counter this phenomenon, the Rain screen principle introduces a cavity between the cladding and the sheeting, where wind is allowed to flow and attain a pressure level equal to the one applied on the exterior of the cladding.

Cavities behind the exterior cladding should be divided into pressure equalization compartments (i.e., into zones of air pressure equal to exterior air pressure). Each compartment should be no more than one storey in height and no more than 6 m wide along building faces. At corners, compartments should be no more than 2.4 m wide, and closed at the edges.

The PER principle requires the cavity behind the exterior cladding to be divided into compartments. This allows for faster equalization of the air pressure on both sides of the cladding. This principle is called Compartmentalization of the Cavity and it is intended to provide better control of wind pressure differences between the exterior side of the cladding and the interior cavity. Smaller compartmentation reduces the likelihood of strong airflows developing inside the cavity. Pressure equalization compartments must also be drained properly.

Recommendation**Rationale**

For higher performance of the exterior envelope, the insulation can be installed on the exterior side (cold side) of the structure.

When the insulation is installed on the exterior (cold side) of the structure and combined with the Pressure Equalized Rain screen principal, it is called PERSIST. The insulation on the exterior of the structure found in the PERSIST principle works well for buildings in Nunavut. It minimizes thermal bridges, movement of the structure due to temperature changes and eliminates structural damage that could occur from moisture due to condensation. The installation of the A/V barrier on the exterior side of the sheeting allows for higher quality installations.

An effective air barrier system is required (see section 3.1.6.2).

During construction, it must be ensured that the air barrier is properly installed to prevent air leakage and movement within the wall assembly.

Sufficient drainage of the assembly is required.

Ensure that the wall assembly is properly drained and maintained dry. The Rain screen, PER and PERSIST principles should be adapted to dry arctic climates to minimize snow infiltration in wall assemblies.

A factory sealed envelope design, hence a moisture and air tight envelope, is also applicable in the Arctic.

An air and moisture tight envelope requires meticulous assembly and quality control during construction to ensure it is well sealed. If properly installed, it eliminates all complications due to moisture migration and accumulations in the exterior wall assemblies. Particular attention is required at corner joints detailing.

Due to the specific knowledge needed to install this type of system, this method is not suitable for residential construction.

A.3.1.6 Materials and Assembly**1. Vapour Barriers**

Materials or the assembly of materials making up the vapour barrier *must* be:

See GBPG A3.1.3 "Control of Condensation within the Building Envelope." The purpose of A/Vapour barrier is to restrict diffusion (water vapour movement through the materials of the assembly).

- Durable
- Impermeable and continuous
- Compatible with other building components

To meet or exceed the service life of the building.

To meet the requirements of the NBC and reference standard CAN/CGSB 51.33 or 51.34.

Differences in chemical composition, creep behaviour, elastic movement, thermal expansion, shrinkage, and moisture changes could result in

Recommendation**Rationale**

reduced permeability or durability of the vapour barrier.

To meet requirements described in Architectural A3.1.3 above. Materials with low vapour permeance, such as plywood sheathing or rigid foamed plastic insulation, can act as a barrier to vapour that is passing through the assembly. The vapour must be allowed to migrate to the exterior by open joints between sheets, or by perforating the material, or it will risk becoming trapped between water vapour tight layers.

The building envelope must be designed so that multiple vapour barriers are avoided.

Any material with a low permeance rating that is located on the low vapour pressure side of the insulation cavity, must be installed in such a way that vapour can migrate past it to the exterior.

If the vapor barrier consists of poly *installed* inside the framing of the structure:

Set staples fastening vapor barrier to *structure* at 2' centers.

To minimize penetration.

Ensure continuous solid backing behind joints in the vapor barrier so the joint will be trapped between the backing and drywall, effectively sealing it.

Apply a thin bead of acoustic caulking to all studs and plates where they contact *the* vapor barrier.

The caulking will seal any punctures made by staples, nails and drywall screws. This will also create separate dead air chambers in the wall. If there is a penetration, the air leak will be contained in a single stud bay, rather than traveling along the wall.

Leave slack in the vapor *barrier* when installing it, especially in the corners.

It is common for drywall screws to pull through the drywall, tearing the poly if it is so tight in a corner that it holds the drywall away from the framing. When this occurs, it is extremely rare that the drywall is removed to repair the poly.

Don't allow the use of hammer staplers when fastening vapor barrier.

These easily tear the poly.

Use acoustic caulking in all *joints* and penetrations of the poly.

Tape doesn't always bond well to dusty or cold poly, and wrinkles in poly or tape can cause air leakage.

Recommendation**Rationale**

If poly is inside framing, use 2"x 2" strapping or equivalent fastened horizontally to the studs and on top of the poly. A semi rigid insulation may be installed in this void.

The insulation will increase the R-value of the wall. More importantly electrical boxes and wiring needn't penetrate the poly improving the seal, and drywall screws fastened to the 2"x 2"s won't "pop" as much due to wood shrinkage. If a drywall screw misses the framing, it won't puncture the poly. There is a great reduction in thermal bridging between the drywall and the wall studs.

In 2 story structures, consider hanging the 2nd level floor joists instead of sitting on the top plate of the wall.

The poly can be installed continuous behind the floor joists. This eliminates the practice of wrapping the box sill with poly, which puts the vapor barrier on the wrong side of the insulation causing condensation problems. Also, thermal bridging through the floor system is decreased. Sometimes rigid foam insulation is fitted between the floor joists and caulked to create a seal and become part of the vapor barrier. This is very labor intensive and there are numerous joints to seal, decreasing the integrity of the building envelope.

2. Air Barriers

Materials, or the assembly of materials making up the air barrier system, must be:

The purpose of an air barrier system is to restrict air movement.

- **Durable**

To meet or exceed the service life of the building.

- **Impermeable** - Acceptable leakage rates for the complete air barrier system are noted in Architectural A3.1.4. The air leakage rates of some common building materials and assemblies can be found in Appendix D.

To minimize the movement of air through the barrier. An air barrier system, consisting of air leakage resisting materials and sealed joints, typically fails at the joints between different materials or near penetrations of the materials. Air leakage resistance of the principal materials used should therefore typically be greater than the air leakage resistance of the complete air barrier system.

- Materials employed in the construction of the air barrier system should have air permeance values no more than 1/110th of the air leakage rate allowable for the complete air barrier system.

Measuring the performance of the entire building envelope is difficult; however, the materials themselves can be easily tested: these values have been suggested by the NRC in the expectation that once installed, the air leakage rate of the entire air barrier system will be below values noted in Architectural A3.1.4.

- **Continuous** – Pay special attention to joints, corners and penetrations.

To ensure that there are no leaks and that all parts of the building envelope restrict air leakage to a similar extent. An opening at anyone location is a failure of the entire system.

- **Rigid and strong** - To withstand both positive and negative air pressures due to wind, mechanical equipment and stack effect in accordance with NBC 4.1.7. Air

If it were not rigid and strong, the material would be easily displaced by the air pressures acting on it -the movement can then cause the material to tear at attachment points, or the joints to fail. The structural

Recommendation**Rationale**

barriers must be designed to transfer such pressures to the structural framing while undergoing minimal deflection.

performance of many common materials and assemblies can be found in "Structural Requirements for Air Barriers" CMHC report No. 30133.0R1.

- **Compatible** – with other building components.

Differences in chemical composition, creep behaviour, elastic movement, thermal expansion or shrinkage or expansion due to moisture changes could result in the loss of strength, continuity, impermeability or durability of the air leakage barrier.

3. Location of Air and Vapour (A/V) Barriers

By locating the A/V barrier (and thus the insulation) on the exterior of structural framing, rather than on the interior, the following can be achieved:

- Coincident air/vapour (A/V) barriers located on the outside of structural framing are recommended. Plywood sheathing located on the exterior of the structure with the joints sealed with torched on modified bitumen strips has been found to be an effective coincident A/V barrier.
- Coincident A/V barriers located on the inside of structural framing are acceptable for small buildings but not recommended. Except as noted under Architectural A3.6.3.2.

- *The potential for damage to the structure due to condensation is virtually eliminated*
- *Interior finishes can be applied directly to structural framing (no need for additional strapping or protection for the A/V barrier)*
- *Penetration of A/V barrier by mechanical and electrical systems is reduced to those elements that must exit the building*
- *With fewer penetrations and use of rigid air barrier materials, a good quality installation is simpler to achieve.*
-

Common practice for smaller buildings, and although this assembly meets the requirements of the NBC for vapour protection, it requires that a number of precautions be taken including:

- *Plumbing and electrical wiring routes in exterior floors, walls and roofs must be carefully detailed to minimize A/V barrier penetrations*
- *Interior strapping or other means of attaching finish materials may be provided to accommodate electrical wiring and outlets without the need for air/vapour barrier penetration*

This system is not recommended because it is very vulnerable if the A/V barrier is pierced. There is a higher probability the membrane will be pierced if situated on the interior side of the wall assembly. For smaller wood frame buildings with batt insulation between studs, it is preferable to have a separate air barrier (cold side) and vapour barrier (warm side).

Recommendation

4. Sealants

Sealants used as part of the air barrier system of the exterior wall assembly must be:

- Serviceable to -50°C in their fully cured state
- Able to be installed under conditions to be encountered during their installation
- Strong enough to resist the anticipated loads without deforming or moving out of position.
- Elastic and compressible to accommodate movement of the joint
- Chemically compatible with adjacent materials
- Accessible for service
- Placed in primed joints of proper dimensions with backing rod or bond breakers

Silicone or one component elastomeric types that meet the above criteria are recommended. Acrylic and solvent curing types are not recommended.

Rationale

The performance of sealants is dependent on choosing the correct sealant for the substrate as well as application under acceptable temperature and moisture service conditions.

Construction typically occurs during cool or cold temperatures in Nunavut. Silicone and elastomeric sealants are available that can be applied at sub-zero temperatures and remain serviceable at temperatures down to -50 °C. Many other sealants cannot be properly applied at sub-zero temperatures and lose their ability to fulfil functional requirements at cold temperatures.

See also "Canadian Building Digest #155 - Joint Movement and Sealant Selection. "

A.3.2 THERMAL RESISTANCE

The thermal resistance of the building envelope serves two important functions: to minimize heat loss energy consumption, and to prevent moisture condensation on the interior skin of the building envelope. The Model National Energy Code for buildings is available from NRC as an advisory document on energy performance. It has not been adopted in Nunavut.

Recommendation

Rationale

A.3.2.1 Recommended Values

The **standard for** thermal resistance of exterior building envelope assemblies typically is recommended to be:

- **Floors on Grade: RSI 3.5**
- **Floors Suspended: RSI 7.0**
- **Walls: RSI 5.6**
- **Roofs: RSI 8.75**

An acceptable overall level of thermal resistance is to be achieved regardless of the type and placement of the insulation in the assembly. The recommended values provided are benchmark values. Thermal resistance of the building envelope is best determined by life-cycle cost-benefit analysis. Such analysis may determine lower or higher thermal resistance to be appropriate for a given building.

An energy modeling study is recommended to determine the amount of insulation in the building envelope that will provide energy savings and life-cycle cost benefits.

However, 1995 ASHRAE Standards increased required ventilation rates. Heating the higher volume of cold outside air shifted the balance of heating load away from envelope losses. In buildings where ASHRAE standards apply, capital costs may be minimized by reducing envelope R-values in consultation with the Client Department and the Consulting Engineer.

For unheated or minimally heated buildings, such as ice arenas and parking garages, thermal resistance may not be a functional requirement of the building envelope.

In buildings or portions of buildings not intended for typical human comfort conditions. Thermal resistance values may be lower and still meet energy consumption standards.

Seasonal use buildings may have reduced insulation specifically designed for the period of the year they are to be occupied.

A.3.2.2 Location of Insulation

All insulation should be located on the cold side of the coincident A/V barrier system.

1. Where the coincident A/V barrier is located on the exterior side of the structural framing, rigid or semi-rigid insulation should be used.

Insulation applied to the exterior of the building structure provides a uniform insulating value over the entire building envelope. Compressible inorganic insulation can also be used, provided it is protected, drained and vented to keep it dry as required by NBC 5.3.1.3.

Recommendation**Rationale**

2. Combustible insulation should be appropriately fire-stopped.
3. Where the coincident A/V barrier is located on the interior side of structural framing, compressible inorganic insulation may be used in the structural framing space, provided the requirements of 5.3.1.3 are met. (A layer of insulating sheathing is recommended in addition to the insulated structural cavities; see Architectural A3.2.3).

The structural members reduce the overall thermal resistance of the assembly. Their thermal bridging effect should be minimized by using insulating sheathing on their exterior. Thermal resistance varies at the junctions of floor and wall, and wall and roof. It is difficult to avoid thermal bridging by framing members at these locations. Insulating sheathing is a practical method for increasing thermal resistance at such locations.

A.3.2.3 Continuity of Insulation

Thermal bridging by structural members needs to be recognized and minimized in the building envelope design.

1. Where insulation is installed outside the structural framing, it should be installed in 2 layers at right angles. The insulation may be secured with 2 layers of girts or strapping installed at right angles, or with one outer layer of girts screw-fastened through the lower layer of insulation into structural framing.
2. Where insulation is installed within structural framing, a layer of insulating sheathing should be provided on the exterior of the framing or the exterior structural sheathing.

The intent is to reduce thermal bridging through girts or strapping.

The intent is to reduce thermal bridging through structural members. This is already common practice in northern building.

A.3.2.4 Localized Low Temperature

Layout of spaces and detailing of assemblies should avoid spaces or compartments that are not readily heated. Concealed spaces that are located on the warm side of the A/V barrier may require transfer grilles to heat the space and keep the surfaces above dew point.

The location of furniture, fixtures and fittings can restrict the convection of heat within a space so that some surface temperatures on the warm side of the A/V barrier may drop below the dew point.

Particular attention should be focused on corners that have large exposed exterior surface area relative to small interior surface area, and to spaces where supplies are stored against exterior walls.

Recommendation**Rationale****A.3.2.5 Combustibility of Insulation**

1. The use of non-combustible types of insulation such as mineral wool in semi-rigid form is recommended.

This can be implemented as a measure to increase resistance to fire spread.

A.3.3 BUILDING ENVELOPE – FLOOR ASSEMBLIES

Where northern buildings are elevated, floors assemblies have an exterior surface on the underside. Basements or concrete foundations are possible in only a few locations and for certain uses. On permafrost sites, foundation-bearing capacity can be maintained by artificial cooling of the ground. Induced draft cold air systems, powered refrigeration or thermosyphon refrigeration are techniques that have been used to keep permafrost intact beneath heated buildings. On grade crawlspace are to be avoided. Above grade (suspended) crawlspaces are recommended.

Recommendation

Rationale

A.3.3.1 Air Movement, Water and Vapour Protection

All recommendations of Architectural.
Section A3.1 applies to building envelope floors.

Clarifies criteria to be used in evaluating floor assemblies with respect to NBC requirements.

All building envelope floors subject to differentials in temperature, water vapour pressure or air pressure require air barriers (AB) and vapour barriers (VB) meeting the recommendations outlined in Architectural A3.1.3 and A3.1.4.

Floors above open crawl spaces are common in continuous and discontinuous permafrost zones in the North. The underside of the Floor assemblies immediately above grade provide opportunities for air leakage, snow infiltration and water vapour diffusion.

A.3.3.2 Thermal Resistance

See Architectural A3.2

A.3.3.3 Materials and Assembly

1. Air/Vapour Barrier

A false floor should be considered wherever insulation is located within the structural framing of a suspended floor and the comfort of users is a consideration, or where space is required to accommodate plumbing.

See Architectural A3.1.6.

A false floor will reduce heat loss due to thermal bridging through the floor joists. A false floor is suggested for residential and institutional facilities such as group homes, and elementary schools where children can be expected to be sitting on the floor. Drains and water supply pipes should not be placed within a suspended floor system, just as they should not be installed within exterior walls in northern buildings.

2. Sealants

See Architectural A3.1.6.4.

3. Insulation

See Architectural A3.2.

Recommendation**Rationale****4. Drainage and Ventilation**

Architectural A3.1.1 and A3.1.3 address precipitation and water condensation management.

Joints of the exterior soffit finish should not be sealed in an effort to create an external air barrier. Plywood resists water vapour migration so as to create A/Vapour barrier if the joints are sealed, creating a second vapour barrier in the floor. See Architectural A3.1.6.4.

5. Exterior Finishes

- a) Exterior soffit materials for suspended floors shall be:

The underside of a suspended floor is not generally in contact with water, snow or soil, nor is it generally visible. Batten strips covering soffit material joints prevent snow, dust and insect entry, but allow enough air movement to effectively ventilate a suspended floor.

- Durable
 - Light weight
 - Easily installed
 - Easily removable and replaceable for repairs to contained services with locally available trades skill.
 - Installed with the minimum number of exposed joints.
- b) Preservative-treated materials for floor soffits are recommended where continually high moisture levels are anticipated.

Materials considered to satisfy these requirements include sheet materials such as plywood, exterior grade particle and oriented strand board suitably battened at the joints, and corrosion protected, ribbed sheet metal with lapped mechanically fastened joints is recommended where any risk of fire due to vandalism exists.

The dry climate of the North, where suspended floor systems are typically used, generally makes the use of preservative-treated materials only necessary where excessive air humidity is expected.

A.3.3.4 Thermal Break

A thermal break should be provided between foundation units and bearing stratum.

See Structural S3.

Where floor assemblies are elevated above ground and present an exterior surface on the underside, a thermal break should be provided between piles and floor structure to prevent cold spots due to thermal bridging in the building envelope and to minimize heat loss from building to frozen soils.

Recommendation**Rationale****A.3.3.5 Above Grade Crawl Spaces****1. Open area below the building**

Open area below buildings should be screened with durable metal mesh security.

The objective is to prevent unauthorized and unsafe uses of the area below buildings.

2. Heated Crawl Spaces

Heated enclosed crawl spaces are recommended for protecting and accessing building systems. All areas containing plumbing and mechanical systems should be served with an enclosed crawl space.

Enclosed crawl spaces provide a comfortable work environment for future maintenance. The enclosed crawl space also provides a heated space directly below the floor, which protects equipment from harsh climatic conditions and provides a heated floor system.

Enclosed crawl spaces should be treated as environmentally different spaces when temperature and humidity conditions of the crawl space will be different from adjacent spaces within the envelope.

The different crawl space environment can result in air/vapour leakage, unwanted heat transfer, or condensation. Differences between interior environments are identified in NBC 5.3, 5.4 and 5.5 as requiring provisions to stop undesirable heat, air and water vapour movement.

3. Crawl Space Drainage

A graded slope of 2% or greater to sump points, or away from the building, is recommended for all crawl space ground surfaces. Any drainage connection or water collection device must not break the continuity of the ground moisture protection barrier in an enclosed crawl space.

This conforms to NBC Section 5.8, to ensure that surface and ground water does not accumulate in crawl spaces. The objective is to dispose of surface water from spring runoff away from an open crawl space, and to collect and dispose of ground water that might enter an enclosed crawl space.

4. Utilidettes

Where pipes and ducts are incorporated into a suspended floor system above an open crawl space, provide a suspended utility space or utilidette to enclose them within the building envelope.

Using utilidettes to enclose grouped pipes and ducts in a floor system above an open crawl space can eliminate the need for an expensive continuous suspended utility space.

It is mandatory that an absolute minimum of 300mm clearance be provided between grade and the underside of utilidettes or any other horizontal structure.

Frost heave must be isolated from acting on the envelope or structure.

A.3.4 BUILDING ENVELOPE – WALLS ASSEMBLIES

Walls make up a large part of a building envelope. Walls usually incorporate a large number of openings and penetrations such as doors, windows, ducts and chimneys, and electrical conduits. Care must be taken to make the air barrier system in walls continuous at all openings and penetrations, and at joints with floors and roofs.

Recommendation

Rationale

A.3.4.1 Air Movement, Water and Vapour Protection

All recommendations of A3.1 apply to building envelope wall assemblies.

Clarifies criteria to be used in evaluating wall assemblies with respect to NBC requirements.

All walls forming part of the building envelope require air leakage barriers and vapour diffusion barriers meeting all requirements outlined in Architectural A3.1.3 and A3.1.4.

Although this applies primarily to exterior walls forming the building envelope, internal walls that subdivide buildings may also be subject to differential temperature, air and water vapour effects. Examples include community arenas, or combined office/warehouse and office/fire hall buildings.

A.3.4.2 Thermal Resistance

Thermal Resistance See Architectural A3.2.1

A.3.4.3 Materials and Assembly

1. Air/Vapour (A/V) Barrier – See Architectural A3.1.6.3 and 3.4.3.5 below.

Note that continuity of the A/V barrier must be provided, including special detailing where roof or floor A/V barriers are located on a different plane from that of the walls

2. Sealants – See Architectural A3.1.6.4.

3. Insulation - See Architectural A3.2.2 and A3.2.3.

4. Drainage and Ventilation - See Architectural A3.1.5.

To meet NBC.5.6.2.1 requirements, consistent with application of the Rain screen, PER and PERSIST Principles.

5. Heated Crawl Spaces with Exposed Grade

Careful detailing is required to eliminate any transfer of freeze/thaw soil movement to the envelope and/or structure

Compressible 'void former' may be considered at interface of grade and insulating walls or grade beams. Note that the wall A/V barrier must be sealed to an interior protected grade A/V barrier. See also Structure 3.1.5.

A.3.5 EXTERIOR WALL FINISHES

"Good Building Practice" does not specify where particular materials are to be used: Materials are selected by the designer and should conform to the recommendations noted here. Maintenance needs, appearance,

durability, ease of repair and availability of repair materials are all considerations made in selecting wall finishes.

Recommendation

Rationale

A.3.5.1 General

All siding should be installed so that the requirements of Architectural A3.1.5 "Applicable Building Envelope Design Principles" are met and adjusted for the dry arctic climate.

Air pressure equalization compartments can be created using strapping applied to support the siding.

Building finishes must be abuse resistant and properly supported to limit the potential for damage due to vandalism.

Finishes that can be maintained and replaced easily should be favoured.

Depending on the function of the building, protect the lower portion of the building by using impact resistant material, or with appropriate accessories such as crash barriers, bollards, landscaping features (boulders).

Frequent damage occurs to the lower portion of exterior walls of schools and arenas, areas around stairs and landings, corners of garages, loading docks, etc. Caulked butt joints are not acceptable.

All seams in finishes must overlap or be covered to prevent leakage.

Siding patterns and edge joints should allow easy replacement at areas susceptible to damage.

A.3.5.2 Wood

Board and batten, lap joint, tongue and groove, channel or drop siding are acceptable.

Although wood siding requires regular maintenance, it is easily applied and repaired, and A/Variety of colours and patterns can be used.

Joints should be installed vertically to speed water draining from the cladding and promote rapid drying

Horizontal joints retain melt water and rain, wetting the wood for longer durations. Research has found increased early life cycle splitting, warping and staining when wood cladding stays wet.

Spruce or cedar siding is acceptable, and siding may be air-dried or kiln-dried.

Commonly used because of acceptable performance experience. Paint seals wood and does not allow moisture from the concealed side of the rain screen to migrate freely outward. As a result, non-breathing paint can peel prematurely.

A semi-transparent stain finish is preferred, and solid colour stains acceptable. Paint finishes for exterior wood may be limited to fascia and trim.

Factory painted wood siding products with long term guarantees are acceptable.

Recommendation**Rationale**

Pre-finished plywood siding, such as "Ranch wall", minimum 15.5 mm thick is an acceptable siding material.

A.3.5.3 Metal Siding

Metal wall siding panels should be factory preformed steel sheet, minimum 0.6 mm (24 gauge) base metal thickness, zinc coated, pre-finished on weathering face.

Typically used with prefabricated metal buildings such as recreational facilities or service buildings. Metal siding is susceptible to damage from impact, and because repairs are not easily undertaken by local maintainers. Often the damage does not get repaired. Wood siding should be considered in areas most susceptible to damage, such as entranceways.

Profile: select from manufacturer's standard profiles.

The extra cost of custom profiles or colours is generally not warranted for public buildings, and delivery time is often increased.

Colours: should be selected from manufacturer's standard colours.

Fasteners: concealed fasteners are preferred.

Aluminum siding is not recommended for northern buildings.

Very susceptible to damage from impact, and subject to large thermal expansion and contraction. With large temperature ranges in the North, rippling and 'oil-canning' occur more readily.

A.3.5.4 Vinyl Siding

Not recommended for northern buildings.

Expansion and contraction in varying temperatures causes warping, and vinyl also becomes very brittle in cold temperatures suffering impact damage easily.

A.3.5.5 Stucco Finish

Not recommended for use on northern buildings.

Easily damaged on impact, and materials are generally unavailable for repairs.

A.3.5.6 Fiber Cement Composite Board

Installed with sufficient backing, fibre cement composite board should be installed in areas to limit the impact from vandals and regular building maintenance such as snow clearing.

Fibre cement composite board is easily damaged when not supported fully. Careful selection of the location and backing should be considered when choosing this type of cladding. Thicker panels should be preferred.

Recommendation

Fibre cement composite boards have proven to be an acceptable alternative to wood or corrugated metal as an exterior finish.

It is not recommended to paint fibre cement composite board.

Rationale

Colour should be embedded in the panel, not applied on its surface. Fibre C by Rieder is an example of a suitable product.

A.3.5.7 Exterior Insulated Finishing Systems (EIFS)

This system has had limited testing in Nunavut and requires skilled labour to install and maintain. This system is not recommended for lower portions of buildings, susceptible to high impact.

EIFS are labour intensive to install and require skilled labour to repair. EIFS have very little impact resistance. The time window for installation in the Arctic is limited.

A.3.5.8 Fiberglass Panels

Fiberglass panels are recommended as an alternative cladding system. The wide variety of colours and finishes available offer design alternatives.

Fiberglass panels have high resistance to moisture and temperature fluctuation. Their installation does not require specialized man power.

This system is not recommended for portions of a buildings susceptible to high impact.

Fiberglass panels come in A/Variety of finishes. Certain finished do not resist well to scratches and should be avoided.

Fiberglass panels covered with aggregates are an esthetical solution to cover-up the above ground portion of underground foundations. These panels can withstand being buried below grade.

A.3.5.9 Other Composite Wall Panels

The term 'Composite wall panel' is applied to A/Variety of products of different characteristics. Particular analysis is required for each specified product.

There has been limited testing done on the impact resistance of composite wall panels at low temperatures.

Generally, composite wall panels should be used where there is limited impact on the panels. This generally occurs at higher portions of the building.

A.3.5.10 Engineered Wood Product

Engineered wood products have proven to be an acceptable alternative to wood or corrugated metal as an exterior finish.

This product requires low maintenance and is an economical alternative to wood siding.

Recommendation**Rationale****A.3.5.11 Prefabricated Insulated Panels (steel, fiberglass)**

This product has been successfully tested in Nunavut.

When budget permits, this system is very efficient in arctic climate. It offers optimal thermal continuity and airtightness and permits flexibility in shape for the building design. However, the product requires long lead time.

Specialized labour is required for installation and on-site adjustments are limited during installation of the panels.

Joint detail between panels is critical. It must be durable, compressible, and elastic and preserve its qualities in arctic temperatures. Exterior fasteners should be stainless steel.

A.3.6 BUILDING ENVELOPE –ROOFS ASSEMBLIES**Recommendation****Rationale****A.3.6.1 Air Movement, Water and Vapour Protection**

All requirements of Architectural A3.1 apply to roof assemblies.

Clarifies criteria to be used in evaluating roof assemblies with respect to NBC requirements.

All roofs are subject to differentials in temperature, water vapour pressure and air pressure, and as such require air barriers and vapour barriers meeting all requirements outlined in Architectural A3. 1.3 and A3.1.4.

Clarifies criteria to be used in evaluating A/V barriers with respect to NBC requirements.

A.3.6.2 Thermal Resistance

See Architectural A3.2.1.

A.3.6.3 Assembly and Materials**1. Air Vapour (A/V) Barriers**

Coincident air/vapour (A/V) barriers located on the outside of structural framing are recommended for all buildings located above the tree line.

Condensation within the roof assembly has caused structural damage to a number of roofs across the Nunavut: locating the structural roof inside of the A/V barrier is a reliable means of avoiding this problem.

Recommendation**Rationale**

Venting roof assemblies above the tree line is problematic as vents allow snow infiltration.

See Architecture 3.1.6.3

Protected, fully adhered coincident air/vapour (A/V) barrier membranes are recommended.

With the membrane fully adhered to a structural backing, the assembly can meet the A/V barrier requirements, and any damage to the membrane will not allow moisture to travel laterally between the membrane and the backing.

2. The location of the A/V barrier on the interior of roof framing is recommended only for small buildings located

The use of better performing insulation and membrane materials becomes necessary when the A/V barriers are located on the exterior of the roof framing. These become cost effective on larger buildings. The additional cost may not always be justifiable for smaller buildings located below the tree line. Where A/Ventilated roof system can perform satisfactorily.

Below the tree line. Great care must be taken to ensure continuous A/V barriers, and a means of venting the assembly that will minimize snow infiltration.

3. Sealants

See Architectural A3.1.6.4.

4. Insulation

See Architectural A3.2.2, A3.2.3.

5. Ventilation and Drainage

Wherever fibrous mineral insulation is used in a roof assembly. The requirements of NBC 5.4 and 5.5, or 5.6 must be met.

It is important that adequate ventilation be provided where fibrous mineral insulation is used as its insulation value is adversely affected by condensation. Snow infiltration through required ventilation openings is difficult to avoid; wetting of the insulation and roof assembly occurs as soon as conditions allow infiltrated snow to melt.

Whenever possible, drainage should be provided from the interior membranes of the assembly to the exterior of the building envelope.

Water that accumulates within the assembly due to snow infiltration, roof leaks or A/V barrier leaks can drain to the exterior.

6. Roof Coverings

Shingles

Asphalt shingles are not recommended for use in Nunavut. If used, install with slope of 4 in 12 or

Areas above the tree line are typically very windy. Shingles can be blown off and are difficult to replace. Asphalt shingles are readily available, generally less

Recommendation**Rationale**

greater, or 2.5 in 12 where fully tabbed shingles are used.

expensive, and represent a lower fire hazard than Wood shingles.

Wood shingles are not recommended.

Early deterioration of wood shingles occurs with excessive drying and long solar exposure common in the North. Combustibility of wood shingles increases fire loss risk compared to other water-shedding membranes.

Modified Bitumen Membrane (MBM)

The 2-ply torched-on MBM roof system is recommended for northern buildings.

The 2-ply torched-on MBM membrane has proven to be suitable for installation at sub-zero temperatures and has performed well to date. Repairs are relatively simple to perform.

EPDM or *Rubber Roofing*

Loose-laid membranes are not recommended for use on northern buildings.

These loose-laid membranes can allow moisture to travel between the membrane and the backing, making it difficult to trace leaks.

Metal Roofing

Metal roofing is acceptable; the standing seam type is recommended for low *slope* installation.

This type of roofing has performed well on northern buildings provided it is installed properly.

A.3.6.4 Flat and Low-Sloped Roofs

All roofs are recommended to have a minimum slope of 4 % (1:25).

To ensure positive drainage and avoid ponding.

A.3.6.5 Stepped Roofs and Offsets

Avoid *stepped* roofs. If two different roof levels are required, a continuous sloping roof section should connect them.

To prevent the occurrence of extensive snow drifting, which may cause excessive roof loading and protracted wetting of wall segments and roof component joints.

A.3.6.6 Parapet Walls

Avoid the use of parapet walls.

Parapets can create an obstruction where snowdrifts will form, adding to snow retention on the roof.

A.3.6.7 Eaves**1. Eave Projections**

Recommendation**Rationale**

Eaves projections beyond the line of the A/V barrier must not weaken the air tightness of the building envelope.

While eaves provide one of the simplest ways to divert rain and melt water away from walls, windows, doors and the building perimeter, careful design is necessary to make sure the A/V barrier joint is continuous and to avoid ice damming on eaves.

Where the A/V barrier is located outside of the structural framing, eave projections should be supported by structural members, which do not pass through the A/V barrier.

Depending on the roof assembly, the continuity of the A/V barrier may be compromised if the structure is extended through the building envelope to provide eave projections.

Minimal eave projections ranging from 200 to 300 mm are preferred in Nunavut.

Ice build-up renders them ineffective, as well as damaging them during spring melt.

2. Eavestroughs

Generally, to be avoided

A.3.6.8 Access

Where roof traffic is anticipated, the finish at access routes should be slip resistant.

Access to the roof will be required for inspection, cleaning and maintenance of roof equipment and the roof system.

Roof access is always required. Plumbing vents require clearing during the winter due to ice build-up.

A.3.6.9 Skylights

Although past technology gave skylights a bad name, new roof and flashing systems and high-quality insulating skylight materials now make their use more acceptable. Skylights are generally not recommended for use in Northern facilities.

The extent of skylights would be inappropriate if the energy lost through the skylight increased the energy management budget unreasonably when compared to the environmental benefits and energy saved in lighting.

When skylights are acceptable for northern buildings, several key design features must be included:

Skylights (especially translucent structural panels) have successfully provided a number of facilities with light in areas where windows were not possible.

1. A Steep slope is required for drainage, i.e., 3.12 to 6.12.
2. Skylight units should be placed on raised up stands above the roof plane a minimum of 200 mm to allow for drainage, expansion and contraction control, and flashing of joints.
3. Adequate ventilation must be provided across the interior of the skylight to minimize condensation,

The quality of overhead natural lighting is comparable to lighting from windows. Past problems experienced with skylights cannot be ignored. Poor detailing with resulting condensation has caused damage to interior furnishings and property. Inappropriate locations allowing direct penetration of sunlight causes discomfort to users who often complain of overheating and glare. Extensive roof damage has occurred as a result of poorly sealed skylight units.

Recommendation**Rationale**

and ample condensation gutters must be provided.

4. Adequate drip pan is to be provided, allowing condensation to evaporate and not overflow. Consideration should be given to force air movement over the surface, eliminating condensation.
5. Framing members should be detailed with a secondary drainage plane leading to the exterior.
6. If clear skylights are proposed, consider equipping them with blinds to reduce overly strong sunlight. The blinds must be easily operable by facility users.

The objective is to catch condensation and allow it to evaporate.

Accumulation of water cannot be totally eliminated on sloped surfaces. Joints exposed to standing water will eventually leak. Secondary drainage relieves the water that passes through the primary weather seal.

A.3.6.10 Clerestory Windows

Clerestory windows are reasonable alternatives to skylights, provided careful design allows them to remain clear of snow accumulation. If clerestory windows are used they should be not operable. Fixed glazing is recommended.

As for skylights, the use of clerestory windows requires extra care, attention and cost. The designer must deal effectively with potential climate and building envelope problems. Clerestory windows often result in a stepped or offset roof design which is not recommended for northern buildings. They also generally result in an increased building volume impacting heating costs of the building.

A.3.6.11 Fall Arrest Anchors

Fall arrest anchors are required to be installed on all roofs where there is a possibility that future maintenance and inspections of the roof would be needed.

Fall arrest anchors should be designed to provide support for workers during construction and performing maintenance or inspections on the roof assembly. These anchors need to be designed so as not to interfere with the water shedding ability of the roof and should not promote ice build-up. A coordination with structure is required.

A.4 DOORS, WINDOWS AND METAL WORKS

Doors and windows can be significant sources of heat loss and of air leakage but are necessary elements of the building envelope. Although door and window performance standards have improved considerably over the past 20 years, available products are often designed to meet performance requirements found in less severe cold weather conditions than are found throughout *Nunavut Territory*. Care should be taken to select doors and windows that will meet the extreme cold weather performance requirements of the North.

A.4.1 EXTERIOR DOORS AND FRAMES

Several problems are commonly experienced with exterior doors. Direct heat loss is inevitable, as doors are not typically insulated to more than RSI 1.8. Leakage at door edges is also common, as weather seals lose flexibility in extreme cold. Excessive air leakage is also common in doors that are loose fitting or difficult to close properly, due to lack of alignment between the door and the frame. Door and frame misalignment can occur from higher than normal door use, or from structural strain on the walls, such as caused by impact damage or even foundation movement. Accesses to the building are recommended to be located in visible and well lighted areas, to deter vandalism and insure safety of the users, and strategically placed to minimize snow accumulation or exposure to high winds. Extended eaves and roof canopies can be used to protect the occupants from the weather and falling ice from the building, along with snow guards and water diverters.

Recommendation

Rationale

A.4.1.1 Doors

All exterior doors should be insulated metal, 16 gauge if steel, and minimum RSI 1.3. For energy conservation all exterior doors should be rated for climate zone "D."

Solid or hollow wood doors cannot achieve this minimal level of insulation, and warp easily in extreme dry cold.

It is not practical to use a second storm door at entrances in public use buildings to keep warm air inside. Vestibules between outer and inner door sets are more practical and more durable.

Warm interior air leaking past the inner doors can cause frost to form on the colder outer door edges, affecting weather seal operation.

Residential grade storm doors wear out quickly from the heavy use encountered in public buildings and are easily damaged.

A.4.1.2 Overhead Doors

All overhead doors should be metal with replaceable panels. Manufacturer's standard metal gauge doors are adequate, unless there is a particular danger of impact damage. Where that is the case, use heavier 16-gauge metal.

Typical uses for overhead doors include arenas, fire halls, and garages. Damaged panels can be easily replaced in sections rather than having to replace the whole door. Heavier than normal gauge metal overhead doors may be special order items needing longer order time, but the increased durability reduces life cycle cost.

Overhead doors in insulated walls should have a high thermal resistance and can be selected from manufacturers' standard products.

Insulated doors provide the best value in insulated walls. Thermal resistance ratings of RSI 1.8 is common in plastic foam, insulated metal pan overhead doors. Some manufacturers produce a door with a higher RSI value and should be considered.

Recommendation**Rationale**

Large dimension, flexible. Angled weather seals designed for 'extreme exposure' should be installed at the exterior head and jambs. Threshold seals should be of a material that will not freeze to the floor.

Weather strip designed for extreme exposure is most effective and is more durable.

Slopes should be provided at the exterior of thresholds to ensure water and ice does not accumulate.

To ensure water and ice do not accumulate.

A.4.1.3 Door Frames

Metal frames are required for exterior doors in public buildings. Where steel, minimum 14 gauges, welded pressed metal frames are recommended for all exterior doors. Knock down frames are not acceptable.

Added strength is required as doorframes can wear out early from high volume use in public buildings. Additional structural reinforcement connecting the doorframe to the wall and floor system is recommended.

All exterior doorframes require a thermal break. However, thermally broken frames need to be reinforced by the manufacturer when they are to be installed in high traffic public use facilities, or other facilities that are subject to break-ins.

The thermal break, although needed because of the extreme cold experienced in the Nunavut Territory, can weaken the frame where strength is required by hinges and latching hardware. Doorframe failure arising from wear and tear and from forced entry has been an ongoing problem in schools and arenas.

The available continuous polyvinyl chloride (PVC) interlocking thermal break system has been found to be the most effective protection in these locations.

Wood frames may be used where security will not be compromised.

Wood frames lose less heat than steel frames; however, they are not as strong as steel, and they should be used in light duty locations where forced entry is not a problem.

Removable mullions should not be used with double doors unless three-point latching is provided for each door leaf to secure each leaf to the frame head and the threshold plate.

A removable mullion (positioned in the centre between the two leaves of the door) can be forced to one side from the exterior and allow easy forced entry if the only latching point is on the astragal bar. This weak security point can result in exit door chaining, which is a serious safety violation. The best way to correct this security weak point is to install fixed mullion frames or use three-point latching.

Consider the use of oversized exterior doors in the place of this system.

A good air barrier seal to the doorframes is essential for energy conservation and to minimize corrosion from moisture.

Air leakage out around doorframes is a common cause of energy loss. Warm interior air can condense at loose air barrier joints, and the resulting water causes corrosion of fastenings and rotting of wood members in the wall. See Architectural A3.1.3.

Recommendation**Rationale****A.4.1.4 Sealants**

See Architectural A3.1.6.4.

A.4.1.5 Glazing in Doors and Sidelights

Sidelight frames should be independent of doorframes.

The intent is to permit replacement of doorframes without replacement of the sidelights. The smaller independent frames are also easier to transport and handle on the site.

Polycarbonate exterior sash protection for the sealed unit glazing is preferred solution to the exterior glazing in doors and sidelights at building entrances. Note that polycarbonate is not allowed as primary glazing at exits by NBC (3.4.1.10)

Typically used for schools, community halls. Health centres, court facilities, libraries, airport terminals and other public access buildings.

A.4.1.6 Vestibules

Vestibules are recommended at all main entrances or other high traffic entrances. In schools the storage of boots as well as the space to put them on and off should be provided.

Vestibules help keep warm interior air inside the building, conserving fuel energy. Larger vestibules are desirable. All vestibules are recommended to have an abuse resistant wall finish on the interior.

When it is possible, the use of an air lock (cold porch) can protect the entrances of the building, providing an area shielded from winds, snow and water precipitation, permitting easier access to the building and protecting entrance doors and hardware.

The combination of an air lock (cold porch) and A/Vestibule should be considered for more efficient energy conservation.

A.4.2 INTERIOR DOORS AND FRAMES

See AWMAC, Part 3 – “Wood Doors”

Recommendation**Rationale****A.4.2.1 Doors**

Solid core wood doors are preferred for all interior locations.

Hollow core doors are too easily damaged in public access buildings, including residential buildings. The best life cycle value is found in more durable solid core doors.

Recommendation**Rationale**

Grade of door should be appropriate to proposed finish.

Paint grade birch veneer plywood faces are acceptable for paint finish, 'Select White' appearance grade suggested for clear finish.

Interior doors requiring a fire protection rating (label) may be wood or metal.

Some solid core wood doors are available with laboratory-tested ratings and may be appropriate for use in some areas of low traffic.

A.4.2.2 Frames

Interior doorframes may be wood or metal.

Metal frames require less attention over their service life than wood and are generally less expensive installed.

Fully welded metal frames are recommended over knockdown frames, particularly in high use locations.

Metal frames are more durable in high use locations and therefore more dependable as a part of a fire separation. Labelled wood frames should be considered only at areas of very light traffic.

Interior doorframes requiring a fire protection rating (label) should be metal and have riveted metal labels.

A.4.2.3 Bi-fold Doors

Bi-fold doors are considered appropriate for use only in residential facilities, at door locations with very low use rates.

Sliding mechanisms of bi-fold doors are too susceptible to damage from heavy use. Bi-fold doors are impractical for most locations and should be avoided whenever possible.

A.4.2.4 Glazing

Restrict the use of glass in the lower portion of doors (closer than 600 mm to the finished floor) to well supervised locations. Where glass must be used in the lower section, it must be tempered.

Although glass can be important for visibility, the lower portion of the door is vulnerable to damage.

A.4.3 DOOR HARDWARE

After construction, Regional maintenance staff is often called on to correct or repair door hardware. As these repairs often require immediate attention, replacement parts are stocked in the Region. Heavy door usage in public access buildings requires reliable, durable and easily repaired hardware.

Recommendation

Rationale

A.4.3.1

Locksets

Selection should be coordinated with maintenance staff so that Regional preferences and standard keying systems are accommodated.

Maintainer preference where Regional keying system in place. Limiting hardware to preferred manufacturers reduces the stock of maintenance materials.

Other Hardware

No preferred products.

A.4.3.2 Overhead Door Openers

Manual operation by chain hoist is preferred. Automatic door openers are recommended only where they are essential to facility operation.

Automatic overhead doors require more ongoing maintenance and are more susceptible to problems than manual doors. The additional cost is not usually justifiable.

A.4.3.3 Power Door Operators

The Office of the Fire Marshal should be approached to relax the requirement of NBC 3.8.3.3(5) in communities where repairs and maintenance is not available in the community.

These are dealt with on an individual basis.

A.4.3.4 Exterior Door Latching

At least two point, and preferably three points latching, should be considered for all exterior doors. Surface bolts combined with a rim device are recommended.

Although more expensive initially than single point latching, three-point latching provides higher security doors and a more airtight seal: forced entries are a recurring problem in public buildings where single point rim device latching is used. Recesses tend to become blocked by ice.

A properly sloped threshold plate is required where threshold recesses are used.

Recommendation**Rationale****A.4.3.5 Keying**

Keying for all buildings to be maintained by PW&S is to be done according to the Regional or Area lock keying system. Regional Maintainers can advise.

This allows buildings to be keyed separately for security reasons but allows Technical officers to cut keys and provide sub-master keys where required.

A.4.3.6 Hinges

Full-length continuous hinges are recommended on exterior main entry doors subject to high traffic

This is to prevent 'jacking' of door or doorframe due to wind forces. Reduces O&M costs. Field evaluation data supports this requirement for schools and like buildings.

A.4.3.7 Weather Stripping

Brush type is recommended for door bottoms.

The rubber type wears rapidly with threshold friction.

A.4.4 WINDOWS

The number and size of windows should be carefully designed in northern building envelopes, given the extreme climate and because of the potential for vandalism of public buildings. Sizes, type, location, and number of windows should be carefully selected to reduce energy costs. The size and shape of windows should be uniform and consistent to reduce the required replacement parts. Views and natural light must be carefully considered when selecting and locating windows.

Recommendation**Rationale****A.4.4.1 Windows Frame**

Insulated frame PVC, vinyl or pultruded fibre reinforced plastic (fiberglass) frames are preferred.

Easy maintenance as there is no need to refinish, and the potential for damage to windows by condensation is eliminated.

High quality metal windows with thermal break frames, or protected wood windows are acceptable.

See 4.4.4

Large windows require special consideration to ensure that the frames are adequately reinforced, that the hardware mounting is strong enough, and that the frame will remain straight and provide an effective seal.

Large windows are not recommended as they are difficult to protect and expensive to replace. Transportation to remote communities can be by small planes that cannot accommodate large windows.

A.4.4.2 Sealants

See Architectural A3.1.6.4.

Recommendation**Rationale****A.4.4.3 Location in Wall Assembly**

Windows should be located in the wall assembly such that the interior of the frame is located on the warm side of the insulation.

Setting of windows at exterior wall should not create a wide interior ledge because this reduces airflow over the glass, which can allow condensation or frost to build up on the inside of the window.

The window frame should straddle the plane of the A/V barrier.

The intent of such placement is to provide A/V barrier continuity through the window frame without offset.

A.4.4.4 Operation

Non-operating windows are preferred for northern buildings.

Depending on the building function and the users' needs and preferences, operable windows or non-operable windows can be specified.

All operating windows in schools and public buildings should be casement or awning type with rugged hinges, and rugged camlock handles.

Impacts on energy due to improper use and poor building management make operable windows a liability. Operating windows also pose a security risk left opened; they can adversely affect Heating and Ventilation systems by negatively affecting the balance of the system.

If operable windows are specified, quality windows with heavy duty and simple hardware are to be installed. Casement windows opening towards the inside are preferable, with a compressible air barrier seal for maximum air tightness. All operable windows should have screens.

Crank handles are not acceptable in schools. Camlocks have been found to be the most maintenance free and to provide the best seal of all opening window types. Note that these handles require the rigidity of metal or pultruded fibre reinforced plastic frame materials.

Windows must be designed so that they will not be blocked by accumulations of snow or ice on sill plates. Awning vents located in the top 1/3 of the window are preferred and awning vents in the lower 1/3 discouraged.

Awning vents in lower 1/3 of frame are more likely to allow wind, dust and snow to blow in. Also, ventilators in lower portions of windows are less secure and ready intrusion points.

Refer to M8. 1 when windows with an operable panel are provided.

Recommendation**Rationale****A.4.4.5 Glazing**

All windows should have double-glazed sealed units with low "E" coating or triple-glazed sealed units.

The objective is to obtain the best insulation value available and economically justifiable.

Wherever recurring vandalism is identified as a potential problem, protection of glazing should be provided. Typically used for schools where windows are subject to vandalism.

Shutters or demountable panels may be used to protect windows. New 3M type films are offered to protect the window from vandalism. Also, a single-glazed removable sash of polycarbonate plastic on the exterior face is recommended to protect double glazed sealed window glazing.

Such protection should be considered for all seasonal use facilities where vandalism is a potential problem. This may also include schools because of shut down for the summer.

Note that combustible glazing is not permitted as primary glazing in exit enclosures by NBC (3.4.1.10).

A.4.4.6 Window Vents – Snow and Forced Entry

In high wind locations these have been successfully protected with full height hoods that discourage snow penetration and prevent forced entry. If wind is not a factor, exterior metal louvers are recommended.

Solid inward opening vents with insect screens have worked successfully with exterior hoods or louvers

A.4.5 METAL WORKS (EXTERIOR AND INTERIOR)**Recommendation****Rationale****A.4.5.1 Metal Works Treatment**

Openwork materials are preferred for stairs and low-sloped ramps.

Openwork materials let wind pass through to sweep surfaces and limits snow accumulation.

Special attention must be given to exterior metal works treatment. When possible, avoid painting surfaces and favour in-shop treatments such as galvanization or anodization.

Applied on-site paints tend to peel over time, requiring constant maintenance and the tedious work of repainting surfaces regularly.

Galvanization (for steel) and anodization (for aluminum) are resistant and long-lasting protections to weathering and aging of the material.

Recommendation

If unavoidable, it is preferable to use powder coating for exterior painted metal works.

For special interior metal works, such as furniture, in-shop applications should be selected when possible.

Rationale

Powder coating is applied in-shop for higher quality control and is more durable than applied on site standard paint.

In-shops paint application allows for higher quality control and increased durability. However, there is a risk these works can be damaged during shipping.

A.5 INTERIOR CONSTRUCTION AND FINISHES

Durability and simplicity are desirable qualities in northern buildings. This applies similarly to interior construction and finishes, as it does to all building systems. Generally, colour schemes and careful placement of building elements must be relied upon to create attractive and pleasing interiors: the range of appropriate materials and architectural details can be limited by cost. The occasional special use facility or high-profile project may call for more elaborate treatment when materials with very long service life are used. Trendy colour schemes that may become dated should be avoided. Increased concern about volatile organic gas from finish materials in recent years should encourage all building designers to investigate new products and to ensure indoor air quality is not adversely influenced by paints. Carpets. Panel products and resilient flooring materials.

A.5.1 FLOORS

Although a large number of floor finishes have been used in northern buildings over the years, only a few have gained overall acceptance by users, maintenance staff, contractors and designers. This section identifies different types of commonly used flooring materials and indicates preferences for some specific applications.

Recommendation

Rationale

A.5.1.1 Resilient Flooring

1. Marbleized Linoleum

This is the preferred flooring for most northern buildings.

Linoleum has proven durability, a good range of colours, and is easy to maintain. Compared to vinyl composite tiles, linoleum is only slightly more expensive to install, requires much less maintenance, and is far more durable. It should be noted that linoleum is too slippery for wet areas such as shower rooms. See 5.1.1.2. Linoleum is a sustainable choice.

Heavy traffic areas:

Minimum 2.5 mm thickness with welded seams.

Typical high traffic areas would include all public lobbies and corridors. And throughout health centres.

Medium traffic areas:

Minimum 1.8 mm thickness with welded seams.

Typical medium traffic areas would include seasonal use facilities, private offices and a few GN facilities where traffic would be deemed consistently light.

Light traffic areas:

Minimum 1.8 mm thickness with welded seams.

There are few northern public buildings considered to have light traffic.

2. Skid Resistant Sheet Vinyl 2 mm thick, homogeneous colour and pattern detail throughout thickness of product. Marbleized or granite patterns and welded seams are recommended. Surface patterned materials or cushioned backing are not recommended.

Typically used in vestibules, washrooms and change rooms where floors may remain wet for some time, or for residential uses where only small areas required. Welded seams are required to provide a durable, watertight joint. Products with surface colours and patterns should not be selected because they show wear too readily in public facilities with medium to heavy traffic. Patterns can serve to hide dirt more easily than plain colours. Cushioned flooring is not

Recommendation**Rationale**

Heavy-duty vinyl sports flooring with slip resistant surface, suitable for surface-painted lines, is acceptable.

practical because it can be easily damaged by furniture.

Typically used in community or school gymnasiums.

3. Vinyl Composite Tiles (VCT)

2.5 mm minimum thickness, colour and pattern detail throughout the thickness of the tile. Use marbleized or granite patterns.

Because VCT is easily installed using local labour, they are especially appropriate where small quantities do not warrant the expense of bringing in a flooring subcontractor.

Do not use vinyl composite tiles in cold porches or unheated rooms. Typically, appropriate only in light traffic areas in smaller buildings.

Typical uses would include smaller buildings such as offices in maintenance garages or fireballs, DSD field offices or summer use staff quarters. Tile shrinkage in cold temperatures makes them a poor choice for cold areas.

Tiles should not be used in wet areas or areas subject to spills.

Water and spilled materials can enter the joints and deteriorate the adhesive. Spilled fuel oil and antifreeze are particularly bad as they also penetrate the sub floor and make repairs difficult.

4. Rubber Flooring

Rubber flooring is generally not recommended for use subject to high water such as vestibules in northern buildings.

Rubber flooring used in public or residential buildings has been found to be difficult to clean, and expensive to install. There is no inherent advantage that makes rubber flooring a better choice than linoleum or vinyl where resilient flooring is called for in GN facilities.

Rubber sports flooring suitable for surface-painted lines is acceptable for use in community or school gymnasiums.

Rubber flooring is suitable for sports activities, but also allows for community events without requiring people to remove footwear: unlike the more traditional wood sports floor, rubber flooring is resistant to damage from sand or mud tracked in by footwear.

Vulcanized rubber skate flooring is acceptable for use in limited areas of community arenas.

Typically installed only between ice surface and areas where skates are put on or removed.

5. Cork Flooring

Generally, not recommended in northern buildings.

Difficult to maintain, and expensive to install. There is no inherent advantage that makes cork flooring a good choice for any particular use in a GN facility.

Recommendation**Rationale****A.5.1.2 Wood Flooring**

Generally, not acceptable for use in northern buildings. Including gymnasiums, because of the typical dry service environment.

Capital, installation and maintenance costs are high. Wood floors in gymnasiums require protective coverings when used for community events, which is inconvenient for users: where protective coverings are not used, floors are easily damaged.

In high school gymnasiums wood flooring can be considered in consultation with the Technical Services on an individual basis.

Evidence indicates an increased level of injuries at the senior sports levels due to the non-slip characteristics of manmade versus wood floors.

A.5.1.3 Ceramic Tiles

Generally, not recommended for use in northern buildings, unless it can be shown that the advantages of durability outweigh the disadvantages of high initial cost.

Although it is recognized that ceramic tiles can be low maintenance, easy to clean, and very durable, capital costs are generally high in the North (especially due to transportation costs). There is also a high risk of breakage in transit, and flexible wood structures typical of most facilities do not provide the most stable substrate for ceramic tiles. Susceptibility to cracking, de-bonding and grout repairs can lead to expensive maintenance.

Installation requires skilled trades' persons, and repairs require special attention by maintainers.

When tile is appropriate, neutral colours should be selected and accent colours avoided.

Examples of where ceramic tile may be appropriate would include specialized facilities such as laboratories or hospital operating rooms, where the tile is applied over stable substrates

The tile finishes will outlast adjacent finishes so the colours must be able to work with changes of decor and changing colour trends.

A.5.1.4 Carpeting

Depending on function of building and more specifically of the room, carpeting can be used in northern buildings.

Carpet is typically used in libraries, office areas, and courtrooms. Not suitably durable or soil resistant for use in such areas as kitchens, main entrances, stairs or bathrooms.

Recommendation**Rationale**

1. Properties

- Yarn: nylon preferred. *Durability, appearance and cost of nylon loop have been found to be most suited to northern buildings.*
- Pile: loop only -do not use cut pile. *Hardwearing and easier to maintain than cut pile.*
- Density: minimum 12.0 kilotex. *Density is the standard measure of carpet "wearability", not carpet weight (i.e., 28 oz. or 32 oz.).*
- Static control: carpets should be rated at less than 3.0 kV. *The dry cold climate of the North promotes static build-up, which can be uncomfortable to users and damage electronic equipment.*
- Colours: prefer patterned carpets only in medium colour ranges. Avoid using solid colours, with the exception of accent borders. *Patterns do not show wear or dirt as easily as solid colours.*

2. Installation

Direct glue-down installation of carpet is generally preferred. Avoid using underlay except for limited residential lounge areas. *Gives a tight. Low surface carpet that does not shift or stretch under heavy traffic. Although underlay can be more comfortable for residential lounge areas. It is not suitable for use in most northern buildings.*

3. Warranty of Carpeting

Heavy Traffic Areas: Minimum 15-year warranty required. Typically includes schools or colleges, airports, or public corridors in multi-unit housing. *The manufacturer's warranty is probably the best indication of its durability. Warranties typically cover wear, anti-static performance, zippering, edge ravel or other seam defects. Warranties do not cover damage by burns, tears, pulls, cuts, use of improper cleaning agents, or inadequate protection from wheeled chairs.*

Medium Traffic Areas: Minimum 10-year warranty required. Typically includes community offices. Student hostels or group homes. *Using less durable carpeting will generally result in higher life cycle costs because of the high cost of shipping materials to Nunavut.*

Light Traffic Areas: Minimum 10-year warranty required. There are few northern buildings where light traffic carpeting would be durable.

A.5.1.5 Epoxy Floor Finishes

Recommended for use only where continuously wet conditions will be encountered in fairly large areas. *Careful application is required, and it is difficult to keep maintenance materials in stock. Shower rooms in correctional centres are an example of where epoxy flooring may be considered.*

Specialized labour is required for installation.

Recommendation**Rationale****A.5.1.6 Concrete Toppings**

As mechanical rooms and fan rooms are required to have a one-hour fire separation (NU Fire Marshal), which often includes the floor, and have a finish that can contain water spills and leaks, concrete toppings sloped to drain are recommended in these rooms.

A.5.1.7 Floor Paint

Where suitable, should be non-skid finish, and applied to marine or exterior grade plywood or concrete.

Suitable for low traffic, non-public areas where protection from water, dirt or spilled oil is required, such as mechanical or fan rooms.

A.5.1.8 Granular or Sand Floors

When arenas are located in areas of permafrost, or on sites where subsurface conditions will trap melted water:

1. A liner should be installed below the ice surface.
2. A means of directing melt water away from the building should be provided.

Floors under the ice surface in arenas have typically been left as compacted granular or sand fill. Allowing melt water to seep through the granular or sand floor can result in damage to the foundation system: degradation of permafrost by melt water changes the soil bearing capacity; increased moisture in the soil can increase frost heaving forces.

A.5.1.9 Base Trims

Integrated base trim are preferred for high-use public areas, especially in wet areas.

Resilient cove/baseboards detach easily from walls and require ongoing maintenance.

Resilient base trim may be used in supervised areas such as classrooms, offices or in passive use areas of a building, such as storage rooms. Carpet base may be considered in fully carpeted areas.

A.5.1.10 Dust Control Devices

Dust control devices (mats, grilles) are recommended to be used in entries.

A.5.1.11 Local Materials

Where a suitable local material is available and work will contribute to the local economy, that material should be given preference if practical. Local materials suitable for floors could include stone.

Can provide opportunities for local employment and skill development, as well as results in a more distinctive community building.

A.5.2 WALLS AND PARTITIONS

Interior wall surfaces are both very visible and subject to impact damage in many northern buildings. Regular maintenance by cleaning, patching and refinishing should rely on local skills. Walls need to be reinforced where they are likely to be kicked, hit, bumped or carved. Surfaces should be washable, and easily repairable and refinishable by local trades people with materials that can be easily obtained and stored.

Recommendation

Rationale

A.5.2.1 Framing of Non-Load Bearing Walls

Wood or steel studs are acceptable for all interior non-load bearing walls.

The use of steel studs simplifies work of electrical and mechanical trades, is relatively simple to install, and may be reusable when renovations are undertaken.

A.5.2.2 Demountable Wall Systems

Acceptable for use in office areas only.

Demountable systems can allow flexibility; however, typically some acoustic separation is required, and built-in-place walls generally perform better at lower cost.

A.5.2.3 Mechanical and Service Room Walls

1. Heat Transfer

The preferred means of reducing heat transfer from mechanical rooms to occupied rooms is to avoid locating them adjacent to one another. Where this cannot be avoided, the interior walls separating the rooms should be thermally insulated. Coordinate with acoustic separation requirements below.

Overheating of rooms adjacent to mechanical rooms is a common problem in larger public buildings such as schools or health centres.

2. Acoustic Isolation

The preferred means of acoustically separating mechanical rooms from occupied spaces is to avoid locating them adjacent to one another. Where this **cannot** be avoided, walls, floors and ceilings of mechanical rooms should be rated to STC 50. Whenever possible, the acoustic isolation should continue through the floor to eliminate transmission by the structure.

Equipment noise from mechanical rooms disturbs users of adjacent spaces in many existing buildings.

STC (Sound Transmission Class) measures the acoustic separation capacity of a wall. The higher the STC rating, the better is the sound separation.

Refer to A9.10.3.1 in the National Building Code for examples of STC ratings. See also Mechanical M8.2.10 and Electrical E4.2.3 of the GBP.

Recommendation**Rationale****A.5.2.4 Gypsum Board**

Gypsum board is the preferred wall finish in most northern buildings.

An industry standard providing good fire resistance and a smooth, easily repaired surface.

A.5.2.5 Plywood Backing

Gypsum board finishes should be backed by, or surfaced with, plywood in vestibules and washrooms. Consider plywood wainscoting in school corridors.

These areas are subject to damage (i.e., from doors or impact damage from users) that gypsum board cannot withstand.

A.5.2.6 Birch Plywood

An acceptable wall finish where durability is important. Use select grade for clear finish, or paint grade for a painted finish.

Provides a reasonably durable wall finish.

Typically used in gymnasiums, change rooms, lobbies and foyers to enhance wall appearance.

A.5.2.7 Wood Panelling

Tongue and groove board finish is acceptable. Wood veneer panelling should be limited to communities where skilled trades people are available.

Hardwood veneer panelling requires skilled finish carpenters to install and maintain it. Pre-finished vinyl veneer panelling should be avoided because it is difficult to repair if damaged, and difficult to match in replacement.

A.5.2.8 Prefinished Wallboard

Not recommended for use in northern public buildings.

Appearance and durability concerns; any damage requires replacement of entire panels.

A.5.2.9 Metal Wall Liner Panels

Where metal panels are used as an interior wall finish, such panels should be factory preformed steel sheet, zinc coated, prefinished on the exposed face. Thickness should be minimum 0.5 mm (26 gauge) base metal thickness, where not exposed to traffic and 0.6 mm (24 gauge) if within the reach of occupants.

Typically used with pre-engineered metal buildings for the interior finish of garages and fire halls. Lighter gauge material is easily dented and should only be used where there is no exposure to damage.

A.5.3 CEILINGS

Although generally inaccessible to occupants, ceilings do need to be able to withstand abuse in many circumstances (schools, gymnasiums, arenas, correctional facilities) and may be subject to periodic cleaning (health facilities, kitchens). The effects of ceiling heights, shapes and materials on acoustic and lighting design must also be considered.

Recommendation

Rationale

A.5.3.1 Drywall

Seamless construction such as Gypsum board is sometimes preferred, however in teaching areas consideration must be given to reverberation time making hearing difficult.

Industry standard but acoustics may prevent its use.

A.5.3.2 Exposed Roof Decks

An acceptable ceiling finish where tongue and groove board deck is used.

Typically used in gymnasiums and school classrooms but may be considered wherever roof assembly allows decking to be exposed and such a finish is appropriate. Does provide an acceptable degree of sound absorption.

A.5.3.3 T – Bar Suspension Grid

Suspended ceiling system recommended only where large ceiling areas need to be covered, and where the ceiling material does not provide part of the thermal, moisture or air barrier functions of the building envelope.

Acoustic units (lay-in tiles) can provide a practical finish concealing ducts and wiring and providing some sound absorption. They are mainly intended for ceilings where access to the plenum space above is routinely needed.

Avoid using suspended ceilings with lay-in boards in public use areas where the ceiling is less than 2.5 m high, or in areas that require frequent cleaning.

Susceptible to impact damage and very difficult to clean.

A.5.3.4 Textured Ceiling Finishes

Not recommended for use in northern buildings.

Easily damaged, and difficult to refinish.

A.5.3.5 Metal Ceiling Liner Panels

Where metal panels are used as an interior ceiling finish, panels should be factory preformed steel sheet, zinc coated, pre-finished on the exposed face.

Typically used with pre-engineered metal buildings as an interior finish for garages and fireballs.

Thickness should be minimum 0.5 mm (26 gauge) base metal thickness, where not exposed to traffic, and 0.6 mm (24 gauge) if within the reach of occupants.

Lighter gauge material is easily dented and should only be used where there is no exposure to damage.

A.5.4 PAINTING AND WALL COVERING

Recommendation

Rationale

A.5.4.1 Acrylic/latex Paints

Water-based, low or no VOC acrylic latex paints are preferred for use in northern buildings.

Environmental and health concerns have encouraged manufacturers to develop water-based paints that can now compete with oil-based paints for durability. Painting trades people are also beginning to stipulate the use of water-based products because of health concerns. Minimizing the availability of harmful products (including solvents) is also an important concern in many northern communities.

A.5.4.2 Alkyd Paints

Oil-based paints are not recommended for interior applications.

Most oil-based paints products can be replaced by an equivalent water-based paint product for the desired application.

Alkyd-based paints are more demanding in application and their use is hazardous to the health due to fumes. However, it is a product that can withstand freezing during shipping and storage.

A.5.4.3 Special Coatings

Special coatings are to be used only where they will be applied to a reinforced drywall, plywood or concrete surface. As noted above, water-based products are preferred.

The purpose of special coatings is generally to provide A/Very damage resistant finish, and so the substrate should be equally resistant.

A.5.4.4 Vinyl Wall Coverings (VWC)

Vinyl wall coverings recommended are for:

- Visible public areas where appearance is important and painted wall finishes would show wear quickly
- Areas where posters, notices, etc., will be affixed to walls

VWC provide a more durable surface than painted drywall. Tape or tacks can be used on vinyl wall surfaces with less visible damage than would occur on a painted surface. Although durable, vinyl wall coverings can be damaged by impact; they are expensive; installation requires more skill than painting. Although more difficult to clean, textured surfaces almost totally conceal tack marks.

Where used in high traffic areas, VWC could be installed so that the lower portion of the wall (up to about 1.2 m) can be replaced independently.

Advances in coating technology have resulted in durable spray-applied coatings to refinish vinyl wall coverings in place.

Recommendation**Rationale**

Avoid using vinyl wall coverings where frequent cleaning will be required, such as near wet areas and service counters.

A.5.4.5 Solid Surfacing

Solid surfacing is recommended for wall covering in visible public areas.

When budget permits, it is durable, non-porous, wear resistant, and allows flexibility in design. It is easy to maintain and can be sanded lightly to restore its surface. Its seamless and resistant surface is appropriate for health care and high traffic areas. Example of this type of product are, amongst others, Corian (by Dupont), Wilsonart (by Richelieu) or Formica Solid Surface

A.5.4.6 Ceramic Tiles

Generally, not recommended for use in northern buildings, unless it can be shown that the advantages of durability outweigh the disadvantages of high initial cost, cracking and debonding susceptibility, and problematic grout maintenance, in which case tiles may be proposed and considered.

Although it is recognized that ceramic tiles can be low maintenance, easy to clean, and very durable, capital costs are generally high in the North (especially due to transportation costs). There is also a high risk of breakage in transit, and flexible wood structures typical of most GN facilities do not provide the most stable substrate for ceramic tiles. Installation requires skilled trades people, and repairs require special attention by maintainers.

When tiles are appropriate, neutral colours should be selected and accent colours avoided.

Examples of where ceramic tiles may be appropriate would include specialized facilities such as laboratories or hospital operating rooms where applied over stable substrates. It has also been successfully used for wall protection in limited areas such as at classroom sinks and at urinals.

The tile finishes will outlast adjacent finishes, so they must be able to work with changes of decor and changing colour trends.

A.6 FINISH CARPENTRY

Finish carpentry requires specialized trades skills often scarce in northern communities. For this reason, as well as for cost considerations, the extent of finish carpentry in northern buildings is usually limited and plain: complex details are generally difficult to execute on remote buildings and should be avoided. AWMAC (Architectural Woodwork Manufacturers Association of Canada) Standards should be used as a quality benchmark for finish woodwork.

A.6.1 CABINETS AND SHELVING

Refer to AWMCA Quality Standards for Architectural Woodwork, Part 2 "Casework", Part 1 "Quality Grades and Material Standards", Part 5 "Factory Finishing", and Part 6 "Installation".

Recommendation

Rationale

A.6.1.1 Casework

Custom grade casework, including drawers, shelving, doors and edge banding as described in AWMAC Part 2.

AWMAC establishes only two grades: custom and premium. Premium would rarely be necessary or justifiable.

Cabinet Doors:

Plywood doors are acceptable if they do not exceed 450 mm (w) x 1200 mm (h) in size.

Large plywood doors often warp.

For larger doors: Hollow core doors or composite boards are both acceptable.

A.6.1.2 Clear Finish

1. Materials

Where a clear finish is to be used, birch veneer hardwood plywood is preferred. To be Select White or Red, as described in AWMAC Part 1, Section 8.

Reasonable appearance and cost.

2. Matching

Book matching is preferred. Slip matching is acceptable. Random matching is not acceptable.

A.6.1.3 Paint Finish

Where a paint finish is to be used, paint grade plywood, as described in AWMAC Part 1, Section 8, is acceptable.

Where a smooth surface is important, but wood grain appearance is not.

Recommendation**Rationale****A.6.1.4 Hardware**

Finish:

- Brushed metal or plastic coated preferred

Good quality, durable and simple hardware is best suited to public use buildings, where long life is expected.

Cabinet hinges:

- Concealed 180-degree hinges preferred

Drawer glides:

- Ball bearing type preferred

Cabinet door and drawer pulls:

- Simple design preferred

A.6.1.5 Shelving

The use of pre-manufactured shelving systems is preferred to custom millwork for most northern buildings, particularly in libraries, resource centres and storage rooms. Metal storage shelving should be considered as an alternative to built-in shelving where appearance is not critical.

Pre-manufactured shelving is generally less expensive than custom millwork and provides users with more flexible furnishings.

1. Supports

Generally, to be supported on metal standards for adjustable shelf brackets.

To give users some flexibility.

2. Materials and Finishes

- Clear finish birch plywood or plastic laminate finish complete with hardwood edge banding is preferred in all public or visible locations.
- Tempered glass shelving should be limited to display cabinets.
- Factory painted metal shelves are preferable for storage rooms or low visibility locations. Melamine or painted wood shelves are acceptable.

Visible shelving is typically required in schools, community offices, health care centres and public reception areas.

Display shelving is used in a limited application in schools and community centres, but would more often be found in visitor centres, cultural centres or museums. Because glass needs to be kept very clean, and may be subject to breakage, its use may be minimized.

Less expensive alternatives to clear finished wood where appearances are not as important. Typically, acceptable for storage rooms, garages, fire halls or seasonal use buildings.

NOTE:

Special attention must be paid to ensure acclimatizing of wood prior to installation, because of the extremely dry climate in the North.

A.6.2 COUNTER TOPS

These can be a major visual element in rooms, making the choice of colours and patterns important. Refer to AWMAC, Part 1, Section 11 and Part 2, Section 7.

Recommendation**Rationale****A.6.2.1 Counter Tops**

Self-edge type, with back splash and side splash sections site installed and sealed using transparent silicone sealant. Hardwood edge may be appropriate in some applications.

Avoid the use of post-formed laminate counter tops with integral back or side splashes.

Experience has shown that post-formed counter tops are often damaged in transit; and exposed edges at nosing/overhangs are easily chipped.

A.6.2.2 Plastic Laminate

General-purpose grade, complete with backing sheets, velour or suede finish. Texture patterns preferred in all high-use areas. Solid colours acceptable only in low-use areas. Generally, avoid using wood grain laminate patterns.

Typical high-use areas include kitchens and washrooms of all public use or residential buildings. Library counters, visitor center information counters and classrooms. Low-use areas, where solid colours are acceptable, would typically include office reception counters, courtrooms. Seasonal-use buildings and staff washrooms. Wood grain patterns are difficult to repair and match for replacement.

A.6.2.3 Chemical Resistance

Where chemical resistance is required, laboratory grade plastic laminate should be used.

Typically required in school science labs, health centres, labs and film development rooms, and DSD labs.

A.6.2.4 Solid Surfacing

Solid surface is an interesting material for counter tops.

When budget permits, it is durable, non-porous and wear resistant. It is easy to maintain and can be sanded lightly to restore its surface. Example of this type of product are, amongst others, Corian (by Dupont), Wilsonart (by Richelieu) or Formica Solid Surface.

A.6.3 MISCELLANEOUS FINISH CARPENTRY

Refer to AWMAC Part 1 "Quality Grades and Material Standards", Part 4 "Frames, Panelling and Specialties", and Part 6 "Installation".

Recommendation

Rationale

A.6.3.1 Grade

Custom grade as described in Part 4, AWMAC standards.

Birch and oak are hard enough to withstand scratching or denting, whereas pine is soft and susceptible to damage from everyday activities.

Recommend clear birch or oak throughout. Avoid pine. Consider using American Poplar as an option for paint grade trim. It has very few knots, machines well, is A/Very stable and durable wood, and accepts paint very well with virtually no knots or sap bleeding through. It is generally less expensive than softwood, and as tough as hardwood. It must be painted as its natural color varies from yellow to green to a purplish color.

A.6.3.2 Coat Racks

Ensure spacing and size of pegs are adequate for heavy winter parkas, coveralls etc. Pegs should be nominal 25mm diameter with rounded ends and mechanically anchored.

Typically provided in schools, community offices and group homes.

Parka hooks in school corridors should be installed with a protective shelf to help prevent head height injuries.

Wood dowel coat hooks mounted at child access heights can present an eye injury hazard.

A.6.3.3 Radiation Covers

Pre-manufactured metal radiation cabinets are preferred for most public buildings: wood cabinets/covers are acceptable only for special use public buildings if a simple means of removing sections to allow cleaning of fins and access to valves is provided: covers that require dismantling of millwork to access valves are not acceptable. Wood radiation cabinets/covers are not recommended for use in high use facilities such as arenas and schools.

Higher initial cost than standard metal cabinets. The design of wood cabinets in past installations has made it impossible to clean the fins without dismantling woodwork. Experience shows that a lot of garbage and debris is dropped into radiation cabinets making ready access for cleaning essential.

A.7 SPECIALTIES

A.7.1 WASHROOM ACCESSORIES

Durability and damage resistance are important because washroom accessories are often subject to abuse. Including scratched or applied graffiti. Accessories should normally be surface-mounted or freestanding for ease of installation. However, Recessed accessories may be considered in small washrooms where reduced volumes are adequate.

Recommendation

Rationale

A.7.1.1 Shower Surrounds

Glass fibre, reinforced acrylic moulded units, or PVC units are preferred. Integral grab-bar system or the ability to attach standard grab bars is recommended.

Pre-moulded units are easily cleaned, easy to install, and provide a durable surface.

The thresholds in handicapped access manufactured units exceed NBC allowable height. Unless the floor system allows the stall to be recessed, a ramp integrated with the non-slip vinyl floor finish is recommended. Avoid using ceramic tiles or prefinished panel materials requiring jointing on site.

PVC is more difficult to clean than acrylic and typically has a shorter service life.

A.7.1.2 Washroom Accessories

Preferred washroom accessories manufactured by:

- Bobrick
- Twin Cee
- Frost Metal
- Watrous Sales

These brands have proven to be an acceptable standard for public buildings.

A.7.1.3 Backing

Backing must be installed for all furniture. Equipment and hardware to be mounted on walls.

Secure, safe and vandal-resistant installation.

A.7.2 SIGNAGE

A sign section was developed and added to the Visual Identity Guideline for the GN and approved by the Department of Executive and Intergovernmental Affairs. It should be used where applicable. The following recommendations are based on the GN Visual Identity Guideline and best practice based on historical information.

Recommendation

Rationale

A.7.2.1 Language

Signs provided to help user and visitor orientation should be integrated signs in all Official Languages of Nunavut and international graphic symbols as appropriate

All languages should be displayed as described in section 4.0 (Official Languages) of the Visual Identity Guideline.

A.7.2.2 Exterior Signs

Sign material and installation method should be selected on a site-specific basis as per the Visual Identity Guideline. Signs must be visible, functional, durable and aesthetically pleasing

Exterior signs should conform to section 4.1 (Primary Identification Signs) of the GN Visual Identity Guideline for the purpose of consistency.

A.7.2.3 Interior

1. Name Plates

Material consistent with that used on directory boards should be used.

Name Plates should conform to section 4.2 (Directory Boards) of the GN Visual Identity Guideline for the purpose of consistency.

Colours can be coordinated with building interiors.

2. Directory Boards

Sign material and installation method should be consistent with the Visual Identity Guideline.

Directory Boards should conform to section 4.2 (Directory Boards) of the GN Visual Identity Guideline for the purpose of consistency.

A.7.2.4 Regulatory, Warning and Information Signs

Regulatory, Warning and Information Signs should be implemented as per CAN-CSA-Z321 (Signs and Symbols for Occupational Environments) and ISO7001 (Public Information Symbols).

All signs of this nature should be installed as required in the interest of safety.

Evacuation Plans and Evacuation Layouts are required in all buildings.

Standards for Evacuation Plans and Evacuation Layouts are available from the Government of Nunavut and should be included in specifications.

A.7.3 WINDOW COVERING

Window coverings are commonly included in construction contracts rather than with furnishings. Blinds and blackout curtains can be used to control day lighting admitted into rooms in public use buildings; in residential applications, curtains and blinds are provided both to control outdoor lighting and for privacy considerations. Daylight control is particularly important during the summer months when most northern communities experience 18 to 24 hours of daylight for 4 months of the year. Bedrooms in residential facilities need to be able to be darkened effectively with curtains or blinds provided, as well as any rooms where photographic slides or other projected images may be used.

Recommendation

Rationale

A.7.3.1 Draperies

Should be machine washable.

Dry cleaning is not available in most northern communities.

A.7.3.2 Blinds

Adjustable vertical blinds are preferred. Perforated plastic (non-toxic) or metal blinds are preferred.

Note that vertical blinds may require stacking room beyond the window opening to access opening vents.

Roll down blinds with operating chains and end tracks are also acceptable in supervised locations.

Vertical blinds do not collect dust as readily as horizontal blinds. Plastic or metal are simple to clean as compared to fabric blinds.

Horizontal blinds are acceptable.

Solar shades or room darkening shades can be used for daylight control.

Solar shades or room darkening shades are a practical way to control natural light within a reasonable budget. They should be considered in specific locations such as hospital rooms or air terminal observation decks.

Avoid using fabric blinds unless the fabric is easily cleanable.

Some fabric blinds have tightly woven smooth textured surfaces allowing vacuum cleaning.

Caution: *Some flame-retardant treatments can be washed out through cleaning. Selection of fabrics must take this into account.*

A.7.4 APPLIANCES

Built-in appliances are commonly included in construction contracts rather than with furnishings.

Recommendation**Rationale****A.7.4.1 Kitchen Appliances**

Preferred manufacturer of stoves, fridges, freezers and other kitchen appliances should be confirmed with local building/asset management agencies. Standard sizes and energy efficient models should be selected.

The objective is to simplify the number of parts stocked, so maintainers can become familiar with repairs.

A.7.4.2 Laundry Equipment

Preferred manufacturer of washing machines, dryers or other laundry equipment should be confirmed with local building/asset management agencies. Standard sizes and energy efficient models should be selected.

The objective is to simplify the number of parts stocked, so maintainers can become familiar with repairs.

A.8 COORDINATION

This section highlights structural, mechanical, electrical, or site considerations that are particularly affected by, or affect, architectural design.

A.8.1 MECHANICAL EQUIPMENT

Recommendation

Rationale

A.8.1.1 Space Requirements

Adequate space should be provided in mechanical rooms for plumbing, heating and ventilation equipment, including required clearances and access for maintenance. See notes in Mechanical Section.

Cramped mechanical rooms with minimal clearances and inadequate access for maintenance have been a common shortcoming of northern building designs.

Space in wall and floor assemblies is often required to accommodate plumbing and ducts. Great care must be taken that these spaces do not interrupt the continuity of the building envelope.

Providing adequate space can be problematic where long plumbing runs are required, and structural floor space is limited.

A.8.1.2 Location

The location of mechanical equipment, grilles and louvers, and servicing points must consider effect on equipment performance and be coordinated with structural systems and architectural finishes.

The location of equipment should satisfy both requirements: giving one consideration priority over the other is unacceptable.

A.8.1.3 Access

Control and maintenance of heating and ventilation system requires access to controls and equipment. Access panels may need to be provided in ceilings and walls.

Fairly frequent access is required, especially when building is newly occupied, and operator is becoming familiar with system.

A.8.1.4 Windows

Heat gain and heat loss through windows must be taken into consideration by heating and ventilation system designers.

Changes to architectural design may not necessarily be passed on to mechanical consultants. When ventilation systems cannot manage heat gains, the facility can become very uncomfortable for occupants.

A.8.2 ELECTRICAL EQUIPMENT**Recommendation****Rationale****A.8.2.1 Space Requirements**

Adequate space is required for electrical equipment, including required clearances and access for maintenance. This may require coordination with mechanical design. See Electrical Section.

Cramped electrical/mechanical rooms with minimal clearances and inadequate access for maintenance have been a common shortcoming of GN building designs.

A.8.2.2 Access

Pull and junction boxes need to be accessible in the event electrical changes are required.

Although access is not frequently required, lack of access means that ceilings and walls will have to be patched any time they must be accessed. Designers should observe electrical section of this publication and the Canadian Electrical Code requirements.

A.8.2.3 Electrical Outlets

Outlets located on exterior walls, roofs and floors, and conductors that run through the building envelope must be positioned so that they do not interrupt the continuity of the building envelope, or they must be efficiently sealed.

A.8.3 LIGHTING DESIGN**Recommendation****Rationale**

Fixture locations need to be coordinated with structural and mechanical elements.

The objective is to avoid the need for on-site changes and to prevent lighting obstructions.

Fixture styles should be coordinated with decorative or architectural themes.

Fixtures should be selected collaboratively by the electrical designer and the architectural designer.

Day lighting zones and electrical lighting zones should be coordinated.

Adequate daylight can make electric lighting redundant at times; however, energy savings can only be realized if electric lighting can be selectively turned off when not required.

A.8.4 RECESSING OF FITTINGS**Recommendation**

Where risk of injury to persons exists because fittings, hardware, or similar items are mounted within two metres of the floor level, such fittings on walls shall be recessed.

Rationale

The intent is to prevent bodily harm to persons and/or damage to equipment. Typical locations where this is important are school gymnasiums and other sport activity rooms.

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CHAPTER S - STRUCTURAL

INTRODUCTION

Structural design of northern buildings must encompass several conditions not typically found in the rest of Canada. Permafrost is the most significant geophysical factor, however, strategic factors due to climate and location play an even greater part. Equally significant are the wind loads in Nunavut. Seismic loads are negligible in some areas of Nunavut and more significant in others. Transportation costs can constitute a large portion of overall project costs. Size restrictions apply such as weight and volume and should be minimized for sealift, barge or air freight. Providing designs that encourage local labour and use and develop construction skills is an important long-range strategy for lowering northern construction labour costs.

A short construction season demands structures that can be erected quickly so buildings can be closed in before winter. Simple wood frame construction has been found to satisfy most northern building conditions. Pre-engineered metal buildings are common because steel framing also satisfies many northern building conditions. Structural concrete is seldom used because of difficulty with quality control, climate and the higher cost of winter hoarding, materials, freight cost, variable aggregate resources and lack of batch plants in small communities. However, as trade skills, materials, batching plants and roads all become more readily available, structural concrete will become more economical.

S.1 CODES, STANDARDS AND REGULATIONS

- National Building Code of Canada
- Consolidation of Engineers and Geoscientists Act - Nunavut, NAPEG
- *CSA S500:14 - Thermosyphon foundations for buildings in permafrost regions*
- *CSA S501:14 - Moderating the effects of permafrost degradation on existing building foundations*
- *CSA S502:14 - Managing changing snow load risks for buildings in Canada's north*
- *CSA Plus 4011:19 - Technical guide: Infrastructure in permafrost: A guideline for climate change adaptation*
- *CSA Plus 4011.1:19 - Technical guide: Design and construction considerations for foundations in permafrost regions.*
- *BNQ 2501:500 - Geotechnical site investigation for building foundations in permafrost zones*

S.2 LOGISTICS

S.2.1 TRANSPORTATION AND HAND

Equipment available to move materials is often limited in small communities. Suitable local equipment may be required for other essential uses around the community, so work must be scheduled carefully. In larger communities this may be less problematic, but it is important to know what equipment will be available in the community before design starts. All components should be sized small enough and light enough so they can be moved to the site and erected with available equipment. Getting materials to the building site at the right time can be more difficult in communities served by annual sealift or summer barge, or only by winter roads.

S.2.2 SCHEDULE

The construction season is much shorter in the North than elsewhere in Canada. Closing buildings in before severe winter conditions set in is critical. Structural work must proceed quickly and smoothly; extra care must be taken to ensure it is also completed correctly in one operation. Material delivery schedules and

seasonal soil conditions generally determine optimum foundation work schedules. Variables include the transportation system to be used (barge, sealift, air, all weather road or winter road) and the foundation system selected (piles, shallow footings, buried footings or slab). Site preparation may be performed a year in advance to permit consolidation of placed fill. Foundation work can be installed in advance of the superstructure to meet delivery or other scheduling constraints. This is particularly appropriate with foundation designs that are not affected by their remaining in place without the superstructure load in place.

S.2.3 STANDARDIZATION

The size and type of structural elements used in a building should be standardized. This may help decrease waste and will simplify erection procedures, reducing erection time and complexity. Whenever possible. Simplify detailed design and minimize the number of operations required to install components. Simple details are likely to bring about a better building.

S.2.4 GREEN BUILDING PRODUCTS

Use Green Building Products that comply with Canadian standards and resource materials endorsed by the Canadian Green Building Council. Green materials are products of environmentally-friendly, energy-efficient and resource-efficient technology.

S.3 FOUNDATIONS

Historical climatic patterns are no longer reliable predictors for future climatic patterns. The ground temperature regime influences differential settlement, frost heaves and frost jacking. Mean annual ground temperatures are reflected directly by the mean annual air temperatures. Thus, the geotechnical report at each location should emphasize current climatic conditions. Refer to *BNQ 2501:500 - Geotechnical site investigation for building foundations in permafrost zones*.

Permafrost soils often have high water content and, as a result, remain stable only when frozen. As noted in the *National Building Code*, foundation design for permafrost soils requires the services of "a person especially qualified in that field of work". Geotechnical investigations should be undertaken as soon as a site is identified, and well in advance of design.

Foundation systems for most northern buildings are designed for typically light structural loads, recognizing the limits imposed by partially or permanently frozen soils. Refer to *CSA Plus 4011.1:19 - Technical guide: Design and construction considerations for foundations in permafrost regions*.

Buildings are typically raised above grade to protect the permafrost from deterioration caused by building heat loss. Thermosyphons have also been installed in a number of northern buildings to maintain permafrost, while allowing buildings to be set on grade. Basements are practical only in locations where well-drained soil is free of permafrost, or where bedrock is near enough to the surface to be used for bearing.

S.3.1 PILES

Steel pipe piles have become one of the most common foundation systems used in the North. Considered one of the most stable and low maintenance systems, piles also allow the heated building envelope to be raised above frozen ground, which can decrease the build-up of drifting snow at the base of the building. Wherever possible, piles are socketed into bedrock, but in areas of permafrost, piles can be supported by the frozen soil. Developments in the use of "ad freeze" piles have included adding welded rings to increase bearing capacity. Saline permafrost found near the sea shoreline has different bearing characteristics than

freshwater permafrost and must be treated differently. Increased salinity decreases the strength of the permafrost and increases the deformation of foundations in permafrost. Saline permafrost is widely distributed beneath coastal communities in Nunavut. Scheduling of piling work has to take into consideration the availability of materials and equipment in the community, as well as seasonal soil conditions that might impede construction. It is best if piles are installed while soils are frozen and before early summer, so that the site will bear the traffic of equipment, bored holes will be less prone to sloughing, and foundations are ready for a construction start in the summer or fall (particularly when materials arrive by sealift in July or August).

Recommendation

Rationale

S.3.1.1 Site Preparation

Avoid cutting into existing slopes to accommodate building foundations where permafrost is present.

Permafrost soils with high water content can melt and/or lose bearing capacity when the insulating top cover is removed. Very wet permafrost soils may even flow when they thaw. Any modification of the terrain must carefully address the effect it will have on the natural balance of the site.

S.3.1.2 Piles Types

1. Steel Pipe Piles

Most commonly used and preferred pile system. Installed as recommended by Structural Engineers: driven to refusal; drilled and frozen in place with slurry or grout; or socketed to bedrock.

Equipment and expertise are readily available, and experience has proven steel pipe piles perform satisfactorily in most cases.

2. Wood Piles

Non-existent in new construction.

3. Concrete Piles

Not recommended

Concrete piles are seldom used because it is difficult to assure adequate concrete quality in most northern communities, and because of the problems related to casting concrete in frozen ground.

S.3.1.3 Active Layer Bond Breakers

Polyethylene sheets coated with heavy grease or heat shrink sleeve should be provided as a bond breaker on all surfaces of steel piles that reside in the active layer. This is true for all steel piles, whether adfreeze or pinned to bedrock.

Seasonal freezing of the active layer, as deep as 3 metres in some areas of the North, can subject piles to considerable uplift force as the active layer freezes. The dead load of a typical one or two storey building is not adequate to counteract uplift force, so bond breakers are usually used to keep the ice from adhering to and lifting the steel piles. Although bond breakers can initially reduce forces acting on piles by as much as 75%, the long-term performance of grease or poly wrap is not known.

Recommendation**Rationale****S.3.1.4 Piles Caps**

Adjustable pile caps are recommended for use wherever piles cannot be pinned to bedrock and in soils that expand dramatically during freezing and thawing such as silts, clays and fine sands.

There is always a potential for pile movement because underground soil characteristics can change, or long-term creep of ad freeze piles can occur. Adjustable pile caps permit levelling of differential settlement.

S.3.1.5 Grade Beams

If used in conjunction with piles, water-resistant void form is required below grade beams to allow the ground to move without pushing the grade beam up.

Void form creates a cushion between the soil and the underside of a grade beam. When frost expands the soil, the void form is compressed, absorbing forces that could otherwise lift the structure. Closed cell foam materials are recommended as they re-expand to maintain the void and do not readily absorb water.

S.3.1.6 Multipoint Foundation Frames

Multipoint foundation frames are structurally sound and an affordable alternative that has been successfully used in problematic regions, i.e., any terrain including unstable soil and permafrost. It provides solid solutions for areas that experience shifting and changing terrain. It is a support system for one- and two-storey buildings.

S.3.1.7 Monitoring Performance

As permitted by the owner, install equipment to measure, record, verify and report foundation settlement rates for research purposes to benefit the academic and design communities.

Information gathered on the performance of pile and thermosyphon foundations is valuable to the design and academic communities.

S.3.2 SHALLOW FOOTINGS

Shallow footings are generally constructed on gravel pads or a layer of suitable sandy soil in the North. The pad must be designed with adequate thickness to protect the thermal equilibrium of the frozen ground and mitigate against the thawing of the underlying permafrost. In moisture or ice rich soils, thermosyphons are to be installed to maintain the frozen soil beneath the footing. Consideration should be given to constructing shallow foundations in the fall in order to allow the cold winter temperatures to freeze the disturbed subsoil area. Adequate diversion of surface runoff water away from the building is essential for long-term stability on this type of foundation.

Recommendation**Rationale****S.3.2.1 Site Preparation**

1. Avoid cutting into existing slopes to accommodate building foundations where permafrost is present.

Permafrost soils with high water content can melt and/or lose bearing capacity when the insulating top cover is removed. Very wet permafrost soils may even flow when they thaw. Any modification of the terrain must carefully address the effect it will have on the natural balance of the site.

Recommendation**Rationale****S.3.2.2 Granular Pads**

Where granular pads are installed as a part of a foundation system on a sloping site or a site susceptible to ponding or surface water accumulation, consider using an impermeable geosynthetic liner to divert surface water from the foundation.

Surface water and freeze-thaw will consolidate and heave granular materials. The objective is to divert water around the pad, rather than allow it to seep under or through it, and potentially degrade permafrost or form ice lenses that may cause frost heaving.

S.3.2.3 Footing (Preserved Wood Foundations)

Generally, in Nunavut shallow foundations such as footings are pressure preservative treated wood pads installed on grade on gravel pads. Concrete is acceptable where quality of concrete can be assured; precast concrete is recommended.

Wood can be easily shipped and assembled and can also be easily adjusted on site to line up with column grid lines.

Wood preservation treatment must comply with CSA O80.15, "Pressure Treatment of Wood for Building Foundation Systems, Basements and Crawl Spaces by Pressure Processes".

S.3.2.4 Adjustment

Pressure preservative treated wood pads are used in combination with adjustable wedges (shims) or screw jacks. The wedges are also preserved wood. An allowance of 100 mm to 150 mm of vertical adjustment is recommended. A minimum clear height of 600 mm must be available for maintenance.

Annual height adjustment should be anticipated, and adequate clearance is essential for workers who may be under the building for several hours at a time.

S.3.2.5 Thermosyphon Foundation System (Thermosyphons)

Wherever thermosyphons are installed as part of the foundation system.

Refer to CSA S500:14 – *Thermosyphon foundations for buildings in permafrost regions*.

The design, construction and monitoring of thermosyphon systems are not covered in the Canadian national codes and regulations. Empirical evidence indicates, however, that satisfactory performance is predicated on avoidance of such factors as: a) poor design/construction of the granular pads on which the thermosyphon evaporator pipes are founded, b) inadequate construction details, poor construction scheduling, and c) inadequate insulation design.

- The cooling medium should be a material that, if leaked below the foundation, will not degrade the permafrost or cause other environmental long-term effects.
- The system should allow for loops to be isolated.

The objective is to prevent accumulation of persisting chemicals in the sub base below a building where their presence may interfere with maintaining the permafrost.

The objective is to isolate failed thermosyphons from functioning units.

Recommendation**Rationale**

- Radiators must be protected from damage by vehicles and be situated away from warm air exhaust vents.
- Thermistors and temperature reading equipment should be permanently installed as part of the foundation system.

The objective is to ensure that equipment is available to allow building operators to regularly monitor the operation of the thermosyphons as outlined in the "Maintenance Management System (MMS) Manual."

S.3.3 BURIED FOOTINGS

Buried footings are typically used in conjunction with a granular pad in areas of permafrost. Because the footings are installed bearing on frozen soil, work must be scheduled so that it does not result in melting or softening of frozen materials beneath footings. In Nunavut the most common type is spread footings (posts and pads) generally constructed in shallow excavations in the granular pad. Posts and pad design for light structures typically include an air space between the main floor and gravel pad in areas of permafrost. Footing and pier/pilaster design for larger buildings should extend below the level of deepest thaw or freeze penetration. Provide for air circulation to avoid heat loss through the floor of the building.

Recommendation**Rationale****S.3.3.1 Site Preparation**

Avoid cutting into existing slopes to accommodate building foundations where permafrost is present.

Permafrost soils with high water content can melt and/or lose bearing capacity when the insulating top cover is removed. Very wet permafrost soils may even flow when they thaw. Any modification of the terrain must carefully address the effect it will have on the natural balance of the site.

S.3.3.2 Granular Pads

Refer to S3.2.2 and L4.1.1 "Built-up Granular Pads"

S.3.3.3 Active Layer Bond Breakers

Polyethylene sheets coated with heavy grease should be provided as a bond breaker on all surfaces of piers that pass through the active layer.

The objective is to minimize uplift forces on the pier that may be caused by seasonal freezing and expansion of the soil in the active layer.

S.3.3.4 Footings

Pressure preservative treated wood pads are rarely used as buried footings in Nunavut, but preferred, if applicable. Concrete is acceptable only where the quality of the concrete can be assured.

Wood can be easily shipped and assembled and can also be easily adjusted on site to line up with column grid lines.

S.3.3.5 Adjustment

Where adjustable wedges or screw jacks are used in conjunction with a shallow buried spread footing, an allowance of 100 mm to 150 mm of vertical

Annual height adjustment should be anticipated, and adequate clearance is essential for workers who may be under the building for several hours at a time.

Recommendation**Rationale**

adjustment is recommended. A minimum clear height of 600 mm must be available for maintenance.

S.3.3.6 Thermosyphon Foundation System

Refer to Section S 3.2.5.

S.3.4 STRUCTURAL SLABS

Concrete slabs would seem an ideal choice for many buildings such as garages, fire halls or warehouses given that they act both as a foundation system and provide a durable, smooth floor surface. Problems caused by heat transferring from the building to underlying frozen soils must be overcome or the slab will fail in a time. Extreme care is required during the installation of the heat removal systems beneath the concrete: once the slab is in place, inspections and repairs become difficult.

Recommendation**Rationale****S.3.4.1 Site Preparation**

Avoid cutting into existing slopes to accommodate building foundations where permafrost is present.

Permafrost soils with high water content can melt and/or lose bearing capacity when the insulating top cover is removed. Very wet permafrost soils may even flow when they thaw. Any modification of the terrain must carefully address the effect it will have on the natural balance of the site.

S.3.4.2 Ventilated Slabs**1. Natural Ventilation**

Naturally ventilated slab foundations are not recommended.

Ventilation can easily fail if ventilators are blocked by snow or fill with water. This will result in a detrimental heat transfer from the building to the underlying permafrost.

2. Mechanical Ventilation

Mechanically ventilated slab foundations are not preferred.

Similar problems as for natural ventilation systems, with added risk of mechanical failures and increased maintenance requirements, and higher initial cost.

S.3.4.3 Thermosyphon Foundation System

Refer to Section S 3.2.5.

S.4 WOOD STRUCTURES

Due to their versatility and general availability, conventional wood frame structures are appropriate for many northern conditions. Wood materials have a high strength-to-weight ratio, are more compact and less susceptible to damage in transit than some prefabricated assemblies.

Timber frame structures: are undergoing a resurgence and may appear in the North in due course. The insulating skin is separated from the timber frame resulting in an efficient energy conserving structure. Using rigid foam panels, the timber frame can now be completely wrapped with a blanket of insulation without interrupting the insulation with the frame as in conventional wood frame construction.

Structural Insulated Panels (SIP): are factory laminated sandwich panels with oriented strand board or plywood face materials and an expanded polystyrene (EPS) core. The panels are roof, wall and floor panels used as the structural frame and facing of a building when resisting transverse, racking and axial compressive loads. The panels are also used to field fabricate wall opening headers. SIP's produce a tight, well-insulated shell that takes less labour to construct than an equivalent stick-framed building.

S.4.1 FLOORS

The structural requirements of floors in the North are no different than requirements elsewhere in the country, except that special attention must be paid to coordination of structure with the building envelope and mechanical systems: floor assemblies must often accommodate thick thermal insulation, plumbing runs and ventilation ducts.

Recommendation

Rationale

S.4.1.1 Joists

Consider using plywood web joists, tube web wood joists or light wood trusses in place of dimensional lumber greater than 210 mm depth.

Engineered joists provide improved strength-to-weight ratio, thereby reducing shipping costs, and are less prone to shrinkage than dimensional lumber. Engineered joists and trusses can also accommodate increased spans and may require fewer lines of foundation bearing.

S.4.2 WALLS

There are no design practices unique to northern environments when it comes to structural systems for walls. Although wind pressures can be very high, especially in the central and high arctic, they are similar to those experienced in other parts of Canada. The structure must be coordinated with the building envelope design to ensure adequate space is provided for insulation, and that elements such as sheathing, and blocking are located to benefit both structural and envelope design. Special attention must be paid to the structural support of air barriers, particularly at building corners where wind loading is greatest.

S.4.3 ROOFS

Structural systems for roofs of northern buildings require no unique design considerations that are not found in other parts of Canada. Wind pressures can be very high, especially in the central and high arctic. Transient loads from snow accumulation typically are lower in most parts of the North than in mountainous regions of Canada. The roof structure must be coordinated with building envelope design to ensure ventilation, air barrier and vapour barrier functions are satisfied, and particularly since high air humidity and moisture levels will cause rapid deterioration of wood structural members. When insulation systems are installed above the primary deck, fastening systems must be designed to resist the wind uplift forces acting upon the insulation and roof finish.

S.4.3.1 Roof Slope – Refer to Section A 3.6.

S.5 STEEL STRUCTURES

Steel is the material of choice for industrial, commercial and institutional (ICI) buildings in Nunavut. The building system utilizes rigid frames (common in metal building systems) or columns and beams (in conventional steel construction) as the primary structural elements. Metal Building Systems (also known as pre-engineered/prefabricated steel frame buildings) are common in the North. Some popular types of rigid primary frames are: tapered beam system; single-span rigid frame; multipin rigid frame and single span truss. The many different types and number of distributors have made prefabricated metal buildings competitive and an option worth considering for certain types of buildings. These include garages, fire halls, arenas and warehouses, which are all buildings with fairly simple spatial requirements, easily defined and require large open spaces. Conventional and custom steel structures may be appropriate for larger non-combustible buildings. Structural sheet steel products such as roof deck, floor deck and cladding complement the structural steel primary frame of a building. These large-surface elements often perform both structural and non-structural functions, thereby enhancing the overall economy of the design. Before deciding to use a steel structure, the designer must be satisfied that equipment is available in the community to move and lift components into place, that shipping costs are reasonable in comparison to wood systems, and that local labour and businesses can provide resources. Bolted connections are preferable to extensive specialized field welding.

Not well known in the North yet is Lightweight Steel Framing (LSF) from coated sheet steel products. Cold-formed sheet steel is an easy to handle, economical, non-combustible, high quality alternative to more traditional framing materials. Lightweight Steel Framing offers a strong, accurate, dimensionally stable and durable framing system. LSF alone can provide all the necessary structural elements or it can be used in combination with other materials for greater building diversity and scope. Lightweight Steel Framing is an increasing popular choice in structures such as schools, assisted care residences and office buildings.

S.5.1 FLOORS

No special structural requirements. See recommendations of S4. Of interest as well, composite deck is made of fluted steel sheets supporting a concrete slab. The composite deck initially acts as a stay-in-place form for the concrete floor slab. After the concrete cures the composite steel deck and the concrete interlock creating a composite slab. This interlocking is achieved through a system of embossments rolled into the webs and flutes of the deck.

A deep composite deck is a similar product to the regular composite deck but is up to 203 mm deep. This deeper section, combined with additional reinforcing steel and concrete, creates a floor system that can achieve spans over 9 m. The long spans provide additional flexibility and efficiencies in the structural framing system.

S.5.2 WALLS

No special structural requirements. See recommendations of S4. The wide variety of cladding profiles, paint systems and colours provides for complete architectural expression. Sheet steel can also be integrated with other building materials for added variety. Sheet steel wall assemblies are a durable and economical solution. The cavity can be sized to accommodate as much thermal insulation as required while maintaining the integrity of the building enclosure.

Insulated metal panels are designed to creatively meet diverse wall applications because these wall panels are made up of controlled polyisocyanurate foam insulation sandwiched between prefinished sheet steel exterior and interior sheets. The combination of polyurethane foam and steel facings results in a light, attractive and easy-to-install structural panel with exceptional insulating characteristics. Panels are also available with mineral wool insulation that is suited to buildings that require fire-rated walls.

S.5.3 ROOFS

No special structural requirements. See recommendations of S4. Fluted steel sheets are used in the construction of a roof as the supporting structural member on which the built-up roofing system is placed. Roof deck is most commonly used in a flat (horizontal) roofing configuration but can also be used for sloping roofs. The in-plane strength of the deck can also be utilized as a steel deck diaphragm to act as the horizontal bracing for the structure, often eliminating the need for discrete bracing.

S.5.4 PERMANENT ROOF ANCHOR SYSTEM

Design and install permanent roof anchor systems on all new buildings for compliance with both applicable CSA Standards and the Occupational Health and Safety Regulations of the Workers Safety and Compensation Commission of Nunavut. Upon completion of a new building, alterations/renovations or repairs to existing roofs, the Consultant/Contractor shall forward the roof anchor *Installation Sign-off*, the *Roof Anchor Manual*, and the *Roof Anchor Plan* to the Owner as part of the Building Maintenance Manual.

Relevant Standards:

- *CSA Standard Z259.15, Anchorage Connectors (Under Development)*
- *CSA Standard Z259.16-04 Design of Active Fall-protection Systems*
- *CSA Standard CAN/CSA-Z271, Safety Code for Suspended Elevating Platforms*
- *CSA Standard Z91-02, Health and Safety Code for Suspended Equipment Operations*

S.6 CONCRETE

The use of concrete is challenging in the Canadian North because granular materials, mixing equipment and testing facilities are not available in many communities. Unstable soil conditions and a limited construction season can also make using concrete problematic as a structural material. In communities where ready-mix concrete is available, or where very small quantities are required so as to make hand batching feasible, concrete may be considered for some structural elements. Typically, this is limited to foundation elements, which are covered in Section S3 above.

S.6.1 FLOORS

S.6.1.1 Slabs - Refer to S 3.4 "Structural Slabs" and S 5.1 "Floors" for composite floors.

S.6.2 WALLS

Concrete walls are not recommended for use except where no other assembly can be used to meet NBC requirements, or where it can be shown that concrete would be the most economical choice. Precast concrete panels as wall finish, concrete tilt-up construction and concrete masonry walls are recommended where geotechnical conditions result in suitable foundations and transportation costs are reasonable.

S.6.3 ROOFS

Concrete roofs are not recommended, except where no other assembly can be used to meet NBC requirements, or where it can be shown that concrete would be most economical choice.

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CHAPTER M - MECHANICAL

INTRODUCTION

People have come to expect a closely controlled, comfortable indoor environment and ample supplies of hot and cold running water in the buildings where they live and work. At the same time high energy costs have resulted in the need to make efficient use of energy. These two factors have led to the use of increasingly sophisticated mechanical systems, particularly with respect to heating and ventilation. However, in the Arctic, operation and maintenance of sophisticated mechanical systems can be difficult as qualified or experienced trades people are not always available in small communities, and response time can be slow if someone has to be brought in.

For this reason, 'simple and reliable' mechanical systems are desired in all buildings. Of course, the demands made of a system limit just how simple it can be. There are no trouble-free systems. Guidelines and recommendations covered in this section include installations that have been found to be acceptable by CG&S to date, balancing the sometimes-conflicting demands for comfort, energy conservation, simplicity and reliability.

M.1 CODES AND REGULATIONS

National Building Code

See G6 "Codes and Regulations"

Other Related Documents

Documents referenced by the NBC or this document include:

- ASHRAE Handbooks and Standards
- National Fire Code
- National Plumbing Code
- SMACNA (Sheet Metal and Air Conditioning National Association)
- CGSB-41-GP-22 Process Equipment: reinforced polyester. Chemical resistant, custom-contact moulded
- Nunavut Impact Review Board (NIRB)
- Installation Code for Oil Burning Equipment CAN/CSA-B139-09
- CAN/CSA-B149.1-05 for Natural Gas and Propane Installations
- CAN/CSA-B214 Installation Code for Hydronic Heating Systems
- Department of Health Building Standards for Potable Water and Sewage Holding Tanks
- National Hydronic Design Standard
- American Society of Plumbing Engineers -Data Book
- ASHRAE 62 -2001 Ventilation for Acceptable Indoor Air Quality
- National Fire Protection Association (NFPA)

M.2 OPERATION AND MAINTENANCE

M.2.1 GENERAL

See G1 "Local Resources" and G4 "Appropriate Technology".

M.2.2 ACCESS

Along with the selection of equipment and systems, the design of mechanical systems must consider how location and access can affect the simplicity and reliability of mechanical systems. For example, the quality and frequency of servicing can be adversely affected if it must be carried out in cramped and uncomfortable spaces, especially when heavy winter clothing is worn. Ducts or equipment concealed in ceiling or floors should be located in such a way that servicing is possible with ease. Mechanical rooms and crawl spaces should be designed to provide adequate space for servicing or replacement of all equipment.

In mechanical equipment spaces, adequate service access is required for the transport of equipment, material and tools in or out of the space. Vertical or ship ladders are not an acceptable means of access to any equipment room above the main floor. It is dangerous to climb a ladder while carrying tools or materials. A full staircase is to be provided, preferably one accessed from outside of the building so as to avoid the need to transport equipment through the building.

For equipment (i.e., fans) suspended from the ceiling in any space, adequate servicing access is to be provided for maintenance and repairs. This may require the installation of a platform or portable lift (and the allowance for adequate storage space for the unit). Fall restraint equipment may also be required.

M.2.3 MAINTENANCE PREVENTION

Design facilities and select equipment requiring minimal maintenance and ease of service when necessary.

M.2.4 PREDICTIVE MAINTENANCE

Determine the life expectancy of facility and equipment components in order to replace them at the optimum time. (If the building is going to outlast its major components, let's have this clearly stated up front so everyone knows where they stand).

M.2.5 SPARES

Regional Maintainers should determine, in consultation with designers, what spares should be provided. Replacement equipment and parts are often difficult to transport to small remote communities.

A minimum two-year supply of spare parts is to be supplied for specific equipment. Some codes mandate a minimum number of spare parts to be kept at all times on the premises (NFPA, for example, requires spare parts for fire dampers).

M.2.6 STANDARDIZATION

In the interest of maintenance, the equipment for any particular function should be of one manufacturer and compatible with the existing O&M parts inventory currently used in the Region or community.

M.2.7 OPERATION & MAINTENANCE MANUALS

Manuals are to be prepared in accordance with good engineering practices. It is recommended to follow ASHRAE Guideline 1.4-2014, Procedures for Preparing Facility Systems Manuals, when preparing the specifications for a given project. Documentation requirements should be integrated into the project specifications to guarantee that they are included in the contractor's bids.

Given the remoteness and limited accessibility at certain times of the year, O&M manuals are essential to support the maintenance staff in their efforts. Also, O&M manuals are the most important tool for training. A draft version of the O&M manuals should preferably be submitted for comments prior to training and updated versions should be submitted prior to Substantial Completion.

M.3 IDENTIFICATION

Operating and maintaining mechanical systems require an understanding of their systems components, including movement of fluids, air and mechanical parts. Nameplates, tags and arrows can all be used to assist quick identification. Consistent identification in all publicly owned buildings is required so that maintainers and operators can orient and familiarize themselves easily within any building in any community across Nunavut.

M.3.1 PIPE PAINTING & IDENTIFICATION

Refer to Community and Government Services Standard Colour and Identification Schedule (see Appendices).

Recommendation

Rationale

M.3.1.1 Text

Complete spellings of material names in English should be used.

Not everyone will be familiar with abbreviations.

M.3.1.2 Locations

Locate pipe markers and direction arrows on piping systems where they are visible from the floor of the usual operating areas or readily accessible points:

This is done for the sake of convenience.

- Beside each valve
- Where pipes penetrate walls, floor and ceilings.

M.3.1.3 Extent of Colour

Paint the piping its entire length in all mechanical rooms. Elsewhere, piping is to be identified by using bands of classification colour (either paint or tape) at selected points including:

This allows for convenient and consistent identification.

- Where pipes penetrate walls, floor and ceilings
- Every 5 metres in concealed spaces

Recommendation**Rationale****M.3.1.4 Labels**

Labels are to be made from plastic coated cloth with protective over coating and wrap-around tape or of the plastic 'snap-on' type. *Stick-on types are not to be used because they falloff after the adhesive dries.*

M.3.2 EQUIPMENT IDENTIFICATION

Refer to Community and Government Services Standard Colour and Identification Schedule (see Appendices).

Recommendation**Rationale****M.3.2.1 Equipment**

Use laminated plastic plates with a black face and white centre, minimum size 90 x 40 x 2.4 mm engraved with 12 mm high lettering for major equipment, 6 mm high for other equipment. All tags and identification labels are to be mechanically fastened to equipment by rivets, bolts or chains, not by adhesives. *These requirements result in high legibility and permanence.*

M.3.3 VALVES AND CONTROLLER IDENTIFICATION

Refer to Community and Government Services Standard Colour and Identification Schedule (see Appendices).

Recommendation**Rationale****M.3.3.1 Valve Tags**

Metal or plastic tags with 12 mm stamped code lettering and numbers filled with black paint are to be used. *These requirements result in high legibility and permanence.*

Ensure that all concealed valves, instrumentation and controllers are identified with Avery coloured adhesive dots (i.e., above ceilings). *This provides a means of quickly identifying the precise location of these devices.*

M.3.3.2 Instrumentation and Controllers

Use laminated plastic plates with a black face and white centre, minimum size 90 x 40 x 2.4 mm. engraved 6 mm high letters, mechanically fastened using pop rivets, screws or bolts (not adhesives). *These requirements result in high legibility and permanence.*

Recommendation**Rationale****M.3.3.3 Valve List**

A typewritten valve list corresponding to 'as-built' plans to be framed under clear acrylic sheet (such as plexiglass) and mounted securely on wall with four screws is to be provided.

This provides maintainers with a permanent reference assisting maintainers to become familiar with an installation, and eases trouble-shooting.

M.3.3.4 Flow Diagram

A single-line flow diagram showing various elements of the system including major valves corresponding to 'as-built' plans is to be provided. The diagram is to be framed under a clear acrylic sheet (such as plexiglass) and mounted securely on the wall with four screws.

This provides maintenance staff with a permanent reference to assist them in becoming familiar with an installation and in easing troubleshooting.

M.3.3.5 Motorized Damper Position Identification

Use laminated plastic plate with black face and white centre, minimum 100 x 50 x 2.4 mm. Engrave with 6 mm wide arrows indicating open and closed position of motorized dampers. Plate to be mounted adjacent to the damper and mounted securely on the ductwork or insulation.

Provides maintenance staff with a permanent reference to assist them in becoming familiar with an installation and in easing troubleshooting.

M.4 PLUMBING AND DRAINAGE

The selection of the type of plumbing system has a significant impact on mechanical construction costs and building life cycle costs.

Some factors to consider are:

- Does the community have a municipal system?
- If it has a municipal system, whether to connect to it or not.
- If a tanked system is selected, what is the size of the water tank and where in the building will it be located?
- If the building has a fire sprinkler system, what is the size of the tank needed for fire suppression?
- If a tanked sewage system is selected, what is the size of the sewage tank and where in the building or outside the building will it be located?

These requirements generally apply to systems contained within the building. The documents "Water Supply and Waste Disposal Systems for Arctic Communities" (<http://pubs.aina.ucalgary.ca/arctic/Arctic26-2-149.pdf>)

"Water and Sewer Service Connections in Permafrost Areas of the NWT", Wilson & Cheema, 1987 (<http://www.nrcresearchpress.com/doi/pdf/10.1139/l89-034>)

"Good Engineering Practice for Northern Water and Sewer Systems", December 2017 (<https://www.maca.gov.nt.ca/sites/maca/files/resources/goodengpractice.pdf>)

Should be referred to for a more complete discussion of municipal servicing requirements affecting building construction contracts.

M.4.1 DOMESTIC WATER – PIPED SERVICE

Less than 20% of all communities in Nunavut have piped service where water lines are either buried or carried in aboveground utilidors. Water treatment in all communities consists of the addition of chlorine and/or filtration and is the responsibility of the municipality. Even though Nunavut has abundant fresh water, capital and operating costs of delivering water are high, making conservation very important.

Recommendation

Rationale

M.4.1.1 Municipal Connection

Connection to a municipal system is preferred, when available.

While usually more costly, especially when an access vault (AV) is required, connection to the municipal system has the following advantages:

- *Lower cost than water truck delivery*
- *The building will not run out of water*

M.4.1.2 Water Meters

Water meters are to be installed only in buildings that are connected to a municipal water system.

Metering of water is required for buildings connected to a municipal water supply in order to monitor water consumption. Buildings supplied by a truck delivery system do not require water meters, as the truck meter meters the water and billings reflect consumption.

M.4.2 DOMESTIC WATER SUPPLY – TANKS

Water delivery by truck for storage in holding tanks located within buildings is common in all communities in Nunavut. Deliveries are generally made once or twice a week following a regular schedule. Conservation is especially important where tanked water supplies are used. The space required to store adequate water for a building can be considerable. Coordinate with the structural designer for proper tank support.

Recommendation

Rationale

M.4.2.1 Environmental Health Standards

For water storage tanks issued June 1992, are to be followed. (Refer to Appendices.)

Note: these standards were developed in consultation with Housing Corporation, CG&S, and the Office of the Fire Marshal.

M.4.2.2 Potable Water Supplies

1. Consumption Estimates

In the case of additions to existing buildings, actual consumption during the preceding three years will form the basis for determining sufficiency of existing tank capacity.

Actual water consumption may deviate significantly from the estimates used to determine the tank capacity for the existing facility and often is much lower than originally anticipated. The lower consumption is often due to changes in usage (of showers) and the substitution of low consumption fixtures during earlier renovations. The project brief should provide appropriate guidance.

The following are the recommended minimum acceptable amounts to be used in calculating the estimated total daily consumption of potable water for new buildings:

Consumption estimates for new buildings are normally based on program information or engineering standards; however, such information is not always available or appropriate for conditions in Nunavut.

2. Residential Occupancies

90 litres/resident/day except that 25 litres/staff/day is sufficient for non-resident staff.

This is the CGS standard for residential occupancies.

3. Non-residential Occupancies

25 litres/person/day.

This is based on a review of actual consumption figures for existing buildings.

4. Supply

A **seven-day** supply should be provided where total daily consumption is estimated at less than 600 litres (calculated on normal building operation).

This would apply to residences with up to six residents or non-residential buildings with up to 24 occupants. The maximum tank size would be 4,200 litres (about 1,000 gallons). Previous CGS direction was to size tanks for a minimum two-week supply; however, this was based on the need to provide adequate water for emergencies, which is not necessary for all facilities. Smaller tank sizes will help to ensure the tank will be replenished with fresh water at least once a week, and that capital and O&M costs will be minimized.

Recommendation**Rationale**

A **three-day** supply should be provided in all buildings where total daily consumption is estimated at more than 600 litres (calculated on normal building operation).

This would normally apply to residences with more than 6 residents or non-residential buildings with more than 24 occupants. Smaller tank sizes will help to ensure the tank will be replenished with fresh water at least once a week and minimize capital and O&M costs.

M.4.2.3 Emergency Water Supplies

Potable water storage capacity may be increased up to a maximum 10-day supply if:

It is generally preferable to keep water supplies to a minimum in order to maintain a fresh water supply. Tanks are generally in a warm mechanical room or crawl space and water can stagnate in that time.

A building is designated as a community reception or evacuation centre under the "Emergency Measure Act", or

There are currently no regulations governing water supplies that must be provided in buildings designated as community reception or evacuation centres. The ten-day supply is suggested by CGS, as interruption to water delivery service could occur during severe winter storms. Typically, this would apply to schools (which are often considered as community evacuation or reception centres), but this could apply to other community buildings as well.

See notes in Appendices.

A prolonged shortage of water would require the relocation of residents.

Typically, this would apply to any long-term care or detention facilities, and student or staff residences.

M.4.2.4 Fire Protection Sprinkler System Reserve

See Section M5.2.

Separate Tanks

Potable water Supplies must be stored in dedicated tanks, separate from any water Supplies reserved for fire protection

Complaints about the quality of potable water in schools where large reserves of water for fire protection have been combined in a single tank (or series of tanks) have been numerous. Combining large water supplies in one tank also makes cleaning operations cumbersome and expensive. Potable water storage tanks require frequent cleaning, while fire protection water supply tanks do not.

M.4.2.5 Tank Construction

All water storage tanks should be fibreglass or plastic and constructed to CGS8-41-GP-22 standards.

The CGSB standard is a more suitable standard for water storage tanks, replacing the previous requirement for water storage tanks to meet AWWA C950. The rated test pressures of the AWWA standard far exceed those required for an

Recommendation

To prevent over pressurization of the tank when the overfill pipes freeze, an interior vent line on water tanks is required.

Galvanized steel, aluminium and concrete are not permitted.

M.4.2.6 Location of Domestic Water Tanks

Potable water tanks must be located in a heated area where the temperature is kept between 5 and 15°C.

Avoid locating tanks in the same room as boilers or furnaces.

Buried water storage tanks are not acceptable.

Small Tanks (up to 4,200 litre capacity)

1. Locating small tanks enclosed within occupied building areas (may include a basement) are preferred.
2. Locating small tanks in a heated crawl space are acceptable.
3. Locating small tanks in a suspended tank room are acceptable but are to be avoided where possible.

Rationale

atmospheric tank, and construction to CGSB ensures better longitudinal strength of pipe tanks.

The CGSB standard does not state a working pressure. Tank manufacturers have stated they cannot build straight walled tanks to meet high-pressure requirements. Pressure requirements of tanks should be limited to the head in the tank, plus a slight margin of safety. Low profile tanks must meet CGSB standards.

Newer water trucks in the community are capable of delivering water at very high volumes and pressure. This should be a consideration in tank selection, arrangement and placement.

The Canadian Plumbing Code does not approve galvanized steel, aluminium and concrete.

This prevents tank contents from freezing or from becoming tepid.

If potable water supply is warm, it is objectionable to users and promotes bacteria and algae growth.

They make access difficult for maintenance.

The tank needs to be small enough to be located in an occupied building area where it is easily accessible

Where a heated crawl space is available, the space may serve as a service space. It is preferable if the tank's location in the crawl space takes advantage of any natural slope on the building site. The objective is to limit the raising of the main floor level to accommodate tanks and access clearance and reduce ramp and stair access requirements.

A suspended tank room is acceptable where the building footprint must be minimized and space cannot be made available within the occupied building area, and where a heated crawl space cannot be provided due to soil conditions. This generally results in the main floor level being raised considerably above grade and can result in the need for extensive ramp and stair construction.

Recommendation**Rationale****Large Tanks** (over 4,200 litre capacity)

1. Locating large tanks in a heated crawl space or basement is preferred.

Tanks of this size take up considerable space and locating them beneath the main floor does not increase the building footprint. Although the main floor level may have to be raised to accommodate tanks and access clearance (resulting in additional costs for stairs and ramps), this is generally preferable to increasing the main floor area, building envelope size and structural capacity.

2. Locating large tanks in a suspended tank room are acceptable.

Where a heated crawl space or basement cannot be provided because of soil or site conditions, a suspended tank room is acceptable. This generally results in the main floor level being raised considerably above grade and can result in the need for an extensive ramp and stair construction. As much as possible, suspended tank rooms should be located to take advantage of any natural slopes of the building site.

3. Locating large tanks in the occupied building area may be considered.

The cost of providing the main floor area with adequate structural support and site limitations makes this alternative undesirable.

Additional floor area must be considered but making the tanks more accessible for maintenance purposes can be considered added value.

M.4.2.7 Fill and Vent Piping

Fill and vent piping is to be Schedule 80 PVC within the building and change to copper pipe where it penetrates exterior walls or fire separations.

Plastic pipe gets very brittle in cold outdoor temperatures and can easily crack or break. See NBC 3.1.9.1 and 3.1.9.4 regarding penetrations of fire separations.

The fill pipe is to be located so water delivery personnel do not have to pass a sewage pump-out connection when connecting the hose from vehicle to fill pipe.

This reduces the risk of the water hose being dragged through spilled sewage at pump-out location. Fill and pump-out service points are to be determined based on the access route, with water fill point being the first accessible to arriving vehicles.

Fill and vent piping to be graded back to tanks.

This is done so that water drains back to the tank, rather than spilling on the ground where it freezes and creates a hazard for water delivery personnel.

Vent outlets are to be located on the side of water tanks or extended 100 mm into the top of the tank.

Vent outlets may reduce the effective capacity of the tank; however, they are necessary to vent and protect the tank from damage.

Provide dual venting for all water tanks: a 75 mm primary vent to the exterior of the building, and a 75 mm secondary vent terminating at an interior drain (i.e. over janitor sink).

Frozen condensation from the tank can block the exterior vent through the winter months and create the potential for the tank to rupture during filling.

Recommendation

Vents terminating outside the building may be screened where dual venting is provided. Otherwise terminate with an elbow to comply with Environmental Health Standards.

Rationale

Environmental Health Standards suggest both means of preventing dust, birds and insects from entering tank, but it should be noted that a screen fine enough to exclude insects during summer months will freeze over in the winter, and the second vent is required for relief.

M.4.2.8 Water Tank Level Alarms

The domestic water tank must be provided with a high-level float-type switch wired to an exterior "Tank Full" light located adjacent to the fill point. A low-level float-type switch is also to be provided which turns off the domestic water pressure system when the water tank level is low. It is wired to an exterior "Tank Empty" light located adjacent to the fill point.

This will guarantee that public buildings are supplied with fresh water when needed, thereby helping water distribution to be prioritized. This also protects the pump from burning out.

M.4.3 DOMESTIC HOT WATER (HW) SUPPLY

Hot water use can account for a significant portion of a building's energy costs. Systems must be selected based on initial capital costs as well as operating costs of the equipment.

Recommendation**Rationale****M.4.3.1 Oil Fired Domestic Hot Water Heaters**

Install Indirect domestic water heaters where the building heating is provided by hydronic heating. This can be utilized in areas where the boilers are not shut down on a seasonal basis.

This would reduce the requirement for an additional chimney and fuel oil piping to the extra appliance. As the heating boiler is being operated throughout the year, the domestic hot water can be produced at a minimal cost.

Dedicated, oil-fired HW heaters should be used where fuel oil is used for the building heating system.

This type of heater has the lowest operating cost where large quantities of domestic hot water are required, and where it can be tied into the same fuel supply used for the building heating system. They are typically installed in schools and recreation facilities with showers, and in residential facilities including student hostels, long-term care facilities and group homes.

Fuel oil usually costs substantially less than electricity.

See "Electric HW Heaters" Mechanical M 4.3.2

In some instances, a combination of oil-fired and electric HW heaters should be considered for the same facility. In all cases, electric use should be minimized considering that electricity is produced by oil-fired power plants.

On-demand oil fired heating systems should be considered in applications where the demand for hot water is minimal.

This minimizes fuel consumption.

Recommendation**Rationale**

High efficiency burners only (80% or better) are to be used.

This minimizes fuel consumption.

Non-combustible block bases with 6 mm steel plates are to be used under all oil-fired HW heating equipment installed on combustible floors.

Past experience has shown that even equipment approved for use on a combustible base has burned into the floor.

The high limit control on fuel oil-fired domestic water heaters is to be the manual reset type.

This provides safety protection shutdowns

Refer to Section M 7.2.2 for chimney and vent requirements.

M.4.3.2 Electric HW Heaters

The use of Electric HW Heaters should be avoided when possible.

*These are typically selected for smaller buildings such as maintenance garages, fire halls, community offices and air terminal buildings with low **HW** use, in conjunction with forced air heating systems. The use of on-demand oil fired HW Heaters should be considered for these applications. (See 4.3.1 Oil-Fired Domestic Hot Water Heaters)*

Small under-the-counter, electric, domestic hot water heaters may be used alone or in addition to an oil-fired HW heater. Electric HW heaters should also be considered where a few fixtures must be located some distance from a central domestic HW source, and a recirculating system would otherwise be needed to maintain HW.

The high cost of a recirculating system is not justifiable where the fixtures use is not high. Local heaters should be considered for complex or multi-purpose buildings where hot water is required at remote areas of the buildings. Typically, this would include public washrooms where HW is only required for hand washing.

M.4.3.3 Temperature

See National Energy Code for Buildings, "Measures for Energy Conservation in New Buildings".

1. When less than 50 percent of the total design flow of a service water heating system has a design discharge temperature higher than 60°C, separate remote heaters or booster heaters shall be installed for those portions of the system with a design temperature higher than 60°C.
2. Tempered water is required for showers, lavatories and classroom sinks in elementary schools and similar applications. The tempered water is to be provided by using a pressure balanced mixing valve located at the fixture and set at 42°C.

This system allows primary domestic HW heaters to be set at lower temperatures to save energy. This is typical for buildings such as air terminal buildings, schools, offices, libraries and service buildings where large volumes of hot water are not required. This is a more cost-effective method of providing tempered water than having two separate domestic storage and distribution systems.

Recommendation**Rationale****M.4.3.4 Provision for Monitoring Performance**

1. Provide thermometers in domestic hot water supply.
2. Provide pressure gauge(s) at domestic hot water recirculation pumps.

Thermostats and gauges provide information for the building maintainers to monitor the system's performance.

M.4.4 DOMESTIC WATER SYSTEM

Domestic water pressure is provided either by a municipal system or by individual pressure pumps when buildings are equipped with holding tanks. Although freezing of water circulation lines was a common problem in older buildings, changes to standard design principles have decreased this risk. Increased insulation and air tightness of new buildings, concentration of plumbing fixtures locations, and keeping plumbing lines out of exterior walls are now accepted as common practice in cold climates.

Recommendation**Rationale****M.4.4.1**

Insulation is not required on domestic cold-water piping systems where the domestic water is supplied from a storage tank in the building.

Insulation is not required on cold water piping because water supplied from ambient temperature domestic water tanks will not be cold.

Insulation is not required on small domestic hot water piping systems that do not have domestic hot water circulating pumps.

Small domestic hot water systems that do not have circulating pumps (i.e., a demand system) realize little benefit from insulation. This reduces the installed cost.

M.4.4.2

Domestic hot water recirculating lines should be provided only where heat loss due to the distance of fixture from HW tank would cause users to waste more water than they need waiting for hot water, and where HW requirement at the fixture is estimated at more than 30 litres per day.

These are typically required wherever showers, baths or laundry facilities are provided, and hot water use is high. The cost and complexity of recirculating systems is generally not warranted in the case of small buildings where only a minimal amount of hot water is used.

When required, recirculating lines are to be controlled by a time clock and kept off during unoccupied hours. Pump is to be smallest kW possible.

This reduces energy requirements.

Extend the circulating line directly to the fixture or group of fixtures to ensure hot water is readily available.

Running circulating lines down corridors still requires wasting water before hot water is available at the fixture(s). Also, this will reduce the length of "dead legs", thus reducing the risk of Legionella developing in tempered water.

Recommendation**Rationale****M.4.4.3 Drain Valves**

All water pipes must be pitched and drain valves must be provided at all low points.

The Canadian Plumbing Code allows pipes to be blown out with air or drained by valves at low points. CGS prefers drains as this simplifies operation for maintainers.

M.4.4.4 Location

Avoid locating water piping in the exterior walls.

This reduces the potential for pipes to freeze.

Domestic water piping is to be installed only in the heated portion of the building.

Domestic hot and cold water lines installed in utilidettes are difficult to heat trace and tend to freeze.

M.4.4.5 Tees

Use factory tees only. Do not use a T-drill.

Factory tees can be repaired without replacing the tee. Repairs to T-drill require special equipment that may not be available to maintainers.

M.4.4.6 Access

Easy access must be provided to all valves and faucets.

This allows maintainers to respond to any problems or to repair equipment.

M.4.4.7 Domestic Water Pressure Pump

Domestic Water Pressure Pump.

Higher-pressure 210-350 KPa pumps are not needed in most small buildings.

Pump to be typically selected to operate at 140-280 KPa.

Typically use shallow well jet pump.

These pumps are readily available.

Isolating valves are to be provided for each pump.

These valves will facilitate maintenance on pumps and eliminate the requirement for draining large portions of the network.

M.4.4.8 Domestic Water Pressure Tank

Bladder type pressure tanks are preferred.

Non-bladder type tanks tend to become water logged, making the system ineffective.

M.4.4.9 Provision for Monitoring Performance

The standard pump-mounted pressure gauge on the discharge is acceptable in most instances.

Provides indication of system operation parameters to the operator.

M.4.5 SANITARY WASTE AND VENTING

The combination of the extremely cold climate and the need to use low volume fixtures in most public sector buildings can cause drainage problems. The goal is for the design to keep the drainage system operational with minimal use of supplementary heating such as heat traces, and to also ensure easy access to clean-outs, so that when problems occur (generally blockages), they can be quickly corrected.

Recommendation

Rationale

M.4.5.1 Grade

All waste lines 75 mm and smaller must be graded a minimum of 2 %.

Although this is the minimum allowed by the NBC within a building, actual grades achieved in construction have commonly been inadequate in this respect.

M.4.5.2 Location of Drain Lines

Do not locate drainage lines in exterior walls.

This requirement reduces the potential for freezing of drain lines.

M.4.5.3 Trap Seal Primers

If a floor drain is provided for occasional use, a trap seal primer is required.

Traps dry out and allow odours into the building. Typically, this occurs in floor drains of mechanical rooms and change rooms.

M.4.5.4 Clean-outs

Clean-outs are required at all changes in direction greater than 45° on sanitary waste lines.

Note: *This exceeds requirements of the Canadian Plumbing Code but is considered necessary because there have been so many cases of blocked drains in public buildings.*

M.4.5.5 Roof Vents

A freeze protection device with heat provided from the building hydronic heating system or with an approved electrical heat trace device suitable for the material being heated and which is certified to the proper CE Code Part II (CSA C22.2) standard and which is supplied with electricity, as required by the CE Code, from a GFI protected circuit, is required.

These types of vents will not block with ice. This eliminates the need to access the roof and inspect vents on a scheduled basis.

M.4.5.6 Special Traps and Piping

1. Plaster Traps

Plaster traps should be installed on sinks used for any biology, horticulture or art activities.

Required because of potential for blockage by materials going into the sink. Typical locations include schools, colleges, adult education facilities, group homes; health care centres, workshops, young offender facilities and hospitals.

Recommendation**Rationale****2. Grease Interceptors**

Interceptors must be installed wherever deep-frying equipment may be used.

Typically required wherever commercial kitchen equipment is installed, such as in correctional facilities and hospitals, and in community kitchens located in community halls and gyms.

3. Acid Dilution Traps and Piping

Acid dilution traps and tanks must be installed wherever acids are used, and they must be independently vented.

Acid dilution tanks are typically required in photo developing facilities and science rooms that may be included in schools or health centres.

All piping and fittings used in these applications must be resistant rated for the application, such as acid resistant and fuse sealed.

The use of proper piping and fittings will extend the service life of the system.

M.4.5.7 Lift Stations and Pumps

To the extent possible, the use of sewage lift stations and sumps should be avoided. However, where provision of such is unavoidable, they should be designed as follows:

The systems are maintenance intensive and there is a risk that if the station fails, flooding will result.

1. Lift Stations

Lift stations are to be provided with duplex pumps, a full-access manhole with lift-out rail assembly, and four float switches for the following alarms:

- Pump 1 off
- Pump 1 on
- Pump 2 on
- High level alarm

The high-level alarm is to be an audible and visual alarm.

2. Sumps

Sumps are to be provided with:

- A sump pump piped to drain the sump, with a check valve on the riser to prevent backflow into sump.
- A fill-access manhole.
- A float switch wired to provide an audible alarm and visual alarm in the event of pump failure.

M.4.6 SEWAGE DISPOSAL – PIPED SERVICES

Less than 20% of all communities in Nunavut have piped sewer systems (either buried or in above- ground utilidors). Where they are in place, the owner is responsible for all costs associated with connecting a new building to existing mains. Work required generally extends beyond the property line and is completed as part of the general construction contract.

In every community with piped services, there are usually some areas still served by truck. Consultation with the municipality is essential to determine the capability and capacity of existing services, and to become aware of any planned changes or improvements to the system that may affect the project.

Recommendation

Refer to the "Water Supply and Waste Disposal Systems for Arctic Communities" (<http://pubs.aina.ucalgary.ca/arctic/Arctic26-2-149.pdf>)

"Water and Sewer Service Connections in Permafrost Areas of the NWT", Wilson & Cheema, 1987 (<http://www.nrcresearchpress.com/doi/pdf/10.1139/l89-034>).

"Good Engineering Practice for Northern Water and Sewer Systems", 2017 (<https://www.maca.gov.nt.ca/sites/maca/files/resources/goodengineeringpractice.pdf>).

Rationale

Complete description and standard details are included in these manuals.

M.4.7 SEWAGE DISPOSAL – HOLDING TANKS

Where piped services are not available, soil conditions make septic fields a viable option in very few locations in Nunavut. The majority of public sector buildings rely on holding tanks serviced by pump-out trucks operated by the municipality. Frequency of pump-out service varies with communities and may be dependent on equipment available. Tanks can be located either in an enclosed crawl space within the building, or sometimes buried outside the building. This system is dependent on regular servicing to function properly; sewage must be emptied as often as water is delivered. Coordinate with the structural designer for proper tank support.

Recommendation

M.4.7.1 Health Standard

Refer to Environmental Health "Building Standards - Sewage Holding Tanks" June, 1992 and included in the Appendices.

M.4.7.2 Capacity

Sewage holding tanks are to be sized relative to the capacity of the domestic potable water supply only (i.e., excluding reserve for fire protection), as follows:

- Large/complex buildings: equal
- Small/simple buildings: 1.5 times

This is a clarification of Environmental Health Standards, which could be interpreted to include fire and emergency reserves. It also clarifies and modifies the previous interpretation of the 1.5 times capacity requirement, which was intended to apply to small buildings only, and not to buildings with large tanks, such as schools or complex occupancies.

Recommendation**Rationale****M.4.7.3 Full Indicator**

The sewage tank must be provided with a high-level float type switch, wired to an exterior "Tank Full" light located adjacent to the emptying point, to turn off the domestic water pressure system when the sewage tank is filled to capacity.

This specifies the type of device referred to in Environmental Health Standards.

M.4.7.4 Construction

All sewage-holding tanks are recommended to be either fibreglass, polyethylene or CPVC.

This specifies the type of device referred to in Environmental Health Standards.

M.4.7.5 Removal of Solid Matter

Environmental Health Standards state that, "Sewage holding tanks shall be designed and constructed to allow the complete removal of solid matter that can be expected to settle in any part of the holding tank".

A clarification provided by Environmental Health notes that this was intended to mean removal by sewage pump-out vehicles. They are concerned over reports that sewage tanks have, on occasion, been cleaned out manually, and will be looking to see that tanks are designed to allow sludge to be effectively removed by the vacuum truck - whether by sloping the tanks or by having extra access points.

M.4.7.6 Location of Sewage Holding Tanks

To prevent tank contents from freezing, tanks must be located in a heated area, or be double walled, insulated and heat traced. The following preferences should serve as a guide:

See Figures 4-4 and 4-5.

1. Tanks buried outside the building are acceptable wherever the soil conditions and water table permit.
2. Tanks enclosed within the building (including enclosed crawl spaces) are acceptable where gravity flow is provided. The use of lift stations and/or grinder pumps is not generally acceptable. Areas intended for tank storage require a containment under and around holding tanks to prevent damage to insulation and sheathing in the event of a spill.
3. Tanks located in unheated crawl spaces are not acceptable.

This installation allows sewage tanks to be located close to roads for servicing and does not require additional building space. When installed in this manner, tanks and connections should be placed away from all doors, windows and fresh air intakes.

This is typical of most public sector buildings in areas of permafrost. Lift stations and grinder pumps increase maintenance problems and costs.

Heat trace would be required to prevent contents from freezing and would result in high electrical operating costs.

Recommendation

4. Tanks located on grade or partially buried are acceptable. These tanks must be double walled. Insulated and heat traced.

Rationale

The placement of the tank on grade is usually less costly overall than locating the tank in a tank space. When installed in this manner, tanks and connections should be placed away from all doors, windows and fresh air intakes.

Where a boiler exists, the tank should be heat traced with the heating glycol system.

Heating provided by the boiler is less costly than electricity, despite the higher construction cost.

Tanks located on grade or partially buried must be prevented from lifting during periods of high ground water conditions.

Movements of over 100 mm due to frost heaving are not uncommon.

Provide flexible piping to the tank to allow for differential movement between the tank and the building.

If problems occur, repair of a tank under the building is very expensive.

Tanks may be positioned under buildings.

Any tank installed under a building must be fully accessible to allow for potential removal and replacement.

M.4.7.7 Pump-out Vent Piping

The sewage tank pump-out suction line is to be graded back to the sewage holding tank and securely anchored to the building.

This prevents sewage spills on the ground around the pump out.

Sewage tank pump-out suction line is to be located away from all doors, windows and fresh air intakes.

This will prevent sewage odours and truck exhaust from entering the building during sewage tank pump-out.

Pump-out piping is to be:

- Black iron piping outside the building and extending 2 metres into the building
- Schedule 80 PVC within the building (with the exception of the first 2 metres)
- Insulated within 2 metres of the building
- Securely anchored to the building
- Heat tracing (optional)

Plastic pipe is not to be used outside, as it is subject to cracking or breaking at very cold temperatures.

The length of black iron pipe into the building could be heat traced with the heating glycol system if deemed necessary, depending on building type or environmental conditions of the site.

Cap and chain are to be installed on the pump-out Suction line quick connect fitting.

This is in addition to the requirements noted in Environmental Health Standards.

A secondary vacuum relief vent is required on all sewage holding tanks. A spring loaded check valve set to 14 KPa must be used.

In the event the tank vent is blocked. The check valve provides a relief to prevent the tank from collapsing while it is being pumped out.

M.4.7.8 Utilidette Piping

All utilidette piping should be PVC.

Heat tracing Should be provided hydronically.

M.4.8 FIXTURES AND BRASS

Fixtures are generally required to be low consumption type to conserve water used and waste water produced. This requirement is most important for buildings with water and sewage holding tanks.

Recommendation**Rationale****M.4.8.1 Colour**

All vitreous china or fibreglass plumbing fixtures are to be white. Coloured fixtures should only be considered under special circumstances.

General appearance and to make matching simple if replacement is necessary.

M.4.8.2 Fittings and Trim

Triple chromium-plated, exposed fitting and trim to be used

Quality and durability are required for public use buildings.

1. Infrared Sensing Plumbing Trim

This is acceptable where the higher cost can be justified. The trim must be wired to the building power source.

Infrared sensing trim has been tried in several installations and works satisfactorily. The benefits are a cleaner public washroom, less odours, and lower water usage. Battery-powered sensors should not be used.

2. Spring-Loaded Faucets

Spring-Loaded faucets are not acceptable.

Spring-Loaded faucets discourage users from using them.

M.4.8.3 Sinks

Stainless steel sinks are preferred.

Stainless steel sinks are required, because enamel finishes would be subject to damage in typical kitchens, health centres, correctional facilities and schools.

P-traps for copper piping are to be cast brass. ABS or PVC traps are to match the installed drainage piping.

Lighter gauge traps require frequent replacement.

All faucets should have flow restrictors to ensure low water use.

This reduces water consumption and waste.

Recommendation**Rationale****M.4.8.4 Hand Basins**

Stainless steel basins are preferred for all high use public facilities.

Stainless steel basins are typically required in schools, community recreation facilities, air terminal buildings, and in all corrections facilities. Fixtures must be durable enough to withstand the level of abuse they are often subject to in these types of buildings. Basins in schools and community recreation facilities are frequently damaged.

Vitreous china or stainless steel basins are acceptable in all non- public use facilities.

Non-public use facilities are less prone to vandalism.

Enamel on steel and plastic or fibreglass basins are not acceptable.

These components have an inadequate service life in public buildings.

All faucets and showerheads are to have flow restrictors to ensure low water use.

This reduces water consumption and waste.

M.4.8.5 Toilets and Urinals

All toilet fixtures should be low water use type (6 litres or less). All urinals are to be low water use type.

The objective is to reduce water use. Dual-flush fixtures are now widely available and are acceptable for many applications.

Vitreous china toilet fixtures are preferred. Fibreglass or plastic models are acceptable only in very low-use facilities.

Fibreglass and plastic models are not durable enough for most public use buildings, although they may be acceptable for installation in facilities normally occupied by fewer than 6 people.

Use of propane-fired incinerating toilets is not acceptable.

Propane supply is generally difficult, and installation and maintenance costs are high.

The toilet seats in schools and community recreation facilities should be extra heavy, open front, seat ring type only.

Toilet seats in arenas and schools have been high vandalism targets.

M.4.8.6 Drinking Fountains

Drinking fountains must be self-contained refrigerated type. Remote refrigeration units are not acceptable.

Water is wasted when people run the water to empty warmed water from lines. Self-contained units are easier to access for maintenance and repairs.

M.4.8.7 Hose Bibs

Hose bibs must be keyed. Non-freeze. Self-draining type. 18 mm complete with stop and drain valves, backflow preventer, inside building.

They are simple to drain in preparation for winter.

Recommendation**Rationale****M.4.8.8 Shock Absorbers**

Manufactured water hammer arresters, c/w isolating valves, are required at all groups of fixtures.

Shock absorbers reduce water hammer and damage to fixtures and piping.

Figure M.4 - 1 – Typical Water Tank

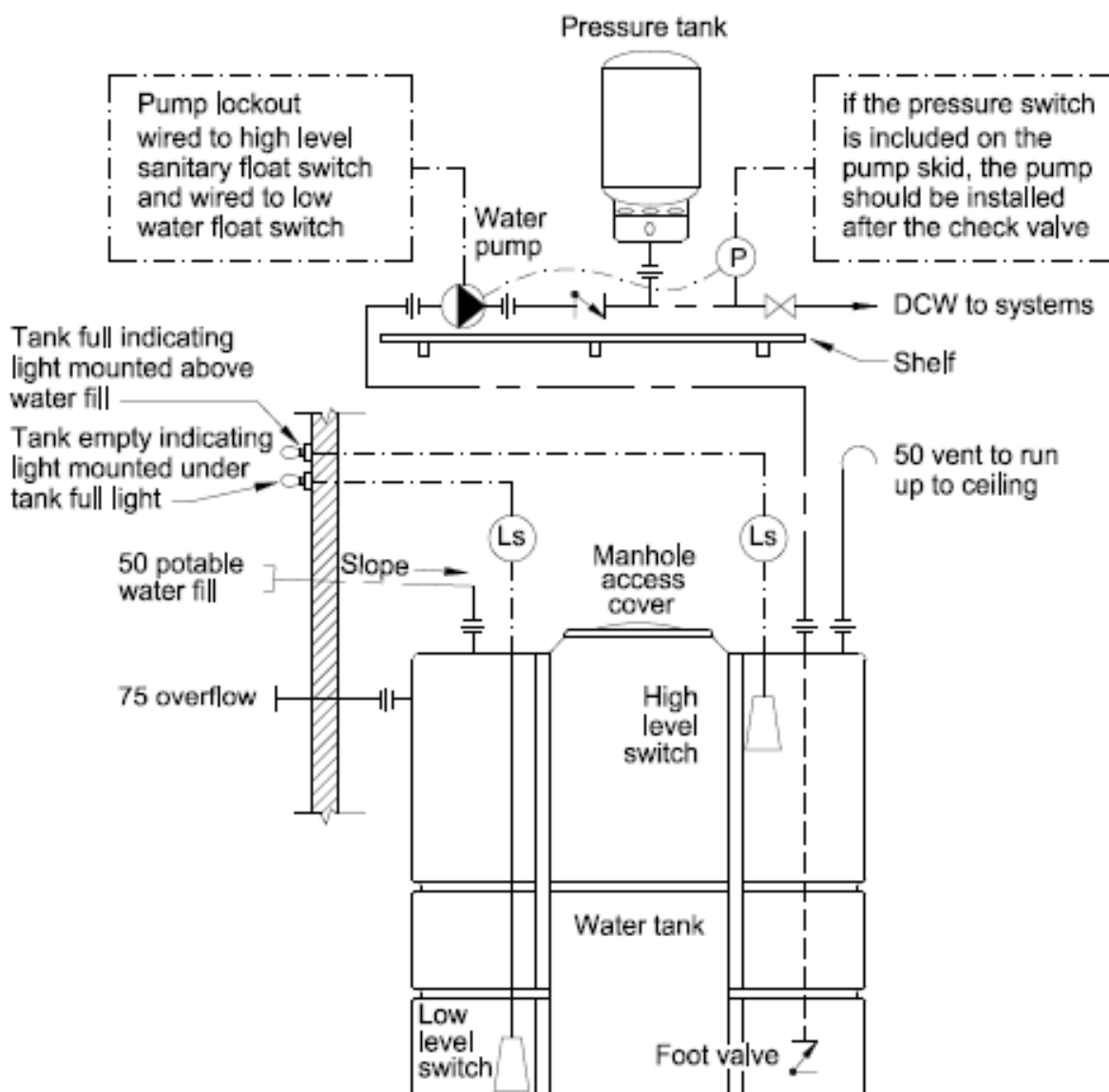


Figure M.4 - 2– Water Tank in Crawlspace

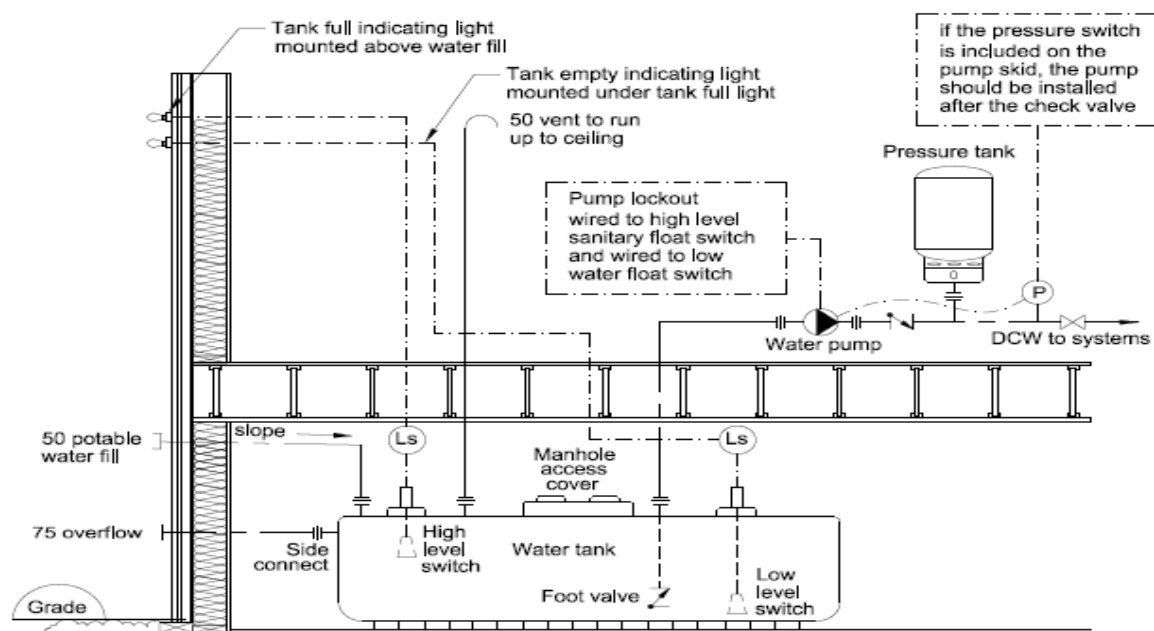


Figure M.4 - 3– Tube Tank in Crawlspace

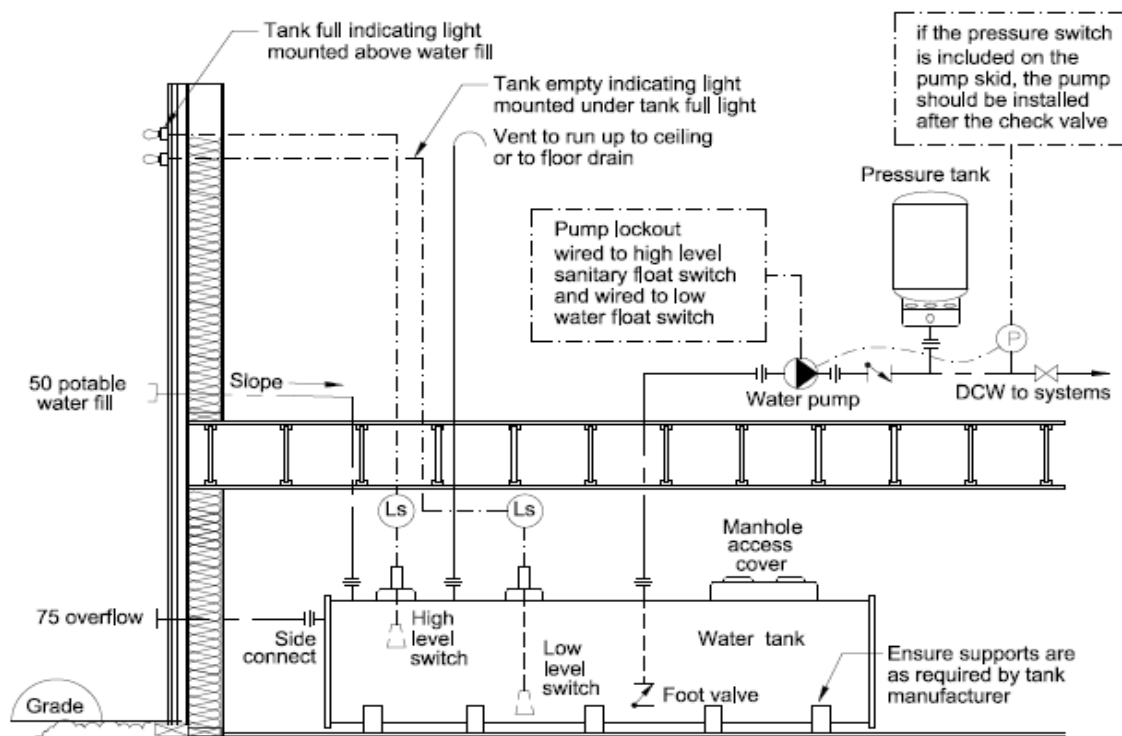


Figure M.4 - 4– Sewage Tank in Heated Space

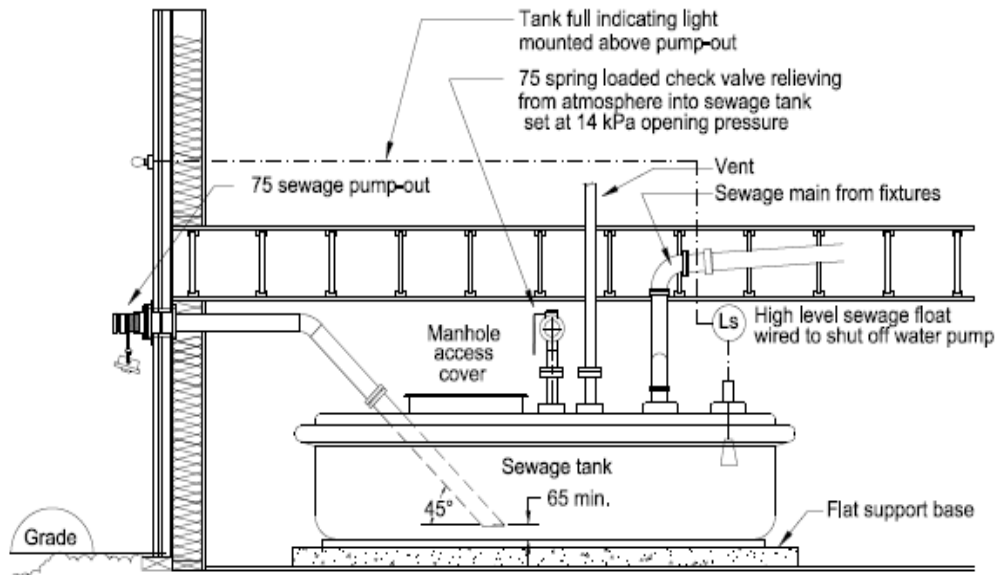
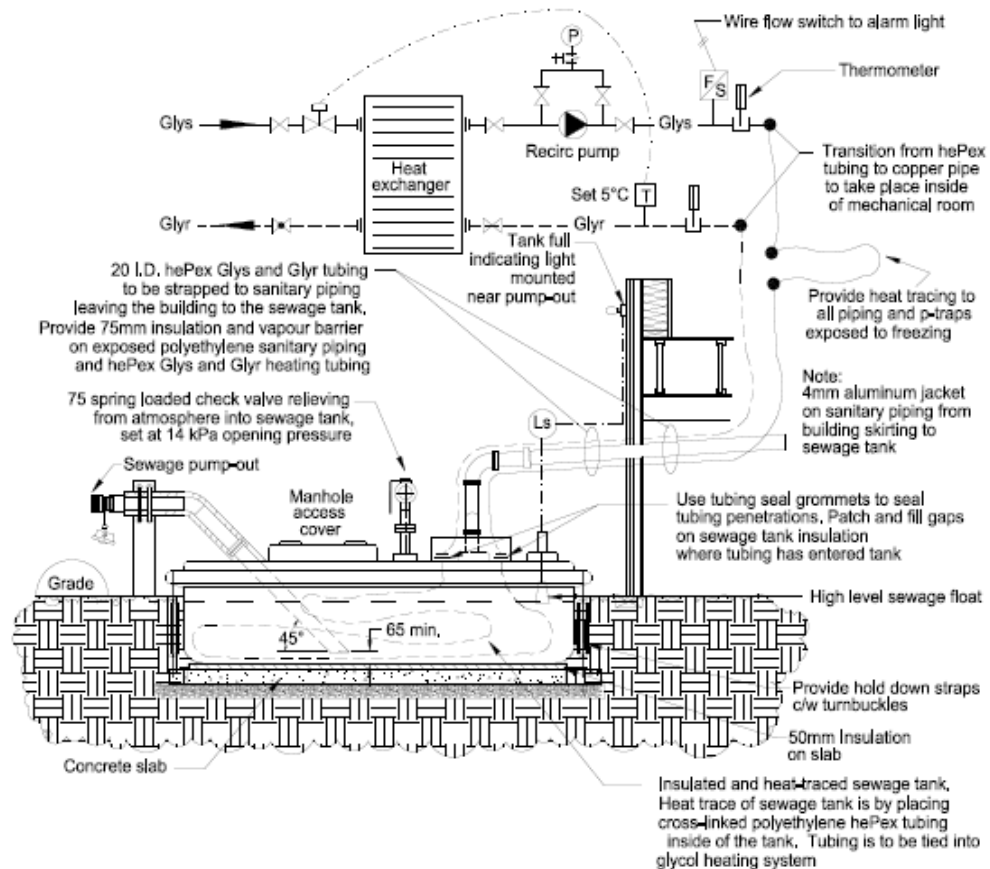


Figure M.4 - 5– Sewage Tank Outside



M.5 FIRE PROTECTION

Firefighting in most Nunavut communities can be challenging, and many obstacles can limit the success of any firefighting operation. Fire is devastating in itself but a fire in a small remote community will displace residents and businesses for an extended period of time. The basic principles in this section are designed to ensure occupants and property are protected, or at least to limit the devastating effects of fire.

Recommendation

Rationale

M.5.1.1 Room Temperature Operation

ULC approved, rechargeable fire extinguishers are acceptable for use in all facilities that are occupied on a daily basis, are not subject to sudden temperature drops, are always maintainable at ambient temperature above freezing, and are equipped with low temperature alarms. Extinguishers are to be ABC rated.

Please note CGS previously required that all buildings be equipped with extinguishers rated for service to -40°C. High insulation levels and air tight construction have greatly reduced the risk of indoor temperatures, in any regularly occupied building, reaching extreme freezing temperatures. ABC rated extinguishers require less maintenance than other types allowed by code, such as pressure water types.

Kitchen fire extinguishers are to be type K to protect cooking operations. Kitchens shall also be protected with standard ABC rated extinguishers for other hazards in the kitchen where the type K extinguisher cannot provide protection (i.e. toaster).

Type K is to supplement kitchen exhaust hood fire suppression systems.

M.5.1.2 Low Temperature Operation

Wherever there is a potential for the temperature where the fire extinguisher is kept to fall below freezing, extinguishers must be multiple purpose dry chemical extinguishers rated for -40°C.

Typical applications are maintenance garages, fire halls, warehouses or any other facility that may not be occupied daily; where opening of large garage doors can cause temperatures to drop quickly; or anywhere extinguishers are intended for outdoor use.

M.5.2 FIRE PROTECTION SYSTEMS

Fire sprinkler systems are automatic fire protection systems designed to control fires and keep a fire within the area of origin until firefighters arrive and suppress the fire. Sprinkler systems have been installed in many new public sector buildings since 1985, either as required by code or regulation, at the request of the Fire Marshal, or at the request of the GN funding department.

Recommendation

Rationale

M.5.2.1 General Requirements

Fire sprinkler design shop drawings and hydraulic calculations must be submitted and reviewed by the Office of the Fire Marshal prior to installation, with as-built drawings and calculations signed by a professional engineer.

The Nunavut Fire Marshal is the authority having jurisdiction.

Recommendation**Rationale**

Fire sprinkler systems shall be designed and installed in accordance with NBC and NFPA 13. Fire sprinkler systems are permitted to be designed and installed in accordance with NFPA 13D and NFPA 13R if the building meets the application requirements found in these standards.

Schools shall be classified as light hazard occupancies. The following rooms/areas in schools shall be classified as Ordinary Hazard Group I: science labs, equipment rooms, service rooms, trade teaching labs, workshops, and engine repair labs.

Dry systems are generally unacceptable for GN facilities.

If not serviced regularly, valve seats can stick, and the system may malfunction.

As an alternative:

1. *Antifreeze sprinkler system: this system can be expensive for large systems and is limited with the concentration of glycerine or propylene glycol, which limits the minimum temperature of the protected area.*
2. *Wet sprinkler system: where the piping is installed in a temperate enclosed area and dry type sprinkler head is used. Dry sprinkler heads shall be tested or replaced every 10 years.*
3. *The dry sprinkler system is the most economical solution for large areas to be protected and for room temperature below -27°C.*

All crawl spaces shall be protected with fire sprinklers. Crawl spaces, unless used for storage or other occupancy type, shall be classified as light hazard. Independent of sprinkler protection, crawl spaces shall be fire stopped in accordance with NBC requirements.

All concealed spaces shall be sprinklered.

M.5.2.2 Sprinkler Heads

Quick response heads rated to 74°C are required. Except as noted below.

By responding quickly, the hazard can be quickly extinguished, and the quantity of water reserved for fire protection can be reduced.

High temperature heads rated at no less than 100°C are required in mechanical equipment rooms, such as generator and boiler rooms.

Temperatures can often be excessive in these areas, which could lead to premature activation of the sprinkler head.

Dry pendant heads are required in entrance foyers and vestibules.

There is a greater potential for freezing in entranceways where doors are opening to the outside. Dry heads must be tested or replaced every 10 years.

Recommendation

A glycol loop is required wherever sprinkler piping is installed in crawl spaces close to outdoor air vents, louvers or intakes.

Rationale

Pipes in these locations are subject to freezing.

New sprinkler systems containing antifreeze require that only factory premixed antifreeze solutions be used. The maximum allowable concentration of glycerine is 48% by volume, which limits the room temperature to a minimum of -27°C for these systems. The maximum allowable concentration of propylene glycol is 38% by volume, which limits the room temperature to a minimum of -20°C for these systems.

For existing buildings, following NFPA25, existing antifreeze systems shall be tested every year and if the concentration of glycerine exceeds 50%, and propylene glycol exceeds 40%, the system shall be drained completely and replaced with an acceptable solution.

M.5.2.3 Piped Water Service Systems

Systems supplied from piped water service systems shall have incoming water main sized to provide flow rate required for occupancy of building calculated as required by relevant NFPA document. The incoming main shall be common for sprinkler water and domestic water but will be sized to provide the greater flow requirement for either system.

When a single main less than 6 inches in diameter serves both domestic and fire systems, the domestic demand should be added to the hydraulic calculations for the fire system at the point of connection unless provisions have been made to isolate the domestic demand.

A ULC-approved backflow prevention assembly shall be provided on the sprinkler side of the system to prevent backflow into domestic water system.

Required by the National Plumbing Code.

An excess pressure pump and a retarding chamber or flow switches with a built-in time delay are to be provided as methods of preventing false alarms during water surges, etc.

Water pressure in municipal and pumped mains systems are known to fluctuate considerably.

M.5.2.4 Pumps and Controllers

Fire pumps and controllers must be ULC listed. This is to conform to the requirements of NFPA 20.

All fire pump systems shall be designed such that access to and usage of regularly required testing features shall be easy and not require any provision of additional equipment.

Code-required system testing should be performed so there is minimal extra work for the maintainer. As an example, drainage tests should be able to run without the need to run a hose connection to the exterior of the building.

Recommendation**Rationale****M.5.2.5 Water Reserve – Tanked Water Supply**

Coordinate with the structural designer for proper tank support.

Wherever an automatic sprinkler system is installed, water supply calculations must be approved by the Fire Marshal, but can generally be based on the following:

1. Buildings where NFPA 13D applies will require a capacity calculated by multiplying the required flow rate by the required duration of flow as laid out in NFPA13D.
2. Buildings where NFPA 13R applies will require a capacity calculated by multiplying the required flow rate by the required duration of flow as laid out in NFPA13R.
3. Buildings where NFPA 13 applies will require a capacity calculated by multiplying the required flow rate by the required duration of flow laid out in NFPA 13 dependant on the occupancy classification of the building (except schools, wherein certain areas are to be designed to Ordinary Hazard Occupancy Group).

This will apply to one- and two-family dwellings only.

This will apply to one- and two-family dwellings and manufactured homes.

Typically, this will apply to small gymnasiums, community offices containing council chambers, courthouses, visitor centres, group homes and libraries where sprinkler systems are installed.

This will apply to all public buildings which require sprinkler protection as laid out in NBC part 3 latest edition, excluding those noted previously.

The Nunavut Fire Marshal has the authority to require a building to be sprinklered.

Designers are advised to confirm sprinkler requirements with the Office of the Fire Marshal for ALL building designs.

Tankage to be provided with means of drainage and access to the tank for periodic cleaning.

This is a code requirement.

Firewater storage tanks are to be provided with a fire water low level alarm float switch wired to a trouble signal at the fire alarm panel to indicate if water level in the firewater tank has fallen to less than required.

Water evaporation reduces the water volume available to fight a fire.

M.5.2.6 Carbon Dioxide

(Co2) Use is limited as to where it is required for commercial range hoods, unless approval is given to use where special electronic equipment is installed.

It is difficult to clean up.

Recommendation**Rationale**

Wet chemical fire suppression systems are installed to protect commercial cooking operations. These fire suppression systems shall be installed in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations".

Easier to clean up.

M.5.2.7 Halon

Not permitted.

Halon use is restricted because of environmental damage (destroys ozone) and transportation hazards.

M.5.2.8 FM-200

FM-200 Systems are permitted for use in LAN rooms and other areas containing sensitive materials.

FM-200 systems require specialized installation and maintenance. The economics of each installation should be reviewed before installing an FM-200 system.

M.5.2.9 NOVEC 1230

NOVEC 1230 systems are permitted for use in LAN rooms and other areas containing sensitive materials.

NOVEC 1230 systems require specialized installation and maintenance. The financial feasibility of each installation should be reviewed before installing a NOVEC 1230 system.

M.5.2.10 Tees

Use factory tees only. Do not use a T-drill.

Factory tees can be repaired without replacing the tee. Repairs to T-drill require special equipment that may not be available to maintainers.

M.5.3 STANDPIPE SYSTEMS

Standpipe systems provide a system of fire hoses throughout a building. They are not normally required in Nunavut buildings due to size and height as per the National Building Code of Canada. Standpipe systems shall be designed and installed in accordance with NBC and NFPA 14. Standpipe systems must be submitted and reviewed by the Office of the Fire Marshal prior to installation.

Recommendation**Rationale**

Standpipe systems should be considered for large buildings even though they are sprinklered and not required by code.

The addition of hose cabinets in large buildings may provide an improved initial attack ability to fight fires in a large building.

M.5.4 OPERATION AND MAINTENANCE**M.5.4.1 Spare Parts**

The following spare parts are to be provided as per the requirements of NFPA 13 for sprinkler systems:

- Not less than 6 spare heads of each type installed for a building up to 300 heads total
- Not less than 12 spare heads of each type installed for a building from 300 to 1,000 heads total
- Not less than 24 spare heads of each type installed for a building over 1,000 heads total
- A head wrench suitable for each type of head installed
- A list of the sprinklers installed on the property shall be posted and shall include the following information: sprinkler identification number (SIN), general description, quantity and issue date.

M.6 FUEL SUPPLY

M.6.1 GENERAL

Electrical power, which is generated by diesel power plants in Nunavut, is usually far too expensive a heating method to realistically serve the North.

A new method of heating buildings, using heat recovery from Qulliq Energy Corporation power plants, is being used and should be considered where the proposed building is near QEC power plant. However, even where heat recovery is available, diesel fuel would likely be used to provide a base amount of heat to the buildings. Refer to the Energy Chapter.

Diesel fuel has been specially designed to flow at temperatures as low as -50°C. Most northern communities receive an annual supply of this fuel by barge. It is stored in a collection of large tanks (a grouping of which is called a fuel storage facility), for distribution (via truck) to required facilities and buildings for the community's use.

The following information is intended to introduce readers to some of the unique characteristics and challenges of storing and safely distributing fuel in Nunavut.

M.6.2 TYPICAL ARRANGEMENTS

All oil installations must be in compliance with the latest edition of the CSA B-139 Installation Code for Oil-Burning Equipment and other applicable codes and regulations.

It will be the designer's responsibility to ascertain and comply with the most stringent requirements of all relevant codes.

The storage and handling of fuel oil for building heating systems generally falls into 4 types of installations:

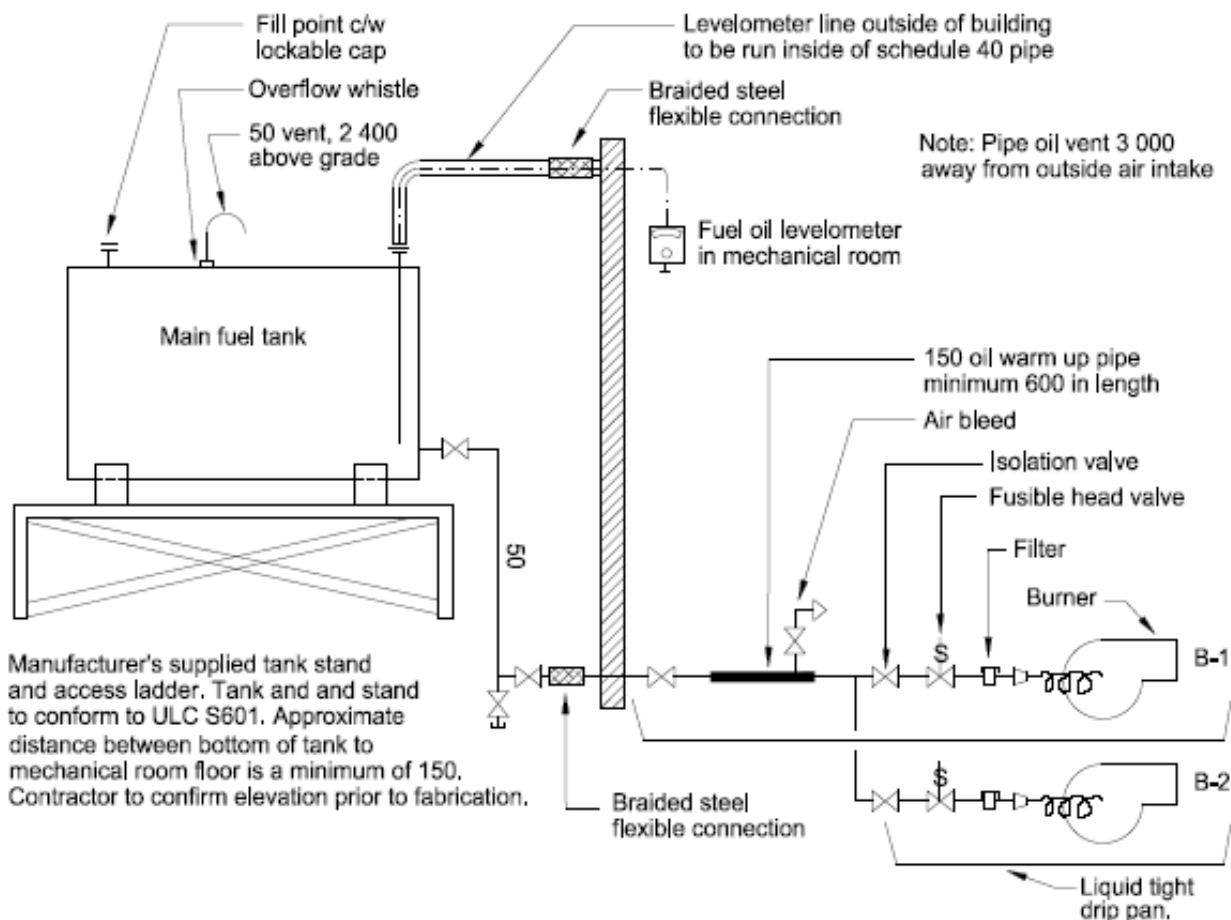
M.6.2.1 Fuel Storage Tanks Less Than 2,500 Litres (500 gal) Located Outside Building

Fuel oil tanks located outside the building are usually mounted adjacent to the building on a tank stand 1,500 mm minimum from any means of egress from the building and from any property line.

The height of the external tank is set to minimize the need of the burner pumps to lift the fuel oil to the burner. Thus, the tank stand is specified to sit the tank at or above the mechanical room floor height.

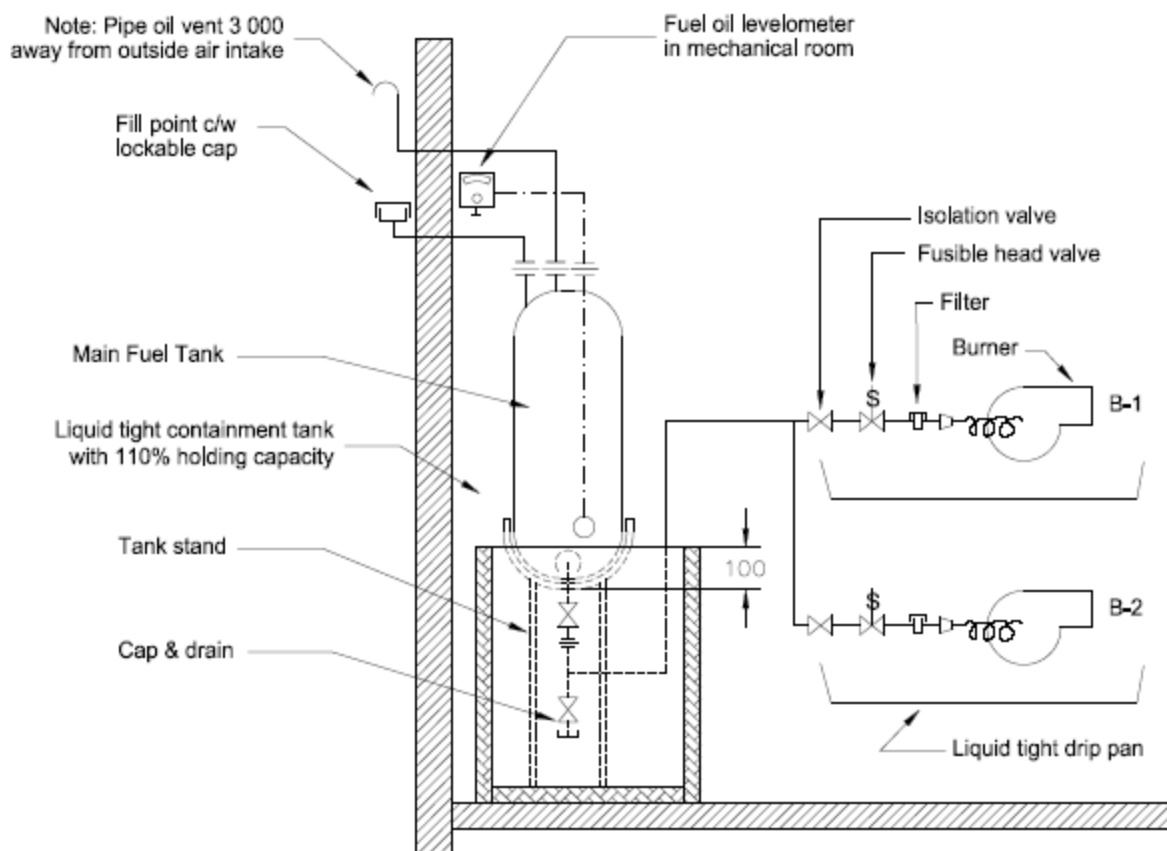
A ladder or stair should be provided to allow the fuel truck driver access to fill the tank. Fuel fill lines and vent lines are normally located on top of the fuel tank. The vent line is fitted with a vent whistle and must be terminated a minimum of 2400 mm above finished grade. The tank stand must be supported on a non-combustible support.

Oil should be heated to an appropriate temperature to be ready for use in oil-burning appliances. Typically, fuel flows by gravity from the outside storage tank to the appliance. If the portion of pipe inside the heated building is short, a large diameter pipe or warming pipe is provided to allow the fuel oil time to warm up. Also, it is important that the fuel distribution inside the building be equipped with bottom containment to capture any fuel leaks that might occur.

Figure M.6 - 1 – Fuel Tank Located Outside**M.6.2.2 Fuel Storage Tanks Less Than 2,500 Litres (550 gal) Located Inside Building**

When total fuel storage is less than 2,500 litres (550 lgal), the fuel may be stored inside or outside of the building. Storing the fuel inside the building is not the best option. It is generally more expensive as adequate space is usually unavailable and adequate clearances of 1500 mm to burners needs to be maintained.

Fuel oil stored inside the building must be located on the lower floor. Location of the fuel tank in a crawl space is prohibited. Fuel fill lines and vent lines are run out through the building wall. The vent line is fitted with a vent whistle and should be at least 2400 mm above ground, within hearing distance of the fuel truck operator and a minimum of 3,000 mm from windows and fresh air intakes.

Figure M.6 - 2– Fuel Tank Located Inside

M.6.2.3 Fuel Storage Tanks Over 2,500 litres (550 gal) Located Outside Building

Fuel tanks over 2,500 litres (550 gal) located outside the building must be contained by a double walled environmental tank, which must be located a minimum of 3000 mm from the building and 3000 mm from property lines.

These storage tanks are located above ground, as soil conditions in the majority of the arctic communities are not suitable for underground (buried) tanks, and environmental protection guidelines are cost prohibitive, and as such are not permitted.

The larger fuel tanks are usually mounted at grade (their large size makes mounting them on any acceptable stand impractical).

These fuel tanks must comply with CSA-B139, be ULC approved, and come complete with stairs, fill fittings, vents, etc. There are several types of fuel tanks available.

The site will dictate the tank arrangement that should be chosen. If the outside fuel storage tank (located at grade) is significantly below the mechanical room, then a dual transfer pump package system should be used (Figure M.6-3). If the fuel storage tank is located significantly above the mechanical room, then again transfer pumps should be used. If the tank is approximately level with the mechanical room, then transfer pumps are not required (Figure M.6-4).

Figure M.6 - 3– Fuel Tank Greater than 2500 Litre Located Outside with Transfer Pump

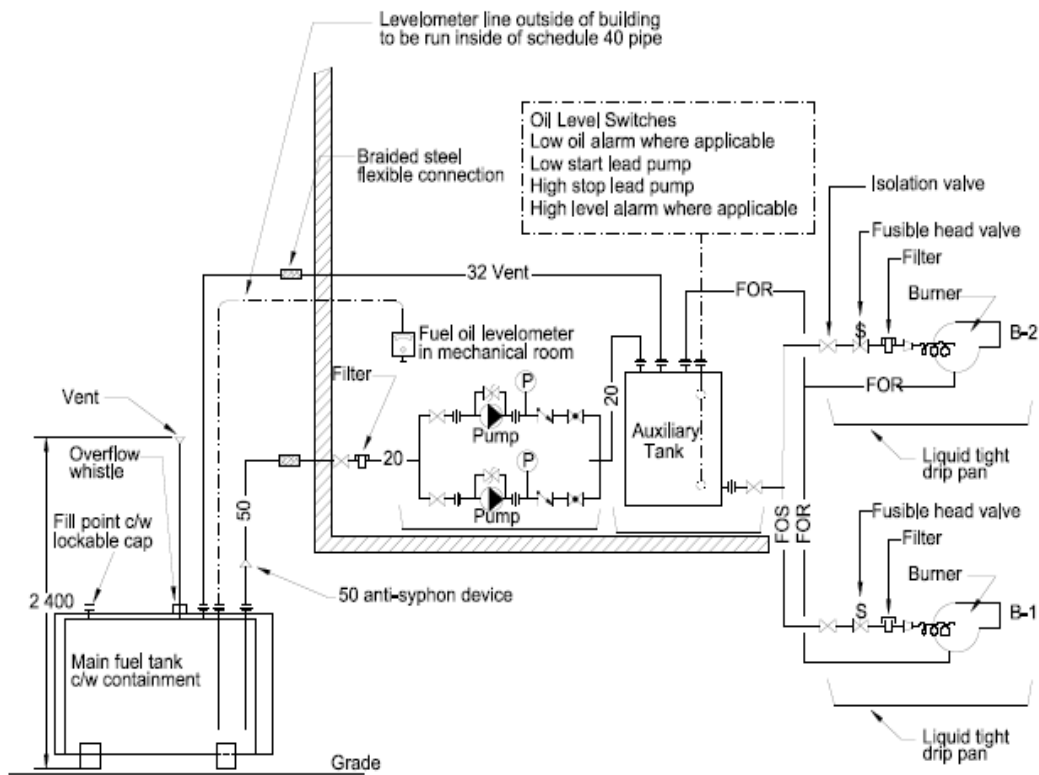
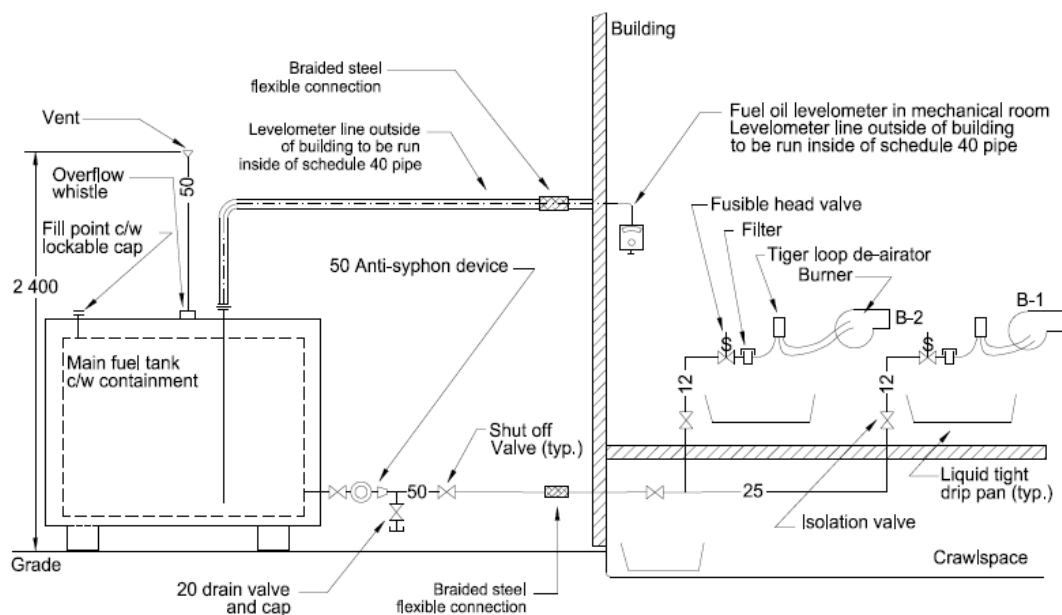


Figure M.6 - 4– Fuel Tank Greater than 2500 Litre Located Outside, Gravity Fed



M.6.2.4 Fuel Storage Tanks Over 2,500 Litres (550 gal) Located Inside Building

If large quantities of fuel need to be stored inside buildings due to property line restrictions or other considerations, a fuel vault must be used. This is rarely done and thus is not discussed in detail here. Underground fuel storage tanks are not acceptable, as explained above.

M.6.2.5 Value Engineering

The most important consideration affecting the fuel system is the selection of the amount of storage capacity that the system should contain. If excessive amounts of fuel are stored, building construction costs will be significantly higher. If too little fuel is stored, then delivery cycles will be excessive and may begin to overload the local delivery service and possibly result in increased fuel costs.

M.6.3 FUEL OIL DELIVERY AND STORAGE

Fuel delivery is either by contract with the Petroleum Products Division of the Community and Government Services, or through private distributors.

Recommendation

Rationale

M.6.3.1 Fuel Meters and Gauges

Totalizing fuel oil meters are not required unless one tank is serving more than one unit in the same building and meters are required to monitor consumption for each unit.

Meters allow maintainers to monitor fuel consumption; however, fuel is metered by the truck meter and billings reflect consumption.

All tanks should be equipped with a remote reading level gauge.

The Code requires some means of measuring the fuel in the tank, and the remote gauge can be located in the mechanical room where it is easy for the maintainers to monitor.

M.6.3.2 Tanks

1. Primary Tanks

If under 2,500 litres, either a circular horizontal tank or up to two 1,250 litre oval tanks may be used.

A supply tank with a capacity of 2,500 L (550 gal) or less located outside the building shall be provided with:

- a) A secondary containment designed for outdoor use having a capacity at least equal to that of the largest surrounded tank; or
- b) A double bottom with interstitial monitoring between the walls, unless the supply tank is a non-metallic tank in compliance with ULC ORD-C80.1;
- c) A protection fence whenever the tank supplies fuel for an emergency power generator as per CSA C282 standard.

Recommendation**Rationale**

If over 2,500 litres, double-walled, self-contained, or self-bermed fuel storage tanks are required.

A dike is required by code for tanks over 2,500 litres, whereas a self-contained tank is usually less costly and provides the best flexibility in its location and relocation in the future.

2. Auxiliary Tanks

Auxiliary tanks may be up to 1,250 litres (275 lgal) in size. Auxiliary tanks shall be horizontal type. A separate, dedicated auxiliary tank is required whenever there is an emergency generator.

An auxiliary tank is required if a transfer pump system is used and is required if an emergency generator is in the building. An auxiliary tank provides storage for the purpose of warming fuel oil for use by oil-burning appliances and for an emergency generator. It provides the minimum 2-hour fuel requirement for operating the generator (when nothing else works).

3. Stands

Fuel storage tank stands should be fabricated from steel. Timber stands are not acceptable.

Although required by code, this is sometimes overlooked.

Coordinate with the structural designer for proper tank support.

4. Oil-Warming Pipe

An oil-warming pipe is to be used in all applications where a day tank is not installed and where gravity feed from an exterior storage tank is possible. The pipe is to be constructed of standard schedule 40 pipe and is not to exceed 45 litres.

When an oil pipe enters a building, the first one or two metres of the pipe will build up frost on the outside of the pipe as the fuel warms up. To facilitate this process, usually an oil-warming pipe is installed. However, if there is an auxiliary tank, the auxiliary tank will act as the warm-up pipe. In the case of where there is a crawl space, the pipe looping through the crawl space will act as a warm-up pipe.

Warming pipe to be equipped with a manual bleed valve at high point and a drain valve at low point.

5. Fittings on Oil Tanks

Plastic fittings on oil tanks are not allowed.

These fittings tend to leak.

M.6.3.3 Fuel Tank Capacity

Primary Tanks

1. A 2-week supply, calculated at continuous maximum operating load (including heat and standby power), is the minimum required wherever a standby generator is to be installed, or a long disruption in heating would require

Even with regular fuel delivery, blizzards or storms can make delivery difficult for periods up to 2 weeks.

Recommendation**Rationale**

- relocation of residents, or could potentially damage essential equipment.
2. A one-week supply, calculated on continuous maximum operating load, is the minimum required for all buildings that are not essential in the event of power failures and can be prepared for freezing conditions (i.e., water lines drained).
 3. For additions to existing buildings, actual fuel consumption over the preceding three years is to be ascertained to determine whether fuel storage capacity needs to be increased.
- Current codes and regulations will dictate the requirements for auxiliary tanks.*
- Actual fuel consumption may be higher or lower than anticipated originally. Projected fuel consumption may or may not increase significantly, depending on whether previous envelope and/or ventilation upgrades were undertaken.*

M.6.3.4 Location and Access**Primary Tanks**

- Suitable platforms with steps and handrails are to be provided for filling exterior tanks. *This provides a safe condition for the fuel deliverer.*
- Buried fuel tanks are unacceptable for public sector buildings. *Soil conditions do not permit buried tanks in most arctic locations and environmental protection requirements make them costly.*
- Tanks of up to 1, 800 litres capacity may be installed within the heated building envelope. *Where space can be provided to allow the tanks to be concealed, the potential for spills makes this option undesirable.*
- No fuel tanks are to be located in crawl spaces. *This is because spills might go undetected in crawl spaces.*
- Wherever possible, elevate the primary storage tank to allow the tank to gravity feed to the fuel burning appliances. Ensure the tank and piping are installed at an appropriate elevation and grade to allow the contents of the tank to be fully utilized. *A gravity feed fuel oil system is the most cost-effective means of providing fuel oil to a building.*

M.6.3.5 Spill Protection**1. Exterior Tanks**

- If a fuel tank is required to have spill protection because of its size, the tank is to be of the horizontal type for above ground installation. The containment dike is to be closed off and secured with a removable cover, and the tank is to be enclosed on all sides by a fence, leaving adequate access on all sides of the tank for maintainers and to permit fuel delivery.
- The Environmental Protection Act specifies when spill protection must be provided; unprotected dikes are a safety hazard, as they can fill with water.*
- Fencing will further discourage access and tampering by unauthorized persons. If the tank is supplying fuel*

Recommendation**Rationale****2. Interior Tanks**

Containment with 110% capacity is required beneath all interior tanks. An equivalent approved double walled storage tank can be used as well.

for an emergency power generator, fencing is mandatory.

A fence is not required if the containment access covers cannot be removed.

Interior tanks are usually located in mechanical rooms. Such rooms normally have painted plywood floors that would permit seepage of fuel into the floor assembly if the fuel were not contained.

3. Auxiliary Tanks

Auxiliary tanks must be vented to the exterior tank. Vents must not be trapped.

This eliminates the possibility of the tank level controls failing to stop the transfer pumps and overfilling the interior tank, such that the tank overflows out of the vent pipe onto grade. If this arrangement cannot be achieved, then additional safety controls should be incorporated into the transfer pump controls.

M.6.4 OIL SUPPLY (DISTRIBUTION)**Recommendation****Rationale****M.6.4.1 Fuel Temperature**

Fuel stored in exterior tanks should be warmed before reaching the burners, by providing either an auxiliary tank, an oil warming pipe or an extended run of supply pipe in the mechanical room that is long enough to allow oil to warm to room temperature.

Oil burners will operate at a higher efficiency when fuel oil is at room temperature.

M.6.4.2 Transfer Pumps

Two bulk fuel oil transfer pumps are required wherever an auxiliary fuel tank is installed that will be controlled by electric liquid level controllers for on-off automatic pump operation.

This is to transfer fuel from exterior primary tank to interior auxiliary tanks.

Pressure gauges and a pressure relief valve (integral or external) are to be installed on all fuel transfer pumps.

One pump is operational, the other a standby pump that can be put into operation quickly and easily. Pressure gauges allow the monitoring of pump performance.

Standby fuel pumps are to be installed and sized to handle 100% of full system load. Do not use automatic start/alternators; use hand selector switches only.

In the event of a pump failure, a maintainer should be called to the facility to become aware that the primary pump has failed. The standby pump is permanently installed to ensure it is there when needed, and the system can be quickly and easily switched over.

Recommendation**Rationale****M.6.4.3 Piping****1. Materials**

All exterior fuel oil piping is to be Schedule 40 steel screwed pipe, minimum 50 mm size, valved at the tank and immediately inside the building, and properly supported. Buried lines should be welded when used -however their use is to be avoided whenever possible.

The use of an ULC-approved, double-walled, environmental pipe is required for any buried pipe.

All fittings must be rated at 907.2 Kg (2,000 Kbs). The connection shall consist of Teflon tape and gasoil thread sealant with PTFE.

2. Two Pipes Systems

Where an auxiliary tank is installed, a two-pipe system (supply and return) is preferred for all oil-burning equipment.

This eliminates problems with air locks and returning the fuel to an interior tank maintains it at room temperature.

3. Gravity Feed

If fuel is gravity fed to burners directly from an exterior tank, do not use a two-pipe system.

This would cause preheated fuel to be returned to the exterior tank and produce condensation in the tank.

4. Drip Leg

A valved 50 x 50 mm nipple and cap is to be installed on all fuel tank piping with installation as follows: tank, valve, 90°elbow, tee (branch to building), valve, 50 x 50 mm nipple and cap.

This will serve as a dirt pocket and allows condensation to be drained from the tank to prevent water and ice build-up in the tank and piping.

M.6.4.4 Flex Connectors

Exterior fuel piping (supply and return) should have braided steel flex connectors installed prior to pipe entering building.

This prevents stress caused by differential settlement of the tank and building.

Adequate steel support shall be provided from the exterior fuel tank to the building. Support to be anchored to a concrete base or steel pipe.

Tanks over 2,500 litres are located at 3,000 mm from the building and piping is installed at a high level. Installing the piping at a high level permits easier access for maintenance around the tank.

Flexible connectors should be long enough to allow for the expected differential movement. A length of at least 600 mm is preferred.

Movements of up to 100 mm are not uncommon.

Recommendation**Rationale**

The burner is to be connected to the fuel piping, with flexible connectors. Using either Type K copper or braided steel flexible connectors.

The burner is disconnected and reconnected during routine maintenance. The flexible connector allows this to be done easier. The use of braided steel connector is preferred, as the copper connector will kink over time.

Braided steel flexible connectors are required on the supply and return lines to the emergency generator.

M.6.4.5 Isolating Valves

Each piece of fuel-burning equipment must have isolating valves.

This will allow equipment to be disconnected for maintenance or replacement.

On a two-pipe system, the return line must not have an isolation valve.

The code does not allow a valve on the return line.

Fusible valves are to be used for all supply lines to all oil-burning equipment, including generating plants.

The CSA B139 code specifies only heating equipment as requiring fusible valves. As generating plants are common in larger public sector buildings, it is important to note that fusible valves are also a requirement on fuel lines to generators to stop flow of fuel in case of fire.

M.6.4.6 Pressure Gauges

Provide dial type pressure gauges with a 90 mm diameter dial scaled to the application intended and located at the discharge of each pump.

Pressure gauges installed at appropriate locations assist the building operators in system operation and performance evaluation. Incremental cost of gauge installation is offset by operational efficiency.

Provide an isolation valve for each gauge, a snubber for pulsating operation and a diaphragm for corrosive service applications.

M.6.4.7 Filters

An adequate oil filter is to be provided at each oil burner.

Filters ensure clean fuel to all burners.

M.7 HEATING

Minimizing the energy consumption of public buildings is important in Nunavut where fuel costs are extremely high. Added to this, the severe climate means that heating must be provided over much of the year. The number of degree-days below 18°C can reach 12,594 in Resolute, as compared to an average of 3,000 in Vancouver or 5,782 in Edmonton.

All buildings, except seasonal-use buildings or cold storage facilities require some type of heating system. Buildings can have their own heating system or be heated by a central plant located in or nearby the facilities. In some locations it may be possible and practical to use recovered heat from a local power plant to heat individual or groups of buildings.

Fuel sources other than fossil fuel should be considered if practical and available. The reduction of greenhouse gas emissions should be a design priority.

Recommendation

Rationale

The design objective for indoor space temperature in occupied areas during winter conditions is 21°C.

It is intended that heating systems be properly sized for the actual requirements of the building.

ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy provides calculation methods on how to evaluate the Mean Radiant Temperature in buildings to achieve comfort. This method shows that using radiant heat allows set points to be reduced in rooms to achieve the same level of comfort.

Whenever possible, implement temperature setback within buildings during unoccupied periods.

This reduces energy consumption

The outdoor air design temperature shall be according to the 2.5 % January design temperature indicated in the most recent supplement to the National Building Code. Similar data from Environment Canada for specific communities that are not listed in the supplement were added in the Appendices.

This advises the design industry of acceptable building design criteria in Nunavut.

M.7.1 FORCED HOT AIR SYSTEMS

Forced hot air heating systems are as common in Nunavut as elsewhere in the country. However, as few buildings in Nunavut have basements, counter-flow furnaces are generally required with ducts located in a raised floor. Although forced hot air systems are not suitable for all types and sizes of facilities, their relatively simple servicing requirements make them a good choice in many circumstances.

Recommendation

Rationale

M.7.1.1 Furnace Type

Two speed fans are required where ventilation is provided by the furnace.

This provides continuous air circulation and reduces the stratification of air.

Where a separate ventilation system is installed, a one-speed fan is to be provided.

Continuous use of the furnace fan is redundant and undesirable considering high electrical costs.

Recommendation**Rationale**

Provide stainless steel heat exchangers on forced hot air heating systems where more than 10% outdoor air for ventilation is required, and/or where the entering air temperature is below 13°C.

Standard heat exchangers tend to corrode and fail prematurely when exposed to low inlet air temperatures.

Refer to Mechanical M7.2.2 for chimney and vent requirements.

Non-combustible block bases with 6 mm steel plates are to be used under all oil-fired heating equipment installed on combustible floors.

Past experience has shown that even equipment approved for use on a combustible base has burned into the floor.

M.7.1.2 Combustion Air

All fuel-burning appliances require a properly sized combustion air supply.

This is a code requirement.

M.7.1.3 Heating Capacity

Forced air heating is suitable only for buildings where multiple heating zones are not required.

Typically used for small buildings such as fire halls, garages, small office buildings, small health centres or residences. Not considered suitable for use in arenas or gyms, or where more than one furnace would be required to provide separate heating zones.

M.7.1.4 Distribution

Ducts located in a raised floor are preferred over those located in ceiling spaces.

Better heat distribution when hot air is introduced at lower levels and avoids penetration of building envelope assembly.

Where exposed ducts are acceptable, they may be located overhead.

Generally, results in poor heat distribution, but this may be acceptable in some situations where comfort levels are not critical. Depending on the application, ceiling fans can be used to eliminate stratification of hot air. Ceiling fans are not expensive and are easy to maintain.

M.7.2 HYDRONIC HEATING SYSTEMS

This is the most commonly used heating system in public sector buildings because of its ability to heat large areas with multiple heating zones. It provides better control and comfort than forced air systems. See figures 7.1, 7.2 and 7.3.

The total boiler plant size is one factor in determining how many qualified operators there should be. In some communities in Nunavut, sufficient or qualified staff may not be available for the plant size.

When selecting the type of hydronic heating system for buildings in Nunavut, consider the building size, complexity and special requirements. Ease of maintenance practices should be considered when designing for all mechanical equipment.

Recommendation**Rationale****M.7.2.1 Boilers**

Two oil-fired, cast irons, wet base boilers, suitable for use with propylene glycol heating solution, are preferred. Each boiler is to be sized to handle 50% of the design load. Exceptions should be noted for facilities which may require heating capacities in excess of these amounts (example: health facilities).

Sizing the two-boiler heating plant to no more than 100% of the building design heating load is intended to ensure that the heating plant capacity

Will not exceed the actual building-heating load. The heating plant will operate more efficiently when not oversized.

Multiple passes, forced draft, fire-tube boilers are preferred in larger buildings where the boiler required exceeds 250 kW.

Only retention head type burners are to be used.

They are the most efficient burners available.

The high limit control on boilers is to be the automatic reset type.

In cases where there is not a daily inspection carried out on the boilers, it is undesirable to have the boilers remain shut down until the high limit is reset manually. If not reset promptly, considerable damage could result to the building from frozen piping and fixtures.

Single stage firing arrangement (not high. low) is required on boilers.

During extreme cold conditions, single stage firing reduces the danger of damaging boiler venting from condensing products of combustion.

Consideration should be given to installing hour meters on each boiler.

Provides runtime indication to operating personnel for lead/lag operation and maintenance.

The use of condensing boilers could be considered to allow lower operating water temperatures and better efficiency.

Water temperatures below 60°C are not possible in regular cast iron boilers due to condensation. But significant energy savings may occur when lower temperatures are used. Designer must ensure that condensing boilers will be supplied with low-sulphur oil meeting the boiler manufacturer's requirements. Otherwise, severe corrosion could occur within the boiler's heat exchanger.

A boiler installation permit is required for any new or retrofit installation for which the Nunavut Boiler and Pressure Vessels Act & Regulations applies (for boilers greater than 30 kW or 102,364 btu/h).

As required by the Nunavut Boiler Safety Section Policy Directive.

M.7.2.2 Chimneys and Vent Connectors

A separate chimney for each oil-burning appliance is preferred.

Although this may increase the number of penetrations through the building envelope, shared chimneys are always oversized.

Note: Although the terms 'stacks' for 'chimneys' and 'breechings' for 'vent connectors' are commonly used, CSA Standard B139 no longer includes these terms in its definitions.

Recommendation**Rationale**

Forced draft appliances require pressure rated chimneys.

Provide a base tee for cleaning access to all chimneys.

All connections and bends are to be “swept” type.

Chimney lengths should be minimized and kept within the heated building envelope as much as possible, with the exposed exterior length also kept to a minimum.

Cold chimneys result in condensation forming in the chimney due to moisture produced from combustion gases. The condensate freezes and builds up over the winter and can eventually block the chimney. Such condensate is also very corrosive and will lead to the premature failure of the chimney. Backpressure due to blockage or leakage through perforations can result in dangerously toxic conditions.

Where vent connectors are necessary, they are to be installed to permit easy removal for cleaning.

Promotes more regular cleaning and inspection of vent connectors and chimneys.

Vent connectors must be insulated.

Insulation is required on vent connectors to prevent accidental burns to maintenance staff. The insulation must be easily replaceable, or there is a risk that it will be improperly replaced.

Each oil-burning appliance is to be provided with its own barometric draft regulator.

The pressure in the chimney varies considerably because of wind conditions, stack effect from temperature difference, and (in the case of multiple fuel-burning appliances) according to how many fuel-burning appliances are operating at a time. Barometric dampers eliminate one major variable and stabilize draft conditions for each fuel-burning appliance.

Cleanouts are required on all changes of direction of the vent piping for fuel-burning appliances.

All portions of venting are to be easily accessible for cleaning.

M.7.2.3 Combustion Air

Where possible, bring the air in at a low point in the mechanical room and duct to an outlet at a high level close to the ceiling.

This installation controls the amount of cold air drawn in for oil-burning equipment and avoids cold air from flooding in at floor level, which can freeze water lines.

If combustion air cannot be ducted within the mechanical room to a high-level outlet, then the air must be preheated using a unit heater. Quantities of preheated air are required (i.e. after expansion) to be calculated as per CSA B139, considering that special engineering practice is necessary in the extremely cold climate of Nunavut. Calculations are to be based on maximum heating loads, not including standby generators.

Combustion air intakes are commonly oversized and colder air than necessary is brought into mechanical rooms. This can result in the freezing of water lines and pumps located in the mechanical room. It is important to recognize the extremely cold temperature of outdoor air and problems associated with bringing it directly into a building. A 33% reduction is recommended to recognize the expansion of cold air to demand temperature.

Recommendation**Rationale****M.7.2.4 Heating Fluids****1. Glycol**

A glycol and water mix is the preferred fluid for use in hydronic heating systems.

Based on past experience, systems using 100% water were prone to freezing resulting in high maintenance costs and disruption to users. Glycol can be tested regularly and inhibitors (di-potassium phosphate) added as required. The use of glycol is sometimes questioned because of its corrosive effects, which can damage equipment. It has been suggested that water may in fact not pose the same threat of frequent freeze-ups as it once did, given the improved quality of building insulation and air tightness. However, until this has been studied further, the GN is unwilling to change the practise of using glycol, which has generally proven to work well.

The heating fluid used in all hydronic-heating systems is to be a premixed 50 % concentration by volume of Dowfrost HD propylene glycol.

Dowfrost HD is currently the only product acceptable to the GN. The selection of Dowfrost as the only acceptable product allows for ease in training, fewer types of test kits and easier storage in the community. A premixed glycol solution will eliminate problems encountered with the on site mixing of glycol utilizing local water. Water in a community that has more than 50 ppm of hardness ions, Ca++ or Mg++, or more than 25 ppm of chloride and sulphate, is considered unsuitable for use as part of the heating fluid. Water quality varies unpredictably between seasons and communities. A premixed glycol solution will ensure proper thermal and corrosion inhibiting characteristics.

Ethylene glycol is toxic, and cases of poisoning have occurred in the past in several communities in Nunavut. Alternatives to Dowfrost HD will not be considered until those products can be shown to be of equivalent and consistent quality.

2. Glycol Fill

Glycol fill provides a convenient and adequate means of charging hydronic heating systems by using either a motor driven pump or an automatic pressure-controlled makeup system. The pressure relief valve on the boilers is to be piped back to a polyethylene glycol fill tank.

Manual vane type pumps have proven to be unsatisfactory. Since most hydronic heating systems do not have continuous supervision, it is preferable to have system pressure maintained for as long as possible in cases of leaks. Piping the glycol relief back to the glycol tank avoids wasting glycol whenever the pressure relief valve is activated.

A manual diaphragm type pump would be acceptable on hydronic heating systems sized at less than 117 kW. Manual vane pumps should not be used.

Manual diaphragm pumps work satisfactorily.

Recommendation**Rationale****M.7.2.5 Circulation****1. Piping**

Primary/secondary piping loops, which allow constant flow on both loops under varying load demands, are preferred for systems supplying over 117 kW. A single loop is acceptable for systems up to 117 kW.

The continuous flow of heating fluid through the boiler and the controlled flow of heating fluid through the heating loop avoids subjecting boilers to temperature shocks.

The use of variable flow pumps for the secondary pumping system will reduce energy use in buildings. This type of control is only recommended on larger systems where Direct Digital Control (DDC) is available.

Unions, isolating valves and drains are to be provided at all heating equipment connections.

They facilitate the isolation of heating coils, heat exchangers, pumps, and heating zones for periodic maintenance and/or repair.

Isolation and by-pass valves are to be installed so that the flow through each heating coil in an air handling system can be adjusted, even if the secondary coil circulating pump and/or the three-way control valve is out of service.

It must be possible to operate the system manually when the three-way control valve is removed for maintenance or repairs. The forced shutdown of systems could result in loss of ventilation and heating in certain applications.

Hydronic system piping arrangements are to be designed to maintain full and balanced flow through each boiler when it is operating. Provide balancing valves in each boiler circuit to facilitate balancing of the system.

This prevents damage to boilers by overheating of boiler sections or tubes.

The T-drill pipe fitting system is not acceptable.

There has been a history of failures of T-drill joints.

All glycol systems, once completed, are to be flushed and degreased.

Avoid using mechanical fittings (i.e., grooved joints) on glycol heating piping even if suitable gaskets are used. Black iron (welded or screwed) and copper are the preferred choice.

Since use of the 50/50 glycol/water heating fluid is not common in other parts of the country, designers easily overlook this.

2. Equipment

Pumps and other heating equipment must be selected while keeping the different properties of glycol vs. water in mind. For example. Expansion tanks must have an ED PM bladder that is compatible with propylene glycol, and the tank must be sized to accommodate the increased expansion of glycol over water.

Standby pumps are to be installed with each pump and sized to handle 100% of a full system load. Do not use automatic starters, but rather a manual selector switch only.

In case of pump failure. A maintainer must come out and is then made aware that the primary pump has failed. The standby pump is permanently installed to

Recommendation**Rationale**

Circulation pumps are to be sized to circulate water through all boilers in multiple boiler installation.

ensure it is there when needed. And the system can be quickly and easily switched over.

This assures there will be a continuous flow through all boilers under all operating conditions.

Circulating pumps are to have mechanical seals. Do not use packings.

Provides a reliable seal.

Isolation valves are required on the suction and discharge of all pumps.

This will facilitate operation and maintenance.

One set of strainers is required for each building heating system.

Strainers catch suspended particles in the system as they circulate. Strainers are not required at every pumped loop.

Side stream filters with sight glass are required for each hydronic heating system over 117 kW (400,000 Btu). However, side stream filters are beneficial for all heating systems. Each side stream filter is to be provided with one case of replacement 10-micron filters.

Side stream filters provide an economical, effective means of keeping the heating fluid clean. Sight glasses provide a means of determining cleanliness of the heating fluid.

Smaller heating systems are less likely to require continual cleaning, and it is not cost effective to provide side stream filters.

3. Insulation

Insulation is required on all circulation piping located in mechanical rooms. Insulation may be omitted from valves. Unions and strainers where piping is 63 mm and smaller. Removable prefabricated insulation is to be used at all valves and unions on all piping over 63 mm.

Heat from uninsulated piping can cause overheating of the mechanical room, wasting energy and creating uncomfortable working conditions for maintenance personnel.

Periodic access to valves and unions requires removal and replacement of insulation at these locations, in such a way that it does not damage adjacent pipe insulation.

4. Jacketing

All visible insulated piping or that located in mechanical rooms is to be covered with a jacket suitable to the location and the environment in which it is installed. Outside piping is to be covered with aluminum jackets.

Jackets protect insulation.

M.7.2.6 Distribution

1. Wall Fin Radiation

Wall fin covers or enclosures are to be sloping top model, minimum 14-gauge steel.

Sloped tops prevent people from placing things on them and obstructing heat. The heavier gauge steel will be less easily damaged than standard gauge covers.

Recommendation**Rationale**

When permanent cabinets or built-in furniture must be located against the same wall as radiation units, appropriate inlet and riser vents are to be installed

Cabinets obstruct airflow, and vents will alleviate this problem.

A shut-off valve is required for each zoned section of radiation.

This allows the zones to be isolated for repairs.

A balancing valve must be provided on the return line for each zone of radiation.

Allows for proper balancing of the heating system.

Isolation valves and unions are to be provided on both sides of zone valves and a piggyback drain valve is to be provided on the discharge side of the zone valve.

This reduces the chance of systems becoming air locked and potential damage to carpeted areas.

In low traffic vestibules and entrances/exits, wall fin radiation is preferred over a force flow unit. The wall fin radiation is to be controlled by a zone valve and a wall thermostat c/w tamper proof metal.

This reduces both overheating in the area and installation costs.

2. Force Flow Units

Force flow units are required for typical high traffic vestibules and entrances. Floor and wall mounted models should be recessed where structural conditions allow.

Force flow heating units provide quick heat recovery in high traffic areas, such as entrances.

Heating is controlled by cycling the fan and/or a control valve.

The control valve is necessary to prevent overheating of the spaces.

3. Radiant Floor System

Where it is important that a warm floor be provided and in-floor heating is approved, a radiant floor system may be used.

The functional program should clearly outline this requirement, which will generally be considered where body contact with the floor will be usual (e.g., kindergartens or play rooms).

The radiant floor piping must have an oxygen barrier.

The oxygen barrier prevents oxygen from entering the heating system and causing premature system failure due to corrosion.

4. Radiant Ceiling Panels

Radiant ceiling panel heating systems may be used in specific building locations and building types.

Radiant ceiling panel systems allow the walls to be free of radiation cabinets and/or convectors, thus increasing the viable floor area and improving floor cleaning and maintenance.

5. Radiant Wall Panels

These may be used instances, but it is important to ensure that furniture or other objects will not block the path of the radiant heat.

As an alternative, ceiling panels can be used when room usage permits.

Recommendation**Rationale****6. Fuel-fired Radiant Heat**

This type of heating may be used in buildings such as arenas and garages. However, it is not particularly efficient, so it is not recommended if there is a better alternative.

7. Air Curtains

In facilities which include large overhead door openings such as fire halls and garages and entrances to a building without a vestibule area, it is recommended to provide air curtains across the openings (e.g. Enershield type).

Air curtains block outdoor air from entering into the facility and cooling down the area. Reheating the space takes a considerable time and is uncomfortable for occupants.

M.7.2.7 Provisions for Monitoring Performance

1. Low Heating Fluid Cut-offs Devices installed to allow testing of low water fuel cut-offs must allow testing without draining the boiler.

This minimizes the loss of the heating medium and protection of the equipment.

2. Thermometers

Provide thermometers scaled to the application intended in the following locations:

Thermometers installed in appropriate locations assist the building operators in system operation and performance evaluation.

- Heating fluid supply and return to each heat generating device
- Chilled water supply and return to each cooling coil
- Return piping from each heating zone
- Supply and return piping to each main heating coil (not required on reheat coils)
- Converging side of 3-way control valves

In piping systems. Brass or stainless steel bulb wells complete with thermal grease are required. Thermometers to be located in a visible and readable location.

3. Gauges

Provide dial type pressure gauges located to measure pump suction and discharge pressure of each pump.

M.7.2.8 Alarms**1. Air Vents**

Recommendation**Rationale**

Manual air vents should be installed at all high points of hydronic heat piping throughout the building and provided with clearly identified access covers.

Because propylene glycol quickly deteriorates the seat of auto vents, their use should be limited to the mechanical room where leaks will not damage carpeting.

2. Bibbs near Boilers

An 18 mm combination cold and hot water hose connection is required close to boilers. Hose bibbs must be equipped with hose vacuum breakers.

This is needed for flushing of boilers. Vacuum breakers are required to prevent backflow and to eliminate the potential for the contamination of the potable water supply.

3. Access to Valves

Access doors to all control valves and isolation valves are required.

Provides ease of maintenance.

4. Radiation Fins

Radiation cabinets should be secure, but easily removable by maintainers.

Provides ease of maintenance.

5. Air/Dirt Separator

Hydronic heating systems are to be provided with an air/dirt separator.

Air/dirt separator removes microbubbles that flash after the fluid passes through the boilers. These microbubbles are responsible in large part for corrosion in heating systems. This simple accessory greatly reduces the amount of air trapped in the heating loops and reduces the use of chemicals.

M.7.3 UNIT HEATERS

Recommendation**Rationale**

M.7.3.1 Unit Heaters

Hydronic unit heaters are to be used only for spaces that are normally unoccupied, such as mechanical rooms, large storage areas, etc., where noise levels are not a consideration. Unit heaters are to be hung with appropriate vibration isolation. Balancing, isolation, drain valves, air vent and unions are required on unit heaters. Unit heaters are to be equipped with fan guards.

Unit heaters are an inexpensive, yet effective means of providing a controlled heat source in unoccupied spaces but are generally considered too noisy for other applications.

Heating is to be controlled both by cycling the fan and closing of a control valve.

The control valve is necessary to prevent overheating.

In garages and fire halls, unit heaters are, when possible, to be wall mounted at an elevation which allows for easy maintenance access.

Unit heaters in these types of facilities have ceilings at an extra high level to provide clearance for vehicles housed below. This high-level mounting installation

Recommendation

Unit heaters are not to be mounted higher than 3 meters from the floor unless a work platform or manlift is provided.

Rationale

results in access and safety issues. Legislation calls for scaffolding, manlifts and other safety features to be used if equipment is mounted above a specific height.

M.7.3.2 Operation and Maintenance**1. Spare Parts**

The following spare parts are to be provided:

- One set of belts for each piece of machinery
- One spare pump for each type and size of pump in the system
- One additional sealed drum of glycol Dowfrost HD
- One motor and fuel pump for each type of oil burner installed
- One additional High/Low limit control
- Two additional water temperature thermometers

M.7.4 SCHEMATICS

The following schematics provide various boiler and heating loop configurations. Typically, and preferably used in the North.

Figure M.7 - 1– Single Boiler, Double Pump

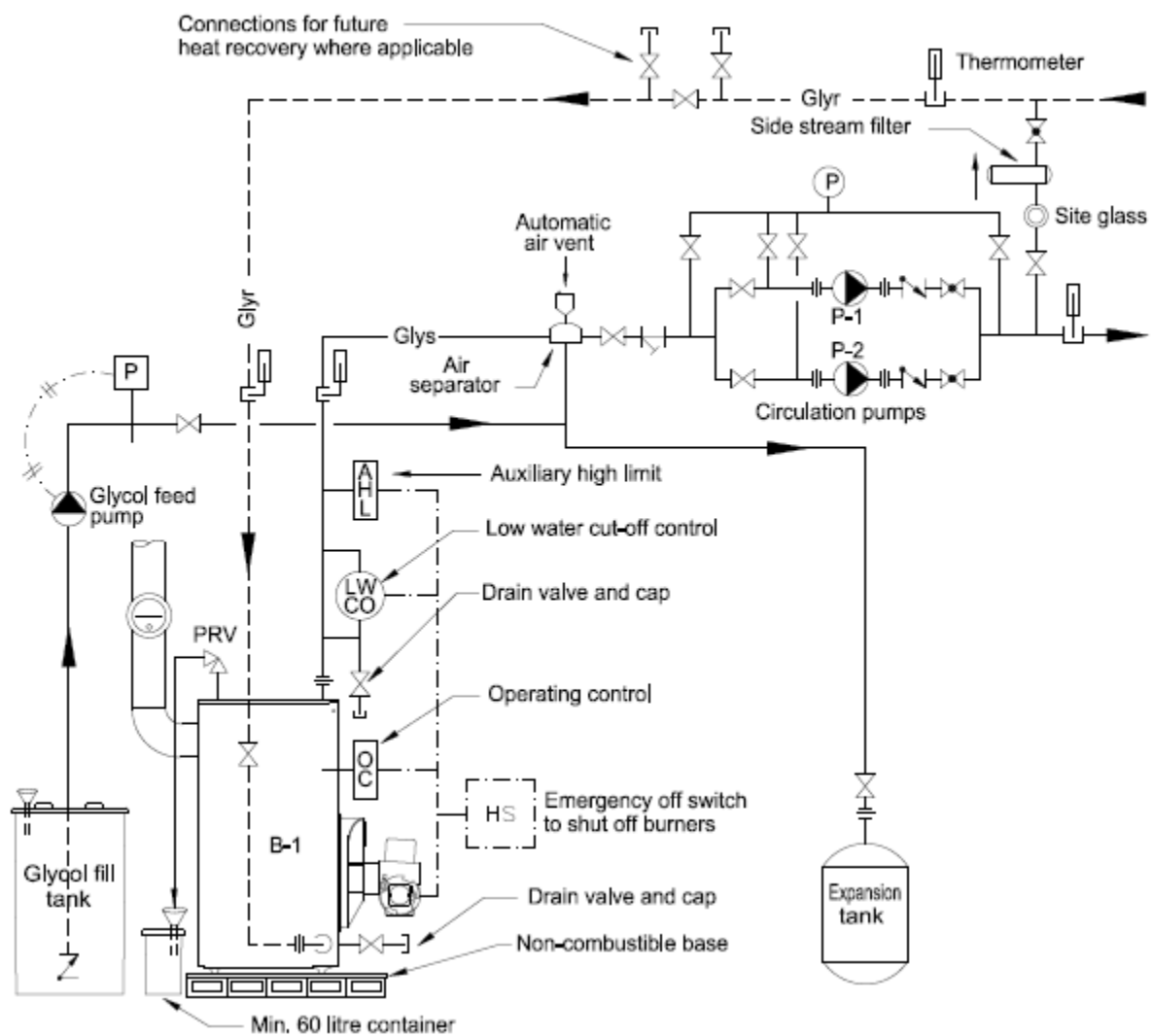


Figure M.7 - 2– Double Boiler, Double Pump

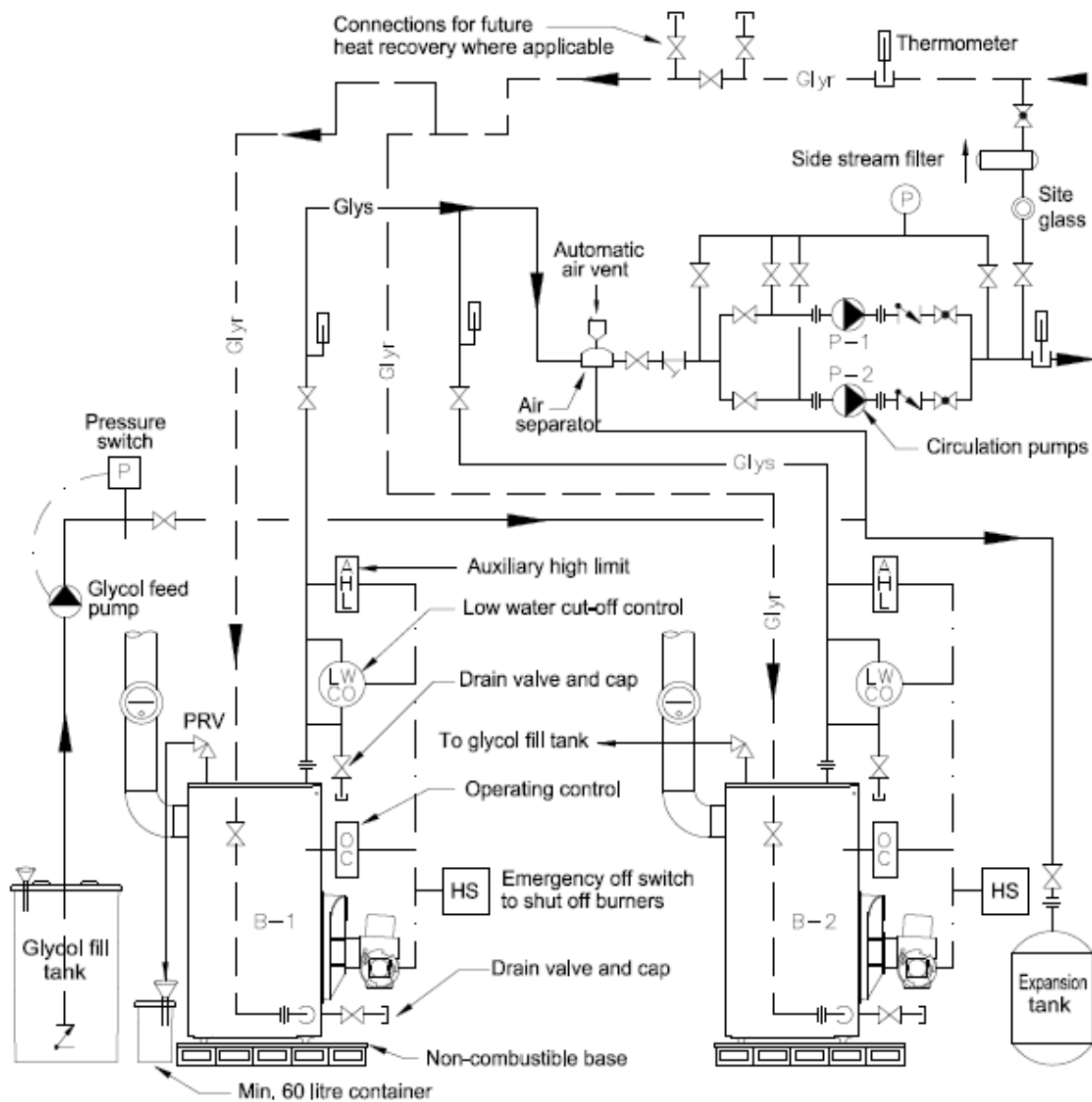
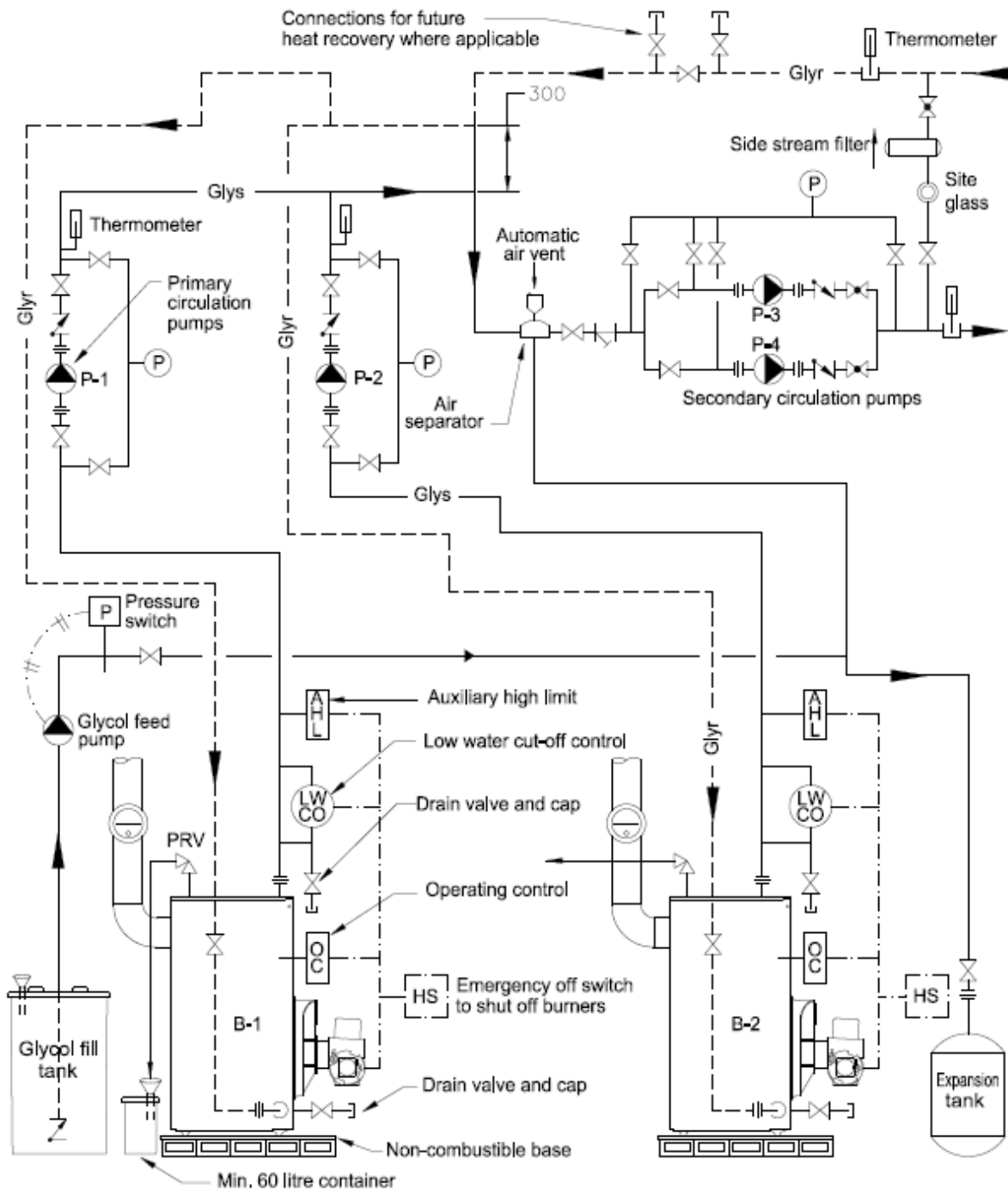


Figure M.7 - 3- Primary-Secondary Boiler System



M.8 AIR DISTRIBUTION

Air quality of a reasonable standard is a basic human need, not a luxury. As buildings have become increasingly air tight in the interest of reducing energy consumption, the supply and control of ventilation has grown to be increasingly important. When ventilation is inadequate, as has been experienced in some public sector buildings, users are not only uncomfortable, but may experience health problems. The extreme cold experienced during much of the year in Nunavut can make it more difficult and costly to achieve adequate ventilation than in other areas of North America. Toxic and noxious chemicals released by building materials and finishes, dust, moulds and microbiological organisms, as well as air used by occupants, must be removed by the ventilation system.

M.8.1 NATURAL VENTILATION

Building users commonly believe that opening windows provides the most satisfactory form of ventilation in a building, even though this is not really a very effective way of introducing adequate fresh air or ensuring even distribution during winter months. Blasts of cold air, often accompanied by snow particles, coming in through a window are not tolerated. This is not to say that natural ventilation is undesirable; however, opening windows is probably not the best means of providing it, if users expect consistently comfortable conditions. A properly designed system relying on natural airflows can provide adequate ventilation without adding to the mechanical and electrical complexity of a building.

For occupied buildings that require ventilation, the harsh climate of the Arctic makes mechanical ventilation the only practical alternative during the heating season. Systems that require the opening of windows or portholes as part of the mechanical ventilation system design have proven to be unsatisfactory in the winter. However, since natural ventilation is often the only means of cooling in the summer, natural ventilation strategies should be considered whenever the need for cooling arises in the summer.

Recommendation

Rationale

M.8.1.1 Supply

Whatever the means of supply air it must prevent entry of snow and dust. Any filters or screens required to do so must be easily accessible and easy to clean. Locate supply air source well away from oil tanks, sewage pump outs, parking lots and other source of odour and toxic gases.

Ventilation hoods are often used in place of operable window sections. They are typically used for residential occupancies or small offices where users are capable and willing to control ventilation. Operable windows are preferred for summer use buildings only.

M.8.1.2 Exhaust

Exhaust must be located to create an even flow of fresh air through rooms, without creating uncomfortable or disruptive drafts. Exhaust is to be located well away from the supply source, eliminating any possibility of cross-contamination.

A common shortcoming of natural ventilation is that air is not mixed, or air currents are so great that paper flies off tables and desks! As stipulated for natural air supply, users must be capable and willing to control exhaust.

M.8.2 MECHANICAL VENTILATION

Most public use buildings are too large or configured in such a way that natural ventilation systems are not feasible. Consequently, mechanical systems are needed to ensure that adequate ventilation is provided in most public sector buildings. The climate also makes mechanical means of ventilation preferable for much of the year. The quantity and temperature of outdoor air brought into a building need to be adjusted frequently to suit changing outdoor conditions and indoor requirements. Automatic controls can perform this function for the building users, while keeping simplicity in mind as an O&M objective.

In the interest of cost savings, designers are encouraged to consider more energy-efficient ventilation strategies while continuing to meet the requirements of ASHRAE 62.1 and maintaining optimum occupant comfort levels for indoor air quality.

The heat required for ventilation air is often the largest contributor to a building's heating load. Heat recovery between exhaust and ventilation air is viable in most systems and should always be considered.

Recommendation

Rationale

M.8.2.1 Choice of Systems

1. Natural air supply and mechanical exhaust:
Limited to use in residential or seasonal use buildings.

The system relies on the users. It generally consists of opening windows for supply and turning on kitchen or bathroom fans for exhaust. It is considered unsuitable for buildings used by the public, or by groups of people who will not likely take on responsibility of controlling ventilation or is concerned with energy conservation.

2. Mechanical air supply and natural exhaust:
Limited to use in small residential, group homes or seasonal use buildings, where a forced air furnace is provided for heating.

This system relies on the users to control the exhaust. Hence, it's not considered suitable for public use buildings, or for groups of people who will not likely take on responsibility of controlling ventilation or be concerned with energy conservation. This approach has been used in several recent school projects with unsatisfactory results.

3. Mechanical air supply and mechanical exhaust:
To be used in most buildings. A two-fan system is required.

Both supply and exhaust can be automatically controlled using temperature sensors and time clocks and do not rely on users. Although improper maintenance, or operational difficulties (which may be design related) can lead to user complaints, this is not a problem exclusive to mechanical systems.

M.8.2.2 Outdoor Air Supply

1. Supply

Outdoor air is to be calculated based on ASHRAE 62.1 (year as referenced in the current version of NBC). Outdoor air is calculated for various types of occupancy by providing a minimum outdoor air flow per person in each individual space. When the exact number of persons is not known, minimum density is provided.

NBC references ASHRAE 62-2001. Ventilation systems are to be sized to provide ventilation to the area served based upon the normal occupancy of that area. Ventilation systems sized for the occasional peak occupancy within gymnasiums or community/assembly halls, result in oversized heating plants and ventilation equipment, which have higher capital costs, higher operating and maintenance costs, and are inefficient as well.

Recommendation**Rationale****2. Free Cooling**

Air volumes and system arrangement must allow up to 100% outdoor air to be used for preventing overheating of occupied spaces.

Most new buildings are very energy efficient, and even at quite low temperatures (i.e., -10°C to -15°C), there may be a need to cool the building during occupied hours in order to dissipate internal heat gains from lights, equipment and people.

3. Outdoor Air Intakes

Outdoor air intakes must be provided with downturn hoods designed to eliminate the potential for the system to draw snow in or to become blocked by snow.

See Figure 8.1

This is intended to prevent the air intake from filling up with snow (a frequent occurrence where precautions have not been taken).

To ensure acceptable indoor air quality is maintained within buildings at all times, the location of outdoor air intakes is critical. Location of roadways, parking and service points and prevailing wind to the building must be considered at design.

Many problems and even closure of buildings have recently occurred when vehicle exhaust, diesel fumes, sewage gases and products of combustion were drawn into the building through the outdoor air intakes.

Considerations should include:

Designers must take into consideration the location of roads near the building's fresh air intake. In some communities in Nunavut, fine sand will generate a dust cloud around the building resulting in filter clogging.

- Intake hoods to have sufficient vertical length (minimum 600 mm) under the louver and velocity (maximum 1.5 m/s).
- Hoods to be set out approximately 200mm from the wall surface, not tight up against it.
- Hoods mounted high enough to avoid becoming blocked by snow accumulations expected in the selected location.
- Outdoor air intakes located on the sides of buildings scoured by the wind or, where possible, on the underside of the building where it is swept clear of snow.
- Do not install insect screen on outdoor air intakes if a properly sized hood cannot be provided.
- Outdoor air intakes should be separated to the greatest degree possible with a minimum distance of 10 meters from all trucked service

To ensure contaminants including snow, wind and insects do not enter the ventilation system, these parameters should be considered.

Winds hitting the face of the building can force snow up into the hood. Setting the hood out from the wall reduces the potential for snow entry during windy conditions.

A review of snow drifting patterns must be done when locating the air intake, as drifts may impede system operation for many months of the year. Setting the hood out from the wall reduces the potential for snow entry during windy conditions.

This reduces the chance of bringing in objectionable odours, vehicle exhaust or flue gases from chimneys, with the outdoor air.

Insect screening becomes blocked by snow and insects can be trapped in filters. This happens most frequently when the hood is undersized and the velocity at the louver face is high.

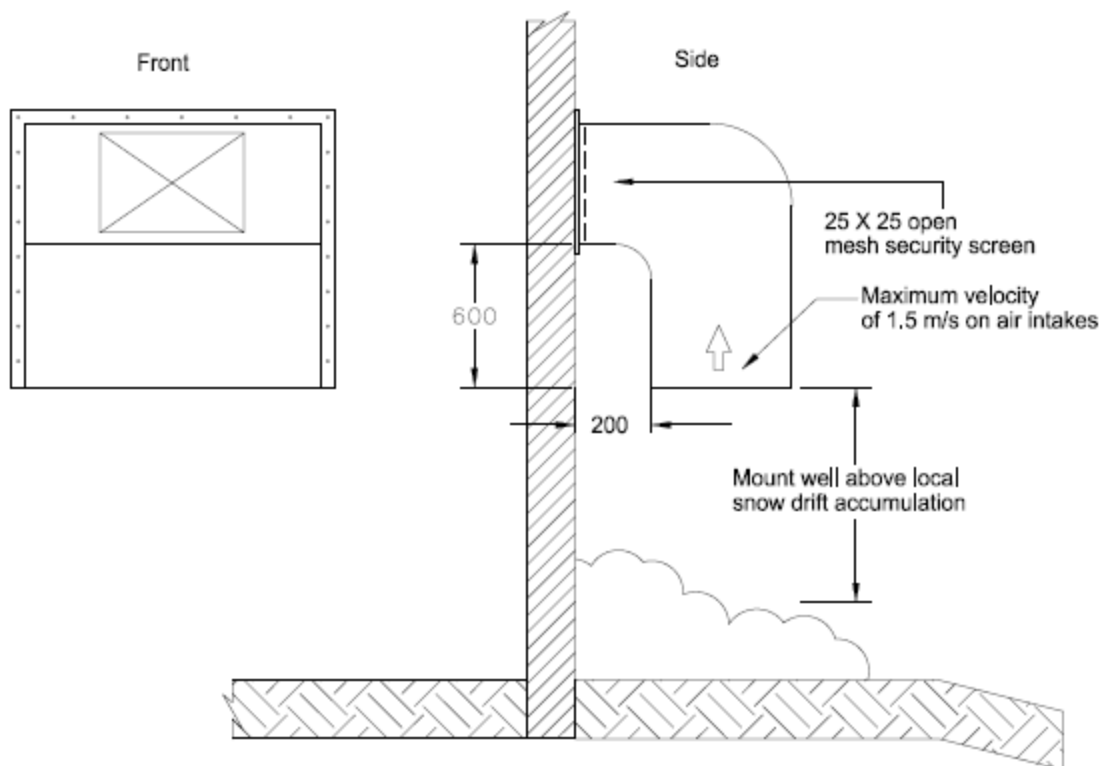
Recommendation

points, including sewage pump-out, water fill and fuel delivery, and from chimneys and exhaust outlets.

Side wall louvers are not recommended.

Rationale

Potential for snow to enter the systems during windy conditions.

Figure M.8 - 1– Outside Air Intake**Recommendation****Rationale****4. Dampers**

Outside air dampers are to be low leakage type and rated for extremely low temperature.

This limits the infiltration of outdoor air.

5. Insulation

Insulate outdoor air ducts using external duct insulation from the louver up to the air handling unit.

The use of duct liner in an outside air intake duct contravenes current ASHRAE recommendations.

M.8.2.3 Air Mixing

Packaged mixing boxes are not recommended.

Conventional equipment is designed for conditions typical of the southern portion of Canada or the central U.S.A. In Nunavut, where outdoor air temperatures may be as low as -50°C, mixing of cold outdoor air with room temperature air is more difficult than standard equipment is designed to handle.

The following guidelines are suggested in order to ensure thorough mixing in most severe conditions:

- Arrange mixing dampers so the coldest air stream (outdoor air) is located physically *This promotes the mixing of warm and cold air by taking advantage of the principles of convection.*

Recommendation**Rationale**

above the warmer (return air) point of connection.

- Use opposed blade type dampers
- Locate connection points at least 3 metres upstream from the heating coil with at least one duct elbow before the mixed air duct connects to the air handling apparatus.

This promotes the mixing by directing streams of air towards each other.

This practice gives air more distance in which to mix before reaching the heating coil.

Air blenders or stratification eliminators are recommended to ensure mixing of (cold) outdoor air and return air.

Packaged air handling units with integral mixing boxes are not designed for arctic winter conditions. Their use should be avoided where possible. During extreme cold conditions, good mixing is important to enable air-handling systems to operate normally, without nuisance tripping from low temperature controls. Effective temperature control is difficult to achieve without good mixing.

Exhaust and relief air ductwork is to be insulated for a length of three (3) metres from the louver connection.

Insulation prevents the formation of condensation on ductwork that is exposed to cold outdoor air when the system is operating or shutdown.

M.8.2.4 Air Distribution**1. Diffusers**

Ceiling diffusers, adjustable for horizontal and downward flow, located at the midpoints of approximately equal divisions of room area, are preferred. The use of several supply registers located along the longest interior wall, blowing towards the perimeter wall, is an acceptable alternative.

Other systems such as fixed horizontal diffusers or floor registers do not promote proper air flow under all conditions and may result in stratification in the winter, which is to be avoided.

Floor diffusers (for return or forced hot air heating systems only) are to be heavy gauge, not the domestic type (unless it is for a residence).

Residential grilles and registers are unsuitable for buildings such as schools, where they may be easily damaged or manipulated. Registers designed for residential use are of a light gauge metal and incorporate balancing dampers, which are easily adjusted, possibly resulting in avoidable air balance problems.

Displacement ventilation systems introduce air at a low level into rooms through displacement supply registers. The airflow is at low velocities and at a temperature only slightly lower than that of the room. For example, air at 18°C is supplied to a room temperature of 21°C. This type of diffusion promotes better air quality and comfort.

Air diffusers located in the floor and blowing through the baseboard radiation are unacceptable unless the baseboards are specifically designed for this use.

Air supply through the baseboard radiation does not permit proper air diffusion and temperature control. Some radiation baseboards are designed to provide displacement ventilation. These specialized

Recommendation**Rationale****2. Dampers**

Balancing dampers are required on all main branches at each branch duct takeoff. Dampers to be in-line mounted and locking quadrant type. Splitter dampers are not acceptable for use as a balancing device. Volume control dampers at diffusers are not an acceptable means of controlling air volume.

baseboards separate the heating convection effect and the ventilation supply.

Line mounted dampers provide a reliable means of balancing. Results of adjustments made with splitter dampers are unpredictable, as the airflow in the main ducts as well as in the branch duct is changed. Dampers placed adjacent to supply outlets contribute to high noise levels because of the high velocity of air at that point.

3. Flexible Ductwork

Flexible ductwork shall be limited to short lengths within one metre of equipment to be connected. Flexible duct is to be fastened to the sheet metal ductwork and diffuser with an approved tie wrap or metal clamp (not with duct tape).

Improperly fastened and excessive lengths of flexible ductwork create air delivery problems by increasing pressure drops in the ductwork, and in many instances when fastened with duct tape, the tape falls off.

4. Flexible Connections

Flexible connections of approved, fire resistant design is required at the suction and discharge connections of fans and air handling units. Fan equipment is to be installed so that the connecting ductwork is lined up with the fan inlet or outlet and the flexible connection does not obstruct the airflow.

Flexible connections reduce the noise and vibration from the fan equipment from being transmitted through the building structure to the occupied spaces. The fan performance is adversely affected if the ductwork connection is offset, or if the flexible connection projects into the air stream. This results in increased energy consumption as well as reduced fan performance.

5. Branch Take-off Ducts

Branch take-off ducts to each air supply or exhaust outlet are to be a minimum 0.5 metre, located in an accessible location with a duct mounted balancing damper positioned near the take-off fitting.

Supply or exhaust (return) air outlets that are mounted directly on the main branch ductwork tend to have uneven velocities and are noisy and Uncontrollable. Balancing dampers located too close to the actual air outlets cause noise.

6. Duct Sealant

An approved duct sealant is to be used for sealing ductwork, such as Duro Dyne duct sealant. Duct tape is **not** acceptable.

Duct tape is not satisfactory for sealing ducts as it loses adhesive properties, particularly on cold ducts.

7. De-stratification Fans

Consider use of de-stratification ceiling fans in applicable high ceiling areas (i.e., garages, theatres, etc.) Size for total area coverage. Provide protective guards over fans where they may be subject to damage.

Allows for better-tempered air distribution during heating and cooling seasons. Reduces energy cost and improves space comfort.

Recommendation**Rationale**

8. Thermal insulation

Thermal insulation is to be provided on outdoor air intakes up to the heating coil and on exhaust ducts leading outside.

9. Jacketing

Jackets must be provided on all exposed ductwork and in mechanical rooms.

10. Acoustic Insulation

Acoustic insulation is to be provided on all transfer ductwork and wherever fan and duct noise may be a problem.

11. Silencers

Silencers are to be provided when required to meet noise criteria levels outlined in the Design Brief or in the Functional Program.

If there are no requirements outlined in the Functional Program, designers are encouraged to follow ASHRAE guidelines regarding acceptable noise levels for each type of room usage.

M.8.2.5 Air Exhaust

1. Location

Outdoor exhaust vents are to be located where they will not be susceptible to snow accumulation, or discharge directly into prevailing wind. Avoid locating in vicinity of the outdoor air intake (i.e., within 10 metres).

Snow accumulation can hamper or eliminate exhaust capability. A review of snow drifting patterns must be done when locating exhaust, as drifts will impede system operation for many months of the year.

2. Insulation

The exhaust air stack must be insulated where contact is made with outside air.

This reduces the amount of condensation that may freeze and build up, reducing the size or possibly closing off the exhaust opening.

3. Local Exhausts

Local exhausts should be provided in all rooms and spaces where high levels of contaminants or odours are generated.

They are typically provided in industrial arts rooms, change rooms, washrooms and kitchens.

Recommendation**Rationale**

Recirculating exhaust systems, such as range hoods, are not acceptable.

If the recirculation air filters are not maintained, the system tends to be ineffective.

- Individual major exhaust fans are to be interlocked with the air handling system.

Unless air is being brought in at the same time it is being exhausted from the building, a strong negative pressure can be created in the building.

- Local exhaust fans must not discharge into boiler rooms.

Unstable draft conditions will affect burner combustion efficiency.

- Areas having manually controlled exhaust fans are to be provided with timed switches.

This avoids the possibility of exhaust fans being left operating unintentionally for long periods of time.

M.8.2.6 Maintenance

600 mm x 600 mm access doors are required for fresh air dampers.

This allows operators and maintainers access for adjustments and repairs.

300 mm x 300 mm access doors are required for fire dampers and should be located no further than 500 mm from the fire dampers.

Ensure that fire dampers are easily accessible. Also, a schedule of fire dampers installed should be provided with the O&M manual and their exact location be clearly indicated on as-built drawings.

500 mm x 500 mm access doors are required for:

- Exhaust air dampers
- Return air dampers
- Filters, coils
- Balancing dampers
- Mixing boxes
- Reheat boxes
- Turning vanes

Isolating and balancing valves must be installed so that the flow through each heating coil in the air handling system can be adjusted with the coil circulating pump operating or not.

Adequate access and space should be provided to allow complete removal of heating coils.

It must be possible to operate the system manually if the three-way valve must be removed for maintenance or repairs.

Provide enough unions and valves to allow complete removal of heating coils.

Basic maintenance requirements.

Provide access panels upstream and downstream of heating coils, adequately sized to allow for cleaning.

M.8.2.7 Provisions of Monitoring Performance**1. Balancing**

Recommendation**Rationale**

Instrument test holes, drilled on site and sealed with duct plugs, are preferred to test ports for ventilation system balancing.

Test ports are costly and not required frequently enough to warrant extra expense. Test holes can be drilled on site by the balancing contractor where and as required, eliminating the need for coordination with other subcontractors.

2. Adjusting Outdoor Air

Instrumentation must be installed to allow operators to regularly monitor temperatures of outdoor air, mixed air and supply air. Dial type thermometers are preferred.

By monitoring temperatures. The correct proportions of outdoor air and mixed air can be set to ensure suitable supply air temperature. When this is not possible, users may be subjected to uncomfortable conditions. Other types of thermometers can be difficult.

Each air-handling unit is to have supply air, mixed air, return air and outdoor air monitoring.

Provides indication to building operator of system performance.

M.8.2.8 Heat Recovery Systems

Due to the need for energy efficiency in buildings, energy recovery ventilators (ERV's) are to be used wherever savings from their use can be demonstrated to provide acceptable payback against the added capital costs of provision of the system.

Package energy recovery ventilators are acceptable for small facilities such as community air terminal buildings, small offices, etc. They must be provided with a pre-heat coil on the outdoor air intake to counter defrost cycles.

ERV's in small buildings are recommended for their low installation cost. Unit could be set to operate on intermittent timing.

Heat pipes and glycol heat recovery runaround loops may be acceptable for larger facilities.

M.8.2.9 Filters

All air shall be filtered before entering coils, equipment or occupied spaces, using throwaway, standard size filters.

The intent is to prevent dust build-up and make it simple to replace filters regularly.

Filtering shall be achieved by one set of filters, not by a summer-winter filter arrangement.

A summer-winter filter bank arrangement is unsatisfactory because it is based on allowing entry of snow into the air handling system. Where this has been tried, the maintainers sometimes may not be aware that they are to remove one set in each season.

On recirculating air systems, provision should be made for having filters capable of an 80% average efficiency. Typically, only 60% efficiency air filters should be installed.

While the lower efficiency filters may not be needed to meet current codes, sufficient space in the ventilation system should be provided to accommodate higher efficiency filters.

Recommendation**Rationale**

Filter size, number and design are to be permanently labelled (lamicoid) on the unit near the filter access door.

This makes it easier for maintenance staff and ensures that proper filters are re-supplied.

M.8.2.10 Acoustic Control**1. Duct Lining**

Acoustic lining should be avoided.

Duct work with an acoustic liner is almost impossible to clean. Duct lining has been identified as a source of contaminant in the air stream. Its use should be minimized, and silencers should be used instead.

2. Acoustic Separations

All components of the mechanical ventilation system must be designed so that sound level will be within noise criteria limits recommended by ASHRAE.

Mechanical noise and vibration of fans and pumps can be objectionable to building occupants. NBC 6.2.1.1 requires HVAC systems to conform to good engineering practice such as described in the ASHRAE Handbooks and Standards.

M.8.2.11 Mechanical Room Cooling

In mechanical rooms and boiler rooms, provide mechanical make up and/or exhaust systems to maintain the rooms at acceptable operating temperatures.

Mechanical and boiler rooms operating at continuous high temperatures will shorten the service life of mechanical and electrical components and create uncomfortable working conditions for operation and maintenance personnel.

M.8.3 AIR CONDITIONING

Although outdoor air temperatures can rise above comfortable indoor levels during the summer months, the additional cost of providing air conditioning is rarely justifiable for the short period of time it will be required. There are instances, however, where it may be justified because important normal operations would otherwise be disrupted.

Recommendation**Rationale****M.8.3.1 Cooling**

For most of the year, varying the amount of outdoor air introduced into the system, and adjusting the heat supplied to heating coils can control the supply air temperature. Free cooling is generally adequate for the hottest days of the year.

The additional expense of cooling equipment must be weighed against the benefit of cooling. Where cooling may be needed only for a few days of the year, the use of cooling equipment is discouraged because of the added capital and O&M costs.

When even the maximum amount of outdoor air (see M8.2.2.2 "Outdoor Air Supply" -reference to free cooling) will produce supply air above 18°C for an extended period of time, the need for cooling equipment should be reviewed.

Recommendation

Where air conditioning is installed, equipment must be designed in conformance with the ACNBC Canadian Heating, Ventilation and Air Conditioning Code.

Rationale

Provision must be made for the proper shutdown in fall and start-up in the spring.

M.8.3.2 Humidification

Humidification is not typically required or recommended in public sector buildings.

Humidification systems in the North have historically proven to be very difficult to operate and maintain because of the continual attention required to ensure efficient and proper operation. During extremely cold outdoor temperatures, the humidification levels in a building must be kept low to prevent excessive condensation on windows and to prevent deterioration of the building envelope. This reduces the benefits of humidifying the building and contradicts the rationale for providing a humidification system in the first place.

Where humidification is deemed necessary and specifically stipulated as a functional program requirement, it should be steam-generated, and the system equipped with controls that automatically reset the humidity level to the outside air temperature. Supply water to the system must be properly treated.

Steam-generated humidification is more reliable than atomization systems, which regularly malfunction due to calcium build-up. A proper water supply to the humidification system is required to ensure long-term system operation.

M.8.4 ENERGY RECOVERY AND DEMAND CONTROL SYSTEMS

Higher energy costs coupled with growing concerns regarding indoor air quality have placed increased demands on energy recovery and control system technologies. A method of maintaining good indoor air quality and conserving energy is to control the ventilation rate according to the needs and requirements of building occupants.

Technologies such as Demand Control Ventilation (DCV), Direct Digital Control (DDC), new energy recovery equipment and associated controls provide opportunities to reduce energy consumption.

Recommendation**Rationale****M.8.4.1 General**

When designing new building systems, whether heating, ventilation, and/or services, every effort should be made to incorporate energy recovery and/or control systems. Consideration should be given when weighing possible marginally higher installation costs versus overall operational cost reductions, especially on smaller systems. Provide the client/user with a capital cost recovery summary as part of the system design and analysis.

Reduces size of primary load equipment (i.e., boilers, chillers, burners, pumps, etc.), thereby reducing overall energy consumption. In many new buildings, the cost savings resulting from the reduction of cooling tonnage and/or heating equipment size, alone offsets the initial cost of thermal recovery units.

Recommendation**Rationale****M.8.4.2 Energy Recovery****Device – General**

When electing heat recovery equipment, select devices that recovery sensible heat.

Sensible heat is the most readily recoverable energy, especially considering the low humidity levels encountered in the North.

Heat wheels can recover latent as well as sensible heat whereas heat pipes, heat exchangers and glycol loops cannot. Note that heat wheels cannot be used where there is danger of cross-contamination between airflows. The efficiency of heat wheels is higher than that of heat pipes or glycol loops. However, the use of heat wheels should be avoided in remote communities because they may be too complex for local maintainers.

Use counter-flow type energy recovery equipment only.

Generally, counter-flow provides the greatest temperature difference and heat transfer rate across the recovery exchanger.

Designer must bear in mind the project location and maintenance preferences when selecting types of heat recovery systems.

When selecting, consider such factors as installation and operational costs, ease of operation, simplicity and maintenance, etc.

M.8.4.3 Demand Control Systems

On large volume systems (i.e., greater than 4000 cfm), maximize usage of demand control ventilation (DCV) systems using sensory controls (i.e., CO2 sensors; time control and/or occupancy sensors). CO2 control is best utilized in rooms where occupancy variation is high and/or unpredictable. Timed control is best used in situations where the occupancy load and load variations of a building are known over time, while occupancy sensors are best utilized in low occupancy, intermittent use areas.

When properly located and installed, DCV systems offer greater payback than energy recovery systems and generally range from two to five years.

M.8.4.4 Variable Frequency Drives (VFDs)

VFDs can be used to control mechanical equipment such as pumps and fans. Installation of VFDs is to be coordinated with the Electrical Designer. A VFD should be rated to match the electrical characteristics of the motor, the starter and the circuit protection.

The use of a VFD to control mechanical equipment that has fluctuating patterns of use can result in energy savings. The Mechanical Designer will determine the need for a VFD, and it is the responsibility of the Electrical Designer to ensure that its installation is in accordance with electrical codes and standards.

Recommendation**Rationale****M.8.5 SERVICE FACILITIES****M.8.5.1 Air Curtains**

Overhead garage or service doors which are often used should be provided with air curtains. Air curtains supply a flow of air down over the door openings when doors are open. This reduces infiltration and saves energy.

Where air curtains are installed on overhead doors, significant heating energy savings can result.

M.9 AUTOMATIC TEMPERATURE CONTROLS

An automatic temperature control system properly designed, installed, maintained and operated provides the best possible occupant comfort and the most efficient mechanical system operation.

M.9.1 GENERAL

Recommendation

Conventional, low voltage (24 volt) electric control systems are acceptable for most buildings.

Direct Digital Control systems with electronically operated control devices may be used in larger type buildings (e.g., schools, health centres, hospitals, etc.).

Rationale

Electric controls are simpler to operate and to service, especially in more remote communities.

The control industry is changing more and more to DDC controls. The systems are now robust enough and easy enough to operate in remote communities. The ability to be diagnosed remotely over a modem has advantages in remote communities.

M.9.2 CONTROL COMPONENTS

Recommendation

Rationale

M.9.2.1 Components – General

All controls, regardless of type, are to be calibrated in degrees Celsius, whenever possible.

The GN has standardized on the metric system. It is confusing to have mixed markings on controls.

CSA approval is required for all control equipment, including alarm panels.

Stand-offs are required for all duct- mounted controls and accessories mounted on externally insulated ducts.

Stand-offs are intended to keep these items fully accessible for operation and servicing.

M.9.2.2 Thermostats and Sensors

Thermostats and/or sensors located in gymnasiums are to be located 2400 mm above the floor and be complete with a heavy-duty metal guard.

Gym thermostats and sensors need to be protected against damage, and the students need to be protected from sharp comers. Gyms are used for public functions, which requires that they have tamper- proof covers.

In cases where a space thermostat controls a heating control valve and a variable air volume or cooling control in sequence, there is to be a dead band of 2°C between the heating and cooling.

The intent is to optimize energy consumption by avoiding simultaneous heating and mechanical cooling, or heating and free cooling.

Thermostats located in public areas must have vandal-proof guards.

This prevents intentional or unintentional tampering by building users.

Locking type thermostats are to be used in public facilities where maintainers only should be able to adjust temperatures.

Where there are a variety of users, it is often preferable to allow only maintenance staff to control temperature in public areas of facilities such as arenas, lobbies, public washrooms, public areas of air terminal buildings.

Recommendation**Rationale**

Locking type thermostats are not to be used where it is desirable to allow users to adjust room temperatures (refer to functional program for direction). Where users should be able to adjust room temperatures, range limits are to be used to restrict the amount of adjustment above or below predetermined values.

In many cases it is more appropriate to allow users to adjust room temperatures (rather than having them rely on maintainers for minimal adjustments). Examples include health Centres, staffed areas of schools (offices, classrooms), and community offices. Range limits would protect against overheating.

Low voltage electric heating thermostats are to be SPST (single pole, single throw, i.e., similar to Honeywell T86A).

In cases where SPDT (single pole, double throw) thermostats have been used, the wiring has sometimes been installed incorrectly. The SPST thermostats are simpler, and less likely to be installed incorrectly.

M.9.2.3 Control Valves

Control valves (i.e., two- and three-way control valves for heating or cooling coils) are to be sized based on a Cv rating required to provide a pressure drop of 21 kPa or other rationale to ensure that there will be no 'hunting' at low flow rates.

Incorrectly sized control valves result in poor controllability.

Normally open, electrically operated heating zone valves are to be used. Do not use thermostatic valves.

This allows for flow through heating system in the event of an actuator failure. Thermostatic valves are not recommended, as they require ongoing calibration.

M.9.2.4 Flow Switches

Flow switches are to be vane type on piping 50 mm and smaller. Paddle type flow switches will be acceptable on larger piping.

On smaller piping sizes, paddle type flow switches are difficult to install properly and do not function adequately. The sensitivity cannot be adjusted, resulting in nuisance alarms.

M.9.2.5 Control Transformers

The number of control devices, i.e., low voltage electric zone control valve for heating radiation, is to be calculated for each given transformer, based on the type of device.

Limiting the number of control devices on a circuit avoids excessive voltage drop for each controlled device and premature failure.

M.9.2.6 Damper Actuators

Independent damper actuators are to be appropriately sized and installed on each outdoor air, return air and relief air control damper.

Where a common damper actuator is used a long connecting rod is sometimes required, which is nearly impossible to set up, and the quality of control is reduced.

M.9.3 VENTILATION UNIT CONTROL**Recommendation****Rationale****M.9.3.1 Outdoor Air**

The amount of outdoor air brought in to the system is to be controlled by a mixed air temperature sensor with its minimum settings to the recommended ASHRAE 62.1 minimum requirement.

Outdoor air (normally cold) is mixed with room temperature return air to produce supply air (mixed air). The amount of outdoor air is varied to provide more or less cooling as needed but never less than the minimum code requirements.

M.9.3.2 Return Air

In no case should the heating coil in the air handling system be controlled by the thermostat in the return air duct.

Normally air returns to the mixing chamber from user areas and will therefore be at or above 20°C. If for any reason it falls below this, the heating coil activates and the ventilation system ends up acting as a heating system (like a forced air system), rendering the hydronic heating system thermostat controls ineffective.

M.9.3.3 Supply Air (Mixed Air)

A supply air controller is required to control the temperature of the supply air to between 13 -16°C. For most of the year, varying the amount of outdoor air introduced into the system can control the supply air temperature. When the maximum amount of outdoor air will produce supply air above 18°C for extended periods of time, the need for cooling equipment should be reviewed. See Mechanical M8.3 "Air Conditioning".

Air is normally supplied at a high level in a room or space. If it is supplied at a temperature equal to or warmer than the room, it tends to remain at a high level in the room and not come down into the occupied space where it is needed.

The mixed air controller in the air handling system (controlling outside and return air dampers) must be the averaging type.

The averaging type sensor avoids inaccurate measurement by averaging colder or warmer air streams.

An automatic reset type freeze stat located downstream of the heating coil must be provided and set at 5°C.

The automatic reset type freeze stat is required to reduce the likelihood of air handling systems shutting down and remaining off during cold weather extremes.

M.9.3.4 Heating Coils

The thermostat controlling the heating coil in each AHU (air handling unit) should be located a minimum of three metres downstream of the coil in the supply air duct and preferably downstream of the supply fan.

The distance from the coil ensures the thermostat reads the actual supply air temperature (not the temperature immediately next to the heating coil).

Fast response type controllers should control heating coil control valves.

Without fast response controllers, the control valve hunts from full open to full closed position, never reaching a position of equilibrium, resulting in the overheating of occupied spaces.

Recommendation

Electric, modulating controls are preferred for heating coils. And they must remain energized even when the AHU fan is shut down.

Rationale

If the controls are de-energized when the air handling system is shut down, the heating medium circulates freely to the heating coil (given that normally open valves are preferred) when it is not required, and often the result is overheating.

M.9.3.5 Time Clock

The operation of mechanical equipment with intermittent usage such as ventilation units is to be controlled by operator/user-activated time clocks appropriately located in the area being served. The timers should be manual spring-wound type or electronic countdown type with operating ranges selected to match the occupancy of the area served.

Operator/user-activated timers that are conveniently located in the area served ensure that the mechanical equipment will operate only as required, thus reducing energy consumption and reducing operating and maintenance costs.

Where it is not possible or appropriate to provide the above user-activated control, provide a 7-day programmable time clock c/w quartz control clock and battery back-up.

This is intended to ensure that mechanical equipment is programmed to operate only during occupied periods and to shut down during unoccupied periods. It also reduces operating and maintenance costs.

M.9.3.6 Typical Ventilation Unit Control

A typical direct digital control system has been developed for ventilation unit control. The control strategy can be applied to many ventilation units, both small and large. Refer to Figure 9.1.

A typical ventilation control strategy will provide some consistency in operation and maintenance.

M.9.3.7 Typical Direct Digital Control (DDC) Sequence of Operation

The ventilation system will start by pressing the system start push button PB-1 located in the general office, gymnasium, or area served. The vent unit will start and operate for the predetermined number of hours as pre-programmed in the DDC and will then shut down (a gym vent unit would typically be set to operate 4 hours). If additional time is required, the unit can be restarted by pushing the start button PB-1 again.

The DDC controller will start the supply fan with the HAND-OFF-AUTO switch in the AUTO position via digital output DO-1. The return fan, associated exhaust fans and heating coil circulating pumps will be hard wired to operate with the supply fan. Supply fan start up will notify the DDC by digital input D1-2, wired to the auxiliary contact of the supply fan starter.

Upon confirmation of start up from D1-2, the vent unit will operate on 100% return air for a preset purge time to stabilize temperatures (i.e., 5 minutes). At the end of the pre-programmed purge time, the supply air control loop will assume control of the mixed air dampers, DA-1, 2,3. The mixed air dampers will be ramped to the minimum or control position over a preset time (i.e., 10 minutes).

The supply air control loop, with inputs from supply air temperature sensor TS-1 and return air temperature sensor TS-2, will modulate the heating coil valve V-1 in sequence with the mixed air dampers DA-1, 2,3 to maintain the supply air temperature at the proper set point as determined by the return air reset loop. A supply air temperature reset potentiometer ADJ-1, located beside the DDC panel, will allow the operator to INCREASE or DECREASE the supply air temperature, within limits (i.e., 3°C), to suit specific building requirements.

CO₂ sensors can be used as part of Demand Control Ventilation (DCV) strategies. Typically, the indoor CO₂ level is compared to the outside level. Based on the room's usage, an acceptable CO₂ differential is determined. Outdoor ventilation is then modulated to meet the acceptable CO₂ differential. Designers should refer to ASHRAE requirements when designing such systems.

Direct mount and readout analog thermometers TI-1, 2, 3, 4 will provide the operator with outdoor, mixed, supply and return air temperatures. A magnehelic type differential pressure gauge, FI-1, mounted on the unit, will provide indication of the differential pressure or loading of the vent unit filters. A differential pressure switch, DP-1, sensing filter loading will input to the DDC controller a dirty filter condition.

A low limit control loop with inputs from the supply air temperature sensor TS-1, located downstream of the supply fan, will shut down the vent unit upon sensing a low supply air temperature, after a 5-minute time delay.

The following user adjustable set point and control parameters will require password access

- Ventilation unit run time (2, 4, 10 hours, etc.)
- Purge time at system start (10 minutes)
- Mixed air dampers ramp time (10 minutes)
- Minimum outdoor air position (15, 20, 30%, etc.)
- Supply/return air temp reset schedule
- Remote supply air temperature reset adjustment span (3°C)
- Low limit supply air temperature set point adjustment (2°C)

Provide continuous trending at 30-minute intervals for the following points:

- Supply air temperature
- Outdoor air temperature (one sensor per project)
- Return air temperature
- CO₂ reading
- Filter status (CLEAN/DIRTY)
- Supply fan status (ON/OFF)

M.9.3.8 Typical DDV Sequence of Operation Diagram

Provide a modem module connection on buildings where required to allow off-site monitoring of the system performance.

Figure M.9 - 1– Ventilation System Control Schematic

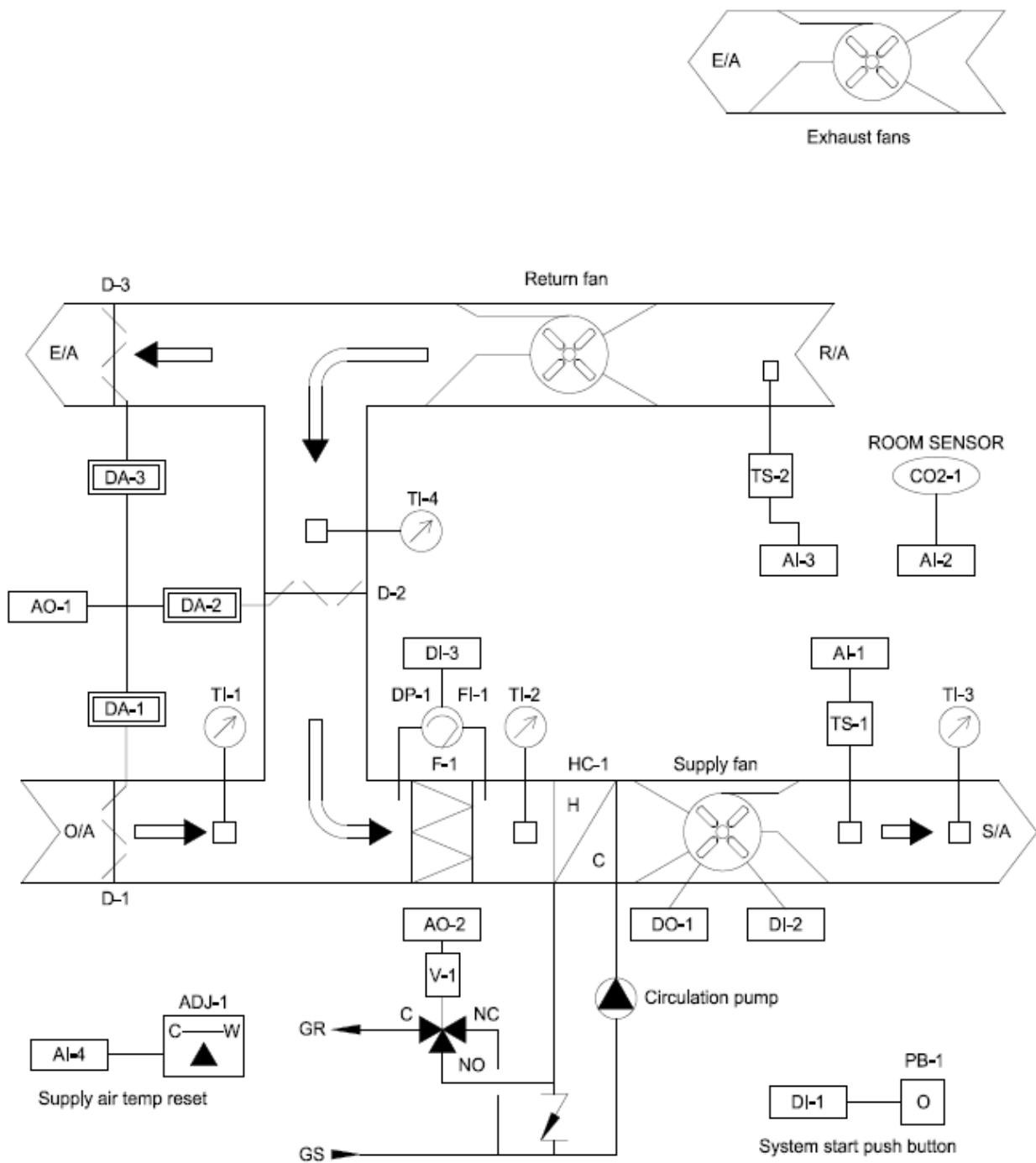
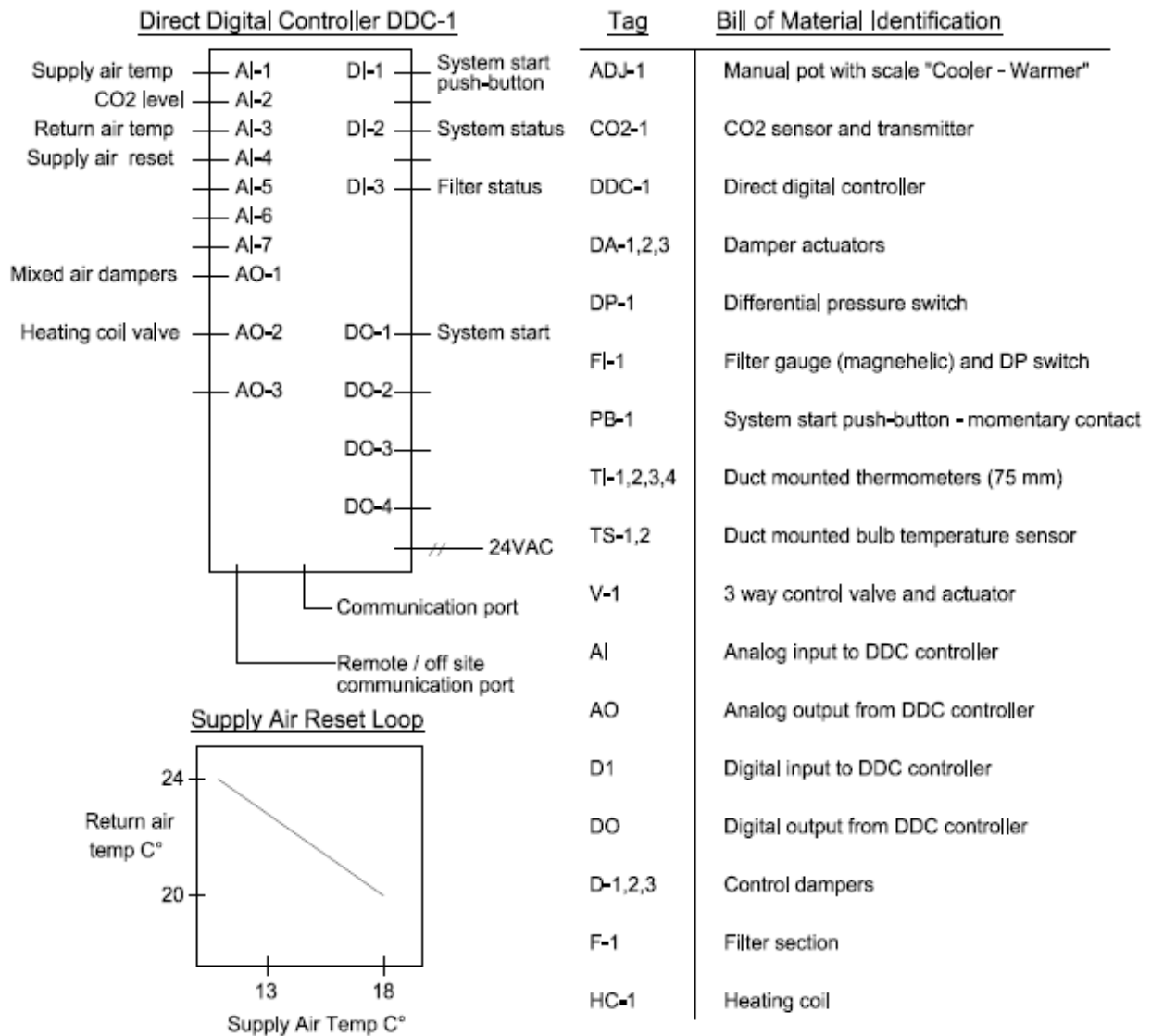


Figure M.9 - 2– Direct Digital Controller Identification



M.9.4 HYDRONIC HEATING CONTROL

Recommendation

Rationale

M.9.4.1 Radiation Control

The radiation zone is to be controlled by a low-voltage room thermostat controlling the normally open (NO) modulating control valve.

This provides a cost-effective radiation zone control.

Recommendation**Rationale**

All heating loops, including those installed in washrooms and storage rooms, are to be provided with individual or zone control, and not 'run wild.'

The small additional initial cost of providing control is much less than the long-term energy savings, given the high cost of heating energy.

M.9.4.2 Force Flow Control

The force flow unit is to be controlled by a line voltage, low-range, wall-mounted thermostat complete with locking metal guard. Provide control valves on units where overheating of the area may occur when the fan is off.

This provides a cost-effective control of force flow units.

M.9.4.3 Unit Heater Control

The unit heater is to be controlled by a line voltage, low-range, wall-mounted thermostat complete with locking metal guard.

This provides a cost-effective control of unit heaters.

Provide control valves on units where overheating of the area may occur when the fan is off.

The room thermostat is to be located on the wall, but not directly in the air stream from the unit and shall be provided with a locking guard.

M.9.4.4 Boiler Temperature Control

Provide indoor/outdoor controls for boilers with 2 or 3 step settings.

Seasonal adjustments to boiler temperatures can occur automatically (increased in cold weather, decreased in warmer weather), thereby increasing energy efficiency.

If existing domestic HW tanks are dependent on boilers, do not use this method of control.

M.9.5 MECHANICAL ALARMS**Recommendation****Rationale****M.9.5.1 Mechanical Alarms**

Mechanical alarms should be minimized and restricted to essential building conditions. Low building temperature is the only condition that is considered to be 'critical' and that must activate the automatic dialer and/or outdoor alarm light.

Elaborate alarm systems, which are costly to install and maintain, have caused many nuisance call-outs and may become ignored. The probability of false alarms is reduced with only one (i.e., low building temperature) alarm designated as critical.

M.9.6 OPERATION AND MAINTENANCE**M.9.6.1 Identification**

When a DDC system is installed, all addressable components must be provided with a permanent lamicoid identification label.

Provide framed glazed schematics for all systems to be mounted on a wall adjacent to the system. A complete sequence of operation is to be included for all systems.

END OF SECTION

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CHAPTER E - ELECTRICAL

INTRODUCTION

Electrical energy in 25 isolated communities of Canada's largest territory is primarily provided by the Qulliq Energy Corporation's stand alone and unconnected power diesel generation systems resulting in very high energy cost. The unique northern operating environment requires the optimum mix of special industry proven; design considerations for installation of efficient and reliable electrical systems and equipment while ensuring safe, economical, optimised operational efficiency leading to a longer lifespan of equipment and investment sustainability. Since the late 1980s electricity has been available in every community in the Nunavut. Electric lighting, appliances, telecommunication and computer equipment are now typical in buildings across the territory. As well, the construction of increasingly airtight buildings, in the interest of reducing fuel costs, has resulted in an increased use of electricity to power mechanical systems and controls. Automatic controls balance the conflicting requirements for comfort, energy conservation, simplicity and reliability.

E.1 CODES AND REGULATIONS

E.1.1 REFERENCE DOCUMENTS

All Electrical installations & equipment are to meet strict compliance with the stringent most requirements of the latest edition of the applicable codes and regulations including, but not necessarily limited to the following:

- National Building Code of Canada (NBC)
- Government of Nunavut Safety Services Division 1 Building Code Act 2
- Government of Nunavut Fire Prevention Act 2
- Government of Nunavut Technical Standards and Safety Act
- Canadian Electrical Code (CEC)
- Underwriters Laboratories Canada (ULC)
- Underwriters Laboratories Incorporated (ULI Canada)
- Canadian Standards Association (CSA)
- Illuminating Engineering Society of North America (IESNA) Lighting Handbook 10th Edition
- Institute of Electrical and Electronics Engineers (IEEE)
- GN Electrical Mechanical Safety Section -Electrical Bulletins
- Government of Nunavut's (CGS-IPS) Structured Cabling Guidelines Version 1.6 – August 2015
- National Fire Code of Canada (NFC)
- National Energy Code of Canada for Building 2015 (NECB)
- Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
- National Electrical Manufacturers Association (NEMA)
- Telecommunications Industries Association (TIA)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Insulated Cables Engineers Association (ICEA)
- Aerodrome Standards and Recommended Practices (TP312E)
- International Electrical Testing Association (ANSI /NETA ATS)
(Standard for Acceptance Testing Specifications for Electrical Power Equipment & System)

Related offices include:

Protection Services Divisions and Safety Services – Community and Government Services

- Qulliq Energy Corporation (QEC)
- NorthwesTel
- Arctic Cable (Local Cable Television Authority)

E.1.2 MATERIAL STANDARDS

All electrical equipment, assemblies and materials is to be approved by Canadian Standards Association (CSA), Warnock Hersey, ULI ULC Canada & ETL Testing Laboratories Inc. or any other accredited agency approved in accordance with the Govt. of Nunavut's Electrical Protection Regulations by the Chief Electrical Inspector, Safety Services, CGS Safety Services Division.

Rational

To ensure the electrical service & distribution equipment, devices, assemblies and materials including appliances and wiring products installed in Nunavut buildings conform to specific national standards recognized by the Intertek, Underwriters Laboratory, Standards Council of Canada (SCC) and Canadian Standards Association's Canadian product certification.

E.2 OPERATION AND MAINTENANCE

E.2.1 GENERAL

See G1 and G4.

E.2.2 ACCESS

Electrical systems generally require relatively little maintenance. However, easy access to equipment that must be serviced is important. Access hatches and spaces to be provided for all electrical equipment are required to ensure a safe working area to service or replace electrical equipment.

E.2.3 SPARES

Regional Maintainers should determine, in consultation with the Technical Officer, Project Manager and design consultants, what spare parts should be provided. The following is a recommended list of regular and emergency spare parts that should be stored in each facility for communities that are not on the road system:

- set of each type of manual starter heater
- 3 spare fuses of each type used (i.e., 600 V and below)
- 5 spare fuses of each type used (i.e., control fuses)
- 1 spare coil of each starter size
- 1 spare control transformer of each type used
- 5 spare pilot lights of each type used (i.e., fire alarm panels, MCCs, transfer switch), 10 of each if they are incandescent
- Spare LED lamps equal to 10% of the number used in the facility. Specify an integer number of lamps rounded to the nearest case
- 5 spares of each other type or size of lamps used
- 5 % spare 1P-15 Amp breakers within each panel board, minimum of 2
- 5 % breaker spaces within each panel or distribution board, minimum of 2

If a generator is required, provide:

- 5 spare oil filters
- 5 spare fuel filters
- 5 spare air filters
- 3 air cleaner elements
- 3 set of fuses for control panel
- 2 spare fan belts of each type used

Where metric size nuts and bolts are used, provide one set of sockets complete with ratchet handle and set of combination.

E.2.4 MAINTENANCE TOOLS

Provide complete sets of specialized tools required for adjustment and maintenance of equipment supplied.

Rationale:

Spare parts are often difficult, if not impossible, to get within many communities, and there is often a long-time lapse required to send in spare parts. As a minimum an inventory of spare parts as listed, if maintained, should cover most of the regular and emergency maintenance required on electrical systems during a facility's lifetime. Spare parts used for repair during warranty period are to be replaced at the end of the warranty period.

E.2.5 STANDARDIZATION

In the interest of maintenance and economy, it would be prudent to ensure that all distribution panels, equipment, assemblies and materials, interior, exterior, exit and emergency lighting fixtures and controls, pumps, starters heating systems and ancillaries including appliances and power outlets devices and wiring products installed in Nunavut buildings be of the same manufacturer throughout each facility.

E.2.6 CSA CODE REQUIREMENTS

CSA specific requirements of CSA-282/CSA, Z32 & Z-462-12 regarding spare parts, special tools, log books, for testing & maintaining systems, and workplace electrical safety. These requirements are to be included in the project specifications for the information and implementation by contractors.

E.2.7 OPERATION AND MAINTENANCE MANUALS (O&M MANUALS)

At present, manuals are to be prepared in accordance with good engineering practice.

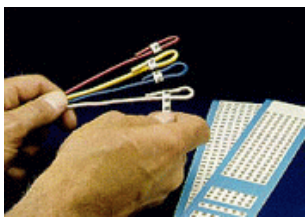


E.3 IDENTIFICATION

Clear identification of electrical equipment is particularly important for the electrical system. Local maintainers and trades people should be able to quickly understand and locate related system equipment. Consistent identification in all public sector buildings is recommended to ensure that maintainers and operators can easily become familiar with any public sector building in any community.

Nameplates of equipment shall be easily visible and easily readable after installation.

The language should be English. There are four official languages (including dialects) in the Nunavut. However, for operations and maintenance staff and trades people, an understanding of English is required, and therefore English is the language recommended for identification of components and systems.

Various levels of identification can be incorporated within a specific building. According to the Canadian Electrical Code, annunciation of main distribution panels, sub-panels, motor control centers, and motor starters is required. Additional steps in identification are listed below for possible implementation.

| | | |
|---|---|---|
|  |  |  |
| Tape style identification | Heat shrink identification | Printable sleeves |

E.3.1 IDENTIFICATION

Colours of conductors shall be as specified in the Canadian Electrical Code.

Recommendation

Self-laminating conductor markers may be used to identify conductors at all panel boards, motor control centers, junction boxes, terminal cabinets and outlet boxes. The numbering system can include circuit numbers on power circuits. In low voltage and control system wiring, the numbering should match the control diagrams.

Rationale

Circuit numbers are useful to identify wiring for trouble-shooting and to avoid accidents by preventing contact with energized conductors. Due to the increasing complexity of electrical systems, it has become important to identify wiring with control diagrams of the system, to be able to trace wiring when correcting operation and maintenance problems. The minimal cost of identifying the conductors is paid back during trouble-shooting, and during training of maintainers or when modifying the system.

E.3.1.1 Power Distribution Identification

Provide comprehensive single line diagram of the power distribution system as part of the contract documents complete with the following:

This ensures the safety of maintenance & emergency response personnel (e.g. fire fighters) to provide a clear understanding of installed systems and where to de-energize equipment when servicing.

Recommendation

- Configuration, type, voltage current rating of all switchgear, transformers panel boards & motor control centres.
- Type, frame size, trip size, interrupting rating of all overcurrent protective devices.
- Available fault current at all switchgear, switchboards, panel boards and MCC's.
- Type Size and current ratings of services & feeders.
- Connected load and anticipated demand load at all switchgear, switchboards, panel boards and MCC's.
- Provide copies of "as-built" single line diagrams as part of the Operating and Maintenance Manuals.

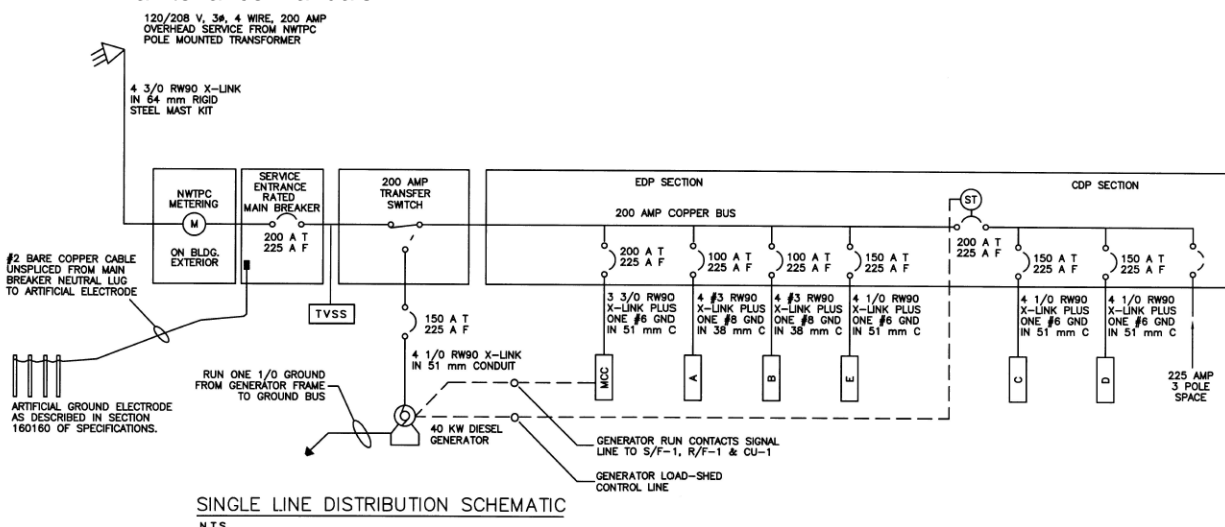
Rationale

Figure E.3 - 1- Sample Single Line Diagram

E.3.2 RACEWAY/JUNCTION BOX IDENTIFICATION**Recommendation****E.3.2.1 Junction Boxes**

Provide identification of the enclosed systems by painting the junction cover plates. See Electrical System Identification Tables E-1 and E-2.

Rationale

This is useful when tracing system conduits, locating devices and system components when troubleshooting or when problems making additions or deletions to the system.

Recommendation**Rationale****E.3.3 EQUIPMENT IDENTIFICATION**

See Electrical System Identification Tables E-1 and E-2.

E.3.3.1 Panel Directory

Computer generated or typewritten panel directories are required.

Hand written directories vary in legibility and durability.

Room numbers used for circuit identification should be those that are identified on the contract documents.

Maintainers should have access to the original & subsequent drawings for reference. The room numbers are required by other sections of the GBP.

At times both a room name and number may be used.

Common names of rooms that are unlikely to change may also be used for quick identification. E.g.: Mechanical Room, Electrical Room, Janitorial etc.

The directory should allow for identification of any future loads added to the panel. A copy of the file should be included in the O & M manual.

This provision would provide ease of future updating the directory when changes are made.

E.3.3.2 Terminal Cabinets

In terminal cabinets for control wiring and low voltage wiring, identify terminal and wiring with appropriate labeling. Provide a computer generated or typewritten panel directory.

This is done for operations and maintenance staff (maintainers to factory representatives) to be able to quickly trouble shoot problems and to add and delete parts of the system.

E.3.3.3 Labels and Lamacoids in Service Rooms

Mechanically fasten all lamacoids in service areas and mount adjacent to, not on, controllers. Fasten all on equipment either by mechanical means or with adhesive backing. Ensure lamacoid is applied on clean level surface.

Mounting labels not on controllers ensure identification is not painted over during maintenance activities.

Alternative: provide lamacoids on cover and inside enclosure, instead of "adjacent to" when two (2) or more panel boards of the same size are installed side by side or in the same room.

Relays in control cabinets must be identified for maintenance and trouble-shooting.

Type D labels should be provided for relays in control cabinets.

E.3.3.4 Control Diagrams

Copies of the control diagrams of the enclosed system may be located within enclosures designated for such and an additional copy provided within the appropriate section of the O & M manual.

Many simple or complex control systems are located in public sector building. No matter the complexity, control diagrams provide the electrical or maintenance staff with the

Recommendation**Rationale**

information they need to understand the proper operation of the system. The minimal cost of providing control diagrams is paid back during future trouble shooting, and during training of maintainers or when modifying/repairing the system.

E.3.4 RECEPTACLE IDENTIFICATION

Circuit and panel may identify receptacles only when it is important that a building user unfamiliar with the electrical system be able to quickly re-set breakers.

Recommendation**Rationale****E.3.4.1 See Electrical System Identification
Tables E-1 and E-2**

This is typically required in basic health care areas of health centers, patient care areas of hospitals and industrial arts rooms of schools.

E.3.4.2 Receptacle Labels

Mount labels adjacent to, not on the cover plate of the receptacle

This practice ensures identification if the cover plates are removed (i.e., during painting).

Use Lamacoids

Printed labels may be easily painted over, whereas lamacoids are raised off the wall surface and even if painted over remain readable

**ELECTRICAL SYSTEM IDENTIFICATION TABLE E-1
LABELS AND LAMACOIDS**

| Component | Type | Information |
|---|------------------|--|
| Main distribution centre | A | Year installed, name of facility, names of electrical engineer and electrical contractor |
| Main breaker | A | Voltage, phase, amps |
| Sub distribution panel | A | Name of panels it is feeding (i.e., Panel A, Panel B) |
| Panel boards | A | Panel designations (i.e., A, B, C or EA, EB, EC for panels fed from emergency power) |
| Terminal cabinets i.e., telephone, low voltage | B | Indicate equipment controlled (i.e., Telephone Rooms 1-12, Intercom Rooms 1-7) |
| Equipment i.e., motors, fans, pumps, etc. | | SEE MECHANICAL IDENTIFICATION STANDARDS |
| Disconnect switches | B | Indicate equipment controlled and voltage |
| Starters / contactors | B | Indicate equipment controlled and voltage |
| Motor control centres | B | Indicate equipment controlled and voltage |
| Transformers | B | Circuit and panel designations |
| Relays | D | Circuit and panel designations |
| Junction boxes, pull boxes | D | Circuit and panel designation for power. Contents for low voltage (i.e., TV rooms 1-12 or security rooms 1,2 & 7) |
| On/Off switches | C | If it is not obvious, then indicate area being served (i.e., service spaces or grouped switches) |
| Fire alarm devices (i.e., pull stations, end of line) | C | Zone number and device number in that zone (i.e., Zone 1-#3, Zone 10 - #7) |
| Receptacles: \$ standard duplex \$ GFCI \$ surge suppression \$ special receptacles | D D D D | Indicate: \$ panel / circuit designation \$ panel / circuit designation \$ panel / circuit designation \$ panel / circuit designation and voltage, phase, amps |

| Label | Letter Height | Type | Colours |
|--------|---------------|-------------------|------------------------------------|
| Type A | 9.5 mm | Riveted lamacoid | white lettering / black background |
| Type B | 6.0 mm | Riveted lamacoid | white lettering / black background |
| Type C | 3.0 mm | Adhesive lamacoid | white lettering / black background |
| Type D | 3.0 mm | Adhesive label | black lettering |

Note: for fire alarm components background shall be red.

ELECTRICAL SYSTEM IDENTIFICATION TABLE E-1
COLOURS

| Component | Conductors or Cables | Raceways and Junction Boxes ¹ | Receptacles | Other |
|--|---|---|-----------------------------|---|
| Normal power: - 120/208, 240 volts - 347/600 volt | Code Code | Gray Sand | As specified by designer | |
| Emergency power: - 120/208, 240 volts - 347/600 volt | Code Code | Orange Sand | Red (see Note 3) n/a | |
| Low voltage and Safety: - switching / controls - emergency - exit lighting - security / panic - mechanical alarms | See Note 2 | Black Orange Orange Blue Amber | | Exterior Strobe (blue) Strobe (amber) |
| Fire alarm: | Red | Red | | Exterior Strobe (red) |
| Communications and Security: - structured wiring - telephone - intercom and sound - television and cable - CCTV - Access Control - Intrusion Alarm | See Note 2 Blue Olive / Gray Brown Black Beige | White White White Brown Brown | | |

- Low voltage cable can be purchased with various colors of the exterior jackets allowing quick identification for tracing of the installed cabling for security, nurse call, intercom, data, video, telephone, television, CCTV, DDC cabling within an area.
- All junction boxes pull boxes and their covers must be painted according to the color-coding schedule. Color coding is not necessary for visible surface mounted junction boxes as they can be easily traced.
- Only receptacles that form part of an Essential Power Supply are required to be red.

E.4 POWER SUPPLY

Qulliq Energy Corporation (QEC) supplies electricity in most communities in Nunavut by diesel generators operated. Fuel is re-supplied annually, and power costs are very high. Voltage fluctuations are typical, as are power outages. Three-phase power is not available in all communities. Power is supplied to consumers primarily by overhead service with larger buildings being supplied by underground conductors from pad mounted transformer.

Service Sizing

Size main services & service transformers according to the connected load or estimated load, whichever is greater. Calculate connected load by using demand factors as dictated by the type of load plus an allowance for future load. Calculate estimated loads based on basic power loads plus additional loads anticipated for heavy power usage areas.

E.4.1 PUBLIC UTILITIES

Power is supplied and distributed by Qulliq Energy Corporation (QEC).

Recommendation

Rationale

E.4.1.1 Consumption Targets

See specific sections regarding energy consumption requirements (i.e., lighting motors).

See General G6.1 National Energy Code.

E.4.1.2 Underground Service

Overhead services are preferred. However, if an underground service is necessary, teck cable is preferred. In non-permafrost areas, the cable needs to be placed below the frost especially if the soil is frost susceptible. In permafrost, or if the cable must be placed in the active layer, it must be surrounded by non-frost susceptible soil.

This can be accomplished by surrounding the screened sand on all sides by gravel, which will ensure drainage of water out of the sand.

Overhead services are preferred as they are easy to repair and maintain. If the service is underground, teck cable is easier to install and less expensive compared to conduit, especially in cold weather. Teck cable is flexible enough to take the stress of frost heaving and installation over uneven or rocky ground. In permafrost areas, surrounding fill should be of a type that does not bond to the wires (because frozen soil tends to contract and crack, causing buried lines to pull apart when the line on each side of the crack is frozen tightly in the soil).

Underground service conductors over 75 meters should be installed inside a PVC sleeve.

By providing a PVC sleeve for long underground service runs, the increased potential of movement from frost heaving, will decrease the stress on the installed cable.

E.4.2 AUXILIARY POWER

Reliability of power supply for equipment is more important in cold climates than in moderate climates because of the dire consequences of failure. Systems depend on electricity for boilers, pumps, fire protection and heating controls. Power failures in northern communities are not uncommon due to extreme weather conditions or equipment failures, which can incapacitate the community generator. For this reason, generators are often required in public sector buildings where essential services must be maintained. Emergency generators, where required by NBC, need to meet stringent requirements. "Standby" or "auxiliary" power supplies are optional and sized according to desired load requirements.

The importance of reliability is mentioned, not so much for community functions, but because of the dependence on electricity for building systems.

Recommendation**Rationale****E.4.2.1 Where Required**

Emergency power is only to be provided in buildings where required by the National Building Code of Canada. Provide standby power where the facility program drives the requirements for a generator.

Emergency power has specific code requirements above and beyond those for standby power.

E.4.2.2 CSA C282-12

This standard "Emergency Electrical Power Supplies for Buildings" is suitable as a guide for standby generation. For emergency generators, it is expected that CSA C282 will be followed

The standby power is provided in most of GN facilities as a backup for convenience, not safety, and shutdown can be scheduled, making a manual by-pass unnecessary. Installing a "standby" or "auxiliary" generator to C282 maintains reliability

E.4.2.3 Components Required

When generators are required, they should be:

- Fueled by a dedicated day tank, located in the service room, capable of operating the generator under full load for four hours
- Day tank to be fed by the same fuel tank provided for the heating system
- Liquid-cooled with mounted radiator fan and water pump (integral radiator only)
- Air-cooled with integral cooling fan and cooling ducting where conditions make an air-cooled generator practical
- Skid mounted with double wall sub base fuel tank complete with day tank feature, transfer pump system, leak detection and low fuel alarm.

Must also include:

- Glow plug and timer
- Steel springs and/or rubber pads as recommended by the manufacturer
- Remote annunciator package for critical functions
- Thermostatically controlled recirculating block heater fed from boiler heat exchanger

Recommendation**Rationale**

- Integral radiator
- Hospital or critical grade muffler
- Flexible exhaust section complete with guard to prevent accidental contact.
- Battery, automatic battery charger, cable and rack
- 12 volts electric start

Generator package should also include:

- eye wash station
- heavy duty acid resistant elbow length rubber gloves
- heavy duty acid resistant apron
- hydrometer

E.4.2.4 Capacity

Where emergency generators are required by code, they must be sized to carry the following only:

- Fire protection system (including fire pump and jockey pump)
- Complete heating system including fuel pumps, controls, boilers and zone valves
- Exit lighting
- Domestic water pumps
- Sanitary pumping
- Lighting (including bathroom lighting in buildings where there are young children the aged or the infirm)
- Power loads deemed necessary by the program requirements
- Loads required by the National Building Code to be powered from an emergency power supply

Besides code requirements, emergency generators allow buildings to continue operating with minimal disruption. In many instances the entire electrical system can function on emergency power, as there is little cost or operational advantage to reducing lighting and receptacle capacities. Refer to the facility program to determine which lighting and power loads are essential. Subject to emergency lighting design of specific building.

E.4.2.5 Automatic Exercising

Automatic exercising of the emergency or standby generators is not required.

In the past there was concern that maintenance staff were either non-existent or untrained for testing the generator regularly. Consequently, time clocks were installed to ensure the generator was cycled regularly to ensure proper operation. With qualified maintainers in all communities and the requirement of CSA C282 and the Maintenance Management System

Recommendation**Rationale**

(MMS) to record and log all instrument readings during a weekly test, the time clock is redundant.

E.4.2.6 Timer

Provide a timer (holdover timer or "time delay, emergency to normal") with a minimum lag time of 10 minutes before retransfer from generator power to normal power after normal power restarts. This feature is a component of the automatic transfer switch settings.

This allows time for the normal power to stabilize. It is especially important when generators have a "Warm-up" period of 3-5 minutes before accepting a load, as the effect of a second blackout would be a further delay for power to resume. (The generator cycles through a cool-down period, then a warm-up cycle starts again).

E.4.2.7 Location

All generators must be installed in a separate room with a 2-hour fire rating. Access to allow potential removal or replacement of the generator must be provided. Locate generator away from noise-sensitive areas and at grade level.

This is a code requirement as per C282.00.

E.4.2.8 Portable Generator

Portable generators are not recommended.

Where a generator is required, it should be permanently installed to ensure reliability and regular maintenance. If it were portable, there would be a good possibility that it would not be readily available when needed. Portable units can also be hazardous if improperly installed, grounded or exhausted.

E.4.2.9 Load Banks

Permanently connected, stepped load banks with customer metering to monitor generator loading is recommended for hospitals & correctional facilities.

Permanently connected stepped load banks provide a means for maintenance staff to properly exercise generators on a weekly and yearly basis avoiding "wetstacking" from small building loads.

Emergency, auxiliary or standby generators 300Kw and over should also have permanently installed stepped load bank.

Where the building load is not adequate for the yearly testing of code required emergency generators, means to safely install a portable load bank should be provided.

This provision will provide a safe way of connecting portable load banks on yearly basis

Where the emergency generator set is required and a permanent load bank is not installed, then provide a suitable junction point between the generator & the transfer switch for the connection of a portable load bank.

This provision will minimize disturbance to the building operation and improve maintainability

Recommendation**Rationale****E.4.2.10 CSA Z32-15**

This standard for "Electrical Safety and Essential Electrical Systems for Hospitals" has been adopted for health care facilities in Nunavut.

The intended use of a health care facility must be determined and designed to meet the chosen needs.

E.4.3 RENEWABLE ENERGY (SUN, WIND)

The seasonal availability of solar and wind energy in the North is often much higher than southern locations annually. However renewable energy systems should only be considered where life cycles costs could be shown to be lower than other alternatives.

Refer to the Energy section.

E.4.4 CONSUMER SERVICE AND DISTRIBUTION**Recommendation****Rationale****E.4.4.1 Electrical Service Rooms****1. Separate Room**

A separate electrical room is recommended for all facilities that have services of 600 V and larger and/or 400 A and larger.

Services greater than 600 V and/or 400A are of such a size that a separate room is desirable to consolidate electrical equipment. Separating it from the mechanical equipment generally ensures better access for maintenance operations, as well as provides a cleaner environment required for electrical equipment that often includes communications equipment, transformers, etc.

Wherever auxiliary power is provided, electrical panels and equipment may be located in the generator room, with the exception of motor control centers, which are ideally located within sight of equipment being served.

As a separate room is already required for the generator, electrical equipment can be located there. Motor control centres are usually better placed in the mechanical room so the controls are within in sight of many of the motors they control.

A separate electrical room is recommended in facilities where the mechanical space is expected to reach temperature that will be higher than 30 deg. C.

Electrical and electronic equipment and in particular breakers are temperature sensitive and should not be located in spaces where their performance will be compromised.

Rooms that serve a dual function such storage or corridor & electrical room should be avoided.

Architectural designers assume that electrical equipment is static and wish to use this "empty" space for other purposes such as pathways to other rooms. This can easily create a dangerous situation such as a door being opened into an electrician working on an electrical enclosure.

Recommendation**Rationale****E.4.4.2 Service Size**

Calculation of service shall be as per the CEC, with no over sizing of service, unless specific mention of future additions is made. Include calculation on drawing.

Service size calculations from the CEC are generally.

Very conservative with best practice margin errors adding to the CEC numbers. If a major renovation takes place in the future, and there is no spare capacity, then the service will need to be upgraded at that point in time.

Sizing & trip settings of the main service breaker must be considered carefully as the available fault current in many communities is very low, and as a result a fault may not clear within a reasonable time. Include available fault current at the service entrance on the single line diagram.

A low available fault current means two things: most interrupt ratings will be sufficient and instantaneous trip setting need to be set so that they open the circuit. Many moulded case circuit breaker have an instantaneous trip setting 10-12 times nominal, and this may be too high to actually open quickly. Local conditions need to be considered to ensure that protective devices function properly.

Transformers Applications K-type Delta-Wye for Non-linear Loads: Conforming to UL 1561 standard. An analysis of whether or not to install transformers should be contingent on a life cycle cost benefit analysis.

K-type transformers (K4, K13, K20, etc.) are isolation transformers. The number indicating the factor (K4, K13, K20 etc.) is the multiplication factor of the losses due to the Foucault currents in the windings that this transformer can support.

Transformers Applications K-type Delta-Wye for Non-linear Loads: Consider the application of "Harmonic Mitigating Transformers" especially for an office environment with a high concentration of computer loads by performing a cost-benefit analysis comparing the cost of conventional or K- rated transformers.

K-type transformers are designed to support the supplementary losses due to the harmonic current circulating in the windings.

Actually, it is less costly overall to provide harmonic mitigating transformer to feed several hundred computers than it is to improve the operation of the SMPS in each computer. This is especially true when we consider that the added cost of the improved SMPS will reappear every three years when a new computer system is purchased.

The inherent ability of Harmonic Mitigating Transformers to cancel harmonic currents within their windings can result in quantifiable energy savings when compared with the losses that would exist if conventional or K- rated transformers were used. The average premium cost of an HMT over a K- rated transformer, the typical payback in energy savings is 1 to 4 years when loading is expected to be in the 50% to 65% range. HMT not only meets NEMATP-1 minimum efficiencies at 35% load but also in the entire operating range from 35% to 65%. In this manner, we can assure energy savings not only at lightly loaded conditions but also at more heavily

They become line conditioners if they are equipped with special electrostatic screens and peak cut-off hybrid filters on the secondary & the primary.

Recommendation**Rationale**

loaded conditions when harmonics have their most significant influence on losses.

To minimize harmonic problems in new installations, avoid the old approach of using a large central transformer with a 120/208V secondary and long 4-wire risers or radial runs through the building. The impedances of these long runs are high so that harmonic currents flowing through these impedances will create high levels of voltage distortion and neutral-to-ground voltage.

To prevent these problems, an effective rule of thumb is to limit each 120/208V run length to that which would produce a 60Hz voltage drop not greater than 1/2% to 3/4%. Combining the use of Harmonic Mitigating Transformers with short 120/208V feeder runs and double ampacity neutrals will ensure compatibility between the distribution system and the non-linear loads.

Careful consideration during the design phase can help to anticipate and avoid the working space being used for storage space.

IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems. This standard recommends maximum acceptable limits for both voltage and current harmonics to prevent problems that can result from heavy non-linear loading. The limits for harmonic currents are designed to minimize the amount of voltage distortion these currents would produce in the power system.

K4

- Electric discharge lighting
- Some UPS with input filtering, no Bypass
- Induction heating equipment
- PLC and solid-state control

K13

- UPS w/o input filtering, with Bypass
 - Telecommunication equipment
 - Multi-wire receptacle circuits
- i. In general care areas of health in hospital facilities and class rooms in schools, etc.
 - ii. Supporting inspection or testing equipment of trade school/college & CGS maintenance workshops and laboratories etc.
 - iii. Automated modern/electronic office buildings

Recommendation**Rationale****E.4.4.3 Working Space**

Adequate space around electrical equipment is to be provided. Minimum working space around electrical equipment is 1.0 meter. Coordination with the other disciplines (especially mechanical) is essential.

Past experience with unacceptable clearances has resulted in need for on-site changes. We intend to ensure that safe working space is provided around electrical equipment (i.e., including space to stand beside panel boards while disconnecting breakers).

Entrance to and exit from the working space around electrical equipment must be kept clear of all obstructions.

E.4.4.4 Components

Standard of acceptance for power systems is Eaton Cutler Hammer, Square D, Schneider or Siemens.

This reduces inventory and allows maintenance staff to become familiar with the products.

Standard of acceptance for control equipment is Allen Bradley, Cutler Hammer, Square D, Eaton, Schneider or Siemens.

E.4.4.5 Spare Capacity

Provide a minimum of 20% as empty spaces in panel boards (i.e., 8 spare spaces in a 40-circuit panel board).

This provides circuits for future loads and avoids creating a hazardous condition caused by overloading the panel board. Additional capacity is required for additional loads expected over the lifetime of the building (e.g., computers).

Note: *These are minimum requirements (i. e., facilities planned for future expansion may require a larger capacity).*

E.4.4.6 Customer Metering

Provide a digital customer meter where service size is in excess of 200kVA that can provide power quality metering, such as harmonic content, phase imbalance transients, protection from phase reversal, overvoltage, under voltage as well as Kwh consumption etc. capable of being tied in to the building system.

The meter provides invaluable O &M data. This can be used to verify utility invoices, provide a quick history for maintenance person and allow for O&M staff to realize problems by reading through the data on their prescribed PM programs and logged evidence of power quality problems originating off site.

Provide digital customer meter where the service size is in excess of 75kVA that can provide consumption, demand, voltage and current information

Digital metering is an excellent tool for troubleshooting and other general maintenance activities.

Provide digital customer demand meter for emergency power to register the maximum demand on the generator.

This will provide information for the Owner when adding loads on the generator is considered.

Recommendation**Rationale****E.4.4.7 Power Quality**

For larger systems that support many loads, the requirements of all loads need to be considered, as well as the potential interactions between them, to decide the appropriate enhancement equipment and system design construction.

E.4.4.8 Variable Frequency Drives

Provide drives complete with harmonic distortion line filters which limit total harmonic current distortion to less than IEEE 519 standard requirements where the drive terminals are the point of common coupling, but in no case more than 3%.

Additional line filtering is often required to reduce the propagation of harmonics and radio frequency interference (RFI) to other equipment.

Coordinate motor selections with mechanical to ensure inverter duty motors are provided.

These motors can withstand repetitive voltage spikes that are 3.1 times the rated RMS voltage.

Use pulse width modulated technology drives. Locate drives within 7 meters of load.

Select drives with proven maintenance capabilities.

E.4.4.9 Separation from Disturbance

Keep equipment that causes electrical disturbances (motors & VFDs Variable frequency drives in HVAC applications and Industrial pumping (water/waste water) electrically separated from electronic equipment susceptible to electrical disturbances (such as computers servers', terminals, monitors, printers, fax machines, telecom systems photocopiers and communication equipment etc.) Provide electrical protection and line power conditioning for affected equipment as follows:

Determine the extent and severity of electrical service disturbances including voltage sags, surges, short term and long-term transients and outages. Consultation with the QEC in order to determine the likely incidence of these disturbances.

Identify electronic equipment and system likely to be affected by disturbances and the extent of protection necessary for normal operation.

- Surge protectors: electronic or varistors surge arrestors for equipment affected by transients.
- Isolation transformers: electro statically shielded transformers for equipment affected by transients and noise.
- Regulated power supplies: for equipment and systems affected by transients, noise, voltage sags and surges.
- Electronic filters: for equipment affected by power line noise.
- Uninterruptible power supplies: for equipment requiring continuity of service.
- All electronic based systems are to be on power conditioning UPSs.

Recommendation**Rationale****E.4.4.10 Uninterrupted Power Supplies**

Provides equipment with the highest level of power protection available.

For equipment requiring continuity of service.

Identify electronic equipment and system likely to be affected by disturbances and the extent of protection necessary for normal operation.

All electronic based systems are to be on Smart Online 3-Phase Intelligent, True On-Line UPSs power conditioning System.

An analysis of whether or not to install these systems should be contingent on a life cycle cost benefit analysis.

Provide wall mounted shelves for UPS units that are supplying fixed wall mounted equipment.

Wall mounting above the floor surface allows ease of area cleaning procedures, and a more protected location.

When grouping computer or equipment in a single room, consider consolidating all UPS power requirements in to a centralized unit feeding a small panel.

Regular servicing of a single larger unit can be more cost effective than servicing many small units. This also provides a higher level of protection from the electrical supply that may have variable quality.

Where available supply building system such as telephone, public address, alarm systems, security systems, networking systems etc.; from a UPS, but also from a generator.

Providing electrical redundancy to systems that are needed for proper operation of the building during utility power failures provides a greater level of reliability.

Where a UPS is fed from a genset, provide a minimum of 15 minute back up, where no genset is present, 30 minutes would be the minimum.

Generators do not always start, and this provides sufficient time to shut equipment down. Because of the frequency of outages, the larger capacity batteries will also last longer before requiring replacement.

E.4.4.11 Transient Voltage Surge Suppression (TVSS)

Transient voltage surge suppression (TVSS) should be provided on building with electronic equipment in accordance with UL-1449/1499-rated. However, surge arrestors for lightning strikes are generally not required.

The Nunavut Territory has low incidence of lightning strikes, so surge arrestors would only be considered an asset on buildings where electrical reliability is critical. Power quality though is not generally high, so some form of TVSS at the service entrance will reduce the exposure of equipment inside the building to harmful surges.

Sensitive electronic equipment should be protected from surges, both those generated from other equipment and those originating from the utility service. This can be accomplished at the service entrance, panel boards, and at receptacles.

This is due to primarily to new power conversion technologies, such as the Switch-mode power supply (SMPS), which can be found in virtually every power electronic device (computers, servers, monitors, printers, telecom systems, photocopiers, VFDs, lighting controls, building automation systems) means that we have more harmonic content that can negatively affect the building systems.

Recommendation

Evaluation of where to place TVSS will depend on the application.

Computer room distribution panel boards should use surge protection bolted directly to the buss.

All units should indicate status in event of TVSS failure.

Point of use devices at workstations or integral to the receptacles may also be incorporated

Rationale

TVSS properly located will provide protection from internal sources of harmonics, voltage spikes and transients.

The cost of providing TVSS is minimal compared to the potential of equipment and/or data lost due to poor power quality issues.

Bolting TVSS directly to the buss bars locates the surge suppression devices in the most effective location and provides downstream protection to many devices.

Status of equipment ensures protection is provided.

TVSS Cascading Grid of Multiple Suppressions

The primary protector at the service entrance performs the initial “coarse” suppression and then the secondary protector at a sub-panel or on a low voltage circuit performs a “fine” suppression, limiting the transient to harmless levels. This “cascading grid” of multiple suppression levels insures that there will be no equipment damage. By connecting the TVSS modules at each power panel in the distribution system, the TVSS filters transients from both load and supply sides and effectively provide “isolation” of each load from any load on another circuit. When used downstream in a cascaded configuration, the panel mounted TVSS will provide the best protection for critical loads.

E.4.4.12 Harmonic Distortion and Noise

Identify non-linear loads including: switch mode power supply (SMPS), (typically found in computers, servers, monitors, printers, fax machines, photocopiers, telecom systems etc.), UPS, rectifiers, variable frequency drives and electronic ballasts. Determine the effects of these loads on the power distribution system.

TVSS receptacles or within power bars is a relatively inexpensive method of providing good protection to single location equipment.

Recommendation

Provide harmonic filtration, either integral with the equipment or separately, to limit total harmonic distortion from each piece of equipment to less than 15%. Limit the harmonic distortions to comply with current edition of IEEE 519.

Provide transient protection and harmonic filtering in power supply to Data and Communication Systems and computer labs.

Provide transformer isolation between large harmonic generating loads and the balance of the distribution system.

Use separate neutrals or increase size of neutral of branch circuits where necessary.

Rationale

Linear loads (heating, incandescent lighting, etc.) do not go well with non-linear loads (computers, laser printers, and photocopiers).

In the non-linear family, computers, do not get along well with the electrical properties of laser printers and photocopiers which consume a great amount of current in an abrupt and irregular fashion, affecting the voltage. The voltage fluctuations that they provoke can seriously damage a computer or can even simulate a blackout.

E.4.4.13 Location of Disconnects & Panels

Do not recess disconnects and panels INSIDE cold exterior walls.

The thermal overloads and breakers trip based on a heat/time characteristic. If the equipment is below freezing, the time to trip is extended and no longer offers proper protection.

E.4.4.14 Panel Boards – Spare Conduit

For flush mounted panels, stub 3 spare 19 mm conduit out to the ceiling space and/or crawl space (whichever is accessible afterwards).

The intent is to provide ready access to the panel boards for future circuitry requirements.

E.4.4.15 Breakers

Wherever possible use breakers rather than fuses.

Tripped breakers can be reset; burned-out fuses must be replaced. Replacement fuses are not readily available in most communities, which can lead to the serious consequences associated with loss of power in cold climates. Fuses may be specified only where a large interrupting rating is required.

E.4.4.16 Location of Receptacles**1. Receptacles Facing Up**

Receptacles must not be mounted facing up, either inside or on shelving units, work surfaces or counters. The only exception permitted is a floor box with a hinged cover.

Dirt accumulation or spilled substances could create problems (e.g., in home economic rooms and science rooms).

Recommendation**Rationale**

2. Receptacles in Exterior Walls

Where possible, avoid locating outlets in exterior walls if the air-vapor barrier must be broken to accommodate the devices.

It is not always possible in large rooms with exterior walls (i.e., gyms, assembly halls), but the intent is to reduce the number of penetrations. (Note: this is not a concern where walls are built or strapped on the warm side of the air- vapor barrier). Careful attention to maintaining the vapour seal is required to avoid air and moisture infiltration.

E.4.4.17 Provision of Branch Circuits

1. Counter Receptacle

At least one 3-wire branch circuit (split receptacle) or 20 Amp T slot receptacle should be provided at counter work surfaces.

This will prevent the overloading of a circuit. and allow a variety of equipment to be used on work counters. These requirements border on adequacy provisions, but experience shows that if there isn't a degree of adequacy in the electrical installation, they quickly become unsafe. Examples include adult education classrooms, school lounges, and. office work counters etc.

2. Refrigerator, Microwave, Freezer

Each receptacle installed for a refrigerator, microwave oven or freezer is to be supplied by a separate branch circuit.

Same as Electrical E4 4.12.1.

3. Circulation Pump, Heat Trace

Each water circulation pump and heat trace outlet is to be supplied by a separate branch circuit. Heat trace circuits to be supplied by a GFCI circuit breaker.

This prevents the freezing of the facility water supply due to a fault in other electrical equipment.

4. Circuits feeding receptacles in a class room should not share a circuit with receptacles in other class rooms.

If a circuit trips in one classroom, it should leave other classrooms unaffected.

5. Circuits feeding receptacles in common corridors for cleaning equipment should not share the circuit with in other areas. Install T slot receptacles.

Modern cleaning equipment can over load circuits that are shared by other devices causing nuisance tripping. T slot receptacles can provide adequate power requirements for a variety of present or future labor-saving cleaning equipment.

6. A minimum of one circuit should feed receptacles within an enclosed office space

Initial design of circuitry & receptacles, if not adequate for future needs within an may result in poor power quality, extension cord usage, or additional circuits having to be added at a future date. Personal use photocopiers and laser printers may be future requirements. See Mechanical M4.8.6.

7. Drinking Fountains

Recommendation**Rationale****E.4.4.18 Electrical Boxes****1. Sectional Boxes**

Avoid ganging together of sectional boxes.

Joined sectional boxes can come apart during rough in, which eliminates the grounding between boxes.

2. Floor boxes

Use floor-mounted receptacles only if there is no alternative to providing power to equipment. Unless a raised floor system has been installed, whose purpose is to provide floor mount receptacles.

Flush-mounted floor boxes with removable covers are undesirable because the covers are often misplaced, leaving the receptacle exposed (Facing up), which is an Electrical hazard.

If construction allows, they should be flush-mounted type complete with hinged covers.

Floor boxes that are flush-mounted are less obtrusive and less of a "tripping" hazard compared to surface-mounted floor boxes and are able to accommodate both line voltage and low voltage wiring.

E.5 GROUNDING AND BONDING

Grounding by connecting to municipal water mains, as is typical in most of urban Canada, is seldom possible for buildings in the Nunavut. In areas supplied by municipal water mains the water lines are insulated and not in contact with the ground due to the cold winter conditions. Buildings within most isolated communities are provided by individually tanked water and sewage system. Means of adequately grounding facilities are covered by the CEC; the preferences stated reflect the northern experience with different situations encountered in public sector buildings. Historically practice has been to reduce the size of ac distribution neutral conductors. Present usage patterns of automated office equipment can be at odds with the original ac distribution system design assumptions, which have resulted in misoperation of sensitive electronic equipment and excess heating of ac distribution elements.

- Size all grounding conductors to carry the fault current necessary to trip the over current devices protecting the loads, panel boards, and feeders associated with the grounding system.
- For installations with more than 12 computers circuit provide a separate panel fed via an isolating transformer with an electrostatic shield. Do not use common neutrals.
- Provide a separate ground wire from each computer circuit to the branch circuit panel board.

E.5.1 ORDER OF PREFERENCE

Recommendation

Rationale

Order of preference is as follows:

1. Exothermic (cad) weld to a minimum of 4 steel piles.
2. Minimum 9.5 mm (3/8") bolts (copper, bronze or brass) tapped and threaded to a minimum of 4 Steel piles.
3. Ufer ground
4. Plate electrodes
5. Municipal piped water system

The large surface area of a steel foundation system that is contact with the ground and commonly used in the north can provide the best ground possible in northern areas. Cad welding provides a permanent connection.

The electrical resistance of the ground in arctic or sub-arctic areas is extremely variable (1 to 1000 ohms for a standard 19 mm by 3.0 m grounding rod). The sensitivities of frozen ground are inadequate to meet the electrical code requirements. The choices given indicate the options in order of preference for providing the best possible ground system.

Consideration must be given at the design stage to pick the best possible system, avoiding dissimilar metals from galvanic action set up under certain soil conditions.

Where low ground resistance is critical or standard means will not obtain a reasonably low ground resistance consider the use of additives.

Additives will degrade over time, reducing the effectiveness of grounding system, however they may be warranted in some situations.

E.5.2 CSA Z32-09 ELECTRICAL SAFETY IN PATIENT CARE AREAS"

Assume procedures as noted in Electrical E6.3. 7.

E.6 WIRING

E.6.1 USE OF CONDUIT

Technical Services Division previously required all wiring to be run in conduit. This was viewed as a worthwhile investment as it simplified any unforeseen expansion or changes. In practice not all facilities make use of this feature over their lifetime. The need for conduit has now been reviewed and modified as noted below.

Recommendation

Rationale

E.6.1.1 Conduit Use

1. Surface-mounted conduit

Surface-mounted conduit is acceptable in service buildings (i.e., garages, fire halls), in recreational buildings (arenas, etc.) and in spaces concealed from the public or not accessible.

This clarifies where surface conduit is acceptable. Spaces such as service rooms and closets, plenums, etc., are not normally seen, so surface conduit use in these areas is acceptable.

2. Concealed Conduit

Install conduit concealed wherever possible to provide clean wall and ceiling surfaces.

Surface conduit should be avoided wherever possible to reduce wall and ceiling trim and painting requirements in new and renovated buildings and maintain visual appeal.

3. Wood Frame Construction

- Where a conduit is not required by the Code but is installed in a wood frame construction for the expansion, the conduit may be terminated in junction boxes convenient to each room (i.e., above T-bar ceilings, in crawl spaces, etc.). NMD90 or armored cable may then be used as wiring to the power outlets from this junction box.

The intent is to reduce construction costs and yet allow some flexibility in wood frame construction by providing a "grid" system of conduit and junction boxes. Facilities where future electrical requirements are most likely to change include maintenance shops. Offices, schools, and health care buildings.

- Conduit is not required for long runs where only a single circuit is used (i.e., exterior lights, exit lights, emergency battery pack remote heads).

Conduit to allow for expansion of electrical power systems is typically not required for residential facilities such as student residences or group homes, arena support space areas, gymnasiums or community halls, garages, warehouses or fire halls.

- Non-Combustible Construction Conduit may be terminated in junction boxes convenient to each room (i.e., above T-bar ceilings, in crawl spaces, etc.) Armoured cable may then be used as wiring to the power outlets from this junction box.

The intent is to reduce construction costs and yet allow some flexibility in non-combustible construction by providing a "grid" system of conduit and junction boxes.

- In Slab Conduit, ensure adequate depth in slab to avoid fasteners.

Conduits need to be protected from mechanical fasteners.

- Coordinate with mechanical heat lines.

Proximity to in slab heating lines can result in de-rating of conductors.

Recommendation**Rationale****E.6.1.2 Cable Tray**

Cable tray is desirable where many structured wiring cables will be installed. Basket tray should also be installed where there is a strong potential for frequent changes to structured wiring, or where multiple systems (i.e.: security, CCTV) may be added at a later date.

Cable tray allows for very fast installation and for ease of changes in the future. Data requirements are changing very quickly, and the tray allows for a neat installation for retrofits.

Cable tray should be designed for future additions.

A minimum of 21mm conduit from the basket tray location should be installed to the point of use.

A 21 mm conduit provides ample room for a variety of cables that may be terminated at one point of use within a room.

E.6.1.3 J Hooks

It is also acceptable to branch off a cable tray system at right angles using J-hooks for support in concealed spaces (above T bar ceilings).

J-hooks provide an approved means of attachment for a variety of cables when few are required to a point of use. This cabling system also improves cabling organization above ceilings.

Install 21 mm conduit sleeve within wall to allow for cable installation.

Conduit provision allows for ease of installation and future cabling upgrades.

E.6.1.4 Surface Mount Raceway

Preference is to concealed raceways, although areas that are being renovated, or frequently upgraded, where the wall finish is not being removed, surface mount raceway may be used, provided the appearance is matched to other architectural finishes in the space.

In areas that experience frequent renovation the visual appearance of surface mount raceway can be offset by lower cost of the renovations and flexibility of surface mounted raceways.

Surface mount raceway would also be acceptable for short runs to feed non-permanent pieces of equipment such as intelligent whiteboards.

These installations are often changed, frequently require different connections than previous generations and are often installed by non-electricians. Architecturally finished surface mount raceways provides a way to run cords in a tidy and inconspicuous manner.

E.6.1.5 Telephones

Telephone cabling be run in structured wiring type cable and follow the latest editions of all applicable codes including GN-(CGS-IPS)-Structured Cabling Guidelines (latest version).

This allows for greatest flexibility in ever changing cable requirements, as each client department is often responsible for all wire installation. Structured wiring also allows for future changes to telephone technology.

Where twisted pair telephone lines are installed in a facility, cables should be installed in conduit where exposed to mechanical injury.

The installation of conduit provides mechanical protection and for future changes within a building.

Recommendation**Rationale****E.6.1.6 Owner Equipment**

Group wiring and cables for centrally controlled or networked equipment in a common conduit or raceway. Conduit should be sized to allow for some expansion.

Examples of systems where this should be applied include computer LANs, intercom systems (independent of telephone), sound systems, and television. Equipment and systems should be identified in facility programs.

E.6.1.7 Air Vapor Barrier

Conduit penetrations through air/vapour barriers need to be sealed inside and outside of the conduit.

See Architectural. Sealing prevents air and moisture penetration that can detrimentally affect installed electrical systems and wiring.

E.6.2 WIRE AND CABLE**Recommendation****Rationale****E.6.2.1 Type and Size**

1. Copper wiring only, thermoset type insulation R90, RW90 (XLPE)

Compared to TW or thermoplastic insulation, thermo set XLPE insulation provides a wider range of acceptable operational temperatures encountered in northern building. XLPE insulation is also more robust and thus not as susceptible to installation damage.

Cable types NMD90, AC90 or Teck90. All wiring to be minimum #12 gauge with the exception of control wiring and low voltage wiring.

#12 is specified to prevent voltage drop problems associated with #14. Heat (I²R) losses are reduced.

It is to be noted that NMD90 cabling is only FT1 rated. It cannot be installed in a return air plenum.

This note is provided for information purposes to ensure where NMD is installed in a wood structured building which is not installed in a return air plenum.

2. Control wiring and low voltage wiring (i.e., fire alarm) can be as per minimum code requirements.

This confirms that minimum code requirements are acceptable for control and low voltage wiring.

3. FAS cable is acceptable for fire alarm systems in wood frame construction.

4. Structured wiring that does not meet the flame spread rating the NBC requires should be removed during renovations.

Older Cat 3 cables or non-plenum rated cables that have been installed in plenum spaces need to be removed to reduce fire load and smoke development.

Capacity and rating of cable should be considered during schematic design.

Rapid changes in industry mean that any specific preference for capacity of structured cabling (i.e.: Cat 6) could easily be outdated prior to new GBP's being issued.

E.6.3 WIRING DEVICES

See Electrical E2.4 "Standardization".

Recommendation

Rationale

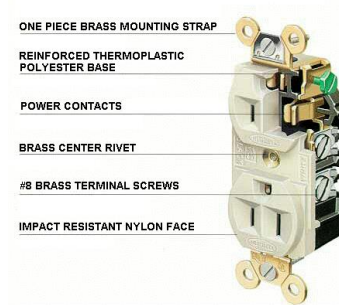
E.6.3.1 Grade

Wiring devices should be "Specification Grade" or better for all applications.

Residential quality is not durable enough for public buildings.

The following set the Standard of Acceptance:

- Standard receptacle: Hubbell 5262, (15 Amp) or 5362 (20 Amp).
- Specification grade Surge suppression receptacle Hubbell 11-5260-SA c/w blue nylon face.
- Ground fault receptacle: Hubbell GF151LA (15 Amp) or GF20ILA (20 Amp T slot).
- Tamper resistant receptacle: Cooper, Hubbell.
- Or Leviton Specification grade Standard switch: Cooper, Hubbell or Leviton Specification grade.



E.6.3.2 Color

Wiring devices (receptacles and switches) should be of the same color throughout the building. Preference is user defined. Exceptions:

The intent is to standardize the color for replacement and stocking purposes yet allow some flexibility for the designer's choice (i.e., ivory, white, brown).

- Surge protection outlets **Blue**
- Emergency outlets **Red**
- Isolated ground **Orange**

E.6.3.3 GFCI Outlets

Interior ground fault receptacles may be the receptacle type that have "test" and "reset" on face of receptacle.

GFCI receptacles are much less expensive than GFCI breakers, and also more likely to be tested regularly because the "test" is readily accessible.

Exterior ground fault receptacles will need to be protected by a GFCI breaker, not from within the receptacles itself.

GFCI receptacles do not function properly in cold temperatures, and exterior receptacles that require GFCI protection must have the GFCI protection a warm location.

E.6.3.4 Cover plates

Stainless steel, enamel finish metal is the preference, however nylon receptacle plates will be considered.

Stainless steel plates are typically used in schools, health centers and detention facilities, as they are the least susceptible to damage. Enamel finish metal or nylon is acceptable for most other uses including student residences, offices, group homes and treatment centers.

Bakelite is not recommended.

Bakelite plates are not durable.

Recess wall receptacles within gymnasiums approximately 1/2" from front wall.

This reduces impact forces on receptacles resulting in broken receptacles and bent cover plates that can become a safety hazard.

E.6.3.5 Crawl Space

Receptacles may be provided in all enclosed crawl spaces. Locate receptacles adjacent to all equipment or mount receptacles so that any point in the area is not more than 25 m horizontally from a receptacle.

The NBC does not clearly cover requirements for crawl spaces, which are a common feature in buildings. These receptacles may be required to provide power for "trouble lights," pumps and/or repair equipment.

Regardless of enclosed crawlspace heights, do not install NMD cabling on bottom cord of floor joists. Provide protection by location of cabling or by mechanical means.

Enclosed crawlspaces are typically used for maintenance activities or material storages. NMD cabling is much more prone to mechanical damage than armored cable or conduit.

Install GFCI protection on crawlspace receptacles.

Moisture and standing water can be found in many crawlspaces during seasonal variations. GFCI protection provides increased safety to maintenance person.

E.6.3.6 Outdoor Plug-ins (see also 6.3.3)

Receptacles should be provided if they are a program requirement.

Minimize the use of exterior electrical cables; keep outlets above snow level.

Flush Mount exterior electrical outlets on the building unless otherwise stipulated and ensure that they are mounted above the level of winter snow accumulation.

Flush Mounting has been found to be less susceptible to vandalism. Mounting on buildings is also desirable because people tend to leave a walking space between the vehicle and the building in order to access the receptacle.

Parking rails with receptacles are preferred. Post may be used only where necessary or unavoidable.

Install rails at or above vehicle grill height, as people will be a lot more cautious when approaching.

Parking outlets should be split receptacles if they serve 2 parking stalls.

Vehicles in the North generally have a block heater, oil pan heater, battery blanket, and may also have an in-car warmer. The loads require a separate circuit for each parking stall.

Where only few exterior receptacles are required for vehicles, use intelligent receptacles that are programmable with a delayed response to initial connected loads, are temperature sensitive and adjustable.

Providing an intelligent receptacle can reduce energy cost due to unnecessary use.

When more than 10 automobile stalls or spaces are required, consider installing a control system that provides power to the outlets in the following manner:

This is required for energy conservation.

- Above -16°C: No power. (Cycle power (i.e., 20-30 min. on, 20-30 min off).
- Below -32°C: Continuous power.

The controller can be either a centralized panel or an intelligent receptacle.

When 10 or more outlets are provided, at temperatures between -20°C and -32°C, the outlets could be cycled in such a manner that only one-half of the outlets are energized at any given time.

This is required for energy conservation. It reduces demand charges.

A separate set of car plug controls needs to be designed for propane and diesel driven vehicles where these types of vehicles will be plugged in.

Propane and diesel driven vehicles require more heating.

Mechanically protect exposed low temperature thermostat sensors so they are exposed to the wind and isolated from sources of heat. (e.g., a wire mesh guard or similar device).

E.6.3.7 CSA Z32-15 “Electrical Safety and Essential Electrical Systems for Hospitals”

Receptacles need to conform to requirements as follows:

Hospitals grade receptacles are identified by a green dot on the receptacle face. These receptacles should only be installed in patient care areas to differentiate from receptacles installed outside of these basic, intermediate or critical care areas.

It is our intent to clearly identify receptacles that must be installed and tested to Z32 requirements, and thereafter tested on a regular basis by maintenance staff.

Classifications of care areas within a Community Health Care Center must be confirmed with the appropriate authority prior to finalizing design.

Hospital grade receptacles that have not been installed to Z32 requirements should either be replaced with the specification grade, or the wiring upgraded to meet Z32 installation requirements. This ensures medical staffs are properly informed of the nature of the installed system.

E.6.3.8 Specialty Installations

Recess wall receptacles within gymnasiums approximately 1/2" from front wall surface.

This reduces impact forces on receptacles resulting in broken receptacles and bent cover plates that can become a safety hazard.

Use recessed duplex receptacles for shelf type microwave installations.

Provides additional space for microwave cord connection and protection for cord cap.

E.7 LIGHTING AND LIGHTING DESIGN

This section deals with lighting not only as it relates to building electrical systems, but also as it relates to architectural and interior design. "Lighting Design" is defined in the Illumination Engineers Society Handbook as, *"Providing light for the visual tasks to be performed and creating a balanced, comfortable, and aesthetically appealing environment coordinated with the decorative and architectural theme."*

GN encourages a greater focus on lighting quality and new approaches to integrated building designs. Strategies include an emphasis on room surface reflectance, glare control, lighting commissioning and proper maintenance. Many time-proven strategies will become more prevalent in GN projects, like "design with climate", day lighting and task/ambient lighting. There are also more technological options that improve both quality and energy conservation, especially in the area of glare control, lamp efficiencies and lighting controls. A greater level of lighting design expertise and design team integration is required to achieve the qualitative and functional needs of a project's lighting, while meeting these new and restrictive energy codes.

E.7.1 INTERIOR LIGHTING

Artificial lighting requirements are not much different in Nunavut than anywhere else in North America, although the potential for day lighting is more limited during winter months. The use of "energy saving" lamps, fixtures, and switching devices which allow discreet control, is important because lighting accounts for a large portion of electrical costs. The use of new and innovative products, however, should be carefully considered in terms of cost, availability and maintenance on a Regional scale. The role played by lighting in enhancing the architectural setting, orientation and atmosphere is to be recognized.

Recommendation

Rationale

E.7.1.1 Illumination Levels

Lighting intensity should be to the recommended minimum of the current edition of the Illuminating Engineering Society's (IES) Lighting Handbook & various Recommended Practices specific to building types & NECB or the minimum as required by the Safety Act, whichever is the most stringent. Recommended IES illumination levels are shown in Appendix F.

Facilities such as schools or health facilities have recommended practice documents that detail many considerations that should be made when designing lighting layouts beyond the simple intensity at the work plane.

E.7.1.2 Energy Efficiency

Designers are encouraged to stay within the energy budgets for lighting as set out in ASHRAE/IES 90.1. For guidance, refer to Appendices, which includes excerpts from the National Energy Code for Buildings (NECB) 2015 which was based on ASHRAE/IES 90.1.

Costs for electrical energy in the northern environment are high. The goal is energy efficiency. The National Energy Code for Buildings (NECB) 2015 addresses the efficient use of energy by building. An "energy effective" strategy is one that conserves energy while meeting all appropriate standards for lighting quality, so the most efficient fixture is not always the best selection. A building-wide approach can best reduce your energy consumption.

E.7.1.3 Daylight

Integrate daylighting early in design. Daylight is a desired amenity, design electric lighting to

Minimum lighting levels must be calculated based on northern winter conditions when day

Recommendation

complement the daylight direction and distribution. Consider control strategies when designing the electric lighting system. Where daylight can contribute to illumination for a significant portion of the annual occupied hours in most interior spaces but does not save energy unless the lights are dimmed or turned off and the artificial lighting levels should be adjustable to be able to take advantage of day lighting.

Lifecycle costing should be performed, as well as attempt to outline the qualitative aspects of day lighting justifications.

Rationale

lighting is not possible in most communities in Nunavut. Where daylight can provide adequate illumination to a room or a portion of a room, there must be the capacity to turn off redundant electrical lighting, if any energy savings are to be achieved. Large areas with rows of fixtures controlled by a single switch for example, do not normally allow the flexibility required.

*The maximum number of fixtures controlled by a **switch** should be determined. Use occupancy sensors, dimming ballasts whenever economically feasible. Dimming in relation to day lighting not only saves more energy but is far less distracting to occupants than multiple-level switching.*

Low angle sunlight and snow accumulation are items that affect northern buildings and differentiate this from southern applications. In general, understanding of daylighting in northern building is poor, although it is clear that there is a benefit well beyond the economic benefit.

E.7.1.4 Indirect Lighting

Indirect lighting should only be considered where the quality of the lighting is the most important factor in the lighting design.

For most public sector buildings, the life cycle cost is the most important factor. Typical applications such as school gyms and entrance foyers should not be considered for indirect lighting unless the additional life cycle cost is insignificant (i.e., <5%).

Fixture that are a combination of direct and indirect lighting are preferred due to the high cost of energy in the north.

Where indirect lighting is appropriate, reasonably uniform ceiling luminance is to be achieved.

If this is achieved, occupants may face in any direction without being subject to excessive ceiling reflections on the tasks.

E.7.1.5 Valence Lighting or Spot Lighting:

Uses only for task lighting, display cases and walls that are intended to be features or where dramatic lighting is important.

Minimize this practice because of poor lumen/watt ratio obtainable and the tendency to pick up irregularities of wall surfaces such as painted drywall.

E.7.1.6 Video Display Terminal (VDT) Lighting

Where VDTs are used, lighting fixture lenses should be low-glare parabolic type.

Visual comfort means little or no glare. Glare from reflective and convex screens can be annoying and even painful for the operator. It is

Recommendation**Rationale**

often difficult to position the VDT to prevent reflections on the screen.

E.7.1.7 Night Lights

Night lighting should be designed to prevent energy waste by a careful examination of the true needs for afterhours lighting. Provide night lighting only where minimum lighting for safety or security is required at night and where light switches are not conveniently located. Some combination of dawn-to-dusk operation only of lights at entry doors, combined with low-level lighting activated by occupancy sensors, should be considered.

The high cost of electricity limits the use of night lighting. Appropriate uses are group home hallways (for safety) or arena lobbies (for security) where switches are normally located at a central panel or in a closed-off room.

Night lights can also be linked with occupancy sensors in low-use areas.

E.7.1.8 Luminaires

1. Polycarbonate luminaires are ideal for use in change rooms and ancillary washrooms.

There is a high potential for vandalism in some washrooms and change rooms (i.e., arenas, schools).

2. Over-counter Lighting

Provide task lighting over separately switched counters (i.e., valance lighting under cupboards).

Work at counter tops often requires good lighting for tasks (e.g., nursing stations -writing reports, kitchens -reading recipes) and helps in overcoming shadows cast by the body from general room lighting.

3. Task Lighting

Wherever possible, provide built- in task lighting to supplement the ambient lighting for critical seeing tasks, rather than providing high ambient lighting.

Balance the task and ambient lighting levels. The light levels supplemented by the task lighting should be no more than two times the light levels supplied by the ambient overhead system. For exhibit or display functions, this ratio can increase to 3-4 times task versus ambient. Office lighting designs that provide 300 lux ambient can be supplemented by an adjustable task light that can provide an additional 200 to 400 lux on the task and be within acceptable luminance ratios.

This assists in energy conservation and accommodates the need for higher lighting levels due to task visual difficulty, glare, etc. Typical applications are desks in student or senior residences, as well as airport control towers.

Recommendation**Rationale****4. Arena / Curling Fixtures**

All luminaries in unventilated (less than 3 air changes / hour) arenas / curling rinks need to be suitable for use in wet locations.

High humidity due to flooding of rinks and the lack of mechanical ventilation causes severe condensation and frost build-up.

Reduced glare, no lens shrinkage, reduced cleaning and design provides improved operating temperature.

5. Indirect T Bar Fixtures

Provide improved optics over deep louvered parabolic fixtures.

E.7.1.9 Light source

1. Light emitting diodes (LED) as indicated in luminaires schedule on drawings.
2. Color temperature of 3000 to 3500°K for warm ambient lighting with a CRI of 80 minimum.
3. Color temperature of 4000°K for cool ambient lighting with a CRI of 80 minimum.

Special applications may include hospital operating rooms and light sensitive display areas in museums.

E.7.1.10 LED Drivers

1. Drivers for LED should be as indicated in the luminaires schedule shown on the drawings.
2. All LED drivers should be 100% compatible with the lighting control system.
3. Drivers should have an operating temperature of -25° C to 50° C for outdoor luminaires.
4. LED lamps should be specified by the luminaire manufacturer; Rated 50,000 hours.
5. Minimum warranty for LED modules and drivers should be 5 years.

E.7.1.11 Plastic Luminous Panels

Use acrylic prismatic lenses with a minimum thickness of 0.125" (K12) mounted within a frame.

This identifies the standard of acceptance. A framed lens is not prone to falling out of the fixture due to lens shrinkage or vibration.

Recommendation**Rationale****E.7.1.12 Lighting Controls**

1. Except as permitted in 7.1.12.2, all interior lighting systems shall be provided with manual, automatic, or programmable controls.
2. Controls are not required where:
 - continuous lighting is required for safety or security purposes, or
 - lighting is emergency or exit lighting.
 - Each space enclosed by walls or ceiling height partitions shall be provided with controls that, together or singly, are capable of turning off all the hard-wired lights within the space.
 - Where practical, subdivide spaces to allow greater flexibility and energy saving where possible.

This is an adoption of requirements outlined in the National Energy Code for Buildings.

The goal is energy efficiency.

The goal is energy efficiency.

E.7.1.13 Location of Controls

1. Except as provided in 7.1.13.2 and 3, lighting controls shall be:
 - located next to the main entrance or entrances to the room or space whose lighting is controlled by those controls;
 - located in such a way that there is a clear line of sight from the control to the area lighted; and
 - Readily accessible to persons occupying or using the space.
2. Low voltage relay cabinets are ideally wall mounted near electrical panels supplying lighting circuits.

This is an adoption of requirements outlined in the National Energy Code for Buildings.

The goal is energy efficiency.

Requiring controls to be located at the entrances to the spaces served will not only encourage the use of the controls but will reduce the likelihood that circuit breakers will be used for that purpose.

This provides ease of access for maintenance and setting of controls.

E.7.1.14 Type of Controls

1. Low Voltage Switching (LVS) Consider LVS wherever there are multiple circuits and the switching is desirable from multiple locations.

This is not economical where there are few circuits. This is typically used in schools, health centers and correctional facilities.

Recommendation

Install programmable controls to provide afterhours sweep off capabilities.

Install low voltage switching in all the cases where 347-volt lighting fixtures are in use.

Network panels in facilities with multiple low voltage control panels.

2. Motion Sensors switches.

Passive Infrared Sensors (PIR) or dual technology sensors should be used to control lighting in all rooms that may be left unoccupied for extended periods of time (i.e., classrooms, offices, washrooms, gyms, boardrooms, utility/storage rooms, garages, janitor rooms) except for crawlspaces.

They should be installed where:

- The SIMPLE payback period is less than 5 years (assume the sensor will switch off the lights for 100 hours/year), or
- Automatic lights are required for security reasons.
- The PIR sensors require an override option.
- Ceiling mounted sensors are preferred to cover large areas.

3. Key Operation

Keyed lighting switches are not recommended.

4. Service Space Lighting

Wherever lighting is provided in typically unoccupied spaces, (i.e., crawl spaces) a pilot light, indicating whether service lights are "on", may be conveniently located at the entrance to the service space.

Rationale

This provision ensures fixtures are not left on after normal operational hours. Flick warning allows after hours use.

This provision limits access to increased hazards when cover plates are removed for painting or electrical maintenance.

This provision allows ease of trouble shooting, programming/setting changes for maintenance staff.

They provide energy efficiency and security. Motion sensors should be used when the reduced energy consumption makes the increased capital cost worthwhile. The cost of electricity, type of fixture and space function will determine when motion sensors should be used. Motion sensors are not acceptable where lights going off unexpectedly may cause life safety issues.

The length of time the lights will be shut off by the sensor is usually unknown; so, to make the calculation and comparisons possible, the shut off period effected by the sensor has been standardized (based on 30 minutes/day x 200 days).

In case of malfunction or inadequate coverage, the occupants must be able to override the lights.

This is because they provide full 360° coverage and are less likely to be subject to tampering.

Keys are easily lost, and lights are then left on unnecessarily resulting in wasteful energy consumption.

Lights can be left on inadvertently for extended periods of time, and nobody would be aware, because that space is not normally used.

Recommendation**Rationale**

5. Daylight Harvesting
Perform life cycle cost analysis.

Where daylight study justifies, install daylight controls for energy efficiency.

6. Power Pack Installations

Access difficulties to power packs can create unsafe working environments when troubleshooting 347-volt lighting circuits.

Where life cycle cost analysis recommends motion sensors or daylight sensors, relays may be mounted above T bar ceilings. Restrict to 120-volt lighting controls. Low voltage wiring needs to be installed where not susceptible to mechanical damage from sharp edges and vibrations.

E.7.1.15 Protection of Light Fixtures

1. Wire Guards

Luminaries require wire guards if located in areas where they are subject to damage.

Protection of luminaries in such locations is necessary to prevent lamps from being damaged by moving objects during games or during storage of equipment, and to prevent subsequent injury to persons. Guards may be required in gyms, service areas, storage areas, industrial arts classrooms, and locker rooms and for exterior lights.

2. Safety Chains/Cables

Suspended fixtures in recreational/sports facilities must not rely on support directly from an outlet or box or fixture hanger; provide safety chains/cables.

This is required to ensure that luminaries cannot fall down when impacted by moving objects.

E.7.2 EXTERIOR LIGHTING

Exterior lighting should be provided for safety and security reasons only (i.e., only install exterior lighting where they are required by code or by function as determined by the facility program). The high cost of electricity in Nunavut makes the use of any decorative lighting undesirable.

Recommendation**Rationale****E.7.2.1 Luminaires**

LED Exterior Lighting luminaires to replace Metal Halide and High-Pressure Sodium luminaires.

The operating temperatures shall be from -50° C to 50° C for outdoor applications.

Recommendation**Rationale**

Polycarbonate are well suited for all exterior lights. For all facilities consider the use of vandal resistant luminaires.

This reduces breakage due to high potential of vandalism. Some facilities experience very high rates of vandalism and it may be warranted to install fixtures and metal guards that will stand up to significant abuse.

Luminaires IESNA dark sky compliant and layout to avoid light trespass to adjacent property.

Reduce energy cost.

E.7.2.2 Light Source

1. Light emitting diodes (LED) as indicated in luminaires schedule on drawings.
2. Colour temperature of 3500°K with a CRI of 80 minimum.

E.7.2.3 Controls

1. Exterior Lighting Controls

This is an adoption of requirements outlined in the National Energy Code for Buildings.

Except as provided in E7.2.4.2, exterior lighting shall be controlled by:

Controllers allow for user defined flexibility between providing security, safety and energy concerns which can vary depending upon location, operational hours and facility type.

- Lighting schedule controllers;
- Photo cells (PEC) located so that the PEC is not covered in snow during the winter or adversely affected by the lights it controls (on/off cycling); **or**
- A combination of lighting schedule controllers and photocells.

The goal is energy efficiency.

This provision will simply operational and maintenance requirements.

Locate PEC on north side of building

The intent is to allow flexibility within various types of facilities.

If networked low voltage control systems are employed in a facility, integrate the exterior lighting control.

2. Lighting Schedule Controllers

- Controllers required in 7.2.4.1 shall be of the automatic type or otherwise capable of being programmed for 7 days and for seasonal daylight schedule variations.

Power outages occur relatively frequently, and maintenance of the schedule is desirable for appropriate operation.

This reduces maintenance cost.

Recommendation

- Schedule controllers should be of a type that does not derive its time base from the AC power line frequency.
- Back-up.
All lighting schedule controllers shall be equipped with back-up provisions to keep time during a power outage of at least 4 hours.
- Daylight Saving Changes Capable of automatic setting changes.

Rationale

The small isolated utility power systems in all Nunavut communities typically have poor frequency stability that is not suitable for clock time bases.

E.7.3 EMERGENCY LIGHTING**Recommendation****Rationale****E.7.3.1 Emergency Lighting Locations**

Emergency lighting should be installed in areas required by the NBC, as well as service spaces (i.e., generator rooms, mechanical rooms, usable crawl spaces and washrooms).

This will allow servicing in service areas when power supply fails; lighting for egress from service areas, crawl spaces and washrooms should be maintained as outlined in the NBC. The provision of lighting in stairwells is for occupant safety during the time it takes for an emergency generator to provide power for lighting.

Where emergency generators provide lighting ensure that emergency battery pack powered luminaires are provided in the generator room and transfer switch locations.

This is a requirement of C282.

Even if Emergency generators provide lighting, install additional battery powered luminaires in stairwells.

The provision of lighting in stairwells is for occupant safety during the time it takes for an emergency generator to provide power for lighting.

E.7.3.2 Location of Battery Packs

Emergency packs should be installed in service spaces, corridors, stair cases or other spaces easily accessible to O & M staff.

Battery packs must be frequently tested and should not be located in areas where they may be subject to vandalism, such as school washrooms.

*This will provide emergency lighting while **HID** lights "restrike". HID lighting with quick restrike lamps and integral quartz lamps which provide instant illumination during the restrike cycle are an acceptable alternative.*

E.7.3.3 Auto-test

Automated self-diagnostic circuitry card (auto-test) should be provided for emergency lighting in facilities with centralized battery pack unit(s).

The auto-test system automatically tests the central battery pack unit monthly. Burned-out lamps are automatically sensed to indicate replacement required. The auto-test system is economical on central battery pack systems.

E.7.3.4 Remote Heads

When located in gymnasiums provide securely mounted and adequate protection around remote heads.

High impact sports require not only strong wire guards covering fragile devices, but these guards need adequate backing to prevent damage to wall finishes.

E.7.4 EXIT SIGNS**Recommendation****Rationale****E.7.4.1 Luminaire**

The exit sign shall conform to CSA C22.2 N0.141, CSA C860 and to NBC 3.4.5.1(2) standards.

Unit should be extruded aluminum housing and face plates.

The exit sign should be illuminated with LEDs, with no external transformer required, a 25-year life expectancy, 10-year warranty, a DC voltage option and a power consumption of 2 watts per face.

Sign should be standard with two green pictogram films per face for direction selection.

This is acceptable because of its low energy consumption.

E.7.4.2 Guards

When located in gymnasiums provide securely mounted and adequate protection for fixture.

High impact sports require not only strong wire guards covering fragile devices, but these guards need adequate backing to prevent damage to wall finishes.

E.8 OWNER/COMMUNICATION EQUIPMENT

While standard equipment, such as telephones, is typically anticipated during building design, computers are now also common in many building types. Current and future equipment use requiring cable or special wiring must be routinely considered during design. Cable tray may be suitable for projects to consolidate all low voltage cable requirements.

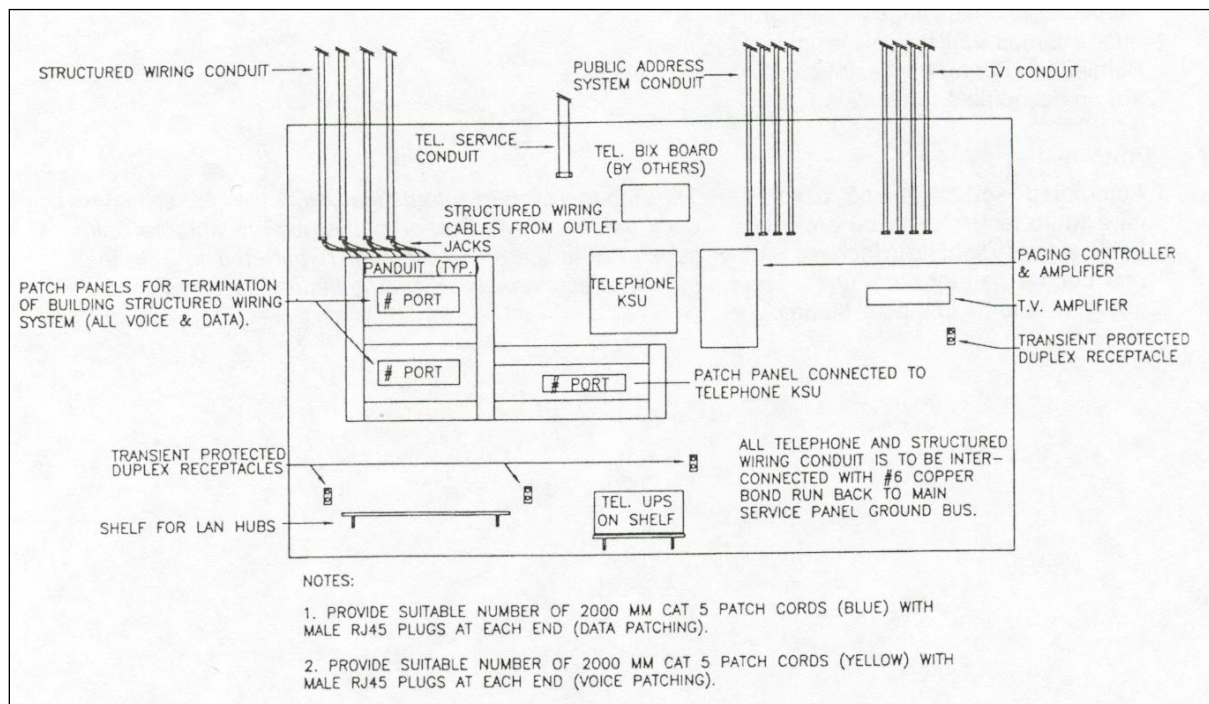


Figure E.8 - 1- Typical Layout for Communication Equipment

E.8.1 TELEPHONES AND INTERCOMS

Northwestel provides telephone services across Nunavut. The utility provider's responsibility is generally to the demarcation point (lightning protection box) usually located within a building. This is the point of interconnection between the utility service wiring, and the property owner's internal wiring and equipment. Communication systems vary from simple two or three line telephone distribution systems to multiple-phone use with teleconferencing and video capability. VoIP (Voice over internet Protocol) use is also gaining popularity.

Recommendation

Rationale

E.8.1.1 Telephone Requirements

Supply and installation of cabling beyond the demarcation point located at the utility providers entrance to the building is the building owners or tenants responsibility.

Recommendation**Rationale****E.8.1.2 Pathways**

Pathways are to be provided as outlined in the Canadian Electrical Code, and TIA 568, 569 and GN-Structured Cabling Guidelines (Latest Version). Cabling is to terminate at a backboard in a service room with a dedicated duplex outlet.

This is done to ensure that a telephone service and raceway system is installed within every building and that a consistent location is chosen for terminations.

The duplex outlet is for the NorthwesterTel power filter. (A quad receptacle shared with the Cable TV is not acceptable as the size of plugs c/w transformers restricts plugging both power supplies into a quad outlet.)

E.8.1.3 Raceways**E.8.1.4 Communication Rooms**

Separate communications rooms should be provided only when the complexity of the communications systems warrants it, as described in GN-Structured Cabling Guidelines.

The following are guidelines for space requirements:

Health centers may require space for video conferencing and associated equipment for medical and educational support.

1. Buildings with 10 or fewer phone lines:
min. 600 mm x 600 mm wood backboard. It can be installed in a mechanical or electrical room.

Modern telephone equipment can withstand a wide range of environmental conditions. Small and medium-sized key systems can operate in almost any interior environment.

2. Buildings with more than 10 phone lines:
min. 1200 x 2400 mm wood backboard. It can be installed in a mechanical or electrical room.

3. Ensure adequate space is provided for future growth of network equipment, RF amplifiers, Security equipment, Sound amplification etc.

Large systems, especially Private Branch Exchange (PBX) with many tie lines, require a more controlled operating environment.

E.8.1.5 Installation

Use star topology for wiring layout.

Simplest systems to trouble shoot and administrate. Problems with wiring are isolated to specific outlet.

E.8.1.6 Power Requirements for Telephone System

The community telephone distribution system has power back up for continued operation through utility power failures. This system provides the power needed for line connected handsets to continue to function.

Recommendation

Wireless hand set end equipment requires a UPS or emergency power to continue operation.

Rationale

Key service units (KSU) which provides onsite telephone exchange and an interface with utility service provider requires a UPS for power filtering and back up during power failures. VoIP networking equipment also requires its own power supply for continued operation.

Building owned equipment that is operated and maintained by various departments requires carefully designed UPS for continued operation.

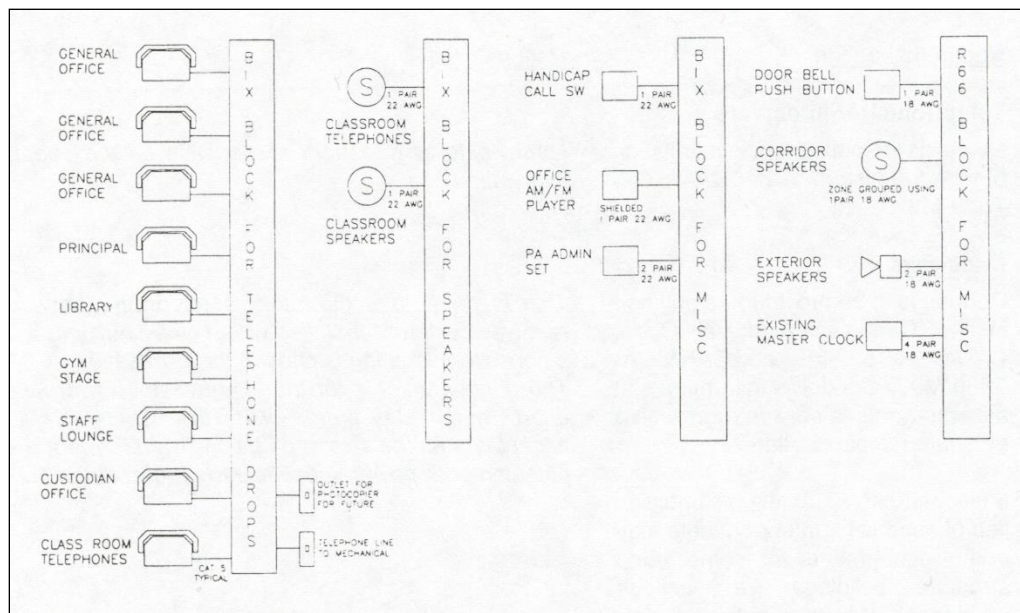


Figure E.8 - 2- Typical Schematic for School Communications Layout

E.8.2 COMPUTERS

Computers require power, routes for networking cables and telephone line connections to allow communication by modem. Electrical design should ensure the system could accommodate future expansion without significantly increasing construction costs. Linear loads (heating, incandescent lighting, etc.) do not go well with non-linear loads (computers, laser printers, and photocopiers). In the non-linear family, computers, do not get along well with the electrical properties of laser printers and photocopiers which consume a great amount of current in an abrupt and irregular fashion, affecting the voltage. The voltage fluctuations that they provoke can seriously damage a computer & other sensitive equipment or can even simulate a blackout. Consider the use of K-factor distribution transformers as it has become a popular means of addressing harmonic related overheating problems where electronic ballasts, drives, personal computers, telecommunications equipment, broadcasting equipment and other similar power electronics are found in high concentrations. It should be noted that this benefit can usually only be obtained during initial installation. It would be unlikely that the savings would justify retrofit.

Recommendation**Rationale**

E.8.2.1 Networking

Recommendation

Wherever computers are identified as a current or future requirement in a facility program, allow for expansion in conduit as outlined in E.6.1.

A minimum 21 mm conduit linking computer workstations to hub or cable tray locations and a 21 mm conduit from the cross connect to the telephone backboard is recommended.

Where conduit is used, a minimum 21 mm conduit linking computer workstations to hub or cable tray locations.

A 21 mm conduit from the cross connect to the communication backboard is recommended.

Rationale

This allows for changes and future expansion.

Conduit infrastructure allows for a wide variety of cable requirements i.e., from a basic single twisted pair of wires (basic modem, networking, communication link), or a 4 pair cable (Category 5 data cabling), or coaxial cable, or fiber optical cable from each workstation.

E.8.2.2 Structured Cabling

Structured cabling for data and telephone drops to be Category 6 as per GN's Structured Cabling Guidelines (Latest Version). Drops to be terminated at jacks and patch panels.

Category 6 cabling is the current standard of acceptance for horizontal wiring. Category 6A or fiber should only be used where required on a specialized basis (i.e. Video Conferencing, Telehealth, Network Backbone etc.). Refer to GN's Structured Cabling Guidelines (Latest Version).

E.8.2.3 Telecommunication Outlets

Telecommunication outlets to be grouped. (i.e. combination Data/Voice Jacks).

Provides a more economical and compact installation when devices are grouped.

E.8.2.4 Wireless Networking

Where wireless systems are to be used, allow for wireless access points consisting of wired LAN drops with adjacent power receptacles located to ensure adequate signal strength.

This allows for accommodation of repeater stations to propagate network signals.

Initial construction should allow for provision of required physical infrastructure for future wireless system.

Wireless network setup and security provisions are to be installed and maintained by the building's users.

The open nature of wireless networking poses a risk that requires ongoing user intervention to ensure security is maintained.

E.8.2.5 Harmonic Distortion and Noise

Harmonics produce an increase in the resistance of the conductor (skin effect) and, in turn, an abnormal common mode (neutral-ground) voltage difference.

1. Identify non-linear loads including: switch mode power supply (SMPS), (typically found in computers, servers, monitors, printers, fax

The Switch-mode Power Supply (SMPS) is found in most power electronics today. Its reduced size and weight, better energy efficiency and lower

Recommendation**Rationale**

- | | |
|---|--|
| <p>machines, photocopiers, telecom systems etc.), UPS, rectifiers, variable frequency drives and electronic ballasts. Determine the effects of these loads on the power distribution system.</p> <p>2. Provide harmonic filtration, either integral with the equipment or separately, to limit total harmonic distortion from each piece of equipment to less than 10%. Limit the harmonic distortions to comply with current edition of IEEE 519.</p> <p>3. Provide transient protection and harmonic filtering in power supply to Data and Communication Systems and computer labs.</p> <p>4. Provide transformer isolation between large harmonic generating loads and the balance of the distribution system.</p> <p>5. Use separate neutrals or increase size of neutral of branch circuits where necessary.</p> | <p><i>cost make it far superior to the power supply technology it replaced.</i></p> <p><i>Harmonic distortion are primarily due to new power conversion technologies, such as the Switch-mode Power Supply (SMPS). The SMPS is an excellent power supply but it is also a highly non-linear load.</i></p> <p><i>The most common form of distorted current is a pulse wave form with a high crest factor. Typically, these high current pulses will cause clipping or flat-topping.</i></p> <p><i>Actually, it is less costly overall to provide a harmonic mitigating transformer to feed several hundred computers than it is to improve the operation of the SMPS in each computer. This is especially true when we consider that the added cost of the improved SMPS will reappear every three years when a new computer system is purchased.</i></p> |
|---|--|

E.8.2.6 Transient Voltage Surge Suppression (TVSS)

Provide transient voltage surge suppression (TVSS) integral with the distribution equipment. Coordinate suppression with anticipated energy levels and sensitive loads.

Dissipation of high-energy transients from lightning is typically provided at the main service point where the energy is first received from the utility power line in the event of a strike.

Provide surge suppression in the following manners: Install surge suppression on utility incoming mains. For areas containing a large group of electrically sensitive loads, provide surge protection on panel boards serving the area.

This provides protection from internal sources of harmonics, voltage spikes, and transients.

Provide individual pieces of sensitive equipment, not otherwise protected, with local surge suppression module (computer power bar or wall plug-in style).

Coordinate surge suppression devices within the same power distribution system.

E.8.2.7 Computer Circuits:

Recommendation

Electronic office space or electronic equipment such as computers, electronic communications micro-processors equipment review the requirements for supplemental electrical protection of electronic equipment with the GN's Technical Services Division.

- Generally, supply only two computer work station per circuit. Review the options for circuiting with Technical Services Division.
- Do not use common neutrals. Provide a separate, isolated ground for each circuit.
- For installation with more than 12 computers grade circuit; provide a separate panel fed via an isolating transformer with an electrostatic shield.
- Provide a separate ground wire from each computer circuit to the branch circuit panel board.
- Provide an isolated ground buss in each branch circuit panel board supplying electronic loads.
- Size all grounding conductors to carry the fault current necessary to trip the over current devices protecting the loads, panel boards, and feeders associated with the grounding system.

Rationale

Determine the extent and severity of electrical service disturbances including voltage sags, surges, short term and long-term transients and outages.

Identify electronic equipment and system likely to be affected by disturbances and the extent of protection necessary for normal operation.

Actually, it is less costly overall to provide a harmonic mitigating transformer to feed several hundred computers than it is to improve the operation of the SMPS in each computer. This is especially true when we consider that the added cost of the improved SMPS will reappear every three years when a new computer system is purchased.

E.8.3 TELEVISION AND CABLE**Recommendation****E.8.3.1 Cable Installation**

Where televisions or television monitors are identified as a current or potential future requirement in a facility program, assume cable connection may be required and allow for capacity in common conduit as outlined in Electrical E6.1.

Rationale

Typically used in classrooms, visitor centers and museums, group homes or detention facilities.

Recommendation

Wherever cable television is identified as a current or future requirement, run individual cables to each TV outlet from a main television service backboard located in a service room, c/w a separate circuit duplex receptacle.

Rationale

The intent is to ensure that the required television service will be installed at a consistent location and to identify that a conduit system is not always required, but that cables are not to be looped to outlets (to prevent a cable malfunction affecting more than one outlet). The duplex receptacle is required for a plug-in transformer or RF (radio frequency) amplifier.

Labeling of cabling is required at both ends of all cable runs.

Cable labeling provides ease of cable management and troubleshooting.

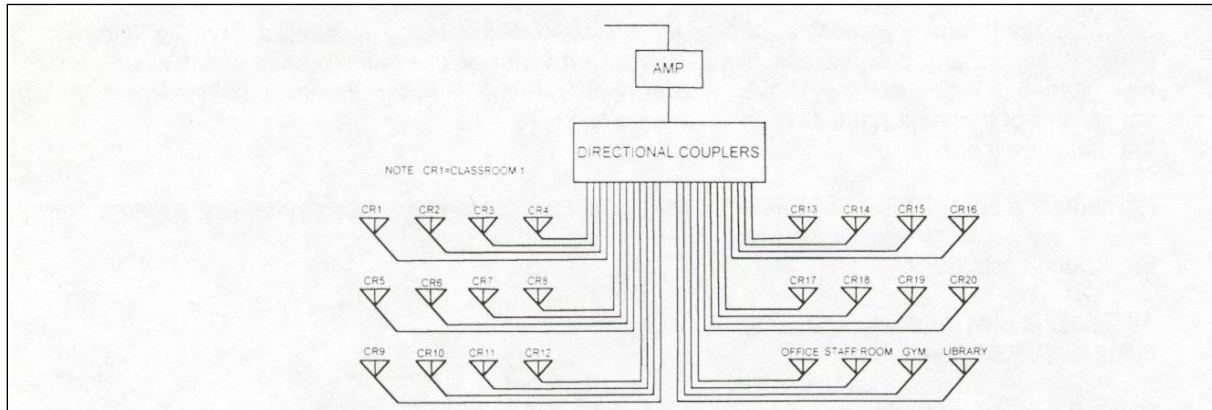


Figure E.8 - 3- Typical School RFTV Distribution System

E.8.4 CLOCKS

Recommendation

Battery powered clocks are preferred. Class change signal clocks may be powered by an AC source but should not derive the time base from the AC line frequency.

Rationale

Power outages and the frequency of fluctuations in cycles/second (Hertz) of diesel-generated power adversely affect the accuracy of 120-volt clocks.

E.9 ALARM SYSTEMS

The primary purpose of an alarm is to issue a warning, preferably before any major damage occurs. Although fire and security alarms are typical across Canada, mechanical system alarms are also commonly used in Nunavut. Alarm systems must be suited to the community and its resources: in some communities resident maintainers may be able to respond quickly when alerted; in other communities residents are expected to notify the Hamlet, who in turn can notify the area maintainer, who may have to fly or drive in.

E.9.1 FIRE ALARMS SYSTEMS

Where clarification is required on fire alarm systems, consult with the Nunavut Fire Marshal early in design. Systems should be as simple as possible (i.e., factory service technician should not be needed to program the fire alarm system).

Recommendation

Rationale

E.9.1.1 Supplier Qualifications

The system supplier (i.e. manufacturer or the manufacturer's authorized agent) must have an office established for a minimum of 5-years with full in-house technical service and maintenance capabilities.

This is intended to clarify the qualifications required to supply a fire alarm system.

Suppliers using third party in subcontracted maintenance services are not acceptable.

E.9.1.2 Product Manufacturers

Fire alarm systems should be supplied by one of the following suppliers:

- Simplex
- Notifier
- Edwards

Substitutions are not recommended.

To ensure competitive bidding, yet limit the number of systems and replacement parts, the GN has specified 3 suppliers.

E.9.1.3 Types of Fire Alarm Systems

- Fire alarm systems should not exceed the requirements of the NBC.
- Exception: Buildings designated, as emergency shelters must have a fire alarm system, although not necessarily required by Code.

This keeps the systems as simple as possible and meets minimum Code requirements.

People may be required to sleep overnight or longer in an emergency shelter, which necessitates a safe haven.

If programming is required, it must be site programmable with a non-volatile memory (i.e., lithium battery back-up for programming).

This maintains programming memory in the event of loss of normal and battery power.

Addressable systems may be capable of remote programming.

This feature is useful for replacement of any devices without incurring the cost of air travel.

Recommendation**Rationale****E.9.1.4 Strobes/Sirens**

See Electrical E9.6

E.9.1.5 Manual Pull Station

To be installed in every floor area near every required exit, including crawl space exits.

This is a clarification of the Code requirements.

Manual pull stations in gymnasiums must be fully recessed.

The intent is to prevent injury to people and damage to pull stations in gyms.

E.9.1.6 Fire Alarm Notification Devices

Horn strobe devices should be used in place of bells. Devices need not be red.

The intent is to ensure audibility and visibility where required. Red horn/strobes often take away from architectural look.

E.9.1.7 Fire Alarm Verification

Verification is to be carried out in accordance with Can/ULC-S537 and Office of the Fire Marshal.

This will clarify verifying agent qualifications.

E.9.1.8 Central Monitoring Stations

Use only where required by the National Building Code 3.2.4.7 and the Nunavut Fire Marshal.

This is intended to clarify which projects require central monitoring with a DACT (Digital Alarm Communicator Transmitter). Consult the Nunavut Fire Marshal to determine which communities have local monitoring systems meeting this requirement of the building code.

E.9.1.9 Auto Dialers

For local fire alarm notification, digital dialers described in E9.5 may be used to dial local fire phone systems. It is to be noted that these dialers do not meet Central Monitoring Station requirements.

In emergency fire situations, local people need to be contacted immediately. Many OPX (Off Premise Exchanges) fire phone systems address this requirement for quick response.

E.9.2 COMMUNITY FIRE SIRENS**Recommendation****Rationale****E.9.2.1 Standard of Acceptance**

Federal Signal Corporation for items listed below:

Most of the community fire alarm sirens in Nunavut are now of this type and this manufacturer.

- Sirens

Recommendation**Rationale**

- Model Eclipse 8
- Controls
- PGA (Predetermined General Alarm) timer or equivalent
- Motor Starter
- Use RC5 Motor Starter (heavy duty relays, capable of handling the operating current) or equivalent
- Exercise Clock
- Model 75 or equivalent

The experience has been that this motor driven siren has given the fewest problems if exercised daily.

E.9.3 MECHANICAL SYSTEM ALARMS

Failures of mechanical and especially heating systems can have serious consequences during long, cold, winter months. The sooner maintainers can be alerted to a problem, the sooner they can make repairs or switch the building over to standby systems while effecting repairs.

Recommendation**Rationale****E.9.3.1 Mechanical Alarm Annunciators**

- Locate the primary annunciator panel in the mechanical room.
- The secondary, remote panel is required to alert building users to mechanical problems.

The intent is to ensure that information is provided for building operators and maintainers.

Typically required in schools, community halls, large residential facilities, and health center where responsible users can notice and alert maintainers. Not required in fire halls, garages, or seasonal use facilities.

E.9.3.2 Nuisance Tripping

Ensure mechanical alarms are not initiated by a power interruption of less than 30 seconds.

False alarm signals produced during a power interruption have created a nuisance both for local staff and personnel contacted by the auto dialer.

E.9.3.3 Auto Dialers

See Electrical E9.5.

E.9.3.4 Alarm lights and Audible Alarms

See Electrical E9.6.

E.9.4 SECURITY SYSTEMS**Recommendation****Rationale****E.9.4.1 Intrusion Alarm Systems**

Where a security system is a program requirement, monitor entrances, exits, corridors, and accessible openings.

Intrusion alarms are typically installed when there is a danger of burglaries because of building contents, or as a means of reducing incidences of vandalism.

Monitor rooms with high value of controlled contents.

1. Device Wiring

Computer labs, specialized equipment storage or pharmacies require controlled access.

Provide each device with individual conductors to main security panel.

Separate wiring allows isolation of failed individual devices rather than total failure of the system. It also provides identification of individual device status for troubleshooting purposes.

2. Door Contacts

Mount within the door frame during new construction.

Mounting door contacts within frame provides excellent mechanical protection to door contact devices.

Install door contacts for all the exterior doors.

Motion sensors do not confirm door position. Experience has shown that motion sensors can be positioned and not noticed until after incidents. Door contacts are not as easily defeated.

3. Alarm Signal

If there is a sound system within the facility, connect the alarm to the tone generator to sound a continuous tone upon receiving an intrusion alarm signal.

Sound system tone generator, if available is a desirable deterrent.

4. Partitionable

Provide partitions to allow separation of areas within a building. This provides access to one area, while continuing to secure other areas. For example, schools with night use requirements (i.e., gyms).

Many communities make good use of schools/gyms in the evening, and therefore, access to some areas is required at night without setting off the intrusion alarm.

5. Enabling Systems

Time clocks or internal time settings may be used to automate the arm and disarm process for buildings that have regular schedules.

This provision insures the facility is secured through the normally unoccupied times.

6. Access Means

Access may be provided by a variety of means; key switch, keypads, key fobs, card access etc.

Keys may be used to reduce the number of people in the community knowing the access code.

E.9.4.2 Video Monitoring

Installation of such system should be discussed with the client and based on the building program.

1. Privacy

Before installing a CCTV system, check local laws regarding privacy and recording.

Never install video surveillance anywhere there is a reasonable expectation of privacy such as bathrooms, locker rooms, changing rooms, medical examination rooms etc.

2. Cameras

- Outdoor cameras may require infrared illuminators to allow night vision. If the camera is a pan / tilt / zoom, a heated enclosure is needed to operate properly in our northern environment.
- Inside cameras that are exposed to brightly lit and dark areas will require a wide dynamic range and dual shutter speeds for picture clarity.
- Aisle cameras may require a long lens, positioned to face away from light sources.
- Large open areas may require day/night cameras with wide angle lens.

Each application requires a specific type of camera that will provide satisfactory image quality.

3. Recording

Digital Video Recorders (DVR) allows greater flexibility for recording space and network access from remote location. Ensure equipment is located in a ventilated, secure environment suitable for continuous operation.

Operational environment will affect the durability of the installed equipment.

Setup recording to only save images when motion is detected.

This feature will allow for considerable extra recording backup time.

E.9.4.3 Access Control Systems

Proximity type sensors are acceptable. Preference is given to door strike hardware. Magnetic door locks are to be avoided wherever possible.

Access control systems simplify the processes of ensuring secure access to various parts of a building. This can easily be done using the system's database. This has significant advantages over key and lock, but in small

centers, it may become an encumbrance that is simply bypassed.

Access control should not be used outside of the larger centres in GN.

Maintenance of these systems requires a level of expertise not commonly found within isolated communities.

Copies of the control diagrams should be located within enclosures designed for such and an additional copy provided within the appropriate section of the O & M manual.

This is to assist future maintenance requirements.

E.9.4.4 Patient Wandering Systems

These systems are typically used in health centers.

Locate wiring diagrams and sequence of operation within front cover of main panel as well as O & M manual.

This is to assist future maintenance requirements.

Ensure patient wandering detection ranges are configured with the assistance of the building user.

This ensures proper operation in accordance with facility requirements.

E.9.4.5 Panic Alarm Systems

These systems are typically used in health centers.

Where panic alarm systems are program requirements, they must be complete with a strategically placed audible alarm connected to the auto dialer. Call buttons should be of industrial quality.

Typically, panic alarms are installed in health centers where a member of staff may be alone with clients and may require immediate assistance in case of emergency.

Copies of the control diagrams should be located within enclosures designed for such and an additional copy provided within the appropriate section of the O & M manual.

This is to assist future maintenance requirements.

E.9.5 ALARM LIGHTS AND AUDIBLE ALARMS

Recommendation

Rationale

E.9.5.1 Exterior Alarm Lights

1. Lights or strobes should be located on high point of buildings, clearly visible from the roadway.

Lights can, be used either to indicate a building condition, or to act as an alarm indicating a critical condition requiring immediate attention. Intended as a supplement to the auto dialer. The intent is to avoid confusion with landing lights, vehicle lights, etc.

Exception: Strobe alarm lights are not to be installed on arctic airports.

Color-coding is standardized on public sector buildings. Blue strobes are typically used for security systems and panic systems in health

Recommendation**Rationale**

centers and correctional facilities, where staff may be alone with clients and could require immediate assistance.

2. Color of lights

- Fire alarm: red
- Mechanical alarm: amber
- Security/panic: blue
- See 3.4.1 Table E-2

E.9.5.2 Sirens/Horns

- Exterior audible alarms are required for fire alarm systems and security systems.
- A siren is not required for mechanical systems.

Audible alarms can unnecessarily disturb the entire community. However, a fire condition is a critical condition that makes this disturbance necessary. Security system audible alarms are a deterrent as it draws attention to the building and the people nearby.

With auto dialers and the strobe lights, the audible is not as necessary for mechanical systems (e.g., while air handling unit low temperature is a problem, it does not require disturbing the community).

E.9.5.3 "High Water" Light

High water level in a holding tank is indicated by using an illuminated amber light mounted at the water fill pipe. Water fill indicating lights should be LED type. Standard of acceptance is Ledtronics, 120 V AC, Edison screw base.

Water delivery pumps are controlled at the vehicle. The light indicates that the tank is full, and that the driver should stop pumping.

LED lights have low energy consumption and low maintenance requirements.

Install a two-lamp fixture.

This provision ensures at least one lamp will illuminate in the event of a lamp failure.

Locate in a visible location convenient to the operator.

Water delivery pumps are controlled at the vehicle. The light indicates that the tank is full, and that the driver should stop pumping.

E.10 MOTORS**E.10.1 CHARACTERISTICS****Recommendation**

Motors must meet the specified minimum efficiencies in National Energy Code for Buildings (NECB) unless it can be shown that a lower efficiency motor will yield lower life cycle cost.

Installation of high efficiency motors should be installed where life cycle costs may be demonstrated. Match voltage rating of motor with supply voltages, i.e., use 200 V motors for 208 V services.

Rationale

This is done in the name of energy conservation.

E.10.1.1 Motor Starters - 3 phase

1. Provide single phase protection for all motors 5 hp or larger with magnetic starters c/w solid state adjustable overload sections offering phase loss protection.
2. Provide "Hand" option and "Running" indicator to allow for ease of O & M. If DDC is present, use CT's to indicate motor status in DDC.
3. Where number of three phase starters in a given location exceed four, give strong consideration to MCC installation.
4. Where multiple 600 volt motors are installed, provide full sized motor starters within an MCC.
5. Copies of the control diagrams should be located within enclosures designed for such and an additional copy provided within the appropriate section of the O & M manual.
6. All motor starters to be combination c/w lockable handle.

Although 240 V motors may function on 208 V, experience has shown that they burn out faster than 200 V motors.

This prevents costly motor replacement of large motors due to single phasing.

These functions may be used rarely but are invaluable for troubleshooting purposes.

This ensures that the failure of one starter does not detrimentally affect other starters in the same enclosure and provides improved maintenance safety.

This provision is to assist future requirements.

This provision provides increased safety during any future requirements. Combination starter equipped with a breaker.

E.10.1.2 Motor Starters- Fractional Horsepower

1. Provide thermal motor protection switches for fractional horsepower motor loads serving pumps.
2. Provide a pilot light on all thermal motor protection switches.

Although motors have built in motor protection, this provision assists in notifying maintenance staff of equipment status.

- | | | |
|----|---|---|
| 3. | Provide lockable toggle plates. | <i>This provision provides a visible indication of power and state of thermal element.</i> |
| 4. | Use hinged lockable covers on suitably sized junction boxes to enclose control and motor relays and/or sensors. If mounting thermal motor protection switch in junction box cover, mount independent of switch cover. | <i>This provision provides increased safety during any future requirements.</i> |
| 5. | Do not use float switches to interrupt motor current where long distances from storage tanks to motors loads are required. | <i>Secure mounting of motor protection switch allows safe access to the thermal elements.</i> |

E.10.1.3 Motor Terminations

| | |
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| <i>Standard wire should be used where wiring to motors ends in a terminal strip.</i> | <i>Installation of motor control relay may reduce voltage drop to motor loads during startups, providing them with the proper operating voltage.</i> |
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E.10.1.4 Variable Frequency Drives

| | |
|--|---|
| Install in conjunction with Direct Digital Control systems for fixed mechanical loads 5 horsepower and larger, or where variable control is determined beneficial by the designer, or where energy savings can be proven (e.g., heat circulation pumps). | <i>This is required because solid wiring to terminal strips in motors tend to become loose due to motor vibrations.</i> |
|--|---|

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|---|--|
| Provide drives complete with harmonic distortion like line and load side reactors & filters which limit total harmonic current distortion to less than IEEE 519 standard requirements where the drive terminals are the point of common coupling, but in no case more than 15%. | <i>The intent is to allow for energy conservation.</i> |
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| Ensure motor matches VFD and is suitable for inverter duty. Use pulse width modulated technology drives. | <i>This provision reduces harmonic distortion from feeding back into the power system.</i> |
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Locate drives with in 7 meters of load.

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| Provide integral bypass for all VFD's. | <i>This allows for equipment operation in the case of VFD failure.</i> |
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E.10.1.5 Soft Starters

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| Large motors with frequent start/stop should have soft starters, especially in smaller communities. | <i>Frequent start/stop can have a significant effect on the electrical supply in small communities, where a large motor starting can cause voltage fluctuations.</i> |
|---|--|

E.10.1.6 Power Factor Correction

| | |
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| Power factor correction of motor loads should be considered and applied if the nature of the load is | <i>Power factor correction can lower overall power and demand charges from the utility.</i> |
|--|---|

supportive of correction, and the designer can show an acceptable cost payback.

Correct power factor to 95% where normal loading yields power factor below 90%.

Provide power factor corrections to individual motors 10kW and larger or groups of motors totaling 50kW or larger.

Locate capacitors close to motor load, usually downstream of starters.

Where switchable capacitor banks are used, take the following precautions:

- First in, first out switching.
- Provide time delay between switch steps.
- Prevent overcorrecting and cycling.
- Conduct harmonic analysis and, where necessary, provide harmonic de-tuning.

E.10.2 DISCONNECTS

Recommendation

A lockable disconnecting means to isolate a motor should be located within sight of and within 9 m of the motor and the machinery driven thereby.

Rationale

The intent is to permit safe operation and maintenance.

E.10.2.1 Motor Disconnects in Public Areas

Motor disconnect switches in public areas should be:

This prevents young children from shutting off motors (e.g., cabinet unit heaters in vestibules) that must operate to prevent property damage (e.g., prevent sprinkler heads from freezing and busting).

1. Installed at 2.1 m above the floor, or above the ceiling tile close to equipment servicing.
2. Provided with a ventilated lockable cover or within manufacturers equipment where possible.

Protecting the switches by location is preferred over lockable covers to avoid the cost and inconvenience of keyed covers.

E.10.2.2 Sprinkler Pumps

Sprinkler jockey pump must be fed by the generator.

Ensure operation of the jockey pump during utility power failures.

E.11 MISCELLANEOUS**E.11.1 AUTOMATIC DOOR OPENERS**

See Architectural A4.3.2 and A4.3.3.

E.11.2 HEAT TRACE**Recommendation**

Where possible, hydronic heat trace system should be installed instead of electrical heat trace.

All electrical heat trace is to be controlled by a temperature controller that limits its operation during high ambient conditions.

Where heat trace is required for water and sewer connections, it should be the self-limiting type.

If used on polyethylene pipe, the heat trace must be T-rated for such application.

For water re-circulation lines, where heat trace is used as a backup, the heat trace should be activated upon a loss of flow.

A pilot light should be used to indicate the heat trace is on.

Rationale

Where heat trace is required, hydronic provides the greatest energy efficiency.

Even self-limiting heat trace only regulates its temperature within a narrow range and, if allowed to run in a high- ambient environment, can cause overheating of the cable and possibly ignite adjacent materials. A temperature controller is a requirement of the Nunavut Electrical / Mechanical Safety Section.

This is required for energy efficiency and premature failures of heat trace cable.

This applies to the typical heat trace system for standard GN water and sewer connections in permafrost areas to ensure "melt-down" does not occur.

This prevents freeze-up when the circulation pump fails. The heat trace should be sized to ensure that it would be of a sufficient size to thaw the pipe.

Depending on the application, the heat trace can also be manually activated when used as a backup.

The intent is to alert/confirm operation.

END OF SECTION

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CHAPTER N - ENERGY

N.1 INTRODUCTION

Buildings are a significant source of energy consumption and greenhouse gas emissions and hence brings up significant costs to building owners and our environment respectively. Heavy reliance on fossil fuels for both heating buildings and electricity generation has resulted in some of the highest utility costs in Canada and buildings consume a significant portion of this energy. Furthermore, due to remoteness of Nunavut, GN purchases fossil fuel for whole year during sealift season which poses other challenges of transportation and storage. Volatility in oil market lead to an added risk on our energy prices. With growing demand for energy sources due to added infrastructure every year, being energy efficient is solution to our problems for powering Nunavut in a sustainable manner.

Primary objective of energy efficient buildings is to consume less energy while subsequently reduce greenhouse gas emissions. This can be achieved by choosing energy efficient systems while also making sure to have best practices in place for energy efficient use of those systems.

Energy efficiency measures are addressed throughout various sections of the GBPG. The present section supplements the energy information from the GBPG and outlines various items which could be included in the design of a facility to make it more energy efficient.

The recommendations in this document could relate to financial incentives and act as a guide for those involved in the construction process.

References

Documents referenced by the NBC or this document include:

- IES Lighting Handbook 10th Edition
- National Energy Code for Building for Canada
- Canada Green Building Council's LEED
- ASHRAE Handbooks and Standards
- ASHRAE 90.1-Energy Standard for Buildings Except Low-Rise Residential Buildings

N.2 ENERGY DESIGN CONSIDERATIONS

N.2.1 ENERGY SOURCE

Energy source options must be determined and evaluated early in the building design process. Fuel oil for heating buildings while electricity generated from fossil fuels has been the traditional choice of energy sources in Nunavut. However, designers are encouraged to look for energy efficient and clean energy alternatives for energy sources early in the design process.

N.2.1.1 HEAT RECOVERY FROM QULLIQ ENERGY CORPORATION (QEC) POWER PLANTS

The GN has Memorandum of Understanding (MOU) with QEC in regard to recovering heat from QEC power plants. This MOU provides for heat recovery systems to be provided by QEC, who will meter and charge the building owner for the heat provided. The charges for the system may result in 10 to 15% saving to the building.

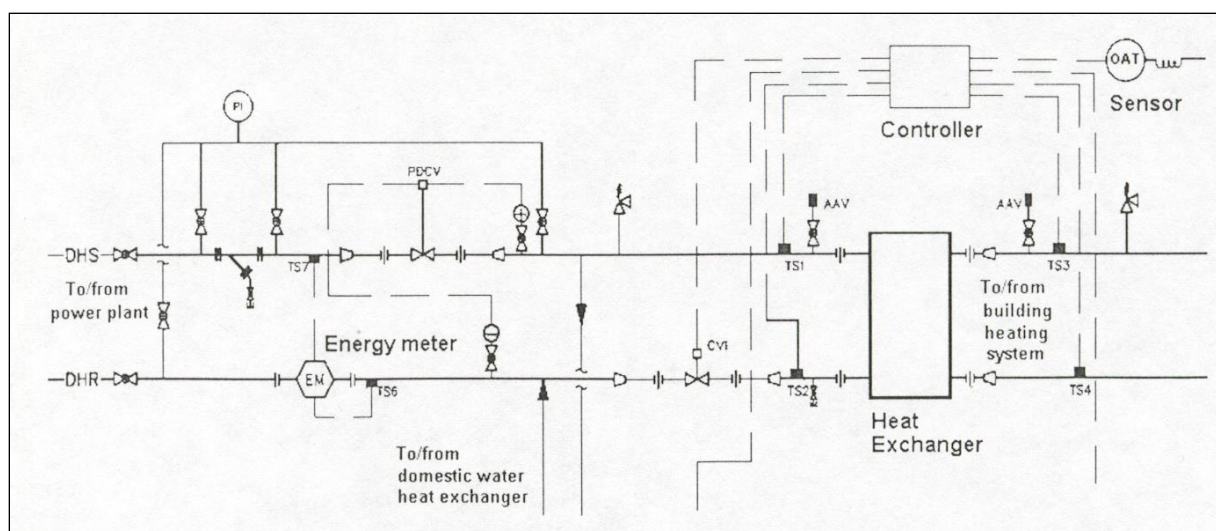


Figure N.3 - 1: Residual Heating System

Some of the benefits of residual heat systems are:

- **Direct Cost Savings.** Where the total costs of building and operating a residual heat distribution system allow the energy to be sold to the customer at a rate that is less than the customer's cost of equivalent heating fuel, a direct savings is realized in annual building operating costs. If a system can provide enough energy to significantly reduce operation of the customer boiler system, the customer may realize a savings in boiler maintenance and/or capital investment costs.
- **Long Term Community Infrastructure Cost Savings.** A system providing thermal energy to buildings normally supplied by oil-fired heat can cause a significant deferral of fuel storage facility upgrades.
- **Environmental Concerns.** Production of greenhouse gas emissions and other pollutants is directly related to the amount of fossil fuel consumed by the community. A given percentage reduction in consumption of fossil fuels results in an identical decrease in emissions.
- There is no increase in electrical production fuel required by the power plant. There is some reduction of transportation and handling hazard, especially where fuel is delivered to the community by sealift and truck.
- Noise pollution caused by radiator fans is often reduced substantially, especially during the winter, when thermal demand on the system is greatest.

N.2.1.2 HEAT RECOVERY: COGENERATION

Cogeneration is the simultaneous production of heat energy and electrical or mechanical power from the same fuel in the same facility. Cogeneration greatly improves overall system efficiency by recovering “waste heat” from combustion processes that would otherwise be released to the environment. The recovered heat can be used for space heating through a district heating grid and thus offset the total amount of fuel oil required.

Recommendation

Evaluate the effectiveness of recovering heat from diesel-powered electricity generation. Consider the application of a district heating grid and perform a cost-benefit analysis comparing the cost of implementing the new technology with the amount of fuel oil for heating which would be offset through cogeneration.

Rationale

The distribution pattern of buildings in the Nunavut community may constraint the effectiveness of a district heating grid. Buildings need to be in close proximity and the feed lines must be well insulated to avoid subsequent losses. Cogeneration may be better suited to larger (multi-residential, commercial, institutional and industrial) buildings.

N.1.1.3 REVEWABLE ENERGY

Considering the high cost of producing electricity with an oil-fueled generator and that renewable energy technologies are becoming more and more accessible; these systems should be considered for various applications.

Renewable energy can also be used for solar pre-heating air or water, thus reducing the amount of fuel used for that purpose.

Recommendation

- Where buildings can be connected to a grid, solar energy technologies that generate electricity should be evaluated.
- Systems that use solar energy primarily to provide lighting should be evaluated considering that typically natural daylight can be used to provide adequate lighting when solar energy is available.
- Solar energy technologies that generate electricity may be considered for remote and/or summer-use facilities such as: parks buildings, field research stations and fire towers.
- All electrical loads need to be reduced to an absolute minimum by using the most efficient hardware and appliances available, before renewable energy hardware should be considered.

Rationale

Until Independent Power Producer Program from QEC has commenced, electricity generation should be evaluated based on a study of load/production considering overall storage.

In the summer months natural daylight is available. Solar panels are not effective in the winter due to short daylight hours and interference due to snow. Some buildings require artificial lighting all year long, thereby making this system a good alternative.

The cost of operating and fueling generators in remote locations in the North is usually very expensive. Alternative energy is expensive also but may be viable because it has very low operational costs.

The initial cost of buying a renewable energy system is normally the largest component of the life cycle costs. As the initial cost is proportional to the size of the loads imposed on the system, reducing the loads will help minimize the life cycle costs of the system.

Recommendation

- Renewable energy should be used to reduce the load on traditional energy sources.

Rationale

Solar Wall technology preheats intake air and minimizes the fuel oil required to heat air to suitable temperatures. This solution is simple to integrate into the architecture of a building and has proven to be effective. It is considered a very low maintenance technology since it has no moving parts. Also, some of these systems serve as intake hoods.

Direct combustion to generate energy from waste is an option which both manages solid waste as well as contributes to reducing heating fuel oil requirements. Costs and emissions from incineration need to be carefully considered.

- Where wind turbines are installed, they will generally require a separate power source.
- Solar hot water heaters can be used for certain applications.

Most wind turbines are induction generators and require excitation from a separate power source.

Vacuum tube solar heaters are the most efficient. They absorb heat by means of radiation and as such are not affected by the outdoor temperature. These systems can be helpful in reducing the overall fuel consumption of a building.

N.2.2 BUILDING DESIGN

Building envelopes must achieve higher effective insulation values and air tightness, with properly-installed vapour and air barriers with minimal thermal bridging.

Electrical energy usage should be minimized by using LED lighting, daylight harvesting and occupancy-based lighting controls, smart parking receptacles for exterior parking, variable speed drives for fan motors and pumps, high efficiency motors, Energy Star rated appliances, and similar features. Electrical demand charges should be considered in the energy cost budget projections.

Heating and ventilation systems consumes most of the heating energy. The required amount of fresh air and total airflow may be minimized while maintaining sufficient quantities of outdoor air using displacement ventilation air supply or other efficient systems. The use of heat recovery devices, such as heat wheels, glycol run-around loops, and similar heat recapture devices on exhaust air systems is recommended to be evaluated during design. Variable Air Volume (VAV) systems for both single and multi-zone AHUs with demand control, where feasible, must be deployed. Removable valve covers are recommended for all uninsulated pipe fittings in boiler room for boiler heating piping network including valves, strainers, pumps etc.

High efficiency boilers, with modulating burners for larger applications, must be selected. Boiler controls for boiler and heating pumps must also be looked at to meet heating demand while keeping the boilers at the lowest possible firing rate.

N.2.2.1 BUILDING CONTROLS

Installing Building Automation Systems (BAS) is one of the most effective energy efficiency initiatives for most of the buildings. BAS can reduce operating costs by automatically controlling the heating/cooling, ventilation, air quality, lighting and security systems. The computerized systems can be essentially programmed to monitor every aspect of heating, ventilation and lighting systems.

Higher energy cost coupled with growing concerns regarding Indoor Air Quality have placed increased demands on energy recovery and control system technologies. A method of maintaining good indoor air quality and conserving energy is to control the ventilation rate according to the needs and requirements of building occupants. Technologies such as Demand Control Ventilation (DCV), Direct Digital Control (DDC), new energy recovery equipment and associated controls provide opportunities to reduce energy consumption.

BAS need to be selected for simplicity and ease of operation. Building operators must be properly trained on BAS for effective operation and regular service. The building operator should understand the system's logic and monitor abnormalities, fine tuning and override functions.

BAS should be intercommunicable, BACnet-based controller or system of controllers. Installation of BAS and associated devices should be intended for connection to the GN's wide area network. Structured cabling scope must conform with GN's latest structured cabling requirements.

The intended system architecture within a building shall be a collection of daisy-chain Ethernet connected application controllers (advanced or application specific) supervised by a single BACnet/IP enabled Building Controller. The building level building controller shall contain a collection of trend log objects that capture data from each of the BACnet objects that are used for monitoring and control.

The devices installed are to be accessible both remotely and locally using a desktop or laptop computer connected to the Government of Nunavut's wide area network, with graphical elements being downloaded from the installed system on demand when accessing the system by means of web browser i.e. no software resides on the access computer aside from latest version web browsing software (Chrome, Firefox, Internet Explorer).

Recommendation

When designing new building systems, whether heating, ventilation, and/or services, every effort should be made to incorporate energy recovery and/or control systems. Consideration should be given when weighing possible marginally higher installation costs versus overall operational cost reductions, especially on smaller systems. Provide the client/user with a capital cost recovery summary as part of the system design and analysis.

Rationale

Reduces size of primary load equipment (i.e., boilers, chillers, burners, pumps, etc.), thereby reducing overall energy consumption. In many new buildings, the cost savings resulting from the reduction of cooling tonnage and/or heating equipment size, alone offsets the initial cost of thermal recovery units.

N.3 ENERGY MODELLING

The National Energy Code of Canada for Buildings (NECB) set out the minimum acceptable measures for energy efficiency in design and construction of new buildings and additions to existing buildings. The Energy Code includes both prescriptive and performance requirements. It outlines how an energy efficient building should be designed, and as such should be considered as an important reference document.

CAN-QUEST is the software that was developed by NRCAN to demonstrate the performance path compliance with the NECB 2011. This software can be a useful tool in evaluating the future performance of a building during design and comparing various design options. The software can be downloaded at <https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-buildings/energy-management-resources-buil/energy-management-software-new-buildings/22468>

Designers and Project Managers are therefore encouraged to become familiar with the NECB.

New GN projects are required to go through Energy Modelling Workshops, depending on the size of the project. The purpose of the workshop is to evaluate and analyze efficiency options to arrive at an optimum cost benefit package within project budget. Building energy simulations are a useful tool to provide feedback to the design team, quantifying the capital and operating impact of various alternative design scenarios (e.g., glazing selection insulation levels, mechanical system selection, lighting levels, etc.)

The building simulations help to optimize the systems type and sizing, while confirming the impacts of various energy performance strategies. The goal is to optimize the design by selecting the most efficient types of systems for a given type of building. GN has developed 'Energy Modelling Guidelines', included in appendix K, which sets out expectations regarding energy modelling for GN new construction and capital renovation projects.

N.4 ENERGY CONSUMPTION

Energy consumption is largely dependent on operating practices; however, the shape, layout, and the quality of the exterior envelope of a building can have a significant effect on fuel and power consumption. Generating stations and distribution systems are in 25 communities and serve approximately 11,000 residential and commercial customers. Any new building in a community adds to the overall infrastructure requirements and can significantly impact capital investment of these infrastructures.

Also, considering that most buildings will be operational for more than 40 years, the best way to reduce energy consumption is to address this topic during the design phase. Evaluating future energy consumption at the design stage by comparing various options will provide insight for the design team. The design team can in turn have a positive impact on energy consumption before the building is even constructed.

Some energy efficient solutions are more expensive than standard systems. As such, these solutions are usually overlooked because of budgetary constraints. However, an integrated approach can generate savings in the construction budget (for example, a better insulated building will yield a smaller heating system).

Moreover, designers are encouraged to evaluate options based on a life cycle approach. Energy savings for the life of the building can then be compared to the capital cost investment of the energy efficient solution. This design approach based on energy efficiency will ensure that design teams always thrive to reduce energy consumption of buildings to the benefit of the communities.

N.5 ENERGY MANAGEMENT

Energy management includes minimizing the environmental impact of energy usage, improving the energy security of individuals, organizations and communities, improving the comfort of homes and buildings and extending the life of equipment, systems and buildings. The management of purchased electrical power, heating fuel and water as well as the management of electrical power, heat and treated water produced internally at a facility or place of operations and the management of fuel used in the transportation of people, goods and materials, are fundamental to energy management.

Minimizing the energy consumption of public buildings is important in Nunavut where energy costs are extremely high: electricity is usually diesel generated and fuel must be transported annually to remote locations. Effective energy management involves establishing an energy policy, performing regular energy audits, targeting, monitoring and sub-metering energy consumption, making improvements to operations and maintenance procedures and training building staff and occupants in the energy efficiency features of the building.

N.5.1 ENERGY AUDIT

An energy audit should include costs, savings and payback period. It can be done for the entire building or for specific systems. An individual systems audit is best suited for instances where funding is limited, where energy savings are needed quickly or where management are aware of energy and performance problems with respect to a major energy-using system. A full building audit is recommended if a building is complex or is older and is scheduled for major renovation. It will make it possible to determine the combination of measures that provides the greatest return on investment. By accurately predicting the impact of measures, including their interaction with other building systems, this indicates what systems are in need of upgrading and what those upgrades should be.

A full energy audit of the building includes reviewing historical energy consumption data, the establishment of new consumption baselines and the identification of any anomalies. A full audit will outline baseline energy consumption levels at the outset of the program so that comparisons with future consumption levels can be used to measure the success of the program. Energy consumption data averaged for a two-year period is usually sufficient to establish baselines. Weather-dependent components of the energy consumption should be adjusted to reflect normal conditions and adjustments can also be made to reflect changes to the building, equipment or occupancy schedules that may have occurred during the baseline period.

N.5.2 ENERGY MONITORING AND BENCHMARKING

In order to effectively manage energy consumption in both existing and new buildings, the first step is to track energy use in buildings. Energy monitoring enables the tracking, recording, and visualization of energy consumed by facility or portfolio of facilities. Whereas building energy benchmarking is the ongoing review of your organization's energy consumption to determine if your building's energy performance is getting better or worse.

All buildings are recommended to be provided with the means to monitor electricity and fuel oil use. In most cases, energy use can be determined from fuel delivery records, or fuel and electrical meter readings. Electrical meters and fuel meters are normally installed on the electrical and fuel supply to each building.

However, if fuel or electricity is used for two or more significant purposes in a building, it may be helpful to meter fuel or electrical use at each large piece of equipment to identify the pattern of energy use.

During the building design phase, theoretical building energy efficiency can be predicted and optimized with the help of design tools such as the operational program, technical design guidelines, and computer modeling. Energy consumption targets may be useful to benchmark desired performance for a particular type of building. For example, the targets will vary for a school versus a health centre.

Ongoing monitoring will help to ensure that factors such as staff turnover, inadequate maintenance, improper operating procedures and faulty equipment do not negatively impact the results of the energy management program.

N.5.3 ENERGY TRAINING

Given the growing number of building projects and the limited numbers of experienced trades people in Nunavut, there is both a need and an opportunity to train and develop building maintainers in every community. When an energy management plan is established, a fully-trained committee should be created to verify, monitor and maintain the effectiveness of the program. Furthermore, as an organization and its functions evolve, new facilities, equipment and staff may be required. Also, new, more efficient technologies are constantly being introduced and manufacturers of energy-consuming equipment are constantly improving the efficiency of their products. Therefore, the committee must be continuously aware of new technologies and equipment and continue to look for new energy management opportunities. The committee should also be fully involved in any plans for building renovations or equipment acquisitions as it may be cost-effective to implement energy management opportunities in conjunction with these projects whereas it would not have been cost-effective to pursue the opportunities as stand-alone projects.

It is also important to keep employees apprised of the positive impact of their participation in the energy management program. Bulletin boards and newsletters are just a couple of ways that staff can be kept apprised of the progress of the program. Regular energy-management training sessions can be a catalyst for boosting morale and facilitating an ethic of continuous improvement.

N.5.4 SUB-METERING

Tenants have varying energy profiles, depending on the nature of the work, and the hours (e.g. shift work). Metering should be provided for every major tenant of the building, whether or not they are charged separately. Being aware of how much energy they consume encourages conservation and efficiency. It also enables management to factor in energy charges in a fair manner. The building should have sub-meters for monitoring major energy uses to establish building load profile and demand structure. To perform load profiling, specific measurements must be obtained within the facility to pinpoint the particular areas that are causing the peak loads. Sub-metering can also single out problem areas and facilitates making targeted repairs.

END OF SECTION

APPENDICES

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APPENDIX A: BUILDING STANDARDS - POTABLE WATER HOLDING TANKS

Note: The following two pages are extracts from documents issued by Environmental Health, Department of Health and Social Services, in June 1992.

1. Water holding tanks shall be water tight and constructed of material that is not subject to decay or corrosion and has been approved for use for drinking water storage by an authority acceptable to the Health Officer.
2. Water holding tanks shall be designed to resist deformation or rupture due to induced hydrostatic pressure.
3. Water holding tanks must be provided with a drain or tap, situated in such a manner that the entire contents of the tank can be drained by gravity.
4. Water holding tanks shall be provided with a means of access for inspection and cleaning. Access holes shall have a minimum inside diameter of 450 mm, be provided with watertight, childproof cover and be easily accessible. On large tanks, the number of access holes shall be as required under the Safety Act and regulations.
5. To exclude dust, birds, insects and animals, water holding tank vents and overflows must either be screened or must terminate with an elbow fitting located a minimum distance of three times the diameter of the pipe away from the opening of the pipe. Ground level vents/overflows must terminate in an inverted U position, the opening of which is a minimum of 600 mm above the ground surface.
6. Water holding tanks shall be provided with a fill pipe, which is accessible to the water delivery truck from the outside of the building, and which is equipped with a self-closing cover or enclosed in a box with a self-closing cover. The water tank filling point shall be separated from the sewage suction pipe by a minimum distance of 1.5 m measured horizontally and shall be located one metre above the sewage tank suction pipe.
7. All piping associated with water holding tanks must conform to the requirements of the Canadian Plumbing Code.
8. The building's water distribution system shall be equipped with an automatic device so that it shuts down when the sewage tank is filled to a level as described in the Sewage Holding Tank Standards. This device should be designed and situated to discourage tampering.
9. Water holding tanks installed and buried below ground surface must be located not less than 15 m from the sewage holding tank.
10. When the capacity of a water holding tank is greater than 15 times the estimated normal daily water flow for the building, the building shall be provided with either:
 - a) A separate holding tank for potable water storage, *or*
 - b) An automatic device for disinfecting the water downstream of the storage tank, *or*
 - c) Some other suitable method, acceptable to the Health Officer that will ensure the water at the taps meets the requirements of the Guidelines for Canadian Drinking Water Quality.

Building Standards - Sewage Holding Tanks

Note: This is the second of two pages extracted from documents issued by Environmental Health, Department of Health and Social Services, in June 1992.

1. Sewage holding tanks shall be designed and constructed in accordance with the standards set by the Canadian Standards Association (CSA). The design and construction of tanks greater than 4500 L must be certified by a professional engineer.
2. Poured-in-place concrete holding tanks shall be designed, reinforced and constructed in accordance with CSA standards and the concrete design provisions of the National Building Code.
3. Prefabricated sewage holding tanks shall be designed and constructed in accordance with the standards set by the Canadian Standards Association and bear the CSA seal of compliance.
4. Sewage holding tanks shall be equipped with a suction pipe ending with a quick connect fitting to allow the sanitary removal of the tank's contents. The size and type of the fitting shall be consistent with local conditions.
5. Sewage holding tanks shall be designed and constructed to allow the complete removal of solid matter that can be expected to settle in any part of the holding tank.
6. Sewage holding tanks must be provided with a means of access for inspection and repairs. Access holes shall have a minimum inside diameter of 450 mm and be provided with a watertight, secure cover.
7. All piping associated with the sewage holding tank must conform with the requirements of the Canadian Plumbing Code.
8. The building drainage system shall be adequately vented to prevent siphoning traps during removal of the tanks contents.
9. Sewage holding tanks shall be equipped with an apparatus or device that causes the building's water distribution system to shut down when the sewage tank is nearing capacity. This device shall be set to activate at a level where there is free remaining storage capacity for a volume of wastewater equalling the combined volume of all fixtures in the building.
10. Sewage holding tanks installed and buried below ground surface must be located not less than 15 m from any subsurface portion of the potable water system.
12. The working capacity of a sewage tank shall not be less than one and one-half the total volume of the water holding tank or tanks.

APPENDIX B: CLIMATIC DESIGN DATA

Climatic Design Data for some Nunavut communities are unlisted in the National Building Code. Climatic Data for these 15 communities are therefore included in this Appendix for reference.



Environment
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Canada

Reference Number
GN-CGS-TSD 20121030

Bathurst Inlet, NU

Latitude: 66 ° 49 ' 59.88 "

Longitude: 108 ° 1 ' 59.88 "

Elevation (Metres): 4

| Design element | Design value |
|--|--------------|
| January 2.5% design dry bulb temperature °C | -40 |
| January 1% design dry bulb temperature °C | -42 |
| July 2.5% design dry bulb temperature °C | 23 |
| July 2.5% design wet bulb temperature °C | 14 |
| Annual total degree days below 18 °C | 11,500 |
| Maximum 15 minute rainfall (mm) | 8 |
| Maximum one day rainfall (50 years) (mm) | 60 |
| Annual rainfall (mm) | 125 |
| Annual total precipitation (mm) | 250 |
| Moisture Index | 0.83 |
| Driving Rain wind pressure 1/5 years (Pa) | 80 |
| Ground snow load, snow component S _s (30 years) (kPa) | 2.5 |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.1 |
| Ground snow load, snow component S _s (50 years) (kPa) | 2.8 |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.1 |
| Hourly wind pressure 1/10 years (kPa) | 0.39 |
| Hourly wind pressure 1/30 years (kPa) | 0.46 |
| Hourly wind pressure 1/50 years (kPa) | 0.50 |
| Hourly wind pressure 1/100 years (kPa) | 0.55 |

Please note that the recommended values may differ from the legal requirements established by the municipal or provincial (territorial) building authorities. The design values may have been interpolated from calculated values at surrounding locations with subjective modification. Topographic effects may introduce local variations in the design values. Environment Canada has not made and does not make any representation or warranties, either expressed or implied, arising by law or otherwise, respecting the accuracy of climatic information. In no event will Environment Canada be responsible for any prejudice, loss or damage which may occur as the result of the use of climatic information.

January 25, 2013



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Canada

Reference Number

GN-CGS-TSD 20121030

Cape Dorset, NU

Latitude: 64 ° 13 ' 54.1 "

Longitude: 76 ° 32 ' 25.1 "

Elevation (Metres): 243

| Design element | Design value |
|--|--------------|
| January 2.5% design dry bulb temperature °C | -33 |
| January 1% design dry bulb temperature °C | -34 |
| July 2.5% design dry bulb temperature °C | 16 |
| July 2.5% design wet bulb temperature °C | 11 |
| Annual total degree days below 18 °C | 9,950 |
| Maximum 15 minute rainfall (mm) | 4 |
| Maximum one day rainfall (50 years) (mm) | 42 |
| Annual rainfall (mm) | 140 |
| Annual total precipitation (mm) | 100 |
| Moisture Index | 0.90 |
| Driving Rain wind pressure 1/5 years (Pa) | 250 |
| Ground snow load, snow component S _s (30 years) (kPa) | 3.6 |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.2 |
| Ground snow load, snow component S _s (50 years) (kPa) | 4.0 |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.2 |
| Hourly wind pressure 1/10 years (kPa) | 0.56 |
| Hourly wind pressure 1/30 years (kPa) | 0.67 |
| Hourly wind pressure 1/50 years (kPa) | 0.72 |
| Hourly wind pressure 1/100 years (kPa) | 0.79 |

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January 25, 2013



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Environnement
Canada

Reference Number

GN-CGS-TSD 20121030

Gjoa Haven, NU

Latitude: 68 ° 37 ' 32.88 "

Longitude: 95 ° 52 ' 30 "

Elevation (Metres): 47

| Design element | Design value |
|--|--------------|
| January 2.5% design dry bulb temperature °C | -43 |
| January 1% design dry bulb temperature °C | -44 |
| July 2.5% design dry bulb temperature °C | 17 |
| July 2.5% design wet bulb temperature °C | 12 |
| Annual total degree days below 18 °C | 11,800 |
| Maximum 15 minute rainfall (mm) | 4 |
| Maximum one day rainfall (50 years) (mm) | 34 |
| Annual rainfall (mm) | 75 |
| Annual total precipitation (mm) | 180 |
| Moisture Index | 0.89 |
| Driving Rain wind pressure 1/5 years (Pa) | 100 |
| Ground snow load, snow component S _s (30 years) (kPa) | 2.1 |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.1 |
| Ground snow load, snow component S _s (50 years) (kPa) | 2.3 |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.1 |
| Hourly wind pressure 1/10 years (kPa) | 0.42 |
| Hourly wind pressure 1/30 years (kPa) | 0.50 |
| Hourly wind pressure 1/50 years (kPa) | 0.54 |
| Hourly wind pressure 1/100 years (kPa) | 0.60 |

Please note that the recommended values may differ from the legal requirements established by the municipal or provincial (territorial) building authorities. The design values may have been interpolated from calculated values at surrounding locations with subjective modification. Topographic effects may introduce local variations in the design values. Environment Canada has not made and does not make any representation or warranties, either expressed or implied, arising by law or otherwise, respecting the accuracy of climatic information. In no event will Environment Canada be responsible for any prejudice, loss or damage which may occur as the result of the use of climatic information.

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Environnement
Canada

Reference Number
GN-CGS-TSD 20121030

Grise Fiord, NU

Latitude: 76 ° 25 ' 3 "


Longitude: 82 ° 53 ' 38.04 "

Elevation (Metres): 45

| Design element | Design value |
|--|--------------|
| January 2.5% design dry bulb temperature °C | -40 |
| January 1% design dry bulb temperature °C | -41 |
| July 2.5% design dry bulb temperature °C | 12 |
| July 2.5% design wet bulb temperature °C | 7 |
| Annual total degree days below 18 °C | 12,100 |
| Maximum 15 minute rainfall (mm) | 5 |
| Maximum one day rainfall (50 years) (mm) | 50 |
| Annual rainfall (mm) | 65 |
| Annual total precipitation (mm) | 165 |
| Moisture Index | 0.89 |
| Driving Rain wind pressure 1/5 years (Pa) | 200 |
| Ground snow load, snow component S _s (30 years) (kPa) | 2.5 |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.1 |
| Ground snow load, snow component S _s (50 years) (kPa) | 2.8 |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.1 |
| Hourly wind pressure 1/10 years (kPa) | 0.54 |
| Hourly wind pressure 1/30 years (kPa) | 0.64 |
| Hourly wind pressure 1/50 years (kPa) | 0.69 |
| Hourly wind pressure 1/100 years (kPa) | 0.77 |


Please note that the recommended values may differ from the legal requirements established by the municipal or provincial (territorial) building authorities. The design values may have been interpolated from calculated values at surrounding locations with subjective modification. Topographic effects may introduce local variations in the design values. Environment Canada has not made and does not make any representation or warranties, either expressed or implied, arising by law or otherwise, respecting the accuracy of climatic information. In no event will Environment Canada be responsible for any prejudice, loss or damage which may occur as the result of the use of climatic information.

January 25, 2013

| | | | |
|---|-----------------------|------------------------------|---|
|  | Environment Canada | Environnement Canada | Reference Number GN-CGS-TSD 20121030 |
| | | | |
| Hall Beach, NU | | | |
| Latitude: 68 ° 46 ' 37.92 " | | Longitude: 81 ° 13 ' 27.12 " | Elevation (Metres): 8 |
| Design element | | | Design value |
| January 2.5% design dry bulb temperature °C | | | -42 |
| January 1% design dry bulb temperature °C | | | -44 |
| July 2.5% design dry bulb temperature °C | | | 15 |
| July 2.5% design wet bulb temperature °C | | | 10 |
| Annual total degree days below 18 °C | | | 11,700 |
| Maximum 15 minute rainfall (mm) | | | 5 |
| Maximum one day rainfall (50 years) (mm) | | | 53 |
| Annual rainfall (mm) | | | 100 |
| Annual total precipitation (mm) | | | 220 |
| Moisture Index | | | 0.92 |
| Driving Rain wind pressure 1/5 years (Pa) | | | 190 |
| Ground snow load, snow component S _s (30 years) (kPa) | | | 2.5 |
| Ground snow load, rain component S _r (30 years) (kPa) | | | 0.1 |
| Ground snow load, snow component S _s (50 years) (kPa) | | | 2.8 |
| Ground snow load, rain component S _r (50 years) (kPa) | | | 0.1 |
| Hourly wind pressure 1/10 years (kPa) | | | 0.42 |
| Hourly wind pressure 1/30 years (kPa) | | | 0.52 |
| Hourly wind pressure 1/50 years (kPa) | | | 0.56 |
| Hourly wind pressure 1/100 years (kPa) | | | 0.62 |

Please note that the recommended values may differ from the legal requirements established by the municipal or provincial (territorial) building authorities. The design values may have been interpolated from calculated values at surrounding locations with subjective modification. Topographic effects may introduce local variations in the design values. Environment Canada has not made and does not make any representation or warranties, either expressed or implied, arising by law or otherwise, respecting the accuracy of climatic information. In no event will Environment Canada be responsible for any prejudice, loss or damage which may occur as the result of the use of climatic information.

January 25, 2013

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|---|-----------------------|------------------------------|---|
|  | Environment Canada | Environnement Canada | Reference Number GN-CGS-TSD 20121030 |
| | | | |
| Igloolik, NU | | | |
| Latitude: 69 ° 22 ' 33.96 " | | Longitude: 81 ° 47 ' 57.84 " | Elevation (Metres): 53 |
| Design element | | Design value | |
| January 2.5% design dry bulb temperature °C | | -40 | |
| January 1% design dry bulb temperature °C | | -42 | |
| July 2.5% design dry bulb temperature °C | | 16 | |
| July 2.5% design wet bulb temperature °C | | 11 | |
| Annual total degree days below 18 °C | | 11,300 | |
| Maximum 15 minute rainfall (mm) | | 3 | |
| Maximum one day rainfall (50 years) (mm) | | 27 | |
| Annual rainfall (mm) | | 100 | |
| Annual total precipitation (mm) | | 290 | |
| Moisture Index | | 0.92 | |
| Driving Rain wind pressure 1/5 years (Pa) | | 190 | |
| Ground snow load, snow component Ss (30 years) (kPa) | | 2.5 | |
| Ground snow load, rain component Sr (30 years) (kPa) | | 0.1 | |
| Ground snow load, snow component Ss (50 years) (kPa) | | 2.8 | |
| Ground snow load, rain component Sr (50 years) (kPa) | | 0.1 | |
| Hourly wind pressure 1/10 years (kPa) | | 0.43 | |
| Hourly wind pressure 1/30 years (kPa) | | 0.52 | |
| Hourly wind pressure 1/50 years (kPa) | | 0.56 | |
| Hourly wind pressure 1/100 years (kPa) | | 0.62 | |

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Kimmirut, NU

Latitude: 62 ° 50 ' 48.12 "


Longitude: 69 ° 52 ' 6.96 "

Elevation (Metres): 53

| Design element | Design value |
|--|--------------|
| January 2.5% design dry bulb temperature °C | -36 |
| January 1% design dry bulb temperature °C | -37 |
| July 2.5% design dry bulb temperature °C | 19 |
| July 2.5% design wet bulb temperature °C | 12 |
| Annual total degree days below 18 °C | 8,900 |
| Maximum 15 minute rainfall (mm) | 3 |
| Maximum one day rainfall (50 years) (mm) | 19 |
| Annual rainfall (mm) | 70 |
| Annual total precipitation (mm) | 330 |
| Moisture Index | 0.89 |
| Driving Rain wind pressure 1/5 years (Pa) | 200 |
| Ground snow load, snow component S _s (30 years) (kPa) | 4.5 |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.2 |
| Ground snow load, snow component S _s (50 years) (kPa) | 5.0 |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.2 |
| Hourly wind pressure 1/10 years (kPa) | 0.57 |
| Hourly wind pressure 1/30 years (kPa) | 0.68 |
| Hourly wind pressure 1/50 years (kPa) | 0.74 |
| Hourly wind pressure 1/100 years (kPa) | 0.82 |

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January 25, 2013

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|---|-------------|------------------------------|------------------------|
|  | Environment | Environnement | Reference Number |
| | Canada | Canada | GN-CGS-TSD 20121030 |
| Kugaaruk, NU | | | |
| Latitude: 68 ° 31 ' 59.16 " | | Longitude: 89 ° 49 ' 36.12 " | Elevation (Metres): 17 |
| Design element | | Design value | |
| January 2.5% design dry bulb temperature °C | | -42 | |
| January 1% design dry bulb temperature °C | | -43 | |
| July 2.5% design dry bulb temperature °C | | 20 | |
| July 2.5% design wet bulb temperature °C | | 13 | |
| Annual total degree days below 18 °C | | 11,275 | |
| Maximum 15 minute rainfall (mm) | | 5 | |
| Maximum one day rainfall (50 years) (mm) | | 40 | |
| Annual rainfall (mm) | | 120 | |
| Annual total precipitation (mm) | | 260 | |
| Moisture Index | | 0.96 | |
| Driving Rain wind pressure 1/5 years (Pa) | | 180 | |
| Ground snow load, snow component Ss (30 years) (kPa) | | 4.1 | |
| Ground snow load, rain component Sr (30 years) (kPa) | | 0.1 | |
| Ground snow load, snow component Ss (50 years) (kPa) | | 4.5 | |
| Ground snow load, rain component Sr (50 years) (kPa) | | 0.1 | |
| Hourly wind pressure 1/10 years (kPa) | | 0.43 | |
| Hourly wind pressure 1/30 years (kPa) | | 0.52 | |
| Hourly wind pressure 1/50 years (kPa) | | 0.56 | |
| Hourly wind pressure 1/100 years (kPa) | | 0.62 | |

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Reference Number
GN-CGS-TSD 20121030

Pangnirtung, NU

Latitude: 66 ° 8 ' 52.08 "

Longitude: 65 ° 41 ' 57.84 "

Elevation (Metres): 23

| Design element | Design value |
|--|--------------|
| January 2.5% design dry bulb temperature °C | -35 |
| January 1% design dry bulb temperature °C | -37 |
| July 2.5% design dry bulb temperature °C | 16 |
| July 2.5% design wet bulb temperature °C | 10 |
| Annual total degree days below 18 °C | 9,600 |
| Maximum 15 minute rainfall (mm) | 5 |
| Maximum one day rainfall (50 years) (mm) | 55 |
| Annual rainfall (mm) | 210 |
| Annual total precipitation (mm) | 360 |
| Moisture Index | 0.90 |
| Driving Rain wind pressure 1/5 years (Pa) | 200 |
| Ground snow load, snow component S _s (30 years) (kPa) | 3.5 |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.2 |
| Ground snow load, snow component S _s (50 years) (kPa) | 3.9 |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.2 |
| Hourly wind pressure 1/10 years (kPa) | 1.00 |
| Hourly wind pressure 1/30 years (kPa) | |
| Hourly wind pressure 1/50 years (kPa) | 1.20 |
| Hourly wind pressure 1/100 years (kPa) | |

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January 25, 2013

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|---|-----------------------|-------------------------|---|
|  | Environment Canada | Environnement Canada | Reference Number GN-CGS-TSD 20121030 |
|---|-----------------------|-------------------------|---|

| Pond Inlet, NU | | |
|--|------------------------------|------------------------|
| Latitude: 72 ° 41 ' 57.12 " | Longitude: 77 ° 57 ' 33.12 " | Elevation (Metres): 55 |
| Design element | Design value | |
| January 2.5% design dry bulb temperature °C | -40 | |
| January 1% design dry bulb temperature °C | -41 | |
| July 2.5% design dry bulb temperature °C | 14 | |
| July 2.5% design wet bulb temperature °C | 10 | |
| Annual total degree days below 18 °C | 12,030 | |
| Maximum 15 minute rainfall (mm) | 5 | |
| Maximum one day rainfall (50 years) (mm) | 33 | |
| Annual rainfall (mm) | 85 | |
| Annual total precipitation (mm) | 190 | |
| Moisture Index | 0.89 | |
| Driving Rain wind pressure 1/5 years (Pa) | 160 | |
| Ground snow load, snow component S _s (30 years) (kPa) | 2.3 | |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.1 | |
| Ground snow load, snow component S _s (50 years) (kPa) | 2.5 | |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.1 | |
| Hourly wind pressure 1/10 years (kPa) | 0.43 | |
| Hourly wind pressure 1/30 years (kPa) | 0.51 | |
| Hourly wind pressure 1/50 years (kPa) | 0.55 | |
| Hourly wind pressure 1/100 years (kPa) | 0.61 | |

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January 25, 2013

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|  Environment Canada Environnement Canada | | Reference Number |
| | | GN-CGS-TSD 20121030 |
| Qikiqtarjuak, NU | | |
| Latitude: 67 ° 33 ' 29.16 " Longitude: 64 ° 1 ' 26.4 " | | Elevation (Metres): 6 |
| Design element | | Design value |
| January 2.5% design dry bulb temperature °C | | -38 |
| January 1% design dry bulb temperature °C | | -40 |
| July 2.5% design dry bulb temperature °C | | 13 |
| July 2.5% design wet bulb temperature °C | | 9 |
| Annual total degree days below 18 °C | | 10,900 |
| Maximum 15 minute rainfall (mm) | | 5 |
| Maximum one day rainfall (50 years) (mm) | | 29 |
| Annual rainfall (mm) | | 40 |
| Annual total precipitation (mm) | | 225 |
| Moisture Index | | 0.89 |
| Driving Rain wind pressure 1/5 years (Pa) | | 220 |
| Ground snow load, snow component S _s (30 years) (kPa) | | 3.3 |
| Ground snow load, rain component S _r (30 years) (kPa) | | 0.2 |
| Ground snow load, snow component S _s (50 years) (kPa) | | 3.6 |
| Ground snow load, rain component S _r (50 years) (kPa) | | 0.2 |
| Hourly wind pressure 1/10 years (kPa) | | 0.44 |
| Hourly wind pressure 1/30 years (kPa) | | 0.53 |
| Hourly wind pressure 1/50 years (kPa) | | 0.57 |
| Hourly wind pressure 1/100 years (kPa) | | 0.63 |

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Reference Number
GN-CGS-TSD 20121030

Repulse Bay, NU

Latitude: 66 ° 31 ' 18.84 "


Longitude: 86 ° 14 ' 6 "

Elevation (Metres): 24

| Design element | Design value |
|--|--------------|
| January 2.5% design dry bulb temperature °C | -41 |
| January 1% design dry bulb temperature °C | -43 |
| July 2.5% design dry bulb temperature °C | 18 |
| July 2.5% design wet bulb temperature °C | 13 |
| Annual total degree days below 18 °C | 11,050 |
| Maximum 15 minute rainfall (mm) | 5 |
| Maximum one day rainfall (50 years) (mm) | 65 |
| Annual rainfall (mm) | 107 |
| Annual total precipitation (mm) | 166 |
| Moisture Index | 0.89 |
| Driving Rain wind pressure 1/5 years (Pa) | 200 |
| Ground snow load, snow component S _s (30 years) (kPa) | 3.1 |
| Ground snow load, rain component S _r (30 years) (kPa) | 0.2 |
| Ground snow load, snow component S _s (50 years) (kPa) | 3.4 |
| Ground snow load, rain component S _r (50 years) (kPa) | 0.2 |
| Hourly wind pressure 1/10 years (kPa) | 0.50 |
| Hourly wind pressure 1/30 years (kPa) | 0.60 |
| Hourly wind pressure 1/50 years (kPa) | 0.64 |
| Hourly wind pressure 1/100 years (kPa) | 0.71 |


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|  | Environment Canada | Environnement Canada | Reference Number |
| | GN-CGS-TSD 20121030 | | |
| Sanikiluaq, NU | | | |
| Latitude: 56 ° 32 ' 34.08 " | | Longitude: 79 ° 13 ' 30 " | Elevation (Metres): 32 |
| Design element | | Design value | |
| January 2.5% design dry bulb temperature °C | | -36 | |
| January 1% design dry bulb temperature °C | | -38 | |
| July 2.5% design dry bulb temperature °C | | 21 | |
| July 2.5% design wet bulb temperature °C | | 15 | |
| Annual total degree days below 18 °C | | 9,150 | |
| Maximum 15 minute rainfall (mm) | | 9 | |
| Maximum one day rainfall (50 years) (mm) | | 54 | |
| Annual rainfall (mm) | | 270 | |
| Annual total precipitation (mm) | | 420 | |
| Moisture Index | | 0.88 | |
| Driving Rain wind pressure 1/5 years (Pa) | | 240 | |
| Ground snow load, snow component Ss (30 years) (kPa) | | 3.8 | |
| Ground snow load, rain component Sr (30 years) (kPa) | | 0.2 | |
| Ground snow load, snow component Ss (50 years) (kPa) | | 4.2 | |
| Ground snow load, rain component Sr (50 years) (kPa) | | 0.2 | |
| Hourly wind pressure 1/10 years (kPa) | | 0.48 | |
| Hourly wind pressure 1/30 years (kPa) | | 0.58 | |
| Hourly wind pressure 1/50 years (kPa) | | 0.63 | |
| Hourly wind pressure 1/100 years (kPa) | | 0.69 | |


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January 25, 2013

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|  | Environment Canada | Environnement Canada | Reference Number | |
| | GN-CGS-TSD 20121030 | | | |
| Taloyoak, NU | | | | |
| Latitude: 69 ° 32 ' 12.84 " | | Longitude: 93 ° 31 ' 36.12 " | | Elevation (Metres): 28 |
| Design element | | | Design value | |
| January 2.5% design dry bulb temperature °C | | | -43 | |
| January 1% design dry bulb temperature °C | | | -44 | |
| July 2.5% design dry bulb temperature °C | | | 18 | |
| July 2.5% design wet bulb temperature °C | | | 12 | |
| Annual total degree days below 18 °C | | | 11,600 | |
| Maximum 15 minute rainfall (mm) | | | 4 | |
| Maximum one day rainfall (50 years) (mm) | | | 33 | |
| Annual rainfall (mm) | | | 80 | |
| Annual total precipitation (mm) | | | 185 | |
| Moisture Index | | | 0.89 | |
| Driving Rain wind pressure 1/5 years (Pa) | | | 100 | |
| Ground snow load, snow component Ss (30 years) (kPa) | | | 1.9 | |
| Ground snow load, rain component Sr (30 years) (kPa) | | | 0.1 | |
| Ground snow load, snow component Ss (50 years) (kPa) | | | 2.1 | |
| Ground snow load, rain component Sr (50 years) (kPa) | | | 0.1 | |
| Hourly wind pressure 1/10 years (kPa) | | | 0.42 | |
| Hourly wind pressure 1/30 years (kPa) | | | 0.50 | |
| Hourly wind pressure 1/50 years (kPa) | | | 0.54 | |
| Hourly wind pressure 1/100 years (kPa) | | | 0.60 | |

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January 25, 2013

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|---|-----------------------|------------------------------|------------------------|
|  | Environment Canada | Environnement Canada | Reference Number |
| | GN-CGS-TSD 20121030 | | |
| Whale Cove, NU | | | |
| Latitude: 62 ° 10 ' 22.08 " | | Longitude: 92 ° 34 ' 45.84 " | Elevation (Metres): 40 |
| Design element | | | Design value |
| January 2.5% design dry bulb temperature °C | | | -41 |
| January 1% design dry bulb temperature °C | | | -42 |
| July 2.5% design dry bulb temperature °C | | | 21 |
| July 2.5% design wet bulb temperature °C | | | 15 |
| Annual total degree days below 18 °C | | | 10,400 |
| Maximum 15 minute rainfall (mm) | | | 8 |
| Maximum one day rainfall (50 years) (mm) | | | 55 |
| Annual rainfall (mm) | | | 185 |
| Annual total precipitation (mm) | | | 375 |
| Moisture Index | | | 0.90 |
| Driving Rain wind pressure 1/5 years (Pa) | | | 240 |
| Ground snow load, snow component Ss (30 years) (kPa) | | | 2.9 |
| Ground snow load, rain component Sr (30 years) (kPa) | | | 0.2 |
| Ground snow load, snow component Ss (50 years) (kPa) | | | 3.2 |
| Ground snow load, rain component Sr (50 years) (kPa) | | | 0.2 |
| Hourly wind pressure 1/10 years (kPa) | | | 0.46 |
| Hourly wind pressure 1/30 years (kPa) | | | 0.55 |
| Hourly wind pressure 1/50 years (kPa) | | | 0.60 |
| Hourly wind pressure 1/100 years (kPa) | | | 0.66 |

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January 25, 2013

APPENDIX C: AIR PERMEABILITY OF COMMON MATERIALS AND ASSEMBLIES

Air Permeability of Common Materials and Assemblies

Note: The following four pages are extracts from documents published by the National Research Council as included in DPW "Building Envelope Systems" seminar notes.

DPW/NWT JUNE 91 BUILDING SYSTEMS ORIENTATION COURSE: ARCHITECTURAL

PAGE No.69

Materials of air barrier systems must exhibit low permeability to air. Design practitioners need to know how building materials and assemblies compare in air permeability along with how to evaluate the differences.

Accurate and reproducible testing procedures, developed a few years ago by IRC and private laboratories, are available to evaluate the air permeability of building materials and assemblies. Typically, the sample occupies one large face of an airtight box. The rate at which air flows through the sample is measured for various pressure differentials. The airflow rate at other pressure differentials can be calculated using a characteristic equation derived from the test results. For comparison, air permeability measured in litres per second per square metre of sample are reported at an air pressure differential of 75 Pascals (Pa).

CMHC sponsored the testing of building components by at least three agencies. IRC tested a dozen wood frame wall assemblies, Air-Ins Inc. tested 36 assorted building materials, and Ortech International evaluated elastomeric membranes applied to masonry walls.

The table presents the air permeability at 75 Pa of most materials and assemblies tested. Keep in mind that the data in the table represent the best performance possible. Tests were conducted in the protected environment of the laboratory with no outside weathering. The harsher conditions of actual installations would likely cause an increase in air permeability.

Selecting materials with low air permeability, however, is only one step in the process of designing an air

barrier assembly. Here are several other important criteria for obtaining and maintaining assemblies that work:

- ☐ Rigidity and strength - to transfer sustained and gust wind loads (1000 Pa and greater), mechanical ventilation and stack effect to the structure with limited deflection. (IRC and Ortech International also examined this aspect of performance in their testing procedure.)
- ☐ Continuity of airtightness, rigidity and support. To obtain and maintain continuity of airtightness at interfaces, consider compatibility between materials, buildability of construction details, necessary level of execution, ease of inspection and need for temporary protection of substrates against weathering to ensure good adhesion of sealants and tapes.
- ☐ Durability - as a function of the quality of the materials used and of the conditions to which the materials are exposed. Durability of the air barrier depends on the overall design of the wall or roof (e.g., location of insulation, presence of a wind barrier, application of the rain screen principle), on the ease of inspection and maintenance, and on the chance of damage during service life.

Another important issue for the design of air barrier systems is the relationship between airflow and moisture damage. This relationship takes into account the amount of air flow per square metre and the indoor and outdoor temperature, humidity and pressure. A few models predicting moisture damage to the building envelope as a function of materials used, and indoor and outdoor environments have been developed,

but their accuracy and limitations are not yet known since they have yet to be thoroughly validated in site conditions.

In 1986, IRC suggested that maximum airflow rates per unit area of air barrier assembly be established according to indoor humidity levels. Starting with the American industry guideline for the maximum allowable leakage for curtain walls (0.3 L's per m² at 75 Pa) and estimating a further 50% reduction achievable in Canadian construction, the levels were suggested as:

- ☐ 0.15L's per m² at 75 Pa for buildings operated at indoor humidity levels up to 27%.
- ☐ 0.1L's per m² at 75 Pa for indoor humidity levels between 27 and 55%.
- ☐ 0.05 L's per m² at 75 Pa for indoor humidity levels over 55%.

These values were proposed for discussion with building envelope specialists, designers and builders. Indeed, the figures are still open for discussion and feedback on their adequacy.

Most recently, Construction Specifications Canada in their document Tek-Aid on Air Barriers suggests using material and assemblies that do not leak more than 0.1 L's per m² at 75 Pa. Remember, though, obtaining this airflow rate via the air barrier assembly will not necessarily prevent all moisture damage in all types of buildings in the Canadian climate. Nevertheless, this target specification, published in March 1990, definitely demands improved design and construction practices.

(Continued on page 4)

Air Permeability of Common Materials and Assemblies

DPW/NWT JUNE '91 BUILDING SYSTEMS ORIENTATION COURSE : ARCHITECTURAL

PAGE No. 70

Technical Enquiries: Air Barrier Systems (continued from page 3)

For more information, refer to Building Science Insight '86, "An Air Barrier for the Building Envelope," NRCC 29943. This publication can be purchased for \$20 from IRC Publications Sales,

Building M-19, Montreal Road, Ottawa Ontario, K1A 0R6, telephone (613) 993-2463. To obtain the three research reports by IRC, Air Ins Inc. and Ortech International, contact Jacques Rousseau, Canada Mortgage and Housing Corporation, 682 Montreal

Road, Ottawa, Ontario, K1A 0P7 fax (613) 748-6192. Tek-Aid on Air Barriers is available from Construction Specifications Canada, telephone (416) 922-3159.
Information: M.Z. Rousseau

Air permeability of building materials and assemblies

| Material or composite wall assembly | Air permeability Us per m ² at 75Pa | Material or composite wall assembly | Air permeability Us per m ² at 75Pa |
|--|---|--|---|
| 9.5 mm plywood sheathing | <0.005 | reinforced non-perforated polyolefin geotextile | |
| 38 mm extruded polystyrene insulation | <0.005 | *11 mm asphalt-impregnated fibreboard covered with 76 mm sprayed polyurethane foam on one side - joints taped | |
| *38 mm extruded polystyrene insulation compatible tape at joints (with or without tape at nail heads) | <0.005 | 13 mm gypsum board | |
| 25 mm foil-backed urethane insulation board | <0.005 | *11 mm asphalt-impregnated fibreboard covered with 76 mm sprayed polyurethane foam on one side - joints untaped | |
| 24 and 42 mm phenolic foam insulation | <0.005 | 16 mm particle board | |
| *28 mm phenolic foam insulation + compatible tape at joints and nail heads | <0.005 | 3.2 mm tempered hard board | |
| 13 mm cement board | <0.005 | | |
| 13 mm foil-backed gypsum board | | 25 mm expanded polystyrene type 2 | |
| aluminum foil on paper backing | <0.005 | 30 lb roofing felt | |
| 1.3 mm modified bituminous self-adhesive membrane | <0.005 | 15 lb non-perforated asphalt felt | |
| 2.7 mm modified bituminous torched-on membrane | <0.005 | *spunbonded olefin film on one face of a 25 mm glass fibre semi-rigid board + compatible tape at joints (with or without tape at nail heads) | |
| *synthetic stucco finish on 51 mm expanded polystyrene insulation on 13 mm exterior gypsum board | <0.005 | 15 lb perforated asphalt felt | |
| *13 mm interior gypsum board painted with 2 coats of latex paint with joint of paper tape and joint compound | <0.005 | spunbonded olefin film on one side of glass fibre semi-rigid board | |
| *9.5 mm sheathing grade plywood on both sides of studs + subfloor adhesive at studs | <0.005 | *Spunbonded olefin film sandwiched between 16 x 38 mm wood strapping @ 406 mm c/c and 11 mm asphalt-impregnated fibreboard | |
| + 64 mm glass fibre batt insulation in the cavity | <0.005 | 11 mm plain fibreboard | |
| | | 11 mm asphalt-impregnated fibreboard | |
| *9.5 mm sheathing grade plywood on both sides of studs (1 sheathing with two 51 mm holes) + subfloor adhesive at the studs + 64 mm glass fibre batt insulation in the cavity | <0.005 | spunbonded polyolefin film | |
| *0.15 mm (6 mu) polyethylene film sandwiched between 11 mm plain fibreboard and 13 mm interior gypsum board | <0.006 | 3 mu perforated polyethylene (4.3-4.5 perforations/cm ²) | |
| 8 mm plywood sheathing | <0.007 | 25 mm expanded polystyrene insulation type 1 | |
| 16 mm waferboard | <0.007 | 15 x 127 mm tongue-and-groove wood planks (8 joints) | |
| 13 mm moisture-resistant gypsum board | <0.009 | 152 mm glass fibre insulation | |
| 11 mm waferboard | <0.011 | 75 mm vermiculite insulation | |
| 13 mm particle board | <0.015 | 38 mm spray-on cellulose insulation | |
| *13 mm exterior gypsum board + compatible tape at joint | <0.015 | | |
| *28 mm phenolic foam insulation + compatible tape at joints | <0.018 | *evaluated as composite assemblies | |

Air Permeability of Common Materials and Assemblies

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List of Materials Tested for Air Leakage

| Material | Air Leakage Rate @ 75 Pa (L/s - m ²) |
|--|--|
| 2 mm smooth-surface roofing membrane | no measurable leakage |
| 2.7 mm modified bituminous torch on grade membrane (glass fibre mat) aluminum-foil vapor barrier | no measurable leakage |
| 1.3 mm modified bituminous self-adhesive membrane | no measurable leakage |
| 2.7 mm modified bituminous torch on grade membrane (Polyester reinforced mat) | no measurable leakage |
| 9.5 mm plywood sheathing | no measurable leakage |
| 38 mm extruded polystyrene | no measurable leakage |
| 25.4 mm foil-back urethane insulation | no measurable leakage |
| 24 mm phenolic insulation board | no measurable leakage |
| 42 mm phenolic insulation board | no measurable leakage |
| 12.7 mm cement board | no measurable leakage |
| 12.7 mm foil-back gypsum board | no measurable leakage |
| 8 mm plywood sheathing | 0.0067 |
| 16 mm wafer board | 0.0069 |
| 12.7 mm gypsum board (MIR) | 0.0091 |
| 11 mm waferboard | 0.0108 |
| 12.7 mm particle board | 0.0155 |
| reinforced non-perforated polyolefin | 0.0195 |
| 12.7 mm gypsum board | 0.0196 |
| 15.9 mm particle board | 0.0260 |
| 3.2 mm tempered hardboard | 0.0274 |
| expanded polystyrene type 2 | 0.1187 |
| 30 lb roofing felt | 0.1873 |

APPENDIX D: COMMUNITY EMERGENCY SHELTERS

Definition

Although commonly referred to as “community emergency shelters”, buildings intended for use by a community during a civil emergency should, in fact, be known as “reception” or “evacuation” centres. For information about the *Civil Emergency Measures Act*, contact the Coordinator of Emergency Measures Organization, Department of Community and Government Services.

Building Designation

- There is no complete listing of designated buildings in communities in Nunavut; however, CGS is currently collecting this information. Regional Directors (CGS) should be contacted to confirm buildings are designated in each community.
- The local authority determines which buildings in a community should be designated.
- The Minister of CGS approves civil emergency plans submitted by the local authority (usually the municipal council).

Building Requirements

- The Department of Health and Social Services is responsible for operation of “reception” or “evacuation” centres.
- There are no written requirements for designated community shelters: it is recommended, however, that auxiliary power generators be capable of operating the entire building. There is no special requirement to increase water storage.

APPENDIX E: STANDARD COLOUR AND IDENTIFICATION SCHEDULE - MECHANICAL SYSTEMS

The following copy is provided for information.

Community and Government Services

STANDARD COLOUR AND IDENTIFICATION SCHEDULE

FIRE PROTECTION PIPING

| | | |
|-----------------------|---|--|
| Fire Protection Water | → | |
| Sprinkler | → | |
| Fire Dry Standpipe | → | |
| Carbon Dioxide | → | |
| Halon | → | |

MEDICAL GAS PIPING

| | | |
|----------------|---|--|
| Nitrogen | → | |
| Medical Air | → | |
| Medical Vacuum | → | |
| Nitrous Oxide | → | |
| Oxygen | → | |

FUEL AND GAS PIPING

| | | |
|-------------------|---|--|
| Propane Gas | → | |
| Natural Gas | → | |
| Fuel Oil Supply | → | |
| Fuel Oil Return | → | |
| Fuel Oil Overflow | ← | |
| Gasoline | → | |
| Diesel Oil | → | |
| Chlorine | → | |

TANK FARM PIPING

| | | |
|---------------|---|--|
| Fuel Oil | → | |
| Gasoline | → | |
| JP- 4 | → | |
| AVGAS 100/130 | → | |

HAZARDOUS PIPING

| | | |
|---------------------------|---|--|
| Domestic Hot Water Supply | → | |
| Domestic Hot Water Return | ← | |
| Glycol Supply | → | |
| Glycol Return | ← | |
| Glycol Feed | ← | |
| Boiler Blow Down | → | |
| Heating Water Supply | → | |
| Heating Water Return | → | |

| | | |
|----------------------------|---|--|
| High Pressure Steam | → | |
| Low Pressure Steam | → | |
| High Pressure Condensate | ← | |
| Low Pressure Condensate | ← | |
| Cond. Pump Discharge | → | |
| Waste Heat Recovery Supply | → | |
| Waste Heat Recovery Return | ← | |

LOW HAZARD PIPING

| | | |
|------------------------|---|--|
| Cold Water | → | |
| Raw Water | → | |
| Treated Water | → | |
| Circulating Water | → | |
| Backwash Water | → | |
| Make-up Water | → | |
| Drain Water | → | |
| Cooling Water | → | |
| Chilled Water Supply | → | |
| Chilled Water Return | ← | |
| Condenser Water Supply | → | |
| Condenser Water Return | ← | |
| Refrigerant Liquid | → | |
| Refrigerant Suction | → | |
| Low Pressure Air | → | |
| Plumbing Vent | → | |
| Roof Drain | → | |
| Sanitary Drain | → | |

| |
|---|
| YELLOW – 1 – GP – 12 – 505 – 101 |
| GREEN – 1 – GP – 12C – 503 – 107 |
| BLUE – 1 – GP – 12C202 – 101 |
| ORANGE – 1 – GP – 12C – 508 – 101 |
| GALWAY GREEN – 1 – GP – 12C – 503 – 111 |

VALVE AND DAMPER FINDERS

| | |
|---|---|
| ● | FIRE PROTECTIVE VALVES FIRE/SMOKE DAMPERS |
| ● | HVAC VALVES |
| ● | PLUMBING VALVES |
| ● | AIR VALVES PRESSURE REGULATORS |
| ○ | MODULATING DAMPERS VAV BOXES |

COLOUR CLASSIFICATION

| |
|--------------------------------|
| RED – 1 – GP – 12C – 509 – 102 |
|--------------------------------|

APPENDIX F: LIGHTING LEVELS BY ACTIVITY, BUILDING AREA OR TASK

The principal source of recommended lighting levels is the current Illuminating Engineering Society (IES) Lighting Handbook. For tasks and activities not listed here, please refer to the following IES Lighting Handbooks.

IES Recommended Practice Lighting for Hospitals and Health Care Facilities-ANSI/IESNA RP-29-06
IES Recommended Practice for Sports and Recreational Area Lighting-IESNA RP-06-01
IES Recommended Practice on Lighting for Educational Facilities-ANSI /IES RP-3-00
IES American National Standard Practice for Office Lighting- ANSI/IESNA RP-1-04
IES Design Criteria for Lighting Interior Living Spaces - IESNA RP-11-1995
IES Lighting & Visual Environment for Senior Living - ANSI/IES RP-28-07
IES/ASHRAE Advanced Energy Design Guide for K-12 School Buildings

Illuminance levels are given in lux and as such are intended as target values with minor deviations (+/- 15%) expected. These target values also represent maintained values. In all cases the recommendations in the following table are based on the assumption that the lighting will be properly designed to take into account the visual characteristics of the task.

Lighting Level Adjustment

The light levels in the following pages are based on the assumptions that the worker's average age is under 40, the speed and/or accuracy of the task is not critical, and the reflectance of the task background is above 30% (greater than 70% in health centre operation areas, examination and treatment rooms). The sum of the weighting factors (see the IES Handbook) is between -1 and 1, and therefore the lighting levels in this table are appropriate. If there is a change in these assumptions, see the IES Handbook for guidance.

Task Lighting

The table lists light levels for specific tasks as well as location. In the cases where this task lighting level is very high, it is often impracticable and wasteful to light the entire room to the recommended value. The general lighting level for areas where tasks are regularly performed may be reduced, but not below a minimum of 200 lux. Supplementary lighting should then be used in combination with the general lighting to achieve proper illumination of the given task.

Lighting Levels by Activity, Building Area or Task

| Activity, Building Area or Task | Lighting Level (Lux) | Activity, Building Area or Task | Lighting Level (Lux) |
|--|----------------------|------------------------------------|----------------------|
| Airports | | Curling (cont.) | |
| Hangar apron | 10 | Recreational | |
| Terminal building apron | | Tees | 200 |
| Parking area | 10 | Rink | 100 |
| Loading area | 20 | Dance halls | 75 |
| (vertical illuminance) | | Educational facilities | |
| Air terminal buildings | | Classrooms | |
| Baggage checking | 300 | General | 400 |
| Boarding area | 150-300 | Industrial arts shops | 500 |
| Concourse | | Science laboratories | 500 |
| General | 50 | Libraries | |
| Seating | 150 | Reading area | 500 |
| Ticket counters | 300 | Stack | 300 |
| Waiting room and lounge | 150 | Office | 500 |
| Auditoriums | | Corridor | 150 |
| Assembly | 300 | Offices | 300 |
| Social activity | 50-75 | Mechanical rooms | 300 |
| Badminton | | Washrooms | 150 |
| Tournament | 500 | Gymnasiums | 300 |
| Club | 300 | Storage rooms | 300 |
| Recreational | 200 | Stairwells | 75 |
| Basketball | | Computer rooms | 300 |
| College intramural and high school | 500 | Science labs | 500 |
| Recreational (outdoor) | 200 | Firehalls | 300 |
| Building (construction) | | Garages | |
| General construction | 100 | Parking only | 55 |
| Excavation work | 20 | Service repairs | 750 |
| Building exteriors | | Health care facilities | |
| Building surrounds | 10 | Corridors | |
| Entrances | | Nursing areas – day | |
| Active pedestrian and/or conveyance) | | Nursing areas – night | |
| Day | 100 | Dental suite | |
| Night | 50 | General | 500 |
| Inactive (locked, infrequent use) | 10 | Instrument tray | 1 000 |
| Conference rooms | | Exam and treatment rooms | |
| Conferring (critical seeing, Refer to individual task) | 300 | General | 300 |
| Curling | | Local | 1 000 |
| Tournament | | Nursing stations | |
| Tees | 1 000 | General | |
| Rink | 750 | Day | 500 |
| | | Night | 100 |
| | | Desk | 500 |
| | | Operating areas delivery, recovery | |

| Activity, Building Area or Task | Lighting Level (Lux) | Activity, Building Area or Task | Lighting Level (Lux) |
|--|----------------------|--------------------------------------|----------------------|
| Health care facilities (Continued) | | Reading | |
| Patients' rooms (good to high colour rendering capability should be considered in these areas) | | Copied tasks | |
| General (variable switching or dimming) | 100 | Micro-fiche reader | 75 |
| Critical examination | 500 | Xerograph | 300 |
| Observation | 100 | Handwritten tasks | |
| Reading | 300 | #2 pencil and softer leads | 300 |
| Toilets | 300 | Ball point pen black | 300 |
| Stairways | 150 | Red, green blue | 400 |
| Toilets | 150 | Printed tasks | 300 |
| Utility Room | 300 | 8- and 10-point typeface | 750 |
| Waiting areas | | Telephone books | 300 |
| General | 150 | Typed originals | |
| Local for reading | 300 | Residences | |
| Hockey, ice (indoor) | | General, conversation and relaxation | 75 |
| Amateur hockey in NT (note amateur hockey in IES is 500 lux) | 750 | Passage areas | 75 |
| Recreational | 500 | Dining | 75 |
| Libraries | | Ironing | 200 |
| Reading and carrels | | Kitchen Work | |
| Individual study areas (See "Reading") | | Non-critical | 150 |
| Book stacks (vertical 760 mm above floor) | | Critical seeing | 500 |
| Active stacks | 300 | Laundry | 200 |
| Inactive stacks | 75 | Reading | 400 |
| Card files | 750 | Desk | |
| Locker rooms | 50 | Primary task plane, casual | 300 |
| Showers | 100 | Primary task plane, study | 500 |
| Vanities | 150 | Schools (See "Educ. Facilities") | |
| Offices | | Skating | |
| General (see also "Reading") | 300 | Ice rink, indoor | 200 |
| Lobbies, lounges and reception areas | 150 | Ice rink, outdoor | 30 |
| Mail sorting | 300 | Stairways | 150 |
| Offset printing and duplicating area | 300 | Tennis, table | |
| Video display terminals (may need to shield or reorient task) | 150 | Club | 300 |
| Parking | | Recreational | 100 |
| (Depends on activity level) | 5-20 | Volleyball | |
| Playgrounds | 50 | Tournaments | 500 |
| | | Recreational | 300 |
| | | Warehouses | 75 |
| | | Inactive | 150 |
| | | Active | |
| | | Rough, bulky items | 300 |
| | | Small items | |
| | | Washrooms | 150 |

APPENDIX G: VISUAL IDENTITY STANDARD

Government of Nunavut
Visual Identity Standards



Section 4.0 – Signage – Official Languages

Official Languages Side By Side

When presenting the four official languages in a side by side format, care must be taken to achieve equivalence in both content and appearance. The following guidelines deal with the process of combining English, French, Inuktitut and Innuinaqtun.

Equivalence

To achieve equivalence in both content and number of lines, a revision of the original text may be required. This could include segmenting the text into main and secondary messages, or rephrasing.

Choosing the Line Breaks

Messages that are to be presented in more than one line should be broken into readable phrases. Articles and prepositions at the end of the line should be avoided. In addition, an attempt should be made to provide a visual balance between the four language columns. Although a visual balance is generally achieved by using the same number of lines for each language, compromises may have to be made to avoid one language column of three or more lines, each consisting of one line only.

Example:

| | | | |
|--|--------------------------|---|-------------------------|
| ᐅᑦᑦᑦᑦᑦᑦ ᑎᑎᑎᑦᑦᑦᑦ ᐅᑦᑦᑦᑦᑦᑦ ᐅᑦᑦᑦᑦᑦᑦ | Choosing the line breaks | Pukungnik titigakhimayut aviktungnilit | Choix des fins ligne |
| ᐅᑦᑦᑦᑦᑦᑦ ᑎᑎᑎᑦᑦᑦᑦ ᑎᑎᑎᑦᑦᑦᑦ ᐅᑦᑦᑦᑦᑦᑦ ᐅᑦᑦᑦᑦᑦᑦ | Choosing the line breaks | Pukungnik titigakhimayut aviktungnilit | Choix des fins ligne |
| ᐅᑦᑦᑦᑦᑦᑦ ᑎᑎᑎᑦᑦᑦᑦ ᐅᑦᑦᑦᑦᑦᑦ ᐅᑦᑦᑦᑦᑦᑦ | Choosing the line breaks | Pukungnik titigakhimayut aviktungnilit | Choix des fins ligne |

Message Elements Common to Both Languages

Many messages include an element that is common to all official languages, e.g. a geographical name or street name that may not be translated, a street number, an expression of time, a distance or a directional arrow.

Depending on its context within the total sign message, a common element may be presented in several ways:

- Where a common element forms the main message (or an important part of the total message), it should be emphasized in relation to the remaining text. In such cases, a repeat of the common element in the right-hand

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Government of Nunavut
Visual Identity Standards



Section 4.0 – Signage – Official Languages

column may be redundant. The examples show the effect of a different character sizes and how a common element should be emphasized.

- Where an element is common to all official languages but does not require emphasis in the context of the message, the common element should appear in each language column of the sign.

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APPENDIX H: MECHANICAL EQUIPMENT -STANDARD OF ACCEPTANCE

The following equipment manufacturers are considered to be equivalent and acceptable for specification purposes, providing that they meet or exceed all capacity ratings, performances, efficiencies, etc., and that they are able to be integrated into the system design without exceeding space limitations, and providing that their substitution for the specified product does not result in changes to related equipment that would increase the cost or reduce the overall performance of the system.

| Mechanical Equipment Type | Standard of Acceptance |
|--|---------------------------------|
| Acoustic Sealant | Duro Dyne |
| Air Handling Units | Engineered Air, Trane, VanEE |
| Air Curtains | Enershield |
| Air to Air Energy Recovery Equipment | Venmar |
| Automatic Air Vents | Maid O'Mist, Amtrol |
| Automatic Temperature Controls | Honeywell, Johnson, Siemens |
| Boilers | Weil McLain, Burnham, Veissmann |
| Centrifugal Fire Pumps | Armstrong Pumps |
| Chimneys | Slkirk, Metalbestos, Excel |
| Circulating Pumps | Grundfos |
| Domestic Hot Water Heaters | Areo, John Woods |
| Domestic Water Holding Tank | Equinox |
| Drinking Fountains | Haws, Elkay |
| Expansion Tanks | Amtrol, Hamlet |
| Energy Management Controls System EMCS | Honeywell |
| Filters | Farr Air, Fram, American Air |
| Flexible Duct Connections | Duro Dyne |
| Fuel Oil Transfer Pumps | Viking, Webster |
| Grilles and Diffusers | EH Price |
| Heating Fluid | Dowfrost HD Propylene glycol |
| Hydronic Pumps | Grundfos |

| Mechanical Equipment Type | Standard of Acceptance |
|------------------------------------|---|
| Insulation | Fiberglas Canada, Johns Manville, Knauf, Manson, Owens Corning, PlastFab |
| Oil Burners | Riello, Carlin, becket |
| Outdoor/Exhaust Air Dampers | Tamco, Westvent |
| Plumbing Vent | Arctic Vent |
| Plumbing Fixtures and Trim | Bradley Corporation, Kindred, Symmons Industries |
| Plumbing Fixtures (Washroom) | Crane Plumbing Company, Kohler Company, Maxx Company, American Standard, Symmons Industries |
| Radiant Heating and Cooling Panels | Twa, Frenger Runtal |
| Side Stream Filters | Armteck |
| Sprinkler Equipment | Viking, Grinnel |
| Tanks | Clemmer, Westeel, Kingland, Granby |
| Sewage Holding Tank | Equinox |
| Time Switches | Paragon, Tork |
| Thermometers | Marsh, Taylor, Terice |
| Valves | Crane, Kitz, Toyo, Red & White, Grinnels |

APPENDIX I: SEISMIC DESIGN REQUIREMENTS

For analysis of Earthquake Loads and Effects, with view to the National Building Code of Canada, obtain the applicable Spectral Acceleration Data for the Community from the link below:

<http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index-en.php>

APPENDIX J: ELECTRICAL EQUIPMENT - STANDARD OF ACCEPTANCE

The following equipment manufacturers are considered to be equivalent and acceptable for specification purposes, providing that they meet or exceed all capacity ratings, performances, efficiencies, etc., and that they are able to be integrated into the system design without exceeding space limitations, and providing that their substitution for the specified product does not result in changes to related equipment that would increase the cost or reduce the overall performance of the system.

A. Electrical Equipment Type - Acceptable Product Manufacturer Standard

| | |
|--|---|
| Service Entrance Switchboards (120/208V 3Ø 4W, 347/600V 3Ø 4W, 60 Hz) | Eaton, Square D, Siemens Schneider Electric |
| Panel boards | Schneider Electric, Eaton, Siemens |
| Moulded Case Circuit Breakers Electric | Eaton, Square D, Schneider Electric, General Electric |
| Wiring Devices | |
| Switches (commercial specification grade) | Hubbell, Leviton, Pass & Seymour, Bryant, Arrow Hart |
| Duplex/Single Receptacles | Hubbell, Pass & Seymour, Bryant, Arrow Hart, |
| Cooper (Industrial specification grade) | |
| Ground Fault Circuit Interrupters Electric | Hubbell, Leviton, Siemens, Eaton, Schneider |
| Lighting Control System devices (Occupancy, dimming & switching) | Lutron Nova, Synergy, SIMPLY5, nLight |
| Lighting Equipment | |
| Interior lighting (lamps) | General Electric, Philips, Cree, Cooper |
| Exterior Lighting (high pressure sodium) | Osram Sylvania, General Electric, Philips |
| Exit Signs & Emergency Lighting | General Electric, Philips, Cree, Lithonia Lighting |
| Intelligent Parking Lot Controller (IPLC) | LED Lumacell, Emergi-Lite, Aim-Lite |
| (Smart parking stall power receptacle) | Vantera M210 complete with weatherproof cover |
| Power Generation | |
| Automatic Transfer Switches | Kohler, Cummins, Caterpillar |
| Fire Alarm Systems (Addressable) | Eaton, Thompson Technology |
| Motor Control Centre | Simplex, Edwards, Notifier |
| Kitchen Appliances/Laundry Equipment | Allen Bradley Canada, Eaton, Siemens |
| "Energise" rated appliances) | KitchenAid, Whirlpool, Maytag, Inglis, Admiral |
| Disconnect Switches - Fused And Non-fused: | |
| Contactors: | Eaton, Siemens, Schneider |
| Motor Starters: | Eaton, Siemens, Schneider |
| Variable Frequency Motor Controllers: | Eaton, Siemens, Schneider |
| Grounding: | Allen Bradley, Eaton, Schneider |
| Hangers and Supports for Electrical Systems: | Erico, Thomas & Betts, OZ-Gedney |
| Splitters, Junction, Pull Boxes And Cabinets: | Erico, Thomas & Betts |
| Outlet Boxes, Conduit Boxes and Fittings: | Hoffman, Hammond, Ace |
| Conduits, Conduit Fastenings and Conduit Fittings: | Thomas & Betts, OZ-Gedney, Wiremold |
| Wireways and Auxiliary Gutters: | IPEX, Thomas & Betts, OZ-Gedney |
| Wire and Box Connectors: | Hoffman, Thomas & Betts |
| | Hoffman, Thomas & Betts, OZ-Gedney |

1. **MANUFACTURER'S INSTRUCTIONS:** Compliance with manufacturer's written recommendations or specifications including product technical data & bulletins, product catalog installation instructions, product carton handling, storage and installation instructions, and data sheets.
2. **QUALIFICATIONS ACCEPTABLE SUPPLIER/ MANUFACTURER:** The System must have an office established for a minimum of five years with full in house technical Services & maintenance capabilities
3. **EQUIPMENT AND DEVICES:** CSA/ULC/ULI listed, certified, labeled and supplied by single manufacturer
4. **SUPPORT SERVICES:** Provide manufacturer/dealer advice, information and support services for 2 year
5. **UNIFORMITY OF MANUFACTURER** should be maintained throughout the project
6. **WARRANTY:** For all materials the warranty period shall be 12 months

APPENDIX K: GOVERNMENT OF NUNAVUT, ENERGY MODELLING GUIDELINES

GOVERNMENT OF NUNAVUT, ENERGY MODELLING GUIDELINES

VERSION 1.0

DEPARTMENT OF COMMUNITY AND GOVERNMENT
SERVICES, TECHNICAL SERVICES DIVISION

2-10-2020

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1.0 Introduction

The Government of Nunavut (GN) Energy Modelling Guidelines outline requirements of Energy Modelling for the purpose of showing compliance with 'Performance Path' as prescribed in the National Energy Code of Buildings (NECB) 2015 Part 8, for all new development projects initiated by GN. This document is not intended to be an exhaustive set of technical and administrative requirements or best practices for energy modelling, and these guidelines are to be used in addition to the applicable requirements for energy performance modelling as written in the NECB 2015 Part 8. This document provides energy modelling guidelines for GN internal new development projects only and does not serve in any capacity as territorial guidelines for Nunavut.

The main objectives of the Energy Modelling Guidelines are to:

- (a) Provide clarity on GN's expectations pertaining to energy modelling while supplementing [GN's Good Building Practices Guideline](#); and,
- (b) Standardize Energy Modelling practice and reporting;

Software limitations shall not limit the accuracy of energy modelling to show compliance with the NECB 2015; consultants are expected to overcome software limitations with appropriate engineering calculations. All other modelling inputs not discussed in these guidelines shall be based on good engineering practice.

1.1. Acronyms used in this guideline

SDSER – Schematic Design Stage Energy Report
DDSER – Design Development Stage Energy Report
HPCER – 100% Construction Energy Report
GN – Government of Nunavut
NECB – National Energy Code of Buildings

2.0 Submission Requirements

SDSER, DDSER and HPCER are required at Schematic Design stage¹, Design Development stage¹ and at least 7 business days before 100% Construction design review stage¹ respectively for new development. Although formal energy model simulation report is only required during three stages as mentioned but GN reserves the right to request changes to energy model to explore more energy efficiency during any phase of the design process, particularly during early stages. This shall be accomplished by adjusting energy simulation model created with requested changes and providing updated energy simulation results to GN design team.

2.1. SDSER and DDSER Submission

The SDSER is aligned with 'Stage 1 – Schematic Design Phase' while DDSER is aligned with 'Stage 2 – Design Development Phase', as outlined in [Design Review Stages and Submissions](#). Since every building design specific detail of various equipment may not be known at Schematic Design stage, Energy Modeller shall make assumptions based on prescriptive requirements of NECB 2015

¹ To learn more about various design review stages, please refer to ['Government of Nunavut Design Review Stages and Submissions'](#).

wherever building system or part of a building system has not been fully specified. All assumptions around mechanical and electrical systems should be documented in the Mechanical and Electrical design briefs.

Once SDSER has been submitted to and reviewed by GN, energy model should be updated based on feedback, if any, to be further carried forward to Design Development stage.

Both DDSER and SDSER must report the summer and winter peak demand. The simulated summer peak demand and winter peak demand for the proposed design must not be greater than the simulated summer peak demand and winter peak demand for the reference building.

2.1.1. Submission Requirements

- Energy Modelling Report completed and signed by the energy modeller and licenced Architect, C.E.T., B.E.M.P., or Professional Engineer.
- Electronic simulation files
- Related supporting drawings and calculations
- Presentation to GN for SDSER and DDSER submissions
- Other documents as may be required

2.2. HPCER Submission

HPCER is aligned with '100% Construction Documents Submission' stage and is essentially a fine-tuned version of DDSER. This implies that DDSER serves as an input to FER. FER reflects the building's final design including any changes made during 'Stage 3 - Construction Document Phase', as outlined in [Design Review Stages and Submissions](#). FER should be submitted at '100% Construction Document Submission' stage.

2.2.1. Submission Requirements

- Energy Modelling Report completed and signed by the energy modeller and licenced Architect, C.E.T., B.E.M.P., or Professional Engineer.
- Electronic simulation files
- Related supporting drawings and calculations
- Modelling notes: General, Building Level, Plant Level, System Level, Occupancy and Minimum Outdoor Air Rates and Warnings, Errors and Troubleshooting
- All external calculations (done outside of modelling software to support the model input) whether be done by hand or electronic. If applicable, calculation for model work-around, exceptional calculations, process energy savings, renewable energy systems, district energy systems, or other required calculations
- Outdoor Air calculations spreadsheets

- Architectural, Mechanical and Electrical Drawings and Specifications (issued for construction)
- Product cut-sheet(s) / spec sheet(s)
- Other documents as may be required

3.0 Acceptable Energy Modelling Software

Energy mode should be completed using any of the following software:

- eQUEST version 3.65 or higher
- CAN-QUEST version 1.2 or higher²
- Energy Plus

3.1. Weather File

Projects shall use the Canadian Weather year for Energy Calculation (CWEC) 2016 weather file. The weather files for NU are available online from Environment Canada here:

https://drive.google.com/open?id=1aKY4sUCJbJ_LYu-jVW9dcPiU_B4FWXh0

² Since CAN-QUEST performs proposed design modelled building comparison with NECB 2011, therefore energy modelling done using CAN-QUEST must demonstrate 10% less overall building energy use for proposed building.

APPENDIX L: NORTHERN INFRASTRUCTURE STANDARDIZATION INITIATIVE – OVERVIEW OF STANDARDS

Standards Council of Canada
Conseil canadien des normes

Item for Discussion:

This document provides an overview of the Northern Infrastructure Standardization Initiative (NISI), as well as a brief synopsis of the standards and guidance documents developed through the program.

Background on the Northern Infrastructure Standardization Initiative

Canada's north is on the frontline of climate change. As temperatures increase, the area is seeing more permafrost thaw, severe storms, precipitation, melting sea ice and coastal erosion. Adapting and repairing buildings in the north can create a heavy financial burden for communities. Northern communities need mechanisms to help them reduce infrastructure's vulnerability to the impacts of climate change.

As Canada's national standardization body, SCC is helping to develop solutions and strategies that keep Canadians healthy and safe while also protecting the environment and economy. SCC is working with communities and experts from across northern Canada to support the development of standards that are effective in addressing climate change impacts to northern infrastructure design, planning and management. Each standard will help building owners and operators – as well as those responsible for public and community infrastructure – build and maintain infrastructure in a changing climate.

The establishment of the Northern Advisory Committee (NAC) has been key to the success of NISI. SCC works with the expertise of this committee in order to establish roadmaps and identify solutions. NISI standards and guidance documents are available online at no charge to Canadians.

Available NISI Standards:

What follows is an overview of each of the standards and the guidance document produced under NISI.

CSA S500:14 - Thermosyphon foundations for buildings in permafrost regions

This standard helps to ensure the ongoing stability of thermosyphon-supported foundations of new buildings constructed in regions of permafrost. It supports users by: (a) describing the life cycle of thermosyphon foundations (e.g., installation, monitoring, design, maintenance), (b) providing guidance on how to maximize the life-time of these systems, (c) specifying what materials should be used in thermosyphon foundations, and (d) describing performance expectations of thermosyphon foundations alongside monitoring and maintenance requirements that should be considered.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CAN%2FCSA-S500-14

CSA S501:14 - Moderating the effects of permafrost degradation on existing building foundations

This standard outlines the procedures to maintain, assess and mitigate permafrost loss to existing buildings. It supports users by: (a) outlining measures to maintain permafrost underneath or next to buildings, (b) providing structural assessment practices for areas impacted by changing permafrost, (c) describing steps to mitigate permafrost degradation, and (d) specifying monitoring and maintenance practices.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CAN%2FCSA-S501-14

CSA S502:14 - Managing changing snow load risks for buildings in Canada's north

This standard describes safe snow removal methods from the rooftops of buildings in Canada's North, and aims to reduce the risk of high snow loads to buildings and occupants. It supports users by describing: (a) maintenance procedures to reduce the impact of high snow loads on buildings, (b) practices to remove snow, and (c) assessment and monitoring practices to understand snow load risks on community infrastructure.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CAN%2FCSA-S502-14

CSA S503:15 - Community drainage system planning, design, and maintenance in northern communities

This standard provides guidance on planning, design, construction, rehabilitation and maintenance of drainage systems in Canada's North. It supports users by: (a) outlining techniques to implement and plan community drainage systems that consider how the climate is changing, (b) promoting health and safety in Canada's northern communities, (c) providing solutions that reflect local capacity and financial barriers, and (d) describing practices for community planning with the goal of conserving community infrastructure.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CAN%2FCSA-S503-15

CSA S504:19 - Fire resilient planning for northern communities

Many northern communities, particularly isolated communities, have limited resources to protect themselves against accidental wildfires (which are being compounded by climate change). This standard helps individuals plan for fire resilience by providing requirements for community planning, building design, appropriate materials for new designs, and more.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CSA%20S504%3A19

CSA PLUS 4011:19 - Technical guide: Infrastructure in permafrost: A guideline for climate change adaptation

This guideline is for decision makers working in permafrost regions, who have a role in planning, purchasing, developing, or operating community infrastructure. It assists non-technical experts by providing guidance and information on: (a) different foundation types for community infrastructure in permafrost, (b) a process to ensure that climate change is considered when siting and designing foundations, (c) climate change trends in the north, and (d) permafrost as an environmental variable that should be considered when designing infrastructure.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=2703076

CSA Plus 4011.1:19 - Technical guide: Design and construction considerations for foundations in permafrost regions

This guideline accompanies CSA Plus 4011 and provides more detailed technical information on the attributes of the various foundation systems, selection criteria, ground conditions, and related issues that should be considered with building foundations in permafrost. The guideline is intended to assist developers, designers, the general public, and others understand the permafrost terrain of Canada, as well as the general selection process and choices for permafrost foundations and their limitations.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CSA%20PLUS%204011.1%3A19

CSA W203:19 - Planning, design, operation and maintenance of wastewater treatment in northern communities using lagoon and wetland systems

Most northern communities use lagoons to store wastewater for a significant portion of the year. This standard specifically addresses the planning, design, operation, and maintenance of intermittent/seasonal discharge lagoon and wetland systems that are most appropriate for use in Northern regions, where effluent discharge is either difficult or not possible in colder months. The standard helps communities with all the lifecycle phases of a wastewater system, from planning, designing, constructing, maintaining, and all the way to closure/remediation of wastewater facilities and wetlands.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CSA%20W203%3A19

CSA W205:19 - Erosion and sedimentation management for northern community infrastructure

Northern communities have seen increased ground erosion, which can lead to unstable foundations for nearby buildings. This standard applies to the management of erosion and sedimentation risks, including the evaluation, planning, design, implementation, monitoring, and maintenance of erosion and sedimentation risk management strategies and mitigation measures for new and existing infrastructure in northern communities. The standard provides steps to manage erosion and sedimentation risks in coastal and lakeshore environments, open-channel environments, and terrestrial environments.

Website Link:

https://store.csagroup.org/ccrz_ProductDetails?viewState=DetailView&cartID=&portalUser=&store=&ccl=en_US&sku=CSA%20W205%3A19

BNQ 2501:500 - Geotechnical site investigation for building foundations in permafrost zones

This standard describes how to perform geotechnical site investigations so that the results can be used to design building foundations. It takes into consideration - in a risk management framework - the conditions at the building site including local and distinct permafrost characteristics, seasonal and inter-annual climate conditions, and projected climate conditions over what will be the service life of the building foundations.

Website Link:

<https://www.bnq.qc.ca/en/standardization/civil-engineering-and-urban-infrastructure/geotechnical-site-investigation-for-building-foundations-in-permafrost-zones.html>

NISI Standards Under Development

What follows is an overview of the NISI standards that are under development.

CSA S505:20 - Techniques for dealing with high winds and snow drifting as it pertains to northern infrastructure (available March 2020)

Community members have noted that wind conditions have been changing as a result of the warming climate. This standard will provide guidance to building operators and owners when dealing with changing wind patterns and strengths, and their impacts on snow drifting.

CSA - Solid waste sites in northern communities: from design to closure (available Fall 2020)

Solid waste management in the North faces unique challenges given the geographic, climatic, transportation and resource differences between southern and northern Canada. This standard will help with the sustainable design, operation, and management of northern solid waste facilities, considering all phases of their life-cycles, and assessing current risks with respect to service life extension.

BNQ 9701-500 - Risk-based approach to community planning in northern regions (available 2021)

When determining the best places to build new community infrastructure, it is important to identify the hazards and vulnerabilities of potential construction areas, as well as the potential future climate risks. This standard will help communities understand the pros and cons of developing infrastructure in different areas.

NORTHERN INFRASTRUCTURE STANDARDIZATION INITIATIVE

Northern Infrastructure Standardization Initiative (NISI) fosters the development of technical standards for sustainable, adaptive infrastructure design, construction and maintenance to address impacts from a changing climate (e.g. severe and erratic weather-related events, degrading permafrost), resulting in more resilient northern infrastructure.

The Standards Council of Canada, with support from Aboriginal Affairs and Northern Development Canada and with funding provided by the Government of Canada, is working with those on the front lines of Northern adaptation to ensure a protected, sustainable future for generations to come.

| NISI STANDARDS | Thermosyphon foundations for buildings in permafrost regions | Moderating the Effects of Permafrost Degradation on Existing Building Foundations | Managing Changing Snow Load Risks for Buildings in Canada’s North | Community drainage system planning, design, and maintenance in northern communities |
|------------------------|--|--|--|--|
| OVERVIEW | Thermosyphons are essentially a heat-transfer device, which draw heat out of the ground. The warmth of the ground causes the liquid contained in the thermosyphon tubes to evaporate into gas which then rises to the top of the tube, where the heat it carries is dissipated into the air; this cycle is continuous and auto-matic.. Thermosyphon foundations help to preserve permafrost underneath critical infrastructure. | Permafrost is ground (soil or rock) that remains at or below a temperature of 0°C for two or more consecutive years. The layer of material above the permafrost that thaws and refreezes annually is called the active layer. Permafrost degradation may cause the foundation of a building to become unstable. | Snow overloading occurs when the weight of the snow on the roof of a building approaches or exceeds its original design capacity to withstand heavy snow conditions. | Community drainage planning in the North is unique due to long periods of extremely low temperatures; exceptionally large and remote drainage basins; permafrost; small, isolated communities with low population density; and consideration for the social and cultural context of land use. |
| RATIONALE FOR STANDARD | <ul style="list-style-type: none">Increased use of thermosyphons.Recent performance failuresNo publically available guidance, set of best practices, or commonly accepted set of key principles for how to design, install, commission, or monitor thermosyphons foundation.Need to understand how to integrate climate change information into the design of thermosyphon supported foundations. | <ul style="list-style-type: none">Increased impacts of permafrost degradation.Climate change will further contribute to the degradation of permafrost, amplifying the destabilizing impact on building foundations.Potential major losses of capital investments and critical services.Improper operations and maintenance practices can accelerate permafrost degradation. | <ul style="list-style-type: none">Increased snowfall, and changing snow-water equivalent and more winter rain events are resulting in heavier snow impacting snow load weight.Increased risks to the health and safety of occupants from building roof failures.More attention is required to ensure that snow loads are adequately incorporated into the design and maintenance of buildings.Consideration of changing climate impacts for the lifespan of structures. | <ul style="list-style-type: none">Accelerated degradation of northern community infrastructure due to ad-hoc development of community drainage planning; increased maintenance and replacement costs.Need to develop and implement drainage plans that account for both site-level and community-wide snowmelt / ice melt / rainfall-induced runoff conditions.Runoff events can contribute to the loss of roads / bridges, and the degradation of permafrost.No generally accepted guidance for development and maintenance of northern community-wide drainage plans. |
| SOLUTIONS | Standardization will help ensure that thermosyphon foundations are sited, designed, installed, and monitored correctly, ensuring the long-term performance of thermosyphon-supported foundation systems under changing environmental conditions. | Engineering-based interventions can play important roles in moderating and remediating the impacts of permafrost degradation on building foundations; ensuring the building maintains its function and usefulness in communities. | Communities need a standardized protocol to establish ongoing practices to reduce snow overloading risks over the lifespan of the building, which include pre-season roof snow removal planning and building maintenance to reduce risks of collapse and extend the life of the roof. | As precipitation levels in various regions of the North continue to change, a new, comprehensive standard is expected to contribute to a needs-based toolkit for designing, building, and maintaining drainage systems, thereby helping to reduce the vulnerability of community infrastructure. |
| KEY ELEMENTS | <ul style="list-style-type: none">Performance, monitoring, and maintenance expectations.Materials specifications.Information regarding the technology throughout its life cycle.Guidance to maximize the long-term viability under changing environmental conditions. | <ul style="list-style-type: none">Measures to maintain permafrost beneath and adjacent to existing buildings or structures.Assessment protocol.Mitigation techniques.Guidance on long-term performance of foundation rehabilitation. | <ul style="list-style-type: none">Snow overload planning and maintenance procedures.Detection, monitoring, and assessment of snow overloading risk for buildings.Guidance on snow removal from roofs safety. | <ul style="list-style-type: none">Techniques to plan for and implement community drainage systems.Practices for site and community planning to conserve community infrastructure.Provide implementable, low cost respecting local constraints on capacity and resources. |
| END USERS | <ul style="list-style-type: none">Owner and operators (building and land)ContractorsDesign professionals, planners and reviewersEngineersEducatorsRegulatorsInspectorsCommunity maintainersCommunity administrators | | | |



**City of Iqaluit Transportation
Master Plan**

Final Report

April 25, 2022

Prepared for:

City of Iqaluit

Prepared by:

Nunami Stantec Limited

The conclusions in the Report titled City of Iqaluit Transportation Master Plan are Nunami Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. The Report relates solely to the specific project for which Nunami Stantec Limited was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Hassan Al Madhoun

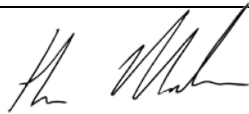


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1.0 INTRODUCTION

1.1 ABOUT THE TRANSPORTATION MASTER PLAN

As a result of becoming the newest capital city in Canada, Iqaluit is experiencing a period of rapid development and growth. Between 2006 and 2016, the City added over 1,550 new residents (a 25% increase), accounting for approximately half of all growth within the broader Baffin Region during that same timeframe. According to the City's General Plan it is expected that by the year 2030 the city will be home to an additional 5,300 people, representing a 69% growth in population over existing levels. With the advent of growth, Iqaluit is faced with several transformative challenges that will dictate its continued success in the Arctic. A major challenge manifests itself in the form of accommodating mobility needs in an arctic climate. While snow and ice aren't unfamiliar to most Canadian communities, Iqaluit's geology, terrain, and climate, although breathtaking, present significant challenges to implementing and maintaining road, off-road vehicle, and active transportation infrastructure. Moreover, the rate of automobile ownership is growing at a rate faster than that of population growth, and consequently driving is forming an increasing percentage of the mode share of trips made by Iqalumiut, further exacerbating transportation infrastructure constraints.

The purpose of the Transportation Master Plan (TMP) is to evaluate the city's transportation network and provide strategic recommendations related to roads, snowmobile trails, active transportation, and public transit, aimed at meeting the needs of residents today and into the future. Consideration is given to both the residents with vehicles and those who are physically, economically, and/or socially disadvantaged who cannot use or have access to an automobile. Taken together, the TMP's package of recommendations is intended to be a contemporary, forward-thinking plan that takes a multi-modal approach to transportation planning, considering the interplay between the different modes of transportation and seeking to create a whole that is greater than the sum of the parts. The result is a plan that is designed appropriately for people, for placemaking, and for prosperity.

1.2 ABOUT NUNAMI STANTEC

Established in 2006, Nunami Stantec is a majority Inuit-owned consulting company based in Rankin Inlet, Nunavut. Nunami Stantec is a partnership between the Sakku Investment Corporation, Kitikmeot Corporation and Stantec Consulting Ltd., providing environmental science and engineering services to organizations throughout all three regions of Nunavut. Nunami delivers quality services and solutions to clients while providing employment, training, and financial profits to beneficiaries under the *Nunavut Agreement*. The partners have committed to delivering their services in Nunavut exclusively through Nunami Stantec. Nunami Stantec is registered as an Inuit Owned Firm with Nunavut Tunngavik Incorporated (IFR0744).

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Existing Conditions

Technical consulting services are delivered through the Stantec partner. The Stantec community unites more than 22,000 employees, including over 160 staff across eight offices in the Canadian North and Alaska. Stantec and Nunami Stantec are registered and licensed to practice engineering services by the Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists.

Our work—professional consulting in planning, engineering, architecture, interior design, landscape architecture, surveying, environmental sciences, project management, and project economics—begins at the intersection of community, creativity, and client relationships. With a long-term commitment to the people and places we serve, Stantec has the unique ability to connect to projects on a personal level and advance the quality of life in communities across the globe.

2.0 EXISTING CONDITIONS

2.1 ABOUT IQALUIT

The City of Iqaluit is Canada's northernmost capital. Translated to mean “a place of many fish,” Iqaluit has been a traditional fishing location used by Inuit for thousands of years. As a result of becoming the newest capital city in Canada, Iqaluit has been experiencing rapid development and growth. The City of Iqaluit is home to 7,740 residents as of 2016, which represents a population increase of 45% from 2001, just after the creation of Nunavut in 1999¹.

Figure 1 illustrates the various neighbourhoods within the city. The Core Area represents the city centre where greater commercial and institutional uses can be found as well as many key points of interest. Various neighbourhoods exist around the core area with lower-density residential areas and subdivisions including but not limited to the Plateau Subdivision, Lake Subdivision and Road to Nowhere.

¹ Population numbers were obtained from Statistics Canada census data from the 2001 and 2016 census

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Existing Conditions



Figure 1: City of Iqaluit neighbourhoods

2.1.1 Demographics

The Arctic climate and remoteness brings about unique mobility needs with limited road, rail or ship transportation connections to the rest of Canada for several months of the year presenting significant challenges. To understand the transportation needs and demand, it's important to understand the current and future population demographics, the geography and spatial design of the city, as well as all mobility options available to residents of Iqaluit. Table 1 compares demographic statistics of the city with those of the Baffin Island region, the territory of Nunavut, and Canada, to understand how Iqaluit aligns and differentiates on various scales.

Table 1: Demographic Information

| Characteristic | Iqaluit | Baffin Island | Nunavut | Canada |
|---------------------------------|---------|---------------|---------|------------|
| Total population (2016) | 7,740 | 18,988 | 35,944 | 35,151,728 |
| Total population (2011) | 6,699 | 16,939 | 31,906 | 33,476,688 |
| Population change (2011 - 2016) | 15.5% | 12.1% | 12.7% | 5% |
| | Iqaluit | Baffin Island | Nunavut | Canada |

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Existing Conditions

| | | | | |
|--|----------------|----------------------|----------------|---------------|
| Dwellings | 3,419 | 6,556 | 11,433 | 15,412,443 |
| Average household size | 2.8 | 3.4 | 3.6 | 2.4 |
| Median household income | 136,119 | 104,896 | 97,441 | 70,336 |
| Unemployment rate | 9.6% | 17.3% | 21.5% | 7.7% |
| Labour force | 4,635 | 8,895 | 16,340 | 18,672,475 |
| | Iqaluit | Baffin Island | Nunavut | Canada |
| Recent immigrants | 45 | 45 | 165 | 1,212,075 |
| (Visible) Minority groups | 7.7% | 3.6% | 2.5% | 22.3% |
| Inuit / First Nations | 59.4% | 80.5% | 85.5% | 6.2% |
| | Iqaluit | Baffin Island | Nunavut | Canada |
| Characteristic | | | | |
| Male | 49.7% | 51.2% | 51.2% | 49.1% |
| Female | 49.8% | 48.8% | 48.8% | 50.9% |
| | Iqaluit | Baffin Island | Nunavut | Canada |
| 14 and younger | 24.9% | 31.5% | 32.5% | 16.6% |
| 15-34 | 33.3% | 33.7% | 33.9% | 25.3% |
| 35-64 | 38.8% | 31.3% | 29.8% | 41.2% |
| 65 and older | 3.0% | 3.6% | 3.8% | 16.9% |
| Average Age | 31 | 28 | 27 | 41 |
| | Iqaluit | Baffin Island | Nunavut | Canada |
| No degree | 28.2% | 46.0% | 50.7% | 18.3% |
| High school only | 18.9% | 16.3% | 15.1% | 26.5% |
| College degree | 20.9% | 16.6% | 15.0% | 19.4% |
| University degree | 23.9% | 13.7% | 10.6% | 23.3% |
| | Iqaluit | Baffin Island | Nunavut | Canada |
| Owned | 23.5% | 19.3% | 20.0% | 67.8% |
| Rented | 76.5% | 80.8% | 80.0% | 31.8% |
| Single detached home | 25.1% | 39.3% | 44.3% | 53.6% |
| Semi-detached home | 6.5% | 9.0% | 8.9% | 5.0% |
| Apartment (<5 storeys) | 37.8% | 19.0% | 13.2% | 18.1% |
| Apartment (>5 storeys) | 4.0% | 2.0% | 1.1% | 9.9% |
| % Spending >30% of income on housing | 10.0% | 7.8% | 5.8% | 24.1% |
| | Iqaluit | Baffin Island | Nunavut | Canada |
| MODE OF COMMUTING | | | | |
| Car (driver) | 45.1% | 33.5% | 29.0% | 74.0% |
| Car (passenger) | 24.1% | 19.7% | 17.9% | 5.5% |
| Transit | 0.2% | 0.5% | 0.8% | 12.4% |
| Walked | 26.2% | 38.0% | 44.2% | 5.5% |
| Bicycle | 0.0% | 0.2% | 0.2% | 1.4% |
| Other | 4.3% | 8.1% | 8.0% | 1.2% |

Source: Statistics Canada, 2016

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

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The City of Iqaluit has grown over 15% since the 2011 Census which is three times the Canadian average of 5%. The growth levels are similar to those seen across the region and territory (approximately 12%). Furthermore, Iqaluit's unemployment rate is 9.6%, slightly higher than the Canadian average, though significantly below the regional and territorial averages, indicating that Iqaluit serves as an employment centre within the territory. The household median income is \$136,119, which is substantially higher than the Canadian average. Notably the territorial average is also higher than the Canadian average which can in part be due to the higher cost of living in the northern territories. Though, despite a high median income, it is important to note that there are many residents on social assistance who are struggling to make ends meet.

In Iqaluit, 60% of the population is Inuit. Many residents speak Inuktitut at home and participate in traditional activities like hunting, fishing, trapping and getting out on the land. The Inuit culture, history and way of life inform all aspects of life in Iqaluit, including how people move through the community.

The average age in Iqaluit is 31 years and is ten years below the Canadian average, with the regional and territorial average similar to that of Iqaluit suggesting a younger demographic in the territory. Approximately 24% of residents own property whereas 76% of residents rent property which is similar to what is observed in the region and territory but significantly different to the rest of the country where approximately 68% of residents own property and 32% of residents rent property.

In terms of commuting, residents of Iqaluit appear to be more car-dependent than the rest of the region and territory, which is likely a result of Iqaluit being the capital city with the most developed road infrastructure, and with the greatest quantity of car imports. Compared to the Canadian average, Iqaluit sees a much lower portion of single-occupant drivers with 45% compared to 74%, however there are significantly more residents who report traveling via car passengers, therefore an overall car mode share of 69% exists in Iqaluit. The high passenger car trips suggest that shared rides are common; a trend that is also in alignment with the service delivery model of Caribou Cabs, the local taxi service provider.

The walking mode share is lower in Iqaluit relative to Baffin Island and Nunavut however remains higher than the Canadian average. With nearly 26% of commuting trips in Iqaluit made by walking or biking to work, this suggests that many trips within the City are short-to-medium distance trips. There may be opportunities to leverage transit as a complementary mode for active transportation within the broader multimodal transportation network, and there may be opportunities to utilize transit as a more convenient alternative for short trips made by foot or by bicycle, especially in inclement weather. Additionally, the relatively high walking mode share suggests that pedestrian infrastructure should be prioritized in the TMP. The limitations of transportation networks in the winter months present challenges with the use of active transportation and transit.

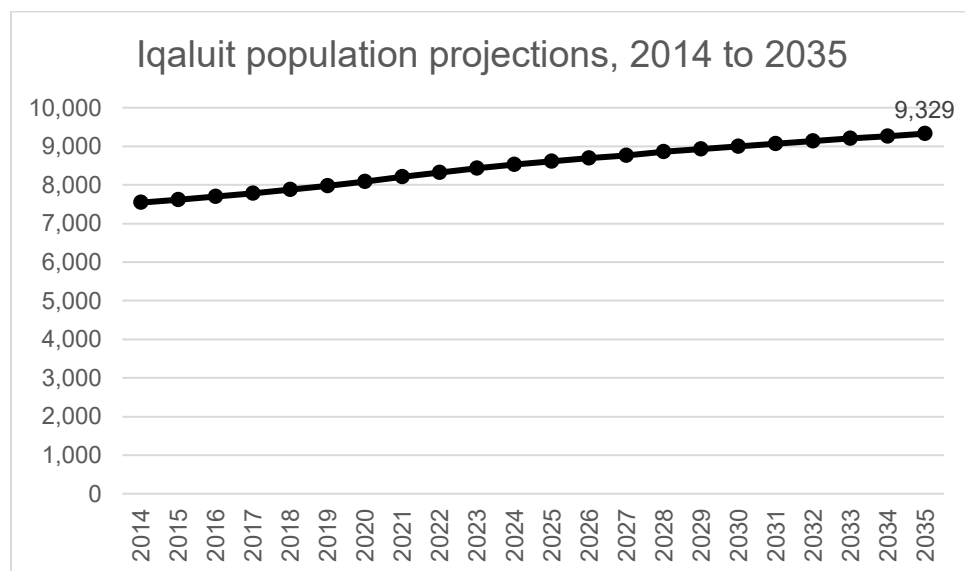
2.1.2 Population Projections

Based on the 2011 Census data, population projections were completed by the government of Nunavut across the territory from 2014 to 2035. By 2035 the population in Iqaluit is expected to increase to 9,329, representing a 21% increase from the population of 7,740 reported in 2016. The transportation

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

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infrastructure will need to be planned to accommodate this rapid population growth, including proactive strategies to mitigate vehicle congestion as the population increases and the provision of safe and accessible transportation networks.



Source: Government of Nunavut

Figure 2: Population projections in Iqaluit, 2014 to 2035

2.1.3 Points of Interest

Figure 3 shows the map of the city and key points of interest, largely located in the core area. With many commercial and institutional buildings located in the Core Area strong pedestrian facilities should be prioritized here. Additionally, given the size of the city, many locations can be reached by walking or cycling when the weather permits. As the city grows and transportation networks become more constrained, the enhancement of active transportation facilities will help to alleviate that congestion.

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Figure 3: City of Iqaluit road network and key points of interest

2.1.4 Land Use

To provide a greater understanding of the relationship of land use and transportation as well as travel patterns in the city, the land uses within the city have been illustrated in Figure 4. A greater concentration of institutional and commercial buildings can be found in the Core Area with more low-density residential found spanning outside the Core Area and some multi-residential units observed in some of the subdivisions. Additionally, several commercial buildings are located in the northwest end of the city along Federal Road, adjacent to the airport. Given the greater institutional, commercial and employment uses found in the Core Area, and supported by an evaluation of traffic volumes and anecdotal observations, it is noted that many trips are made to and from here during AM and PM peak hours.

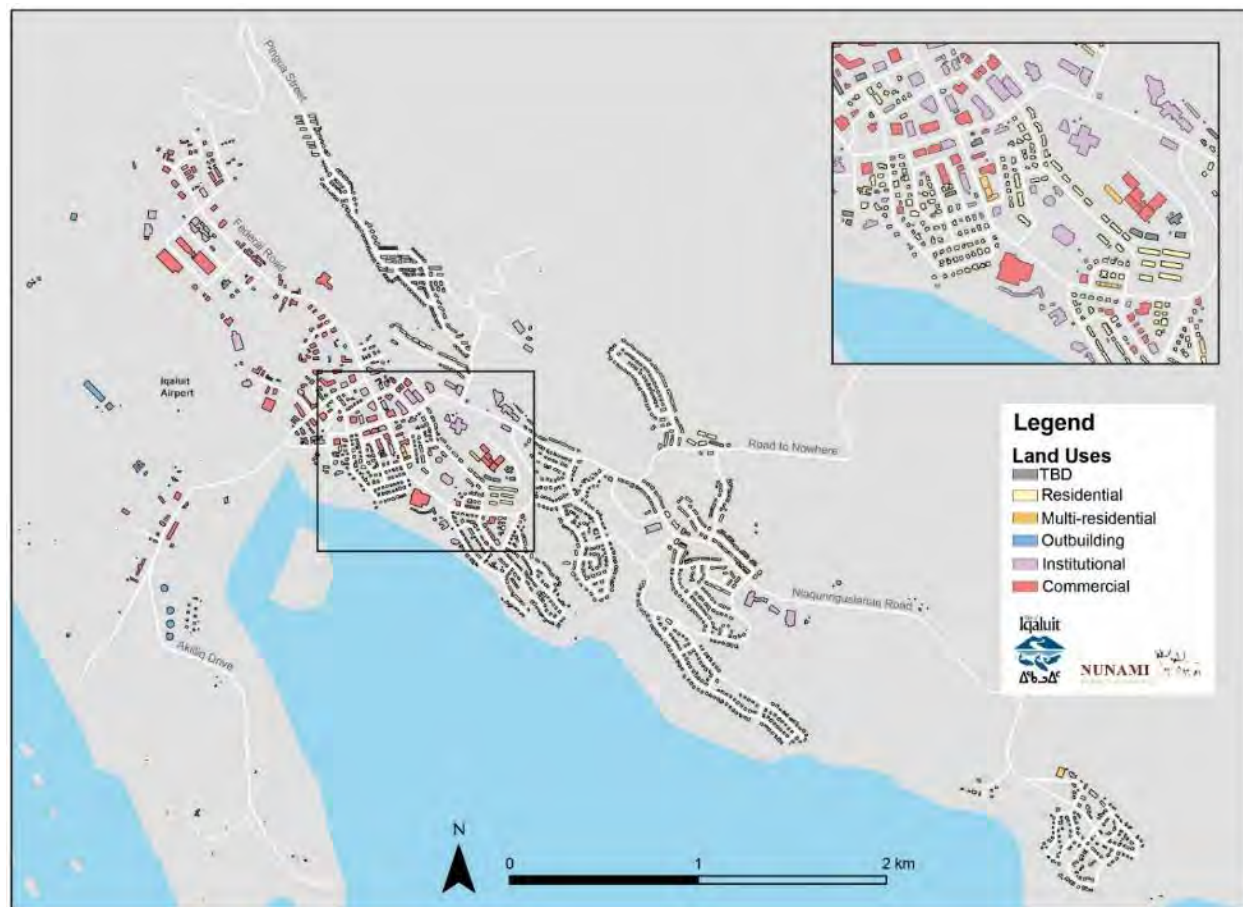


Figure 4: City of Iqaluit land use map

2.2 BACKGROUND DOCUMENT REVIEW

The current planning process relies on an understanding of previous planning efforts, successes, and challenges. This section provides an overview of important planning documents and studies that offer insights on the existing and future transportation networks in Iqaluit.

2.2.1 Iqaluit General Plan (2010)

The Iqaluit General Plan was completed in 2010 and aims to guide the physical development of Iqaluit to the year 2030. In a time of significant growth, the General Plan establishes a policy direction to strengthen land use planning policies and processes. The plan outlines a number of visions with associated actions to achieve these as well as a development strategy for growth. Among other elements related to the development of Iqaluit, mobility is discussed with respect to all transportation modes including pedestrian walkways, trails, cycling routes, snowmobile trails and the road network including various classifications. A Transportation Master Plan (TMP) is identified to be needed to appropriately plan for the growth and resultant mobility needs.

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According to the 2006 census, 59% of Iqaluit residents commuted by vehicle, while 32% walked and 8% used other means. While vehicle commuting has increased over the last 10 years, there is still a significant percentage of residents who commute via walking, making good pedestrian infrastructure important. Policies that prioritize pedestrian access, and enhancement of walkways and cycling trails are identified, specifically within the core area. The protection of snowmobile trails and investigation of snowmobile crossings were identified to enhance safety. Additionally, given the utilization of the existing shared taxi service, and related feedback, there is community interest in re-introducing some form of transit service. Lastly, the General Plan outlines the adopted road classification policy that directs future road works including arterial, collector, local, and bypass roads including designated right-of-way. Identifying gaps in the pedestrian and cycling networks in this TMP will aid in planning for future growth.

2.2.2 Former Navigator Inn Traffic Impact Study (2019)

A Traffic Impact Study (TIS) was completed to determine the transportation impacts of a planned mixed-use development at the site of the former Navigator Inn, at the intersection of Mivvik Street and Allanngua Street. The TIS findings concluded that transportation improvements are needed to mitigate the expected future traffic volumes expected due to population growth, but that the development itself would not generate major traffic impacts. The improvements recommended include the signalization of the Mivvik/Allanngua intersection, addition of left-turn lanes at several locations, re-alignment of Alwoodhouse Street to create a two-way access, and improved channelization using physical barriers.

2.2.3 Master Drainage Plan (2019)

Stantec completed Iqaluit's Master Drainage Plan (MDP) in 2019, which has implications on the development of the future transportation network – primarily in influencing flooding patterns which occur due to non-functioning drainage systems. The MDP identified major drainage areas, routes and channels within the City, characterized existing conditions, and assessed the effectiveness of existing drainage infrastructure at conveying drainage and mitigating environmental impacts. The MDP then identified culvert repairs and replacements, municipal design standard updates, and made other strategic recommendations.

2.2.4 Federal Road Development Area Transportation Study (2018)

A Transportation Study was completed for the Federal Road Development Area (FRDA) as a result of a proposed change in land use designation. The study examines existing and future traffic conditions in the study area, including a transportation engineering assessment of the General Plan's By-Pass Road alignments and feasibility. Three By-Pass road alignment road options were assessed based on the developed criteria. Overall, the alignments through Masak Court and via an extension to Ulu Lane were considered feasible and recommended to be protected in the General Plan including considering the appropriate right-of-way with the extension of the hotel access road. The preferred option road network is recommended for adoption and to proceed to detailed design. Connection to the future road network is recommended to be retained through the road network and its construction and future development. The impacts of the By-Pass road alignment are considered within the TMP traffic assessment.

2.2.5 Iqaluit Ports Traffic Study (2018)

A traffic study was completed to assess and mitigate the transportation impacts of the construction of two new ports within Iqaluit, the Deep Sea Port and Small Craft Harbour. The outcome of the analysis determined that no intersection improvements were needed, although parking stall designs for the port sites were recommended to be carried forwards to implement. In addition, due to significant traffic volumes along Akilliq Drive, it was recommended that the roadway be widened to a 7m width, with 1.5m shoulders (subject to further analysis).

2.2.6 Iqaluit International Airport Improvements Traffic Impact Study (2014)

Stantec completed a TIS to quantify impacts to the transportation network due to the expansion of the Iqaluit International Airport. A new planned terminal (built in 2017) will be accessed via Ungalliqaat Crescent. The TIS findings concluded that while 400 new trips will be generated on opening day due to the airport expansion, the only improvement required is the signalization of the Four Corners intersection by the 5-year horizon (2022).

2.2.7 Traffic Light Signal Controls Final Report (2009)

The Traffic Light Signal Controls Final Report provided a traffic assessment including a warrant analysis, capacity analysis, collision analysis and pedestrian and snowmobile features analysis at key intersections in the core area of the city which includes Niaqunngusiariaq Road from the Four Corners to the Hospital intersection.

The report recommends the following traffic operations improvements:

- Installation of traffic lights and left-turn lanes at all approaches at the Four Corners Intersection (with potential consideration of a roundabout which necessitates higher costs and property acquisition);
- Implement an exclusive right-turn lane at the northbound and southbound approaches of the Hospital intersection;
- Implement an exclusive 15-metre left-turn lane at the High School intersection;
- Develop a standard city-wide crosswalk design based on the Transportation Association of Canada's *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC) standards;
- Develop sign design standards for consistency and increased safety with specific regard to the order of languages on a sign;
- Designate entrance-only and exit-only driveways at the High School intersection to ease circulation and prevent conflicts; and
- Review the illumination of crosswalks for visibility of pedestrians by oncoming road traffic.

2.2.8 Iqaluit Core Area By-Pass Road Preliminary Design Report (2007)

The Iqaluit Core Area By-Pass Road Preliminary Design Report was completed as part of the site analysis phase of the Iqaluit Core Area By-Pass Report project with the goal of providing a detailed assessment of the proposed By-Pass Road alignment as recommended in the Transportation and Urban Design Study (Dec 2005). The issues, options and recommendations of each segment or intersection

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was completed, beginning at the corner of Queen Elizabeth Drive and Niaqunngusiariaq Road and following the proposed alignment north towards Masak Court and Sikituuq Court.

Construction of the By-Pass Road is recommended to occur in three phases:

- Phase 1: Niaqunngusiariaq Road from Saputi Road to Kangiq & Iniq Drive
- Phase 2: Extension of Kangiq & Iniq Drive north to Masak Court
- Phase 3: Improvement of the Queen Elizabeth Drive and Niaqunngusiariaq Road intersection

It is suggested that the cost analysis of the road past Masak Court (Phase 3) will be high due to the presence of rock to the east and therefore in the immediate future the Core Area By-Pass Road may terminate at Masak Court. The report concludes that the construction of the By-Pass Road is feasible, however the City may consider whether or not it should be built considering impact on adjacent properties, pre-construction and planning works, and whether any required changes to the alignment will impact the benefits of the road. Lastly, in order to see benefits from the By-Pass Road it is noted that it will need to be an arterial road and not a collector or local thoroughfare.

2.2.9 Iqaluit Transportation and Urban Design Study (2005)

The Transportation and Urban Design Study was completed to identify improvements or modifications to increase the functionality of the City's Central Area transportation networks, including the off-road transportation network, with a focus on the plan for a By-Pass Road north of the Four Corners intersection.

The report presents immediate actions (current year) and short-term actions (2 to 5 years). Immediate actions focus on quick opportunities to enhance the pedestrian environment and control traffic demand prior to infrastructure improvements whereas short-term actions include the implementation of the By-Pass Road and other key infrastructure improvements.

The recommendations are as follows:

Immediate Term (Current Year):

- Organize a meeting with major employers, all levels of government and representatives from major institutions in the City to explore opportunities for a Staggered Work Hours Program and a Cooperative Transit Service.
- Meet with the Postal Office Management to recommend a postal sub-station in the south end of the City as a means of managing traffic demand in the Core Area.
- Define which option of the By-Pass Road east of Federal Road is preferred and proceed to detailed design, tendering, and construction stages.
- Develop the Terms of Reference for a city-wide Transportation Master Plan study.

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Short-Term (2 to 5 years):

- As part of the first phase of the By-Pass Road (section east of Federal Road) the crosswalk along the By-Pass should be implemented as well.
- Implement the pedestrian access improvements along Niaqunngusiariaq Road and the Four Corners intersection.
- Complete the Transportation Master Plan.

2.2.10 Municipal Design Guidelines (2004)

The Municipal Design Guidelines provide an outline for municipal infrastructure with respect to roadways, walking trails and snow mobile trails design criteria. Trip generation rates, road design classifications with associated cross-sections and design speeds are provided. Various roadway design elements are noted for cul-de-sacs, intersections, walking trails and snowmobile trails, driveways, and signage.

As the TMP provides further insight into strategies and policies related to roadway classification and right-of-way, the design criteria provided in the Municipal Design Guidelines will serve as a starting point to build off of and modify to meet transportation needs into the future.

2.2.11 Design & Development of Trails, Interim Report (2002)

The Design & Development of Trails Report was created in response to public concerns and interests in improving and enhancing the quality of life in the community including the need for improved pedestrian access, parks and open spaces. A series of consultations were conducted to determine the level of interest in the community for walking trails, investing interests in recreation, commuting and tourism activities. Notably, there was interest in utilizing walking trails for both commuting and recreational purposes, though it was expressed that these trails will not completely replace driving trips as weather, schedule variability, and long distances were factors that influenced driving. Key areas within the urban core and towards the edge of the city were identified. The issue of cost and maintenance was raised as a concern. The pedestrian and non-motorized traffic patterns were identified. Based on the analysis and consultation, a proposed trail system was outlined consisting of Primary Trails serving primarily commuters and visitors, Secondary Trails serving joggers and tourists, and Tertiary Trails serving hikers heading out of the community. The plan is proposed to be phased for ease of implementation.

When considering trail and pedestrian facilities and movements in the TMP, consideration for desired trail elements outlined through stakeholder and public consultation will be made. Additionally, key pedestrian travel patterns and connection to key areas of interest will be considered.

2.3 WHAT WE HEARD

To develop a Transportation Master Plan that responds to the specific mobility challenges within the Iqaluit transportation network, it was important to reach out to a wide range of community members and

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stakeholder groups. To do this we planned and carried out a series of different engagement activities with the goal of:

- Informing stakeholders and the public about:
 - why a Transportation Master Plan is being completed
 - the basic status of Iqaluit's transportation system
 - the opportunities and challenges we see with the existing system and infrastructure
 - trends and northern solutions
 - the types of problems the Transportation Master Plan can solve
- Getting an understanding of:
 - the values and vision of Iqaluit residents as related to the future of their transportation network
 - where people travel, how, and why
 - what the specific challenges are and any potential solutions
- Engaging a wide range of stakeholders and community members
- Building relationships and a future transportation system by using culturally-appropriate engagement techniques

Throughout the engagement process we focused on the following questions:

WHERE are people going? **Identify key destinations** in the community

WHO is going to these places? **Categorize destinations** in the community by user groups

HOW are they getting there? **Identify and categorize routes** for each user group (industrial routes, emergency routes, pedestrian routes, etc.)

Is there a **BETTER WAY**? **Identify missing pieces** (routes, modes of transportation, etc.) that would help people get where they're going more effectively

2.3.1 Engagement Activities and Participation

During this engagement process, different activities were planned in order to reach out to the wide range of people potentially impacted by the outcomes of this project. Separate workshops were held with Mayor and Council and representative from key City of Iqaluit departments. We reached out to stakeholder groups and had one-on-one meetings with those who were interested. We held specific sessions with youth and elders. To reach out to the public, we held pop-up engagement events in public locations people are already visiting (pool and arena), had two community drop-in meetings, and promoted an online survey.

The engagement activities took place in February and March 2020. The workshops and the in-person stakeholder meetings took place during the week February 24 to 28, 2020 when our team was in Iqaluit.

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Table 2: List of Public Engagement Events

| Tool | Participants |
|--------------------------------|--|
| Collaborative workshops | <ul style="list-style-type: none"> Workshop with City Staff (representatives from Public Works and Engineering, Municipal Enforcement, Recreation, Community Economic Development, Planning and Development) Workshop with Mayor and Council |
| In person stakeholder meetings | <ul style="list-style-type: none"> Hunters and Trappers Association Uquutaq Men's Shelter, Executive Director Makkuttukkuvik Youth Centre Baffin Chamber of Commerce, Executive Director Department of Economic Development and Transportation (Transportation Policy Planning and Nunavut Airports) Elders meeting at the Qammaq Travel Nunavut Iqaluit District of Education, School Bussing Committee Caribou Cabs Iqaluit Public Works Department staff RL Hanson Construction RCMP – Iqaluit Detachment |
| Telephone meetings | <ul style="list-style-type: none"> Nunastar Nunavut Sealink and Supply Inc. |
| Written input received | <ul style="list-style-type: none"> Nunatta Sunakkutaangit Museum Kakivak Association Qikiqtani General Hospital |
| Public pop-up planning desk | <ul style="list-style-type: none"> Arnaitok Arena (one evening from 5 to 7) Aquatic Centre (two evenings from 5 to 7) AWG Arena (one evening from 5 to 7) |
| Public meetings | <ul style="list-style-type: none"> Community drop-in meeting at the Abe Okpik Hall in Apex Community drop-in meeting at the Elders Qammaq |
| Online survey | <ul style="list-style-type: none"> Open to the public from February 20, 2020 to March 14, 2020 |

The engagement process was successful in reaching out to a wide range of people and groups in Iqaluit and getting a well-rounded understanding of how the transportation system is working, how vehicles, pedestrians, and goods move, specific challenges, safety concerns, and potential solutions. During the community sessions, we engaged with over 125 people, and received additional feedback through 421 survey responses.

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Figure 5: Session with Elders and translator at the Qammaq



Figure 6: Community Drop-in Event in Apex

2.3.2 Online Survey Results

The public online survey was hosted from February 20, 2020 to March 14, 2020 using SurveyMonkey. The survey was provided in both English and Inuktitut and advertised via the City's existing communications methods including the City's website and Facebook page and was promoted at the public events. In total, 421 surveys were completed, all through the English survey.

This survey collected information on:

- Where people live, where they are going and how they are getting there (both in summer and winter)
- If respondents have access to a personal vehicle.
- If respondents would consider using public transit if it was available.
- What factors respondents use to decide which mode of transportation to use.
- Level of satisfaction with the current transportation system.
- Comments about specific concerns that respondents have.

The following are key findings from the public survey.

- 68% of respondents travel to the core area daily for work or school.

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- 69% of respondents would consider using public transit.
- Overall people were not satisfied with transportation in Iqaluit and gave it, on average, 2 stars out of 5.
- When deciding how to get around, respondents think that reliability and safety are the most important factors to consider.
- In terms of the comments that people made, significant feedback was received regarding the road network (107 comments), regarding shared transportation including taxis and transit (61 comments), and regarding the pedestrian network (35 comments).

The results of the survey, including the written comments, are considered along with all other inputs received in the analysis of the key engagement themes in the following section.

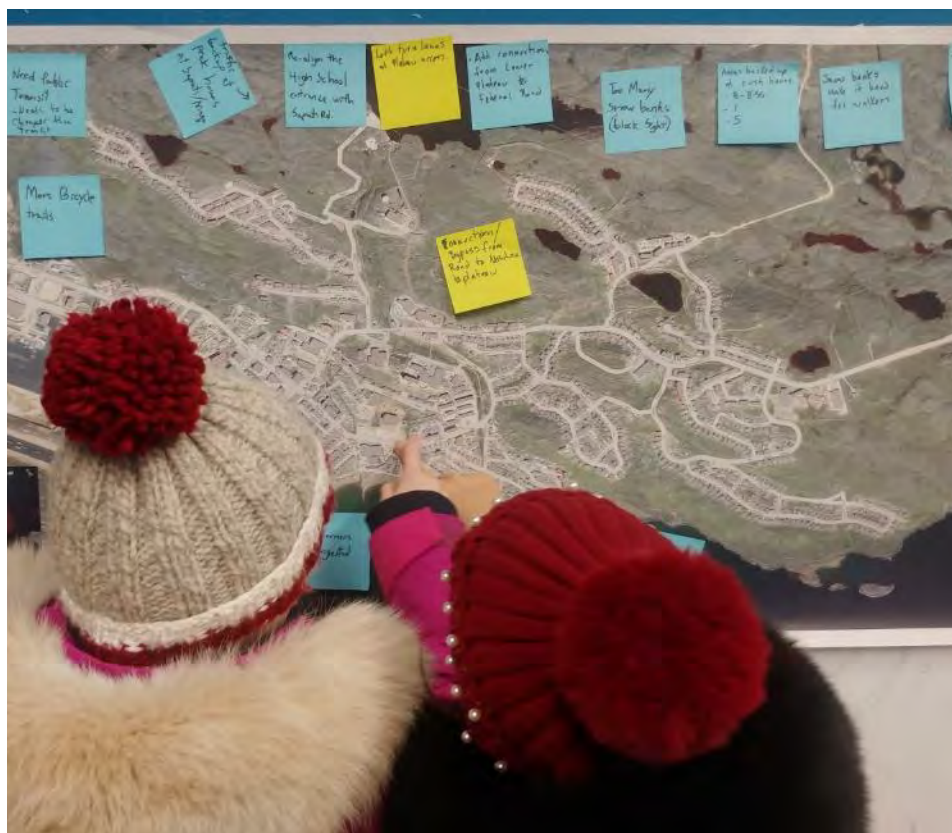


Figure 7: Youth adding comments to the map at the Arnaitok Arena

2.3.3 Key engagement themes

In this section, the input from all sources is considered and summarized by theme. This includes information from the online survey, the stakeholder meetings, sessions with youth and elders, and the community meetings.

How People Get Around

- According to the survey, most people get around by car (56% in summer and 66% in winter), walking (28% in summer and 14% in winter) and taxi (5% in summer and 12% in winter).
- Snowmobiles and ATVs are used to get out of the community and onto the land and are sometimes used to get around the city.
- Personal vehicle ownership has increased, with an estimated 200 to 400 cars arriving on the sea lift every year. There are challenges for people who do not have access to a car, especially youth and elders.
- The community's most vulnerable people walk or use taxis; and taxi fares are expensive for elders, people on social assistance and families. People are given vouchers for medical visits, but struggle to afford trips for other purposes such as accessing services and visiting family.
- Visitors usually take taxis or walk, and it can be difficult for people with mobility issues. An airport shuttle (could be shared) would be good for visitors. Will need to consider impacts of growing cruise ship industry in the community.
- Children are bussed to and from school; elementary students are also bussed home at lunch. This impacts traffic as parents need to go home to meet children.
- There are several employers that pick employees up for work in a shuttle. This used to be more common but has decreased, as more people own their own vehicle.

Roads, Intersections and Congestion

- Traffic congestion has increased over the last 10 years and many key intersections get backed up during the morning, lunch, and afternoon "rush minutes". The existing network was not designed for the current level of vehicle use.
- In the online survey, over 40% of the suggestions for improvements were related to roads.
- Many of the comments across all engagement methods were related to challenges and congestion at key intersections and along specific roads.
- Intersections that participants flagged for improvement are Federal Road and Mivvik Street (Four Corners), the hospital access on Niaqunngusiariaq (at Queen Elizabeth), the access to Plateau at

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Saputi Road, and Queen Elizabeth Way at Kuugalaaq Street near DJ Specialties. Potential solutions suggested by participants were varied and included traffic lights, turning lanes, crossing guards, roundabouts, and re-aligning roads.



Figure 8: The Four Corners intersection

- Many comments suggested adding new road connections to improve traffic flow. This could include a bypass from Federal Road to Niaqunngusiariaq Street, a connection between the Plateau and the Road to Nowhere, and a second access from Lower Plateau (Qulliq Court) to Federal Road.
- Niaqunngusiariaq Road from the hospital to Federal Road has lots of traffic, pedestrians, vehicles making turns, and access to busy destinations. This section was described as needing to be re-designed and improved.
- There is appetite to consider making some streets one way to give more space and improve circulation.

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- The new airport has changed the traffic patterns through the core. For all future development, it will be important to consider impacts that these changes will have on the transportation network during the planning and approval stage.
- Better maintenance is needed as potholes, ruts, mud, and dust are a problem. Badly maintained roads are hard on vehicles.
- Consider paving the community's busiest roads. People requested paving specifically for the Niaqungusiariaq Road to Apex, the Akilliq Drive to the deep sea port, and Ikaluktuutiak Drive.
- Need to consider snowplowing processes and prioritization, taking into consideration the areas where drifting is frequent, in an effort to keep residents safe and traffic flowing.
- Need to consider a change to the system where children get bussed home at lunch time; this leads to lots of extra traffic and the lunch time rush.

Safety

- Many people voiced concerns about safety, especially for pedestrians.
- Participants feel that there are dangerous sections of road and where it is dark and there is no sidewalk or shoulder to separate vehicles from walkers. Improvements for pedestrians are needed in the core area, near the hospital and schools, and at the intersection near DJ Specialties.
- People voiced concerns about speeding and suggested that there could be more enforcement of speed limits. Improved driver education is needed to make sure all drivers are following the rules of the road.
- Better lighting is needed along key pedestrian routes and at busy intersections.
- Some people have concerns about the taxi service, feeling that taxi drivers are not following the traffic rules and are driving aggressively. Others feel that vulnerable people including single women and children may be at risk when travelling alone in taxis.
- Not many people are getting around by bike and there is a feeling that road shoulders are not wide enough to accommodate cyclists safely. Also, cyclists need to better understand the rules of the road.
- During storms it is important to keep plows on the road until the school busses have delivered children and are off the road.
- High access vault at the corner of Ikaluktuutiak Drive and Mivvik Street blocks views and is dangerous. (It is noted that this has been re-installed such that it no longer obstructs the intersection; however, it is included in this list because it was a theme which came up in the engagement process).
- School bus stops need to be improved for safety.

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- Allowed speeds are too fast in some areas and some drivers use cell phones while driving. Should provide driver training and public education.
- Unwritten Iqaluit rules of the road mean that drivers will stop to let others in randomly and at mid-block locations. Some people feel that this is dangerous and contributes to congestion.

Pedestrian Routes and Access

- The community is very walkable and improving conditions for pedestrians may help to encourage walking, which will reduce traffic congestion.
- Improvements are needed to make the system safer for pedestrians. Adding sidewalks along busy stretches would improve access for pedestrians. Crosswalk signs and lights at busy intersections are also needed.
- With each new building and residential development, it is important to consider how pedestrians will be accommodated. Sidewalks should be required in the core area.
- People prefer to use off-road trails to walk between neighbourhoods; these should be added and formalized where possible. Routes chosen should be short cuts where possible.
- Need to consider how best to separate pedestrian areas from the roadway. There are now some sidewalks and this network should be expanded throughout the core. Some streets have wooden bollards to separate pedestrian area (many of which have since been replaced with flex bollards). This may need to be redesigned and/or replaced. In residential areas, there should be a wide shoulder for walking.
- Snow should be cleared from shoulders, sidewalks, and separated paths. Snowbanks should not be left where they can be a barrier to walkers, especially for elders and those with mobility challenges.
- Better maintenance throughout the year is needed for key pedestrian routes. There should be consideration with respect to how to improve the drainage system and reduce dust.
- Improved signage would be helpful for visitors.

Transit and Taxis

- Taxi company has made some changes which are perceived favourably, and many people are happy with the new mobile app.
- Some people are not satisfied with the taxi service. Concerns include: the price is too high, the vehicles are run down and not clean, the service is not reliable, the cars make too many stops, the cars do not have winter tires, and the drivers do not help elders. Some people also do not feel safe using the taxi service.

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- 56% of survey respondents feel that taxi fares are too high. Taxi fares add up quickly for a family, for those who take them daily, or for a trip with multiple stops. Some people believe that the taxis should move to a meter-based system.
- Nearly 70% of survey respondents would consider using transit if it was available. A significant percentage of respondents feel that the fare should be between \$2 and \$4.
- People feel believe that public transit would help relieve traffic. A previous attempt did not work so a good plan is needed for a system that will work for Iqaluit. A transit system must be efficient and affordable, and complement the taxi service. The transit system could be valuable particularly during peak times.
- A hybrid transit system might be considered with on-call options for off-peak times. Transit service should include stops at key community destinations including stores, recreation facilities, residential areas, hospital and health offices, the city centre, social housing, and the location of important services.
- A hotel shuttle would be helpful for visitors.

Snowmobiles and ATVs

- There is a network of known trails that snowmobiles use. Access to key routes is very important, especially for getting out on the land.
- Motorized use trails need to be formalized, protected, and signed. There are some crossings that are signed, but more signs are needed to keep everyone safe.
- Need to consider the snowmobile routes when plowing snow on the roads, as leaving berms can make it difficult for snowmobiles to access trails.
- Parking lots should include space for ATVs and snowmobiles.
- There could be access to specific funding to improve roads or trails that provide access to the land.
- A formal and current map of snowmobile routes should be developed and kept up to date. Snowmobile drivers also need to do a better job of following the rules - education and enforcement are needed.
- Snowmobile routes should be sensible and safe and should avoid going too close to people's houses.

Parking

- There are problems in parking areas at many key community destinations including Northmart, Arctic Ventures, and the Aquatic Centre.
- Back-in parking in the core area can be dangerous for pedestrians.

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- The parking at the airport is not big enough; the stalls are too small and there is limited space. Airport traffic is growing, but there is no space to expand.
- Specific parking areas for snowmobiles and ATVs are needed at stores.
- Plug-in stalls are needed for employees.

Movement of Goods

- Deep sea port will mean that goods will not be arriving in the centre of the city; this may relieve some congestion.
- The new deep sea port will also impact how goods are delivered, as we may be able to move away from the plywood crate system to different containerized system.
- There has been some discussion about using airships for the delivery of goods and to support mining, but this is likely many years away.

3.0 ROADWAY NETWORK

3.1 EXISTING ROADWAY NETWORK

The City of Iqaluit has a local road system that connects to the nearby community of Apex in the east to the Sylvia Grinnell Territorial Park in the west. The road system is local and is not connected to a highway system or any other nearby settlements in the Territory.

Niaqunngusiariaq Road (also known as the Road to Apex) forms a key east-west spine connecting the City with the nearby community of Apex. Other key roadways include Queen Elizabeth, Mivvik Street, and Federal Road.

All key intersections in the City of Iqaluit currently operate as stop-controlled intersections. There are currently no traffic control signals present in the City.

City of Iqaluit roadways area intersections and existing traffic control are illustrated in Figure 9. Notably, all intersections in the City do not have defined turning lanes at present.

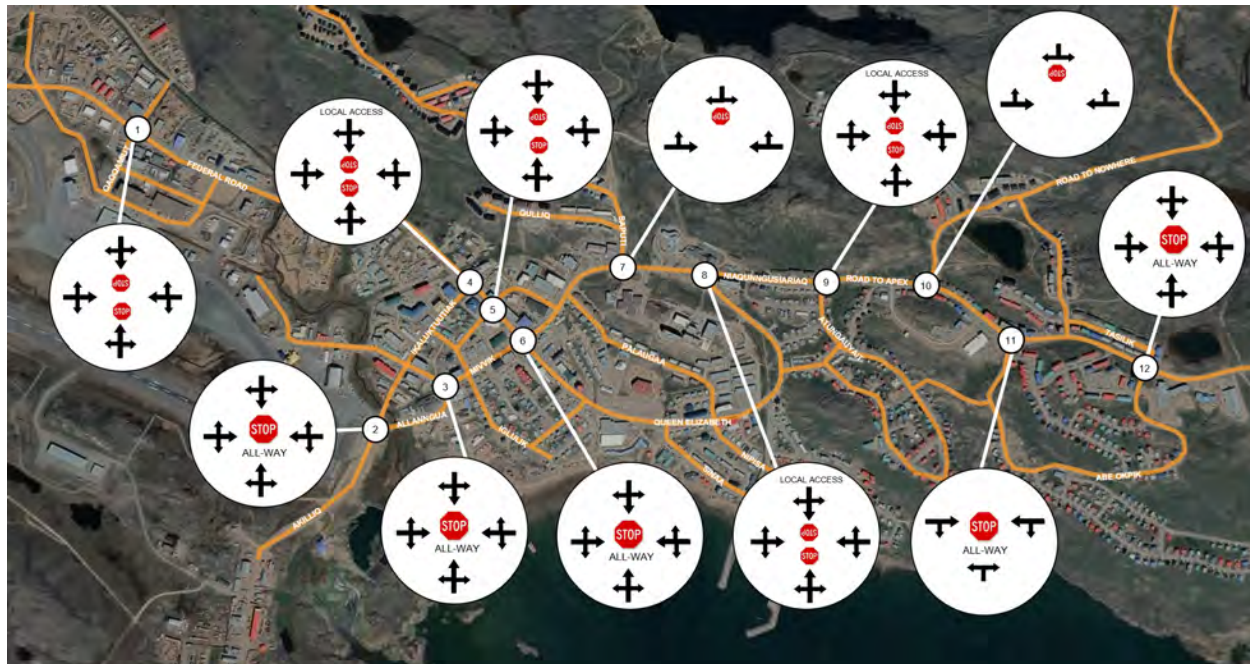


Figure 9: Existing Intersection Lane Geometry and Traffic Control

3.2 TRAFFIC COUNTS

Updated traffic count data was collected at key intersections to evaluate current traffic demands and to help establish a baseline of existing operating conditions. Turning Movement Count (TMC) data was collected in 2021 for the following intersections:

1. Federal Road / Ungalliqaat-Qaqqamiut
2. Akilliq/Ikaluktuutiak Drive / Allanngua
3. Mivvik Street / Allanngua
4. Federal Road / Ikaluktuutiak Drive
5. Federal Road / Nunavut
6. Federal Road-Queen Elizabeth / Mivvik Street-Niaqunngusiariaq (The Four Corners intersection).
7. Niaqunngusiariaq (Road to Apex) / Saputi Road (The High School Intersection).
8. Niaqunngusiariaq (Road to Apex) / Queen Elizabeth (The Hospital Intersection).
9. Niaqunngusiariaq (Road to Apex) / Atungauyait

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10. Niaqunngusiariaq (Road to Apex) / Road to Nowhere

11. Niaqunngusiariaq (Road to Apex) / Abe Okpik

12. Niaqunngusiariaq (Road to Apex) / Tasilik-Abe Okpik

Updated 2021 traffic count data was cross-referenced with historical 2017 counts at one sample intersection. 2017 count data at the intersection of Federal Road-Queen Elizabeth / Mivvik Street-Niaqunngusiariaq (The Four Corners intersection) was extrapolated to 2021 levels through an assumed annual growth rate of 2% per year up to 2021. A comparison of the two data points determined that updated 2021 count data is within 5% of grown historical 2017 counts, indicating that current traffic demands are representative of pre-pandemic activity (i.e. COVID-19).

Existing traffic volumes are summarized in Figure 10.

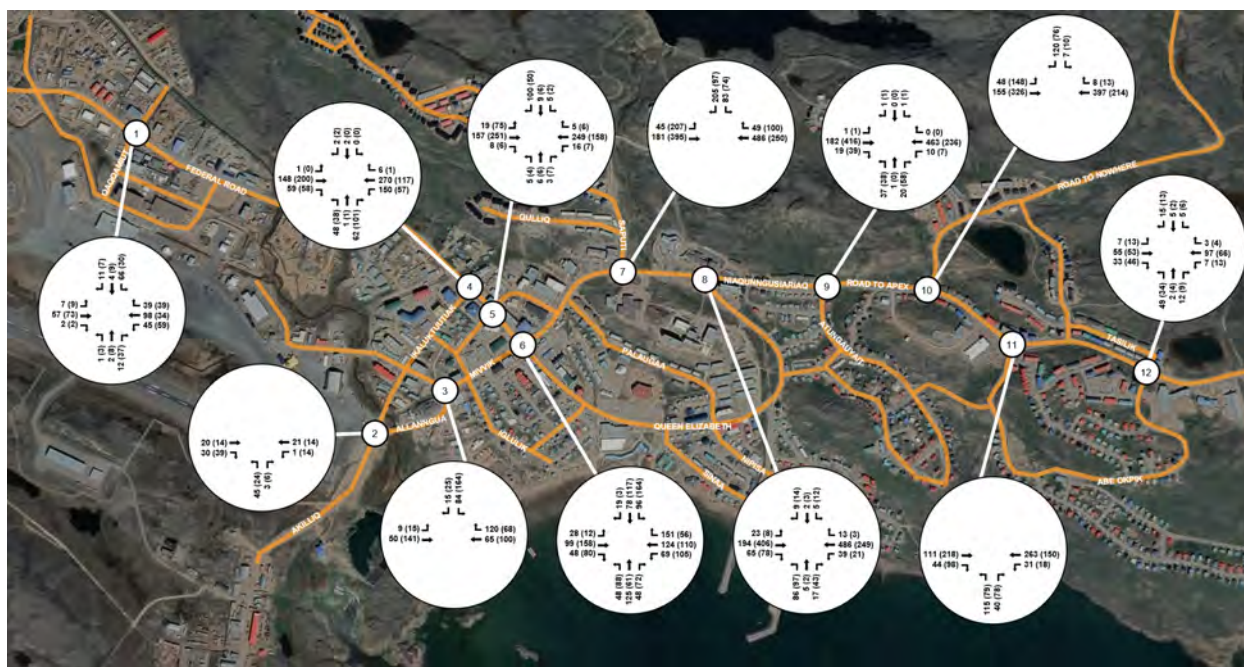


Figure 10: Existing AM Peak Hour (PM Peak Hour) Traffic Volumes

3.3 EXISTING OPERATIONS ANALYSIS

In order to establish a baseline of operating conditions, an assessment of the study area intersections was undertaken to determine the operational characteristics under current conditions. Intersection operational analysis was facilitated with Synchro 10.0™ software package.

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Roadway Network

The study area intersections were modeled with the existing geometry and traffic control. Capacity analyses are evaluated based on a Level of Service (LOS) rating for “average vehicular delay”. The LOS ratings range from an LOS rating of A (excellent) to and LOS rating of F (poor).

Table 3 outlines the LOS thresholds based on the methodologies of the Highway Capacity Manual (HCM).

Table 3 – Intersection Level of Service Criteria

| LOS | Control Delay Per Vehicle (seconds) | |
|-----|-------------------------------------|------------------------------|
| | Signalized Intersection | Stop-Controlled Intersection |
| A | ≤ 10 | ≤ 10 |
| B | >10 and ≤20 | >10 and ≤15 |
| C | >20 and ≤35 | >15 and ≤25 |
| D | >35 and ≤55 | >25 and ≤35 |
| E | >55 and ≤80 | >35 and ≤50 |
| F | > 80 | > 50 |

From a traffic operations perspective, LOS ratings ranging between an LOS of A through to an LOS of D are considered acceptable.

For stop-controlled intersections, the LOS for the approach with the greatest delays was reported. A LOS rating of “D” or better is considered acceptable. Other parameters used to identify critical intersection movements that may require mitigation include:

- Intersection movements operating at traffic volume to roadway capacity (v/c) ratios of 0.90 or higher (LOS E)
- Intersection movements operating with average delays of 35 seconds or more (LOS E) for stop-controlled intersections, and 55 seconds or more (LOS E) for signalized intersections.
- 95th percentile queues that exceed available storage capacity at auxiliary turning lanes.

Based on the updated 2021 turning movement count data, a traffic operational analysis was completed. Under existing conditions, the majority of study area intersections are currently operating with acceptable overall levels of service (LOS) ratings of LOS D or better during the AM and PM peak periods.

Under existing PM peak conditions, the intersection of Niaqunngusiariaq Road (Road to Apex) and Saputi Road is currently operating with a LOS rating of E in the southbound approach. This indicates that this intersection is currently operating near capacity in its current configuration.

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Existing intersection level of service ratings are summarized in Figure 11.

Detailed LOS output summaries are included in **Appendix A**.

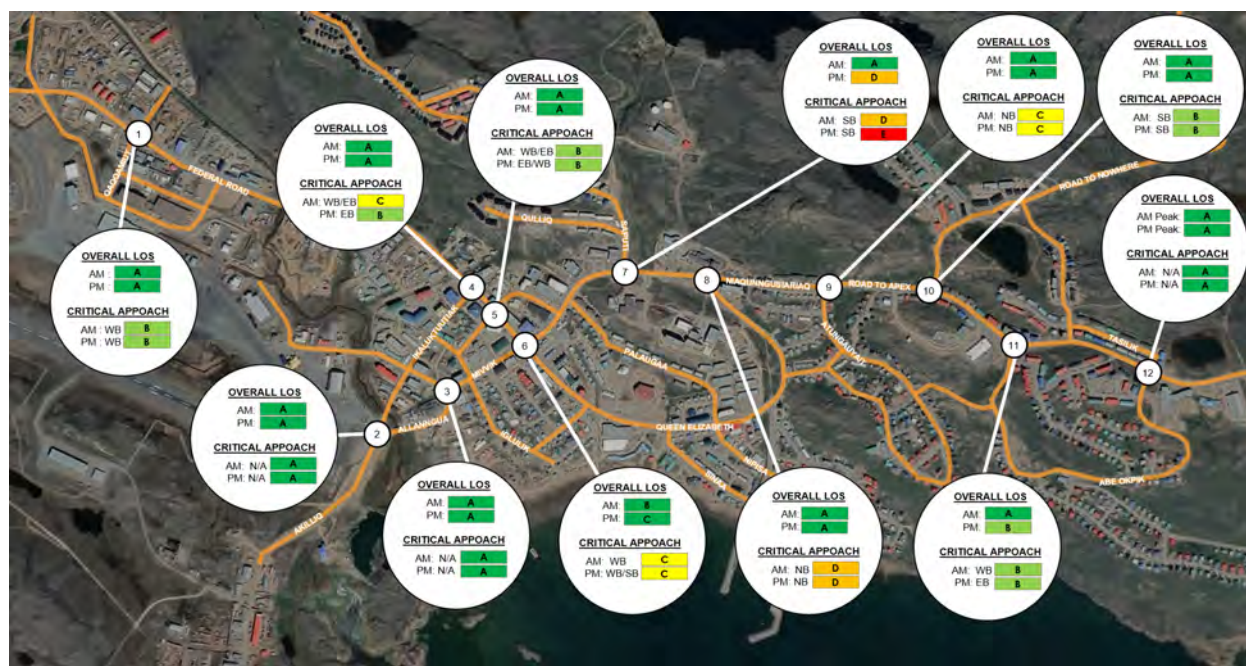


Figure 11: Existing Intersection LOS Summary

Note: WB, EB, NB, and SB refer to the westbound, eastbound, northbound, and southbound approaches respectively.

3.4 FUTURE CONDITIONS

Future transportation demand forecasts in the City of Iqaluit were developed for the 2030 Horizon Year. To inform the future traffic growth forecasts, background transportation studies for planned developments were reviewed and served as a baseline to estimate future traffic growth as well as identify any planned transportation network improvements.

3.4.1 Planned Development Growth and Roadway Improvements

Studies related to future development in the City of Iqaluit were reviewed as part of the development of the TMP. The background studies were incorporated into the development of the future 2031 traffic growth forecasts and were used as a basis to identify anticipated roadway connections and improvements.

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Key growth areas in the City of Iqaluit include developments to the north along Federal Road, development growth along Niaqunngusariaq Road west of Apex, and development in the vicinity of Road to Nowhere near Dead Dog Lake.

A summary of future development incorporated into the planned network is included in **Appendix B**.

Planned roadway connections identified in the City's General Plan were identified and accounted for as part of the future 2030 transportation scenarios. In addition, localized intersection improvements identified in a number of stand-alone studies were also accounted for as part of the future 2030 transportation scenarios. The planned Major Road Network improvements identified in the General Plan are:

- The Four Corners Bypass Road: This road would provide a direct connection between Niaqunngusariaq (Road to Apex) and Federal Road. The alignment in the eastern portion follows the general alignment of the road between the Aquatic Centre (Building 900) and the Nunavut Justice Centre (Building 510). For the western portion of the road, of the three alignment options discussed in the Federal Road Development Area Transportation Study (Section 2.2.4), it has been determined that the preferred or most likely option for implementation is connecting the bypass road to Ulu Lane.
- Future Development Area B roadway connection to Road to Apex; there is a planned connection between Road to Nowhere and Road to Apex through Future Development Area B.
- Access roadway to Future Development Area A is also anticipated at the newly formed intersection, connecting Future Development Area A to Road to Apex. This may not occur within the 2030 TMP horizon.

Table 4 identifies the localized intersection improvements that were subject to stand-alone studies and were considered for the 2030 planning horizon.

Table 4: Localized Intersection Improvements

| | Location | Document | Improvement |
|---|---|---|--|
| 1 | Queen Elizabeth Way / Road to Apex | Apex Road & Hospital pedestrian crossing RFP 2021 | Pedestrian Crosswalk with flashing lights (Type C) and roadway pavement markings on Road to Apex. |
| 2 | Four Corners Intersection | Traffic Lights PIC Boards, 2009 FRDA Transportation Study, Sep-5-2018 | Traffic Signals in addition to left turn storage lanes in all directions. Identifies signalization by the year 2020. |
| 3 | Road to Apex at Saputi Road (referred to as the High School intersection) | Traffic Lights PIC Boards, 2009 FRDA Transportation Study, Sep-5-2018 | Addition of an eastbound left turn storage lane. Identifies signalization by the year 2025. |
| 4 | Road to Apex at Queen Elizabeth Way (referred to as the Hospital Intersection). | Traffic Lights PIC Boards, 2009 | Introduction of a northbound and a southbound left turn storage lane |

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The Planned Developments and assumed Roadway Network Improvements are illustrated in Figure 12. While Future Development Areas A and B are not anticipated to be completed by 2030, they have been considered nonetheless as we imagine an ‘eventual’ growth scenario for a year to-be-determined. Although the analysis focuses on 2030, these additional developments have been considered to provide further clarity for the City’s longer term transportation needs, and to account for all growth and development possibilities as a contingency, in recognition that conditions often evolve differently from what we anticipate. In general, it is recommended that the City treat the Transportation Master Plan as a ‘living document’. This means that major transportation investments should be implemented as they are required. It is likely that not all long-term recommendations will be necessary to implement by 2030, and conversely, it is possible that some medium or long-term recommendations may need to be accelerated to the short or medium terms accordingly, if future growth is faster than forecasted.

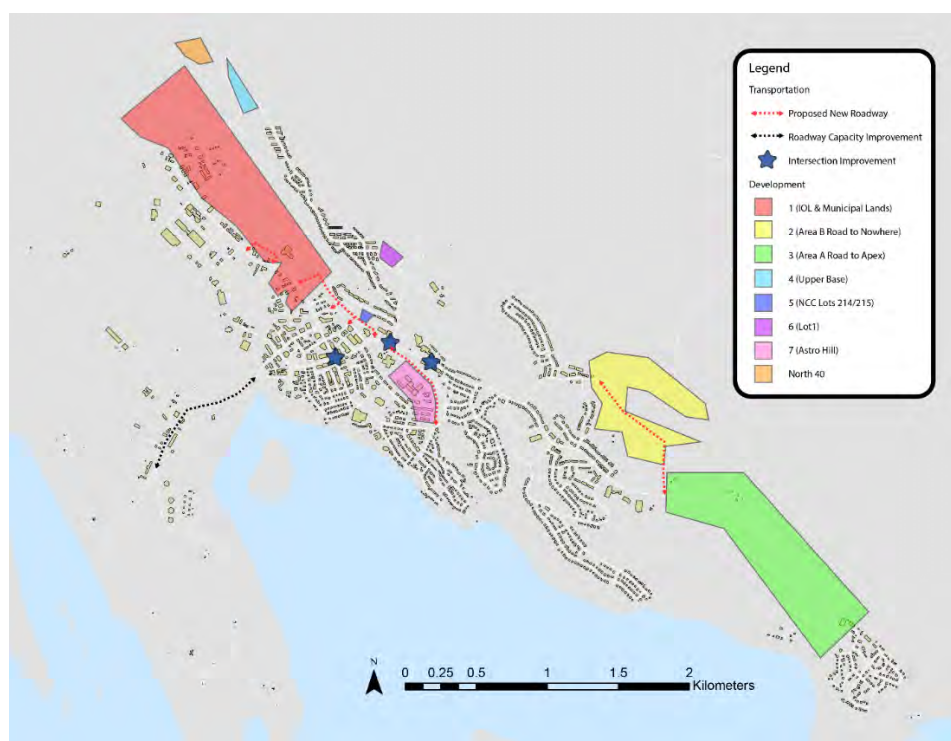


Figure 12: Planned Developments and Roadway Network Improvements

3.4.2 2030 Future Scenarios

Future traffic forecasts were developed for the 2030 horizon year and assessed for the following scenarios:

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Scenario 1 (Do Nothing) – assumes future 2030 transportation demands on the existing transportation network.

Figure 13 summarizes the assumed 2030 transportation network under Scenario 1.

Figure 14 summarizes projected 2030 future volumes under Scenario 1.

Scenario 2 (Planned Network Improvements) – assumes future 2030 transportation demands with the planned network improvements to support known development as outlined in Section 3.4.1.

Figure 15 summarizes the assumed 2030 transportation network under Scenario 2.

Figure 16 summarizes projected 2030 future volumes under Scenario 2.

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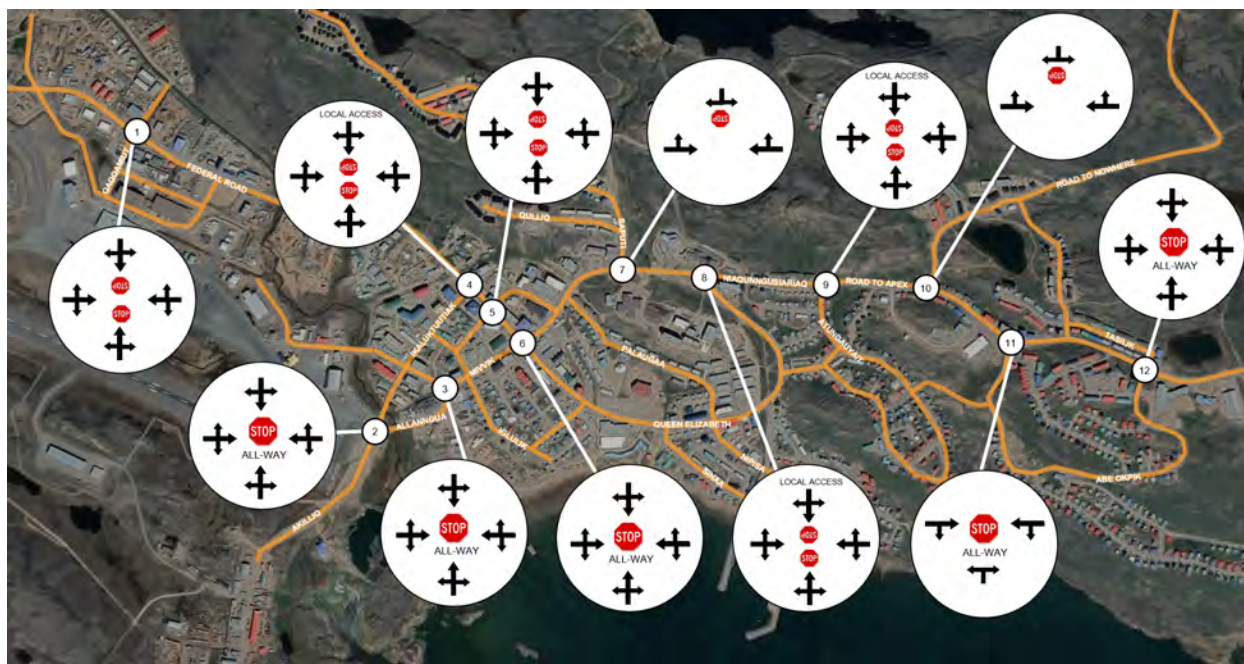


Figure 13: Future 2030 Intersection Lane Geometry and Traffic Control (Scenario 1)

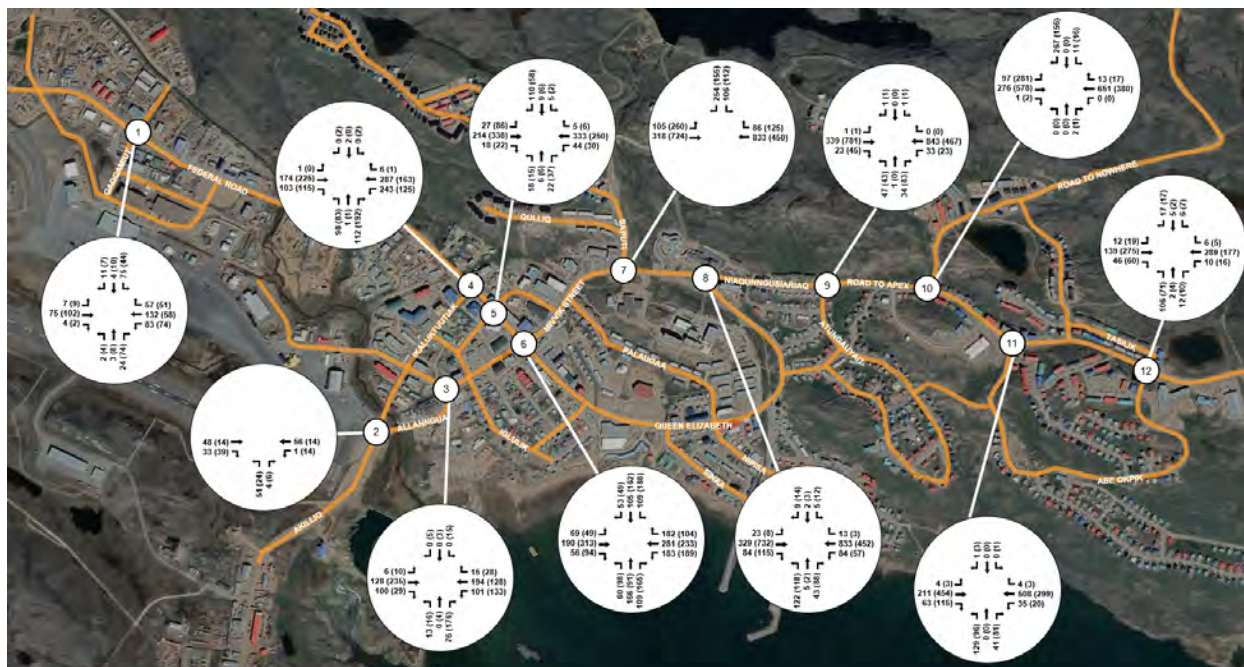


Figure 14: Future 2030 AM Peak Hour (PM Peak Hour) Traffic Volumes for Scenario 1

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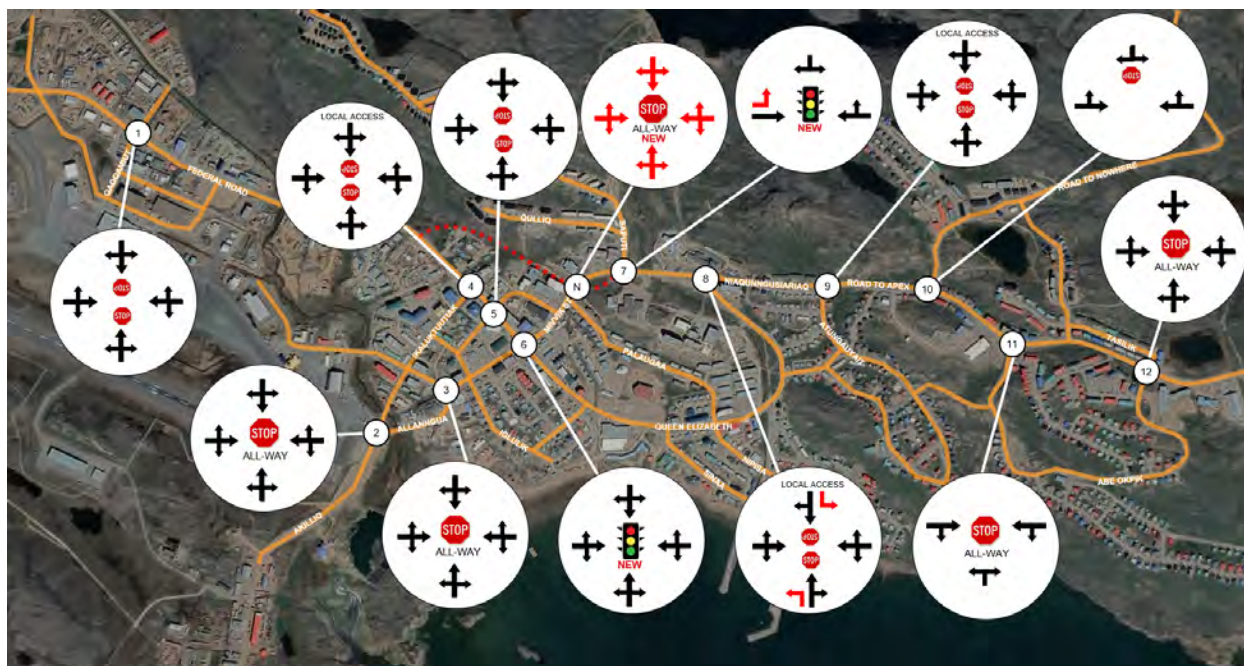


Figure 15: Future 2030 Intersection Lane Geometry and Traffic Control (Scenario 2)

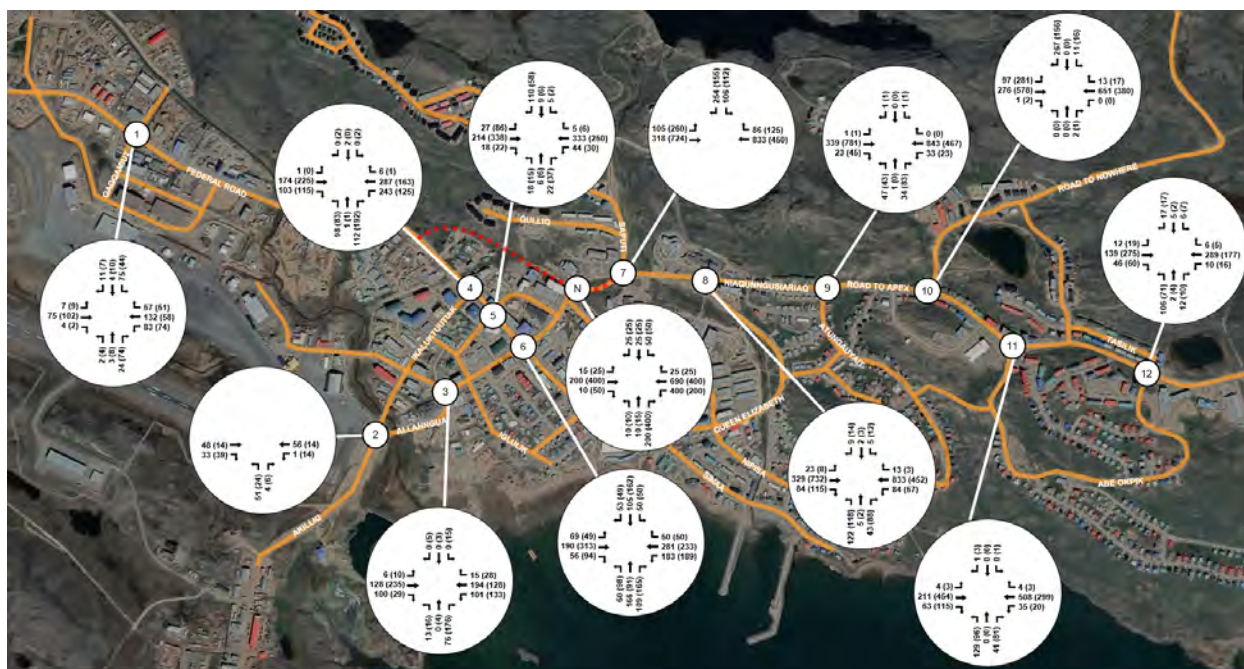


Figure 16: Future 2030 AM Peak Hour (PM Peak Hour) Traffic Volumes for Scenario 2

3.4.3 2030 Future Operational Analysis

Traffic operational analysis was undertaken for various 2030 growth scenarios using the Synchro 10.0™ software package.

Scenario 1 (Do Nothing):

Under the 'Do Nothing' future 2030 scenario, a number of intersections and corridors within the City of Iqaluit are anticipated to reach and operate at or above capacity. Key intersections that are projected to reach capacity under this scenario include:

1. **Federal Road / Ikaluktuutiak Drive:** Under the current two-way stop control configuration, this intersection is projected to operate at or close to capacity with an LOS rating of F on the minor approaches during both the AM and PM peak periods.
2. **Queen Elizabeth/Federal Rd & Mivvik Street/Niaqunngusiariaq (Four Corners):** Under the existing roadway and intersection configuration, this intersection is projected to operate above capacity with all movements operating with an LOS rating of F during the AM and PM peak hours.
3. **Niaqunngusiariaq / Saputi:** Under the current two-way stop control configuration, this intersection is projected to operate at capacity with an LOS rating of F on the southbound minor approach during the AM and PM peak periods.
4. **Queen Elizabeth / Niaqunngusiariaq:** Under the current two-way stop control configuration, this intersection is projected to fail with an LOS rating of F and excessive delays and queues on the northbound approach during the AM and PM peak periods.
5. **Atungauyait / Niaqunngusiariaq:** Under the current two-way stop control configuration, this intersection is projected to operate at or close to capacity with LOS ratings of E and F on the minor approaches during the AM and PM peak periods.
6. **Niaqunngusiariaq / Road to Nowhere:** Under the current two-way stop control configuration, this intersection is projected to operate at or close to capacity with an LOS rating of F on the minor southbound approach during the AM peak period.

Intersection level of service (LOS) summary outputs for Scenario 1 (Do Nothing) are included in **Appendix A**.

Future 2030 intersection level of service ratings under Scenario 1 (Do Nothing) are summarized in Figure 17.

Based on the findings above, it is anticipated that the existing road network does not have enough capacity to accommodate projected growth in the City of Iqaluit. Planned road network improvements will be required to be in place by the 2030 horizon to accommodate growth.

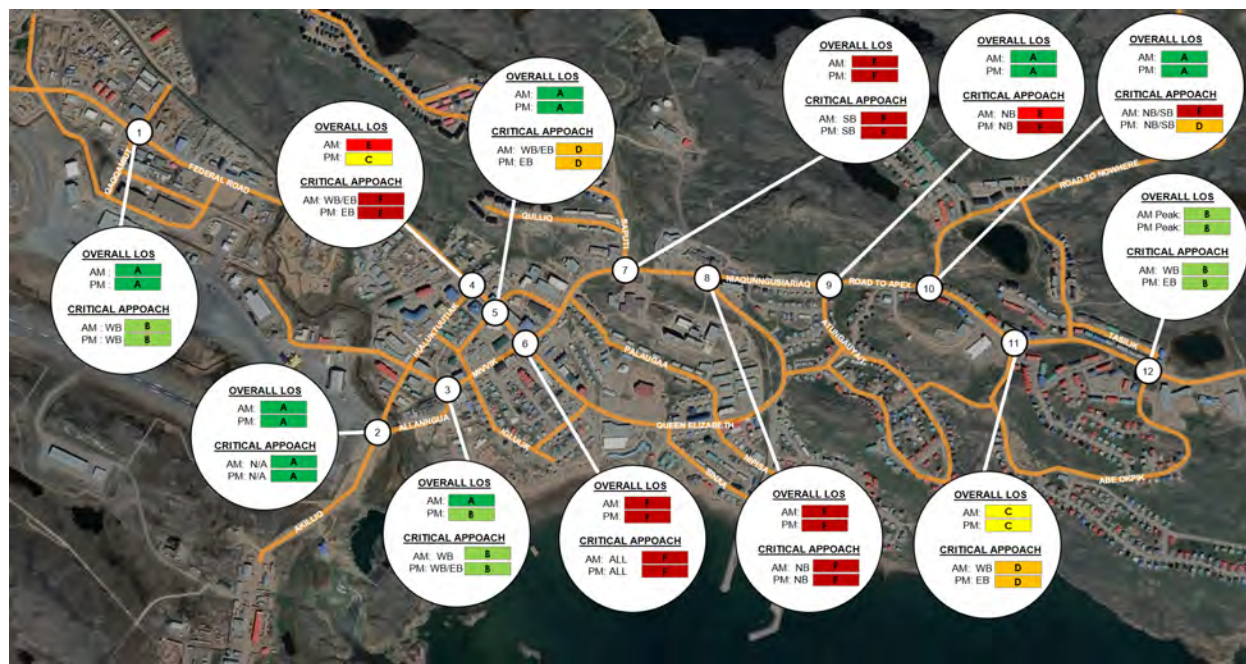


Figure 17: Future 2030 Intersection LOS Summary (Scenario 1 – Do Nothing)

Scenario 2 (Planned Network Improvements):

Under the 'Planned Network Improvements' future 2030 scenario, future traffic growth was assessed with the planned roadway and intersection improvements assumed to be implemented as outlined in Section 3.4.1. Under the 'Planned Network Improvements' future 2030 scenario, the following capacity issues were identified:

1. **Federal Road / Ikaluktuutiak Drive:** Under the proposed roadway network, this two-way stop-controlled intersection is projected to operate with acceptable overall LOS ratings. However, delays are projected to occur on the westbound approach during the AM peak period. Additional mitigation measures, such as the conversion from a two-way stop to an all-way stop controlled intersection, may be warranted to improve future operations.
2. **Queen Elizabeth/Federal Rd & Mivvik Street/Niaqunngusiariaq (Four Corners):** Under the proposed signal operations, this intersection is projected to operate acceptably with an overall LOS rating of C during the AM and PM peak periods. The westbound (WB) approach is projected to operate with a LOS rating of D. The intersection is projected to operate acceptably under this scenario as a significant proportion of future growth traffic is anticipated to utilize the future Bypass Road connection. It is recommended that traffic volumes and operations be monitored at this intersection to ensure adequate operations in the future.

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3. **Niaqunngusiariaq / Saputi:** The proposed roadway network improvement at this intersection includes the addition of an eastbound left-turn lane with storage and traffic signals. With these improvements, the intersection is projected to have improved operations. However, delays are projected to occur on the southbound approach (i.e. vehicles heading southbound on Saputi Road) during the AM peak period with this approach projected to operate close to its critical threshold. Additional improvements above what was assumed to occur may warranted at this intersection. This could include widening of the southbound approach to allow for separate southbound right and left turn lanes at the intersection.
4. **Queen Elizabeth / Niaqunngusiariaq:** The proposed roadway network improvement at this intersection includes the addition of dedicated northbound and southbound left-turn lanes with storage under the existing two-way stop control configuration. Under the current two-way stop control configuration, this intersection is projected to fail with an LOS rating of F and excessive delays and queues on the northbound approach during the AM and PM peak periods. Additional improvements above what was assumed to occur may warranted at this intersection. This could include the installation of traffic control signals.
5. **Atungauyait / Niaqunngusiariaq:** No improvements were identified at this intersection as part of the Scenario 2 Network. Under the current two-way stop control configuration, this intersection is projected to operate at or close to capacity with LOS ratings of E and F on the minor northbound approaches during the AM and PM peak periods.
6. **Niaqunngusiariaq / Road to Nowhere:** No improvements were identified at this intersection as part of the Scenario 2 Network. Under the current two-way stop control configuration, this intersection is projected to operate at or close to capacity with LOS ratings of D and E on the minor approaches during the AM and PM peak periods.
7. **Niaqunngusiariaq / Bypass Road Connection at Kangiq & Iniq Road:** Under the proposed configuration for the new bypass connection, which is assumed to be stop-controlled on all approaches, this intersection is projected to operate at capacity with LOS ratings F during the AM and PM peak periods. This indicates that the future Bypass Road intersection at Niaqunngusiariaq will require traffic control signals under the 2030 (and beyond) full build out scenario.

Intersection level of service (LOS) summary outputs for Scenario 2 (Planned Network Improvements) are included in **Appendix A**.

Future 2030 intersection level of service ratings under Scenario 2 (Planned Network Improvements) are summarized in Figure 18.

Based on the findings above, it is anticipated that the planned road network improvements under Scenario 2, which were identified through background studies, will not have sufficient capacity to accommodate the projected growth in the City of Iqaluit.

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It is anticipated that under a full build out scenario by 2030, additional roadway capacity improvements, above what has been identified as required to date, will be required by the 2030 horizon. It is important to note that the projected road network capacity limitations identified are associated with full development build out by the year 2030 and will only be required to accommodate development growth.

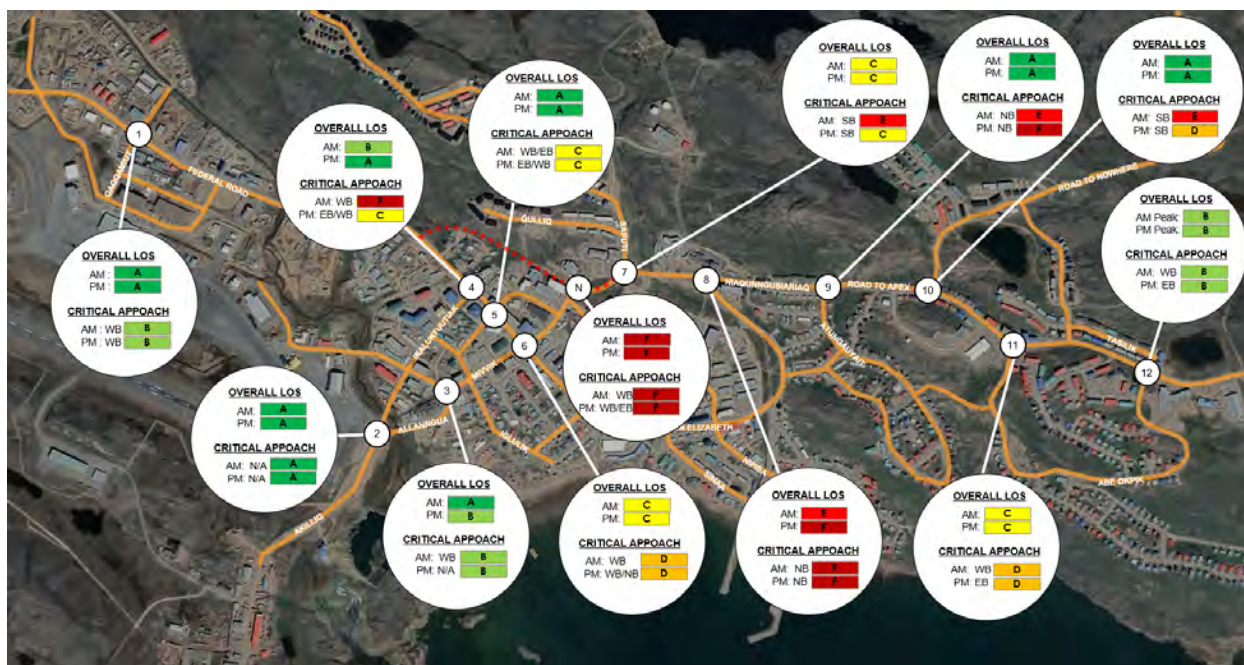


Figure 18: Future 2030 Intersection LOS Summary (Scenario 2 – Planned Network Improvements)

3.4.4 2030 Future Mitigation Measures

To address the projected capacity issues under a 2030 (and beyond) full build out scenario, additional road network mitigation measures were evaluated under a new **Scenario 3 (Ultimate Road Network)**, which identifies additional transportation network improvements needed to support the assumed full build out growth scenario for the City of Iqaluit for the 2030 (and beyond) horizon year.

In addition to the assumed road network improvements outlined in Scenario 2, the following road network improvements were assumed and evaluated for Scenario 3:

Scenario 3 (Ultimate Road Network):

1. **Federal Road / Ikaluktuutiak Drive:** Conversion from a two-way stop to all-way stop controlled intersection to address anticipated capacity issues.

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2. **Niaqunngusiariaq / Saputi:** In addition to the installation of traffic control signals and the addition of an eastbound left-turn lane with storage, the addition of exclusive southbound left and right turn lanes was assumed.
3. **Queen Elizabeth / Niaqunngusiariaq:** In addition to the installation of dedicated northbound and southbound left-turn lanes with storage, the installation of traffic control signals was assumed at this intersection.
4. **Atungauyait / Niaqunngusiariaq:** No improvements were identified at this intersection as part of the Scenario 2 Network. Under the Scenario 3 Network, the installation of traffic control signals was assumed. The conversion of the existing two-way stop control configuration to an all-way stop control was reviewed and deemed unfeasible due to the excessive queues and delays anticipated to occur on Niaqunngusiariaq (Road to Apex).
5. **Niaqunngusiariaq / Road to Nowhere:** No improvements were identified at this intersection as part of the Scenario 2 Network. Under the Scenario 3 Network, the installation of traffic control signals and an exclusive eastbound left turn lane was assumed. The conversion of the existing two-way stop control configuration to an all-way stop control was reviewed and deemed unfeasible due to the excessive queues and delays anticipated to occur on Niaqunngusiariaq (Road to Apex).
6. **Niaqunngusiariaq / Bypass Road Connection at Kangiq & Iniq Road:** Under the Scenario 3 Network, the installation of traffic control signals was assumed at the new Bypass Road intersection with Niaqunngusiariaq (Road to Apex). In addition, a westbound auxiliary turning lane was assumed due to anticipated turning traffic demands.

Figure 19 summarizes the assumed 2030 (and beyond) ultimate road network under Scenario 3.

With the inclusion of the additional capacity improvements outlined under Scenario 3, all key study area intersections are projected to operate acceptably under 2030 (and beyond) future horizon demands.

It is anticipated that development growth in the City of Iqaluit will occur incrementally based on market conditions and may not be fully realized by the 2030 future horizon year. A number of the road network improvements identified are driven by growth and will only be required as the City of Iqaluit reaches the full build out conditions assumed in this TMP. As such, implementation timelines for these improvements are dependent on the timelines of the corresponding developments.

Intersection level of service (LOS) summary outputs for Scenario 3 (Ultimate Road Network) are included in **Appendix A**.

Future 2030 (and beyond) intersection level of service ratings under Scenario 3 (Ultimate Road Network) are summarized in Figure 20.

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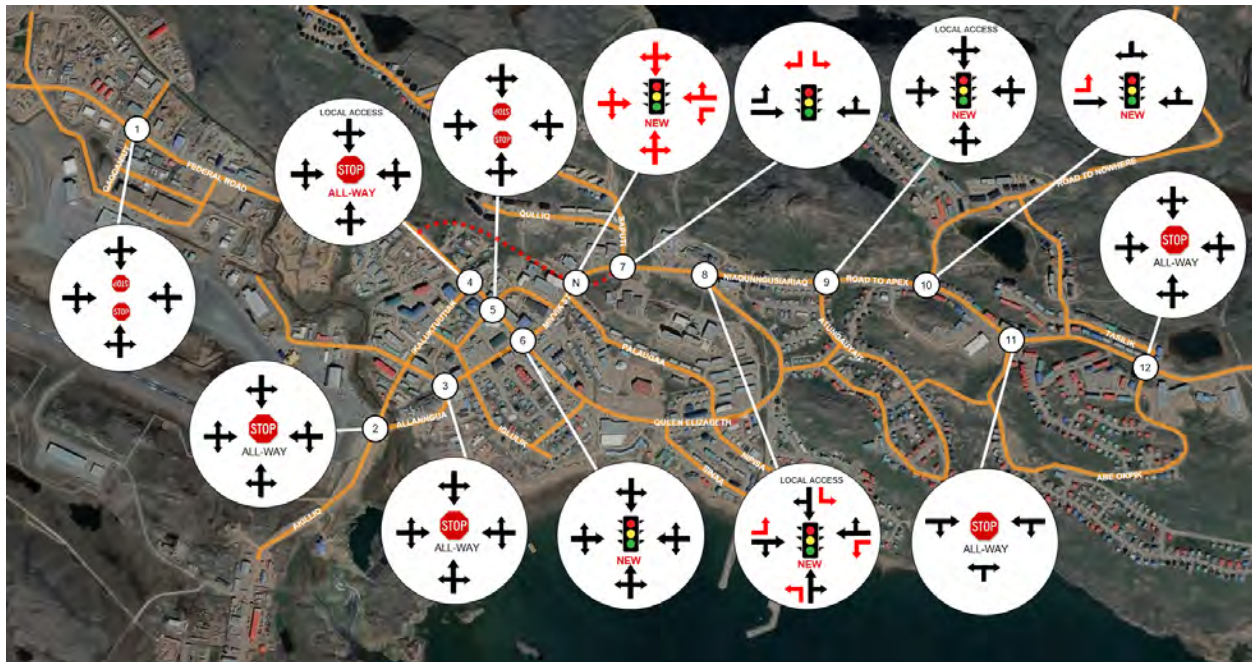


Figure 19: Future 2030 Intersection Lane Geometry and Traffic Control (Scenario 3)

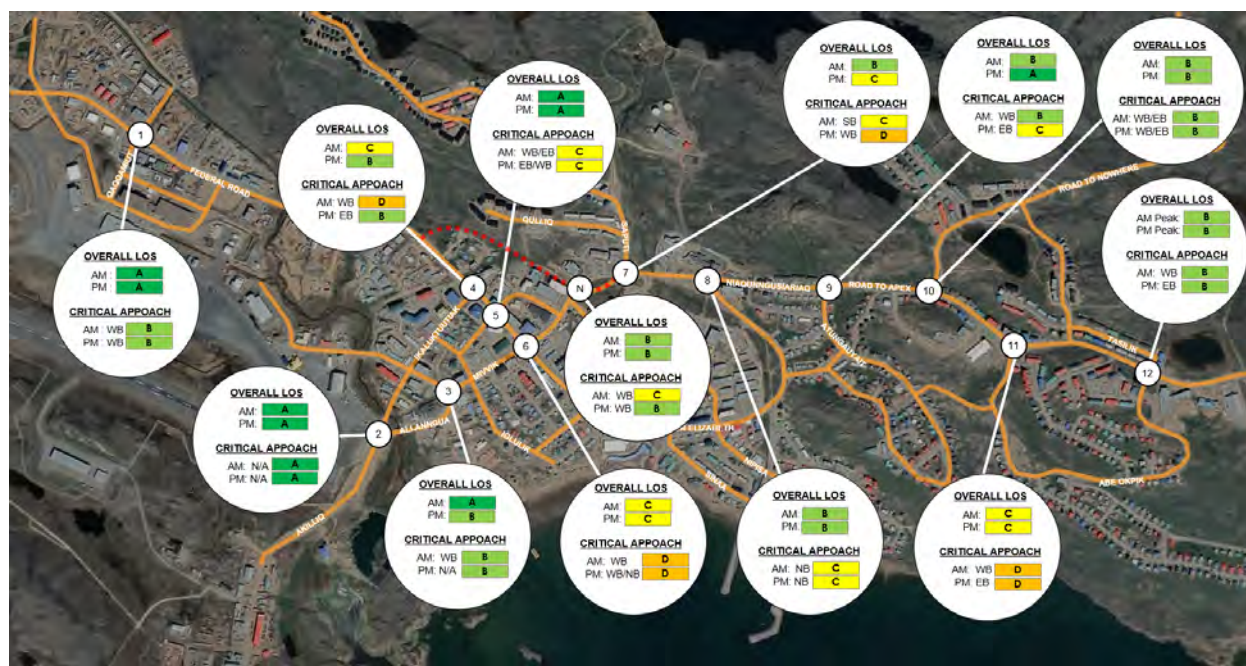


Figure 20: Future 2030 Intersection LOS Summary (Scenario 3 – Ultimate Road Network)

3.5 ROAD NETWORK RECOMMENDATIONS

It is anticipated that development growth in the City of Iqaluit will occur incrementally based on market conditions. As a result, the future land use assumptions adopted as part of the TMP may not be fully realized by the 2030 future horizon year.

The need for the road network improvements identified in this TMP are driven by development growth assumptions, this will require monitoring of proposed development applications and traffic count data in order to confirm the need and timing of road network improvements.

As part of the TMP, the need and timing of road network recommendations have been categorized as immediate, short-term, medium-term, or long-term. These are defined below:

Immediate: Recommended improvements are currently required to address existing capacity constraints.

Short-Term: Recommended improvements are anticipated to be required in the short-term to accommodate anticipated growth, likely within the next 5 years. Regular monitoring of traffic volumes and intersection operations is recommended to confirm timing of need.

Medium-Term: Recommended improvements are anticipated to be required by the 2030 horizon, largely dependent on the planned developments. Monitoring of proposed development applications and traffic volumes is recommended to identify timing.

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Long-Term: Recommended improvements are anticipated to be required under the full development build out scenario, including the build out of developments which may not necessarily come to fruition, such as Future Development Areas A & B. This is subject to actual development growth and is envisioned to occur beyond the 2030 time horizon.

A summary of road network improvements and timing is provided in Table 5.

Table 5: Summary of Road Network Improvements

| | Location | Improvement | Timing |
|---|--|--|---|
| 1 | Niaqunngusiariaq / Saputi | <p>Addition of an eastbound left turn storage lane and installation of traffic control signals.</p> <p>Addition of exclusive southbound left and right turn lanes.</p> | <p>Immediate: Improvements are currently required to address existing capacity issues.</p> <p>Medium-Term: As development growth continues to occur, the installation of southbound left and right turn lanes will be required.</p> |
| 2 | Queen Elizabeth / Niaqunngusiariaq | <p>Addition of northbound and southbound left turn storage lanes.</p> <p>Installation of traffic control signals, with eastbound left and westbound left turn storage lanes.</p> | <p>Short-Term: The northbound approach is currently operating at the acceptable capacity threshold of LOS D. Short term improvements include the addition of northbound and southbound left turn lanes to provide additional capacity.</p> <p>Medium-Term: As development growth continues to occur, the installation of traffic control signals with auxiliary lanes will be required.</p> |
| 3 | Queen Elizabeth/Federal & Mivvik / Niaqunngusiariaq (Four Corners) | <p>Installation of traffic control signals.</p> <p>Localized widening to accommodate left turn storage lanes on all approaches.</p> | <p>Immediate: Monitoring of intersection operations on a regular basis to assess safety and traffic flow capacity.</p> <p>Medium-Term: As development growth continues to occur, the installation of traffic control signals will be required.</p> <p>Long-Term: At full 2030 build out, the realignment of Niaqunngusiariaq and construction of the Bypass Road Connection will be required to accommodate future development growth, and help reduce traffic demands at the Four Corners intersection.</p> |

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| | Location | Improvement | Timing |
|---|---|--|--|
| 4 | Niaqunngusiariaq / Bypass Road Connection at Kangiq & Iniq Road | Construction of a Bypass Road connection between Federal Road and Niaqunngusiariaq. Installation of traffic control signals at the intersection of Niaqunngusiariaq and the Bypass Road connection. | Long-Term: At full 2030 build out, the construction of a Bypass Road connection between Federal Road and Niaqunngusiariaq will be required. The timing of this connection is tied to the level of development growth, particularly along Federal Road as part of the IOL and Municipal Lands Development. |
| 5 | Federal Road / Ikaluktuutiak Drive | Conversion from two-way stop control to all-way stop control. | Medium-Term / Long-Term: As development growth continues to occur, this conversion is recommended. The timing of this conversion is tied to the level of development growth, particularly along Federal Road as part of the IOL and Municipal Lands Development. |
| 6 | Atungauyait / Niaqunngusiariaq | Installation of traffic control signals. | Long-Term: At full 2030 build out, traffic control signals may be warranted at this intersection. The need for this improvement is tied to development growth, particularly in areas to the east in Area A (Road to Apex) and Area B (Road to Nowhere). |
| 7 | Niaqunngusiariaq / Road to Nowhere | Installation of traffic control signals and an eastbound left turn storage lane. | Long-Term: At full 2030 build out, traffic control signals and an eastbound left turn lane may be warranted at this intersection. The need for this improvement is tied to development growth, particularly in areas to the east in Area A (Road to Apex) and Area B (Road to Nowhere). |

A number of intersections are proposed to feature the addition of auxiliary turning lanes to accommodate traffic growth. It is recommended that the delineation of turning lanes at intersections be defined through the installation of lane control signs in accordance to the Manual of Uniform Traffic Control Devices for Canada (MUTCD).

3.6 TRAFFIC CONTROL WARRANTS POLICY

Using the Ontario Traffic Manual as an appropriate proxy, the all-way stop warrant policy described below describes the conditions under which all-way stop signs may be installed at an intersection. It should be

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noted that 'vehicles' referenced below includes automobiles, off-road vehicles (ATVs or snowmobiles), and bicycles.

The below all-way stop warrant policy is intended to be a starting point for the City of Iqaluit to build off of. It is recommended that the City use this information to build its own warrants policy, and it is recommended that the policy be reviewed on a regular basis for updates that might be needed.

Volume Warrants

The following warrants must all be met for the road type to proceed with all-way stop signs.

For arterial/collector roads:

- The road volume total for all intersection approaches should exceed 500 vehicles per hour for any eight hours of the day
- The combined total vehicular and pedestrian volume on the minor street should exceed 200 units per hour
- The volume split should not exceed 70/30 (percent), where the 70% represents vehicular volume on the major street and the 30% represents the volume of all vehicles and pedestrians on the minor street. (If the volume split does exceed 70/30 then a two-way stop would likely be more appropriate).

For local roads:

- The road volume total for all intersection approaches should exceed 350 vehicles for the highest hour recorded
- The volume split should not exceed 75/25 for three-way control or 65/35 for all-way control, where volume is defined as vehicles only

Collision Warrants

An accident frequency of four relevant collisions per year, over a three-year period, should be considered the threshold to implement all-way stop signs. Relevant collisions include those which are susceptible to relief through all-way stop sign implementation, such as right-angle or turning-type collisions.

Exceptions

All-way stop signs should not be implemented under the following conditions:

- Solely as a speed control device
- Solely to deter through-traffic in a residential area
- On urban roads which have a speed limit in excess of 60km/h
- Along transit or truck routes, except where two routes cross
- Where traffic would be required to stop on steep grades

3.7 ROADWAY CLASSIFICATIONS

Roads are classified by how they function within a city's transportation system. Functional classifications within the City of Iqaluit are divided into three categories: Arterial, Collector, and Local roadways. All three roadway types provide varying levels of mobility and access.

Arterials typically carry most of the traffic through a city or region. Access is typically restricted or limited to allow for greater mobility, and higher traffic volumes and speeds, and they typically have the greatest right-of-way widths. Arterial roads generally have a more diverse mix of adjacent land uses (commercial, industrial, and sometimes high-density residential) compared to collectors and local roads.

Collectors provide traffic circulation within an area and connect local roadways with arterials. Collectors provide a balance between providing mobility and access within a transportation network.

Local roads include most residential streets – especially in areas of lower density – and access roadways to land uses. The primary objective of local streets is to provide access. Mobility is generally limited as local roads are not designed to accommodate large traffic volumes or high traffic speeds.

Figure 21 illustrates the City of Iqaluit roadway classification, consistent with the General Plan road classification.



Figure 21: Roadway Classification

3.8 PARKING CONSIDERATIONS

Parking management involves the application of various specific strategies in an integrated program. Not every strategy is appropriate in every situation. Actual impacts vary depending on geography, demography, implementation, and other factors.

3.8.1 Context

The City of Iqaluit has seen high growth in automobile ownership rates and therefore is experiencing new strains in demand for parking. Currently, the City does not operate a paid parking program, with all parking spots available at no cost to the driver. Free parking has further increased demand on the parking network, with deficiencies in parking availability noted especially west of Four Corners and at the Iqaluit Airport. As a unique city that sees a variety of transportation modes in use, other vehicle types such as snowmobiles, trailers, and trucks should be considered in determining future parking needs. At the same time, a balance must be maintained between adding new parking spaces and using the land for most productive uses – comments in the public engagement process indicated a desire to promote a high-quality urban realm downtown, which promotes walkability and pedestrian safety.

As seen below in Figure 22, a high percentage of land use in the Four Corners area is dedicated to parking. This is typical of many auto-centric urban centres, and conversely, the relative ease of finding parking makes driving an automobile attractive relative to other transportation modes. As a city develops and land values in the central business district increases, parking lots are often re-developed into residential or employment land uses.



Figure 22: Example of significant percentage of land used for parking in Four Corners

3.8.2 Parking Management Measures

There are several parking measures that could be further explored to manage parking demand in and around Four Corners over time so that the City can fulfill its strategic objectives. Importantly, these parking management measures can also serve to help ensure there is adequate parking supply for workers starting their shifts in the mid-afternoon and during other peak hours. These measures are discussed in the following subsections.

3.8.2.1 Parking Pricing

Currently, lot parking in Iqaluit is privately owned and street parking in Iqaluit is not priced. This has led to unconstrained demand for street parking in the busier areas of the city, such as Four Corners. A central principle of Transportation Demand Management (TDM) is the relationship between supply and demand. Without an increase in supply, parking demand can be reduced by developing a paid parking solution. By placing a price on parking within Iqaluit's prime real estate, automobile trips shift to other transportation modes and parking demand distributes to areas with lesser demand. A parking pricing system could include traditional parking meters or modern smartphone app-based parking systems (or a combination of both). While the City of Iqaluit does not operate any paid off-street public parking lots, pricing could be implemented through the use of on-street parking meters.

Demand Priced Parking

In the medium-to-long-term, assuming that paid street parking has been implemented, a system could be developed whereby the City compares the actual parking occupancy with the desired on/off-street parking

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occupancy and every few weeks nudges prices up or down accordingly based on demand. Prices can be set by block and time of day to produce one or two open spaces on every block and thus reduce demand and shift motorists to other modes of transportation. This could bring in additional revenue for the City while also helping to reduce parking demand during the peak hours of 1-4pm.

Applying a demand priced parking strategy might mean that at certain times the parking is free while at other times (such as during Saturday afternoons) there is a charge. The expansion of paid parking areas could act as a deterrent for driving and encourage a shift to active modes and (upon implementation) transit. At the same time, the City should consider deploying additional on-street bicycle parking facilities to further encourage a shift to active modes, and in anticipation of additional bicycle imports in the future. Bicycle parking should be able to accommodate regular bicycles as well as fat tire bicycles.

3.8.2.2 Increase capacity and utilization of existing facilities

Existing facilities could be optimized by using spaces that are currently wasted areas such as corners, edges, and undeveloped land to increase the parking supply. This can be particularly appropriate for compact car, snowmobile, and bicycle parking. Another method is to reduce parking stall widths in order to create compact car parking, while acknowledging the unique parking conditions in Iqaluit in terms of allowing for space to plug in vehicles, and considering that vehicles are generally larger on average compared to elsewhere in Canada). It is not recommended to consolidate street parking in a similar fashion as this can add congestion due to the additional challenges of parallel parking.

In addition to increasing the parking supply within existing facilities, there may be opportunity to improve the utilization of existing facilities. Utilization could be increased if there is appetite among businesses to enter agreements with the City whereby unused capacity in privately-owned lots may be used for public parking. Regardless of whether there is an appetite for such agreements, it is recommended to maintain open communication channels with the owners of private lots, to ensure that a paid parking strategy does not create an issue of vehicle users starting to use private lots for the sole purpose of avoiding paid street parking.

Parking Stall Sizing

In accordance with the Nunavut Good Building Practices Guidelines, minimum parking stall dimensions are recommended to be 2.5m x 6m for automobiles and 2m x 2m for off-road vehicles (ORVs), including snowmobiles and ATVs. Where added capacity is needed, parking stall sizing can be investigated to determine if existing stall sizing is above the recommendations in the guidelines, and parking stalls can be re-sized within the limits of the guidelines. Alternatively, dedicated ORV parking stalls can be added in place of existing automobile parking stalls to increase capacity, as three ORV stalls can fit within one automobile parking stall.



Figure 23: Multi-modal parking needs in Iqaluit

3.8.2.3 Parking Space Sales and Leasing

A website which allows residents or workers to look for parking to rent on a daily, weekly, or monthly basis might be created and marketed. Facilities or businesses with excess parking capacity can lease or trade it to others. Residents could also use such a platform to rent their parking spaces to interested parties, for example to seasonal workers, who would like a dedicated parking space but do not want to compete with visitors for parking spots. This prospect may also be attractive to some visitors, depending on where and how long they are staying.

3.8.2.4 Transferable Parking Rights and Developer Agreements

Developers can choose between constructing required parking spaces or transferring parking spaces to another development. This works best in areas where parking maximums limit the amount of parking that

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can be built. Whitehorse, YT is an example of a city that established maximum parking ratios for new developments in 2011.² A transfer program could allow historic properties, low-income housing, and senior housing projects, where parking demand is lower, to transfer parking spaces to another development that would like additional spaces above the maximum allowed.

Developer agreements are a similar parking management strategy that can be successful in encouraging mode shift to alternative forms of transportation (transit and active transportation) if transit planning and land use planning are collaborative. One example is parking offsets, whereby developers provide residents with a transit pass in lieu of a parking space. This strategy, recommended to be studied only after a future transit service is operational and has been deemed sustainable, relies on the presence of effective transit service and prevalent active transportation infrastructure.

3.8.2.5 Unbundled Parking

Parking facilities and infrastructure can be unbundled from the rent or purchase price of residential and commercial units and sold or rented out as a premium add on service. Including the costs of parking in rents or purchases encourages automobile ownership and is a disincentive to active modes. Unbundling also allows a more equitable allocation of costs by allowing tenants and owners to pay only if they use the parking infrastructure. Unused parking spaces could be used for public parking at an hourly rate, in areas of mixed land use, or where residential areas may be adjacent to commercial, recreational, and/or industrial destinations.

Unbundling parking from the rent or purchase price encourages renters to only purchase and use the parking spaces that they need. For example, the Federal and GN Government, major renters in the city, require minimum standards for parking provision for all units they rent, which dictates the amount of parking spaces the City must supply. However, minimum standards can often be higher than the actual observed demand for parking. By unbundling parking from their rental cost and requiring tenants to rent parking spaces separately, tenants are more likely to use fewer spaces, which frees up parking stalls for other uses and brings down the overall need for building more parking spaces across the city.

Given this strategy's reliance on mixed-use development in Iqaluit's core, this supports a recommendation for Iqaluit to encourage this type of development in future. Mixed-use development, which is typically a style of property development which can incorporate residential, commercial, retail, institutional, or industrial uses in a single development, creates a more efficient use of the most in-demand urban land. Mixed-use development also has the benefit of providing services for residents who live above which may have required a car trip to previously access, reducing traffic and emissions.

3.8.2.6 Wayfinding and Signage

A comprehensive and uniform wayfinding and signage (parking information) program for the City's parking system can help guide drivers to parking options and reduce confusion about payment and

² <https://www.whitehorse.ca/home/showpublisheddocument/12020/636987814676870000>

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restrictions. Improved signage can alleviate demand by providing directions to nearby destinations and other peripheral lots. Information can also be used to clearly identify lots that are available to the general public and those that are restricted to monthly pass-holders, providing information on fines and discouraging noncompliance. Improved wayfinding is a notable opportunity in Four Corners and the “new downtown” area by encouraging parking in other locations within the core area, at lots which may be underutilized at times relative to street parking directly at the Four Corners and in the “new downtown”. Wayfinding and signage is explored further in section 3.9.

3.8.2.7 Streetscaping and Landscaping

Making outer city parking lots more appealing with safe pedestrian routes and promoting cleanliness will encourage people to want to park there and will help people enjoy their walk to work. Improving walkability (the quality of walking conditions) expands the range of parking facilities that serve a destination. It increases the feasibility of sharing parking facilities and the use of remote parking facilities. Improving walkability also increases “park once” trips, that is, parking in one location to access multiple destinations, rather than driving to each destination individually. This reduces vehicle trips and the amount of parking required at each destination.

3.8.2.8 Curbside Demand Management

As the urban areas continue to intensify and grow, notably in the several developments planned throughout the city, the demand on the road network, existing parking facilities, and curbside space will grow considerably. The public curbside—the space along the street between travel lanes and walking paths (or sidewalk)—is precious real estate. Potential users of the curbside include residents, workers, visitors, patrons, deliveries, and travelers of all other modes. The needs and peak demands for curbside use are not uniform and will expectedly vary across the neighbourhoods. It is also noted that heavy snowfall and lack of sidewalk infrastructure can create ‘messier’ curbsides relative to other cities.

The average dwell time for a vehicle picking up and dropping off a person is dependent on idling policies and the surrounding urban landscape, but can range from 1-3 minutes, meaning a designated pick-up & drop-off space has a theoretical capacity of being able to serve at least 20 vehicles per hour. Commercial vehicle dwell times are closer to 10-15 minutes meaning curbside capacity for deliveries can only serve approximately 4-6 delivery vehicles per hour.

To maintain an equitable balance between competing users, urban jurisdictions need to take steps to shift from curbsides dominated by “on-street parking” to reliable freight loading, public space, and active transportation infrastructure. Figure 24 is more relevant for a larger and more urbanized area than Iqaluit but illustrates in concept some of the features of a managed curbside. Concepts relevant to Iqaluit include:

- Dedicated loading space for taxis and deliveries
- Active transportation infrastructure/protected curbs (bollards)
- Turn pockets

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These concepts are likely most relevant to Four Corners and elsewhere in the core area due to the inflows of commuter traffic, commercial activity, and relative high-density characteristics.

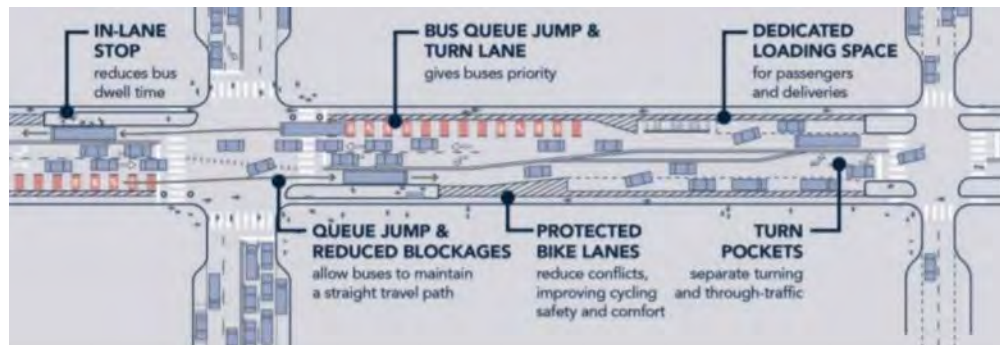


Figure 24: A reference of what a managed curbside looks like

Source: NACTO Curb Appeal, 2017

3.8.3 Downtown Parking Management Recommendations

It is recommended that the City proactively consider the on and off-street parking needs today and into the future, with a more detailed consideration of future curbside demand usage and how parking lots on the periphery of the Four Corners—new downtown area may be better leveraged. As an example, Astro Hill is centrally located and appears to have spare parking capacity. In collaboration with the local businesses that manage these parking lots, there may be opportunity to repurpose some of the parking as public spaces, and develop strategies to encourage drivers to park here rather than at Four Corners or the new downtown. The impacts of active transportation, future transit service, and wayfinding investments should also be considered, as should the potential impacts of emerging technology.



Figure 25: Spare parking capacity in Astro Hill

3.8.3.1 Mivvik Street

As a central road in the Four Corners area, Mivvik Street sees traffic and pedestrian activity and experiences high parking demand. Specific complaints have been raised at the junction of Mivvik, Allanngua, and Al Woodhouse. The poorly delineated accesses, egresses, and parking spaces for the various businesses in the area create unsafe conditions for drivers and pedestrians and contribute to traffic congestion. Mivvik Street will see road construction and residential development in the coming year, so this creates a timely opportunity to implement improvements. The following recommendations are provided to manage parking along this corridor:

- Implement improved signage and wayfinding to indicate parking lot entrance and exit points, and to indicate directional flows into and out of parking lots.
- The City should work with property owners to improve parking space markings and signage on their properties, and implement similar improvements on any City-owned land/parking lots in the area.

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- As sidewalks are recommended along this corridor (discussed further in Section 5 of the TMP), it is suggested that the City should consider the installation of these sidewalks in tandem with the currently planned roadway improvements.
- Strategically install flex bollards at locations where parking is not desired, such as areas which may impede traffic flow.
- Revisit parking space sizing to determine if additional parking can be created within the given footprint.

3.9 SIGNAGE AND WAYFINDING CONSIDERATIONS

Safety concerns was a recurring theme that emerged from stakeholder engagement activities in the early stages of the TMP. The general sentiment was less related to notable hazards at specific nodes in Iqaluit's transportation network, and more related to general safety limitations arising from factors such as inadequate lighting, challenging driving conditions, pedestrians and drivers sharing the same road space, and improper driver behaviour. In theory, these challenges can be solved through infrastructure – expanding right-of-ways, adding sidewalks, paving roadways, introducing traffic calming, and improving street lighting – however a large-scale citywide deployment of these strategies would be a massive and costly undertaking that also necessitates significant incremental annual maintenance. As such, these strategies are best reserved for areas of high traffic and pedestrian volume where they are expected to have a favourable business case. A more prudent approach to addressing these concerns at a strategic/citywide level is to bolster wayfinding and signage efforts, which in many cases can prove to be just as effective as costlier infrastructure-based solutions.

Additional signage can be deployed to better delineate between roads, snowmobile trails, multi-use trails, and sidewalks / pedestrian walkways. At present, there are many instances of pedestrians walking along the side of the road in high-traffic areas, and there are many instances of snowmobile trails intersecting with pedestrian walkways and roads without any warning. Figure 26 illustrates one of these instances.



Figure 26: Potential danger as a snowmobile trail and a pedestrian walkway converge without warning near Niaqunngusiariaq / Abe Okpik

A signage strategy should target all transportation network users – alerting pedestrians, snowmobile users, and automobile users of areas of convergence between roads, snowmobile trails, and pedestrian walkways. Potential hazards should be identified by signage at the points of intersection, and also along the roadway to demarcate school zones, areas where children play, and to provide advanced notice of upcoming crosswalks. Signage can also be used to provide gentle reminders such as “share the roadway” or “watch your speed”. Such measures can be implemented alongside other traffic calming measures such as posting additional speed limits and narrowing roadway widths where appropriate. Figure 27 illustrates the convergence of roads and snowmobile trails in Apex, but without any signage to alert motorists of this convergence. Figure 27 also illustrates an opportunity to deploy signage that cautions motorists of the narrowing roadway in advance of the bridge. Figure 28 illustrates good signage, though the School Zone sign may be easy to miss since it is smaller than the stop sign and the speed limit sign, and if black text on an orange background is more difficult to read for some people with visual impairments compared to black text on a white background.

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Figure 27: Signage opportunity in Apex



Figure 28: Stop sign (foreground), speed limit sign and school zone sign (background)

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In addition to safety benefits, opportunities for improving signage across Iqaluit could bring benefits in the following areas:

- **Parking.** As noted above in section 3.8, signage could be useful in providing drivers with clearer direction to parking facilities. In the event of implementing paid parking in the city, the signage could clearly delineate between areas of paid parking and free parking, and encourage drivers to park on the periphery of Four Corners and the “new downtown” where there is a greater supply and lesser demand of parking spaces. At the same time, additional signage can be used to better delineate accesses and egresses to parking facilities, which was noted to be a challenge in particular at the Mivvik/Allanngua intersection.
- **Traffic Flow.** With the additional delineation between automobile, snowmobile, and pedestrian areas throughout Iqaluit (via signage, flex bollards, and/or other infrastructure as appropriate), the City has the opportunity to reduce areas of confusion throughout the city. Specifically, there are many instances throughout the city of significant roadway widths, but unclear direction on how the roadway should be best used, and how the space should be shared between users of different modes of transportation. In tandem with the signage, where there is spare roadway capacity, the City might also consider reallocating some of the right-of-way as additional parking space, particularly where there is opportunity to do so within the Core Area.



Figure 29: There are many examples throughout the city of opportunities to deploy signage to better communicate how transportation corridors should be used

- **Wayfinding.** Many cities across North America are taking advantage of signage as a means of improving wayfinding. This includes not only alerting residents and visitors as to where key destinations are located, but also alerting them on how they should best reach their destinations. Signage illustrating where specifically to turn to enter parking lots, for example, can help avoid

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confusion. Following the construction of a Four Corners By-Pass, signage can also be deployed in the short-term following implementation to educate drivers as to how utilize the By-Pass. Figure 30 below shows a good example of signage towards parking – something that there is opportunity to do more of across Iqaluit – but it also illustrates a stop sign that is of inconsistent design compared to those elsewhere across the city.



Figure 30: Signage at the Iqaluit International Airport

It is recommended that the City of Iqaluit conduct a full traffic signage review. This would include inventorying existing signs across the city, providing specific recommendations for where and how signage can be bolstered, and then deploying the signage accordingly. All signage should be standardized, having consistent designs across the city (including shape, font, size, height, language, reflectiveness, etc.). Where appropriate, signage, wayfinding, and other elements affecting transportation safety should be accompanied by a marketing and public education campaign to maximize the full value of each investment.

4.0 TRANSIT NETWORK

4.1 TRANSIT IN IQALUIT – AN INTRODUCTION

4.1.1 The Market for Transit

Public transit is a service offered by many cities, towns, and municipalities to foster improved mobility, and by extension an improved quality of life. For a community such as Iqaluit which is rapidly growing, has a harsh climate, and for which the cost of owning a vehicle is very high, public transit can be a lifeline that connects residents to work, school, errands, and recreation/leisure opportunities. Although public transit has been piloted before in Iqaluit, many years have passed since the previous service ceased operation in 2005. Since that time, the city has grown considerably in terms of population, employment, and density, and vehicles imports have grown even faster contributing to congestion, road maintenance, and parking needs at levels not previously experienced by the city. Taxi operations have also consolidated with a single operator, Caribou Cabs, delivering trips at a rate where demand is outpacing supply. With continued growth anticipated in the city, there has never been a more relevant moment to revisit the possibility of transit in Iqaluit and the role it might play in alleviating these constraints and improving mobility, particularly for those without other viable means of transportation.

4.1.2 Considerations from Stakeholder Engagement

Public transit was an important theme explored during the round of public consultation for this TMP. 69% of respondents to our online survey indicated they would consider using public transit if it were available. Many individuals engaged throughout the course of the consultation often brought up the topic of public transit and how beneficial it would be for transportation to and from key destinations such as Northmart, the Four Corners area, the Hospital, and residential areas, and more generally speaking for helping to relieve congestion. While the existing taxi service provides an important mobility service to the community, it is important to recognize that one provider cannot be all things to all people, and several residents cited high taxi fares, service reliability, vehicle cleanliness, and safety as reasons for not using taxis. In addition, it was observed that the demand for public transportation appears to be in excess of what Caribou Cabs is able to supply.

Relatedly, in the survey, respondents indicated reliability and safety as being the two most important factors to consider when deciding how to travel. While findings from stakeholder engagement illustrated support for the development of a public transit service in Iqaluit, it also became apparent that the resulting public transit concept would need to be distinct from the taxi service. The benefit of this would be twofold. First, the transit service would be complementary to Caribou Cabs, rather than competitive; and second, it could better align with the public's expectations for a transit service and streamline public engagement and marketing efforts accordingly. Transit service concepts are discussed further in section 4.4.1.

4.2 VISION, MISSION, AND GOALS

Before exploring transit service concepts further, it is important to first establish a vision for public transit, as well as goals for the prospective transit system. Visioning, mission setting, and goal setting is an important exercise for several reasons:

1. It provides a basis upon which the resulting public transit service may be monitored and evaluated, helping to foster informed decision-making about how the service may be tweaked to better serve the community.
2. It can be motivating and inspirational for staff of all levels involved either directly or indirectly in service delivery, and it helps to instill a culture of accountability between service delivery staff and City stakeholders overseeing the operation, as well as with the general public.
3. It is useful for ensuring that public transit objectives align with broader mobility objectives, and in turn for creating a harmonious multi-modal mobility network.

A suggested vision statement for a prospective Iqaluit Transit system is “a connected, prosperous, and sustainable Iqaluit that is supported by transit as a preferred mode choice”. This provides a long-term and high-reaching goal for the City while acting as a communication tool to riders, staff, and other stakeholders as to what the City is striving for. A statement such as this would also help instill confidence in residents who may be wary about using the service due to concerns about its long-term sustainability, remembering the fate of the former Iqaluit Transit system which ceased operation after two years. Naturally, in support of this vision it will be important for the City to ensure the system has appropriate revenue sources (discussed further in section 4.5.3) to ensure that transit can indeed succeed in the long-term. One important revenue source is fare revenues, the magnitude of which is driven by ridership, which is also a good measure of service quality and effectiveness. The mission and goals help to provide a framework for how transit in Iqaluit can be successful in generating strong ridership.

A suggested mission statement for Iqaluit Transit is “a safe, reliable, and affordable bus system that responds to residents’ needs and enhances the city’s livability”. Unlike the vision statement, which is more abstract in nature, the intent of the mission statement is to communicate more specifically how Iqaluit Transit is envisioned to function. And, while the vision statement should be one that is public, the mission statement is more pertinent to the staff responsible for managing and operating the transit service. Of note, the mission statement touches on the themes of safety, reliability, and affordability, all of which are very important to residents in deciding how to travel, per the feedback received during stakeholder engagement.

After establishing a vision and mission for the transit service, the setting of goals provides a means by which progress towards the vision and mission can be tracked and evaluated. The goals also act as a guideline for day-to-day activities related to transit service operation. For an Iqaluit Transit service, goals might include (but are not limited to) the following:

1. **Build ridership.** Ridership levels are a clear indicator of how valuable the transit service is to the community. The better the service design (coverage, frequency, service span, etc.) can be

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tailored to residents' needs, the greater the ridership can be expected. Ridership can be expected to grow over time as residents become increasingly familiar with the service, and benchmarks may be set in terms of a targeted number of boardings per month.

2. **Value customers' time.** This refers to the provision of convenient and reliable service, and is often evaluated in terms of the system's on-time performance (percentage of trips that are in between 0 and X minutes late, where 'X' is a policy decision). The more reliable the transit service is, the less time customers will need to spend waiting for their bus. Strategies such as optimizing route directness and mobile apps that give live updates to customers on when the next bus is expected to arrive also help to value customers' time both on-board and off-board the vehicle. Further, the City might consider surveying both riders and non-riders on their journey times to see how well transit is faring compared to other modes of transportation in terms of providing competitive travel times.
3. **Optimize the return on investment in transit.** Tax dollars will form an important component of funding for Iqaluit Transit, and they need to be used optimally in order for the service to be deemed efficient. This is an important consideration not only for the riders but also for the non-riding taxpayers, and this related to the theme of affordability as referenced in the mission statement. Typical measures can include cost per hour of service, cost per trip, and farebox recovery ratio (% of costs recovered through farebox revenues). Investments in capital assets such as fleet, technologies, and bus stop infrastructure also need to demonstrate value and return on investment in the form of increased ridership.
4. **Minimize safety incidents.** Safety is also a core component of the proposed mission statement and should be considered at all stages of a users' journey from the time they begin their trip to the time they arrive at their destination. Safety can be evaluated in a number of ways, such as the quantity of preventable accidents or road calls per X number of boardings, and the number of incidents per year occurring at a bus stop.

4.3 PEER PUBLIC TRANSIT SYSTEMS

4.3.1 Rankin Inlet, Nunavut

Ranken Inlet Transit was launched in September 2019 to service the hamlet of Ranken Inlet, which contains a population of almost 3,000 over approximately 20 square kilometres. Ranken Inlet Transit was initially launched as a free service to drum up interest, but with a fare structure enforced starting in October 2019. The fare was \$10 per trip for an adult, which was more expensive than a taxi, but the service was targeted towards frequent users with significant cost savings for buying a monthly, 6-month, or 12-month pass (\$100, \$510, and \$840 respectively). The service is no longer in operation as of 2021 – it was not subsidized and was therefore totally reliant on passenger fares, and ridership uptake was not significant enough to offset the costs of operation. (By comparison, most small transit operations in Canada recover 20-40% of their operating costs through passenger fares – a statistic that the City of Iqaluit should be cognizant of). Ranken Inlet Transit nevertheless provides a valuable case study for consideration in the Iqaluit TMP.

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The service was managed by Rankin Auto Value, which operated a single minibus along a single route from Monday to Sunday, 7am to 7pm. Additional vehicles were kept as spares. Anecdotally, the service was used by different types of users across the community, and was not targeted to any particular subset of the population. Accessible service for persons with disabilities was available provided it was arranged by the user prior to pickup.

Before Rankin Inlet Transit ceased operation, its operating parameters were tweaked in an effort to make the service more sustainable while better adapting it to the community's needs. Specifically, the fare structure and route were updated. Fares became free for all users up to age 17 or over the age of 60, and the original route consisting of 29 stops had been straightened out to include only 22 stops. This allowed Rankin Inlet Transit to operate the route every 30 minutes rather than every 60 minutes, while providing faster (less circuitous) travel for users and still maintaining adequate coverage throughout the hamlet. Destinations along the Rankin Inlet Transit route included the airport, grocery stores, schools, banks, and public centres such as the post office, area, and health centre.

4.3.2 Merritt, British Columbia

Merritt Regional Transit services Merritt, a city of over 7,000 in British Columbia, as well as the adjacent rural community of Lower Nicola. Merritt Regional Transit is managed by BC Transit, the provincial crown corporation that coordinates the operation of public transit across much of the province. Operation of the service is delivered by the Nicola Valley Transportation Society. Fares are \$2 per trip, and may be purchased in books of 10 tickets (\$18) or as monthly passes (\$42). Funding is also provided by the City of Merritt and BC Transit, in partnership with the Thompson Nicola Regional District and the Lower Nicola Indian Band.

Merritt Regional Transit operates four fixed routes which converge at a central transfer location downtown by the city's main intersection. These are supplemented by on-request service which extends service beyond the reach of fixed routes and provides curb-to-curb service on request, if booked over the phone 24 hours in advance. Service operates from approximately 6:45am to 10:15pm on Monday-Saturday, with reduced hours on Sunday, though the routes have different start and end times. Route 1 operates every 30 minutes during peak hours, while routes 2 and 3 operate every 60 minutes. Route 4 which transports users between Merritt and Lower Nicola operates less frequently. The service is interlined, meaning that all four routes are serviced in succession with a single vehicle. Other vehicles are rotated into the fixed route service throughout the day, allowing for efficient scheduling, operator breaks, and the delivery of on-request trips. Three vehicles in total combine to provide service across the four fixed routes as well as the on-request service.

Major stop locations for Merritt Regional Transit include the downtown, schools, grocery stores, Walmart, and other shopping destinations. Merritt Regional Transit is a large operation for a city of its size and delivers approximately 75,000 passenger trips per year, or about 14.7 trips per service hour. Service for persons with disabilities is delivered in tandem with the on-request service, allowing for the vehicles to be used more productively.

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4.3.3 Nuuk, Greenland

Nuuk is the capital and largest city of Greenland and is similar to Iqaluit in terms of climate and in terms of demographics, with its population consisting primarily of a mix of Greenlandic Inuit and Danes. It is also spread out in a similar fashion with different subdivisions, including one somewhat isolated from the rest of the community, similar to Apex relative to the rest of the City of Iqaluit. Nuuk is notably larger than Iqaluit though, with a population of a little over 18,000.

The bus system in Nuuk, unlike in Rankin Inlet and Merritt, consists of a large fleet of 18 full length buses with 6 additional smaller vehicles. It operates along 4 routes, with some branches/variants, including peak-hour-only variants. Service frequency during peak hours ranges from every 10 minutes to every 40 minutes depending on the route. Service is provided in between 6:18am and 12:15am by a local bus company, Nuup Bussii A/S. The service was established in 1980, and over 2,000,000 trips are delivered per year.

Nuup Bussii has embraced technology such as smart fare cards, real-time bus tracking, and customer service updates on Facebook. Fares can be loaded onto the smart cards online, at the Nuup Bussii office, or at resellers. There is also an agreement in place with the local school board where passes are provided to every school-age child who can ride the bus for free. It is unclear if this supplementary to, or in lieu of, yellow school bus services.

4.3.4 Takeaways from Peers

In all three of the peer case studies reviewed, fixed-route services were introduced. While other jurisdictions such as Okotoks, AB and Innisfil, ON have rolled out pure on-request service in recent years, the success of fixed route service in other small and northerly jurisdictions suggests that fixed-route service may be appropriate in Iqaluit. In order to ensure success, a transit service in Iqaluit would have to be launched in a way that complements rather than competes with the existing shared taxi model. The Merritt, BC example illustrates that a fixed-route system and on-request service can coexist and create a whole that is greater than the sum of the parts. A similar hybrid fixed-route and on-request system might also be considered for Iqaluit, especially considering there is already a working shared-taxi model in operation today in the form of Caribou Cabs, which might be engaged in the provision of on-request transit services. These concepts are discussed further in section 4.5.4.

The Rankin Inlet example illustrates the importance of appreciating that a transit service cannot be everything to everybody. The originally drawn route was very indirect and therefore required longer travel times and operated less frequently. It also illustrates the importance of the transit service being supported with an operating subsidy, to help ensure service quality and financial sustainability.

For a transit service to work effectively in Iqaluit, journey travel times (including time spent waiting for the bus and/or transferring if applicable) will need to be faster than walking and comparable to other forms of

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transportation. If multiple fixed routes are proposed, the possibility of interlining them similar to the Merritt example can aid in expediting travel times. The Rankin Inlet example also illustrates the importance of the ongoing review and tweaking (as needed) of transit service to ensure we are best matching supply with demand and delivering a service that people find useful. It is not only the structure of routes that may need tweaking but also the fare structure, customer service policies, and other service delivery strategies.

The Nuuk example takes the concept of matching supply with demand a step further by illustrating the appropriateness of an equitable distribution of service, rather than an equal distribution. That is, downtown aside, some parts of the city may see more travel demand and therefore require more transit service than other parts of the city. Nuuk also demonstrates that the embracing of technology can be used to provide a better service and encourage ridership, and it need not be viewed as something that is only viable in larger cities or in the south.

Overall, the peer case studies illustrate that a transit service can be successful in similar communities if executed effectively and efficiently and these case studies support the business case for launching a transit service in Iqaluit. It will also be important to learn from the shortcomings of the former Iqaluit Transit service which operated from 2003-2005. As was learned during the stakeholder engagement process of this TMP, there was anecdotally not enough service provided for the service to be useful to residents, and accordingly very few riders were attracted to the service despite the competitive fare of \$2/trip.

Finally, of note, Cambridge Bay, NU is anticipating to launch a transit service pilot in the fall of 2021. The service is envisioned to consist of one route operated by a single 17-passenger vehicle every half hour from 7:30am to midnight during weekdays (reduced hours on weekends). In addition to public transit, the operator is exploring opportunities for the service to serve dual-purpose and fill school transportation needs, as Cambridge Bay does not currently have school buses operating the way Iqaluit currently does. It is recommended that Iqaluit monitor the developments of transit in Cambridge Bay and keep communication channels open with the hamlet, benefiting from any lessons learned with their transit pilot that Cambridge Bay may be able to share (and in turn, sharing the City's lessons learned as appropriate).

4.4 DEVELOPING AN IQALUIT TRANSIT PILOT

4.4.1 Transit Service Models

There are a wide variety of transit service models that have proven successful in jurisdictions across North America and may be considered by Iqaluit. They are summarized as follows:

1. **Conventional transit.** This generally refers to the traditional model of a bus operating on a fixed route in accordance with a fixed schedule. There are countless examples of fixed route including the examples described above in Rankin Inlet, NU, Merritt, BC, and Nuuk, Greenland. Fixed route systems generally service fixed bus stops, but in areas of lower density they sometimes

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follow a flag stop model where users can board and alight at locations along the route outside of the defined bus stop locations.

2. **Alternative service delivery.** This generally refers to transit services that have variable routing and scheduling. Alternative service delivery strategies have become common over the last decade as scheduling algorithms have become more sophisticated and as the target ridership increasingly have smartphone and internet access, facilitating easy access to information and trip booking, although most agencies also accommodate telephone bookings. Some alternative service delivery strategies employed by transit operators seeking to maximize service quality while minimizing costs include the following:
 - a. Home-to-Stop Model: Service is delivered between home locations and designated stop locations, usually (but not always) to stops that are shared with an accompanying fixed-route network. Trips are typically booked via an app or call centre and the intention is to group customers together for shared travel, based on demand. The home-to-stop model is ideal for areas adjacent to a fixed-route service area, and for areas with low density and low forecasted demand but where residents have common destinations.
 - b. Stop-to-Stop Model: Service operates between designated stops, usually marked with a stop post. The user may request travel between any two stops via an app or call centre, with the route itself changing based on demand. The main difference between this and the home-to-stop model are that customers are not picked up from their homes. The stop-to-stop model is ideal for larger areas with dispersed destinations and for areas where low-to-moderate demand is forecasted and where resource constraints may limit the feasibility of transporting customers to/from their homes.
 - c. Deviated Fixed Route Model: Service operates along a fixed route but deviates from the route as required. Whereas the stop-to-stop model can result in many different permutations of routes with varying termini, this model usually has consistent termini and generally follows the same alignment with more subtle deviations. Deviations are usually with regards to sections of the route alignment that can be skipped to save revenue-hours and kilometres if nobody has booked pick-ups or drop-offs accordingly. This model is also often operated on a pseudo-fixed schedule based on subscription trips, with ad hoc trip requests permitted but referred to the closest available scheduled trip. The deviated fixed route model is ideal for areas that are more “linear” or with challenging road networks, and for areas where low-to-moderate demand is forecasted.
3. **Other.** Other transit service models can include a hybrid of conventional transit and alternative service delivery, for example a fixed-route on-demand system where fixed-route service is delivered to fixed stops only when there is demand (i.e. when a customer requests the service). This strategy has proven successful in jurisdiction such as York Region, ON. Alternatively, transit service models need not involve the deployment of a dedicated service, be it conventional or alternative service delivery. Rather, the transit service model may involve a subsidy towards the cost of a taxi or ridesharing trip as has been deployed in Innisfil, ON.

4.4.2 Defining the Target Audience

Before selecting the appropriate transit service model(s) it is important to define the target audience for Iqaluit Transit. As noted above, for transit to succeed, it is important to appreciate that transit cannot be everything to everybody – this is true regardless of a community’s size. At the same time, if transit is to be supported (in part) by tax dollars, the City has a responsibility to ensure it is maximizing value for money by delivering the best service possible for the most number of people, and for the people who need the service the most.

In defining the target audience, transportation needs across the City were evaluated anecdotally, community destinations were reviewed spatially, and the City’s subdivisions were reviewed for population and demographics. Observations included the following:

- Important community destinations are located primarily along Iqaluit’s Ring Road (Queen Elizabeth, plus Road to Apex from Four Corners to Queen Elizabeth). Such destinations include, but are not limited to, Northmart, Qikiqtani General Hospital, Nunavut Arctic College, the Aquatic Centre, Canada Post, Arctic Ventures, and Inuksuk High School.
- Residences of Iqalummiut with lower levels of car ownership (and therefore higher likelihood of using transit) are also centrally located. Such residences include, but are not limited to, the Tamaativvik Boarding Home, the Sivummut and Uquutaq Shelters, and the Elders Residence.
- Corridors in and around Four Corners, and west to the “New Downtown” in and around Mivvik Street, are the most constrained, have the greatest parking challenges, and generally could benefit the most from alternative forms of transportation (such as transit) to help alleviate the existing constraints.
- Residential density is generally aligned with the subdivisions that contain the greatest numbers of dwelling units. The most populated neighbourhoods (at the time of writing) include:
 - Plateau (520 estimated dwelling units)
 - Core Area (445 estimated dwelling units)
 - Tundra Ridge + Joamie Court (423 estimated dwelling units, combined)
 - Lake Subdivision + Road to Nowhere (377 estimated dwelling units, combined)
- The subdivisions experiencing the highest growth (at the time of writing) include:
 - Core Area (245 dwelling units proposed or under construction)
 - Plateau (80 dwelling units proposed or under construction)
 - Happy Valley (82 dwelling units proposed or under construction)
 - Tundra Ridge + Joamie Court (52 dwelling units proposed or under construction, combined)

4.4.3 Recommended Transit Service Model

To launch an Iqaluit Transit service it is recommended that the City begin with a pilot that focuses on the areas of the city where transit is most likely to succeed based on the factors identified above.

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A transit pilot is recommended to consist of the services illustrated in the following figure and described below. Of note, a conventional transit model is recommended for the pilot, with services delivered on 30-minute cycle times, and generally also on 30-minute headways, i.e. the bus arrives every 30 minutes from the users' perspective. The service is proposed to include fixed bus stops, with the option for drop-offs in between stops in the evening hours for women and other vulnerable populations.

Although not recommended for the initial pilot, alternative service delivery options, such as on-demand transit, can also be considered in the future (discussed further in section 4.5.3). On-demand transit may not be distinct enough from the local taxi service, and would require significant investment in communication up-front to ensure that all users, including those without smartphone access, understand how the service works and how to book trips. In the future, however, on-demand transit can be considered for areas where ridership demand doesn't justify fixed-route service, and can be used to augment the fixed-route services which are envisioned to form the backbone for Iqaluit's transit system.



Figure 31: Proposed Iqaluit Transit Network

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Core Area Loop (illustrated by the convergence of the red and blue lines in Figure 31 above). This loop is envisioned to be the backbone of transit service in Iqaluit, servicing Queen Elizabeth, the Road to Apex (in between Four Corners and Queen Elizabeth), and the “New Downtown” area. Bus stop locations can be strategically distributed throughout the loop at areas adjacent to key destinations and in locations where the bus can stop safely and without disrupting traffic flow. Northmart can act as a layover point, facilitating good schedule adherence while allowing the operator to take a break at a location that provides food and bathrooms.

Upsides:

- Provides service to (or within acceptable walking distance of) most key destinations within the city, as well as to areas where parking was noted to be a constraint
- Short anticipated route runtime means high service frequencies are more viable, as are opportunities to interline the route with connecting routes (discussed further below)
- Layover point at Northmart provides the opportunity to capture impulse riders, i.e. individuals leaving Northmart that see the bus laying over and opt to take the bus home rather than walk

Downsides:

- One-way loop, meaning that the route can be inconvenient for some users depending on where their destinations are relative to their origins
 - Rationale: service can be delivered bi-directionally, i.e. with one vehicle operating the loop clockwise and another operating it counterclockwise, particularly during peak hours
- Adhering to schedule may be challenging when the roads are congested
 - Rationale: transit can help alleviate congestion along these main corridors and stop locations, and it is important to build buffer / recovery time into schedules to account for schedule adherence challenges

Plateau Route (illustrated by the red line in Figure 31 above). This route is envisioned to service Lower Plateau (at least as far as Building 513 where there appears to be a viable turnaround spot), and Upper Plateau (as far as Nirukittuq Nuna Crescent). For residents living beyond these locations on the Lower and Upper Plateaus, they remain within an acceptable walking distance of the route (within 800 metres). Once the bus arrives at the Saputi/Road to Apex intersection, the route is proposed to turn into the Core Area Loop, connecting residents in the Plateau with a variety of destinations in the Core Area.

Upsides:

- The road network is linear compared to other parts of the city, meaning that it can more effectively be served by transit compared to subdivisions with more circuitous road networks
- The Plateau is the most populated subdivision in the city, with significant development still expected to come
- The Plateau is far enough away from the Core Area that transit can offer considerable travel time savings compared to walking, but it is close enough that operating expenditures are relatively low and operational viability is relatively high

Downsides:

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- The Plateau is a newer subdivision with higher-priced accommodations (generally speaking), which may be indicative of higher levels of car ownership and therefore a lesser likelihood of taking transit
 - Rationale: ridership is still anticipated to be high due to the large population of the Plateau; moreover, as new people move into the Plateau, they will be able to use transit as their primary mode of travel before they form other travel habits
- The Plateau Route does not serve mixed land uses – only residential purposes
 - Rationale: by interlining the Plateau Route with the Core Area Loop, residents of the Plateau will have access to destinations without having to alight the bus

Lake Subdivision – Tundra Ridge Route (illustrated by the blue line in Figure 31 above). This route is envisioned to service the Lake Subdivision and the higher density apartments within Tundra Ridge. Residents in Road to Nowhere and along (or nearby) the Road to Apex at the north end of Happy Valley also have the option of using this route with a short walk to their bus stop. Similar to the Plateau Route, once the bus arrives at the Queen Elizabeth/Road to Apex intersection, the route turns into the Core Area Loop, connecting residents in the subdivisions to the east with a variety of destinations in the Core Area.

Upsides:

- Efficient service deployment – parts of multiple subdivisions are all serviced by a single route
- The route's runtime lends itself well to being interlined with the Core Area Loop, effectively providing connectivity between origins and destinations
- The route alignment is productive in that it serves almost exclusively some of Iqaluit's highest-density areas, with no unproductive "gaps" along the way

Downsides:

- Some locations within Road to Nowhere, Happy Valley, and Tundra Ridge are missed
 - Rationale: many of these areas are lower density and remain within a reasonable walk from the proposed route; also further extension of this route is inadvisable as it would add travel time for users and would detract from the viability of operating the route on 30-minute headways (and from on-time performance)
- Contains a one-way loop, meaning that the route can be inconvenient for some users depending on where their destinations are relative to their origins
 - Rationale: due to the challenging road network a one-way loop is unavoidable, however, it has been kept minimal in size to ensure two-way service is provided along the Road to Apex (up to the intersection with Road to Nowhere), and to ensure travel times are not significantly impacted

In terms of scheduling, it is recommended that service be piloted in between 7am and 7pm, Monday through Saturday. Two buses can service the three routes, operating in a fashion such as that described in the table below. This would translate into approximately 24 revenue-hours of service per day.

Table 6: Possible Iqaluit Transit Schedule

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| Time | Bus #1 | Bus #2 |
|-----------|--|--|
| 7:00-7:30 | <ul style="list-style-type: none"> • Depart Northmart along the Core Area Loop in the counterclockwise direction • At Queen Elizabeth/Road to Apex, operate the Lake Subdivision – Tundra Ridge Route • Upon returning to Queen Elizabeth/Road to Apex, continue along the Core Area Loop in the counterclockwise direction • Arrive Northmart around 7:26am • Layover until 7:30am | <ul style="list-style-type: none"> • Depart Northmart along the Core Area Loop in the clockwise direction • At Saputi/Road to Apex, operate the Plateau Route • Upon returning to Saputi/Road to Apex, continue along the Core Area Loop in the clockwise direction • Arrive Northmart around 7:26am • Layover until 7:30am |
| 7:30-8:00 | <ul style="list-style-type: none"> • Depart Northmart along the Core Area Loop in the clockwise direction • At Queen Elizabeth/Road to Apex, operate the Lake Subdivision – Tundra Ridge Route • Upon returning to Queen Elizabeth/Road to Apex, continue along the Core Area Loop in the clockwise direction • Arrive Northmart around 7:56am • Layover until 8:00am | <ul style="list-style-type: none"> • Depart Northmart along the Core Area Loop in the counterclockwise direction • At Saputi/Road to Apex, operate the Plateau Route • Upon returning to Saputi/Road to Apex, continue along the Core Area Loop in the counterclockwise direction • Arrive Northmart around 7:56am • Layover until 8:00am |
| ... | ... | ... |

If 24 hours of revenue-service per day is too significant of a level of service from a budgetary standpoint, there is the option to drop down to one vehicle outside of peak hours. With a single vehicle, the Core Area Loop would continue to be serviced every 30 minutes, but only unidirectionally, and service to the Plateau Route and the Lake Subdivision – Tundra Ridge Route would drop down to every 60 minutes as the vehicle alternates between servicing these two routes. In the single vehicle model, it is recommended that the Core Area Loop be serviced in the counterclockwise direction as this is the likely direction that would result in optimal travel times for off-peak trip purposes.

4.4.4 Other Alternatives

It is noted that the routes described in the previous subsection are only one possible permutation of what a transit pilot may look like in Iqaluit. While these routes are expected to have the highest likelihood of successfully attracting strong ridership, other possible services for consideration in a pilot consist of the following route options. These routes may be tested during the pilot in addition to (or in lieu of) the services described above at the City's discretion, if equal distribution of conventional transit services across the City is of high importance.

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Lower Iqaluit – Happy Valley Route. A route that completes the Atungauyait loop in Happy Valley and also completes a loop in Lower Iqaluit consisting of Sinaa and Nipisa.

Upsides:

- The route, as described above, would operate on comparable runtimes to the Plateau Route and the Lake Subdivision – Tundra Ridge Route, making it possible to interline with the Core Area Loop
- Due to the age of these neighbourhoods, their proximity to the Core Area, and their average rent, it is likely that these neighbourhoods have lower levels of car ownership compared to elsewhere in the City, potentially suggesting higher levels of demand
- This route would service mixed land uses, as well as locations such as the Hunters and Trappers Association, the Isaccie Group Home, and the Hillside Housing Co-op

Downsides:

- Large portions of Lower Iqaluit and Happy Valley are within an acceptable walk distance of Queen Elizabeth, which is serviced by the Core Area Loop, so residents may prefer to either walk to the Core Area Loop or just walk to their final destination
- The total populations of Lower Iqaluit and Happy Valley are smaller than the average Iqaluit subdivision's population, meaning the total market of possible transit users is relatively small
- The lack of connectivity between Lower Iqaluit and Happy Valley (by means other than Queen Elizabeth) makes for indirect routing leading to long travel times for riders

Apex – Astro Hill route. A route that runs back and forth along the Road to Apex terminating at Astro Hill in the west and doing a small loop through Apex in the east.

Upsides:

- Apex's distance from the rest of Iqaluit means residents are not likely to walk to their destinations and may find the transit fare to be excellent value for money, likely resulting in higher ridership
- In addition to servicing Apex, this route has the potential to capture residents of the Astro Hill developments, as well as others in the Core Area, provided their destinations are to the east (the Arctic Winter Games Arena, for instance)
- Terminating the route at Astro Hill puts a significant portion of the Core Area within an acceptable walking distance for Apex residents riding until the end of the line

Downsides:

- Apex's distance from the rest of Iqaluit means this route cannot be interlined with the Core Area Loop while keeping the service on 30-minute headways
- Apex has the smallest number of dwelling units out of Iqaluit's subdivisions, and therefore is also a small transit market
- The route's long length means it will be costly to operate, and the Road to Apex has long unproductive stretches where boardings and alightings would not be expected

4.5 IMPLEMENTATION CONSIDERATIONS

4.5.1 Alignment with Other Transportation Providers

It is important that Iqaluit Transit be distinct in its offering and not be viewed as a substitute for other transportation providers across the city, including the following:

- **Caribou Cabs.** Given that Caribou Cabs already operates a shared-ride taxi service, not unlike on-demand transit systems in existence across the transit industry today, the proposed fixed-route model for Iqaluit Transit in itself should be distinct enough to help ensure Caribou Cabs and Iqaluit Transit are not competing for the same customers. Rather, the existence of the two services can help ensure that neither is overburdened and that service quality can remain front of mind. In the medium-to-long term when it becomes prudent to explore on-demand transit in further detail, a partnership with Caribou Cabs to deliver the service might be explored at this time.



Figure 32: Caribou Cabs taxis

- **Independent Shuttle Services.** Independent shuttle services operate throughout Iqaluit, operated by companies such as Canadian North and Frobisher Inn which provide transportation for their staff. Many of these businesses are located in areas where transit is not proposed to serve, such as the North 40 and Astro Hill, so Iqaluit Transit is not envisioned to be competing for customers whose needs are already served by independent shuttle services. While the Elders Qammaq provides a bus service for Elders, scheduling is limited to 12:30pm arrivals and 4:30pm departures, so ensuring that Elders have access to transportation at other hours of the day remains an important consideration.
- **RL Hanson Services.** RL Hanson provides school bus and charter bus service throughout Iqaluit, primarily serving K-12 students in the morning and afternoon, and also K-8 students during the lunch hour. These school transportation services are not available for the general public, so the transportation markets are fundamentally different. From the perspective of RL Hanson, transit would be a great asset for the city, particularly if service levels are sufficient along the main corridors in the Core Area.

4.5.2 Service Delivery Options

It is recommended that the City of Iqaluit contract out transit operations to a third-party provider – one with experience in providing transportation services, with in-house maintenance expertise, and where the City can benefit from economies of scale. RL Hanson is a strong candidate to provide the service, although it is recommended that the City put out an RFP for service delivery to ensure it receives high quality bids that are reflective of good value for money.

The contracting out of Iqaluit Transit services also allows the City to pass on various risks (to a certain extent) to the third-party operator such as:

- **Financial risk**, in the cost trending of ongoing operating expenditures such as fuel, and in liabilities.
- **Demand risk**, which refers to the possibility (and eventuality) that transit service levels will need to be adjusted upwards or downwards.
- **Service interruption risk**, which refers to the possibility of a labour union strike, employee turnover, fleet defects, or an important supplier going out of business, as a few examples.
- **Force majeure risk**, which refers to unanticipated acts outside of the control of the City or the contractor, such as fuel shortages or natural disasters.

At the same time, it is important for the City to be cognizant of the downsides of contracting out transit service delivery, most notably the lack of direct control over service quality. These concerns can be minimized by ensuring that the City remain directly responsible for the management and oversight of transit services. In the RFP the City may also specify its expectations of the service delivery contractor with respect to key performance indicators such as on-time performance, operator conduct, and vehicle maintenance. By remaining directly responsible for the management and oversight of transit, the City can also be nimbler in responding to residents' needs and tweaking service parameters accordingly to fulfill

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those needs; and the City can have an improved ability to lower operating costs by restructuring unproductive services or rationalizing work rules to the local environment to achieve greater productivity.

Although successful in Nuuk, Greenland and other jurisdictions, a traditional full-sized (40-foot) bus is not recommended for Iqaluit Transit for the pilot. A minibus model such as the GMC Crestline or the ARBOC Spirit of Freedom (or a similar model), is anticipated to have sufficient capacity and specifications to suit the City of Iqaluit's present needs. Smaller vehicles are also less costly to procure, easier to maneuver throughout the city, and require less space when dwelling at a bus stop to let passengers board and alight. While it is recommended that the City contract out operations and maintenance as indicated above, the City may consider maintaining ownership of the vehicles in-house if there is opportunity to manage capital costs through a joint procurement with other City department fleet needs. In the event that the pilot illustrates that the selected minibus model is not ideal for Iqaluit Transit operations, the City may also more easily redeploy these vehicles for other purposes, or may consider divesting the vehicles to independent shuttle operators.

These minibus models are also accessible and can double as a "specialized transit" service for the transportation of persons with disabilities. While the Territory of Nunavut (or the Government of Canada) does not have specific legislation mandating the delivery of such a specialized transit service, it is recommended that the City make every effort to accommodate individuals with physical, sensory, and cognitive disabilities such as to ensure an equitable service offering across all populations within the defined Iqaluit Transit service area.

It is also recommended for the City of Iqaluit to generate a General Transit Feed Specification (GTFS) feed to enable Iqaluit Transit to provide real-time updates about service to application developers in an open data format. In turn, third-party application platforms such as the Transit App and Google Maps can use the GTFS feed to provide real-time information to transit users who can access these applications using their mobile phones or computers. The real-time information includes next bus arrival times and estimated travel times, allowing users to make real-time transportation decisions and improve their overall experience with using transit. This is anticipated to be a key success factor for transit during winter months in particular, as users are less likely to wait by a bus stop in extreme temperatures and darkness. Through tools such as Transit App, users will be able to wait indoors and venture outside when the app indicates the bus is approaching, minimizing the time they need to spend waiting outside in the cold. Notably, generating a real-time GTFS feed requires the investment into technologies such as automatic vehicle location (AVL) to provide the requisite data.

4.5.3 Fare Structure and Financial Planning

Setting an appropriate fare is crucial to balancing the objectives of growing ridership and managing operating expenditure funding requirements. It was noted during stakeholder engagement for the TMP that nearly 70% of survey respondents would consider using transit if it were available, and the greatest number of respondents felt that the fare should be between \$2 and \$4. It is recommended that Iqaluit Transit set its fares, to start, at \$3. Round numbers are easier for customers to remember, easier for

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customers to have the exact change (for those paying cash), and help to minimize the costs of collection. \$3 is also noticeably less expensive than the \$8 cost for a taxi trip, and is in line with other transit fares in the industry. By comparison, Yellowknife Transit offers a \$3 cash fare and Whitehorse Transit offers a \$2.50 cash fare. Iqaluit Transit may also consider concession fares (discounts for seniors, elders, students, children, etc.), monthly passes, and/or consider a promotional program where the first month of operation is free, to help encourage ridership. Alternatively, a low-income pass may be considered in lieu of concession fares, for residents deemed eligible based on predetermined annual income threshold(s). It will be important to not create an overly complex fare structure with an excessive quantity of fare categories, as this can be confusing for users and detract from ridership objectives.

The City of Iqaluit will become more familiar with costs of operation upon receipt of bids in response to the RFP for service delivery. The transit pilot described above is envisioned to be the minimum level of service for transit to be successful. In the event that the City's budget for transit is in excess of the costs of operation, the pilot period may be extended for longer, or additional routes may be piloted. Service is typically contracted on a per-revenue-hour basis and is driven by the local costs of labour, fuel, parts, materials, equipment, overheads, and other commodities. Generally in the transit industry, over 50% of operating costs are associated with the wages and fringes paid to bus operators.

4.5.4 Post-Pilot Implementation

It is recommended that the transit pilot described above operate for a minimum of a 12-month period. This will allow sufficient time for Iqalummiut to become acquainted with the service and form new travel routines, and it will also allow the City to evaluate the seasonality in ridership levels. When the pilot is operating, it is important for the City to be actively managing and overseeing the Iqaluit Transit operation as noted above. This includes (among other things) responding to customer queries and complaints, and analyzing any and all transit data. While it is not necessary in the context of the pilot to invest in technologies such as automatic passenger counters to provide sophisticated datasets, the City can request, for example, that the contractor track passenger boardings and alightings manually, on certain dates and during certain time periods, to help broaden the base upon which future service planning decisions may be made. Performance indicators that should be evaluated include, but are not limited to:

- Ridership
- On-time performance
- Missed trips
- Road calls (vehicle issues)
- Preventable accidents
- Customer complaints

While the pilot period is underway, assuming there are no significant concerns that would suggest early on that transit should not be continued past the end of the pilot, it will be important for the City to secure long-term funding to ensure that the transit service is financially sustainable into the future. If early indicators suggest that service levels should be increased, it is recommended that additional funding be

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secured accordingly. Otherwise, in the short-term, funding should be secured commensurate with the operating costs of the pilot and adjusted for inflation. This is not to suggest that the pilot should necessarily continue exactly as is, rather that the levels of service present in the pilot are appropriate for full implementation. It may be necessary throughout the pilot, and at the pilot's conclusion, to “give and take” – that is, tweak various elements of the service parameters (routes, scheduling, etc.) to better meet the needs of the community.

As additional funding may be secured over time, there are several options for improving service. Additional routes (or services) may be added, the service span may be expanded (to provide service on Sundays, or later into the evening on weekdays and Saturdays, for example), and/or route frequencies may be improved. Depending on how transit is funded, if Iqalumiut living in communities such as Lower Iqaluit, Tundra Valley, and Apex are contributing to the transit subsidy, it will be important in the long-term to ensure the benefits of transit are equitably distributed across the Town's communities. This would include identifying transit solutions for these communities that are not proposed to be served by the initial pilot. As many of these communities are lower in population density and are located farther away from the core, they may be cost-prohibitive to deliver these services by conventional transit (fixed-route) means, and the alternative service delivery concepts summarized above in section 4.4.1 may be considered instead as a means of providing transit service effectively and efficiently.

In addition to securing additional funding, the City may also explore diversifying its portfolio of funding sources. One opportunity could involve partnering with the school board or with local businesses to run service, funded either in full or in part (depending on negotiations) by these third parties. These third parties may find that kicking in funds for Iqaluit Transit to bolster service to/from their important destination(s) are more economical for them than running their own standalone shuttle services in-house.

Over time it will also be important to identify how the City is tracking with respect to the vision, mission, and goals for public transit. As the city continues to evolve, it may also be appropriate to revisit the scope and the target audience of the transit service. While the purpose of the transit pilot is to provide connectivity between neighbourhoods and important destinations in the Core Area, in the longer term it may be prudent to seek to expand transit's reach and provide connectivity beyond the Core Area. For example, connectivity to the airport and the employment lands of the North 40 might be explored, as well as connectivity to destinations such as the Deep Sea Port, Sylvia Grinnell Park, and Nunavut Brewing Company in the West 40.

5.0 ACTIVE TRANSPORTATION NETWORK

The City of Iqaluit currently has a limited disconnected network of active transportation facilities, primarily comprised of informal trails and a small number of relatively new sidewalks. As new developments are constructed, such as at Astro Hill, active transportation infrastructure will assist in reducing traffic congestion and promoting healthier lifestyles of local residents. This TMP provides an opportunity to re-evaluate the strategic goals of the active transportation network and update them to consider new active

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transportation best practices, research, updated growth trends and travel demand in Iqaluit, as well as integrate them holistically with the broader multi-modal network.

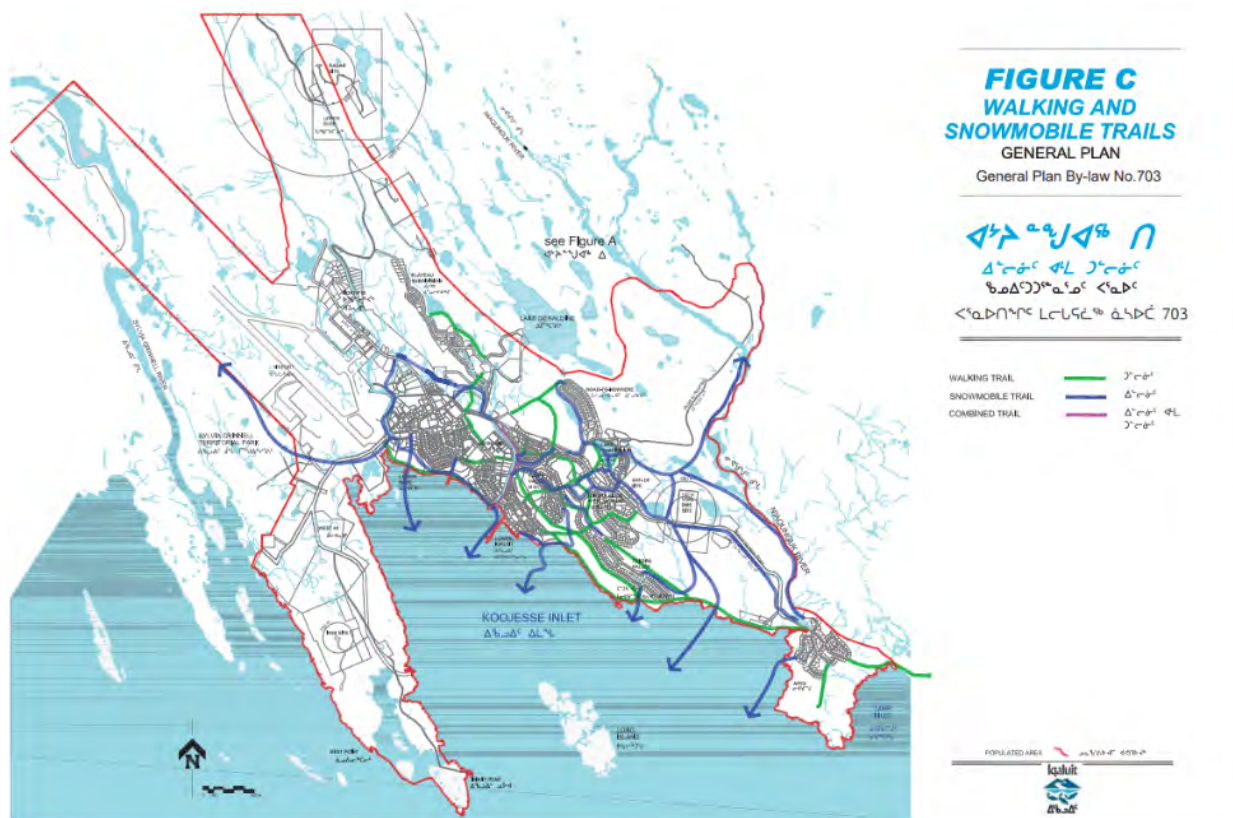


Figure 33: Iqaluit's existing active transportation network

5.1 NETWORK EVALUATION CRITERIA

The evaluation criteria for active transportation improvements are focused around four (4) criteria including:

- Population Density;
- Incline;
- Access to Major Destinations; and
- Network Connectivity

These evaluation criteria and rationale are described below.

Population Density

Rationale: Active transportation facilities are more likely to be used where they are connected to more people or jobs. The higher the density, the higher the likelihood that active transportation facilities will encourage and shift people to use them.

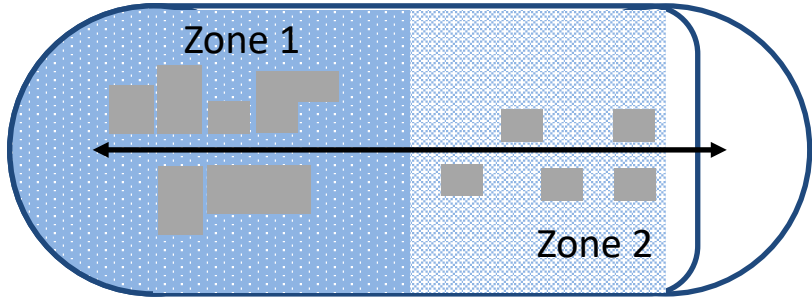
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Analysis Approach: Dwelling unit by neighbourhood and by development municipal data can be used as a proxy for population density.

Evaluation: Qualitative scores can be assigned based on population density thresholds, as summarized in Table 7.

Table 7: Evaluation Criteria for Population Density

| | |
|--|--|
|  | Criteria (Average Dwelling Unit Density) |
| | <15 units/km |
| | 15 - 50 units/Km |
| | >50 units/Km |

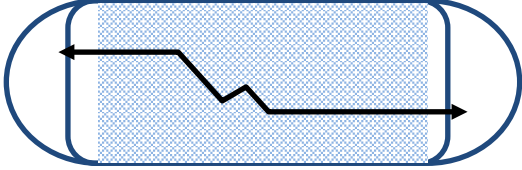
Incline

Rationale: Roadway/path incline can present a significant challenge and deterrent for pedestrians using available facilities, especially in light of high levels of snow and ice buildup. If a route is too challenging, pedestrians will choose to use an alternate route to access their destination. A flat route provides the most comfortable trip, while inclines of 1-3% present a slight impact on effort, but are mostly manageable for casual users. A 4-6% incline presents some challenge over extended lengths for casual users and inclines greater than 7% present a challenge for all users. It should be noted that heavy snowfall experienced in Iqaluit can create seasonal shifts in the perceived difficulty of inclines. Additionally, high inclines may not necessarily disqualify an active transportation route, but identify a need for assistive infrastructure such as stairs or handrail to mitigate the effects of the incline.

Analysis Approach: Incline may be ascertained using GIS data and Google Maps data. In the absence of data, user input can be used to identify road segments with large inclines. The City may consider documenting roadway grades for inclusion within its GIS dataset.

Evaluation: Qualitative scores can be assigned based on incline percentage thresholds are summarized in Table 8.

Table 8: Evaluation Criteria for Incline

| | | |
|---|-----------------|--|
|  | Percent Incline | Description |
| | <1% | A flat road |
| | 1-3% | Slightly uphill but not particularly challenging |
| | 4-6% | A manageable gradient that can |

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| | | |
|--|------|---|
| | | cause fatigue over long periods |
| | 7-9% | Starting to become uncomfortable for users, and very challenging for casual users |
| | 10%+ | Difficult for all users |

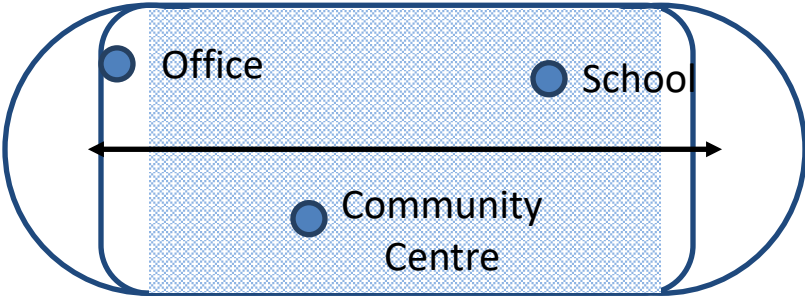
Access to Major Destinations

Rationale: Major destinations such as community centres or the Elders Qammaq, employment centres, schools and parks/trails are all places that people typically travel to. Providing an active transportation network is as much about providing an available, and connected option, as well as creating a network that takes people where they want to go.

Analysis Approach. Community designations were classified as community centres, qammaqs, parks, trails, libraries, hospitals, grocery stores and arenas. Additionally, business parks, commercial core areas and commercial service providers were classified as key commercial destinations. Connections to schools was given a higher weighting as school trips represent a significant opportunity to enhance active transportation given the length, time period and nature of the trips, particularly for older students.

Evaluation: Qualitative scores can be assigned for each major destination type within a candidate route's buffer area are summarized in Table 9.

Table 9: Evaluation Criteria for Major Destinations

| Criteria | |
|--|---------------------------------|
|  | Community Destinations |
| | Supporting Active School Travel |
| | Key Commercial Areas |

Network Connectivity

Rationale: It is important that active transportation corridors create a connected network that doesn't leave users isolated or stranded. Greater connections improve the usability of active transportation infrastructure, and the likelihood for one to walk to their destination. Across Iqaluit, informal trails created by repeated footfall are already popular to connect destinations which are not easily accessible using existing roadways. This factor evaluates which candidate corridors will provide the best network connections between existing and future corridors.

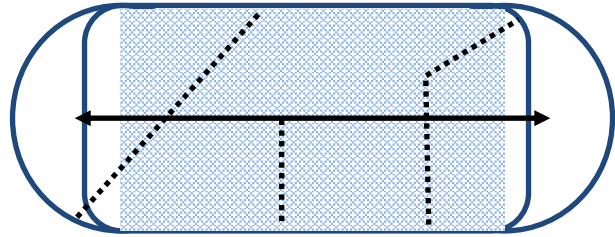
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Analysis Approach: The number of network connections for each candidate corridor can be evaluated based on whether they are existing connections (formal or informal), thus requiring no additional investment and providing an immediate benefit once built or formalized, or whether it would connect to future corridors that would require varying degrees of investment (signage, lighting, bollards, etc.) to make a useful connection. Each of the different connection types were assigned points.

Evaluation: The qualitative scores that were assigned based on network connectivity attributes are summarized in Table 10.

Table 10: Evaluation Criteria for Network Connectivity

|  | Criteria | Description |
|---|---------------------|---|
| | Existing Facility | Connects to an existing active transportation route. |
| | Minor Additions | A future candidate corridor that would require minor cost/effort to implement. |
| | Rehab Additions | A future candidate corridor that would be able to be implemented as part of a regular rehab or maintenance work, which would typically be more long-term. |
| | Capital Investments | A future candidate corridor that would require specific capital investment to implement, thus potentially being much longer-term. |

5.2 NETWORK EVALUATION

The network options were evaluated using the developed criteria in order to identify corridors which would benefit from new or improved pedestrian facilities. Proposed pedestrian facilities are summarized in Table 11 while the proposed active transportation network (including snowmobile trails, to be discussed further in section 6) is shown in Figure 34.

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Table 11: Proposed pedestrian facilities

| ID | Proposed Network Modifications | Limits | Rationale |
|----|---|--|--|
| 1 | Walking trail at Frobisher Inn | Between Niaquinngursiariaq and Astro Hill | Formalize existing informal trail |
| 2 | Walking trail at Paunna | Between Queen Elizabeth and Palaugaa (Creekside Village) | Formalize existing informal trail |
| 3 | Walking trail at Kuugalaq | Between Queen Elizabeth and Astro Hill (Geraldine Creek) | Formalize existing informal trail |
| 4 | Walking trail at Saputi | Between Saputi and Qikiqtani General Hospital | Formalize existing informal trail |
| 5 | Walking trail at Pingua | Between Pingua and Qulliq | Formalize existing informal trail |
| 6 | Walking trail around Dead Dog Lake | Between Road to Nowhere and Imiqtarviminiq | Formalize existing informal trail |
| 7 | Walking trail at Hospital Hill | Between Road to Nowhere and Hospital Hill | Formalize existing informal trail |
| 8 | Walking trail at Arnaitok Arena | Between Qulliq and Kangiq & Iniq, between Masak Court and Kangiq & Iniq | Formalize existing informal trail |
| 9 | Sidewalk at Inuksuk High School and Qikiqtani General Hospital | Along Niaquinngursiariaq, between Palaugaa and Queen Elizabeth (eastern end) | Formalize existing informal trail, meet demand for pedestrian infrastructure, and improve safety for vulnerable pedestrians (hospital patients and students) |
| 10 | Sidewalk at Joamie Ilinniavik School, Aqsarniit Ilinniavik School and École des Trois-Soleils | Along Abe Okpik from Ukaliq to Niaqunngusiariaq, along Niaqunngusiariaq from Joamie Ilinniavik School to Arctic Winter Games Arena | Meet demand for pedestrian infrastructure, improve safety for vulnerable pedestrians (students) |
| 11 | Sidewalk at Federal Road/Queen Elizabeth | Between Ikaluktuutiak Drive and Mattaaq | Meet demand for pedestrian infrastructure downtown, improve safety for vulnerable pedestrians (students) |
| 12 | Sidewalk at Niaquinngursiariaq/Mivvik Street | Between Palaugaa and Allanngua | Meet demand for pedestrian infrastructure downtown |

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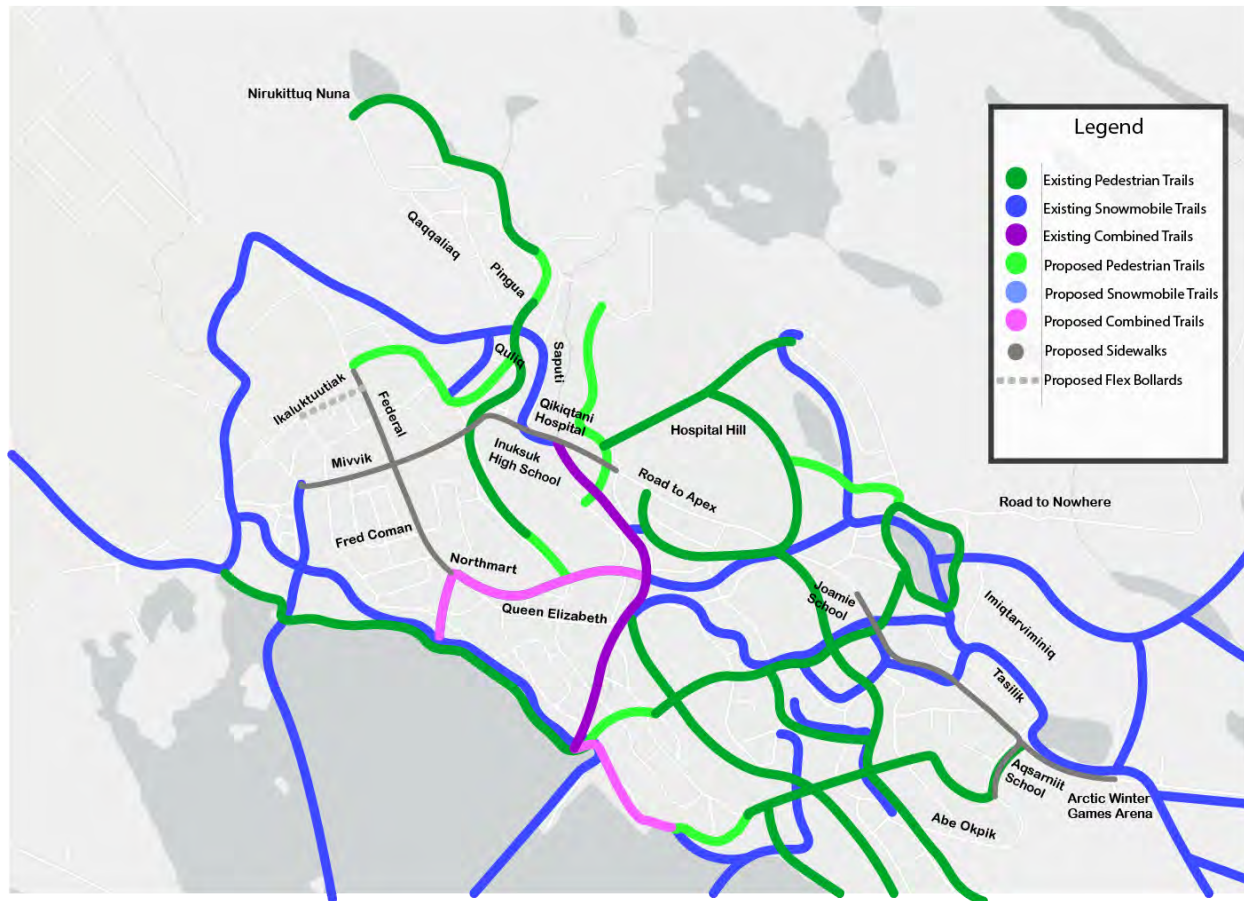


Figure 34: Proposed active transportation network

Pedestrian facilities should be clearly marked and should also clearly communicate who is / is not allowed to use these facilities. Figure 35 below is a good example of clear signage that alerts snowmobile users not to proceed with using a trail that is meant for pedestrians.



Figure 35: The start of the Trail to Apex

5.3 PEDESTRIAN SAFETY AND CROSSWALKS

Pedestrian safety presents challenges for municipal authorities across North America. The challenge is created by the inherent vulnerability of pedestrians in relation to other modes of mobility on the transportation network, particularly where conflicting movements between modes exist. Since pedestrians involved in traffic accidents are much more likely to be injured, safety must be a high priority in analyzing pedestrian facilities.

During public consultation through this TMP, several safety-related comments about improving sidewalks, trails, and pedestrian walkways, as well as comments such as “it’s too dangerous for me to consider walking with my family” point to the need for an improved pedestrian travel experience. This can be accomplished, in part, through additional pedestrian safety and crosswalk infrastructure.

This can also be accomplished through standardization of pedestrian facilities throughout the city. Currently, pedestrian walkways vary in appearance and functionality from corridor to corridor, creating some confusion as to where pedestrians should be walking. Figure 36 below illustrates a series of

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boulders off to the side of the road near Four Corners, potentially leading pedestrians to question whether they should be walking on the left side or the right side of the boulders. On the left side, there may be some safety implications if pedestrians are too close to traffic, particularly along this busy corridor; but on the right side, the walk appears to be more “challenging”, requiring the navigating around some obstacles along the way. It is recommended that the City standardize its pedestrian walkway design with sidewalks (where appropriate), or flex bollards (where they aren’t, but where traffic volumes remain significant enough to warrant a delineation of pedestrian walkways).



Figure 36: The approach to Four Corners

When deciding on appropriate pedestrian traffic control, it is important to consider guidelines such as the Transportation Association of Canada (TAC)’s Geometric Design Guide for Canadian Roads, which provides information and guidance to transportation practitioners to promote uniform roadway design, and the Manual of Uniform Traffic Control Devices for Canada (MUTCDC), which consists of traffic control devices and systems.

5.3.1 Pedestrian Crossing Guidelines

In the absence of Nunavut territorial transportation design guidelines, which seek to be consistent with the intent of the relevant laws (i.e., the territorial Traffic Safety Act (TSA)), the Ontario Traffic Manual in Ontario, the Transportation Association of Canada's (TAC) design manuals can be consulted as a reference to industry practices.

The TAC Geometric Design Guide for Canadian Roads provides practical guidance and application information on the planning, design, and operation of pedestrian roadway crossing treatments for transportation practitioners. The TAC manuals are quite comprehensive in describing where, how, and why to provide pedestrian crossing controls, but do not provide guidance on when crossing controls are justified (volume warrants), and do not address when a pedestrian facility is required to address concerns with system connectivity, pedestrian safety, or pedestrian desire lines.

This presents a challenge for local municipalities with lower vehicular volumes to justify pedestrian crossing facilities. For this reason, many smaller municipalities in Canada often implement courtesy crosswalks. However, courtesy crosswalks do not provide any legal protection and right-of-way for pedestrians under the TSA and are often a band-aid solution for a larger safety concern.

Iqaluit has a significant number of courtesy crosswalks, however, significant feedback was received in public engagement that was specific to the safety and effectiveness of the existing crosswalks. Given the broader comments related to the active transportation network, and in the interest of further improving safety, Iqaluit might consider converting some of these courtesy crosswalks into stop-signed or traffic controlled intersections. Alternatively, and perhaps more appropriately such as not to impede traffic along high traffic volume corridors unnecessarily, Iqaluit might consider installing flashing amber lights that can be activated by the push of a button, to improve the visibility of these courtesy crosswalks. Such measures are recommended to be given priority by the City in the short-term.



Figure 37: Despite the visible sign, some pedestrians may not feel comfortable crossing the road here unless additional measures are deployed

5.3.2 Guiding Principles

The following four (4) guiding principles were developed to help with the development and identification of initiatives to enhance pedestrian safety:

Reduce collision risk and severity: This is the key objective in providing pedestrian crossing control and other supporting facilities and devices. It is fundamental that the road system protects pedestrians and other vulnerable road users by achieving a high level of compliance from drivers, pedestrians, and other road users, and by minimizing pedestrian exposure to traffic.

Enhance connectivity: Effective crossing opportunities should be provided to ensure system connectivity for pedestrians while considering driver workload and expectation, proximity to other crossings, and the safety of pedestrians. Facilitating connectivity between crosswalks and sidewalks, and/or trail networks involves understanding and monitoring pedestrian desire lines, which evolve as a function of land use, the location of pedestrian generators and attractors, and proximity to existing crossing facilities. When alternatives to pedestrian desire lines are required due to other factors, these facilities should be simple, convenient, and clearly marked, and should effectively channel pedestrians so that they modify their natural choice with the shortest possible deviation.

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Enhance accessibility: The demographics of the pedestrian population, as well as the mix of road users at different time periods, should be considered and crossing treatment systems should be designed accordingly. As the population changes, a “design pedestrian” should be considered to ensure the accessibility of all road users and not only those with good visual, mental, and physical capabilities.

Enhance system maintenance: Ongoing rehabilitation and maintenance of pedestrian infrastructure should be equally as important as its implementation. A safe transportation system must not only be properly planned and designed but should also be properly maintained through an annual maintenance program. Maintenance-related issues such as irregular surfaces, debris on sidewalks, inadequate snow removal, water accumulation due to drainage problems, and others, can pose safety hazards for pedestrians, particularly the elderly and those with disabilities.

5.3.3 Pedestrian Crossing Site Prioritization Methodology

A methodology for evaluating pedestrian crossing implementation sites that do not satisfy minimum traffic/pedestrian volumes was developed with criteria related to pedestrian network connectivity, pedestrian demand, and safety. There is no industry standard methodology to select the criteria to use when evaluating candidate sites. Rather, the criteria and methodology should balance the unique needs of the City and the availability of existing data to quantify criteria.

Three pedestrian prioritization criteria themes were developed including:

- **Connectivity-based criteria;**
- **Demand-based criteria;** and
- **Safety-based criteria.**

Each of these three broad criteria categories have several additional specific criteria, levels and draft scoring, as shown in the bulleted list below, that were developed based on analysis throughout this study. The criteria were also developed based on best practices with the intention of providing a framework that will empower residents, councilors, and City staff to implement additional pedestrian crosswalks in Iqaluit based on the vision and objectives developed within this TMP, which may or may not be shared by territorial standards that take a broader approach to planning. At the same time, it will be important for Iqaluit to have procedures in place to manage the number of prospective crossing sites that are evaluated using these criteria. Depending on the demand for crosswalk review, Iqaluit might consider a minimum threshold of constructive feedback received internally or from the public before a review in the site prioritization methodology is triggered.

Beyond identifying a suitable location for a pedestrian crosswalk, additional consideration should be given for what type of crosswalk is appropriate. Section 5.3.4 below summarizes several different pedestrian crosswalk solutions and their applicability based on where a potential crossing is desired. There is no

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standard criteria or threshold for most crosswalk facilities, as such recommended solutions often require consulting with the local community to determine which solution would best serve a location.

Although this evaluation methodology is critical for developing objective metrics for assessing potential pedestrian crosswalks, there are other factors that are considered when the feasibility or appropriateness of locations (e.g., coordination with other planned roadway projects, site investigation to select exact crossing location, and site-specific installation costs).

Additionally, it must be recognized that the evaluation might change in between the planning and implementation stages (e.g., implementation of new nearby pedestrian crossovers, new transit routes, changes in roadway characteristics, changes to surrounding built environment). It should be noted that, although this TMP provides broad guidance on specific criteria to consider, these criteria should be refined and formalized such that the total evaluation scores are an optimized reflection of the suitability of a pedestrian crossover at each location. This should be done through additional study and consultation between City staff, councilors, and the local community.

Potential Pedestrian Crossing Criteria and Points for Consideration:

- Proximity to elder facilities and major medical centres
- Proximity to elementary and middle schools
- Proximity to Inuksuk High School or Nunavut Arctic College
- Proximity to another major trip generator
- Connection to multi-use trail or to major trail facility crossing
- Proximity to nearest controlled crossing opportunity
- Community request – have local residents requested a crosswalk in this location?
- Land use – higher score for institutional, employment, and high-density residential land uses; lower score for lower-density residential land uses
- Pedestrian collision history
- Road class – higher score for major roadways with increased traffic and pedestrian volumes; lower scores for minor and local roadways
- Posted speed limit – higher scores for roadways with higher speed limits
- Road maintenance – higher scores for roadways which are maintained to a standard which promotes safe pedestrian crossing and vehicle braking
- Visibility concerns – higher scores for good visibility at target crosswalk location, free of visual obstructions such as buildings or terrain

5.3.4 Types of Pedestrian Crossing Measures

The City can implement a variety of pedestrian crossing measures to improve safety at crossing locations. A traditional measure is improved crosswalk markings, using white paint to indicate the crosswalk on the roadway with a 'zebra' or 'ladder' pattern. However, it is acknowledged that the weather and environmental conditions in Iqaluit may limit the effectiveness of roadway markings. Therefore, other measures such as signage and lighting may be more impactful to indicate crosswalk locations to drivers.

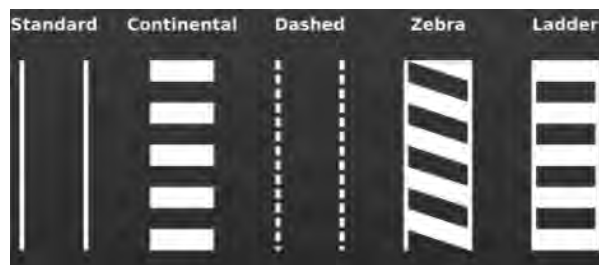


Figure 38: Crosswalk marking types

Signage is an effective measure to indicate the crosswalk location, but can also be hampered by poor visibility in winter weather conditions which are common in Iqaluit. Therefore, the addition of flashing lights activated by the pedestrian would improve the visibility of the crosswalk. A final option is the addition of a signalized intersection if traffic/pedestrian volumes warrant it.



Figure 39: Typical signalized crosswalk design

If crossing distances are long across a roadway or intersection, a 'bump-out' can be installed to reduce the crossing distance for the pedestrian. These are extensions of the curb which are either made of concrete, or in lower-cost rapid implementations, using temporary materials such as flexi-post bollards, pylons, or plastic curb dividers.



Figure 40: A low-cost bump-out has been created using flexi-post bollards (Source: Strong Towns)

5.3.5 Traffic Calming

As part of the pedestrian safety initiative, improved active transportation and pedestrian infrastructure addresses one aspect of the problem – the ‘carrot’. However, traffic calming, which seeks to reduce speeding and reduce vehicle traffic, addresses the other aspect, a ‘stick’ to those driving recklessly.

Measures which can be implemented to calm roadway traffic can include:

- Speed limit reductions: NACTO recommends a 30km/h speed limit on local urban roads, and 40km/h for collector urban roads. This includes streets in and around the Four Corners area of Iqaluit, which should have appropriate speed limits to promote the pedestrian experience by lowering vehicle speeds.
- Speed humps: Raised sections of the roadway which are uncomfortable to drive over at high speeds, encouraging drivers to travel at a safe speed. These should be used sparingly (if at all), however, as they can bring downsides such as more challenging access for emergency vehicles.
- Roadway narrowing: Generally, drivers will drive slower when roadways are narrower. Solutions such as medians, on-street parking, cycling lanes, and sidewalks all promote safe driving speeds.
- Signage: Signs reminding drivers to drive slowly, watch for children and elders, and obey the speed limit can all assist with promoting traffic calming principles, although they should not be the only solution.

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The installation of crosswalks should be paired with traffic calming solutions to ensure that drivers are moving at a speed which allows them to brake in time to allow pedestrians to cross safely, reducing collisions.

5.3.6 Pedestrian Safety Recommendations

Pedestrian crosswalks and traffic control devices play a vital role in pedestrian safety and must be implemented to ensure that the most troublesome locations receive attention commensurate with the problem. It is essential that pedestrian traffic control issues be continually monitored to ensure that the treatment measures remain effective and the available funds derive the best value.

It is recommended that the City of Iqaluit develop a pedestrian safety program to systematically and proactively address pedestrian safety issues. This is an important undertaking, especially given the population growth projected for the city and the city's focus on promoting active transportation as an encouraged mode of travel. The plan should lay out a vision for improving safety, examining existing conditions, and using a data-driven approach to match safety programs and improvements with demonstrated problems.

In addition, it is recommended that the City include design criteria in the City of Iqaluit Municipal Design Guidelines to improve safety, using the territorial Traffic Safety Act (TSA), the Ontario Traffic Manual in Ontario, the Transportation Association of Canada's (TAC) design manuals and this TMP as guidance. While the specific criteria (including design thresholds) should be established upon completion of a detailed pedestrian safety plan, categories of design criteria under Roadways, Walking Trails, and Snowmobile Trails for the City's consideration include:

- Pedestrian crossings shall be prioritized on major roads with high vehicle and pedestrian volumes and speeds, near major trip generators and community facilities, and/or in locations with a history of collisions involving pedestrians.
- Crosswalks should be enhanced with flashing lights or signalization on major roads (arterial and sometimes connector roads) to improve the visibility of the crosswalk.

Pedestrian crossing types and traffic calming measures such as speed reductions, roadway narrowing, and signage should be studied further during through the pedestrian safety plan and examined using a data-driven approach before including design guidelines for these measures in the Municipal Design Guidelines.

Active Transportation Recommendations:

- Develop a pedestrian safety plan that encompasses an evaluation system for active transportation infrastructure and pedestrian crossings, and a procedure for ensuring that the City is not overwhelmed with unwarranted crosswalk review requests. Using criteria outlined in this section, apply a scoring matrix to perform quantitative assessments.

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- Based on the findings from the pedestrian safety plan, revise the City's Municipal Design Guidelines to include guidelines for pedestrian crosswalk design and traffic calming measures.
- Investigate the use of flexi-post bollards for lower-cost and easily implementable pedestrian safety infrastructure, acknowledging visibility obstruction challenges with the existing wooden bollards.
- Seek greater access to crash statistics, including Motor Vehicle Crash Rates (MVCRs), to help justify capital works related to road safety improvements.
- Investigate the feasibility of drainage improvements, such as ditches, in tandem with sidewalk construction.
- No traffic calming measures are recommended for immediate implementation; however, they should be considered in the future as transportation data collection improves (especially with respect to crash rates) and if the initial measures of crosswalks and flexi-post bollards are seen to be insufficient in abating safety concerns.

6.0 SNOWMOBILE NETWORK

As Iqaluit is situated in Northern Canada, the cold temperatures make snowmobiling a popular mobility option for the local community. Several policy recommendations are provided to ensure that snowmobiles can continue to be operated safely, and encourage recreation. Not only are snowmobiles much more affordable relative to automobiles, the lower emissions produced by snowmobiles relative to automobiles make them a potential contributor to the achievement of local climate change objectives. Iqaluit should seek to promote the use of snowmobiles as an efficient transportation solution which co-exists safely with other forms of transportation.

6.1 PARKING

Snowmobiles are often used within the community to run errands, which means that adequate parking facilities should be provided to allow them to access the resources and destinations that their riders need. The Nunavut Good Building Practices Guidelines recommend a minimum parking stall size of 2m x 2m.

It is recommended that future residential and commercial developments provide dedicated parking spaces for snowmobiles. In addition, not all snowmobiles have the ability to drive in reverse, so parking stall design should strategically allow snowmobiles to pull through the stall to exit the parking lot, where possible.

6.2 ROUTE FORMALIZATION

One major request which arose from the public engagement process was the formalization and improvement of snowmobile routes. Other than signage which is in place to designate where snowmobiles should safely cross the roadway, the routes are generally determined by the snowmobile users rather than the City.

In addition, snowmobile routes change in accordance with the weather conditions. For example, a year with significant snowfall could allow for snowmobile users to create new informal routes which were not previously possible. Therefore, it is important to acknowledge that snowmobile routes, even when formalized, may still require the ability to make seasonal modifications. It is recommended that the City publish annual snowmobile route maps, and maintain the indicated routes to a proper standard.

6.2.1 Criteria for candidate routes

It is important that candidate snowmobile routes are assessed based on their safety, usefulness, and impact to surrounding populations. The following criteria were developed to qualitatively assess snowmobile routes:

- **Route curvature/sight lines:** To minimize collisions between snowmobiles and other roadway users, snowmobile routes should be identified with visibility as a central factor. The curvature of the roadway and sight lines should be investigated along candidate routes, ensuring that visibility is maintained along all curves and at all intersections.
- **Proximity to everyday destinations:** While snowmobiling is a popular recreational activity, the official route network should acknowledge that many use snowmobiles as a legitimate form of everyday transportation. This means that official routes should seek to connect key destinations such as employment centres, grocery stores, along with recreational sites. In addition, several comments from the public requested that the routes accommodate for the use of qamutiik during hunting seasons.
- **Proximity to sensitive populations/land uses:** While snowmobile routes should allow for straightforward travel between popular destinations, the specific routing should be developed in a way which minimizes disruption to sensitive populations and land uses. Therefore, routes which pass by medical centres, daycares, schools, and the Elders Residence/Qammaq should ensure that adequate separation is implemented, or the route should detour around these areas where possible.
- **Free of obstructions:** Due to the ad-hoc nature of existing snowmobile routes, safety concerns can arise when a route is established which contains obstructions such as electrical poles, structures, fences or large rocks. Care should be taken to ensure official routes mitigate the danger of potential obstructions.

Snowmobile Network

- **Route incline:** Official routes should be restricted to those which have an incline which is manageable to traverse safely and at a range of snowmobiling skill levels, ensuring the trails are accessible to all.

6.3 ROADWAY CROSSINGS

A key consideration for the operation of snowmobiles is ensuring the ability for them to safely cross roadways. As it currently stands, many crossings are not designed with safe snowmobile operation in mind, and create hazards for snowmobilers. Commonly noted concerns with existing crossings include:

- High snowbanks
- Roadway drainage features (run-off trenches, ditches, etc.)
- Paved roadways completely cleared of snow

At crossings identified as part of a snowmobile route network, these concerns should be alleviated by ensuring that City crews maintain a relatively level surface with adequate snow cover. In addition, consistent, highly visible signage should be used at the crossing, and additional signage upstream of the crossing which prepares the automobile drivers to stop. For crossings along high-traffic roadways, flashing lights or signalized crossings should be implemented.



Figure 41: Example of a snowmobile trail / road intersection which could be better marked

6.3.1 Best Practices

6.3.1.1 Alberta

The Alberta Infrastructure and Transportation provincial department supplies guidelines pertaining to the installation and use of Snowmobile Crossing signs.³

In Alberta, snowmobile operators must stop their snowmobile at a designated crossing, dismount passengers, and yield to oncoming traffic prior to crossing the highway. As visibility of these crossings can be impacted by weather and road curvature, Snowmobile Crossing signs are used prior to the crossing (200m-300m) to prepare automobile drivers.



Figure 42: Examples of snowmobile crossing signage

As snowmobile operators must yield to oncoming traffic and wait until it is safe to cross, automobile drivers are technically not required to be notified of snowmobile crossing locations (as they have right of way). However, it has been found to be in the interest of safety if drivers are prepared for the possibility of encountering a snowmobile mid-crossing when driving on a roadway which may present safety concerns, such as poor visibility.

The warrants used to assess if a Snowmobile Crossing sign should be assessed include:

³ <https://open.alberta.ca/dataset/f38dab02-6a10-453c-8ac5-6eea377e2535/resource/04c0c571-0f8a-4602-9d21-a8d808622419/download/trans-snowmobile-crossing-sign-2008-03.pdf>

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- If a designated snowmobile trail crosses the roadway
- The frequency of snowmobile crossing maneuvers
- If conditions of the crossing present a 'unusual degree of hazard'
- Safety concerns at the crossing location, determined by collision history and stakeholder input

Snowmobile Crossing signage is typically requested by the public, through official channels such as a local stakeholder group (snowmobile club). The request is then assessed by Alberta Infrastructure and Transportation for review. Assessment criteria include:

- Location of the crossing (mid-block, intersection)
- Traffic volumes
- Frequency of snowmobile crossing maneuvers
- Operational conditions of the trail approaches and crossing, from the trail and from the roadway
- Safety issues

The department avoids encouraging snowmobile crossings across provincial highways, and instead implements alternatives such as trail re-alignment, use of existing intersection, or crossing re-location to local roads.

6.3.1.2 Minnesota

The US state of Minnesota published an in-depth research study into best practices for at-grade trail crossings.⁴ As a northern state, Minnesota can see weather conditions similar to Alberta and other colder Canadian provinces/territories.

⁴ <https://www.dot.state.mn.us/research/TS/2013/201323.pdf>



Figure 43: Minnesota snowmobile crossing signage

The study notes that the relatively high speeds of snowmobile have design implications on trails and crossings, as stopping sight distances are affected. It highlights a unique physics problem, where snowmobiles operating at night at high speeds can “over-run” their stopping sight distance, as the headlights will not illuminate far enough ahead to stop safely.

For snowmobile crossings, it is highlighted that signage may be chosen for areas with narrow shoulders or steep sideslopes to improve awareness and visibility. The study recommends installation of the signage at least 750 feet (228 metres) from the crossing.

7.0 IMPLEMENTATION PLANNING

This TMP’s recommendations have been grouped into categories including road network recommendations, transit recommendations, active transportation recommendations, signage and wayfinding recommendations, parking recommendations, and other recommendations. They have also been phased as immediate term, short-term, medium-term, or long-term recommendations.

As the City of Iqaluit’s transportation network is a complex system involving many different types of transportation modes and infrastructure, it will be important to appreciate throughout the implementation process that the city’s ongoing growth and evolution will bring impacts to the larger transportation network that can be difficult to predict. Particularly in the medium-to-long-term, it will be necessary for the City to revisit some of the findings and assumptions with respect to future conditions made in the TMP for their relevance, and adapt the implementation strategy as appropriate to be responsive to future conditions that may not be captured in the TMP. As acknowledged in section 3.4.1, given that Future Development Areas A and B are not anticipated to be completed by 2030, long-term recommendations can generally be interpreted as ‘2030 and beyond’.

Further, it is important to appreciate that all elements of a transportation system are interrelated, and that improvements to one aspect of transportation infrastructure or transportation policy in Iqaluit will bring implications with respect to other elements of transportation in the city. As such, as the City begins actioning these recommendations, it is important that the City consider not only the individual project in

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and of itself, but give consideration to secondary impacts across other elements of transportation in Iqaluit. To aid the City in this integrated approach to improving the city's transportation system, all of the above-noted categories have been considered throughout all phases of implementation (immediate, short, medium, and long term).

Implementation planning for each of the above-noted categories are summarized below in Table 12 through Table 17.

Table 12: Phasing of Road Network Recommendations

| <u>Immediate Term</u> <u>(current year)</u> | <u>Short Term</u> <u>(1-5 years)</u> | <u>Medium Term</u> <u>(5-8 years)</u> | <u>Long Term</u> <u>(beyond 2030)</u> |
|--|---|---|--|
| Road Network Recommendations | | | |
| <u>Niaqunngusiariaq / Saputi</u> Addition of an eastbound left turn storage lane and installation of traffic control signals. <u>General</u> Develop a plan for traffic count data collection on a recurring basis to help inform future decision-making. | <u>Queen Elizabeth / Niaqunngusiariaq</u> Addition of northbound and southbound left turn storage lanes. | <u>Niaqunngusiariaq / Saputi</u> Addition of exclusive southbound left and right turn lanes <u>Queen Elizabeth / Niaqunngusiariaq</u> Installation of traffic control signals, with eastbound left and westbound left turn storage lanes. <u>Four Corners</u> Installation of traffic control signals. <u>Federal Road / Ikaluktuutiak Drive</u> Conversion from two-way stop control to all-way stop control. | <u>Niaqunngusiariaq / Bypass Road Connection at Kangiq & Iniq</u> Construction of a Bypass Road connection between Federal Road and Niaqunngusiariaq; and installation of traffic control signals at the intersection of Niaqunngusiariaq and the Bypass Road connection. <u>Atungauyait / Niaqunngusiariaq</u> Installation of traffic control signals. <u>Niaqunngusiariaq / Road to Nowhere</u> Installation of traffic control signals and an eastbound left turn storage lane. |

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Table 13: Phasing of Transit Recommendations

| <u>Immediate Term</u> (current year) | <u>Short Term</u> (1-5 years) | <u>Medium Term</u> (5-8 years) | <u>Long Term</u> (beyond 2030) |
|--|--|---|---|
| Transit Recommendations | | | |
| Further study of the Iqaluit Transit opportunity and implementation strategies, using the TMP's recommendations as a starting point. | Launch of Iqaluit Transit pilot (early in the short-term). Full rollout of Iqaluit Transit (later in the short-term). | Ongoing monitoring of the Iqaluit Transit system's performance. Expand and/or tweak service as needed depending on performance, city growth, evolving travel needs, and available funding. | Ongoing monitoring of the Iqaluit Transit system's performance. Expand and/or tweak service as needed depending on performance, city growth, evolving travel needs, and available funding. |

Table 14: Phasing of Active Transportation Recommendations

| <u>Immediate Term</u> (current year) | <u>Short Term</u> (1-5 years) | <u>Medium Term</u> (5-8 years) | <u>Long Term</u> (beyond 2030) |
|--|--|--|---|
| Active Transportation Recommendations | | | |
| Develop a pedestrian safety plan, in tandem with the signage and wayfinding plan. The plan should lay out a vision for examining existing conditions, improving safety, and using a data-driven approach to match safety programs and improvements with demonstrated problems. Consider flex bollard implementation as an interim solution before sidewalks can be implemented. | Complete pedestrian safety plan and begin standardizing pedestrian facilities across the city in accordance with the plan's recommendations. Consider additional flex bollard implementation and, as funding allows, begin implementation of the sidewalk recommendations summarized in Table 11. Investigate the feasibility of drainage improvements, such as ditches, in tandem with sidewalk construction. Improve existing pedestrian crossings and implement additional pedestrian safety measures as per Sections 5.3.1-5.3.4. | Continued implementation of sidewalk recommendations and of drainage improvements. | Continued implementation of sidewalk recommendations and of drainage improvements (including consideration of additional sidewalks not identified in Table 11). |

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Implementation Planning

| <u>Immediate Term</u> <u>(current year)</u> | <u>Short Term</u> <u>(1-5 years)</u> | <u>Medium Term</u> <u>(5-8 years)</u> | <u>Long Term</u> <u>(beyond 2030)</u> |
|--|---|--|--|
| | Revise the City's Municipal Design Guidelines to include guidelines for pedestrian crosswalk design and traffic calming measures. | | |

Table 15: Phasing of Signage and Wayfinding Recommendations

| <u>Immediate Term</u> <u>(current year)</u> | <u>Short Term</u> <u>(1-5 years)</u> | <u>Medium Term</u> <u>(5-8 years)</u> | <u>Long Term</u> <u>(beyond 2030)</u> |
|---|--|--|---|
| Signage and Wayfinding Recommendations | | | |
| Inventory and review existing transportation signage and wayfinding and develop a signage and wayfinding plan. Identify quick, low-cost interim signage and wayfinding solutions to improve road safety at critical nodes such as the Mivvik/Allanngua junction, in advance of the signage and wayfinding plan's completion. | Complete signage and wayfinding plan and begin implementation of findings. | Continue implementation of findings from the signage and wayfinding plan. Evaluate impact of signage and wayfinding implementations and identify if more significant actions might be needed in the form of infrastructure updates (expanding right-of-ways, additional sidewalks, traffic calming measures, etc.). | Continue evaluating the impact of signage and wayfinding recommendations and considering other actions as needed. |

Table 16: Phasing of Parking Recommendations

| <u>Immediate Term</u> <u>(current year)</u> | <u>Short Term</u> <u>(1-5 years)</u> | <u>Medium Term</u> <u>(5-8 years)</u> | <u>Long Term</u> <u>(beyond 2030)</u> |
|--|---|--|--|
| Parking Recommendations | | | |
| Give further consideration to the appropriateness of parking management measures, using Section 3.8 of the TMP document as a starting point. | Begin implementation of parking management measures as appropriate. | Continue implementation of parking management measures as appropriate. | Ongoing monitoring and evaluation of parking supply versus demand, taking actions to balance supply and demand as appropriate. |

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Conclusion

Table 17: Phasing of Other Recommendations

| <u>Immediate Term</u> (current year) | <u>Short Term</u> (1-5 years) | <u>Medium Term</u> (5-8 years) | <u>Long Term</u> (beyond 2030) |
|---|---|---|---|
| Other Recommendations | | | |
| Seek greater access to crash statistics, including Motor Vehicle Crash Rates (MVCRs), to help justify capital works related to road safety improvements, and to help identify additional road safety improvements which may be warranted. | Develop a traffic control warrants policy, using Section 3.6 of the TMP as a starting point. Publish annual snowmobile route maps and ensure the routes are maintained to a proper standard. | Revisit the traffic control warrants policy for any needed updates. | Revisit the traffic control warrants policy for any needed updates. Review roadway classifications for any needed updates. |
| In consultation with the District Education Authority, propose a change to the system where K-8 children are bussed home at lunch time since this leads to congestion during the midday period. | Seek funding to offer lunch programs at elementary schools to eliminate the need for lunchtime bussing. | | |

It is further recommended that the City commission an Asset Management Plan and develop an asset management strategy for its infrastructure, including all transportation assets. In the course of the Asset Management Plan's development, it is recommended that the City review and document of the state of repair of all existing transportation assets, evaluate current transportation infrastructure maintenance practices, and develop a plan to ameliorate notable deficiencies, and for ongoing monitoring and evaluation into the future. This will help ensure that the City gets the most out of its transportation assets, and can lead to cost savings through a proactive approach to maintenance (as opposed to a reactive approach), and if major capital expenses can be deferred as a result of maintaining asset quality. Effective asset management can further provide benefits to the quality of life of Iqalumiut. As additional transportation assets and infrastructure are deployed over the short, medium, and long terms, the City should ensure that these assets are included in the City's Asset Management Plan and its ongoing asset management strategies and practices.

8.0 CONCLUSION

The purpose of this Transportation Master Plan (TMP) is to develop a long-term strategic vision for the future of transportation in Iqaluit, evaluating all aspects of the transportation network including but not limited to roads, active transportation, and snowmobile trails. Emphasis was placed on sustainable modes of transportation including active modes and transit, for which a feasibility study for an Iqaluit Transit service was included, with the objective of achieving a mode shift away from single-occupancy

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Conclusion

vehicles to the extent feasible. Emphasis was also placed on low-hanging fruit items such as signage and wayfinding, as well as improved walkway, lane, and intersection definition, which can bring significant positive impacts to transportation in Iqaluit for minimal costs.

The TMP process began with a round of engagement and a review of current and future transportation conditions in the City. From here, growth forecasts were undertaken, needs and opportunities were evaluated, and multimodal transportation network recommendations were developed. Implementation considerations were then drafted alongside a series of policies and strategies for consideration, intended to support the transportation network recommendations. In the course of this TMP, reference was made to past relevant studies such as the Federal Road Development Area Transportation Study (2018), the Iqaluit General Plan (2010), and the Traffic Light Signal Controls Final Report (2009), and the outcomes of this TMP seek to align and integrate with these studies as appropriate, keeping in mind the local context in 2021 is different from that of years past. Recommendations are also considerate of maximizing the City's value-for-money and getting the most out of its existing transportation assets and infrastructure, although further study is required to flesh out detailed costing of the recommendations.

When moving forward with implementation, it must be appreciated that the suite of recommendations, policies, and strategies presented in this TMP are best treated as pieces of a larger puzzle rather than as standalone action items. That is, all elements of the transportation network are interrelated, and the package of recommendations together is greater than the sum of the parts. Active transportation infrastructure recommendations, for example, have synergies with wayfinding and signage recommendations; and both are influenced by the proposed transit concept in consideration that transit trips always begin and end with a walk to and from the bus stop. With this integrated focus on implementation, and on transportation in Iqaluit more generally speaking, the City will be well-positioned for economic prosperity, for community building, for neighbourhood preservation, and for maintaining and strengthening the quality of life for Iqalumiut into the future.

APPENDICES

APPENDIX A INTERSECTION LEVEL OF SERVICE (LOS) SUMMARY OUTPUTS

(Begins on the following page)

Notes:

EBL = Eastbound approach, left turning traffic

EBT = Eastbound approach, through traffic

EBR = Eastbound approach, right turning traffic

WBL = Westbound approach, left turning traffic

WBT = Westbound approach, through traffic

WBR = Westbound approach, right turning traffic

NBL = Northbound approach, left turning traffic

NBT = Northbound approach, through traffic

NBR = Northbound approach, right turning traffic

SBL = Southbound approach, left turning traffic

SBT = Southbound approach, through traffic

SBR = Southbound approach, right turning traffic

HCM Unsignalized Intersection Capacity Analysis

101: Federal Rd & Qaqqamiut

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 1 | 2 | 12 | 66 | 4 | 11 | 45 | 98 | 39 | 7 | 57 | 2 |
| Future Volume (Veh/h) | 1 | 2 | 12 | 66 | 4 | 11 | 45 | 98 | 39 | 7 | 57 | 2 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 2 | 13 | 72 | 4 | 12 | 49 | 107 | 42 | 8 | 62 | 2 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | None | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 319 | 326 | 63 | 319 | 306 | 128 | 64 | | | 149 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 319 | 326 | 63 | 319 | 306 | 128 | 64 | | | 149 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 100 | 100 | 99 | 88 | 99 | 99 | 97 | | | 99 | | |
| cM capacity (veh/h) | 605 | 570 | 1002 | 606 | 585 | 922 | 1538 | | | 1432 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 16 | 88 | 198 | 72 | | | | | | | | |
| Volume Left | 1 | 72 | 49 | 8 | | | | | | | | |
| Volume Right | 13 | 12 | 42 | 2 | | | | | | | | |
| cSH | 882 | 635 | 1538 | 1432 | | | | | | | | |
| Volume to Capacity | 0.02 | 0.14 | 0.03 | 0.01 | | | | | | | | |
| Queue Length 95th (m) | 0.4 | 3.6 | 0.7 | 0.1 | | | | | | | | |
| Control Delay (s) | 9.2 | 11.6 | 2.0 | 0.9 | | | | | | | | |
| Lane LOS | A | B | A | A | | | | | | | | |
| Approach Delay (s) | 9.2 | 11.6 | 2.0 | 0.9 | | | | | | | | |
| Approach LOS | A | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 4.4 | | | | | | | | | |
| Intersection Capacity Utilization | | 36.3% | | ICU Level of Service | | | A | | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions AM 7:00 am 08/03/2021 Existing

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HCM Unsignalized Intersection Capacity Analysis

102: Allanngua & Akiliq/Ikaluktuutiak Dr

04/25/2022

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 20 | 30 | 1 | 21 | 45 | 3 |
| Future Volume (Veh/h) | 20 | 30 | 1 | 21 | 45 | 3 |
| Sign Control | Stop | Stop | Stop | Free | Free | Free |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 22 | 33 | 1 | 23 | 49 | 3 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | None | | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 98 | 0 | 144 | 100 | 0 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 98 | 0 | 144 | 100 | 0 | |
| IC, single (s) | 6.5 | 6.2 | 7.1 | 6.5 | 4.1 | |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 4.0 | 3.3 | 3.5 | 4.0 | 2.2 | |
| p0 queue free % | 97 | 97 | 100 | 97 | 97 | |
| cM capacity (veh/h) | 768 | 1085 | 765 | 767 | 1623 | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | | | |
| Volume Total | 55 | 24 | 52 | | | |
| Volume Left | 0 | 1 | 49 | | | |
| Volume Right | 33 | 0 | 3 | | | |
| cSH | 931 | 767 | 1623 | | | |
| Volume to Capacity | 0.06 | 0.03 | 0.03 | | | |
| Queue Length 95th (m) | 1.4 | 0.7 | 0.7 | | | |
| Control Delay (s) | 9.1 | 9.8 | 6.9 | | | |
| Lane LOS | A | A | A | | | |
| Approach Delay (s) | 9.1 | 9.8 | 6.9 | | | |
| Approach LOS | A | A | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 8.4 | | | |
| Intersection Capacity Utilization | | 13.3% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

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HCM Unsignalized Intersection Capacity Analysis

103: Allanngua & Mivvik Street

04/25/2022

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|-----------------------------------|-------|------|-------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop |
| Traffic Volume (vph) | 84 | 15 | 65 | 120 | 9 | 50 |
| Future Volume (vph) | 84 | 15 | 65 | 120 | 9 | 50 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 91 | 16 | 71 | 130 | 10 | 54 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | | | |
| Volume Total (vph) | 107 | 201 | 64 | | | |
| Volume Left (vph) | 0 | 71 | 10 | | | |
| Volume Right (vph) | 16 | 0 | 54 | | | |
| Hadj (s) | -0.06 | 0.10 | -0.44 | | | |
| Departure Headway (s) | 4.2 | 4.3 | 4.1 | | | |
| Degree Utilization, x | 0.12 | 0.24 | 0.07 | | | |
| Capacity (veh/h) | 836 | 830 | 807 | | | |
| Control Delay (s) | 7.8 | 8.6 | 7.5 | | | |
| Approach Delay (s) | 7.8 | 8.6 | 7.5 | | | |
| Approach LOS | A | A | A | | | |
| Intersection Summary | | | | | | |
| Delay | | | 8.2 | | | |
| Level of Service | | | A | | | |
| Intersection Capacity Utilization | | Er% | | ICU Level of Service | | H |
| Analysis Period (min) | | 15 | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions AM 7:00 am 08/03/2021 Existing

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HCM Unsignalized Intersection Capacity Analysis

104: Federal Rd & Ikaluktuutiak Dr

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 48 | 1 | 62 | 0 | 2 | 0 | 150 | 270 | 6 | 1 | 148 | 59 |
| Future Volume (Veh/h) | 48 | 1 | 62 | 0 | 2 | 0 | 150 | 270 | 6 | 1 | 148 | 59 |
| Sign Control | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free | Free | Free |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 52 | 1 | 67 | 0 | 2 | 0 | 163 | 293 | 7 | 1 | 161 | 64 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | None | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 818 | 821 | 193 | 885 | 850 | 296 | 225 | | | 300 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 818 | 821 | 193 | 885 | 850 | 296 | 225 | | | 300 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 80 | 100 | 92 | 100 | 99 | 100 | 88 | | | 100 | | |
| cM capacity (veh/h) | 265 | 272 | 849 | 221 | 261 | 743 | 1344 | | | 1261 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 120 | 2 | 463 | 226 | | | | | | | | |
| Volume Left | 52 | 0 | 163 | 1 | | | | | | | | |
| Volume Right | 67 | 0 | 7 | 64 | | | | | | | | |
| cSH | 431 | 261 | 1344 | 1261 | | | | | | | | |
| Volume to Capacity | 0.28 | 0.01 | 0.12 | 0.00 | | | | | | | | |
| Queue Length 95th (m) | 8.6 | 0.2 | 3.1 | 0.0 | | | | | | | | |
| Control Delay (s) | 16.5 | 18.9 | 3.6 | 0.0 | | | | | | | | |
| Lane LOS | C | C | A | A | | | | | | | | |
| Approach Delay (s) | 16.5 | 18.9 | 3.6 | 0.0 | | | | | | | | |
| Approach LOS | C | C | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 4.6 | | | | | | | | | |
| Intersection Capacity Utilization | | 62.3% | | ICU Level of Service | | | B | | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

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105: Federal Rd & Nunavut

04/25/2022

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106: Queen Elizabeth/Federal Rd & Mivvik Street/Niaqunngusiariaq

04/25/2022

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107: Niaqunngusiarlaq & Saputi

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108: Queen Elizabeth

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Existing Conditions Iqaluit TMP - Existing Conditions AM 7:00 am 08/03/2021 Existing

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HCM Unsignalized Intersection Capacity Analysis

109: Atungauyait & Niaqunggusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 1 | 182 | 19 | 10 | 463 | 0 | 37 | 1 | 20 | 1 | 0 | 1 |
| Future Volume (Veh/h) | 1 | 182 | 19 | 10 | 463 | 0 | 37 | 1 | 20 | 1 | 0 | 1 |
| Sign Control | Free | | | Free | | | Stop | | | Stop | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 198 | 21 | 11 | 503 | 0 | 40 | 1 | 22 | 1 | 0 | 1 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 503 | | | 219 | | | 736 | 736 | 208 | 758 | 746 | 503 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 503 | | | 219 | | | 736 | 736 | 208 | 758 | 746 | 503 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 99 | | | 88 | 100 | 97 | 100 | 100 | 100 |
| cM capacity (veh/h) | 1061 | | | 1350 | | | 332 | 344 | 832 | 312 | 339 | 569 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 220 | 514 | 63 | 2 | | | | | | | | |
| Volume Left | 1 | 11 | 40 | 1 | | | | | | | | |
| Volume Right | 21 | 0 | 22 | 1 | | | | | | | | |
| cSH | 1061 | 1350 | 420 | 403 | | | | | | | | |
| Volume to Capacity | 0.00 | 0.01 | 0.15 | 0.00 | | | | | | | | |
| Queue Length 95th (m) | 0.0 | 0.2 | 4.0 | 0.1 | | | | | | | | |
| Control Delay (s) | 0.0 | 0.3 | 15.1 | 14.0 | | | | | | | | |
| Lane LOS | A | A | C | B | | | | | | | | |
| Approach Delay (s) | 0.0 | 0.3 | 15.1 | 14.0 | | | | | | | | |
| Approach LOS | | C | B | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | 1.4 | | | | | | | | | | |
| Intersection Capacity Utilization | | 46.9% | | ICU Level of Service | | | A | | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

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HCM Unsignalized Intersection Capacity Analysis

110: Niaqunggusiariaq & Road to Nowhere

04/25/2022

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|----------------------|------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 48 | 155 | 397 | 8 | 7 | 120 |
| Future Volume (Veh/h) | 48 | 155 | 397 | 8 | 7 | 120 |
| Sign Control | Free | Free | Free | Stop | | |
| Grade | 0% | 0% | 0% | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 52 | 168 | 432 | 9 | 8 | 130 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 441 | | | | 708 | 436 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 441 | | | | 708 | 436 |
| IC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 95 | | | | 98 | 79 |
| cM capacity (veh/h) | 1119 | | | | 382 | 620 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 220 | 441 | 138 | | | |
| Volume Left | 52 | 0 | 8 | | | |
| Volume Right | 0 | 9 | 130 | | | |
| cSH | 1119 | 1700 | 598 | | | |
| Volume to Capacity | 0.05 | 0.26 | 0.23 | | | |
| Queue Length 95th (m) | 1.1 | 0.0 | 6.7 | | | |
| Control Delay (s) | 2.3 | 0.0 | 12.8 | | | |
| Lane LOS | A | | B | | | |
| Approach Delay (s) | 2.3 | 0.0 | 12.8 | | | |
| Approach LOS | | B | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 2.8 | | | | |
| Intersection Capacity Utilization | | 54.7% | ICU Level of Service | | A | |
| Analysis Period (min) | | 15 | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions AM 7:00 am 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

111: Abe Okpik & Niaqunggusiariaq

04/25/2022

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|-----------------------------------|-------|-------|----------------------|------|------|------|
| Lane Configurations | | | | | | |
| Sign Control | Stop | | Stop | Stop | | |
| Traffic Volume (vph) | 111 | 44 | 31 | 263 | 115 | 40 |
| Future Volume (vph) | 111 | 44 | 31 | 263 | 115 | 40 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 121 | 48 | 34 | 286 | 125 | 43 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | | | |
| Volume Total (vph) | 169 | 320 | 168 | | | |
| Volume Left (vph) | 0 | 34 | 125 | | | |
| Volume Right (vph) | 48 | 0 | 43 | | | |
| Hadj (s) | -0.14 | 0.06 | 0.03 | | | |
| Departure Headway (s) | 4.6 | 4.6 | 5.1 | | | |
| Degree Utilization, x | 0.22 | 0.41 | 0.24 | | | |
| Capacity (veh/h) | 735 | 749 | 657 | | | |
| Control Delay (s) | 8.9 | 10.8 | 9.6 | | | |
| Approach Delay (s) | 8.9 | 10.8 | 9.6 | | | |
| Approach LOS | A | B | A | | | |
| Intersection Summary | | | | | | |
| Delay | | 10.0 | | | | |
| Level of Service | | A | | | | |
| Intersection Capacity Utilization | | 46.8% | ICU Level of Service | | A | |
| Analysis Period (min) | | 15 | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions AM 7:00 am 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

112: Abe Okpik/Taslik & Niaqunggusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|----------------------|-------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 7 | 55 | 33 | 7 | 97 | 3 | 49 | 2 | 12 | 5 | 5 | 15 |
| Future Volume (vph) | 7 | 55 | 33 | 7 | 97 | 3 | 49 | 2 | 12 | 5 | 5 | 15 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 8 | 60 | 36 | 8 | 105 | 3 | 53 | 2 | 13 | 5 | 5 | 16 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 104 | 116 | 68 | 26 | | | | | | | | |
| Volume Left (vph) | 8 | 8 | 53 | 5 | | | | | | | | |
| Volume Right (vph) | 36 | 3 | 13 | 16 | | | | | | | | |
| Hadj (s) | -0.16 | 0.03 | 0.08 | -0.30 | | | | | | | | |
| Departure Headway (s) | 4.1 | 4.3 | 4.5 | 4.2 | | | | | | | | |
| Degree Utilization, x | 0.12 | 0.14 | 0.08 | 0.03 | | | | | | | | |
| Capacity (veh/h) | 855 | 823 | 759 | 803 | | | | | | | | |
| Control Delay (s) | 7.6 | 7.9 | 7.9 | 7.3 | | | | | | | | |
| Approach Delay (s) | 7.6 | 7.9 | 7.9 | 7.3 | | | | | | | | |
| Approach LOS | A | A | A | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | 7.8 | | | | | | | | | | |
| Level of Service | | A | | | | | | | | | | |
| Intersection Capacity Utilization | | 25.3% | ICU Level of Service | | A | | | | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions AM 7:00 am 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

101: Federal Rd & Qaqqamiut

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 3 | 8 | 37 | 30 | 9 | 7 | 59 | 34 | 39 | 9 | 73 | 2 |
| Future Volume (Veh/h) | 3 | 8 | 37 | 30 | 9 | 7 | 59 | 34 | 39 | 9 | 73 | 2 |
| Sign Control | Stop | | | Stop | | | Free | | | Free | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 3 | 9 | 40 | 33 | 10 | 8 | 64 | 37 | 42 | 10 | 79 | 2 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | | | None | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 299 | 307 | 80 | 330 | 287 | 58 | 81 | | | 79 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 299 | 307 | 80 | 330 | 287 | 58 | 81 | | | 79 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 100 | 98 | 96 | 94 | 98 | 99 | 96 | | | 99 | | |
| cM capacity (veh/h) | 616 | 577 | 980 | 568 | 592 | 1008 | 1517 | | | 1519 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 52 | 51 | 143 | 91 | | | | | | | | |
| Volume Left | 3 | 33 | 64 | 10 | | | | | | | | |
| Volume Right | 40 | 8 | 42 | 2 | | | | | | | | |
| cSH | 849 | 615 | 1517 | 1519 | | | | | | | | |
| Volume to Capacity | 0.06 | 0.08 | 0.04 | 0.01 | | | | | | | | |
| Queue Length 95th (m) | 1.5 | 2.1 | 1.0 | 0.2 | | | | | | | | |
| Control Delay (s) | 9.5 | 11.4 | 3.5 | 0.9 | | | | | | | | |
| Lane LOS | A | B | A | A | | | | | | | | |
| Approach Delay (s) | 9.5 | 11.4 | 3.5 | 0.9 | | | | | | | | |
| Approach LOS | A | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | 4.9 | | | | | | | | | | |
| Intersection Capacity Utilization | | 31.2% | | ICU Level of Service | | | A | | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

102: Allanngua & Akiliq/Ikaluktuutiak Dr

04/25/2022

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 14 | 39 | 14 | 14 | 24 | 6 |
| Future Volume (Veh/h) | 14 | 39 | 14 | 14 | 24 | 6 |
| Sign Control | Stop | | Stop | Free | | |
| Grade | 0% | | 0% | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 15 | 42 | 15 | 15 | 26 | 7 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 59 | 0 | 105 | 56 | 0 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 59 | 0 | 105 | 56 | 0 | |
| IC, single (s) | 6.5 | 6.2 | 7.1 | 6.5 | 4.1 | |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 4.0 | 3.3 | 3.5 | 4.0 | 2.2 | |
| p0 queue free % | 98 | 96 | 98 | 98 | 98 | |
| cM capacity (veh/h) | 819 | 1085 | 819 | 822 | 1623 | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | | | |
| Volume Total | 57 | 30 | 33 | | | |
| Volume Left | 0 | 15 | 26 | | | |
| Volume Right | 42 | 0 | 7 | | | |
| cSH | 999 | 821 | 1623 | | | |
| Volume to Capacity | 0.06 | 0.04 | 0.02 | | | |
| Queue Length 95th (m) | 1.4 | 0.9 | 0.4 | | | |
| Control Delay (s) | 8.8 | 9.6 | 5.7 | | | |
| Lane LOS | A | A | A | | | |
| Approach Delay (s) | 8.8 | 9.6 | 5.7 | | | |
| Approach LOS | A | A | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 8.2 | | | | |
| Intersection Capacity Utilization | | 18.4% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

103: Allanngua & Mivvik Street

04/25/2022

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|-----------------------------------|-------|------|-------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Sign Control | Stop | | Stop | Stop | | |
| Traffic Volume (vph) | 164 | 25 | 100 | 68 | 15 | 141 |
| Future Volume (vph) | 164 | 25 | 100 | 68 | 15 | 141 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 178 | 27 | 109 | 74 | 16 | 153 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | | | |
| Volume Total (vph) | 205 | 183 | 169 | | | |
| Volume Left (vph) | 0 | 109 | 16 | | | |
| Volume Right (vph) | 27 | 0 | 153 | | | |
| Hadj (s) | -0.05 | 0.15 | -0.49 | | | |
| Departure Headway (s) | 4.5 | 4.7 | 4.3 | | | |
| Degree Utilization, x | 0.25 | 0.24 | 0.20 | | | |
| Capacity (veh/h) | 773 | 732 | 774 | | | |
| Control Delay (s) | 9.0 | 9.1 | 8.4 | | | |
| Approach Delay (s) | 9.0 | 9.1 | 8.4 | | | |
| Approach LOS | A | A | A | | | |
| Intersection Summary | | | | | | |
| Delay | | 8.9 | | | | |
| Level of Service | | A | | | | |
| Intersection Capacity Utilization | | Err% | | ICU Level of Service | | H |
| Analysis Period (min) | | 15 | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

104: Federal Rd & Ikaluktuutiak Dr

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 38 | 1 | 101 | 0 | 0 | 2 | 57 | 117 | 1 | 0 | 200 | 58 |
| Future Volume (Veh/h) | 38 | 1 | 101 | 0 | 0 | 2 | 57 | 117 | 1 | 0 | 200 | 58 |
| Sign Control | Stop | | | Stop | | | Free | | | Free | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 41 | 1 | 110 | 0 | 0 | 2 | 62 | 127 | 1 | 0 | 217 | 63 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | | | None | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 502 | 500 | 248 | 610 | 532 | 128 | 280 | | | 128 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 502 | 500 | 248 | 610 | 532 | 128 | 280 | | | 128 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 91 | 100 | 86 | 100 | 100 | 100 | 95 | | | 100 | | |
| cM capacity (veh/h) | 461 | 450 | 790 | 336 | 432 | 923 | 1283 | | | 1458 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 152 | 2 | 190 | 280 | | | | | | | | |
| Volume Left | 41 | 0 | 62 | 0 | | | | | | | | |
| Volume Right | 110 | 2 | 1 | 63 | | | | | | | | |
| cSH | 660 | 923 | 1283 | 1458 | | | | | | | | |
| Volume to Capacity | 0.23 | 0.00 | 0.05 | 0.00 | | | | | | | | |
| Queue Length 95th (m) | 6.7 | 0.0 | 1.2 | 0.0 | | | | | | | | |
| Control Delay (s) | 12.1 | 8.9 | 2.9 | 0.0 | | | | | | | | |
| Lane LOS | B | A | A | | | | | | | | | |
| Approach Delay (s) | 12.1 | 8.9 | 2.9 | 0.0 | | | | | | | | |
| Approach LOS | B | A | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | 3.8 | | | | | | | | | | |
| Intersection Capacity Utilization | | 52.2% | | ICU Level of Service | | | A | | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

105: Federal Rd & Nunavut

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 4 | 6 | 7 | 2 | 6 | 50 | 7 | 158 | 6 | 75 | 251 | 6 |
| Future Volume (Veh/h) | 4 | 6 | 7 | 2 | 6 | 50 | 7 | 158 | 6 | 75 | 251 | 6 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 4 | 7 | 8 | 2 | 7 | 54 | 8 | 172 | 7 | 82 | 273 | 7 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | None | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 690 | 636 | 276 | 644 | 636 | 176 | 280 | | | 179 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 690 | 636 | 276 | 644 | 636 | 176 | 280 | | | 179 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 99 | 98 | 99 | 99 | 98 | 94 | 99 | | | 94 | | |
| cM capacity (veh/h) | 316 | 370 | 762 | 358 | 370 | 868 | 1283 | | | 1397 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 19 | 63 | 187 | 362 | | | | | | | | |
| Volume Left | 4 | 2 | 8 | 82 | | | | | | | | |
| Volume Right | 8 | 54 | 7 | 7 | | | | | | | | |
| cSH | 452 | 726 | 1283 | 1397 | | | | | | | | |
| Volume to Capacity | 0.04 | 0.09 | 0.01 | 0.06 | | | | | | | | |
| Queue Length 95th (m) | 1.0 | 2.2 | 0.1 | 1.4 | | | | | | | | |
| Control Delay (s) | 13.3 | 10.4 | 0.4 | 2.2 | | | | | | | | |
| Lane LOS | B | B | A | A | | | | | | | | |
| Approach Delay (s) | 13.3 | 10.4 | 0.4 | 2.2 | | | | | | | | |
| Approach LOS | B | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | | 2.8 | | | | | | | | |
| Intersection Capacity Utilization | | | 44.0% | | ICU Level of Service | | | | A | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

106: Queen Elizabeth/Federal Rd & Miwvik Street/Niaqunngusariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|-------|------|----------------------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 12 | 158 | 80 | 105 | 110 | 56 | 88 | 61 | 72 | 164 | 117 | 3 |
| Future Volume (Veh/h) | 12 | 158 | 80 | 105 | 110 | 56 | 88 | 61 | 72 | 164 | 117 | 3 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 13 | 172 | 87 | 114 | 120 | 61 | 96 | 66 | 78 | 178 | 127 | 3 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 690 | 636 | 276 | 644 | 636 | 176 | 280 | | | 179 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 690 | 636 | 276 | 644 | 636 | 176 | 280 | | | 179 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 99 | 98 | 99 | 99 | 98 | 94 | 99 | | | 94 | | |
| cM capacity (veh/h) | 316 | 370 | 762 | 358 | 370 | 868 | 1283 | | | 1397 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 272 | 295 | 240 | 308 | | | | | | | | |
| Volume Left | 13 | 114 | 96 | 178 | | | | | | | | |
| Volume Right | 87 | 61 | 78 | 3 | | | | | | | | |
| Had (s) | -0.15 | -0.01 | -0.08 | 0.14 | | | | | | | | |
| Departure Headway (s) | 6.2 | 6.3 | 6.4 | 6.4 | | | | | | | | |
| Degree Utilization, x | 0.47 | 0.52 | 0.42 | 0.55 | | | | | | | | |
| Capacity (veh/h) | 516 | 515 | 501 | 509 | | | | | | | | |
| Control Delay (s) | 14.6 | 15.8 | 14.0 | 16.9 | | | | | | | | |
| Approach Delay (s) | 14.6 | 15.8 | 14.0 | 16.9 | | | | | | | | |
| Approach LOS | B | C | B | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 15.4 | | | | | | | | |
| Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | 68.6% | | ICU Level of Service | | | | C | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

107: Niaqunngusariaq & Saputi

04/25/2022

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 207 | 395 | 250 | 100 | 74 | 97 |
| Future Volume (Veh/h) | 207 | 395 | 250 | 100 | 74 | 97 |
| Sign Control | Free | Free | Free | Stop | Stop | Stop |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 225 | 429 | 272 | 109 | 80 | 105 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 381 | | | 1206 | 326 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 381 | | | 1206 | 326 | |
| IC, single (s) | 4.1 | | | 6.4 | 6.2 | |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 2.2 | | | 3.5 | 3.3 | |
| p0 queue free % | 81 | | | 51 | 85 | |
| cM capacity (veh/h) | 1177 | | | 164 | 715 | |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 654 | 381 | 185 | | | |
| Volume Left | 225 | 0 | 80 | | | |
| Volume Right | 0 | 109 | 105 | | | |
| cSH | 1177 | 1700 | 292 | | | |
| Volume to Capacity | 0.19 | 0.22 | 0.63 | | | |
| Queue Length 95th (m) | 5.4 | 0.0 | 30.4 | | | |
| Control Delay (s) | 4.5 | 0.0 | 36.5 | | | |
| Lane LOS | A | | E | | | |
| Approach Delay (s) | 4.5 | 0.0 | 36.5 | | | |
| Approach LOS | E | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 7.9 | | | |
| Intersection Capacity Utilization | | | 78.8% | | ICU Level of Service | D |
| Analysis Period (min) | | | 15 | | | |

















Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

108: Queen Elizabeth

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (veh/h) | 8 | 406 | 78 | 21 | 249 | 3 | 97 | 2 | 43 | 12 | 3 | 14 |
| Future Volume (veh/h) | 8 | 406 | 78 | 21 | 249 | 3 | 97 | 2 | 43 | 12 | 3 | 14 |
| Sign Control | | Free | | | Free | | | Slop | | | Slop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 9 | 441 | 85 | 23 | 271 | 3 | 105 | 2 | 47 | 13 | 3 | 15 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, conflicting volume | | | | | | | | | | | | |
| vC, conflicting volume | 274 | | | 526 | | | 836 | 822 | 484 | 868 | 862 | 272 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 274 | | | 526 | | | 836 | 822 | 484 | 868 | 862 | 272 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 98 | | | 61 | 99 | 92 | 95 | 99 | 98 |
| cM capacity (veh/h) | 1289 | | | 1041 | | | 272 | 300 | 583 | 244 | 284 | 766 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 535 | 297 | 154 | 31 | | | | | | | | |
| Volume Left | 9 | 23 | 105 | 13 | | | | | | | | |
| Volume Right | 85 | 3 | 47 | 15 | | | | | | | | |
| cSH | 1289 | 1041 | 326 | 372 | | | | | | | | |
| Volume to Capacity | 0.01 | 0.02 | 0.47 | 0.08 | | | | | | | | |
| Queue Length 95th (m) | 0.2 | 0.5 | 18.4 | 2.1 | | | | | | | | |
| Control Delay (s) | 0.2 | 0.9 | 25.6 | 15.6 | | | | | | | | |
| Lane LOS | A | A | D | C | | | | | | | | |
| Approach Delay (s) | 0.2 | 0.9 | 25.6 | 15.6 | | | | | | | | |
| Approach LOS | | D | C | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 4.7 | | | | | | | | | |
| Intersection Capacity Utilization | | | 52.9% | | ICU Level of Service | | | | | A | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis

109: Atungauyait & Niaqunggusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | ↔ | | | ↔ | | | ↔ | | | ↔ | |
| Traffic Volume (veh/h) | 1 | 416 | 39 | 7 | 236 | 0 | 38 | 0 | 58 | 1 | 0 | 1 |
| Future Volume (Veh/h) | 1 | 416 | 39 | 7 | 236 | 0 | 38 | 0 | 58 | 1 | 0 | 1 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 452 | 42 | 8 | 257 | 0 | 41 | 0 | 63 | 1 | 0 | 1 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 257 | | | 494 | | | 749 | 748 | 473 | 811 | 769 | 257 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 257 | | | 494 | | | 749 | 748 | 473 | 811 | 769 | 257 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 99 | | | 87 | 100 | 89 | 100 | 100 | 100 |
| cM capacity (veh/h) | 1308 | | | 1070 | | | 326 | 338 | 591 | 265 | 329 | 782 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 495 | 265 | 104 | 2 | | | | | | | | |
| Volume Left | 1 | 8 | 41 | 1 | | | | | | | | |
| Volume Right | 42 | 0 | 63 | 1 | | | | | | | | |
| cSH | 1308 | 1070 | 447 | 395 | | | | | | | | |
| Volume to Capacity | 0.00 | 0.01 | 0.23 | 0.01 | | | | | | | | |
| Queue Length 95th (m) | 0.0 | 0.2 | 6.8 | 0.1 | | | | | | | | |
| Control Delay (s) | 0.0 | 0.3 | 15.5 | 14.2 | | | | | | | | |
| Lane LOS | A | A | C | B | | | | | | | | |
| Approach Delay (s) | 0.0 | 0.3 | 15.5 | 14.2 | | | | | | | | |
| Approach LOS | | C | B | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | 2.0 | | | | | | | | | | |
| Intersection Capacity Utilization | | 41.6% | | ICU Level of Service | | | | A | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

110: Niaqunggusiariaq & Road to Nowhere

04/25/2022

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|----------------------|------|------|------|
| Lane Configurations | | ↔ | ↔ | | ↔ | ↔ |
| Traffic Volume (veh/h) | 148 | 326 | 214 | 13 | 10 | 76 |
| Future Volume (Veh/h) | 148 | 326 | 214 | 13 | 10 | 76 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 161 | 354 | 233 | 14 | 11 | 83 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 247 | | | | 916 | 240 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 247 | | | | 916 | 240 |
| IC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 88 | | | | 96 | 90 |
| cM capacity (veh/h) | 1319 | | | | 265 | 799 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 515 | 247 | 94 | | | |
| Volume Left | 161 | 0 | 11 | | | |
| Volume Right | 0 | 14 | 83 | | | |
| cSH | 1319 | 1700 | 647 | | | |
| Volume to Capacity | 0.12 | 0.15 | 0.15 | | | |
| Queue Length 95th (m) | 3.2 | 0.0 | 3.8 | | | |
| Control Delay (s) | 3.4 | 0.0 | 11.5 | | | |
| Lane LOS | A | | B | | | |
| Approach Delay (s) | 3.4 | 0.0 | 11.5 | | | |
| Approach LOS | | B | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 3.3 | | | | |
| Intersection Capacity Utilization | | 57.7% | ICU Level of Service | | B | |
| Analysis Period (min) | | 15 | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

111: Abe Okpik & Niaqunggusiariaq

04/25/2022

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|-----------------------------------|-------|-------|----------------------|------|------|------|
| Lane Configurations | ↔ | | | ↔ | ↔ | |
| Sign Control | Stop | | | Stop | Stop | |
| Traffic Volume (vph) | 218 | 98 | 18 | 150 | 79 | 78 |
| Future Volume (vph) | 218 | 98 | 18 | 150 | 79 | 78 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 237 | 107 | 20 | 163 | 86 | 85 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | | | |
| Volume Total (vph) | 344 | 183 | 171 | | | |
| Volume Left (vph) | 0 | 20 | 86 | | | |
| Volume Right (vph) | 107 | 0 | 85 | | | |
| Hadj (s) | -0.15 | 0.06 | -0.16 | | | |
| Departure Headway (s) | 4.4 | 4.8 | 4.9 | | | |
| Degree Utilization, x | 0.42 | 0.24 | 0.23 | | | |
| Capacity (veh/h) | 777 | 710 | 670 | | | |
| Control Delay (s) | 10.6 | 9.3 | 9.5 | | | |
| Approach Delay (s) | 10.6 | 9.3 | 9.5 | | | |
| Approach LOS | B | A | A | | | |
| Intersection Summary | | | | | | |
| Delay | | 10.0 | | | | |
| Level of Service | | B | | | | |
| Intersection Capacity Utilization | | 42.6% | ICU Level of Service | | A | |
| Analysis Period (min) | | 15 | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

112: Abe Okpik/Taslik & Niaqunggusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|----------------------|-------|------|------|------|------|------|------|------|------|
| Lane Configurations | | ↔ | | | ↔ | | | ↔ | | | ↔ | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 13 | 53 | 46 | 13 | 66 | 4 | 34 | 4 | 9 | 6 | 2 | 13 |
| Future Volume (vph) | 13 | 53 | 46 | 13 | 66 | 4 | 34 | 4 | 9 | 6 | 2 | 13 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 14 | 58 | 50 | 14 | 72 | 4 | 37 | 4 | 10 | 7 | 2 | 14 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 122 | 90 | 51 | 23 | | | | | | | | |
| Volume Left (vph) | 14 | 14 | 37 | 7 | | | | | | | | |
| Volume Right (vph) | 50 | 4 | 10 | 14 | | | | | | | | |
| Hadj (s) | -0.19 | 0.04 | 0.06 | -0.27 | | | | | | | | |
| Departure Headway (s) | 4.0 | 4.2 | 4.4 | 4.1 | | | | | | | | |
| Degree Utilization, x | 0.13 | 0.11 | 0.06 | 0.03 | | | | | | | | |
| Capacity (veh/h) | 883 | 830 | 766 | 820 | | | | | | | | |
| Control Delay (s) | 7.6 | 7.7 | 7.7 | 7.3 | | | | | | | | |
| Approach Delay (s) | 7.6 | 7.7 | 7.7 | 7.3 | | | | | | | | |
| Approach LOS | A | A | A | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | 7.6 | | | | | | | | | | |
| Level of Service | | A | | | | | | | | | | |
| Intersection Capacity Utilization | | 22.0% | ICU Level of Service | | A | | | | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Existing Conditions Iqaluit TMP - Existing Conditions PM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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101: Federal Rd & Qaggamiut

04/25/2022

[illegible]

Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
Page 1

102: Allannqua & Akilliq/Ikaluktuutiak Dr

04/25/2022
















[illegible]

Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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103: Allannqua/Mivvik Street

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR | | | |
| Lane Configurations | Stop | | | Stop | | | Stop | | | Stop | | | | | |
| Sign Control | | | | | | | | | | | | | | | |
| Traffic Volume (vph) | 6 | 128 | 16 | 101 | 194 | 15 | 13 | 0 | 76 | 0 | 0 | 0 | | | |
| Future Volume (vph) | 6 | 128 | 16 | 101 | 194 | 15 | 13 | 0 | 76 | 0 | 0 | 0 | | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | | | |
| Hourly flow rate (vph) | 7 | 139 | 17 | 110 | 211 | 16 | 14 | 0 | 83 | 0 | 0 | 0 | | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | | | | |
| Volume Total (vph) | 163 | 337 | 97 | 0 | | | | | | | | | | | |
| Volume Left (vph) | 7 | 110 | 14 | 0 | | | | | | | | | | | |
| Volume Right (vph) | 17 | 16 | 83 | 0 | | | | | | | | | | | |
| Hadj (s) | -0.02 | 0.07 | -0.45 | 0.00 | | | | | | | | | | | |
| Departure Headway (s) | 4.5 | 4.4 | 4.6 | 5.2 | | | | | | | | | | | |
| Degree Utilization, x | 0.20 | 0.41 | 0.12 | 0.00 | | | | | | | | | | | |
| Capacity (veh/h) | 774 | 795 | 713 | 625 | | | | | | | | | | | |
| Control Delay (s) | 8.6 | 10.4 | 8.2 | 8.2 | | | | | | | | | | | |
| Approach Delay (s) | 8.6 | 10.4 | 8.2 | 0.0 | | | | | | | | | | | |
| Approach LOS | A | B | A | A | | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | | | | |
| Delay | | | | 9.6 | | | | | | | | | | | |
| Level of Service | | | | A | | | | | | | | | | | |
| Intersection Capacity Utilization | | | | 43.7% | | | ICU Level of Service | | | A | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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104: Federal Rd & Ikaluktuutiak Dr

04/25/2022

[illegible]

Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

105: Federal Rd & Nunavut

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|------|------|------|----------------------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 18 | 6 | 22 | 5 | 9 | 110 | 44 | 515 | 5 | 27 | 323 | 18 |
| Future Volume (Veh/h) | 18 | 6 | 22 | 5 | 9 | 110 | 44 | 515 | 5 | 27 | 323 | 18 |
| Sign Control | Stop | | | Stop | | | Free | | | Free | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 20 | 7 | 24 | 5 | 10 | 120 | 48 | 560 | 5 | 29 | 351 | 20 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | | | None | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 1202 | 1080 | 361 | 1105 | 1088 | 562 | 371 | | | 565 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | 1202 | 1080 | 361 | 1105 | 1088 | 562 | 371 | | | 565 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 82 | 97 | 96 | 97 | 95 | 77 | 96 | | | 97 | | |
| cM capacity (veh/h) | 114 | 203 | 684 | 168 | 201 | 526 | 1188 | | | 1007 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 51 | 135 | 613 | 400 | | | | | | | | |
| Volume Left | 20 | 5 | 48 | 29 | | | | | | | | |
| Volume Right | 24 | 120 | 5 | 20 | | | | | | | | |
| cSH | 208 | 439 | 1188 | 1007 | | | | | | | | |
| Volume to Capacity | 0.25 | 0.31 | 0.04 | 0.03 | | | | | | | | |
| Queue Length 95th (m) | 7.1 | 9.8 | 1.0 | 0.7 | | | | | | | | |
| Control Delay (s) | 27.9 | 16.8 | 1.1 | 0.9 | | | | | | | | |
| Lane LOS | D | C | A | A | | | | | | | | |
| Approach Delay (s) | 27.9 | 16.8 | 1.1 | 0.9 | | | | | | | | |
| Approach LOS | D | C | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 3.9 | | | | | | | | | |
| Intersection Capacity Utilization | | | 60.4% | | | | ICU Level of Service | | | B | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

106: Queen Elizabeth/Federal Rd & Miwvik Street/Niaqunngusariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|--------|------|------|------|----------------------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 69 | 190 | 56 | 183 | 281 | 363 | 60 | 166 | 109 | 218 | 105 | 53 |
| Future Volume (vph) | 69 | 190 | 56 | 183 | 281 | 363 | 60 | 166 | 109 | 218 | 105 | 53 |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 75 | 207 | 61 | 199 | 305 | 395 | 65 | 180 | 118 | 237 | 114 | 58 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 343 | 899 | 363 | 409 | | | | | | | | |
| Volume Left (vph) | 75 | 199 | 65 | 237 | | | | | | | | |
| Volume Right (vph) | 61 | 395 | 118 | 58 | | | | | | | | |
| Had (s) | -0.03 | -0.19 | -0.13 | 0.06 | | | | | | | | |
| Departure Headway (s) | 9.3 | 8.9 | 9.1 | 9.2 | | | | | | | | |
| Degree Utilization, x | 0.89 | 2.22 | 0.92 | 1.04 | | | | | | | | |
| Capacity (veh/h) | 375 | 411 | 386 | 391 | | | | | | | | |
| Control Delay (s) | 53.3 | 578.4 | 58.7 | 87.3 | | | | | | | | |
| Approach Delay (s) | 53.3 | 578.4 | 58.7 | 87.3 | | | | | | | | |
| Approach LOS | F | F | F | F | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | 295.5 | | | | | | | | | |
| Level of Service | | | F | | | | | | | | | |
| Intersection Capacity Utilization | | | 124.9% | | | | ICU Level of Service | | | H | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |





Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

107: Niaqunngusariaq & Saputi

04/25/2022

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|---|---|------|
| Lane Configurations | |  |  |  |  | |
| Traffic Volume (veh/h) | 105 | 318 | 833 | 86 | 106 | 254 |
| Future Volume (Veh/h) | 105 | 318 | 833 | 86 | 106 | 254 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 114 | 346 | 905 | 93 | 115 | 276 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 998 | | | 1526 | 952 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 998 | | | 1526 | 952 | |
| IC, single (s) | 4.1 | | | 6.4 | 6.2 | |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 2.2 | | | 3.5 | 3.3 | |
| p0 queue free % | 84 | | | 0 | 12 | |
| cM capacity (veh/h) | 693 | | | 108 | 315 | |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 460 | 998 | 391 | | | |
| Volume Left | 114 | 0 | 115 | | | |
| Volume Right | 0 | 93 | 276 | | | |
| cSH | 693 | 1700 | 202 | | | |
| Volume to Capacity | 0.16 | 0.59 | 1.94 | | | |
| Queue Length 95th (m) | 4.4 | 0.0 | 218.6 | | | |
| Control Delay (s) | 4.5 | 0.0 | 479.2 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 4.5 | 0.0 | 479.2 | | | |
| Approach LOS | | F | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 102.5 | | | |
| Intersection Capacity Utilization | | | 114.1% | ICU Level of Service | | H |
| Analysis Period (min) | | | 15 | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

108: Queen Elizabeth

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|--------|------|------|------|----------------------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 23 | 329 | 84 | 84 | 833 | 13 | 122 | 5 | 43 | 5 | 2 | 9 |
| Future Volume (Veh/h) | 23 | 329 | 84 | 84 | 833 | 13 | 122 | 5 | 43 | 5 | 2 | 9 |
| Sign Control | Free | Free | Free | Free | Stop | | Stop | | | Stop | | |
| Grade | 0% | 0% | 0% | 0% | 0% | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 25 | 358 | 91 | 91 | 905 | 14 | 133 | 5 | 47 | 5 | 2 | 10 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | None | | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 919 | | | 449 | | | 1558 | 1554 | 404 | 1597 | 1593 | 912 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 919 | | | 449 | | | 1558 | 1554 | 404 | 1597 | 1593 | 912 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 97 | | | 92 | | | 0 | 95 | 93 | 93 | 98 | 97 |
| cM capacity (veh/h) | 743 | | | 1111 | | | 80 | 100 | 647 | 70 | 95 | 332 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 474 | 1010 | 185 | 17 | | | | | | | | |
| Volume Left | 25 | 91 | 133 | 5 | | | | | | | | |
| Volume Right | 91 | 14 | 47 | 10 | | | | | | | | |
| cSH | 743 | 1111 | 103 | 139 | | | | | | | | |
| Volume to Capacity | 0.03 | 0.08 | 1.79 | 0.12 | | | | | | | | |
| Queue Length 95th (m) | 0.8 | 2.0 | 113.1 | 3.1 | | | | | | | | |
| Control Delay (s) | 1.0 | 2.2 | 462.4 | 34.5 | | | | | | | | |
| Lane LOS | A | A | F | D | | | | | | | | |
| Approach Delay (s) | 1.0 | 2.2 | 462.4 | 34.5 | | | | | | | | |
| Approach LOS | | F | D | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 52.7 | | | | | | | | | |
| Intersection Capacity Utilization | | | 106.0% | | | | ICU Level of Service | | | G | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

















Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

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HCM Unsignalized Intersection Capacity Analysis

109: Atungauyait & Niaqunggusiariaq

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (veh/h) | 1 | 339 | 23 | 33 | 843 | 0 | 47 | 1 | 34 | 1 | 0 | 1 |
| Future Volume (Veh/h) | 1 | 339 | 23 | 33 | 843 | 0 | 47 | 1 | 34 | 1 | 0 | 1 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 368 | 25 | 36 | 916 | 0 | 51 | 1 | 37 | 1 | 0 | 1 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 916 | | | 393 | | | 1372 | 1370 | 380 | 1408 | 1383 | 916 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 916 | | | 393 | | | 1372 | 1370 | 380 | 1408 | 1383 | 916 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 3.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 97 | | | 57 | 99 | 94 | 99 | 100 | 100 |
| cM capacity (veh/h) | 745 | | | 1166 | | | 120 | 141 | 667 | 107 | 139 | 330 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 394 | 952 | 89 | 2 | | | | | | | | |
| Volume Left | 1 | 36 | 51 | 1 | | | | | | | | |
| Volume Right | 25 | 0 | 37 | 1 | | | | | | | | |
| cSH | 745 | 1166 | 182 | 161 | | | | | | | | |
| Volume to Capacity | 0.00 | 0.03 | 0.49 | 0.01 | | | | | | | | |
| Queue Length 95th (m) | 0.0 | 0.7 | 18.1 | 0.3 | | | | | | | | |
| Control Delay (s) | 0.0 | 0.8 | 42.2 | 27.6 | | | | | | | | |
| Lane LOS | A | A | E | D | | | | | | | | |
| Approach Delay (s) | 0.0 | 0.8 | 42.2 | 27.6 | | | | | | | | |
| Approach LOS | | | E | D | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | 3.2 | | | | | | | | | | | |
| Intersection Capacity Utilization | 90.2% | | | ICU Level of Service | | | E | | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

















Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

110: Niaqunggusiariaq & Road to Nowhere

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (veh/h) | 97 | 276 | 1 | 0 | 651 | 13 | 2 | 0 | 0 | 11 | 0 | 267 |
| Future Volume (Veh/h) | 97 | 276 | 1 | 0 | 651 | 13 | 2 | 0 | 0 | 11 | 0 | 267 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 105 | 300 | 1 | 0 | 708 | 14 | 2 | 0 | 0 | 12 | 0 | 290 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 722 | | | 301 | | | 1516 | 1232 | 300 | 1226 | 1226 | 715 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 722 | | | 301 | | | 1516 | 1232 | 300 | 1226 | 1226 | 715 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 4.1 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 88 | | | 100 | | | 93 | 100 | 100 | 92 | 100 | 33 |
| cM capacity (veh/h) | 880 | | | 1260 | | | 29 | 156 | 739 | 141 | 157 | 431 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 406 | 722 | 2 | 302 | | | | | | | | |
| Volume Left | 105 | 0 | 2 | 12 | | | | | | | | |
| Volume Right | 1 | 14 | 0 | 290 | | | | | | | | |
| cSH | 880 | 1260 | 29 | 398 | | | | | | | | |
| Volume to Capacity | 0.12 | 0.00 | 0.07 | 0.76 | | | | | | | | |
| Queue Length 95th (m) | 3.1 | 0.0 | 1.6 | 47.2 | | | | | | | | |
| Control Delay (s) | 3.5 | 0.0 | 137.8 | 37.4 | | | | | | | | |
| Lane LOS | A | | F | E | | | | | | | | |
| Approach Delay (s) | 3.5 | 0.0 | 137.8 | 37.4 | | | | | | | | |
| Approach LOS | | | F | E | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 9.1 | | | | | | | | | |
| Intersection Capacity Utilization | | | 90.2% | | ICU Level of Service | | | | E | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

















Scenario 1 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

111: Abe Okpik & Niaqunggusiariaq

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 4 | 211 | 63 | 35 | 508 | 4 | 129 | 0 | 41 | 0 | 0 | 1 |
| Future Volume (vph) | 4 | 211 | 63 | 35 | 508 | 4 | 129 | 0 | 41 | 0 | 0 | 1 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 4 | 229 | 68 | 38 | 552 | 4 | 140 | 0 | 45 | 0 | 0 | 1 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 301 | 594 | 185 | 1 | | | | | | | | |
| Volume Left (vph) | 4 | 38 | 140 | 0 | | | | | | | | |
| Volume Right (vph) | 68 | 4 | 45 | 1 | | | | | | | | |
| Hadj (s) | -0.10 | 0.04 | 0.04 | -0.57 | | | | | | | | |
| Departure Headway (s) | 5.2 | 5.0 | 6.1 | 6.0 | | | | | | | | |
| Degree Utilization, x | 0.43 | 0.82 | 0.31 | 0.00 | | | | | | | | |
| Capacity (veh/h) | 655 | 713 | 549 | 511 | | | | | | | | |
| Control Delay (s) | 12.1 | 26.4 | 11.9 | 9.1 | | | | | | | | |
| Approach Delay (s) | 12.1 | 26.4 | 11.9 | 9.1 | | | | | | | | |
| Approach LOS | B | D | B | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 19.9 | | | | | | | | |
| Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | | 76.7% | | | ICU Level of Service | | | D | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

101: Federal Rd & Qaqqamiut

04/25/2022

[illegible]

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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102: Allanngua & Akilliq/Ikaluktuutiak Dr

04/25/2022

[illegible]

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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103: Allanngua/Mivvik Street

04/25/2022


















[illegible]

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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104: Federal Rd & Ikaluktuutiak Dr

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR | |
| Lane Configurations | |  | | |  | | |  | | |  | | |
| Traffic Volume (veh/h) | 83 | 1 | 192 | 2 | 0 | 2 | 125 | 266 | 1 | 0 | 413 | 115 | |
| Future Volume (veh/h) | 83 | 1 | 192 | 2 | 0 | 2 | 125 | 266 | 1 | 0 | 413 | 115 | |
| Sign Control | | Slop | | | Slop | | | Free | | | Free | | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | |
| Hourly flow rate (vph) | 90 | 1 | 209 | 2 | 0 | 2 | 136 | 289 | 1 | 0 | 449 | 125 | |
| Pedestrians | | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | | |
| Median storage (veh) | | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | | |
| vC, conflicting volume | 1075 | 1074 | 512 | 1282 | 1136 | 290 | 574 | | | 290 | | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | | |
| vCu, unblocked vol | 1075 | 1074 | 512 | 1282 | 1136 | 290 | 574 | | | 290 | | | |
| tC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | | |
| tC, 2 stage (s) | | | | | | | | | | | | | |
| tF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | | |
| p0 queue free % | 49 | 99 | 63 | 97 | 100 | 100 | 86 | | | 100 | | | |
| cM capacity (veh/h) | 176 | 190 | 562 | 80 | 175 | 750 | 999 | | | 1272 | | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | | |
| Volume Total | 300 | 4 | 426 | 574 | | | | | | | | | |
| Volume Left | 90 | 2 | 136 | 0 | | | | | | | | | |
| Volume Right | 209 | 2 | 1 | 125 | | | | | | | | | |
| cSH | 338 | 144 | 999 | 1272 | | | | | | | | | |
| Volume to Capacity | 0.89 | 0.03 | 0.14 | 0.00 | | | | | | | | | |
| Queue Length 95th (m) | 64.6 | 0.6 | 3.6 | 0.0 | | | | | | | | | |
| Control Delay (s) | 60.4 | 30.7 | 4.0 | 0.0 | | | | | | | | | |
| Lane LOS | F | D | A | | | | | | | | | | |
| Approach Delay (s) | 60.4 | 30.7 | 4.0 | 0.0 | | | | | | | | | |
| Approach LOS | F | D | | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | | |
| Average Delay | 15.3 | | | | | | | | | | | | |
| Intersection Capacity Utilization | 85.7% | | | ICU Level of Service | | | | | E | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

105: Federal Rd & Nunavut

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|------|-------|------|------|----------------------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 15 | 6 | 37 | 2 | 6 | 58 | 30 | 353 | 6 | 86 | 526 | 22 |
| Future Volume (Veh/h) | 15 | 6 | 37 | 2 | 6 | 58 | 30 | 353 | 6 | 86 | 526 | 22 |
| Sign Control | Stop | | | Stop | | | Free | | | Free | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 16 | 7 | 40 | 2 | 7 | 63 | 33 | 384 | 7 | 93 | 572 | 24 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | | | None | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 1290 | 1227 | 584 | 1267 | 1236 | 388 | 596 | | | 391 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | 1290 | 1227 | 584 | 1267 | 1236 | 388 | 596 | | | 391 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 86 | 96 | 92 | 98 | 96 | 90 | 97 | | | 92 | | |
| cM capacity (veh/h) | 112 | 159 | 512 | 119 | 157 | 661 | 980 | | | 1168 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 63 | 72 | 424 | 689 | | | | | | | | |
| Volume Left | 16 | 2 | 33 | 93 | | | | | | | | |
| Volume Right | 40 | 63 | 7 | 24 | | | | | | | | |
| cSH | 238 | 459 | 980 | 1168 | | | | | | | | |
| Volume to Capacity | 0.26 | 0.16 | 0.03 | 0.08 | | | | | | | | |
| Queue Length 95th (m) | 7.8 | 4.2 | 0.8 | 2.0 | | | | | | | | |
| Control Delay (s) | 25.5 | 14.3 | 1.0 | 2.0 | | | | | | | | |
| Lane LOS | D | B | A | A | | | | | | | | |
| Approach Delay (s) | 25.5 | 14.3 | 1.0 | 2.0 | | | | | | | | |
| Approach LOS | D | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | | 3.6 | | | | | | | | |
| Intersection Capacity Utilization | | | | 76.6% | | | ICU Level of Service | | | D | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

106: Queen Elizabeth/Federal Rd & Miwvik Street/Niaqunngusariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|-------|--------|------|------|----------------------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Traffic Volume (vph) | 49 | 313 | 94 | 189 | 233 | 207 | 98 | 91 | 165 | 376 | 162 | 49 |
| Future Volume (vph) | 49 | 313 | 94 | 189 | 233 | 207 | 98 | 91 | 165 | 376 | 162 | 49 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 53 | 340 | 102 | 205 | 253 | 225 | 107 | 99 | 179 | 409 | 176 | 53 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 495 | 683 | 385 | 638 | | | | | | | | |
| Volume Left (vph) | 53 | 205 | 107 | 409 | | | | | | | | |
| Volume Right (vph) | 102 | 225 | 179 | 53 | | | | | | | | |
| Hadq (s) | -0.07 | -0.10 | -0.19 | 0.11 | | | | | | | | |
| Departure Headway (s) | 9.5 | 9.5 | 9.4 | 9.7 | | | | | | | | |
| Degree Utilization, x | 1.31 | 1.79 | 1.00 | 1.71 | | | | | | | | |
| Capacity (veh/h) | 386 | 385 | 385 | 376 | | | | | | | | |
| Control Delay (s) | 182.8 | 390.4 | 78.0 | 356.1 | | | | | | | | |
| Approach Delay (s) | 182.8 | 390.4 | 78.0 | 356.1 | | | | | | | | |
| Approach LOS | F | F | F | F | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 279.2 | | | | | | | | |
| Level of Service | | | | F | | | | | | | | |
| Intersection Capacity Utilization | | | | 139.5% | | | ICU Level of Service | | | H | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

107: Niaqunngusariaq & Saputi

04/25/2022

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|--------|------|----------------------|-----|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 260 | 724 | 450 | 125 | 112 | 155 |
| Future Volume (Veh/h) | 260 | 724 | 450 | 125 | 112 | 155 |
| Sign Control | Free | Free | Free | Stop | | |
| Grade | 0% | 0% | 0% | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | |
| Hourly flow rate (vph) | 283 | 787 | 489 | 136 | 122 | 168 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 625 | | | 1910 | 557 | |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 625 | | | 1910 | 557 | |
| IC, single (s) | 4.1 | | | 6.4 | 6.2 | |
| IC, 2 stage (s) | | | | | | |
| IF (s) | 2.2 | | | 3.5 | 3.3 | |
| p0 queue free % | 70 | | | 0 | 68 | |
| cM capacity (veh/h) | 956 | | | 53 | 530 | |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 1070 | 625 | 290 | | | |
| Volume Left | 283 | 0 | 122 | | | |
| Volume Right | 0 | 136 | 168 | | | |
| cSH | 956 | 1700 | 110 | | | |
| Volume to Capacity | 0.30 | 0.37 | 2.63 | | | |
| Queue Length 95th (m) | 9.4 | 0.0 | 201.8 | | | |
| Control Delay (s) | 6.9 | 0.0 | 820.1 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 6.9 | 0.0 | 820.1 | | | |
| Approach LOS | F | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 123.5 | | | |
| Intersection Capacity Utilization | | | 121.2% | | ICU Level of Service | H |
| Analysis Period (min) | | | 15 | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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HCM Unsignalized Intersection Capacity Analysis

108: Queen Elizabeth

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|-------|------|------|----------------------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 8 | 732 | 115 | 57 | 452 | 3 | 118 | 2 | 88 | 12 | 3 | 14 |
| Future Volume (Veh/h) | 8 | 732 | 115 | 57 | 452 | 3 | 118 | 2 | 88 | 12 | 3 | 14 |
| Sign Control | Free | Free | Free | Free | Stop | | Stop | | | Stop | | |
| Grade | 0% | 0% | 0% | 0% | 0% | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 9 | 796 | 125 | 62 | 491 | 3 | 128 | 2 | 96 | 13 | 3 | 15 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 494 | | | 921 | | | 1510 | 1494 | 858 | 1590 | 1556 | 492 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 494 | | | 921 | | | 1510 | 1494 | 858 | 1590 | 1556 | 492 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 92 | | | 0 | 98 | 73 | 78 | 97 | 97 |
| cM capacity (veh/h) | 1070 | | | 741 | | | 88 | 112 | 356 | 58 | 103 | 576 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 930 | 556 | 226 | 31 | | | | | | | | |
| Volume Left | 9 | 62 | 128 | 13 | | | | | | | | |
| Volume Right | 125 | 3 | 96 | 15 | | | | | | | | |
| cSH | 1070 | 741 | 129 | 111 | | | | | | | | |
| Volume to Capacity | 0.01 | 0.08 | 1.75 | 0.28 | | | | | | | | |
| Queue Length 95th (m) | 0.2 | 2.1 | 129.7 | 8.0 | | | | | | | | |
| Control Delay (s) | 0.2 | 2.2 | 425.5 | 49.4 | | | | | | | | |
| Lane LOS | A | A | F | E | | | | | | | | |
| Approach Delay (s) | 0.2 | 2.2 | 425.5 | 49.4 | | | | | | | | |
| Approach LOS | F | F | E | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | | 56.9 | | | | | | | | |
| Intersection Capacity Utilization | | | | 96.0% | | | ICU Level of Service | | | F | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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HCM Unsignalized Intersection Capacity Analysis

109: Atungauyait & Niaqunggusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 1 | 781 | 45 | 23 | 467 | 0 | 43 | 0 | 83 | 1 | 0 | 1 |
| Future Volume (Veh/h) | 1 | 781 | 45 | 23 | 467 | 0 | 43 | 0 | 83 | 1 | 0 | 1 |
| Sign Control | Free | | | Free | | | Stop | | | Stop | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 849 | 49 | 25 | 508 | 0 | 47 | 0 | 90 | 1 | 0 | 1 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 508 | | | 898 | | | 1434 | 1434 | 874 | 1524 | 1458 | 508 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 508 | | | 898 | | | 1434 | 1434 | 874 | 1524 | 1458 | 508 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 97 | | | 57 | 100 | 74 | 99 | 100 | 100 |
| cM capacity (veh/h) | 1057 | | | 756 | | | 108 | 129 | 349 | 70 | 125 | 565 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 899 | 533 | 137 | 2 | | | | | | | | |
| Volume Left | 1 | 25 | 47 | 1 | | | | | | | | |
| Volume Right | 49 | 0 | 90 | 1 | | | | | | | | |
| cSH | 1057 | 756 | 198 | 124 | | | | | | | | |
| Volume to Capacity | 0.00 | 0.03 | 0.69 | 0.02 | | | | | | | | |
| Queue Length 95th (m) | 0.0 | 0.8 | 32.7 | 0.4 | | | | | | | | |
| Control Delay (s) | 0.0 | 0.9 | 56.0 | 34.4 | | | | | | | | |
| Lane LOS | A | A | F | D | | | | | | | | |
| Approach Delay (s) | 0.0 | 0.9 | 56.0 | 34.4 | | | | | | | | |
| Approach LOS | | F | D | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | 5.3 | | | | | | | | | | |
| Intersection Capacity Utilization | | 65.4% | | ICU Level of Service | | | | | C | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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HCM Unsignalized Intersection Capacity Analysis

110: Niaqunggusiariaq & Road to Nowhere

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|-------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 281 | 578 | 2 | 0 | 380 | 17 | 1 | 0 | 0 | 16 | 0 | 156 |
| Future Volume (Veh/h) | 281 | 578 | 2 | 0 | 380 | 17 | 1 | 0 | 0 | 16 | 0 | 156 |
| Sign Control | Free | | | Free | | | Stop | | | Stop | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 305 | 628 | 2 | 0 | 413 | 18 | 1 | 0 | 0 | 17 | 0 | 170 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 431 | | | 630 | | | 1831 | 1670 | 629 | 1661 | 1662 | 422 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 431 | | | 630 | | | 1831 | 1670 | 629 | 1661 | 1662 | 422 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 73 | | | 100 | | | 97 | 100 | 100 | 72 | 100 | 73 |
| cM capacity (veh/h) | 1129 | | | 952 | | | 34 | 70 | 482 | 61 | 71 | 632 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 935 | 431 | 1 | 187 | | | | | | | | |
| Volume Left | 305 | 0 | 1 | 17 | | | | | | | | |
| Volume Right | 2 | 18 | 0 | 170 | | | | | | | | |
| cSH | 1129 | 952 | 34 | 342 | | | | | | | | |
| Volume to Capacity | 0.27 | 0.00 | 0.03 | 0.55 | | | | | | | | |
| Queue Length 95th (m) | 8.4 | 0.0 | 0.7 | 23.7 | | | | | | | | |
| Control Delay (s) | 5.8 | 0.0 | 114.1 | 27.5 | | | | | | | | |
| Lane LOS | A | | F | D | | | | | | | | |
| Approach Delay (s) | 5.8 | 0.0 | 114.1 | 27.5 | | | | | | | | |
| Approach LOS | | F | D | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | 6.9 | | | | | | | | | | |
| Intersection Capacity Utilization | | 96.3% | | ICU Level of Service | | | | | F | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

111: Abe Okpik & Niaqunggusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|-------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Traffic Volume (vph) | 3 | 454 | 115 | 20 | 299 | 3 | 96 | 0 | 81 | 1 | 0 | 3 |
| Future Volume (vph) | 3 | 454 | 115 | 20 | 299 | 3 | 96 | 0 | 81 | 1 | 0 | 3 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 3 | 493 | 125 | 22 | 325 | 3 | 104 | 0 | 88 | 1 | 0 | 3 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 621 | 350 | 192 | 4 | | | | | | | | |
| Volume Left (vph) | 3 | 22 | 104 | 1 | | | | | | | | |
| Volume Right (vph) | 125 | 3 | 88 | 3 | | | | | | | | |
| Hadj (s) | -0.09 | 0.04 | -0.13 | -0.37 | | | | | | | | |
| Departure Headway (s) | 5.0 | 5.4 | 6.1 | 6.5 | | | | | | | | |
| Degree Utilization, x | 0.86 | 0.53 | 0.33 | 0.01 | | | | | | | | |
| Capacity (veh/h) | 710 | 638 | 552 | 478 | | | | | | | | |
| Control Delay (s) | 30.1 | 14.3 | 12.1 | 9.6 | | | | | | | | |
| Approach Delay (s) | 30.1 | 14.3 | 12.1 | 9.6 | | | | | | | | |
| Approach LOS | D | B | B | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | 22.3 | | | | | | | | | | |
| Level of Service | | C | | | | | | | | | | |
| Intersection Capacity Utilization | | 60.3% | | ICU Level of Service | | | | | B | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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HCM Unsignalized Intersection Capacity Analysis

112: Abe Okpik/Taslik & Niaqunggusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Traffic Volume (vph) | 19 | 275 | 60 | 16 | 177 | 5 | 71 | 4 | 10 | 7 | 2 | 17 |
| Future Volume (vph) | 19 | 275 | 60 | 16 | 177 | 5 | 71 | 4 | 10 | 7 | 2 | 17 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 21 | 299 | 65 | 17 | 192 | 5 | 77 | 4 | 11 | 8 | 2 | 18 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 385 | 214 | 92 | 28 | | | | | | | | |
| Volume Left (vph) | 21 | 17 | 77 | 8 | | | | | | | | |
| Volume Right (vph) | 65 | 5 | 11 | 18 | | | | | | | | |
| Hadj (s) | -0.06 | 0.04 | 0.13 | -0.29 | | | | | | | | |
| Departure Headway (s) | 4.4 | 4.7 | 5.4 | 5.1 | | | | | | | | |
| Degree Utilization, x | 0.47 | 0.28 | 0.14 | 0.04 | | | | | | | | |
| Capacity (veh/h) | 790 | 730 | 595 | 604 | | | | | | | | |
| Control Delay (s) | 11.4 | 9.5 | 9.3 | 8.4 | | | | | | | | |
| Approach Delay (s) | 11.4 | 9.5 | 9.3 | 8.4 | | | | | | | | |
| Approach LOS | B | A | A | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | 10.4 | | | | | | | | | | |
| Level of Service | | B | | | | | | | | | | |
| Intersection Capacity Utilization | | 44.3% | | ICU Level of Service | | | | | A | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

Scenario 1 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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101: Federal Rd & Qaggamiut

04/25/2022

[illegible]

Scenario 2 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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102: Allannqua & Akilliq/Ikaluktuutiak Dr

04/25/2022

[illegible]

Scenario 2 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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103: Allannqua/Mivvik Street

04/25/2022

[illegible]

Scenario 2 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Existing

Synchro 11 Report
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104: Federal Rd & Ikaluktuutiak Dr

04/25/2022

[illegible]

Scenario 2 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Existing

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HCM Unsignalized Intersection Capacity Analysis

105: Federal Rd & Nunavut

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 18 | 6 | 22 | 5 | 9 | 10 | 44 | 333 | 5 | 27 | 214 | 18 |
| Future Volume (Veh/h) | 18 | 6 | 22 | 5 | 9 | 10 | 44 | 333 | 5 | 27 | 214 | 18 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop | Stop |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 20 | 7 | 24 | 5 | 10 | 11 | 48 | 362 | 5 | 29 | 233 | 20 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | 155 | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 778 | 764 | 243 | 789 | 772 | 364 | 253 | | | 367 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 778 | 764 | 243 | 789 | 772 | 364 | 253 | | | 367 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 93 | 98 | 97 | 98 | 97 | 98 | 96 | | | 98 | | |
| cM capacity (veh/h) | 287 | 314 | 796 | 281 | 311 | 680 | 1312 | | | 1192 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 51 | 26 | 415 | 282 | | | | | | | | |
| Volume Left | 20 | 5 | 48 | 29 | | | | | | | | |
| Volume Right | 24 | 11 | 5 | 20 | | | | | | | | |
| cSH | 418 | 393 | 1312 | 1192 | | | | | | | | |
| Volume to Capacity | 0.12 | 0.07 | 0.04 | 0.02 | | | | | | | | |
| Queue Length 95th (m) | 3.1 | 1.6 | 0.9 | 0.6 | | | | | | | | |
| Control Delay (s) | 14.8 | 14.8 | 1.2 | 1.0 | | | | | | | | |
| Lane LOS | B | B | A | A | | | | | | | | |
| Approach Delay (s) | 14.8 | 14.8 | 1.2 | 1.0 | | | | | | | | |
| Approach LOS | B | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 2.5 | | | | | | | | | |
| Intersection Capacity Utilization | | | 42.9% | | | | | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| ICU Level of Service | | | | | | | | | | | | A |

Scenario 2 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Existing

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HCM Unsignalized Intersection Capacity Analysis

108: Queen Elizabeth

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|--------|------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 23 | 329 | 84 | 84 | 833 | 13 | 122 | 5 | 43 | 5 | 2 | 9 |
| Future Volume (Veh/h) | 23 | 329 | 84 | 84 | 833 | 13 | 122 | 5 | 43 | 5 | 2 | 9 |
| Sign Control | Free | Free | Free | Free | Free | Free | Free | Free | Free | Free | Free | Free |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 25 | 358 | 91 | 91 | 905 | 14 | 133 | 5 | 47 | 5 | 2 | 10 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | 284 | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 919 | | | | 449 | | | 1558 | 1554 | 404 | 1597 | 1593 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 919 | | | | 397 | | | 1561 | 1557 | 349 | 1602 | 1598 |
| IC, single (s) | 4.1 | | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 |
| p0 queue free % | 97 | | | | 92 | | | 0 | 95 | 93 | 92 | 98 |
| cM capacity (veh/h) | 743 | | | | 1107 | | | 76 | 95 | 661 | 66 | 90 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | |
| Volume Total | 474 | 1010 | 133 | 52 | 5 | 12 | | | | | | |
| Volume Left | 25 | 91 | 133 | 0 | 5 | 0 | | | | | | |
| Volume Right | 91 | 14 | 0 | 47 | 0 | 10 | | | | | | |
| cSH | 743 | 1107 | 76 | 421 | 66 | 229 | | | | | | |
| Volume to Capacity | 0.03 | 0.08 | 1.76 | 0.12 | 0.08 | 0.05 | | | | | | |
| Queue Length 95th (m) | 0.8 | 2.0 | 87.5 | 3.2 | 1.8 | 1.3 | | | | | | |
| Control Delay (s) | 1.0 | 2.2 | 483.1 | 14.8 | 63.8 | 21.6 | | | | | | |
| Lane LOS | A | A | F | B | F | C | | | | | | |
| Approach Delay (s) | 1.0 | 2.2 | 351.4 | | 34.0 | | | | | | | |
| Approach LOS | | | F | | D | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 40.5 | | | | | | | | | |
| Intersection Capacity Utilization | | | 102.8% | | | | | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| ICU Level of Service | | | | | | | | | | | | G |

Scenario 2 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Existing

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HCM Unsignalized Intersection Capacity Analysis

109: Atungauyait & Niaqunngusiaraiq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|------|------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 1 | 339 | 23 | 33 | 843 | 0 | 47 | 1 | 34 | 1 | 0 | 1 |
| Future Volume (Veh/h) | 1 | 339 | 23 | 33 | 843 | 0 | 47 | 1 | 34 | 1 | 0 | 1 |
| Sign Control | Free | Free | Free | Free | Free | Free | Free | Free | Free | Free | Free | Free |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 368 | 25 | 36 | 916 | 0 | 51 | 1 | 37 | 1 | 0 | 1 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 916 | | | | 393 | | | 1372 | 1370 | 380 | 1408 | 1383 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 916 | | | | 393 | | | 1372 | 1370 | 380 | 1408 | 1383 |
| IC, single (s) | 4.1 | | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 |
| p0 queue free % | 100 | | | | 97 | | | 57 | 99 | 94 | 99 | 100 |
| cM capacity (veh/h) | 745 | | | | 1166 | | | 120 | 141 | 667 | 107 | 139 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 394 | 952 | 89 | 2 | | | | | | | | |
| Volume Left | 1 | 36 | 51 | 1 | | | | | | | | |
| Volume Right | 25 | 0 | 37 | 1 | | | | | | | | |
| cSH | 745 | 1166 | 182 | 161 | | | | | | | | |
| Volume to Capacity | 0.00 | 0.03 | 0.49 | 0.01 | | | | | | | | |
| Queue Length 95th (m) | 0.0 | 0.7 | 18.1 | 0.3 | | | | | | | | |
| Control Delay (s) | 0.0 | 0.8 | 42.2 | 27.6 | | | | | | | | |
| Lane LOS | A | A | E | D | | | | | | | | |
| Approach Delay (s) | 0.0 | 0.8 | 42.2 | 27.6 | | | | | | | | |
| Approach LOS | | | E | D | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 3.2 | | | | | | | | | |
| Intersection Capacity Utilization | | | 90.2% | | | | | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| ICU Level of Service | | | | | | | | | | | | E |













Scenario 2 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Existing

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HCM Unsignalized Intersection Capacity Analysis

110: Niaqunngusiaraiq & Road to Nowhere

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 97 | 276 | 1 | 0 | 651 | 13 | 2 | 0 | 0 | 11 | 0 | 267 |
| Future Volume (Veh/h) | 97 | 276 | 1 | 0 | 651 | 13 | 2 | 0 | 0 | 11 | 0 | 267 |
| Sign Control | Free | | | Free | | | Stop | | | Stop | | |
| Grade | 0% | | | 0% | | | 0% | | | 0% | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 105 | 300 | 1 | 0 | 708 | 14 | 2 | 0 | 0 | 12 | 0 | 290 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | None | | | None | | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 722 | | | 301 | | | 1516 | 1232 | 300 | 1226 | 1226 | 715 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 722 | | | 301 | | | 1516 | 1232 | 300 | 1226 | 1226 | 715 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 88 | | | 100 | | | 93 | 100 | 100 | 92 | 100 | 33 |
| cM capacity (veh/h) | 880 | | | 1260 | | | 29 | 156 | 739 | 141 | 157 | 431 |
| Direction, Lane # | | | | | | | | | | | | |
| | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 406 | 722 | 2 | 302 | | | | | | | | |
| Volume Left | 105 | 0 | 2 | 12 | | | | | | | | |
| Volume Right | 1 | 14 | 0 | 290 | | | | | | | | |
| cSH | 880 | 1260 | 29 | 398 | | | | | | | | |
| Volume to Capacity | 0.12 | 0.00 | 0.07 | 0.76 | | | | | | | | |
| Queue Length 95th (m) | 3.1 | 0.0 | 1.6 | 47.2 | | | | | | | | |
| Control Delay (s) | 3.5 | 0.0 | 137.8 | 37.4 | | | | | | | | |
| Lane LOS | A | | F | E | | | | | | | | |
| Approach Delay (s) | 3.5 | 0.0 | 137.8 | 37.4 | | | | | | | | |
| Approach LOS | | | F | E | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | 9.1 | | | | | | | | | | | |
| Intersection Capacity Utilization | 90.2% | | | ICU Level of Service | | | | | E | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis

111: Abe Okpik & Niaqunngusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | ⬆ | | | ⬆ | | | ⬆ | | | ⬆ | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 4 | 211 | 63 | 35 | 508 | 4 | 129 | 0 | 41 | 0 | 0 | 1 |
| Future Volume (vph) | 4 | 211 | 63 | 35 | 508 | 4 | 129 | 0 | 41 | 0 | 0 | 1 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 4 | 229 | 68 | 38 | 552 | 4 | 140 | 0 | 45 | 0 | 0 | 1 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 301 | 594 | 185 | 1 | | | | | | | | |
| Volume Left (vph) | 4 | 38 | 140 | 0 | | | | | | | | |
| Volume Right (vph) | 68 | 4 | 45 | 1 | | | | | | | | |
| Head (s) | -0.10 | 0.04 | 0.04 | -0.57 | | | | | | | | |
| Departure Headway (s) | 5.2 | 5.0 | 6.1 | 6.0 | | | | | | | | |
| Degree Utilization, x | 0.43 | 0.82 | 0.31 | 0.00 | | | | | | | | |
| Capacity (veh/h) | 655 | 713 | 549 | 511 | | | | | | | | |
| Control Delay (s) | 12.1 | 26.4 | 11.9 | 9.1 | | | | | | | | |
| Approach Delay (s) | 12.1 | 26.4 | 11.9 | 9.1 | | | | | | | | |
| Approach LOS | B | D | B | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | 19.9 | | | | | | | | | | |
| Level of Service | | C | | | | | | | | | | |
| Intersection Capacity Utilization | | 76.7% | | ICU Level of Service | | | | | D | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis

112: Abe Okpik/Tasiik & Niaqunngusiariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|-------|------|----------------------|------|------|------|------|------|------|------|------|
| Lane Configurations | | ⬆ | | | ⬆ | | | ⬆ | | | ⬆ | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 12 | 139 | 46 | 10 | 289 | 6 | 106 | 2 | 12 | 6 | 5 | 17 |
| Future Volume (vph) | 12 | 139 | 46 | 10 | 289 | 6 | 106 | 2 | 12 | 6 | 5 | 17 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 13 | 151 | 50 | 11 | 314 | 7 | 115 | 2 | 13 | 7 | 5 | 18 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 214 | 332 | 130 | 30 | | | | | | | | |
| Volume Left (vph) | 13 | 11 | 115 | 7 | | | | | | | | |
| Volume Right (vph) | 50 | 7 | 13 | 18 | | | | | | | | |
| Head (s) | -0.09 | 0.03 | 0.15 | -0.28 | | | | | | | | |
| Departure Headway (s) | 4.7 | 4.6 | 5.4 | 5.1 | | | | | | | | |
| Degree Utilization, x | 0.28 | 0.43 | 0.19 | 0.04 | | | | | | | | |
| Capacity (veh/h) | 739 | 746 | 609 | 609 | | | | | | | | |
| Control Delay (s) | 9.4 | 11.0 | 9.7 | 8.4 | | | | | | | | |
| Approach Delay (s) | 9.4 | 11.0 | 9.7 | 8.4 | | | | | | | | |
| Approach LOS | A | B | A | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | 10.2 | | | | | | | | | | |
| Level of Service | | B | | | | | | | | | | |
| Intersection Capacity Utilization | | 41.5% | | ICU Level of Service | | | | | A | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |

HCM Signalized Intersection Capacity Analysis

106: Queen Elizabeth/Federal Rd & Mivvik Street/Niaqungusariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|------|------|---------------------------|------|------|-------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 69 | 190 | 56 | 183 | 281 | 50 | 60 | 166 | 109 | 50 | 105 | 53 |
| Future Volume (vph) | 69 | 190 | 56 | 183 | 281 | 50 | 60 | 166 | 109 | 50 | 105 | 53 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | | |
| Lane Util. Factor | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | | |
| Frt | 0.98 | | | 0.99 | | | 0.96 | | | 0.97 | | |
| Flt Protected | 0.99 | | | 0.98 | | | 0.99 | | | 0.99 | | |
| Satd. Flow (prot) | 1627 | | | 1634 | | | 1597 | | | 1608 | | |
| Flt Permitted | 0.81 | | | 0.75 | | | 0.91 | | | 0.84 | | |
| Satd. Flow (perm) | 1338 | | | 1239 | | | 1459 | | | 1361 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 75 | 207 | 61 | 199 | 305 | 54 | 65 | 180 | 118 | 54 | 114 | 58 |
| RTOR Reduction (vph) | 0 | 11 | 0 | 0 | 6 | 0 | 0 | 20 | 0 | 0 | 15 | 0 |
| Lane Group Flow (vph) | 0 | 332 | 0 | 0 | 552 | 0 | 0 | 343 | 0 | 0 | 211 | 0 |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | 35.6 | | | 35.6 | | | 24.4 | | | 24.4 | | |
| Effective Green, g (s) | 35.6 | | | 35.6 | | | 24.4 | | | 24.4 | | |
| Actuated g/C Ratio | 0.49 | | | 0.49 | | | 0.34 | | | 0.34 | | |
| Clearance Time (s) | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | | |
| Vehicle Extension (s) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| Lane Grp Cap (vph) | 661 | | | 612 | | | 494 | | | 461 | | |
| v/s Ratio Prot | | | | | | | | | | | | |
| v/s Ratio Perm | 0.25 | | | c0.45 | | | c0.23 | | | 0.16 | | |
| v/c Ratio | 0.50 | | | 0.90 | | | 0.69 | | | 0.46 | | |
| Uniform Delay, d1 | 12.2 | | | 16.6 | | | 20.6 | | | 18.6 | | |
| Progression Factor | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | | |
| Incremental Delay, d2 | 0.6 | | | 16.6 | | | 7.8 | | | 3.3 | | |
| Delay (s) | 12.8 | | | 33.2 | | | 28.4 | | | 21.9 | | |
| Level of Service | B | | | C | | | C | | | C | | |
| Approach Delay (s) | 12.8 | | | 33.2 | | | 28.4 | | | 21.9 | | |
| Approach LOS | B | | | C | | | C | | | C | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | 25.6 | | | HCM 2000 Level of Service | | | C | | | | | |
| HCM 2000 Volume to Capacity ratio | 0.82 | | | | | | | | | | | |
| Actuated Cycle Length (s) | 72.0 | | | Sum of lost time (s) | | | 12.0 | | | | | |
| Intersection Capacity Utilization | 87.2% | | | ICU Level of Service | | | E | | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |
| c Critical Lane Group | | | | | | | | | | | | |

HCM Signalized Intersection Capacity Analysis

107: Niaqungusariaq & Saputi

04/25/2022

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|--------|-------|---------------------------|-------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (vph) | 105 | 318 | 833 | 86 | 106 | 254 |
| Future Volume (vph) | 105 | 318 | 833 | 86 | 106 | 254 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 6.0 | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Frt | 1.00 | 1.00 | 0.99 | | 0.90 | |
| Flt Protected | 0.95 | 1.00 | 1.00 | | 0.99 | |
| Satd. Flow (prot) | 1601 | 1685 | 1664 | | 1503 | |
| Flt Permitted | 0.14 | 1.00 | 1.00 | | 0.99 | |
| Satd. Flow (perm) | 235 | 1685 | 1664 | | 1503 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 114 | 346 | 905 | 93 | 115 | 276 |
| RTOR Reduction (vph) | 0 | 0 | 4 | 0 | 87 | 0 |
| Lane Group Flow (vph) | 114 | 346 | 994 | 0 | 304 | 0 |
| Turn Type | Perm | NA | NA | | Prot | |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | | | |
| Actuated Green, G (s) | 66.0 | 66.0 | 66.0 | | 21.4 | |
| Effective Green, g (s) | 66.0 | 66.0 | 66.0 | | 21.4 | |
| Actuated g/C Ratio | 0.66 | 0.66 | 0.66 | | 0.22 | |
| Clearance Time (s) | 6.0 | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | 156 | 1118 | 1104 | | 323 | |
| v/s Ratio Prot | | 0.21 | c0.60 | | c0.20 | |
| v/s Ratio Perm | 0.49 | | | | | |
| v/c Ratio | 0.73 | 0.31 | 0.90 | | 0.94 | |
| Uniform Delay, d1 | 10.9 | 7.1 | 14.0 | | 38.4 | |
| Progression Factor | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | 25.8 | 0.7 | 11.7 | | 34.8 | |
| Delay (s) | 36.7 | 7.8 | 25.7 | | 73.1 | |
| Level of Service | D | A | C | | E | |
| Approach Delay (s) | | 15.0 | 25.7 | | 73.1 | |
| Approach LOS | | B | C | | E | |
| Intersection Summary | | | | | | |
| HCM 2000 Control Delay | | 33.0 | | HCM 2000 Level of Service | | C |
| HCM 2000 Volume to Capacity ratio | | 0.91 | | | | |
| Actuated Cycle Length (s) | | 99.4 | | Sum of lost time (s) | | 12.0 |
| Intersection Capacity Utilization | | 100.4% | | ICU Level of Service | | G |
| Analysis Period (min) | | 15 | | | | |
| c Critical Lane Group | | | | | | |

101: Federal Rd & Qaggamiut

04/25/2022

[illegible]

Scenario 2 Iglood TWP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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102: Allannqua & Akilliq/Ikaluktuutiak Dr

04/25/2022

[illegible]

Scenario 2 Igloolik TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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103: Allannqua/Mivvik Street

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|------|-------|-------|------|----------------------|------|------|------|------|------|------|
| Lane Configurations | | Stop | | | Stop | | | Stop | | | Stop | |
| Sign Control | | | | | | | | | | | | |
| Traffic Volume (vph) | 10 | 235 | 29 | 133 | 128 | 28 | 16 | 4 | 176 | 15 | 3 | 5 |
| Future Volume (vph) | 10 | 235 | 29 | 133 | 128 | 28 | 16 | 4 | 176 | 15 | 3 | 5 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 11 | 255 | 32 | 145 | 139 | 30 | 17 | 4 | 191 | 16 | 3 | 5 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 298 | 314 | 212 | 24 | | | | | | | | |
| Volume Left (vph) | 11 | 145 | 17 | 16 | | | | | | | | |
| Volume Right (vph) | 32 | 30 | 191 | 5 | | | | | | | | |
| Hadj (s) | -0.02 | 0.07 | -0.49 | 0.04 | | | | | | | | |
| Departure Headway (s) | 4.9 | 5.0 | 5.0 | 5.9 | | | | | | | | |
| Degree Utilization, x | 0.41 | 0.44 | 0.29 | 0.04 | | | | | | | | |
| Capacity (veh/h) | 689 | 687 | 651 | 519 | | | | | | | | |
| Control Delay (s) | 11.3 | 11.8 | 10.0 | 9.1 | | | | | | | | |
| Approach Delay (s) | 11.3 | 11.8 | 10.0 | 9.1 | | | | | | | | |
| Approach LOS | B | B | B | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 11.1 | | | | | | | | |
| Level of Service | | | | B | | | | | | | | |
| Intersection Capacity Utilization | | | | 57.2% | | ICU Level of Service | | | | B | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

Scenario 2 Iglood TWP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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104: Federal Rd & Ikaluktuutiak Dr

04/25/2022

[illegible]

Scenario 2 Igloolik TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

105: Federal Rd & Nunavut

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 15 | 6 | 37 | 2 | 6 | 58 | 30 | 250 | 6 | 86 | 338 | 22 |
| Future Volume (Veh/h) | 15 | 6 | 37 | 2 | 6 | 58 | 30 | 250 | 6 | 86 | 338 | 22 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 16 | 7 | 40 | 2 | 7 | 63 | 33 | 272 | 7 | 93 | 367 | 24 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | None | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | 155 | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 973 | 910 | 379 | 950 | 918 | 276 | 391 | | | 279 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 973 | 910 | 379 | 950 | 918 | 276 | 391 | | | 279 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 92 | 97 | 94 | 99 | 97 | 92 | 97 | | | 93 | | |
| cM capacity (veh/h) | 192 | 247 | 668 | 204 | 245 | 763 | 1168 | | | 1284 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 63 | 72 | 312 | 484 | | | | | | | | |
| Volume Left | 16 | 2 | 33 | 93 | | | | | | | | |
| Volume Right | 40 | 63 | 7 | 24 | | | | | | | | |
| cSH | 367 | 595 | 1168 | 1284 | | | | | | | | |
| Volume to Capacity | 0.17 | 0.12 | 0.03 | 0.07 | | | | | | | | |
| Queue Length 95th (m) | 4.6 | 3.1 | 0.7 | 1.8 | | | | | | | | |
| Control Delay (s) | 16.8 | 11.9 | 1.1 | 2.2 | | | | | | | | |
| Lane LOS | C | B | A | A | | | | | | | | |
| Approach Delay (s) | 16.8 | 11.9 | 1.1 | 2.2 | | | | | | | | |
| Approach LOS | C | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | | 3.5 | | | | | | | | |
| Intersection Capacity Utilization | | | 61.6% | | ICU Level of Service | | | | B | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

Scenario 2 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

108: Queen Elizabeth

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 8 | 732 | 115 | 57 | 452 | 3 | 118 | 2 | 88 | 12 | 3 | 14 |
| Future Volume (Veh/h) | 8 | 732 | 115 | 57 | 452 | 3 | 118 | 2 | 88 | 12 | 3 | 14 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 9 | 796 | 125 | 62 | 491 | 3 | 128 | 2 | 96 | 13 | 3 | 15 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | None | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | 284 | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 494 | | | 921 | | | 1510 | 1494 | 858 | 1590 | 1556 | 492 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 494 | | | 483 | | | 1517 | 1490 | 373 | 1658 | 1598 | 492 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 90 | | | 0 | 97 | 75 | 56 | 94 | 97 |
| cM capacity (veh/h) | 1070 | | | 615 | | | 48 | 63 | 383 | 30 | 54 | 576 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | |
| Volume Total | 930 | 556 | 128 | 98 | 13 | 18 | | | | | | |
| Volume Left | 9 | 62 | 128 | 0 | 13 | 0 | | | | | | |
| Volume Right | 125 | 3 | 0 | 96 | 0 | 15 | | | | | | |
| cSH | 1070 | 615 | 48 | 347 | 30 | 221 | | | | | | |
| Volume to Capacity | 0.01 | 0.10 | 2.69 | 0.28 | 0.44 | 0.08 | | | | | | |
| Queue Length 95th (m) | 0.2 | 2.5 | 103.2 | 8.7 | 10.6 | 2.0 | | | | | | |
| Control Delay (s) | 0.2 | 2.7 | 946.2 | 19.4 | 199.3 | 22.8 | | | | | | |
| Lane LOS | A | A | F | C | F | C | | | | | | |
| Approach Delay (s) | 0.2 | 2.7 | 544.3 | | 96.8 | | | | | | | |
| Approach LOS | | | F | | F | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | | 73.3 | | | | | | | | |
| Intersection Capacity Utilization | | | 90.1% | | ICU Level of Service | | | | E | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

Scenario 2 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

109: Atungauyait & Niaqunngusiaraiq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 1 | 781 | 45 | 23 | 467 | 0 | 43 | 0 | 83 | 1 | 0 | 1 |
| Future Volume (Veh/h) | 1 | 781 | 45 | 23 | 467 | 0 | 43 | 0 | 83 | 1 | 0 | 1 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| Grade | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 849 | 49 | 25 | 508 | 0 | 47 | 0 | 90 | 1 | 0 | 1 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | None | None | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 508 | | | 898 | | | 1434 | 1434 | 874 | 1524 | 1458 | 508 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 508 | | | 898 | | | 1434 | 1434 | 874 | 1524 | 1458 | 508 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 97 | | | 57 | 100 | 74 | 99 | 100 | 100 |
| cM capacity (veh/h) | 1057 | | | 756 | | | 108 | 129 | 349 | 70 | 125 | 565 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 899 | 533 | 137 | 2 | | | | | | | | |
| Volume Left | 1 | 25 | 47 | 1 | | | | | | | | |
| Volume Right | 49 | 0 | 90 | 1 | | | | | | | | |
| cSH | 1057 | 756 | 198 | 124 | | | | | | | | |
| Volume to Capacity | 0.00 | 0.03 | 0.69 | 0.02 | | | | | | | | |
| Queue Length 95th (m) | 0.0 | 0.8 | 32.7 | 0.4 | | | | | | | | |
| Control Delay (s) | 0.0 | 0.9 | 56.0 | 34.4 | | | | | | | | |
| Lane LOS | A | A | F | D | | | | | | | | |
| Approach Delay (s) | 0.0 | 0.9 | 56.0 | 34.4 | | | | | | | | |
| Approach LOS | | F | D | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | | 5.3 | | | | | | | | |
| Intersection Capacity Utilization | | | 65.4% | | ICU Level of Service | | | | C | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |

















Scenario 2 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

110: Niaqunngusiaraiq & Road to Nowhere

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (veh/h) | 281 | 578 | 2 | 0 | 380 | 17 | 1 | 0 | 0 | 16 | 0 | 156 |
| Future Volume (Veh/h) | 281 | 578 | 2 | 0 | 380 | 17 | 1 | 0 | 0 | 16 | 0 | 156 |
| Sign Control | | Free | | | Free | | | Slop | | | Slop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 305 | 628 | 2 | 0 | 413 | 18 | 1 | 0 | 0 | 17 | 0 | 170 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 431 | | | 630 | | | 1831 | 1670 | 629 | 1661 | 1662 | 422 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 431 | | | 630 | | | 1831 | 1670 | 629 | 1661 | 1662 | 422 |
| IC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 73 | | | 100 | | | 97 | 100 | 100 | 72 | 100 | 73 |
| cM capacity (veh/h) | 1129 | | | 952 | | | 34 | 70 | 482 | 61 | 71 | 632 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 935 | 431 | 1 | 187 | | | | | | | | |
| Volume Left | 305 | 0 | 1 | 17 | | | | | | | | |
| Volume Right | 2 | 18 | 0 | 170 | | | | | | | | |
| cSH | 1129 | 952 | 34 | 342 | | | | | | | | |
| Volume to Capacity | 0.27 | 0.00 | 0.03 | 0.55 | | | | | | | | |
| Queue Length 95th (m) | 8.4 | 0.0 | 0.7 | 23.7 | | | | | | | | |
| Control Delay (s) | 5.8 | 0.0 | 114.1 | 27.5 | | | | | | | | |
| Lane LOS | A | | F | D | | | | | | | | |
| Approach Delay (s) | 5.8 | 0.0 | 114.1 | 27.5 | | | | | | | | |
| Approach LOS | | | F | D | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | | 6.9 | | | | | | | | |
| Intersection Capacity Utilization | | | | 96.3% | ICU Level of Service | | | | | | F | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

HCM Signalized Intersection Capacity Analysis

106: Queen Elizabeth/Federal Rd & Mivvik Street/Niaqunngusariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|--------|------|------|---------------------------|------|------|-------|------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 49 | 313 | 94 | 189 | 233 | 50 | 98 | 91 | 165 | 50 | 162 | 49 |
| Future Volume (vph) | 49 | 313 | 94 | 189 | 233 | 50 | 98 | 91 | 165 | 50 | 162 | 49 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | | |
| Lane Util. Factor | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | | |
| Frt | 0.97 | | | 0.99 | | | 0.94 | | | 0.97 | | |
| Flt Protected | 0.99 | | | 0.98 | | | 0.99 | | | 0.99 | | |
| Satd. Flow (prot) | 1630 | | | 1629 | | | 1558 | | | 1627 | | |
| Flt Permitted | 0.91 | | | 0.63 | | | 0.78 | | | 0.85 | | |
| Satd. Flow (perm) | 1484 | | | 1050 | | | 1234 | | | 1404 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 53 | 340 | 102 | 205 | 253 | 54 | 107 | 99 | 179 | 54 | 176 | 53 |
| RTOR Reduction (vph) | 0 | 13 | 0 | 0 | 6 | 0 | 0 | 41 | 0 | 0 | 11 | 0 |
| Lane Group Flow (vph) | 0 | 482 | 0 | 0 | 506 | 0 | 0 | 344 | 0 | 0 | 272 | 0 |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | 36.8 | | | 36.8 | | | 24.1 | | | 24.1 | | |
| Effective Green, g (s) | 36.8 | | | 36.8 | | | 24.1 | | | 24.1 | | |
| Actuated g/C Ratio | 0.50 | | | 0.50 | | | 0.33 | | | 0.33 | | |
| Clearance Time (s) | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | | |
| Vehicle Extension (s) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| Lane Grp Cap (vph) | 749 | | | 530 | | | 407 | | | 464 | | |
| v/s Ratio Prot | | | | | | | | | | | | |
| v/s Ratio Perm | 0.32 | | | c0.48 | | | c0.28 | | | 0.19 | | |
| v/c Ratio | 0.64 | | | 0.95 | | | 0.85 | | | 0.59 | | |
| Uniform Delay, d1 | 13.2 | | | 17.3 | | | 22.7 | | | 20.3 | | |
| Progression Factor | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | | |
| Incremental Delay, d2 | 1.9 | | | 27.9 | | | 19.0 | | | 5.4 | | |
| Delay (s) | 15.1 | | | 45.1 | | | 41.7 | | | 25.6 | | |
| Level of Service | B | | | D | | | D | | | C | | |
| Approach Delay (s) | 15.1 | | | 45.1 | | | 41.7 | | | 25.6 | | |
| Approach LOS | B | | | D | | | D | | | C | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | 32.2 | | | HCM 2000 Level of Service | C | | | | | | | |
| HCM 2000 Volume to Capacity ratio | 0.91 | | | | | | | | | | | |
| Actuated Cycle Length (s) | 72.9 | | | Sum of lost time (s) | 12.0 | | | | | | | |
| Intersection Capacity Utilization | 106.8% | | | ICU Level of Service | G | | | | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |
| c Critical Lane Group | | | | | | | | | | | | |

HCM Signalized Intersection Capacity Analysis

107: Niaqunngusariaq & Saputi

04/25/2022

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|-------|------|------|---------------------------|-------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (vph) | 260 | 724 | 450 | 125 | 112 | 155 |
| Future Volume (vph) | 260 | 724 | 450 | 125 | 112 | 155 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 6.0 | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Frt | 1.00 | 1.00 | 0.97 | | 0.92 | |
| Flt Protected | 0.95 | 1.00 | 1.00 | | 0.98 | |
| Satd. Flow (prot) | 1601 | 1685 | 1636 | | 1521 | |
| Flt Permitted | 0.31 | 1.00 | 1.00 | | 0.98 | |
| Satd. Flow (perm) | 528 | 1685 | 1636 | | 1521 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 283 | 787 | 489 | 136 | 122 | 168 |
| RTOR Reduction (vph) | 0 | 0 | 14 | 0 | 51 | 0 |
| Lane Group Flow (vph) | 283 | 787 | 611 | 0 | 239 | 0 |
| Turn Type | Perm | NA | NA | | Prot | |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | | | |
| Actuated Green, G (s) | 40.6 | 40.6 | 40.6 | | 19.7 | |
| Effective Green, g (s) | 40.6 | 40.6 | 40.6 | | 19.7 | |
| Actuated g/C Ratio | 0.56 | 0.56 | 0.56 | | 0.27 | |
| Clearance Time (s) | 6.0 | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | 296 | 946 | 918 | | 414 | |
| v/s Ratio Prot | | 0.47 | 0.37 | | c0.16 | |
| v/s Ratio Perm | c0.54 | | | | | |
| v/c Ratio | 0.96 | 0.83 | 0.67 | | 0.58 | |
| Uniform Delay, d1 | 15.0 | 13.0 | 11.1 | | 22.7 | |
| Progression Factor | 1.00 | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | 40.2 | 6.3 | 1.8 | | 5.8 | |
| Delay (s) | 55.2 | 19.4 | 12.9 | | 28.5 | |
| Level of Service | E | B | B | | C | |
| Approach Delay (s) | 28.8 | 12.9 | | | 28.5 | |
| Approach LOS | C | B | | | C | |
| Intersection Summary | | | | | | |
| HCM 2000 Control Delay | 23.8 | | | HCM 2000 Level of Service | C | |
| HCM 2000 Volume to Capacity ratio | 0.83 | | | | | |
| Actuated Cycle Length (s) | 72.3 | | | Sum of lost time (s) | 12.0 | |
| Intersection Capacity Utilization | 83.6% | | | ICU Level of Service | E | |
| Analysis Period (min) | 15 | | | | | |
| c Critical Lane Group | | | | | | |

101: Federal Rd & Qaggamiut

04/25/2022

[illegible]

Scenario 3 Iglouit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
Page 1

102: Allannqua & Akilliq/Ikaluktuutiak Dr

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|------|------|-------|----------------------|------|------|------|------|------|------|------|
| Lane Configurations | Stop | | | Stop | | | Stop | | | Stop | | |
| Sign Control | | | | | | | | | | | | |
| Traffic Volume (vph) | 0 | 48 | 33 | 1 | 56 | 0 | 51 | 0 | 4 | 0 | 0 | 0 |
| Future Volume (vph) | 0 | 48 | 33 | 1 | 56 | 0 | 51 | 0 | 4 | 0 | 0 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 52 | 36 | 1 | 61 | 0 | 55 | 0 | 4 | 0 | 0 | 0 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 88 | 62 | 59 | 0 | | | | | | | | |
| Volume Left (vph) | 0 | 1 | 55 | 0 | | | | | | | | |
| Volume Right (vph) | 36 | 0 | 4 | 0 | | | | | | | | |
| Hadj (s) | -0.21 | 0.04 | 0.18 | 0.00 | | | | | | | | |
| Departure Headway (s) | 3.9 | 4.2 | 4.4 | 4.3 | | | | | | | | |
| Degree Utilization, x | 0.10 | 0.07 | 0.07 | 0.00 | | | | | | | | |
| Capacity (veh/h) | 904 | 847 | 785 | 814 | | | | | | | | |
| Control Delay (s) | 7.3 | 7.5 | 7.7 | 7.3 | | | | | | | | |
| Approach Delay (s) | 7.3 | 7.5 | 7.7 | 0.0 | | | | | | | | |
| Approach LOS | A | A | A | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 7.5 | | | | | | | | |
| Level of Service | | | | A | | | | | | | | |
| Intersection Capacity Utilization | | | | 15.2% | ICU Level of Service | | | | | | A | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

Scenario 3 Iglouit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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103: Allannqua/Mivvik Street

04/25/2022














[illegible]

Scenario 3 Igloolik TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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104: Federal Rd & Ikaluktuutiak Dr

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | | | | | | | | | | | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 98 | 1 | 112 | 0 | 2 | 0 | 243 | 287 | 6 | 1 | 174 | 103 |
| Future Volume (vph) | 98 | 1 | 112 | 0 | 2 | 0 | 243 | 287 | 6 | 1 | 174 | 103 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 107 | 1 | 122 | 0 | 2 | 0 | 264 | 312 | 7 | 1 | 189 | 112 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 230 | 2 | 583 | 302 | | | | | | | | |
| Volume Left (vph) | 107 | 0 | 264 | 1 | | | | | | | | |
| Volume Right (vph) | 122 | 0 | 7 | 112 | | | | | | | | |
| Hadj (s) | -0.19 | 0.03 | 0.12 | -0.19 | | | | | | | | |
| Departure Headway (s) | 5.9 | 6.8 | 5.2 | 5.3 | | | | | | | | |
| Degree Utilization, x | 0.38 | 0.00 | 0.84 | 0.44 | | | | | | | | |
| Capacity (veh/h) | 566 | 457 | 682 | 647 | | | | | | | | |
| Control Delay (s) | 12.5 | 9.9 | 29.4 | 12.4 | | | | | | | | |
| Approach Delay (s) | 12.5 | 9.9 | 29.4 | 12.4 | | | | | | | | |
| Approach LOS | B | A | D | B | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | 21.3 | | | | | | | | | | | |
| Level of Service | C | | | | | | | | | | | |
| Intersection Capacity Utilization | 80.1% | | | ICU Level of Service | | | D | | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

















Scenario 3 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

105: Federal Rd & Nunavut

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (veh/h) | 18 | 6 | 22 | 5 | 9 | 110 | 44 | 333 | 5 | 27 | 214 | 18 |
| Future Volume (Veh/h) | 18 | 6 | 22 | 5 | 9 | 110 | 44 | 333 | 5 | 27 | 214 | 18 |
| Sign Control | | Stop | | | Stop | | | Free | | | Free | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 20 | 7 | 24 | 5 | 10 | 120 | 48 | 362 | 5 | 29 | 233 | 20 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | | None | | None | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | 155 | | | | |
| vC, conflicting volume | 886 | 764 | 243 | 789 | 772 | 364 | 253 | | | 367 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 886 | 764 | 243 | 789 | 772 | 364 | 253 | | | 367 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 90 | 98 | 97 | 98 | 97 | 82 | 96 | | | 98 | | |
| cM capacity (veh/h) | 203 | 314 | 796 | 281 | 311 | 680 | 1312 | | | 1192 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 51 | 135 | 415 | 282 | | | | | | | | |
| Volume Left | 20 | 5 | 48 | 29 | | | | | | | | |
| Volume Right | 24 | 120 | 5 | 20 | | | | | | | | |
| cSH | 338 | 596 | 1312 | 1192 | | | | | | | | |
| Volume to Capacity | 0.15 | 0.23 | 0.04 | 0.02 | | | | | | | | |
| Queue Length 95th (m) | 4.0 | 6.6 | 0.9 | 0.6 | | | | | | | | |
| Control Delay (s) | 17.5 | 12.8 | 1.2 | 1.0 | | | | | | | | |
| Lane LOS | C | B | A | A | | | | | | | | |
| Approach Delay (s) | 17.5 | 12.8 | 1.2 | 1.0 | | | | | | | | |
| Approach LOS | C | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | 3.9 | | | | | | | | | | | |
| Intersection Capacity Utilization | 47.2% | | | | ICU Level of Service | | | | A | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

















Scenario 3 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

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HCM Unsignalized Intersection Capacity Analysis

111: Abe Okpik & Niaqungusiariq

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | | |  | | |  | | |  | | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Traffic Volume (vph) | 4 | 211 | 63 | 35 | 508 | 4 | 129 | 0 | 41 | 0 | 0 | 1 |
| Future Volume (vph) | 4 | 211 | 63 | 35 | 508 | 4 | 129 | 0 | 41 | 0 | 0 | 1 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 4 | 229 | 68 | 38 | 552 | 4 | 140 | 0 | 45 | 0 | 0 | 1 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 301 | 594 | 185 | 1 | | | | | | | | |
| Volume Left (vph) | 4 | 38 | 140 | 0 | | | | | | | | |
| Volume Right (vph) | 68 | 4 | 45 | 1 | | | | | | | | |
| Had _j (s) | -0.10 | 0.04 | 0.04 | -0.57 | | | | | | | | |
| Departure Headway (s) | 5.2 | 5.0 | 6.1 | 6.0 | | | | | | | | |
| Degree Utilization, x | 0.43 | 0.82 | 0.31 | 0.00 | | | | | | | | |
| Capacity (veh/h) | 655 | 713 | 549 | 511 | | | | | | | | |
| Control Delay (s) | 12.1 | 26.4 | 11.9 | 9.1 | | | | | | | | |
| Approach Delay (s) | 12.1 | 26.4 | 11.9 | 9.1 | | | | | | | | |
| Approach LOS | B | D | B | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | 19.9 | | | | | | | | | | | |
| Level of Service | C | | | | | | | | | | | |
| Intersection Capacity Utilization | 76.7% | | | | ICU Level of Service | | | | D | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

















Scenario 3 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

112: Abe Okpik/Tasilik & Niaqungusiariq

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Traffic Volume (vph) | 12 | 139 | 46 | 10 | 289 | 6 | 106 | 2 | 12 | 6 | 5 | 17 |
| Future Volume (vph) | 12 | 139 | 46 | 10 | 289 | 6 | 106 | 2 | 12 | 6 | 5 | 17 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 13 | 151 | 50 | 11 | 314 | 7 | 115 | 2 | 13 | 7 | 5 | 18 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 214 | 332 | 130 | 30 | | | | | | | | |
| Volume Left (vph) | 13 | 11 | 115 | 7 | | | | | | | | |
| Volume Right (vph) | 50 | 7 | 13 | 18 | | | | | | | | |
| Had _j (s) | -0.09 | 0.03 | 0.15 | -0.28 | | | | | | | | |
| Departure Headway (s) | 4.7 | 4.6 | 5.4 | 5.1 | | | | | | | | |
| Degree Utilization, x | 0.28 | 0.43 | 0.19 | 0.04 | | | | | | | | |
| Capacity (veh/h) | 739 | 746 | 609 | 609 | | | | | | | | |
| Control Delay (s) | 9.4 | 11.0 | 9.7 | 8.4 | | | | | | | | |
| Approach Delay (s) | 9.4 | 11.0 | 9.7 | 8.4 | | | | | | | | |
| Approach LOS | A | B | A | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | 10.2 | | | | | | | | | | | |
| Level of Service | B | | | | | | | | | | | |
| Intersection Capacity Utilization | 41.5% | | | | ICU Level of Service | | | | A | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

Scenario 3 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

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HCM Signalized Intersection Capacity Analysis

106: Queen Elizabeth/Federal Rd & Mivvik Street/Niaqungngusariaq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|------|---------------------------|------|------|-------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 69 | 190 | 56 | 183 | 281 | 50 | 60 | 166 | 109 | 50 | 105 | 53 |
| Future Volume (vph) | 69 | 190 | 56 | 183 | 281 | 50 | 60 | 166 | 109 | 50 | 105 | 53 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | | |
| Lane Util. Factor | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | | |
| Flt | 0.98 | | | 0.99 | | | 0.96 | | | 0.97 | | |
| Flt Protected | 0.99 | | | 0.98 | | | 0.99 | | | 0.99 | | |
| Satd. Flow (prot) | 1627 | | | 1634 | | | 1597 | | | 1608 | | |
| Flt Permitted | 0.81 | | | 0.74 | | | 0.90 | | | 0.84 | | |
| Satd. Flow (perm) | 1334 | | | 1233 | | | 1457 | | | 1370 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 75 | 207 | 61 | 199 | 305 | 54 | 65 | 180 | 118 | 54 | 114 | 58 |
| RTOR Reduction (vph) | 0 | 10 | 0 | 0 | 5 | 0 | 0 | 21 | 0 | 0 | 15 | 0 |
| Lane Group Flow (vph) | 0 | 333 | 0 | 0 | 553 | 0 | 0 | 342 | 0 | 0 | 211 | 0 |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | 36.5 | | | 36.5 | | | 26.3 | | | 26.3 | | |
| Effective Green, g (s) | 36.5 | | | 36.5 | | | 26.3 | | | 26.3 | | |
| Actuated g/C Ratio | 0.49 | | | 0.49 | | | 0.35 | | | 0.35 | | |
| Clearance Time (s) | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | | |
| Vehicle Extension (s) | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | | |
| Lane Grp Cap (vph) | 650 | | | 601 | | | 512 | | | 481 | | |
| v/s Ratio Prot | | 0.25 | | | c0.45 | | | c0.23 | | | 0.15 | |
| v/c Ratio | | 0.51 | | | 0.92 | | | 0.67 | | | 0.44 | |
| Uniform Delay, d1 | | 13.1 | | | 17.8 | | | 20.6 | | | 18.6 | |
| Progression Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 0.7 | | | 19.2 | | | 6.8 | | | 2.9 | |
| Delay (s) | | 13.8 | | | 37.0 | | | 27.3 | | | 21.5 | |
| Level of Service | | B | | | D | | | C | | | D | |
| Approach Delay (s) | | 13.8 | | | 37.0 | | | 27.3 | | | 21.5 | |
| Approach LOS | | B | | | D | | | C | | | D | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | | 26.9 | | | HCM 2000 Level of Service | | | C | | | | |
| HCM 2000 Volume to Capacity ratio | | 0.81 | | | | | | | | | | |
| Actuated Cycle Length (s) | | 74.8 | | | Sum of lost time (s) | | | 12.0 | | | | |
| Intersection Capacity Utilization | | 87.2% | | | ICU Level of Service | | | E | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |
| c Critical Lane Group | | | | | | | | | | | | |

Scenario 3 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Signalized Intersection Capacity Analysis

107: Niaqungngusariaq & Saputi

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|-------|------|---------------------------|-------|-----|------|-----|-----|-----|-----|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 105 | 318 | 833 | 86 | 106 | 254 | | | | | | |
| Future Volume (vph) | 105 | 318 | 833 | 86 | 106 | 254 | | | | | | |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | | | | | | |
| Total Lost time (s) | 6.0 | 6.0 | 6.0 | | 6.0 | 6.0 | | | | | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | | 1.00 | 1.00 | | | | | | |
| Flt | 1.00 | 1.00 | 0.99 | | 1.00 | 0.85 | | | | | | |
| Flt Protected | 0.95 | 1.00 | 1.00 | | 1.00 | 0.95 | | | | | | |
| Satd. Flow (prot) | 1601 | 1685 | 1664 | | 1601 | 1432 | | | | | | |
| Flt Permitted | 0.19 | 1.00 | 1.00 | | 0.95 | 1.00 | | | | | | |
| Satd. Flow (perm) | 314 | 1685 | 1664 | | 1601 | 1432 | | | | | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | | 0.92 | 0.92 | | | | | | |
| Adj. Flow (vph) | 114 | 346 | 905 | | 93 | 115 | | | | | | |
| RTOR Reduction (vph) | 0 | 0 | 3 | | 0 | 0 | | | | | | |
| Lane Group Flow (vph) | 114 | 346 | 995 | | 0 | 115 | | | | | | |
| Turn Type | Perm | NA | NA | | Prot | Perm | | | | | | |
| Protected Phases | | 4 | 8 | | | 6 | | | | | | |
| Permitted Phases | 4 | | | | | 6 | | | | | | |
| Actuated Green, G (s) | 66.3 | 66.3 | 66.3 | | 13.2 | 13.2 | | | | | | |
| Effective Green, g (s) | 66.3 | 66.3 | 66.3 | | 13.2 | 13.2 | | | | | | |
| Actuated g/C Ratio | 0.72 | 0.72 | 0.72 | | 0.14 | 0.14 | | | | | | |
| Clearance Time (s) | 6.0 | 6.0 | 6.0 | | 6.0 | 6.0 | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | 3.0 | | 3.0 | 3.0 | | | | | | |
| Lane Grp Cap (vph) | 227 | 1220 | 1205 | | 230 | 206 | | | | | | |
| v/s Ratio Prot | | 0.21 | c0.60 | | | 0.07 | | | | | | |
| v/s Ratio Perm | | 0.36 | | | | c0.09 | | | | | | |
| v/c Ratio | | 0.50 | 0.28 | | 0.83 | 0.50 | | | | | | |
| Uniform Delay, d1 | | 5.5 | 4.4 | | 8.6 | 36.1 | | | | | | |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | 1.00 | | | | | | |
| Incremental Delay, d2 | | 7.7 | 0.6 | | 6.5 | 1.7 | | | | | | |
| Delay (s) | | 13.2 | 5.0 | | 15.2 | 37.8 | | | | | | |
| Level of Service | | B | A | | B | D | | | | | | |
| Approach Delay (s) | | 7.0 | 15.2 | | 40.2 | | | | | | | |
| Approach LOS | | A | B | | D | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | | 18.4 | | | HCM 2000 Level of Service | | | B | | | | |
| HCM 2000 Volume to Capacity ratio | | 0.79 | | | | | | | | | | |
| Actuated Cycle Length (s) | | 91.5 | | | Sum of lost time (s) | | | 12.0 | | | | |
| Intersection Capacity Utilization | | 82.9% | | | ICU Level of Service | | | E | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |
| c Critical Lane Group | | | | | | | | | | | | |

Scenario 3 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Signalized Intersection Capacity Analysis

108: Queen Elizabeth

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|------|-------|------|------|---------------------------|------|------|-------|------|------|------|------|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (vph) | 23 | 329 | 84 | 84 | 833 | 13 | 122 | 5 | 43 | 5 | 2 | 9 |
| Future Volume (vph) | 23 | 329 | 84 | 84 | 833 | 13 | 122 | 5 | 43 | 5 | 2 | 9 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Flt | 1.00 | 0.97 | 1.00 | 1.00 | 1.00 | 0.86 | 1.00 | 0.88 | 1.00 | 0.88 | 1.00 | 0.88 |
| Flt Protected | 0.95 | 1.00 | 0.95 | 1.00 | 0.95 | 1.00 | 0.95 | 1.00 | 0.95 | 1.00 | 0.95 | 1.00 |
| Satd. Flow (prot) | 1601 | 1634 | 1601 | 1681 | 1601 | 1457 | 1601 | 1475 | 1601 | 1475 | 1601 | 1475 |
| Flt Permitted | 0.19 | 1.00 | 0.46 | 1.00 | 0.75 | 1.00 | 0.72 | 1.00 | 0.72 | 1.00 | 0.72 | 1.00 |
| Satd. Flow (perm) | 323 | 1634 | 780 | 1681 | 1263 | 1457 | 1219 | 1475 | 1219 | 1475 | 1219 | 1475 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 25 | 358 | 91 | 91 | 905 | 14 | 133 | 5 | 47 | 5 | 2 | 10 |
| RTOR Reduction (vph) | 0 | 10 | 0 | 0 | 1 | 0 | 0 | 37 | 0 | 0 | 8 | 0 |
| Lane Group Flow (vph) | 25 | 439 | 0 | 91 | 918 | 0 | 133 | 15 | 0 | 5 | 4 | 0 |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | 61.5 | 61.5 | | 61.5 | 61.5 | | 19.5 | 19.5 | | 19.5 | 19.5 | |
| Effective Green, g (s) | 61.5 | 61.5 | | 61.5 | 61.5 | | 19.5 | 19.5 | | 19.5 | 19.5 | |
| Actuated g/C Ratio | 0.68 | 0.68 | | 0.68 | 0.68 | | 0.22 | 0.22 | | 0.22 | 0.22 | |
| Clearance Time (s) | 4.5 | 4.5 | | 4.5 | 4.5 | | 4.5 | 4.5 | | 4.5 | 4.5 | |
| Lane Grp Cap (vph) | 220 | 1116 | | 533 | 1148 | | 273 | 315 | | 264 | 319 | |
| v/s Ratio Prot | | 0.27 | | | c0.55 | | | 0.01 | | | 0.00 | |
| v/s Ratio Perm | | 0.08 | | | 0.12 | | | c0.11 | | | 0.00 | |
| v/c Ratio | | 0.11 | | | 0.39 | | | 0.05 | | | 0.02 | |
| Uniform Delay, d1 | | 4.9 | | | 6.2 | | | 10.0 | | | 27.7 | |
| Progression Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 1.0 | | | 0.7 | | | 5.9 | | | 0.1 | |
| Delay (s) | | 5.9 | | | 7.2 | | | 15.8 | | | 27.8 | |
| Level of Service | | A | | | A | | | B | | | C | |
| Approach Delay (s) | | 7.1 | | | 14.9 | | | 34.5 | | | 27.8 | |
| Approach LOS | | A | | | B | | | C | | | C | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | | 15.0 | | | HCM 2000 Level of Service | | | B | | | | |
| HCM 2000 Volume to Capacity ratio | | 0.72 | | | | | | | | | | |
| Actuated Cycle Length (s) | | 90.0 | | | Sum of lost time (s) | | | 9.0 | | | | |
| Intersection Capacity Utilization | | 79.5% | | | ICU Level of Service | | | D | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |
| c Critical Lane Group | | | | | | | | | | | | |

















Scenario 3 Iqaluit TMP - Future 2030 Conditions AM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Signalized Intersection Capacity Analysis

109: Atungayait & Niaqungngusariaq













04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (vph) | 1 | 339 | 23 | 33 | 843 | 0 | 47 | 1 | 34 | 1 | 0 | 1 |
| Future Volume (vph) | 1 | 339 | 23 | 33 | 843 | 0 | 47 | 1 | 34 | 1 | 0 | 1 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | | 4.5 | | | 4.5 | | | 4.5 | | | 4.5 | |
| Lane Util. Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| rt | | 0.99 | | | 1.00 | | | 0.94 | | | 0.93 | |
| Flt Protected | | 1.00 | | | 1.00 | | | 0.97 | | | 0.98 | |
| Satd. Flow (prot) | | 1671 | | | 1682 | | | 1546 | | | 1533 | |
| Flt Permitted | | 1.00 | | | 0.98 | | | 0.85 | | | 0.94 | |
| Satd. Flow (perm) | | 1669 | | | 1645 | | | 1350 | | | 1469 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 1 | 368 | 25 | 36 | 916 | 0 | 51 | 1 | 37 | 1 | 0 | 1 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 28 | 0 | 0 | 2 | 0 |
| Lane Group Flow (vph) | 0 | 391 | 0 | 0 | 952 | 0 | 0 | 61 | 0 | 0 | 0 | 0 |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actualized Green, G (s) | | 52.5 | | | 52.5 | | | 18.5 | | | 18.5 | |
| Effective Green, g (s) | | 52.5 | | | 52.5 | | | 18.5 | | | 18.5 | |
| Actualized g/C Ratio | | 0.66 | | | 0.66 | | | 0.23 | | | 0.23 | |
| Clearance Time (s) | | 4.5 | | | 4.5 | | | 4.5 | | | 4.5 | |
| Lane Grp Cap (vph) | | 1095 | | | 1079 | | | 312 | | | 339 | |
| v/s Ratio Prot | | | | | | | | | | | | |
| v/s Ratio Perm | | 0.23 | | | c0.58 | | | c0.04 | | | 0.00 | |
| v/c Ratio | | 0.36 | | | 0.88 | | | 0.19 | | | 0.00 | |
| Uniform Delay, d1 | | 6.2 | | | 11.2 | | | 24.7 | | | 23.6 | |
| Progression Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 0.9 | | | 10.4 | | | 1.4 | | | 0.0 | |
| Delay (s) | | 7.1 | | | 21.7 | | | 26.1 | | | 23.7 | |
| Level of Service | | A | | | C | | | C | | | C | |
| Approach Delay (s) | | 7.1 | | | 21.7 | | | 26.1 | | | 23.7 | |
| Approach LOS | | A | | | C | | | C | | | C | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | 18.0 | | | HCM 2000 Level of Service | | | | | B | | | |
| HCM 2000 Volume to Capacity ratio | 0.70 | | | | | | | | | | | |
| Actuated Cycle Length (s) | 80.0 | | | Sum of lost time (s) | | | | | 9.0 | | | |
| Intersection Capacity Utilization | 91.4% | | | ICU Level of Service | | | | | F | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |
| c Critical Lane Group | | | | | | | | | | | | |

HCM Signalized Intersection Capacity Analysis

110: Niaqunngusiariaq & Road to Nowhere

















04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations |  |  |  |  |  |  |  |  |  |  |  |  |
| Traffic Volume (vph) | 97 | 276 | 1 | 0 | 651 | 13 | 0 | 0 | 0 | 11 | 0 | 267 |
| Future Volume (vph) | 97 | 276 | 1 | 0 | 651 | 13 | 0 | 0 | 0 | 11 | 0 | 267 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 4.5 | 4.5 | | | 4.5 | | | | | 4.5 | | |
| Lane Util. Factor | 1.00 | 1.00 | | | 1.00 | | | | | 1.00 | | |
| Frt | 1.00 | 1.00 | | | 1.00 | | | | | 0.87 | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | | | | | 1.00 | | |
| Satd. Flow (prot) | 1601 | 1684 | | | 1681 | | | | | 1464 | | |
| Flt Permitted | 0.22 | 1.00 | | | 1.00 | | | | | 0.99 | | |
| Satd. Flow (perm) | 377 | 1684 | | | 1681 | | | | | 1456 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 105 | 300 | 1 | 0 | 708 | 14 | 0 | 0 | 0 | 12 | 0 | 290 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 136 | 0 |
| Lane Group Flow (vph) | 105 | 301 | 0 | 0 | 721 | 0 | 0 | 0 | 0 | 0 | 166 | 0 |
| Turn Type | Perm | NA | | | NA | | | | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | 2 | | | | 6 | | |
| Actuated Green, G (s) | 32.5 | 32.5 | | | 32.5 | | | | | 18.5 | | |
| Effective Green, g (s) | 32.5 | 32.5 | | | 32.5 | | | | | 18.5 | | |
| Actuated g/C Ratio | 0.54 | 0.54 | | | 0.54 | | | | | 0.31 | | |
| Clearance Time (s) | 4.5 | 4.5 | | | 4.5 | | | | | 4.5 | | |
| Lane Grp Cap (vph) | 204 | 912 | | | 910 | | | | | 448 | | |
| v/s Ratio Prot | | 0.18 | | | c0.43 | | | | | | | |
| v/s Ratio Perm | 0.28 | | | | | | | | | c0.11 | | |
| v/c Ratio | 0.51 | 0.33 | | | 0.79 | | | | | 0.37 | | |
| Uniform Delay, d1 | 8.7 | 7.7 | | | 11.0 | | | | | 16.2 | | |
| Progression Factor | 1.00 | 1.00 | | | 1.00 | | | | | 1.00 | | |
| Incremental Delay, d2 | 9.0 | 1.0 | | | 7.0 | | | | | 2.3 | | |
| Delay (s) | 17.7 | 8.6 | | | 18.0 | | | | | 18.5 | | |
| Level of Service | B | A | | | B | | | | | B | | |
| Approach Delay (s) | | 11.0 | | | 18.0 | | | 0.0 | | 18.5 | | |
| Approach LOS | | B | | | B | | | A | | B | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | | 16.1 | | | HCM 2000 Level of Service | | | B | | | | |
| HCM 2000 Volume to Capacity ratio | | 0.64 | | | | | | | | | | |
| Actuated Cycle Length (s) | | 60.0 | | | Sum of lost time (s) | | | 9.0 | | | | |
| Intersection Capacity Utilization | | 85.9% | | | ICU Level of Service | | | E | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |
| Critical Lane Group | | | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis

101: Federal Rd & Qaqqamiut

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (veh/h) | 4 | 8 | 74 | 44 | 10 | 7 | 74 | 58 | 51 | 9 | 101 | 2 |
| Future Volume (Veh/h) | 4 | 8 | 74 | 44 | 10 | 7 | 74 | 58 | 51 | 9 | 101 | 2 |
| Sign Control | | Stop | | | Stop | | | Free | | | Free | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 4 | 9 | 80 | 48 | 11 | 8 | 80 | 63 | 55 | 10 | 110 | 2 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 395 | 409 | 111 | 466 | 382 | 90 | 112 | | | 118 | | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 395 | 409 | 111 | 466 | 382 | 90 | 112 | | | 118 | | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | 4.1 | | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | 2.2 | | |
| p0 queue free % | 99 | 98 | 92 | 89 | 98 | 99 | 95 | | | 99 | | |
| cM capacity (veh/h) | 526 | 500 | 942 | 436 | 517 | 967 | 1478 | | | 1470 | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 93 | 67 | 198 | 122 | | | | | | | | |
| Volume Left | 4 | 48 | 80 | 10 | | | | | | | | |
| Volume Right | 80 | 8 | 55 | 2 | | | | | | | | |
| cSH | 841 | 480 | 1478 | 1470 | | | | | | | | |
| Volume to Capacity | 0.11 | 0.14 | 0.05 | 0.01 | | | | | | | | |
| Queue Length 95th (m) | 2.8 | 3.7 | 1.3 | 0.2 | | | | | | | | |
| Control Delay (s) | 9.8 | 13.7 | 3.3 | 0.7 | | | | | | | | |
| Lane LOS | A | B | A | A | | | | | | | | |
| Approach Delay (s) | 9.8 | 13.7 | 3.3 | 0.7 | | | | | | | | |
| Approach LOS | A | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | 5.4 | | | | | | | | | | | |
| Intersection Capacity Utilization | 35.3% | | | | | | | | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |
| ICU Level of Service | | | | | | | | | | | | |
| A | | | | | | | | | | | | |





















Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

102: Allanngua & Akiliq/Ikaluktuutiak Dr

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  | | | | | | | | |
|------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|--|--|--|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR | | | | | | | | |
| Lane Configurations | <div> <div></div> <div></div> </div> <div> <div></div> <div></div> </div> <div> <div></div> <div></div> </div> <div> <div></div> <div></div> </div> | | | | | | | | | | | | | | | | | | | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | | | | | | | | | |
| Traffic Volume (vph) | 0 | 52 | 48 | 14 | 44 | 0 | 27 | 0 | 6 | 0 | 0 | 0 | | | | | | | | |
| Future Volume (vph) | 0 | 52 | 48 | 14 | 44 | 0 | 27 | 0 | 6 | 0 | 0 | 0 | | | | | | | | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | | | | | | | | |
| Hourly flow rate (vph) | 0 | 57 | 52 | 15 | 48 | 0 | 29 | 0 | 7 | 0 | 0 | 0 | | | | | | | | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | | | | | | | | | |
| Volume Total (vph) | 109 | 63 | 36 | 0 | | | | | | | | | | | | | | | | |
| Volume Left (vph) | 0 | 15 | 29 | 0 | | | | | | | | | | | | | | | | |
| Volume Right (vph) | 52 | 0 | 7 | 0 | | | | | | | | | | | | | | | | |
| Had _i (s) | -0.25 | 0.08 | 0.08 | 0.00 | | | | | | | | | | | | | | | | |
| Departure Headway _i (s) | 3.8 | 4.2 | 4.3 | 4.3 | | | | | | | | | | | | | | | | |
| Degree Utilization, x _i | 0.11 | 0.07 | 0.04 | 0.00 | | | | | | | | | | | | | | | | |
| Capacity _i (veh/h) | 932 | 849 | 792 | 809 | | | | | | | | | | | | | | | | |
| Control Delay _i (s) | 7.3 | 7.5 | 7.5 | 7.3 | | | | | | | | | | | | | | | | |
| Approach Delay _i (s) | 7.3 | 7.5 | 7.5 | 0.0 | | | | | | | | | | | | | | | | |
| Approach LOS | A | A | A | A | | | | | | | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | | | | | | | | | |
| Delay | 7.4 | | | | | | | | | | | | | | | | | | | |
| Level of Service | A | | | | | | | | | | | | | | | | | | | |
| Intersection Capacity Utilization | 20.1% | | | | | | | | | | | | | | | | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | | | | | | | | | |













Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

103: Allanngua/Mivvik Street

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | | | | | | | | | | | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Traffic Volume (vph) | 10 | 235 | 29 | 133 | 128 | 28 | 16 | 4 | 176 | 15 | 3 | 5 |
| Future Volume (vph) | 10 | 235 | 29 | 133 | 128 | 28 | 16 | 4 | 176 | 15 | 3 | 5 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 11 | 255 | 32 | 145 | 139 | 30 | 17 | 4 | 191 | 16 | 3 | 5 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 298 | 314 | 212 | 24 | | | | | | | | |
| Volume Left (vph) | 11 | 145 | 17 | 16 | | | | | | | | |
| Volume Right (vph) | 32 | 30 | 191 | 5 | | | | | | | | |
| Hadj (s) | -0.02 | 0.07 | -0.49 | 0.04 | | | | | | | | |
| Departure Headway (s) | 4.9 | 5.0 | 5.0 | 5.9 | | | | | | | | |
| Degree Utilization, x | 0.41 | 0.44 | 0.29 | 0.04 | | | | | | | | |
| Capacity (veh/h) | 689 | 687 | 651 | 519 | | | | | | | | |
| Control Delay (s) | 11.3 | 11.8 | 10.0 | 9.1 | | | | | | | | |
| Approach Delay (s) | 11.3 | 11.8 | 10.0 | 9.1 | | | | | | | | |
| Approach LOS | B | B | B | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | 11.1 | | | | | | | | | | | |
| Level of Service | B | | | | | | | | | | | |
| Intersection Capacity Utilization | 57.2% | | | | | | | | | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |
| ICU Level of Service | | | | | | | | | | | | |
| B | | | | | | | | | | | | |

















Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

104: Federal Rd & Ikaluktuutiak Dr

















04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 83 | 1 | 192 | 2 | 0 | 2 | 125 | 163 | 1 | 0 | 225 | 115 |
| Future Volume (vph) | 83 | 1 | 192 | 2 | 0 | 2 | 125 | 163 | 1 | 0 | 225 | 115 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 90 | 1 | 209 | 2 | 0 | 2 | 136 | 177 | 1 | 0 | 245 | 125 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 300 | 4 | 314 | 370 | | | | | | | | |
| Volume Left (vph) | 90 | 2 | 136 | 0 | | | | | | | | |
| Volume Right (vph) | 209 | 2 | 1 | 125 | | | | | | | | |
| Hadj (s) | -0.32 | -0.17 | 0.12 | -0.17 | | | | | | | | |
| Departure Headway (s) | 5.3 | 6.2 | 5.4 | 5.1 | | | | | | | | |
| Degree Utilization, x | 0.44 | 0.01 | 0.47 | 0.52 | | | | | | | | |
| Capacity (veh/h) | 625 | 459 | 623 | 675 | | | | | | | | |
| Control Delay (s) | 12.5 | 9.2 | 13.2 | 13.5 | | | | | | | | |
| Approach Delay (s) | 12.5 | 9.2 | 13.2 | 13.5 | | | | | | | | |
| Approach LOS | B | A | B | B | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 13.1 | | | | | | | | |
| Level of Service | | | | B | | | | | | | | |
| Intersection Capacity Utilization | | | | 68.6% | ICU Level of Service | | | | C | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis

105: Federal Rd & Nunavut

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (veh/h) | 15 | 6 | 37 | 2 | 6 | 58 | 30 | 250 | 6 | 86 | 338 | 22 |
| Future Volume (Veh/h) | 15 | 6 | 37 | 2 | 6 | 58 | 30 | 250 | 6 | 86 | 338 | 22 |
| Sign Control | | Stop | | | Stop | | | Free | | | Free | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 16 | 7 | 40 | 2 | 7 | 63 | 33 | 272 | 7 | 93 | 367 | 24 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | 155 | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 973 | 910 | 379 | 950 | 918 | 276 | 391 | | | | 279 | |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | | | | | | | | | | | 279 | |
| IC, single (s) | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | 4.1 | | | | 4.1 | |
| IC, 2 stage (s) | | | | | | | | | | | | |
| IF (s) | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | 2.2 | | | | 2.2 | |
| p0 queue free % | 92 | 97 | 94 | 99 | 97 | 92 | 97 | | | | 93 | |
| cM capacity (veh/h) | 192 | 247 | 668 | 204 | 245 | 763 | 1168 | | | | 1284 | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 63 | 72 | 312 | 484 | | | | | | | | |
| Volume Left | 16 | 2 | 33 | 93 | | | | | | | | |
| Volume Right | 40 | 63 | 7 | 24 | | | | | | | | |
| cSH | 367 | 595 | 1168 | 1284 | | | | | | | | |
| Volume to Capacity | 0.17 | 0.12 | 0.03 | 0.07 | | | | | | | | |
| Queue Length 95th (m) | 4.6 | 3.1 | 0.7 | 1.8 | | | | | | | | |
| Control Delay (s) | 16.8 | 11.9 | 1.1 | 2.2 | | | | | | | | |
| Lane LOS | C | B | A | A | | | | | | | | |
| Approach Delay (s) | 16.8 | 11.9 | 1.1 | 2.2 | | | | | | | | |
| Approach LOS | C | B | | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | 3.5 | | | | | | | | | | | |
| Intersection Capacity Utilization | 61.6% | | | | ICU Level of Service | | | | B | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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HCM Unsignalized Intersection Capacity Analysis

111: Abe Okpik & Niaqungusiariq

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|-------|------|-------|-------|------|------|----------------------|------|------|------|------|------|
| Lane Configurations | | ↕ | | | ↕ | | | ↕ | | | ↕ | |
| Sign Control | Stop | | | Stop | | | Stop | | | Stop | | |
| Traffic Volume (vph) | 3 | 454 | 115 | 20 | 299 | 3 | 96 | 0 | 81 | 1 | 0 | 3 |
| Future Volume (vph) | 3 | 454 | 115 | 20 | 299 | 3 | 96 | 0 | 81 | 1 | 0 | 3 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 3 | 493 | 125 | 22 | 325 | 3 | 104 | 0 | 88 | 1 | 0 | 3 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 621 | 350 | 192 | 4 | | | | | | | | |
| Volume Left (vph) | 3 | 22 | 104 | 1 | | | | | | | | |
| Volume Right (vph) | 125 | 3 | 88 | 3 | | | | | | | | |
| Had _j (s) | -0.09 | 0.04 | -0.13 | -0.37 | | | | | | | | |
| Departure Headway (s) | 5.0 | 5.4 | 6.1 | 6.5 | | | | | | | | |
| Degree Utilization, x | 0.86 | 0.53 | 0.33 | 0.01 | | | | | | | | |
| Capacity (veh/h) | 710 | 638 | 552 | 478 | | | | | | | | |
| Control Delay (s) | 30.1 | 14.3 | 12.1 | 9.6 | | | | | | | | |
| Approach Delay (s) | 30.1 | 14.3 | 12.1 | 9.6 | | | | | | | | |
| Approach LOS | D | B | B | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | 22.3 | | | | | | | | | | | |
| Level of Service | C | | | | | | | | | | | |
| Intersection Capacity Utilization | 60.3% | | | | | | ICU Level of Service | | | B | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

















Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

Synchro 11 Report
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HCM Unsignalized Intersection Capacity Analysis

112: Abe Okpik/Tasilik & Niaqungusiariq

04/25/2022

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 19 | 275 | 60 | 16 | 177 | 5 | 71 | 4 | 10 | 7 | 2 | 17 |
| Future Volume (vph) | 19 | 275 | 60 | 16 | 177 | 5 | 71 | 4 | 10 | 7 | 2 | 17 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 21 | 299 | 65 | 17 | 192 | 5 | 77 | 4 | 11 | 8 | 2 | 18 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 385 | 214 | 92 | 28 | | | | | | | | |
| Volume Left (vph) | 21 | 17 | 77 | 8 | | | | | | | | |
| Volume Right (vph) | 65 | 5 | 11 | 18 | | | | | | | | |
| Had _j (s) | -0.06 | 0.04 | 0.13 | -0.29 | | | | | | | | |
| Departure Headway (s) | 4.4 | 4.7 | 5.4 | 5.1 | | | | | | | | |
| Degree Utilization, x | 0.47 | 0.28 | 0.14 | 0.04 | | | | | | | | |
| Capacity (veh/h) | 790 | 730 | 595 | 604 | | | | | | | | |
| Control Delay (s) | 11.4 | 9.5 | 9.3 | 8.4 | | | | | | | | |
| Approach Delay (s) | 11.4 | 9.5 | 9.3 | 8.4 | | | | | | | | |
| Approach LOS | B | A | A | A | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | 10.4 | | | | | | | | | | | |
| Level of Service | B | | | | | | | | | | | |
| Intersection Capacity Utilization | 44.3% | | | | ICU Level of Service | | | | A | | | |
| Analysis Period (min) | 15 | | | | | | | | | | | |

Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

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Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

04/25/2022

Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

04/25/2022

Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030













04/25/2022

Scenario 3 Iqaluit TMP - Future 2030 Conditions PM 5:00 pm 08/03/2021 Future 2030

HCM Signalized Intersection Capacity Analysis

110: Niaqunngusiariaq & Road to Nowhere

04/25/2022

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations |  |  |  |  |  |  |  |  |  |  |  |  |
| Traffic Volume (vph) | 281 | 578 | 2 | 0 | 380 | 17 | 0 | 0 | 0 | 16 | 0 | 156 |
| Future Volume (vph) | 281 | 578 | 2 | 0 | 380 | 17 | 0 | 0 | 0 | 16 | 0 | 156 |
| Ideal Flow (vphpl) | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 | 1700 |
| Total Lost time (s) | 4.5 | 4.5 | | | 4.5 | | | | | 4.5 | | |
| Lane Util. Factor | 1.00 | 1.00 | | | 1.00 | | | | | 1.00 | | |
| Frt | 1.00 | 1.00 | | | 0.99 | | | | | 0.88 | | |
| Flt Protected | 0.95 | 1.00 | | | 1.00 | | | | | 1.00 | | |
| Satd. Flow (prot) | 1601 | 1684 | | | 1676 | | | | | 1472 | | |
| Flt Permitted | 0.45 | 1.00 | | | 1.00 | | | | | 0.98 | | |
| Satd. Flow (perm) | 752 | 1684 | | | 1676 | | | | | 1451 | | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 305 | 628 | 2 | 0 | 413 | 18 | 0 | 0 | 0 | 17 | 0 | 170 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 118 | 0 |
| Lane Group Flow (vph) | 305 | 630 | 0 | 0 | 428 | 0 | 0 | 0 | 0 | 0 | 69 | 0 |
| Turn Type | Perm | NA | | | NA | | | | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | 32.5 | 32.5 | | | 32.5 | | | | | 18.5 | | |
| Effective Green, g (s) | 32.5 | 32.5 | | | 32.5 | | | | | 18.5 | | |
| Actuated g/C Ratio | 0.54 | 0.54 | | | 0.54 | | | | | 0.31 | | |
| Clearance Time (s) | 4.5 | 4.5 | | | 4.5 | | | | | 4.5 | | |
| Lane Grp Cap (vph) | 407 | 912 | | | 907 | | | | | 447 | | |
| v/s Ratio Prot | | 0.37 | | | 0.26 | | | | | | | |
| v/s Ratio Perm | c0.41 | | | | | | | | | c0.05 | | |
| v/c Ratio | 0.75 | 0.69 | | | 0.47 | | | | | 0.16 | | |
| Uniform Delay, d1 | 10.6 | 10.1 | | | 8.5 | | | | | 15.1 | | |
| Progression Factor | 1.00 | 1.00 | | | 1.00 | | | | | 1.00 | | |
| Incremental Delay, d2 | 12.0 | 4.3 | | | 1.8 | | | | | 0.7 | | |
| Delay (s) | 22.6 | 14.3 | | | 10.2 | | | | | 15.8 | | |
| Level of Service | C | B | | | B | | | | | B | | |
| Approach Delay (s) | | 17.0 | | | 10.2 | | | 0.0 | | 15.8 | | |
| Approach LOS | | B | | | B | | | A | | B | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 2000 Control Delay | | 15.0 | | | HCM 2000 Level of Service | | | B | | | | |
| HCM 2000 Volume to Capacity ratio | | 0.53 | | | | | | | | | | |
| Actuated Cycle Length (s) | | 60.0 | | | Sum of lost time (s) | | | 9.0 | | | | |
| Intersection Capacity Utilization | | 80.7% | | | ICU Level of Service | | | D | | | | |
| Analysis Period (min) | | 15 | | | | | | | | | | |
| c Critical Lane Group | | | | | | | | | | | | |

APPENDIX B PLANNED DEVELOPMENTS SUMMARY

| ID | Development | Relevant Documents | Planned units and land uses | TMP Assumptions / Next Steps |
|----|-------------|--|---|--|
| 1 | IOL | <ul style="list-style-type: none">IOL & IOL North, Concept - Option A, Feb-2016FRDA QBDC Dvpt Agmt, DP 17-001, FINAL (2019)FRDA Land Use Recommended (Aug-2017)<u>FRDA & IOL update Oct 2019</u>IOL Parcel E Development Scheme FINAL (2015)IOL & IOL North, Concept - Option B, Feb-2016 | <ul style="list-style-type: none">Mixed use; use the FRDA & IOL update Oct 2019 statistics. | <ul style="list-style-type: none">No TIAs available; traffic will be generated using ITE rates and assigned to the network based on the engagement week survey of origin/destination trip distribution.Note future roadway (Crescent) in the vicinity of Ulu Lane, north of Federal Road.Includes Inuit and municipal lands.Additional information requested: redevelopment GFAs for the municipal lands in addition to existing uses GFAs. |
| 2 | Area B | <ul style="list-style-type: none">FDA A & B DASR Report - Aug-29-2013.<u>FDA B Development Scheme, FINAL, ENG, with schedules (2015).</u> | <ul style="list-style-type: none">Residential, commercial, and institutional | <ul style="list-style-type: none">No TIA available. Road to nowhere extension to be built and connected to Road to Apex.Generate traffic based on planned development statistics.Proposed 490 units; however, likely up to 600 units will be included for the purpose of the TMP.Additional information requested: If available, refined distribution of residential unit types (i.e., single family, townhomes, apartments). In the absence of information that team can scale the anticipated 490 units distribution to 600 units. |
| 3 | Area A | <ul style="list-style-type: none"><u>FDA A & B DASR Report - Aug-29-2013</u> | <ul style="list-style-type: none">Residential, commercial, and institutional | <ul style="list-style-type: none">No TIA or later documents. The 2013 preliminary future development area selection report (2013) will be used. It is noted that detailed statistics are not available.The following ranges were extracted:<ul style="list-style-type: none">Developable units’ range: 460-535 units. 535 residential units were assumed, at the higher range with a blended trip generation rate of single-family homes as a conservative estimate.Based on discussion with the City, it is likely that up to 600 units will be developed and will be considered for the purposes of the TMP.Additional information requested: If available, a distribution of residential unit types (i.e., single family, townhomes, apartments). In the absence of information that team can scale the anticipated Area A units’ distribution to 600 units and use it as an approximation for Area B. |
| 4 | Upper Base | <ul style="list-style-type: none">Upper Base Industrial Area - May18_2012_B&W. Upper Base Industrial background Aug 2019. | <ul style="list-style-type: none">9 lots; no additional details available | <ul style="list-style-type: none">Confirm if development plans are anticipated and confirm land uses and site statistics.Based on discussion with the City, due to servicing constrains, the City will relook at this area.Additional information requested: For the purposes of the TMP, the team is looking for confirmation on the likely GFAs and land uses and |

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Appendix B Planned Developments Summary

| ID | Development | Relevant Documents | Planned units and land uses | TMP Assumptions / Next Steps |
|----|---|--|---|---|
| | | | | units. If no development is anticipated prior to the 2030 year, it will be excluded from the TMP. |
| 5 | NCC Lots 215/215 | <ul style="list-style-type: none">NCC Lots 214 and 215 site plans 2019 | <ul style="list-style-type: none">4-storey mixed-use building with 1,919 sq.m of office space and 22 residential units (apartments).Email correspondence reflect 4,000 sq.m of commercial and 44 apartment units. | <ul style="list-style-type: none">No TIA is availableDevelopment traffic will be forecasted using ITE rates and assigned to roadway network based on the engagement week’s collected origin-destination survey data.Based on discussion with the City, 4,000 sq.m of commercial and 44 apartment units are anticipated.Additional information requested: NA. |
| 6 | Plateau (Lot 1) | <ul style="list-style-type: none"><u>feasibility study plateau subdivision development scheme oct 2004</u> | <ul style="list-style-type: none">Fully buildout with NCC and Lot 1. | <ul style="list-style-type: none">Based on discussion with the City, there is interest in developing the lands north of Saputi Road.Assume up to 70 residential units for the purposes of the TMP.Additional information requested: NA. |
| 7 | Astro Hill | <ul style="list-style-type: none">Email communication (Feb 2020). 20190617 Astro Hill Parking Management Plan Version 2 (2019). 2018.06.07 AstroHill Draft (reduced, 2018). | <ul style="list-style-type: none">Email communications indicate that in the 10–15-year plan, 344 new residential apartment units and 132 hotel rooms are anticipated.Ultimate plan indicates mixed use developments but is not assumed to be implemented prior to the 2030 horizon year. | <ul style="list-style-type: none">Traffic generation will be based on the 10-15 year planned developments.Development traffic will be assigned to roadway network based on the engagement week’s collected origin-destination survey data.Additional information requested: NA. |
| 8 | North 40 | <ul style="list-style-type: none">Email communication (March 2019).North 40 Project Presentation (2019).- Provisional Plan_ West 40 Lands Transfer (2015). | <ul style="list-style-type: none">City plans a new dump site and quarry towards end of upper base.No additional information on planned activity is available. | <ul style="list-style-type: none">Dump and extraction activities are typically low traffic generators.Additional information requested: Confirm with the City planned operations (number of trucks daily) and generate to assign traffic accordingly. |
| 9 | *Multiple (Not reflected in Figure 12 of the TMP) | <ul style="list-style-type: none">Communication with the City | <ul style="list-style-type: none">Airport expansion to add 408 daily trips between 2017-2022 and to be considered as per the 2014 TIA; The difference between 2017 trips and 2022 trips will be assigned to the network.Akilliq Road is anticipated to connect to the 10 hectares for an industrial subdivision assumed to be developed prior to the 2030 horizon year. Additional details on the type of development is requested. Relevant documents would be helpful, if available.Additional developments may be anticipated at the end pf Plateau Phase 3. For the purposes of the TMP 90 residential units will be assumed.Lower base redevelopment. Densification is likely; confirm with the City potential added GFAs and land uses.Developments may take place along Queen Elizabeth between Arctic Ventures and Elders Qammaq . confirm timelines and development preliminary statisticsMivvik St / Queen Elizabeth large density development. Confirm timeline and statistics with the City.West 40 industrial lands development is likely in the next 30 years. Assumed to be outside the TMPs analyses horizon years. | |

CITY OF IQALUIT TRANSPORTATION MASTER PLAN

Appendix C TMP Online Survey Results

APPENDIX C TMP ONLINE SURVEY RESULTS

(Begins on the following page)

Online Survey Results

City of Iqaluit Transportation Master Plan

March 2020

Prepared for:
City of Iqaluit
Iqaluit, Nunavut

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NUNAMI STANTEC

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SURVEY OVERVIEW

To inform the City of Iqaluit Transportation Master Plan, a public online survey was hosted from February 20, 2020 to March 14, 2020 via SurveyMonkey. The survey was provided in both English and Inuktitut and advertised via the City's existing communications methods including the City's website and Facebook page. In total, 421 surveys were completed, all through the English survey.

As an incentive to complete the survey, respondents were given the option to enter a draw to win a small prize upon completion.

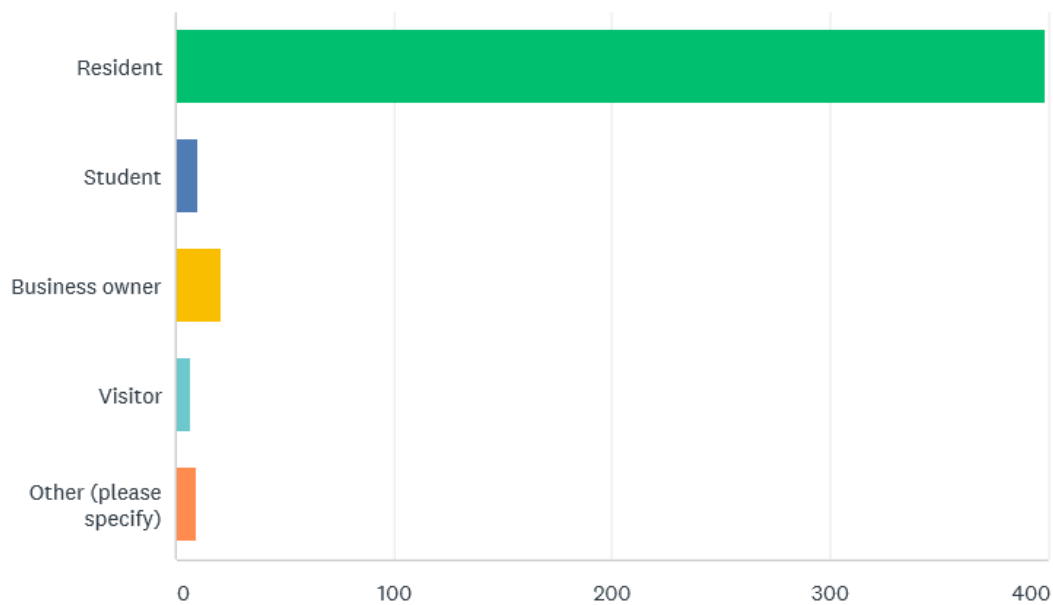
SUMMARY OF RESPONSES BY QUESTION

Section 1: General

Q1: What is your relationship to Iqaluit? (Select all that apply)

Answered: 420

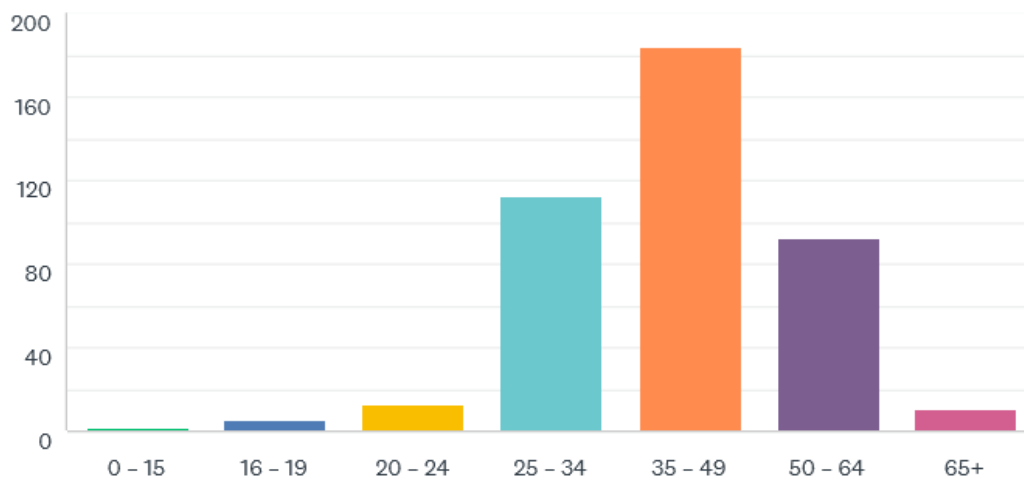
Skipped: 1



City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 1: General

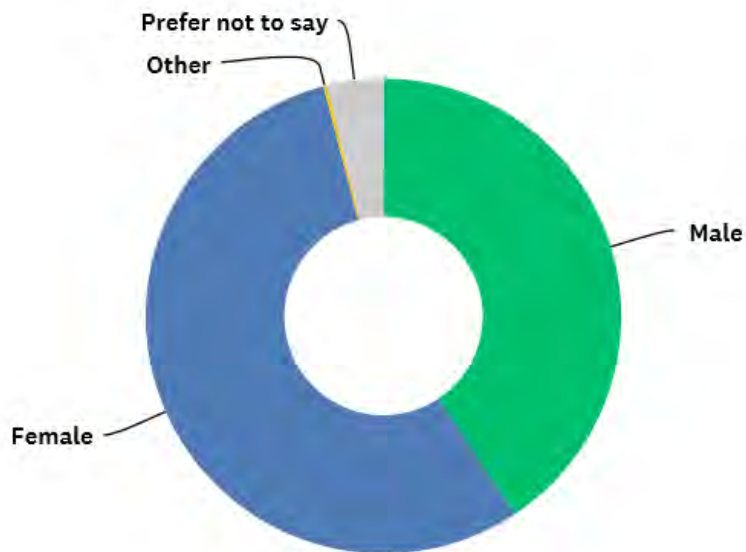
Q2: What is your age?

Answered: 420 Skipped: 1



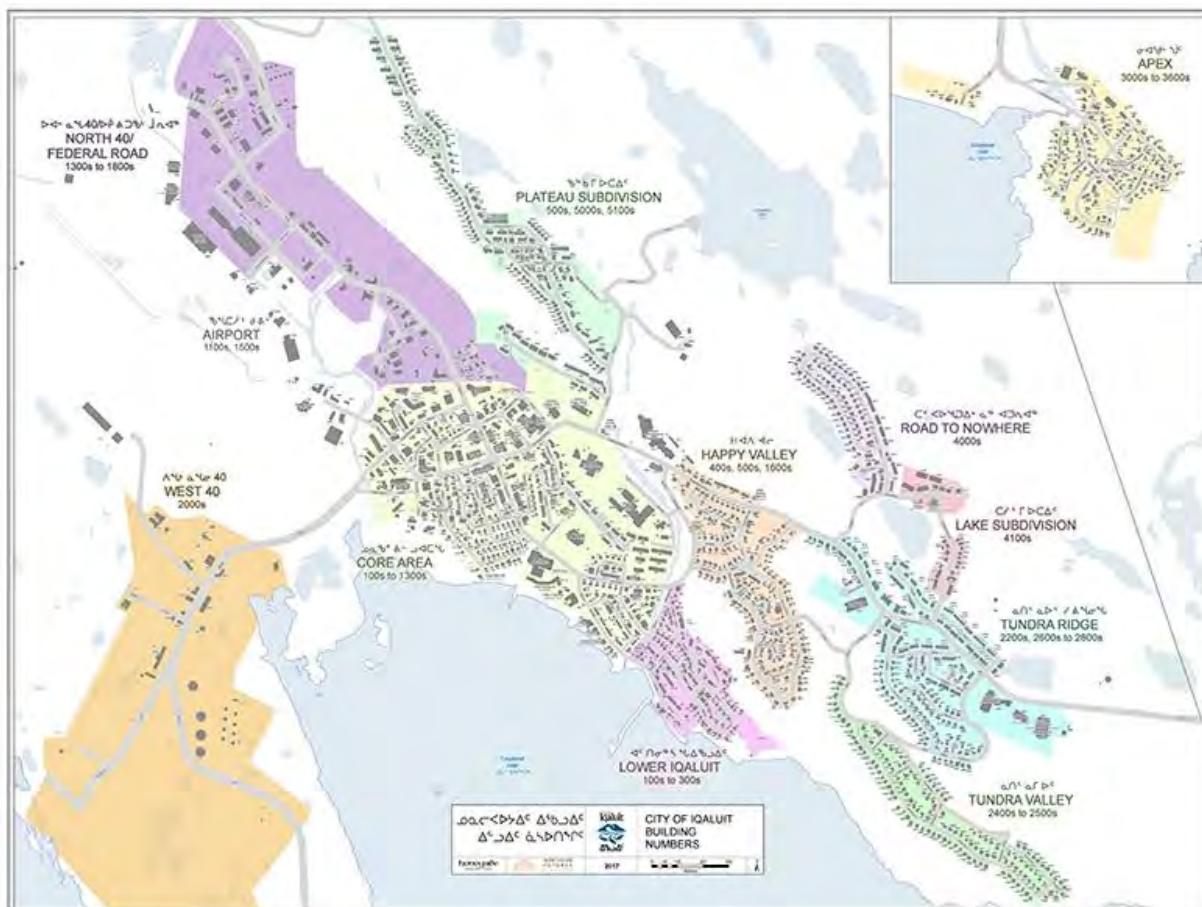
Q3: With which gender do you identify?

Answered: 420 Skipped: 1



Section 2: Where are you going?

Questions within this theme were asked based on the map shown below.

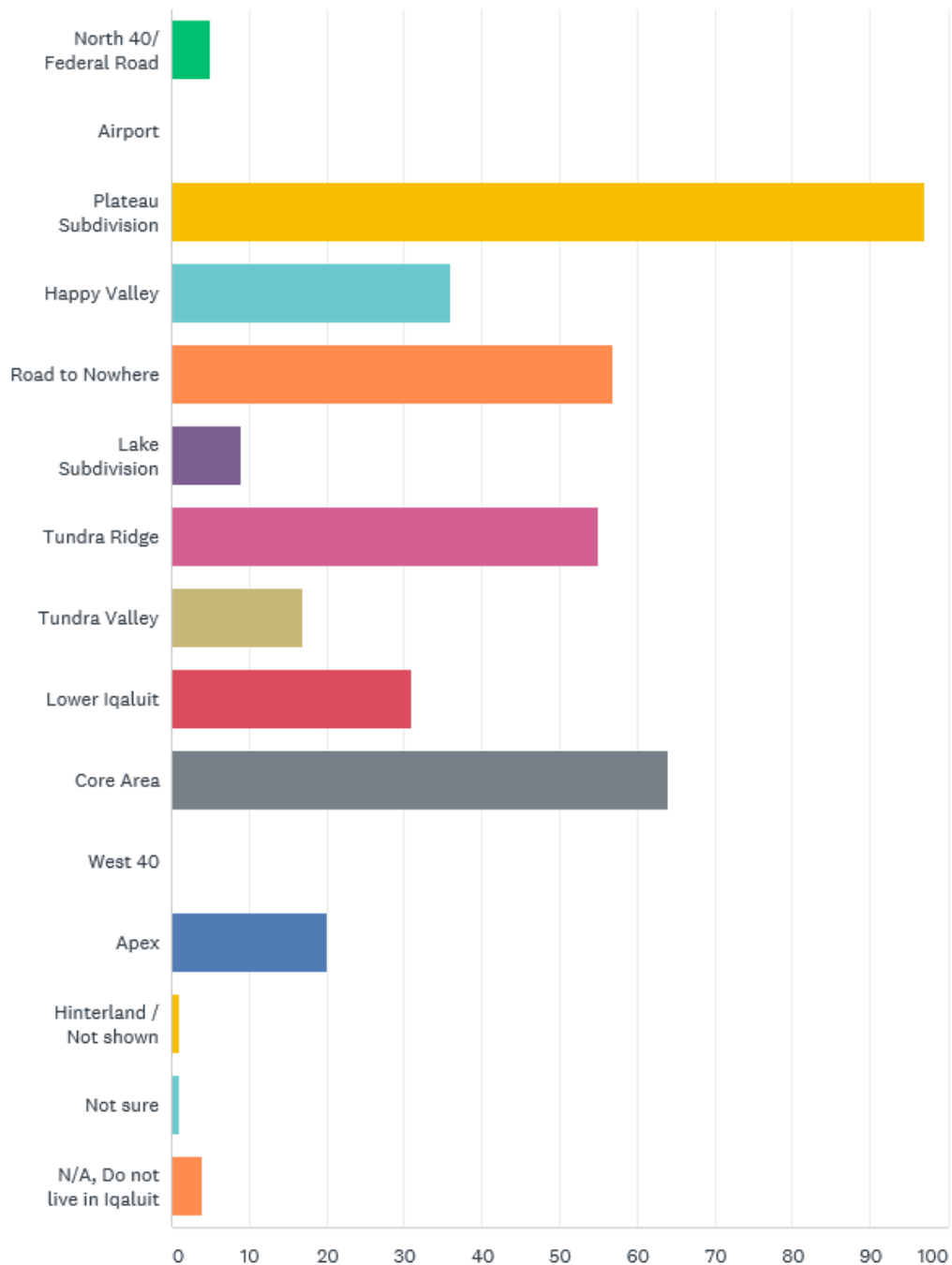


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 2: Where are you going?

Q4: Based on the map above, which area of Iqaluit do you LIVE in?

Answered: 397

Skipped: 24

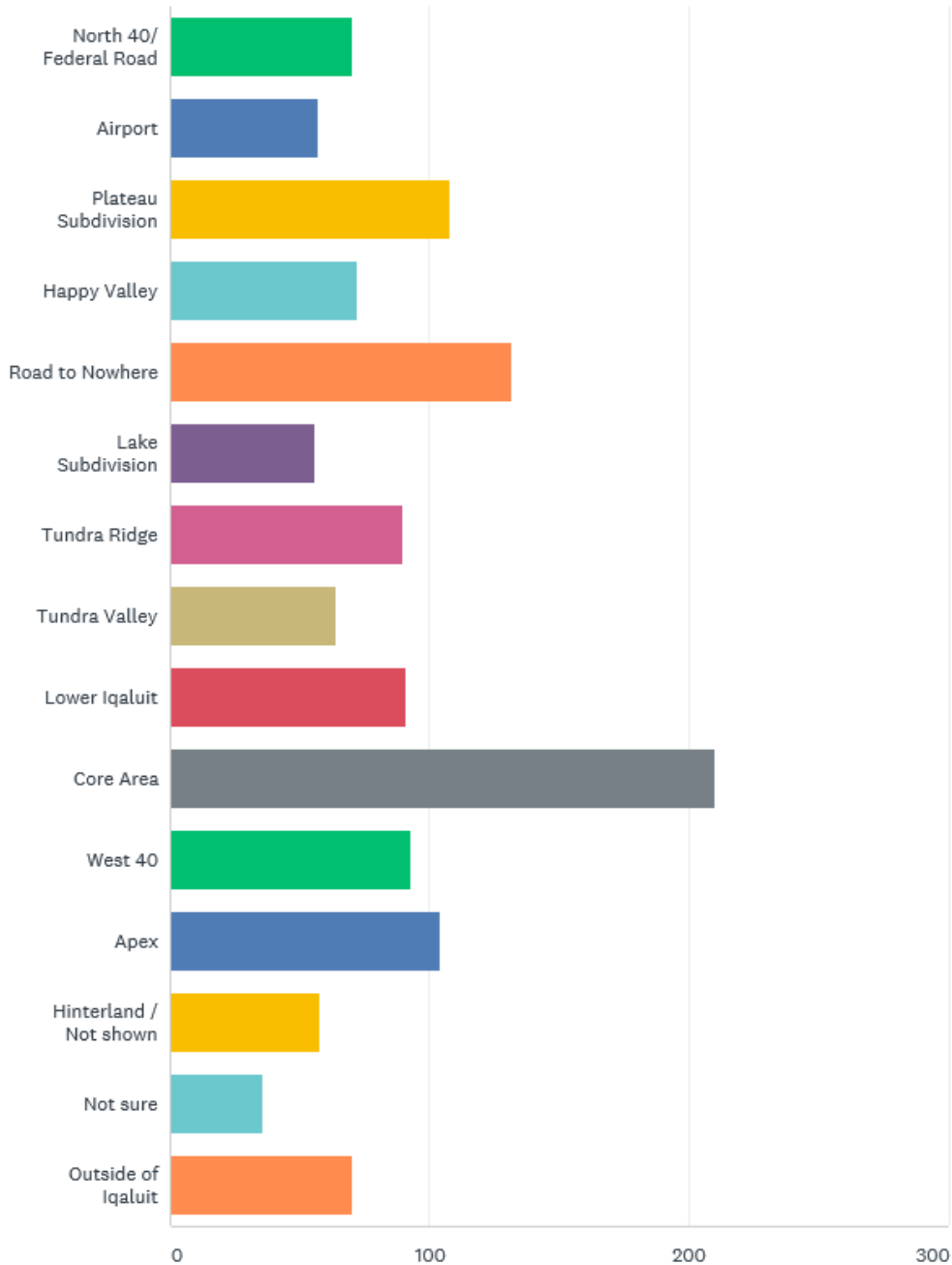


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 2: Where are you going?

Q5: Based on the map above, which areas of Iqaluit do you PLAY in?

Answered: 391

Skipped: 30

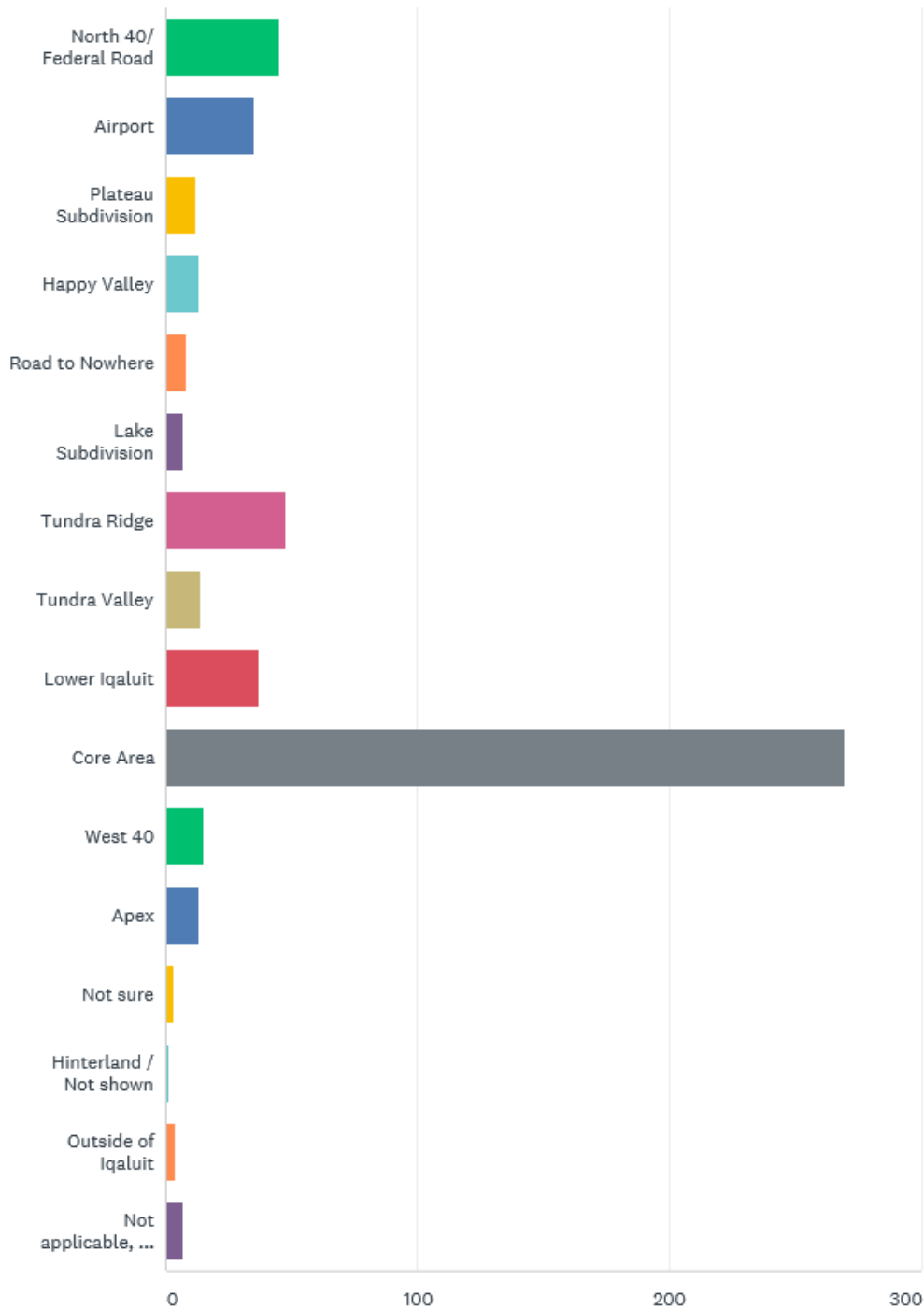


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 2: Where are you going?

Q6: Based on the map above, which areas of Iqaluit do you WORK or ATTEND SCHOOL in?

Answered: 395

Skipped: 26

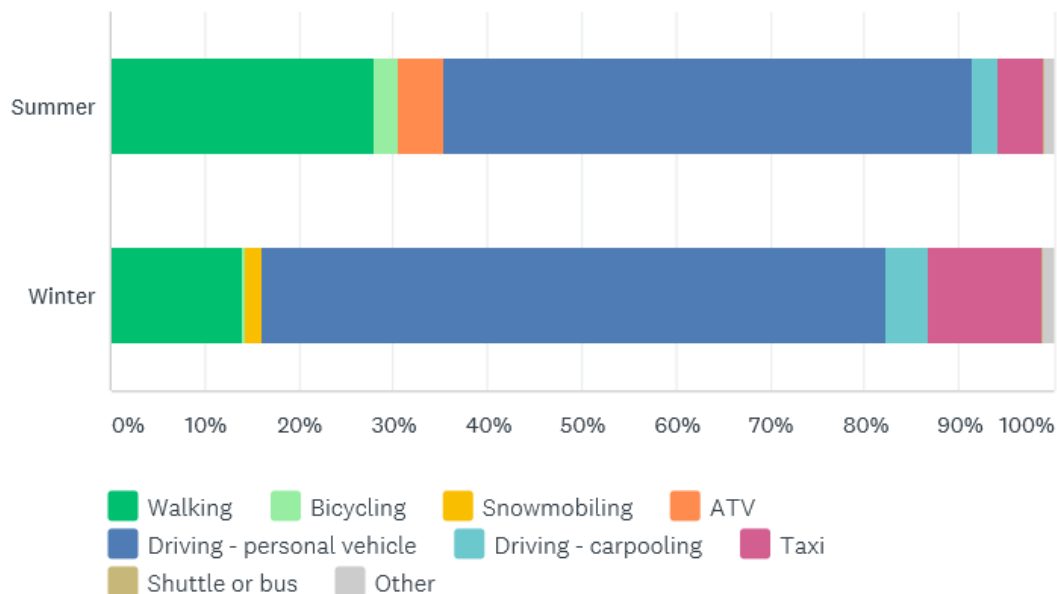


Section 3: How Do you get there?

Q7: What is your primary method of getting around town?

Answered: 386

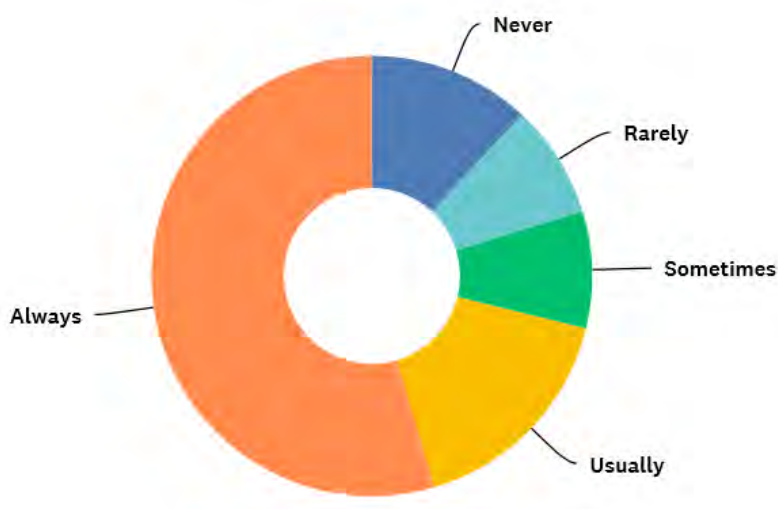
Skipped: 35



Q8: How often do you have access to a personal vehicle?

Answered: 385

Skipped: 36

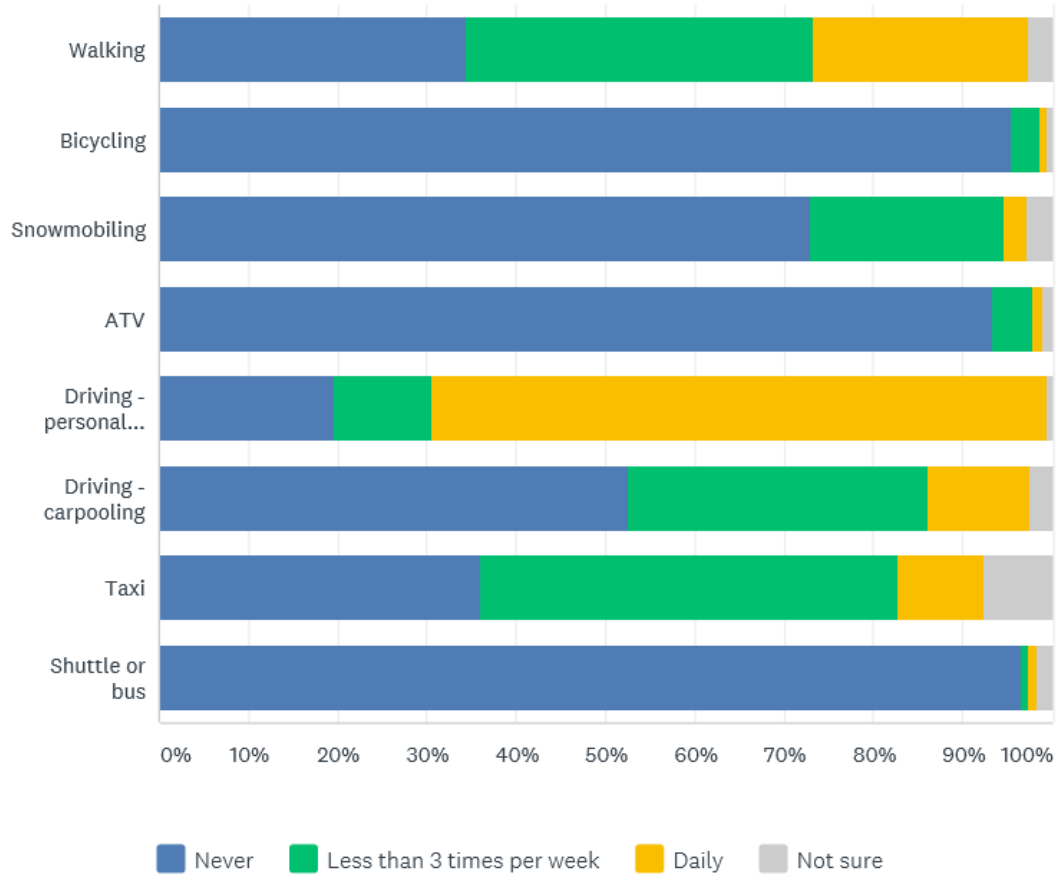


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 3: How Do you get there?

Q9: In the WINTER, how often do you use the following methods to get around town?

Answered: 386

Skipped: 35

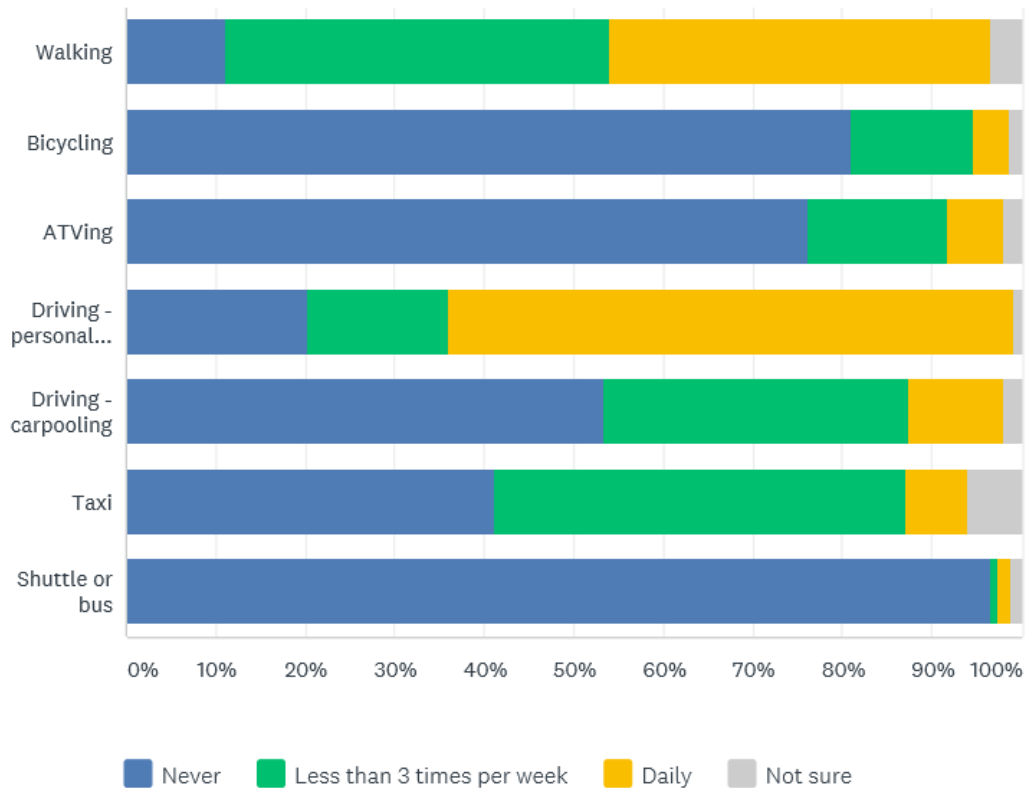


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 3: How Do you get there?

Q10: In the SUMMER, how often do you use the following methods to get around town?

Answered: 386

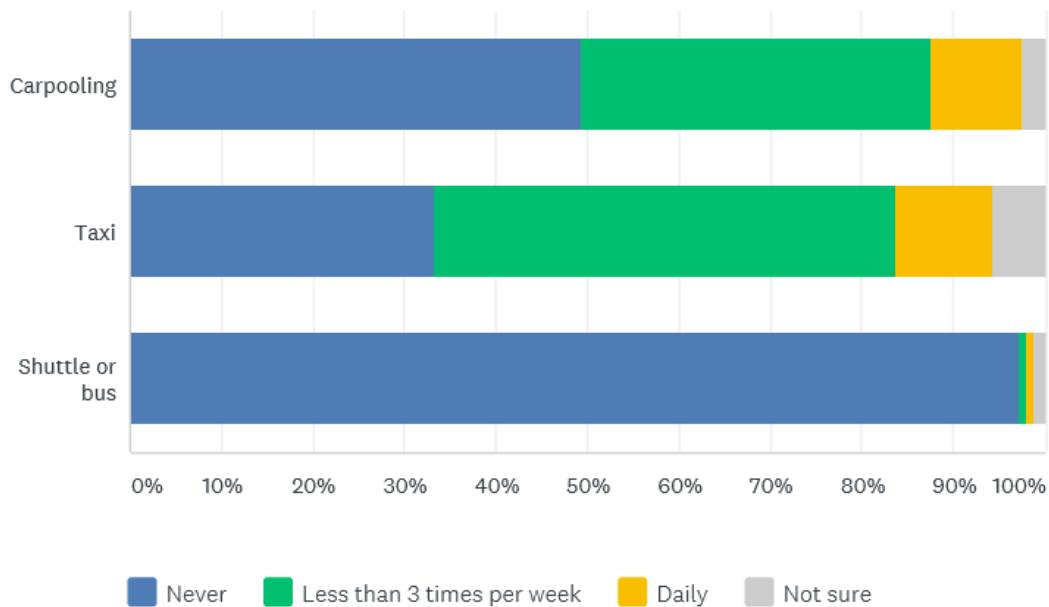
Skipped: 35



SHARED TRANSPORTATION

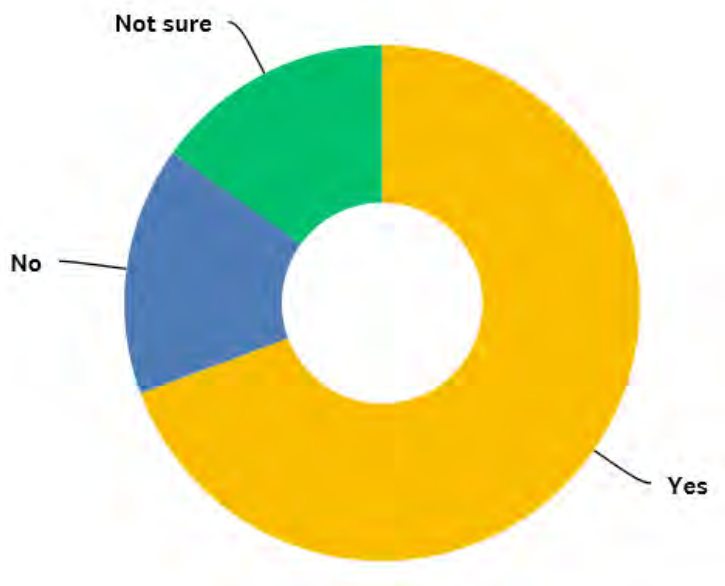
Q11: How often do you use the following shared transportation methods?

Answered: 375 Skipped: 46



Q12: Would you consider using transit if it were available?

Answered: 378 Skipped: 43

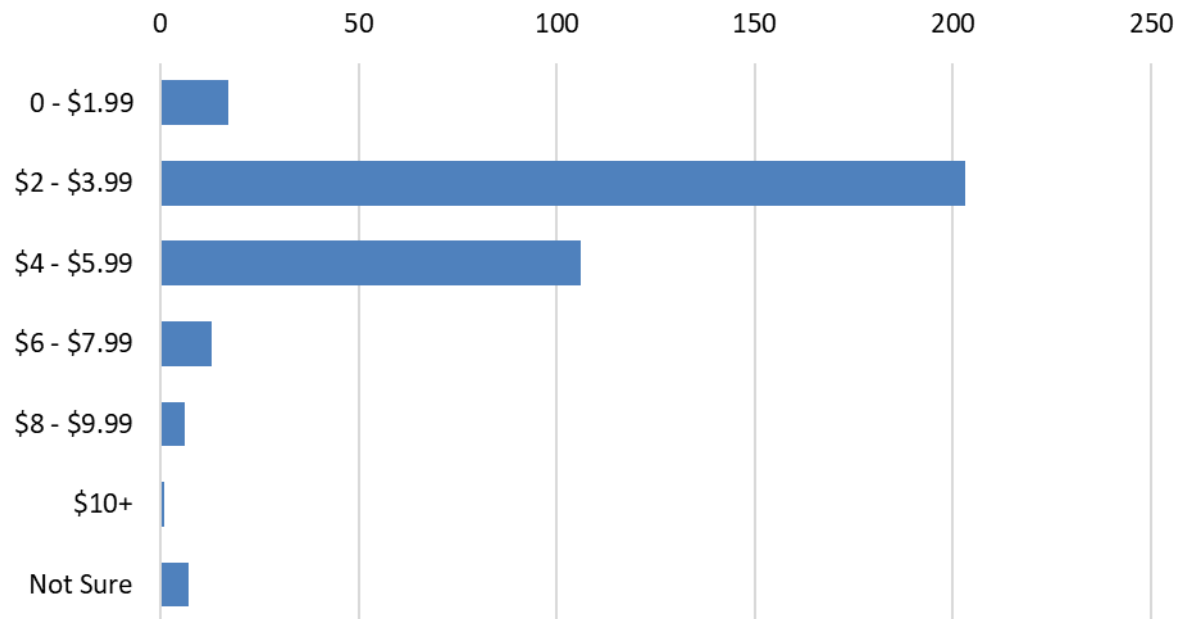


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 3: How Do you get there?

Q13: What do you think would be a fair price for a one-way transit trip in Iqaluit?

Answered: 353

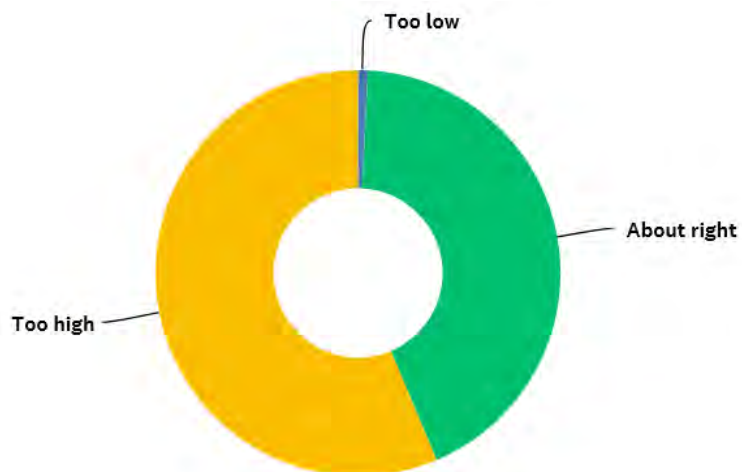
Skipped: 68



Q14: How do you feel about the current cost of taking a taxi in Iqaluit?

Answered: 378

Skipped: 43

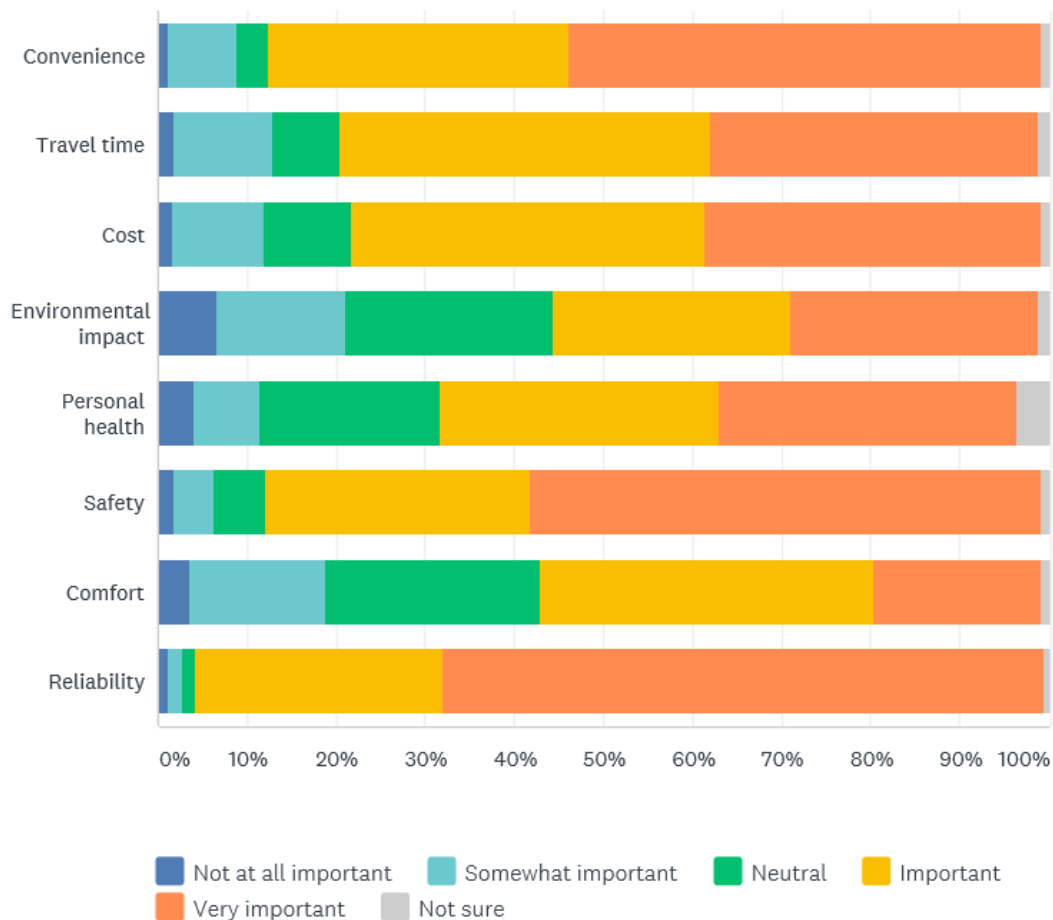


Section 4: Is there a better way?

Q15: How important are the following factors when selecting a transportation method?

Answered: 352

Skipped: 69

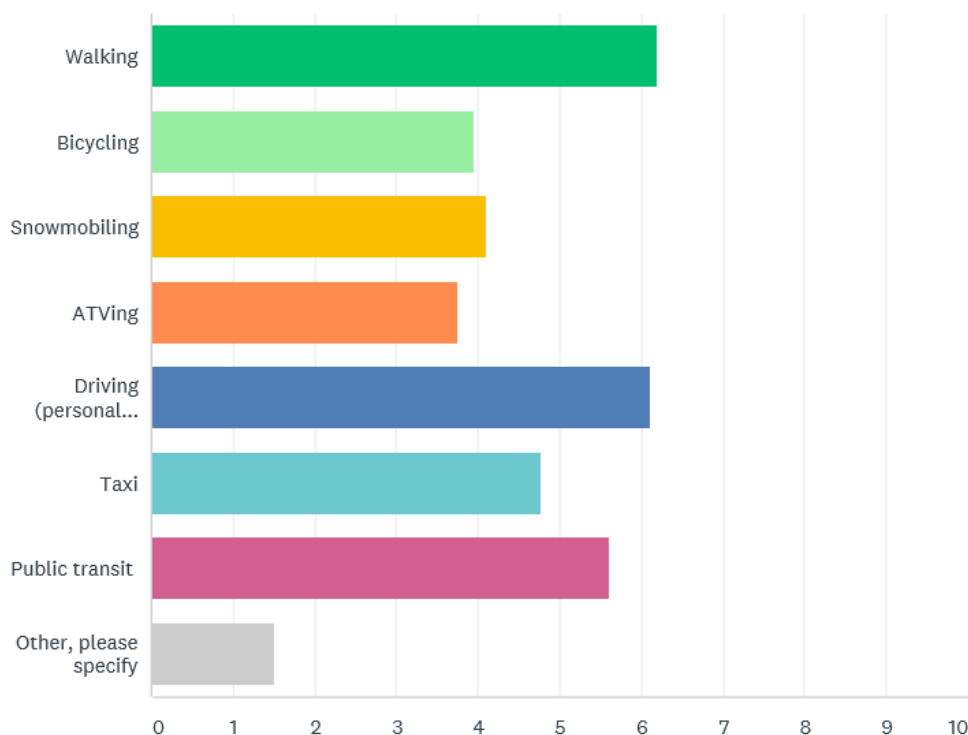


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 4: Is there a better way?

Q16: In your opinion, please rank the following land-based modes of transportation from most important to least important.

Answered: 345

Skipped: 76



Q17: Overall, how satisfied are you with the existing Iqaluit transportation network?

Answered: 329

Skipped: 92



| | 1 | 2 | 3 | 4 | 5 | TOTAL | WEIGHTED AVERAGE |
|---|---------------|--------------|--------------|-------------|------------|-------|------------------|
| ★ | 37.39% 123 | 30.09% 99 | 26.44% 87 | 5.17% 17 | 0.91% 3 | 329 | 2.02 |

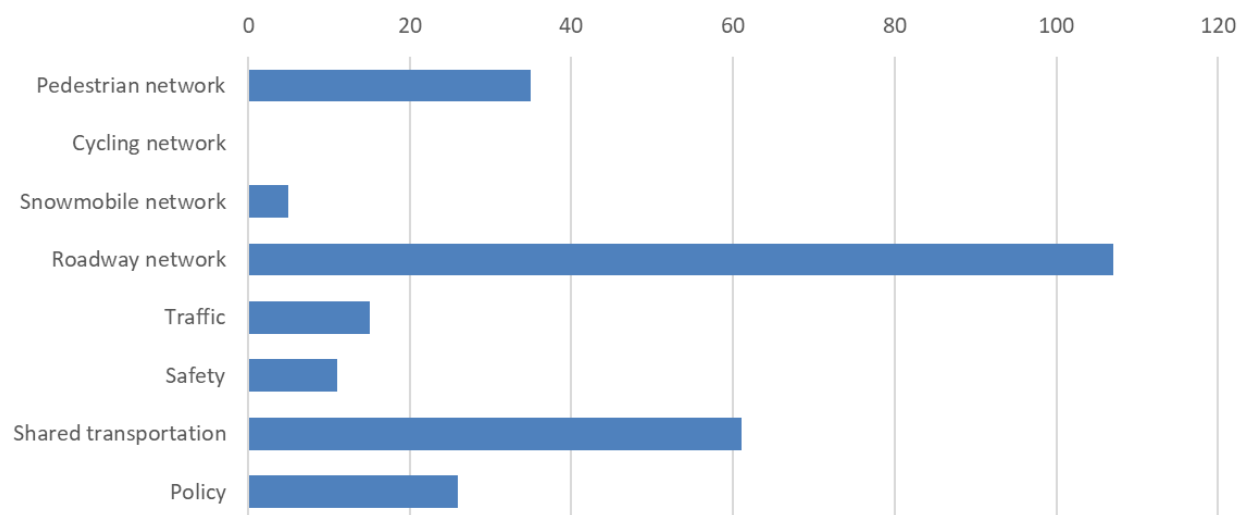
Section 5: Final thoughts

Questions in this section were open-ended; as such, what is shown below is a summary. A listing of all comments provided in response to these questions is provided in Appendix A.

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement? –Shown by theme

Answered: 266

Skipped: 155



City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 5: Final thoughts

Quantity of comments by themes and sub-themes

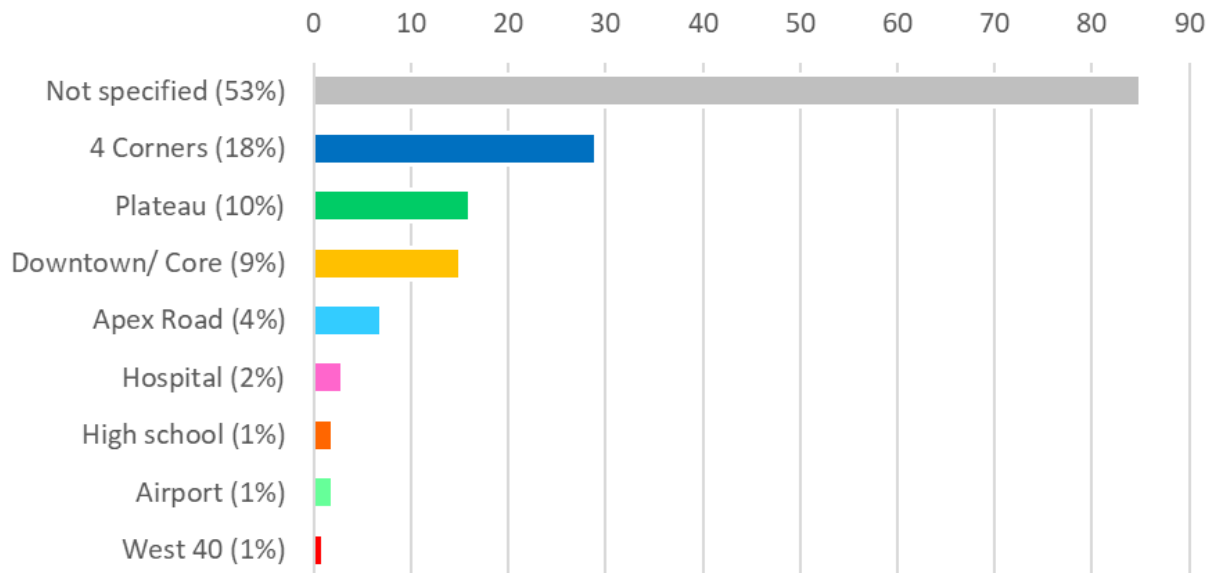
| Theme/ Sub-Theme | Comments |
|------------------------------|------------|
| Pedestrian network | 35 |
| Trails | 9 |
| Sidewalks | 11 |
| Crosswalks | 3 |
| Other | 12 |
| Cycling network | 0 |
| Snowmobile network | 5 |
| Roadway network | 107 |
| Condition | 21 |
| Paving | 37 |
| Intersection improvement | 11 |
| New roads | 3 |
| Road design | 8 |
| Parking | 2 |
| Stormwater management | 0 |
| Other | 25 |
| Traffic | 15 |
| Congestion | 12 |
| Lunch time school buses | 3 |
| Safety | 11 |
| Drivers/ enforcement | 6 |
| Winter tires | 3 |
| Other | 2 |
| Shared transportation | 61 |
| Reducing cost of living | 59 |
| Carpooling | 1 |
| Other | 1 |
| Policy | 26 |
| Reducing cost of living | 5 |
| Taxi regulations | 19 |
| Accessibility | 2 |
| Environmental concern | 0 |
| Other | 35 |

City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 5: Final thoughts

Quantity of comments by location specified, if applicable.

Location-applicable comments: 160

Non-location applicable comments: 114

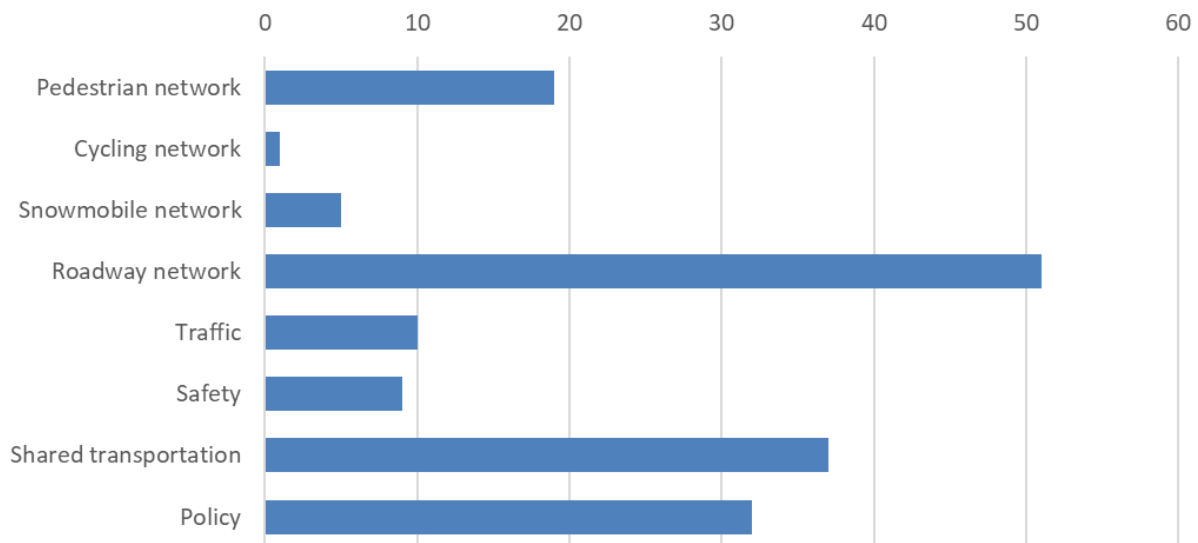


City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 5: Final thoughts

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?
–Shown by theme

Answered: 172

Skipped: 249



City of Iqaluit Transportation Master Plan Online Survey Results
Summary of Responses by Question
Section 5: Final thoughts

Quantity of comment themes and sub-themes

| Theme/ Sub-Theme | Comments |
|------------------------------|-----------|
| Pedestrian network | 19 |
| Trails | 6 |
| Sidewalks | 8 |
| Crosswalks | 1 |
| Other | 4 |
| Cycling network | 1 |
| Snowmobile network | 5 |
| Roadway network | 51 |
| Condition | 2 |
| Paving | 5 |
| Intersection improvement | 23 |
| New roads | 6 |
| Road design | 11 |
| Parking | 3 |
| Stormwater management | 0 |
| Other | 0 |
| Traffic | 10 |
| Congestion | 8 |
| Lunch time school buses | 2 |
| Safety | 9 |
| Drivers/ enforcement | 6 |
| Winter tires | 0 |
| Other | 3 |
| Shared transportation | 37 |
| Reducing cost of living | 35 |
| Carpooling | 1 |
| Other | 1 |
| Policy | 32 |
| Reducing cost of living | 9 |
| Taxi regulations | 9 |
| Accessibility | 3 |
| Environmental concern | 3 |
| Other | 13 |

RPT_

Appendix A Section 5 - Final Thoughts
Open-Ended Questions

APPENDIX A

**Section 5 - Final Thoughts
Open-Ended Questions**

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

Listing of comments, sorted by theme and sub-theme

| Comment | Theme | Sub-Theme | Specific Location |
|---|--------------------|-------------|-------------------|
| Pedestrian crosswalks need better lighting Address congestion issues at the following: 4 Corners Intersection Plateau Hill Entrance beside NAC Road to Nowhere Entrance ***especially during peak times*** | Pedestrian network | Cross-walks | 4 Corners |
| More designated crosswalks | Pedestrian network | Cross-walks | Not specified |
| More pedestrian crossings and at least a limited bus service | Pedestrian network | Cross-walks | Not specified |
| Core.. need sidewalks | Pedestrian network | Sidewalks | Downtown/ Core |
| sidewalks in the downtown area, wide shoulder for walking on all other streets, designated/maintained off road walking trails between neighbourhoods (e.g. trail along creek from Frobisher to Ventures store area), dedicated bicycle lanes on key roads (ring road, apex road, federal road, hill from happy valley to tundra valley), too few roads access the plateau area, stop lights at key intersections (4 corners, plateau access road) | Pedestrian network | Sidewalks | Downtown/ Core |
| Signage/Lighting for Pedestrian Crossings Broadening of roads at pinch points for safe transit of walkers. The utilidor access port next to the Pai-Pai office towards Yummy Schwarma dangerously obstructs vision. | Pedestrian network | Sidewalks | Downtown/ Core |
| Iqaluit suffers from a lack of safe accessible sidewalks and walking trails that separate pedestrians from traffic. Iqaluit needs right and left turn lanes at all major intersections (4 corners, hospital, turn-off to plateau) Iqaluit needs to consider traffic flow when designing in new subdivisions. Joamie Court will be a nightmare once lot owners start building and traffic will endanger elementary school kids. | Pedestrian network | Sidewalks | Not specified |
| pedestrian safety, demarcation of sidewalks and trails | Pedestrian network | Sidewalks | Not specified |
| sidewalks, bike lane, public transit | Pedestrian network | Sidewalks | Not specified |
| Sidewalks, pavement, lights for congestion | Pedestrian network | Sidewalks | Not specified |
| walking routes need to be maintained to encourage walking and provide safe walking. drivers routinely drive on shoulder due to lack of traction putting pedestrians at risk. Winter snow build up and spring erosion places barriers to walking. Limited of cross walks puts walkers, snowmobile users and drivers at risk. School bus stops should be better identified to alert drivers of waiting pedestrians/children in the area. | Pedestrian network | Sidewalks | Not specified |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

| Comment | Theme | Sub-Theme | Specific Location |
|--|--------------------|-----------|-------------------|
| Walkways in between houses in Plateau that do not impinge on privacy. Safe sidewalks on main arteries without silliness of a few yrs ago about poles that offended some people's sensibilities. | Pedestrian network | Sidewalks | Not specified |
| Walkways, pedestrian signs etc. People need to learn to look both ways and respect the pedestrian signs around the city. And not walk across the street 20 feet away from the pedestrian sign at a four-way! | Pedestrian network | Sidewalks | Not specified |
| We need sidewalks. It's too dangerous for me to consider walking with my family. | Pedestrian network | Sidewalks | Not specified |
| As a person that passes through Iqaluit it would be very useful to have a path that connects the new airport with the old airport road so it is quicker to walk into town when we have a few hour stop over in Iqaluit. Cant always afford both a taxi and to by stuff from the stores in town. | Pedestrian network | Trails | Not specified |
| For pedestrians: Need more off-road walkways that are maintained year-round. This includes stairways, pathways, and elevated walkways. Need more crosswalks at more intelligent locations to reduce jaywalking (like at high school/Plateau Road). Need a managed walkway from Upper Plateau to Lower Plateau to downtown, including a safe mini-bridge over the swampy area/diesel line near the Court of Justice. Need managed pathway from Plateau to hospital, including a safe crossing over the creek (good bridge over the diesel line though!) Need cleared road shoulders to ensure pedestrian safety. Require pull-off room and shelters for bus transportation in every new subdivision. Start a commuter bus service. | Pedestrian network | Trails | Not specified |
| I would like to see better cared for walking trails/sidewalks/paths. Iqaluit is not that large, you should be able to walk all around town without impediments. All paths/sidewalks/etc should be plowed, not too slippery and well lit! | Pedestrian network | Trails | Not specified |
| More walking paths joining different neighbourhoods. The shortest distance between two points is a straight line. There should be no need to walk from BCC down federal road through four corners to get to the plateau, for instance. There are also numerous hiking trails around town. Walking paths leading to these areas would increase Iqaluit's value to tourists and allow Iqalummiut to truly experience this city's natural beauty during their morning commutes. As well, the combination of a lack of sidewalks and slippery roads creates hazardous walking conditions for pedestrians. I often have feared tripping on federal road and being hit by a car while laying on the ground. I would imagine the concerns of an elder would be greater than my own. This places a unnecessary financial burden on people with a fixed income who must take a taxi to travel safely, limits their movement within the city and discourages the most basic form of exercise available, walking. | Pedestrian network | Trails | Not specified |
| More walking trails (on the tundra and away from dusty roads; look at the existing trails used and marked by regular footprints in the winter), less parking, fewer cars (make it easier for people to walk, atv, and snowmobile) affordable transit, marked skiing trails, (though not transit related, look into building a ski hill made of that dump garbage), carpool app during rush hours and/or carpool facebook group, but most of all: PAVED ROADS and SIDEWALKS. Get | Pedestrian network | Trails | Not specified |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

| Comment | Theme | Sub-Theme | Specific Location |
|---|--------------------|-----------|-------------------|
| creative; what about a tabbogan trail down plateau to the core (or a proper trail connecting tundra ridge to tundra valley)? What about a cut through trail connecting road to nowhere to plateau? What about strategically placed warming stations (modified seacan) to enable longer walks/transit stops? REPLACE DOWNTOWN PARKING WITH HIGH DENSITY AFFORDABLE HOUSING with ground level retail/institutional! Build high density hubs in neighborhoods like Apex, area between road to nowhere/tundra ridge (near schools). | | | |
| Pedestrian safety paths, taxi safety (most cars are not maintained), | Pedestrian network | Trails | Not specified |
| Walking /biking paths. Too scary to use current infrastructure while biking. | Pedestrian network | Trails | Not specified |
| walking infrastructure public transit better signage | Pedestrian network | Trails | Not specified |
| Walking paths/sidewalks, road maintenance, core traffic volume | Pedestrian network | Trails | Not specified |
| All sidewalks. No bicycle infrastructure. Apex road will be a future bottle neck from the east side of town to the core | Pedestrian network | | Apex Road |
| - downtown, pedestrians have to walk is the exhaust fumes of parked cars. - too many cars downtown - street crossing during busy time can be somewhat dangerous (road to apex in the core, queen elizabeth, even federal road.) | Pedestrian network | | Downtown/ Core |
| There should be less cars! There is so much air pollution in town, especially at peak time that it is very hard to walk around without getting intoxicated. There city should be more walkers' friendly. | Pedestrian network | | N/A |
| 1. There are too may vehicles on Iqaluit's roads. Use of buses could lesson the number of vehicles that are used daily to get to and from work. 2. Several years ago " people" walkways were built through the core of the city . These walkways are no longer tended to, some have been wiped out completely and some have become skidoo trails. Walkways must exist in order to make it safe for pedestrians. 3. Attention needs to be paid to road safety (making it safe for pedestrians) . Right now very few vehicle drivers stop at stop signs or pedestrian crosswalks. Drivers also go above the speed limits. And yet no one at the City seems to care if drivers follow the rules of the road. 4. Attention needs to be paid to cyclists. More and more each year cyclists fill the roads AND the walkways . The City does NOT make cyclists follow any rules, or even advise cyclists what the rules are. Many of the cyclists are children - including very young ones- who do not even know what side of the road you should ride on as a cyclist. It is the City's responsibility to inform cyclists what the rules are and then enforce them. It is perhaps time for the City to initiate bike paths throughout the City. Bike paths and walking paths can co-exist providing the paths are set up so that there is a lane for walkers, and a lane for cyclists. 5. Skidoo trails . The City has a useless map of skidoo trails within | Pedestrian network | | Not specified |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

| Comment | Theme | Sub-Theme | Specific Location |
|---|--------------------|-------------------------|-------------------|
| the City. Again, the use of these trails is not enforced and the City has refused to tell people that they must use the trails and stay off people's personal property. | | | |
| Better boat launches. Better pedestrian walkways. | Pedestrian network | | Not specified |
| Clearly marked cross walks and larger/better sidewalks for pedestrians. Stop lights at Four Corners. | Pedestrian network | | Not specified |
| I would give zero stars. More walkable, connected trails; public transit; more pedestrian pathways; more pedestrian friendly spaces (lights, crosswalks, maintained paths.) | Pedestrian network | | Not specified |
| More safety for pedestrians. More bike friendly | Pedestrian network | | Not specified |
| The road is the side walk which is not good for pedestrian traffic | Pedestrian network | | Not specified |
| There are too many personal vehicles. People should walk more, for the environment and their own health | Pedestrian network | | Not specified |
| There needs to be serious thought about the existing infrastructure used to support pedestrians and bicyclists. There are so many unconsidered benefits to facilitating and encouraging Iqalummuit to walk or bike. I understand that it is cold in the winter and it may not be used as frequently in the coldest parts of winter but if we were able to help normalize walking or biking, in part by making it more appealing, I think this would be a viable and appealing part of the city's transportation network. I would suggest looking to other northern communities for solutions, including internationally (e.g. Greenland, Norway). In doing so, you would also be doing a service to two important groups - those who do not have the means to acquire personal transportation and tourists who arrive and probably prefer to see the city on foot to the extent they can. | Pedestrian network | | Not specified |
| The road to the plateau ... no shoulder for walkers. People are being hit by cars more often in this area. Also road in front of post office has heavy volumes of traffic. Need drivers to slow down. Cannot expect the RCMP to fix everything! | Pedestrian network | | Plateau |
| Elders need a way to get around town. Too many people are throwing away money taking cabs back and forth to work everyday-that's not how it should work | Policy | Accessibility | N/A |
| The stairs need to be shoveled in the winter. I find it incredible that the city caters like puppy dogs to cars and straight out refuses to make walking an option for 70% of the people. It's actually disgraceful. There is no reason not to have a network of pleasant routes for pedestrians that are not close to the now vicious vehicle traffic. How about spending 20% of the city's transportation expenses on 80% of the population, those that do not have cars. You could transform the city. It always happens. | Policy | Accessibility | N/A |
| Cabs should be \$7 again | Policy | Reducing cost of living | N/A |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

| Comment | Theme | Sub-Theme | Specific Location |
|---|--------|-------------------------|-------------------|
| Convenience and cost of taxi fare | Policy | Reducing cost of living | N/A |
| Cost of taxis | Policy | Reducing cost of living | N/A |
| Taxis are too expensive and too often unreliable. Public transit is needed, such as public buses. Better walking/ biking paths and sidewalks are also needed. | Policy | Reducing cost of living | N/A |
| Taxis are too expensive. \$8 each way really adds up! I live downtown so I can easily walk to work, but any time I want to go anywhere else, it's really far to go when it's freezing cold out. A reasonably priced alternative would be awesome | Policy | Reducing cost of living | N/A |
| Safe taxi drivers Road conditions | Policy | Taxi regulations | N/A |
| Also that people offering transportation services here in town could have more than just a dome light and a car number on their car. They should have a logo of the company that they work for so people who cannot see very well can also see the cars. The walking in town would be much easier for people with disabilities if there were sidewalks. And properly marked crosswalks. | Policy | Taxi regulations | N/A |
| Cab drivers/ cars need a ton of work | Policy | Taxi regulations | N/A |
| Taxi is not affordable, and it can be unsafe, so many people (especially single women) do not take them. Walking is fine if it is accessible for you, but not after dark for some. Iqaluit desperately needs a bus system. | Policy | Taxi regulations | N/A |
| taxi service needs some type of safety training and have experience driving in northern conditions for at least 2 winter seasons before becoming cab drivers. they also need better winter tires! | Policy | Taxi regulations | N/A |
| Taxi drivers need more restrictions around the maintenance of their vehicles. Bad tires, seats that need repairing, seatbelts that sometimes don't work. | Policy | Taxi regulations | N/A |
| Taxi service, should be scared to get in an accident while taking taxis | Policy | Taxi regulations | N/A |
| Taxi Service. I think it should be the taxi companies RESPONSIBILITY to provide SAFE vehicles for their employees to use. I do not feel safe in the taxis that are provided especially the Crown Victoria's that are currently on the road. The taxi drivers have to foot a lot of money themselves: dispatch fees, gas, car rental. Yet, the vehicles they drive are not safe! This should be reviewed by the taxi review committee! But having said that, I feel because they have their own garage, they are just going to say the vehicles are road worthy even though they aren't (in my opinion). | Policy | Taxi regulations | N/A |
| Taxi's are dirty, unsafe and rude drivers | Policy | Taxi regulations | N/A |
| Taxis are crap. Broken, poorly maintained, smelly with rude drivers. Unreliable. A bus service would be awesome!! | Policy | Taxi regulations | N/A |
| Taxis need to be better maintained. I feel unsafe a lot of the time. | Policy | Taxi regulations | N/A |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

| Comment | Theme | Sub-Theme | Specific Location |
|--|-----------------|------------------|-------------------|
| Taxi drivers are unsafe and inappropriate. Transit NEEDS winter tires!! | Policy | Taxi regulations | N/A |
| Reliability of taxis. When paying for a cab I don't want to have to pick up others or drop others off during my ride. | Policy | Taxi regulations | N/A |
| Stop letting taxis pick up more than one fare a trip! | Policy | Taxi regulations | N/A |
| Taxi fares have been rising while fuel costs have been lowering, I feel if i am paying 8 dollars I should be allowed to have the fair myself and not share it with someone under the influence of alcohol or drugs. Also should be a set fare for the family. | Policy | Taxi regulations | N/A |
| Taxi sharing is dumb. | Policy | Taxi regulations | N/A |
| Taxis need to stop picking up so many people and making you late for events | Policy | Taxi regulations | N/A |
| The cost of taxis has increased from \$6 to \$8 in the last few years which is too much for the short trips we often make. The drivers are often rude , on their phones, or drenched in cologne that makes me feel sick. There is no alternative though. It makes access to things like medical appointments difficult for anyone on a reduced income. Traffic is bad around the government schedule with only scattered stop signs. In spring, the potholes are brutal. | Policy | Taxi regulations | N/A |
| The taxi fair are alright, however there should be rules put in place to prevent taxis from acting as car pools. There is no financial benefit to the user if there are multiple occupants in the cab. | Policy | Taxi regulations | N/A |
| Apex Road is in rough shape, the west 40 area is bad, more public parking is needed. Having a bus system to get people to and from work could help. | Roadway network | Condition | Apex Road |
| All the dirt roads needs to be paved, the pot holes creates damages to all lot vehicles | Roadway network | Condition | Not specified |
| Better roads, more access roads. Separate road system for industrial/ heavy equipment vehicles | Roadway network | Condition | Not specified |
| Definitely the roads that are not paved. For quality of some roads cause a lot of damage which in some cases is not environmentally friendly, especially when people can't afford to fix them | Roadway network | Condition | Not specified |
| Existing roads are in terrible condition. Asphalt is allowed to collapse on road shoulders. The Plateau subdivision shoulda be paved. | Roadway network | Condition | Not specified |
| Fix the roads so you can maintain actual public transportation and not have a broken down bus every week. | Roadway network | Condition | Not specified |
| high-volume graveled roads in spring.... | Roadway network | Condition | Not specified |
| Road conditions | Roadway network | Condition | Not specified |
| Road conditions and maybe a road connectioning plateau to road to nowhere | Roadway network | Condition | Not specified |

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| Road conditions, congestion points, need for public transit | Roadway network | Condition | Not specified |
| Road conditions, crime/safety, loose dogs/packs of dogs, regulation of rush hour "traffic", lowering price of taxis | Roadway network | Condition | Not specified |
| road maintenance | Roadway network | Condition | Not specified |
| Road maintenance, Traffic Lights, flow of traffic | Roadway network | Condition | Not specified |
| Road quality and quantity | Roadway network | Condition | Not specified |
| Road repairs, public transportation, sidewalks | Roadway network | Condition | Not specified |
| Roads need improvement | Roadway network | Condition | Not specified |
| Roads need improvement (potholes!) Public transit would be great, but it needs to be convenient enough to justify over simply walking. | Roadway network | Condition | Not specified |
| Roads needs to be asphalted and we surely need a traffic light at the 4 corner (rbc bldg). More sidewalks too for pedestrians safety. | Roadway network | Condition | Not specified |
| Roadways need paved Parking Remove the backwards angle parking | Roadway network | Condition | Not specified |
| snow removal crews should ensure that snowmobile crossings are not filled in with walls of snow; trenches for spring melt run off do often force snowmobiles to reroute which makes travel (with qamutik) around town quite complicated; road from plateau subdivision to core area easily clocks up because of heavy traffic (relief road, or some sort of traffic control at college, high school, hospital intersection might help); the intersection of road to nowhere and federal road is of concern: no pedestrian space, the first left curve on road to nowhere is very slippery every winter (straighten out the road maybe) and if RtN keeps developing further traffic will start to clock there; leaving parking lot at arctic ventures is very dangerous; the following roads provide especially in wintertime limited space for pedestrians 1 way street, hospital to 4 corners, section from 1 way street to DJ's Federal Road from RCMP to airport. | Roadway network | Condition | Not specified |
| The roads being maintained and cleared better and more efficiently. Need safe places to walk beside on the roads in some places. | Roadway network | Condition | Not specified |
| The four corners and the Plateau core area entry/exit are both bottlenecks at crucial times of the day when people are going to and from work. The City should consider roundabouts as these could significantly increase flow and help get people to work on time while decreasing air pollution by having vehicles not run longer than they need to. | Roadway network | Intersection improvements | 4 Corners |
| 4 corners intersection near hospital bottom of plateau hill is very difficult to exit or enter morning, noon and evening (end of work day) traffic lights may help at these 3 places | Roadway network | Intersection improvements | 4 Corners |
| 4 corners, and the apex or ring road from 4 corners to the middle school. There needs to be turning lanes to avoid congestion and | Roadway network | Intersection improvements | 4 Corners |

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| more one way streets to slow down the traffic that tries to cut 4 corners by using other roads. I have almost been hit several times walking the streets in the downtown core that are near 4 corners by impatient GN and federal employees trying to get home 2 minutes faster. Its a severe safety risk. The parking lot by 4 corners is also a bad culprit for accidents. People cut through it to avois 4 corners, disregarding pedestrians. | | | |
| As difficult as it would be, I think street lights at congested areas i.e the 4 corners would be a start. | Roadway network | Intersection improvements | 4 Corners |
| At peak times the 4corners intersection is too congested. | Roadway network | Intersection improvements | 4 Corners |
| Find ways to avoid the 4 corners intersection | Roadway network | Intersection improvements | 4 Corners |
| For vehicles: Need more alternative routes to take pressure off key intersections (like Four Corners). Need more all-way stop signs and/or combination stop/yield signs at heavily-trafficked intersections (like the bottom of the Plateau road). Need priority access to hospital. Need more right and left turn lanes. | Roadway network | Intersection improvements | 4 Corners |
| The four corners down town need to be reworked or a stop light put in. right now traffic cuts up by the Parks Canada Office and goes between city hall and curling rink, or swimming pool, causes jams and unsafe driving conditions at lunch time and quitting time. This area really needs an over haul, Maybe a 1 way. | Roadway network | Intersection improvements | 4 Corners |
| The 4 corners in the core is a disaster at lunch rush hours...lunch and 5pm not sure if traffic lights would help.... | Roadway network | Intersection improvements | 4 Corners |
| The 4 way stop by RBC needs traffic lights to better control the flow of traffic in that area | Roadway network | Intersection improvements | 4 Corners |
| The core 4 way stop needs work and the rush hour on main streets needs work. | Roadway network | Intersection improvements | 4 Corners |
| The four corners need to be converted into a roundabout. People just need to learn a new method, while easing congestion. This is used in other territories. The middle (island) can be as small as a barrel, so no excuse about it not fitting. | Roadway network | Intersection improvements | 4 Corners |
| the roads, or more specifically, the configuration of, start with the 4 coroners, install turning lanes and traffic lights, they dont have to be active all the time, they can flash red and yellow for after hours..but this will certainly make that intersection more effective..not sure what the hold up is on it..but seems to work every where else in the world.. | Roadway network | Intersection improvements | 4 Corners |
| Traffic congestion is terrible at the 4 way, plateau area | Roadway network | Intersection improvements | 4 Corners |
| Traffic jam at 4 corners, and the turn off to federal road | Roadway network | Intersection improvements | 4 Corners |
| Traffic light at 4 corners during peak hours. Turning lanes. | Roadway network | Intersection improvements | 4 Corners |
| Traffic lights at Mivvik and Queen Elizabeth would alleviate traffic back-up. Toughwr testing protocols would improve the general driving capabilities of the people using our streets. | Roadway network | Intersection improvements | Airport |

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| More right hand turn lanes. Street lights on the road to Apex from AWG arena to Angel Street | Roadway network | Intersection improvements | Apex Road |
| Turning lane near the high school/plateau. Three lanes, two for the lanes required based on rush hour direction (like the Gatineau bridge) | Roadway network | Intersection improvements | High school |
| Traffic from hospital road all the way down to the 4 way stop by RBC needs major work | Roadway network | Intersection improvements | Hospital |
| All intersections. | Roadway network | Intersection improvements | Not specified |
| Intersections. Enforcement of the law; specifically, Right of Way. | Roadway network | Intersection improvements | Not specified |
| Major intersections | Roadway network | Intersection improvements | Not specified |
| Need stop lights at major intersections and turning lanes on main road to plateau, hospital, and Road to Nowhere and 4 corners | Roadway network | Intersection improvements | Not specified |
| Right hand turns, alternate routes at main intersections, modify new roads for existing volumes (not volumes of 20 years ago), parking, traffic light at 4 corners | Roadway network | Intersection improvements | Not specified |
| the Roads to get around town and the addition of stop signs on ring road. | Roadway network | Intersection improvements | Not specified |
| traffic lights | Roadway network | Intersection improvements | Not specified |
| Traffic lights, 4 way stops, turn lanes, paving, roundabout | Roadway network | Intersection improvements | Not specified |
| turning lanes should be instituted at the corner to the plateau and the hospital to ring road. | Roadway network | Intersection improvements | Plateau |
| The access road to get to plateau needs a turning lane. More enforcement for dangerous drivers. (People who stop on the road with no stop sign) | Roadway network | Intersection improvements | Plateau |
| The bottom of the plateau intersection entering the core area needs more lanes. | Roadway network | Intersection improvements | Plateau |
| The bottom of the plateau should have 2 lanes. One for turning right | Roadway network | Intersection improvements | Plateau |
| We need a round about at the bottom of plateau by the college and high school would help with the downtown congestion during rush hours | Roadway network | Intersection improvements | Plateau |
| Yes. Coming off the plateau needs a right turning lane. | Roadway network | Intersection improvements | Plateau |
| Better traffic control in some areas of downtown core could be improved during busy times - turn from Frob and road to plateau but NAC to Niaqungusiariaq, four corners, turn near DJs onto Queen Elizabeth Way | Roadway network | Intersection improvements | Plateau |
| Need turning lanes, another main road connecting plateau to the core, traffic lights would at least create space for side street traffic to get on the main road instead of relying on kind drivers letting people in which will lead to accidents. Completely totally inadequate | Roadway network | Intersection improvements | Plateau |

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| parking through the entire city. Simply no excuse for this when we have plenty of space. | | | |
| Need turning lanes, Plateau is a nightmare during high traffic times and causes congestion. Pedestrians Have the right of way..... but sometimes traffic does not move because there are so many pedestrians crossing a 4 corners. One crosses and before they are done another one starts ect..... | Roadway network | Intersection improvements | Plateau |
| Bottleneck issues are bad at certain times and I think a bypass road would help. | Roadway network | New roads | Not specified |
| infrastructure beyond iqaluit area | Roadway network | New roads | Not specified |
| More roads | Roadway network | New roads | Not specified |
| More roads and right or left turn lanes. | Roadway network | New roads | Not specified |
| Need more outside roads | Roadway network | New roads | Not specified |
| Needs additional avenues to relieve pressure at high traffic times. Possibly adding turning lanes at bottom of plateau, other areas to speed traffic along and diminish some backlogs | Roadway network | New roads | Not specified |
| Need a second road from Plateau to downtown. Need public transportation options. | Roadway network | New roads | Plateau |
| Need a second road from Plateau to downtown. Stop allowing new building constructions on already congested roads (like Lower Plateau road) without consulting the public on traffic flow first. Lower Plateau road is dangerous -- the road is too narrow already, there are always cars parked on the side of the road, and there are two day cares and kids playing on that road. Ask anyone on that road and they'll tell you it's only a matter of time when someone gets seriously hurt -- and we are all frightened that it's going to be a little kid. And yet the city allows the developers to increase the size of their buildings, and allows them to have a parking lot directly onto the road, or creates little dead-end parking areas instead of a cul-de-sac that allows people to turn around safely. The proposed new building is no different. They are getting a parking lot right off the street, instead of being below the building than what was in their original development plan! How many more cars are going to be on that already narrow street now? What happened to having a road at the end of that street that connected to Federal Road? A new building was put there instead. Really shortsighted city planning. And this is not the only area in town where they are more concerned about putting up buildings than thinking of how people are going to safely access them. | Roadway network | New roads | Plateau |
| Need another route down from the Plateau. | Roadway network | New roads | Plateau |
| Residential centres (plateau, road to nowhere, etc) with only one road connecting to main arteries leading to long backups during rush hour. Drivers rely on each other to allow cars through, rather than proper road rules. | Roadway network | New roads | Plateau |

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| More road connections to increase network redundancy: Connect Anuri Street with Saputi Road by the QEC power plant; Connect Federal Road with the Plateau neighbourhood through IOL; Connect Masak court with Kangiq&Iniq Drive; Connect Mivvik with Ukkivik Lane/ new airport terminal area. | Roadway network | New roads | |
| Do not increase parking downtown, and enforce traffic fines for illegally parked cars. Reduce number of car on the roads by making it uncomfortable for vehicle owners. Subsidize taxi fares to keep them as an affordable alternative, and reinforce the safety requirement of taxi vehicles (they are offputtingly and scarily dangerous). | Roadway network | Parking | Downtown/ Core |
| What happened to the back in parking in the core area (Post office and Iqaluit House) is this actually part of the zoning by law? it is not being followed anymore, and more and more people just pull in and back out to the main street...this is a traffic issue especially for those backing across the road. | Roadway network | Parking | Downtown/ Core |
| breakwaters, boating access with parking. Parking in general. | Roadway network | Parking | Not specified |
| The road to Apex needs to be paved. Cars often drive on wrong side of road to avoid bad sections of road. This is safety hazard for oncoming vehicles. | Roadway network | Paving | Apex Road |
| Pave more roads, do them properly (drainage) make sidewalks or walk ways for pedestrians. Pave Apex, Pave west 40. Stop having HD equipment during sealift driving on these roads or have a better plan for them. | Roadway network | Paving | Apex Road |
| LESS dusty roads!!! How bad the roads are. Signalization. public transit. | Roadway network | Paving | Not specified |
| Mud roads are to be paved | Roadway network | Paving | Not specified |
| Pave the road to the causeway, driving our boat and trailer there we lost a wheel bearing and it cost us a fortune to get it faxed. Need speed bumps in the plateau, too many people drive crazy up there and there are kids everywhere playing, plus unmarked skidoo crossing paths | Roadway network | Paving | Not specified |
| Paved roads is needed in at least half the town. More ways to drive through town which cause more traffic plus year over year vehicle sealift is the main reason why. Add roads below lower plateau and college and new hotel on federal road. | Roadway network | Paving | Not specified |
| We need paved roads, public transit, designated and maintained walking trails and snowmobile crossings. | Roadway network | Paving | Not specified |
| PAVE Ikaluktuuliak! Put strong street lights at ALL intersections and cross walks...and maybe flashing cross walk lights. Either install smart traffic lights at four corners (i.e. are simply flashing most of the time, but become typical red/yellow/green during high traffic times OR have bylaw direct traffic during heavy traffic time. | Roadway network | Paving | |
| Airport road should be reverted back to 50km...from the RCMP to the end of the industrial area. | Roadway network | Roadway design | Airport |
| to reduce congestion, roads starting from Niaqunngusiariaq travelling through Nunavut or Kangisiniq to Federal Road should be | Roadway network | Roadway design | |

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| turned in to a one way street. Intersection of Federal Road and Nunavut should then become a four way stop. Intersection of Ikaluktuutiaq Drive and Federal Road should become a four way stop. Intersection of Ikaluktuutiaq Drive and Mivvik Road should become a four way stop. Potential accident area because of the utilidor system is too high off the ground. Intersection of Niaqunngusiariaq and Saputi should become a three lane road. With the middle lane close to Saputi be a left turning lane only. Install a cross walk either from Road to Nowhere and Niaqunngusiariaq or Naiqunngusiariaq and Paunna. Lots of pedestrians on that area. The closest cross walk is either by Joamie School or by the Hospital. Install a crosswalk or Bus stop close to the water booster station on Niaqunngusiariaq. Lots of children are forced to cross Niaqunngusiariaq to catch the bus on Atungauyait. Turn the Queen Elizabeth way and Sinaa intersection to a three way stop | | | |
| 4 corners Bottom of Plateau Road to the brown across from the hospital | Roadway network | | 4 Corners |
| 4 corners, near clinics | Roadway network | | 4 Corners |
| 4 corners. plateau hill @ main road. hospital entrance @ boarding home | Roadway network | | 4 Corners |
| driving: 4 corners, near the discovery lodge-miviik street, walking: AWG to downtown | Roadway network | | 4 Corners |
| Four corners and intersection at bottom of Plateau | Roadway network | | 4 Corners |
| Four Corners Intersection, Apex Road, West 40 Road, Federal road | Roadway network | | 4 Corners |
| four corners, intersection Federal & Ikaluktuulak, | Roadway network | | 4 Corners |
| Four Corners, turning on to or off of Queen Elizabeth Way wherever there isn't a four way stop (intersections at Plateau entrance, High School, Arctic College, Hospital, Boarding Home, Women's Shelter-400) | Roadway network | | 4 Corners |
| The four corners, through to the hospital intersection. | Roadway network | | 4 Corners |
| Apex | Roadway network | | Apex Road |
| Core area | Roadway network | | Downtown/ Core |
| Core traffic | Roadway network | | Downtown/ Core |
| Down town core | Roadway network | | Downtown/ Core |
| Downtown | Roadway network | | Downtown/ Core |
| Downtown | Roadway network | | Downtown/ Core |

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| Downtown core | Roadway network | | Downtown/ Core |
| Downtown Core | Roadway network | | Downtown/ Core |
| High school should switch their entry and exits. Completely dangerous And slows traffic. | Roadway network | | High school |
| At the cross road | Roadway network | | Not specified |
| Drainage system | Roadway network | | Not specified |
| More lanes Public bus | Roadway network | | Not specified |
| Roads | Roadway network | | Not specified |
| Roads and sidewalks | Roadway network | | Not specified |
| The roads | Roadway network | | Not specified |
| Better lighting/signage, better access to Plateau and RTN. Taxis MUST have winter tires at a minimum, and should be 4x4. So many drivers cut corners, I'm not sure if road lines would help with that at all. | Roadway network | | Plateau |
| Traffic flow and driver education - stop trying to be nice by stopping to let someone go. Accidents will happen! Also crosswalks are in dangerous areas. OHHHH and the high school entrance is a complete cluster fuck with people turning up to plateau too... It takes like 4 vehicles and that road is blocked solid... | Safety | Drivers/ enforcement | Hospital |
| More enforcement against poor driving. | Safety | Drivers/ enforcement | N/A |
| -Something has to be done about the "unwritten rules of the road" in Iqaluit. People yield and stop when there's no stop sign (Plateau intersection and Boarding Home intersection) which causes too much confusion. If people are going to stop there anyway, put up some stop signs or something. Even RCMP vehicles do this (which is ridiculous). You can stop to let someone in within reason, but it should be the exception and not the rule. People coming down from the Plateau at rush minute think you're a jerk if you don't let them in. -Cell phone use is rampant among drivers--mainly cab drivers, people driving company trucks, and young drivers. Someone is going get into a serious accident. -Cabs and Snack drivers are extremely aggressive on the road and their vehicles can't handle icy roads. -Speed bumps should continue to be added, there are too many fast drivers. People use the Lake Subdivision to go cruising at high speeds and children play on that road and there's a blind turn. Taxis make u-turns all the time on that road. -People from smaller communities (usually at the boarding home) don't seem to understand how pedestrian crosswalks work. They either rush across not knowing they have the right of way, or they cross a little | Safety | Drivers/ enforcement | N/A |

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| further down the road where there's no crosswalk. It would be good to have some signs at the boarding home to explain how they work. -Apologies for all the complaints, but I think the city has grown too fast and there are too many vehicles in town. I'm happy to hear that you're moving ahead with a transportation plan. Kudos to you and your staff. | | | |
| Set up stop sign cameras, so many people roll thru especially at the cross road on Happy Vally thru the coop housing, at the bottom of the Tundra Valley hill to Happy valley as well, at the bottom of the one way street... | Safety | Drivers/enforcement | N/A |
| Slow traffic down overall and make it safer. Bylaw is non existent in areas where kids are biking and playing. But they can be found ticketing on Federal road. More speed bumps. MORE ENFORCEMENT!! | Safety | Drivers/enforcement | N/A |
| Need to do inspection every year for the private cars make it as a law. Some cars no lights some cars with spare tires. Some cars no signals There's no safety at all | Safety | Drivers/enforcement | N/A |
| More driver training and mandatory 'ice tires' on taxis... beyond tired of fish tailed drives ... a stop sign at the hospital and a study / implementation of continuous traffic flow to reduce congestion there and at four corners ie round about or similar as traffic lights are too expensive to install and maintain. | Safety | Winter tires | N/A |
| Taxis should be mandated to upgrade from this white cars to reliable vehicles and actual winter tires. Maybe a transit system might work...?? | Safety | Winter tires | N/A |
| Taxis should be required to have winter tires | Safety | Winter tires | N/A |
| Costumer attitude | Safety | | N/A |
| Is there really a network? A network would mean there's a plan and ways to move people around safely, doesn't it? Seems like we have a road system but not a network--every person for himself/herself. | Safety | | N/A |
| there needs to be promotion of car pooling along with available public transportation | Shared transportation | Carpooling | N/A |
| Unlicensed transportation is needed | Shared transportation | Transit | N/A |
| Any options for public transportation would be an improvement. Relying on taxis as a stand in for a city bus is inefficient and costly to individuals. Pedestrian safety is also a major issue that needs to be addressed. Walking from some areas of town is difficult/unsafe due to lack of a shoulder/sidewalk or adequate street lighting. | Shared transportation | Transit | N/A |
| As a growing capital city, we really need to invest in public transit. Be more pedestrian-friendly (sidewalks for safety). Promote maps of snow-mobile and walking trails. Limit the number of cars being brought into the city until we have sufficient parking and more efficient roadways. | Shared transportation | Transit | N/A |
| bus | Shared transportation | Transit | N/A |
| Bus in the city of growing Iqaluit is needed | Shared transportation | Transit | N/A |

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| Bus needed, taxis are so expensive. People who can't afford cars must pay out \$100's a pay period. Add kids to that. | Shared transportation | Transit | N/A |
| Bus service would be great | Shared transportation | Transit | N/A |
| Bus system | Shared transportation | Transit | N/A |
| Free public transport | Shared transportation | Transit | N/A |
| Get a bus! | Shared transportation | Transit | N/A |
| Having a bus system, would increase the overall health of the community. There are numerous days were walking is not ideal. Some residents do not have a car, or do not have the money for taxis during these times. An affordable public transport would be highly favorable for these situations. | Shared transportation | Transit | N/A |
| Having accessible affordable public transportation | Shared transportation | Transit | N/A |
| I think the 1st step is to offert public transit will be during rush hours. That is the main need. Use the same school bus line and time (add busses or go around on those same line) and that will allow people from plateau, road to nowhere and apex to go downtown on sharing transportation. | Shared transportation | Transit | N/A |
| I would take a bus or shuttle if it was available | Shared transportation | Transit | N/A |
| In every way, need public transportation, proper sidewalks for walking, bi-cycle paths. Respect skidoo pathways, stop piling snow over key paths | Shared transportation | Transit | N/A |
| Iqaluit needs a bus route like yesterday!!! | Shared transportation | Transit | N/A |
| Iqaluit needs its own transit system , public taxis , public bus or shuttle ... monopoly established by the current system is not productive. | Shared transportation | Transit | N/A |
| It would be ideal to have access to a public transit system, that runs a few times a day in which people can have the option to pay a flat/lower rate say to go from Apex to town (Northmart as an example) and return. We live in times where the majority of the people who need access to transportation are those on limited to no income. We need start taking steps to help our people get back on their feet and if that means saving them 3 bucks a ride, that is 3 more dollars that they can use towards paying for food and provide clothing for their family. | Shared transportation | Transit | N/A |
| it would be nice if there was a better bus system. I would prefer to take the bus over the cab if the price is right. Also bus should be free for kids and youth | Shared transportation | Transit | N/A |
| Just lower the cost of taxi, we do not need a bus! | Shared transportation | Transit | N/A |
| Low cost consistent transport for College, women's shelter, downtown core and airport | Shared transportation | Transit | N/A |

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| Need a bus | Shared transportation | Transit | N/A |
| Need a looping public bus route that runs through major areas. | Shared transportation | Transit | N/A |
| Need public transit | Shared transportation | Transit | N/A |
| Need public transit, particularly to get people to/from work during the morning and evening rush. | Shared transportation | Transit | N/A |
| No access to public transit | Shared transportation | Transit | N/A |
| No bus. Time to try again!!! :) | Shared transportation | Transit | N/A |
| No existing public transportation - Iqaluit is large enough that we should have something that is also wheelchair accessible. Safer and larger sidewalks. Taxis need to be more accountable - they're the most irresponsible drivers in town. | Shared transportation | Transit | N/A |
| Public trans | Shared transportation | Transit | N/A |
| Public transit | Shared transportation | Transit | N/A |
| Public transit | Shared transportation | Transit | N/A |
| Public transit | Shared transportation | Transit | N/A |
| Public transit | Shared transportation | Transit | N/A |
| Public Transit Snowmobile paths and routes | Shared transportation | Transit | N/A |
| Public transit (bus service) could help ease congestion, particularly in the city core. Sidewalks are desirable to better separate pedestrians from vehicles. Bicycle paths would be helpful to give children in particular a safe place to ride free to vehicles. | Shared transportation | Transit | N/A |
| Public transit along ring road, to Apex and back, and along Fed road, would be nice. | Shared transportation | Transit | N/A |
| Public transit could help reduce vehicles on the road and reduce reliance on taxi companies . Also, traffic lights need to be considered for the core area. | Shared transportation | Transit | N/A |
| Public transit needs to become a priority. Families drain their monthly funds on taxis. The city is getting bigger and bigger and flat rate taxis work, but there needs to be a municipal option. | Shared transportation | Transit | N/A |
| Public transit service should be established. Space for walking and cycling incorporated on roadways. Buildings need secure bike parking spaces. | Shared transportation | Transit | N/A |
| Public transit should be considered an essential service. | Shared transportation | Transit | N/A |

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| Public transportation | Shared transportation | Transit | N/A |
| Public transportation | Shared transportation | Transit | N/A |
| Public transportation such as a bus or shuttle | Shared transportation | Transit | N/A |
| Public transpotation | Shared transportation | Transit | N/A |
| Regular affordable Public transit | Shared transportation | Transit | N/A |
| There is no public transit. Buses would be great. Or taxibus (they have this system in Montreal, reserve and pay ahead) | Shared transportation | Transit | N/A |
| There needs to be a dedicated bus service during rush hours morning starting at 7am till 6pm. More runs during rush hours and every hour during the day. | Shared transportation | Transit | N/A |
| There should be more affordable and reliable transportation available to people who do not own their own vehicles. A bus that makes rounds every hour around town would be a huge improvement. Make it accessible, convenient and affordable and people will use it. | Shared transportation | Transit | N/A |
| There's no reliable and cost efficient public transportation system. People that can't afford a cab or vehicle relies on others or walk in really cold weather sometimes at their own risk if they can't afford warm attire. | Shared transportation | Transit | N/A |
| Transit Organised Trail system Road conditions | Shared transportation | Transit | N/A |
| Transportation sucks, public transportation and walking paths are needed | Shared transportation | Transit | N/A |
| We need a public transit bus | Shared transportation | Transit | N/A |
| WE need public transit. i think a mix of buses and taxis in rush hour used for transit could work | Shared transportation | Transit | N/A |
| We need public transport of some type here in the city. And it needs to be separate from the students school bus system. | Shared transportation | Transit | N/A |
| We need public transportation. Cabs are not a luxury, they're a necessity for many | Shared transportation | Transit | N/A |
| A bus service, even if it is only day time hours | Shared transportation | Transit | N/A |
| a bus that services main areas would be very nice | Shared transportation | Transit | N/A |
| access to public transit | Shared transportation | Transit | N/A |
| Affordable public transit | Shared transportation | Transit | N/A |

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Open-Ended Questions

Q18: Are there any specific areas in Iqaluit's transportation network that need improvement?

| Comment | Theme | Sub-Theme | Specific Location |
|--|-----------------------|-------------------------|-------------------|
| Taxi competition, bus, late night bar shuttle, more turning lanes on the roads | Shared transportation | | N/A |
| Official snow machine trails through town. Parking for snow machines. And better bike / walking trails through town. Bike racks for locking bikes | Snowmobile network | | Not specified |
| Prominent skidoo cross-ways across roads are often blocked by plowing, which makes it really hard to get around on snowmachine. | Snowmobile network | | Not specified |
| road clearing needs to be aware of skidoo trails and clear the roads strategically. The Cost of a taxi is too high, but the drivers need to be able to afford a living as well. taxi radio and car rental rates need regulation. | Snowmobile network | | Not specified |
| snowmobile trails, snow clearing along trails, gravel along crossings, steep snow banks. The road to the causeway for boating needs work. This is a vital part of the transportation infrastructure in town. | Snowmobile network | | Not specified |
| Routes for snow machines to out of town areas (sea ice or land) that do not impinge on people's home privacy and noise at night. Route for snow machines that is sensible and avoids Lake Geraldine. | Snowmobile network | | Not specified |
| Bottle-necking at the 4 corners, traffic congestion on main roads heading to the core during rush hour times. Sidewalks would keep pedestrians safer and off the side of the road. | Traffic | Congestion | 4 Corners |
| Congestion from main 4 way needs to be controlled. | Traffic | Congestion | 4 Corners |
| the core is too condense, the 4 corners by 922, in front of NorthMart, by the hospital and boarding home | Traffic | Congestion | 4 Corners |
| The Apex road is too congested during rush hours. Traffic needs other routes to flow. Access to Inuksugait plaza is terrible - on foot or vehicle. Wasn't NCC supposed to build a sidewalk? | Traffic | Congestion | Apex Road |
| Downtown core at rush hour/lunch | Traffic | Congestion | Downtown/ Core |
| Congestion from Uptown to Downtown at peak times during the workday. | Traffic | Congestion | Downtown/ Core |
| they should direct traffic for 20 minutes at key times to alleviate the traffic jams on hospital hill, four corners, the one-way, etc. | Traffic | Congestion | Hospital |
| High time traffic | Traffic | Congestion | N/A |
| Too many vehicles in town - will the number of vehicles be regulated? We need a public transit system that is well planned, well thought out and well advertised and promoted. | Traffic | Congestion | N/A |
| Congestion and bottle neck at rush times | Traffic | Congestion | Not specified |
| Rush hour | Traffic | Congestion | Not specified |
| Main roads are becoming quite congested during peak times. It some areas it seems that too much traffic is funneled through choke points (i.e. Plateau) | Traffic | Congestion | Plateau |
| Children should stay at school over lunch, reducing the amount t of vehicles on the road. Affordable, reliable public transit that is frequent and centralizes in a depot in the core area should be a | Traffic | Lunch time school buses | N/A |

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| Comment | Theme | Sub-Theme | Specific Location |
|--|---------|-------------------------|-------------------|
| priority - served by a fleet of small buses per neighbourhood to downtown. | | | |
| Negotiate with schools to stop lunchtime bus service, with a school lunch program as an alternative. Encourage lunch businesses downtown for office clientele. Get the cars off the road at lunchtime. | Traffic | Lunch time school buses | N/A |
| Stop bussing students home at lunch. Reduce lunch hour traffic. Have public transportation or Uber. | Traffic | Lunch time school buses | N/A |
| Don't know | | | N/A |
| Everything is fine | | | N/A |
| I didn't even know Iqaluit has one. | | | N/A |
| No | | | N/A |
| The city doesn't provide much of a network. | | | N/A |
| The city planners must smoke a shit ton of crack | | | N/A |
| There isn't a transportation network besides taxi.. | | | N/A |
| To be cost effective. | | | N/A |
| we have a transportation network?? | | | N/A |
| We need a good way to get to and from work, for one, and to get to grocery stores as well as picking up parcels at the post office. Picking up and dropping off kids at daycare is also important, as are similar logistics with school-age kids, including lunch. | | | N/A |
| What is your definition of Iqaluits transportation network? | | | N/A |
| all | | | Not specified |
| All of them | | | Not specified |
| every area in Iqaluit transportation needs to be improved | | | Not specified |
| Every where | | | Not specified |
| everywhere | | | Not specified |
| West 40 | | | West 40 |

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Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

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Listing of comments, sorted by theme and sub-theme

| Comment | Theme | Sub-Theme |
|--|--------------------|-------------|
| I wouldn't mind the extra time to bike to work considering a safe path without any motorized traffic. Could be shared with walkers. Especially from awg to ball diamond through downtown. | Cycling network | |
| Crosswalks need lights. I have seen numerous pedestrians that are barely visible in blowing snow and darkness nearly get hit. If they could activate a button at a crosswalk vehicles would know someone is there in poor conditions. | Pedestrian network | Cross-walks |
| I know that there are other priorities such as the water situation but the roads do need to be addressed not just for their condition but for the safety of all the vehicles and people on them. Sidewalks should be a future consideration to keep pedestrians safe from unruly drivers and slipping accidents. | Pedestrian network | Sidewalks |
| Improved and clearly sidewalks. Cars currently use the space for walking to gain traction. Not safe for pedestrians. There is no bicycle infrastructure. And see above | Pedestrian network | Sidewalks |
| Iqaluit needs proper sidewalks, bicycle paths and public transportation for safer and more environmentally friendly solutions | Pedestrian network | Sidewalks |
| More sidewalks, clear pedestrian crossings with lights, stagger work/lunch times to reduce traffic congestion | Pedestrian network | Sidewalks |
| New communities (like Joamie Court) should have shoulders for walking built in to the design. | Pedestrian network | Sidewalks |
| -Pedestrians need more space to walk. There's going to be a bad accident one day. -More stop signs where people are self-directing traffic. Ideal would be traffic lights or a roundabout, but these would cost a lot of money. It would be better to try stop signs first. Maybe turn-off ramps. | Pedestrian network | Sidewalks |
| Sidewalks sidewalks sidewalks | Pedestrian network | Sidewalks |
| You should study what happens when a city installs pedestrian networks based on the routes already used. People use them. Public transportation consisting of maybe 5 routes with Frequent 7 passenger vehicles is a great idea. Starting with one route federal road to apex going by the grocery stores is perfect. One staff should be able to handle the entire project. More and the cost of operating it gets out of hand. | Pedestrian network | Sidewalks |
| more pedestrian trails and better snow clearing of walkways along streets | Pedestrian network | Trails |
| There should be walking trails outside the main streets system to avoid air pollution and be safer. These trails could be marked. It would invite more people to walk. Big work. Better get to it sooner than latter. Try to get people walking. Fight the car system! | Pedestrian network | Trails |
| Walking/cycling paths would be helpful for safety. | Pedestrian network | Trails |
| We need provision for more walking trails to connect neighbourhoods. Given that we've decided to use a windy suburban street layout in more recent subdivisions, we need to accommodate walkers who want to take | Pedestrian network | Trails |

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Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|--|--------------------|---------------|
| more direct routes. However, currently this entails walking through back yards, etc. | | |
| we should really try to limit the number of personal vehicles in the street and promote alternative ways : walking, cycling, dogsledding :) | Pedestrian network | Trails |
| Your questions about areas we use refer to outside Iqa. For me that meant outside of the zones you coloured, i.e. on the land and sea ice, where I ski, hike, snowmachine, although some of these areas are within Iqaluit limits. Question was not clear and could mean other communities or south. Other things needed: Walkways in between houses in Plateau that do not impinge on privacy. Safe sidewalks on main arteries without silliness of a few yrs ago about poles that offended some people's sensibilities. Routes for snow machines to out of town areas (sea ice or land) that do not impinge on people's home privacy and noise at night. Route for snow machines that is sensible and avoids Lake Geraldine. | Pedestrian network | Trails |
| Consider the future growth of the city and the number of cars that are continually being brought in each year. Planning for alternate modes of transportation such as a bus and better walking routes would be helpful. | Pedestrian network | |
| Considering most Iqaluit residents walk, bike, or taxi the focus of the transportation plan should be on encouraging safe, active, affordable (or free) modes of transit. I walk every day up and down the hill to Plateau (-60, blizzard, with groceries - doesn't matter because I always have the appropriate gear). Unless disabled anyone can walk if they have easy access to warm winter gear. The City could have an active living/walking campaign where walking is promoted and awarded (post #walking picture and a random/frequent post could get a free month gym pass). Warm gear should be donated to shelters, and schools; City could organize! Short and long hikes could be organized by the Aquatic centre (IQ walks, berry picking, etc). Likewise the aquatic centre could start a bike club/paid outdoor bike class during the warmer months. Bars should be required to give out taxi vouchers to anyone that they have to kick out. Roads should be paved so pedestrians don't have to inhale dust and particulates. Roads should have bike lanes. RESIST the 'need' for more downtown parking. Iqaluit is a small town. Most people could walk to work within the time span of 10 to 40 mins and they'd live longer with less of a carbon footprint. Build HIGH density (8 story) housing with mixed use ground level retail where there is existing wasted space in the Downtown, currently reserved for rushhour parking. Examples: sivammuit parking, Inuksagiat plaza parking, aquatic centre's second parking lot (that's always empty). Could have streetside parking instead, along federal, etc. | Pedestrian network | |
| Discourage extensive car use, come up with paid parking | Pedestrian network | |
| Walking is healthy and leads to better outcomes for your citizens. In the winter it can be nearly impossible to walk particularly if you have a disability. Take for example the route between 630 and Northern and imagine you have an issue with walking strength and balance. This needs to be prioritized. | Pedestrian network | |
| I think that the city should be following up with ndms to incorporate all aspects of disabilities and what people need. | Policy | Accessibility |
| If we were to have bus system, could you please consider accessible vehicles that kneel for seniors and parents with strollers, others who have trouble with steps or other issues with getting on and off buses. When using the taxi vans and having to climb into the back or get out of the back it's very challenging as we age. Thank you! | Policy | Accessibility |

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Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|--|--------|-------------------------|
| We need a way for children and elders get home safely | Policy | Accessibility |
| If we expect the world to care about Arctic climate change, we need to act like we care, too. High taxes on imported cars and good public transit are essential. | Policy | Environmental concern |
| Innovative technologies from up and coming environmentally friendly movements. Taking time to research a northern specific plan that focuses on environmental stewardship rather than spending hundreds of thousands of dollars on consulting companies. Stand your ground on what is right and the upmost best solution for generations to come. | Policy | Environmental concern |
| There is TONS of federal funding for public transit initiatives in response to climate change efforts. Feel free to contact the GN's Climate Change Secretariat for more info! | Policy | Environmental concern |
| For public transport have a subsidized monthly pass for low income | Policy | Reducing cost of living |
| I walk every day 20min minimum to go to work because I cannot afford taxi and rent per month. Leaving in a Capital we should have access to public transportation. | Policy | Reducing cost of living |
| Regulate properly the cost of taxi fare. Assuming you are riding a taxi daily at the cost of \$8 per ride multiply by 2x daily multiply by 5 days X 29 days X 12 mos. the sum would total to more than enough monthly premium for a personal car loan. But if everyone avails for a loan traffic will be disruptive. Population in Iqaluit is getting bigger, and it's time to rethink a public transport that would ease everyone's burden. The government will profit from it and is convenient for riding public. | Policy | Reducing cost of living |
| Sustainable financially. Remember nobody used the bus because it was not good. Two buses, use one and keep the other as spare and have a bus app so that you know at all times where is the bus in case there is a traffic jam. You cannot rely on bus schedule. One full-time driver and a dozen relief on-call drivers to run the bus from 6 am to 6 pm Monday to Sunday leaving city hall on the hour every hour. How much does Nunavut Arctic College spend on bus budget every year? This is an indication how much our bus service would cost. This will remove quite a few cars from the road. You cannot charge money because people have too many cars. In Brisbane Australia inner city there are two free shuttle bus routes. | Policy | Reducing cost of living |
| Taxi service is not an affordable accessible form of transportation. A bus system would mean less taxis on the road improving traffic flow and also allowing taxi drivers to have a sustainable living wage. People should be provided incentives for walking, biking, and carpooling with work colleagues. Like reduced price at the pool or for the gym or perhaps grocery vouchers. For eco friendly transportation that reduces traffic flow. | Policy | Reducing cost of living |
| thanks for the survey. looking forward to seeing affordable public transportation someday soon. | Policy | Reducing cost of living |
| The most important things are for transportation to be affordable, reliable and accessible to everyone. | Policy | Reducing cost of living |
| Unfortunately I don't think it financially feasible to have a bus service. I think for the locals with no car etc and who need financial assistance the taxi service could be subsidized 50%. | Policy | Reducing cost of living |
| What do people really want, AFFORDABLE TRANSPORT (subsidize) or RELIABLE TRANSPORT (paid for service)? | Policy | Reducing cost of living |

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Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|---|--------|------------------|
| get the taxis off the roads | Policy | Taxi regulations |
| I feel unsafe in most taxis here. Many drivers do not drive appropriately for the conditions or are distracted when driving - this can be terrifying when you are unable to use the seat belt. I do everything I can to avoid taking a taxi. | Policy | Taxi regulations |
| It should be mandatory that all taxi's require 4x4 S am option. Either AWD or 4x4 selectable option for every taxi permitted to operate. Public transit should be a high priority for the city. But some sort of system should be required to ensure all riders are paying for each trip or be required to obtain some sort of pass that allows them to board to avoid fre riders occupying seats all the time | Policy | Taxi regulations |
| Stop letting taxis pick up more than one fare a trip! | Policy | Taxi regulations |
| TAXi are still driving people around the whole town before getting to a destination. They need culture training very racist towards Inuit. They are still bootlegging as well. | Policy | Taxi regulations |
| Taxi company should not be allowed to eat up all of the fare increases... | Policy | Taxi regulations |
| Taxis are terrible because of forced sharing and stopping to pick up multiple customers. Can't believe this is allowed. It's ridiculous. I never use taxi but my dies and my 9 year old son has been with her when the cab stops to pick up drunks. I don't appreciate my family being put in that situation. Luckily we have our own vehicle and seldom have to use a taxi service. Would love to see driverless public transport you can order and pay for from your cell phone. Change the taxi bylaw to prevent multiple pickups. One client per cab please. City seems to do well in maintaining, clearing, sanding etc streets. | Policy | Taxi regulations |
| The local taxi service is an economic based company and such act that way. Which I don't disagree with but at times it takes sometimes 40mins from the time you call for one to the time you reach your final destination because of the amount of time it takes to round up the passengers, deal with traffic congestion and dropping off passengers to various locations. There needs to be an alternative method of transportation for those who don't own a personal vehicle. | Policy | Taxi regulations |
| Transportation is currently monopolized by [REDACTED], which is the worst possible reality. [REDACTED]'s attention to customer needs is pathetic, while his greed is enormous. Transportation needs to be ENTIRELY handled by the government. There NEED to be rules that are not only in place but also followed. Cab drivers are under paid and under appreciated and as a result they are careless and dangerous drivers. If the government were to pay drivers a salary rather than a fare based wage they may be more inclined to present themselves as respectable. As transportation is such an important part of northern communities it should be taken seriously, and with private business owners taking advantage that will never happen. Please fix this issue, as it has been out of control for far too long and it is only getting worse. | Policy | Taxi regulations |
| DP process should be realistic and establish higher percentages for large developers when high density buildings are being approved. present rates for offsite infrastructure improvements are less than 10% of the developers construction cost on average. | Policy | |

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| Comment | Theme | Sub-Theme |
|--|--------|-----------|
| I have been twice asked to leave areas designated "No Parking" when I was in my vehicle with the engine running. As I understood this - this is not "parking" but, rather "standing." Can we have appropriate signs in areas if "standing" is not permitted? | Policy | |
| I would like the Mayor, Councillors, and authors of Master Plan to take seriously the role that beautification takes when considering transportation in the city. For example, when a new road is built, tundra or other natural plans are removed. This seems especially shameful not only because tundra is so beautiful but because of the hundreds of years it takes to grow. In the south, I have often scene that when developers are building new subdivisions or new buildings there is special consideration for green space and re-planting. I think the same should occur in Iqaluit. This will also have a direct impact on transportation in any case, because vegetation plays an essential road in flooding (i.e. in spring and pothole season) and in summer when there is an enormous amount of dust in the air. Considering beautification in relation to your transportation plan I would imagine is relatively inexpensive, particularly if the plan is to build new roads (all you would have to do is ensure the plants being dug up in construction of the road are preserved and then replanted). In relation to this point, it might be a consideration of the city, to consider a policy or by-law that requires that with any construction in Iqaluit, builders are required to preserve and replant at least 50% of the tundra they excavate in the process of building. Beautification touches on the general well-being of the community who are intended to enjoy the city and also the impression on tourists and visitors who come and see the city. I think its important. | Policy | |
| It needs to be sustainable and have room for growth. Too much here is reactionary. Iqaluit is growing, and the plan needs to include room for that. | Policy | |
| It's great to see that you have taken the steps to study this, businesses and organizations love to talk but rarely get to action the idea. Let's see this one through! | Policy | |
| plan should discourage using vehicles on a daily basis to get to downtown offices for work by making it safer and more enjoyable to walk and bicycle | Policy | |
| Survey in french please (as an official language of Canada.) . Thanks for doing this! | Policy | |
| The prioritization of personal cars in this city's transportation system is a problem that should be solved. People would rather purchase cars at great expense than walk more than 15 minutes to work. In order to purchase a new or used car from a dealer, one must ship them up here on a sealift. This creates a barrier to owning a car. Yet despite this, many people do buy cars in a city that is too small to require them. This may be because of the cold but it may also be because this city's transportation system currently functions only to serve people driving their own personal cars, the most inefficient form of transportation available, over pedestrians. While there are no car dealerships in Iqaluit, there are places to buy ATVs and snowmobiles. Creating a transportation system that favours these vehicles instead has the potential to inject more money into the local economy. These vehicles are cheaper than cars and therefore better for Iqaluit residents. They're more efficient and use less fuel. They're also the only vehicles capable of allowing people to explore Iqaluit's natural beauty beyond city limits. To build a city like this with the idea that cars will be the primary mode of transportation is a southern solution to a Northern problem. We should find made-in-Nunavut solutions and follow through on them. | Policy | |

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| Comment | Theme | Sub-Theme |
|---|-----------------|---------------------------|
| Fix the roads. Public transit will come after that. Or do public transit first and keep incurring costs because of repair. | Roadway network | Condition |
| Graders should scarify the compacted snow before sanding the roads. That way the sand sticks to the snow. | Roadway network | Condition |
| A light at the hospital, four corners and northmart which only works during rush hour. And blinking red all other hours (blinking red means it's just like any other stop sign) | Roadway network | Intersection improvements |
| Add turning lanes at busy intersections. | Roadway network | Intersection improvements |
| Aside from roundabouts, there really needs to be a transit system. Not a big bus, but multiple smaller buses. The addition of bus stops with non slip surfaces is vital. | Roadway network | Intersection improvements |
| Establish turning lanes | Roadway network | Intersection improvements |
| Explore opportunity for a roundabout at both intersections | Roadway network | Intersection improvements |
| I'd like to see a roundabout maybe in the central area of town and one at the bottom of plateau. They are 30% faster and safer when drivers are used to using them. I would actually like to see this properly surveyed out to see if it is possible to be done i believe it could work. if the statue would need to be moved it could center the roundabout as well. | Roadway network | Intersection improvements |
| In addition to exploring public transit and roundabouts, the City should seriously consider using a Complete Streets policy to also make safe and efficient walking and biking paths that would benefit both residents and tourists: https://www.completestreetsforcanada.ca/ . Thank you for this opportunity! :) | Roadway network | Intersection improvements |
| install traffic control lights so to be used during the busiest hours on both four corners. During off hours, turn them in to a four way stop. | Roadway network | Intersection improvements |
| People's ignorance of how to use modern infrastructure technology is not a good reason to avoid installing it. Teaching people to understand a traffic light is better than leaving 150 cars at a time idling downtown. The smog around my home in the winter is worse every year. | Roadway network | Intersection improvements |
| Same as above, if we can't have stop lights let's use some roundabouts! | Roadway network | Intersection improvements |
| Stop lights at 4 corners | Roadway network | Intersection improvements |
| Street lights instead of the ridiculous 4 way and individuals trying to get off the plateau. Prior to transit street lights are a vital aspect in progression and moving forward. | Roadway network | Intersection improvements |
| Street lights or traffic officers at busy intersections | Roadway network | Intersection improvements |
| streetlights or roundabouts, or both are now needed | Roadway network | Intersection improvements |
| there should be a roundabout at the 4 corners | Roadway network | Intersection improvements |
| there should be some consideration for traffic lights at difficult areas | Roadway network | Intersection improvements |

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Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|---|-----------------|---------------------------|
| Think about roundabouts instead of 4 way stops. Dont put in streetlights! Too much maintenance. Roundabouts work and they can be quite attractive is done well. Roundabouts support safe walking if built properly. | Roadway network | Intersection improvements |
| Traffic circles work well to alleviate congestion | Roadway network | Intersection improvements |
| Traffic control at major intersections | Roadway network | Intersection improvements |
| Traffic lights at four corners, old hospital T-intersection, blinking light at DJ's corner. Turning lane at the bottom of plateau road to ring road. Tear down and rebuild Apex Road. Paid crossing guards at school crossings. | Roadway network | Intersection improvements |
| Traffic Lights during rush hours at 4 corners Lighted crosswalks | Roadway network | Intersection improvements |
| traffic lights or one of those ppl that stand outside and direct traffic or a round about, need public transit, lights for the road behind the Joamie School. | Roadway network | Intersection improvements |
| We probably need a few more stop signs or lights but I don't drive in those areas so I can't comment. I do understand though there are very long cues to get up and down the new plateau subdivision and the T stop at hospital/boarding home needs to be addressed, could be a 3 way stop. | Roadway network | Intersection improvements |
| I really feel the city needs to look at how terrible it is to get into the core area of town. We need more backroads that allow transport around the outskirts to better bypass the core area. Also think it would make sense to have the high schools driveway access looked at since it holds up traffic excessively during peak hours. Possibly look at more stop signs on ring road to better help traffic on plateau road and hospital area. The accidents and near misses caused by people speeding and no one letting people into the main road is terrible. | Roadway network | New roads |
| Needs extra roads built. | Roadway network | New roads |
| Please, please, please create alternative feeder roads to the airport, to the new Federal Road development, and around Four Corners. Please, please, please create efficient alternative walking pathways to encourage walking. Ideally create off-road pathways that are safe, quick, and maintained year-round. Re-consider roundabouts, yielding traffic patterns, and more 3-way and 4-way stops. | Roadway network | New roads |
| Road connecting lower plateau to Federal road. Public lessons on 4 way stops :) | Roadway network | New roads |
| There are only 2 ways to access the core of Iqaluit from tundra valley. There needs to be more access points. People coming to town turning left at hospital hold up traffic, people who are nervous to turn left at house 400 also back up traffic pretty bad. Something needs to be done to help traffic flow. Turning lanes. | Roadway network | New roads |
| would be nice to be able to drive personal vehicle to recreational/cabin/hunting/siteseeing like the rest of Canada | Roadway network | New roads |
| Focus on vehicular travel while making pedestrians safe. Car/trucks will always rule Iqaluit streets. Don't pretend otherwise. Provide adequate parking. | Roadway network | Parking |
| Parking space is critical Remove ALL the rocks | Roadway network | Parking |

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| Comment | Theme | Sub-Theme |
|---|-----------------|----------------|
| Proper parking | Roadway network | Parking |
| All roads should be paved | Roadway network | Paving |
| Definitely the roads, which will also eliminate a lot of unhealthy dust that people are breathing into their lungs. | Roadway network | Paving |
| Pave all roads | Roadway network | Paving |
| Pave all roads and have side walks. | Roadway network | Paving |
| Paved roads and sidewalks | Roadway network | Paving |
| Consider a third lane for ring road, apex road till middle school, Mivvik street, and federal road. | Roadway network | Roadway design |
| Design roads with ice slippage/ black ice in mind especially on the plateau. Road surface needs to be rethought for that area... I've slid to the T junction in the past as well as on coronation street and the street at 5151... scary! | Roadway network | Roadway design |
| I think there needs to be something done about the wooden posts in the downtown area. Driver's hit them all the time and then the posts become an eyesore. It has also been a safety issue during the "rush hour" when an emergency vehicle tries to go through the traffic and driver's can't pull over because of the post's. | Roadway network | Roadway design |
| Improve drainage to avoid water build up, blocked culverts/drains, and potholes, especially before paving unlike previous paving projects. Look at less expensive, but proven asphalt alternatives for Arctic environments. Improve pedestrian safety. | Roadway network | Roadway design |
| It would be great if we didn't plan to direct all traffic to the core area. It makes sense to be able to drive from Plateau to lower Plateau, or from plateau down to core, via the IOL parcel on federal road. And please - enforce the turning lanes near the new daycare! | Roadway network | Roadway design |
| Large signage | Roadway network | Roadway design |
| Make the streets going into the town hall and the courthouse one way!! | Roadway network | Roadway design |
| More one way streets, speed deterrents such as more bylaw catching speeders. And a change so that there are fines that are followed up on to tickets issued. Right now there are no penalties if you do not pay an outstanding traffic ticket. | Roadway network | Roadway design |
| More signs, better lit areas including signs that have lights eg. crosswalk lights | Roadway network | Roadway design |
| -Proper street lighting at smaller intervals for enhanced visibility especially during the dark season -Properly signalled pedestrian crosswalks with good lighting | Roadway network | Roadway design |
| The road by the court house and the Old Arena should be one way to stop people from stopping traffic on the main road to give breaks to the cars coming from those roads. | Roadway network | Roadway design |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|---|-----------------------|---------------------------|
| Iqaluit needs proper storm water drainage to protect pavement and road beds | Roadway network | Stormwater management |
| Many vehicles drive with no insurance. This is a major concern. Perhaps another viable option may curb this habit and cut down # of cars on the road. | Safety | Drivers/enforcement |
| Maybe not the right place but there are an awful lot of people texting and driving. I drive a lot and see at least 10 people a day texting and driving. | Safety | Drivers/enforcement |
| More by law enforcement of speed limits. | Safety | Drivers/enforcement |
| The issue of cars stopping anywhere to allow pedestrians to cross anywhere or to allow other cars into the flow of traffic is dangerous as you cannot anticipate when the cars in front will do this. Education campaign for road safety is important. | Safety | Drivers/enforcement |
| Train all taxi drivers the rules of the road. We drive on the right side of the road! And we stop at stop signs. | Safety | Drivers/enforcement |
| Yes Can you please Do inspection on the private cars. And also add more stop signs. | Safety | Drivers/enforcement |
| Municipal enforcement of burnt out headlights, taillights, and turn signals. | Safety | Vehicle condition (taxis) |
| Safety for pedestrians | Safety | |
| Safety is key. I do not feel safe at all to walk around town due to the high number of loose dogs and the safety risks due to public drunkenness, drug induced intoxication, physical fights and overall crime rates in town. Very sad and unfortunate but true. | Safety | |
| Carpooling organization would be helpful | Shared transportation | Carpooling |
| Code of conduct for taxi drivers when taking taxi's. More consideration for those getting to and from apex. | Shared transportation | Taxi |
| A Bus service never worked before. Its been tried twice before, a losing proposition. City is always trying to reinvent the wheel. stop flogging a dead horse. | Shared transportation | Transit |
| A bus service put in place | Shared transportation | Transit |
| A public transportation system would be awesome! What about the traffic issue in Iqaluit? It's not good. | Shared transportation | Transit |
| -Access to public transit -streetlights that dim or turn off in low density areas -higher tax on larger vehicles like trucks -roads and walkways developed for pedestrian, skidoo, ski, and bicycle use -use of roundabouts and traffic slow down measures like vancouver -mandatory sidewalk construction alongside new road construction -incentives for employees who walk to work (longer break times) | Shared transportation | Transit |
| Affordable, reliable, accessible, timely, clean, plenty of options for pick up/stops has enough seats for enough people | Shared transportation | Transit |
| Bring back short buses for transportation. Cab drivers don't like to pick up people who are in apex. | Shared transportation | Transit |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|---|-----------------------|-----------|
| Bus routes should include Apex. | Shared transportation | Transit |
| Bus service may be helpful, however I'm sure the taxi service will complain....Taxi fare is reasonable however many taxis are unfit for the road and not clean ..perhaps if the taxis were better maintained and clean and the drivers maintained a higher level of personal hygiene more of us would take taxis | Shared transportation | Transit |
| Busses! | Shared transportation | Transit |
| City bus should be considered | Shared transportation | Transit |
| City really needs to look at a busing program and eliminate the need for so many taxis... | Shared transportation | Transit |
| Consider bus service? | Shared transportation | Transit |
| For cost reasons a bus to and from work areas weekdays only mornings and after work | Shared transportation | Transit |
| I think a bus, or mini van, or shuttle service should be established. Mainly for short trips around the community, and up and down the hills to the neighborhoods to the downtown core where people work. I feel that there are too many vehicles used for commuting short distances with only the driver. The air quality suffers | Shared transportation | Transit |
| I would absolutely love to see a city bus service. I would use it in my everyday commuting. I would much rather pay a bus service than take a taxi. \$8 per ride adds up really quick. I would suggest bus stops be at the airport, northmart, AWG and apex for very basic stops. | Shared transportation | Transit |
| Introducing a public transit Bus could be beneficial and save cost on taxi's for families (good for environment too). Summertime, a bus schedule for the parks would be beneficial so, citizens can go for picnics/fishing and, have it run into the evenings to get back to town. | Shared transportation | Transit |
| It's time for a bus system | Shared transportation | Transit |
| Maybe it doesn't have to be a specific "route" but there should be at least one bus stop in each neighbourhood so you could get on/off and walk to your actual location from there | Shared transportation | Transit |
| Need wheelchair accessible public transportation | Shared transportation | Transit |
| please consider shuttles from various neighbourhoods to downtown, reliable schedule is very important. A shuttle from the downtown to outdoor recreational areas ie. summer months from the hotels to Sylvia Grinnel park, downtown to causeway, Sylvia Grinnel park and Apex In the winter there could be a shuttle from neighbourhoods to the park for cross country skiing Make sure new roads are wider to allow for pedestrians and cyclists Consider urban ski trails to and from recreation centres and through town Improve and define skidoo trails in town and leading out of town, make sure there are skidoo trails to the gas stations | Shared transportation | Transit |
| Please have public transit system such as city bus. | Shared transportation | Transit |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|---|-----------------------|-----------|
| Please implement a public bus system, that's inexpensive, covers all of Iqaluit, invest in the future. One cab company is not sustainable and puts customers at the mercy of this one contractor. As a driver I would love to see the roads paved without potholes and properly ploughed and sanded when it's icy. I live up on the plateau in the west 40 area and that road is extremely dangerous and slippery during spring and warmer conditions thawing the snow. | Shared transportation | Transit |
| Please put bus public transport | Shared transportation | Transit |
| Please re-introduce a bus I think Iqaluit is ready for it. Taxi's are awfully disgusting and gross especially in the evenings when they are picking up drunks. Not safe at all for young teenagers who like to go to the youth center or who babysit It scares me having to think the drivers will pick up drunks with my 16 year old daughter in the car. She doesn't see it at home, she shouldn't have to be exposed to it just to go to the youth center for activities | Shared transportation | Transit |
| Public bus systems would fail miserably and would cost the city a lot of money | Shared transportation | Transit |
| Public Transit Snowmobile paths and routes | Shared transportation | Transit |
| Public transit or a City-led initiative for carpooling would greatly reduce traffic at the start, mid and end of the workday. An airport shuttle would be an awesome public transit route feature. | Shared transportation | Transit |
| Public transit should be considered; build and maintain year round walkable trails to encourage reduction in car use, and increase in safe walking spaces. | Shared transportation | Transit |
| Public transit. Airport shuttle | Shared transportation | Transit |
| Public Transport, like buses, is a very reasonable expectation for a town with our size and spread. | Shared transportation | Transit |
| Public transportation | Shared transportation | Transit |
| Public transportation like city buses would be fantastic! I would use it and leave my car at home. | Shared transportation | Transit |
| Rankin has one and is way smaller than Iqaluit! | Shared transportation | Transit |
| Try buses again. The city is big enough for it now. And not just ring road. I would be a user. For sure. | Shared transportation | Transit |
| We desperately need a public transportation system. Consider atypical changes to the existing plan. Consider alternatives to the norm, especially given the environment. How about a toll road? A roundabout at congestion points? Instituting a convenience tax on households with more than one (1) vehicle? Look farther afield than Canada for choices, i.e., what is done in Nuuk or Reykjavik, and other cities which are remote. | Shared transportation | Transit |
| I would appreciate more consideration be given to snowmobile with qamutik (hunters) traffic through town, especially better solutions for spring time when snow free paved road, high snow banks and/ or run off trenches make navigation very difficult and wear out gear fast. more pedestrian safety and encouraging walking over driving would be great, also setting up public | Snowmobile network | |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|--|--------------------|-------------------------|
| garbage containers that will be emptied regularly throughout town might help with a cleaner city, | | |
| Iqaluit should strengthen its identity as a northern city by prioritizing convenient snowmobile trails to get around instead of always focusing on cars. | Snowmobile network | |
| Official snow machine trails through town. Parking for snow machines. And better bike / walking trails through town. Bike racks for locking bikes | Snowmobile network | |
| Some of the snow mobile trails around town are a bit tricky, like crossing Road to Nowhere, but I'm not sure how that could be improved. | Snowmobile network | |
| standards for snowmobile trails and address multi-use trails | Snowmobile network | |
| 1st step is to focus on Monday to Friday, am, lunch and pm, to stop having so many people coming downtown with a personal vehicle when everyone can share. I hope that buses will be accessible to young/student. For example, now, the rate for swimming is way too much for teens. It should be at least 1/2 price to encourage them to use those facilities/services and build good habit for life. Thank a lot for everything. | Traffic | Congestion |
| Actually, I think a component of this plan would be to encourage government and businesses to operate offset hours, which would smooth out the 5-minute rush at the times work starts and stops. | Traffic | Congestion |
| Any way to make congestion charges practical is so small a city? | Traffic | Congestion |
| City crews do a good job of keeping roads cleared and maintained in the winter (thank you!). Traffic can be bad during morning, lunch, and right at 5pm but it does clear in 15 minutes. Cost of new road connections could be offset by new lots for development. | Traffic | Congestion |
| Don't get a bus for the city, it'll attract others from out of Nunavut and Iqaluit is already over crowded as is | Traffic | Congestion |
| Having different dinner time for the Gouvernement employees to avoid congestion at the rush hour | Traffic | Congestion |
| if this goes through there should be enough bus to cut down wait times during rush hour. | Traffic | Congestion |
| Staggered work dismissals and start times. Not everyone needs to be on the road at the same time. Students stay in school all day like everywhere else in Canada. We don't need all those school buses on the roads at noon and at 1:00 pm everyday. | Traffic | Congestion |
| Giving the students at schools the option of remaining at school for the lunch hour would definitely help during the lunch hour. | Traffic | Lunch time school buses |
| Reduce school Bus traffic. | Traffic | Lunch time school buses |
| Cost versus true need , get it right or don't do it | | |
| Ferry and air transportation are required | | |
| Let's do this right so it doesn't fail! Federal Govt. should support the development of public transit in Iqaluit, capital city of Nunavut. | | |
| maintenance and long term planning | | |
| Make it so that it works for people. Especially people in need | | |
| No | | |

City of Iqaluit Transportation Master Plan Online Survey Results

Appendix A Section 5 - Final Thoughts

Open-Ended Questions

Q19: Do you have any other comments that should be considered in the Transportation Master Plan?

| Comment | Theme | Sub-Theme |
|---------|-------|-----------|
| No | | |
| No | | |

City of Iqaluit

Traffic Light Signal Controls Final Report

Iqaluit, NU

October 2009

City of Iqaluit

Traffic Light Signal Controls Final Report

Iqaluit, NU

October 2009

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EXECUTIVE SUMMARY

A. Introduction

The City of Iqaluit (City) is the capital of the Territory of Nunavut. Though Iqaluit has long been the administrative centre of the eastern arctic territories, the City has experienced increased growth in recent years due to the recently established territorial government. With a growing population of over 7,250, and an increasing vehicle ownership rate, the traffic volumes in the City are steadily climbing. In order to address the existing congestion and mitigate potential future problems, an analysis of traffic movements at key intersections in the Core Area has been undertaken.

The study area consists of Niaqunngusiaq Road from the Four Corners intersection to the Hospital intersection. The intersections studied are:

- Mivvik Street / Niaqunngusiaq Road at Federal Road / Queen Elizabeth II Way (Four Corners intersection)
- Niaqunngusiaq Road at Kangiq & Iniq Drive (City Hall intersection)
- Niaqunngusiaq Road at Saputi Road (High School intersection)
- Niaqunngusiaq Road at Queen Elizabeth II Way / Hospital Driveway (Hospital intersection).

As part of this study the following reports were reviewed:

- Qikiqtani General Hospital Traffic Impact Assessment, July 2003
- Core Area and Capital District Redevelopment Plan, July 2004
- Transportation and Urban Design Study, December 2005
- Nunavut Court of Justice Building Pre-Feasibility Study, April 2003
- Iqaluit Pedestrian Walkways Phase I – Core Area, October 2004

A visit of the study area took place from July 27, 2009 to July 31, 2009. As part of the visit, turning movement counts were conducted at each of the study area intersections. A photo library was developed of the study area at the same time.

B. Issues Paper

Transportation Characteristics

Based on observations of traffic, the following was noted:

- Drivers hesitate at stop signs which causes confusion
- ATVs travel on roads like all other passenger vehicles
- Large trucks are infrequent
- Traffic is highly peaked, particularly at the start and end of lunch hours
- There are no pavement markings
- The order in which the English and Inuktitut instructions appear on road signs of the same type is not consistent.

Warrants

Traffic light warrants were conducted for the Four Corners intersection and the Hospital intersection utilizing the TAC *Canadian Traffic Signal Warrant Matrix Procedure*.

- The Four Corners intersection warrants traffic lights. If traffic lights are to be installed at this intersection, left turn lanes must also be constructed on all four legs of the intersection to ensure the smooth flow of traffic through the intersection.
- Traffic lights are not warranted for current traffic at the Hospital intersection. Based on traffic analysis, using a uniform growth rate of 2.5% per annum, traffic lights are projected to be warranted at this intersection in approximately 20 years.

Left turn lane warrants were undertaken for the City Hall intersection, High School intersection, and Hospital intersection using the warrant procedure outlined in the *Geometric Design Standards for Ontario Highways* (MTO), as referenced in the *Geometric Design Guide for Canadian Roads* (TAC).

- A left turn lane is warranted for the High School intersection.

An all-way stop warrant was conducted for the Hospital intersection. In the absence of a national standard, the Ontario Traffic Manual Book 5 method was used.

- An all-way stop is not warranted at the Hospital intersection.

Capacity Analysis

The capacity analysis for existing traffic established that the current traffic system operates at a Level of Service (LOS) 'C' or better on all approaches at all times with the exception of the northbound approach at the Hospital intersection, which operates at a LOS 'D' during the mid-day and PM peaks. Level of Service is a measure of delay experienced by drivers, and is commonly defined by the Highway Capacity Manual, 2000. The best level of service is LOS 'A', with all other levels of service incrementally worse with increased delay. All movements have reserve capacity to accommodate additional traffic volumes.

The delay associated with each Level of Service, as defined in the Highway Capacity Manual, 2000, is summarized in **Table A**.

Table A: Level of Service Definitions

| Level of Service | Signalized Intersection Delay (seconds) | Unsignalized Intersection Delay (seconds) |
|------------------|---|---|
| A | ≤ 10 | ≤ 10 |
| B | > 10 and ≤ 20 | > 10 and ≤ 15 |
| C | > 20 and ≤ 35 | > 15 and ≤ 25 |
| D | > 35 and ≤ 55 | > 25 and ≤ 35 |
| E | > 55 and ≤ 80 | > 35 and ≤ 50 |
| F | > 80 | > 50 |

The 5-year horizon volumes were analyzed with traffic lights at the Four Corners intersection and northbound and southbound right turn lanes at the Hospital intersection. The Four Corners intersection will operate at an overall LOS 'B' during all peak periods for all traffic movements. The northbound left and through lane during the mid-day and PM peaks at the Hospital intersection will operate at a LOS 'D'. All remaining movements will operate at a LOS 'C' or better. All movements will have reserve capacity to accommodate additional traffic volumes.

The 10-year horizon volumes were analyzed with the same improvements as were applied to the 5-year horizon. The Four Corners intersection will operate at a LOS 'B' during all peak periods for all traffic movements. The southbound approaches of the City Hall intersection and High School intersection will operate at a LOS 'D' during the PM peak period. At the Hospital intersection, the northbound left and through during the AM and PM peak periods and the southbound left and through during the PM peak period will also operate at a LOS 'D'. The northbound left and through at the Hospital intersection will operate at a LOS 'E' during the mid-day peak. All remaining movements will operate at a LOS 'C' or better. All movements will have reserve capacity to accommodate additional traffic volumes.

In our analysis roundabouts were considered for both the Four Corners intersection and the Hospital intersection as a potential solution to help improve traffic control. The construction of a roundabout requires a significantly higher up front capital cost than the installation of traffic lights. However, once built, the roundabout has a lower maintenance cost than traffic lights. To fit a roundabout at the Four Corners intersection, some property would have to be acquired. A small single lane roundabout with a truck apron would be the preferred design.

The question of a roundabout at the Four Corners intersection is addressed below in Section C. At the Hospital intersection, the traffic analysis revealed that no improvements are necessary. Therefore, on the basis of that conclusion, it wasn't justified to consider a roundabout for that intersection.

Pedestrian Features

Pedestrian walkways, crosswalks, and the associated road signs and pavement markings, are collectively referred to as pedestrian 'facilities' or 'features' for the purposes of this report. There are five existing crosswalks with signs in the study area. These crosswalk signs do not meet the Transportation Association of Canada's *Manual of Uniform Traffic Control Devices for Canada* (MUTCD) standards for the type of sign, number of signs, and pavement marking. The MUTCD, although not formally adopted by the Government of Nunavut, is used as the basis of the driver's manual and test in Nunavut. The signs used in the city do not meet the MUTCD standards. In some locations the signs are not the same in both directions of travel.

Snowmobile Features

Snowmobile ‘facilities’ or features consist of designated trails and road crossings for the purposes of this report. There is only one road sign in the study area indicating snowmobile crossings and paths, which does not accurately reflect actual crossing patterns. The result is conflicts with pedestrian use of facilities.

Collision Analysis

The Royal Canadian Mounted Police (RCMP) provided collision data from January 1, 2006 to July 31, 2009 for the study area. The collision data included any reported collisions on the along the roadway whether they occurred on the road right-of-way or on adjacent private property. The collision data also did not make it clear which collisions occurred within the intersection. As a result, it was not possible to determine a collision rate for each intersection.

In total, 27 collisions were reported for the entire study area for the 3.5-year period. Of these collisions, there were no fatalities, 2 injury collisions, 13 reportable property damage collisions, and 12 non-reportable property damage collisions.

C. Draft Solutions

Four Corners Intersection

There are two potential solutions, in addition to the “do-nothing” option, to help improve traffic control at the Four Corners intersection:

- The installation of traffic lights with left hand turn lanes at every approach; and
- The construction of a roundabout.

As noted earlier in the report, traffic lights with left turn lanes on every approach are warranted at the Four Corners intersection. The “do-nothing” option would maintain the existing conditions into the future indefinitely.

A roundabout is another way of improving traffic conditions at that intersection. However, the footprint of a small single lane roundabout with a truck apron doesn’t fit within the limits of the existing road right-of-way and encroaches on the neighbouring lots. Therefore, building a roundabout at that intersection would require property acquisition, particularly in the northeast and southwest quadrants of the intersection.

Both options provide increased safety and will help address traffic congestion at the Four Corners intersection. The installation cost of the traffic lights is significantly lower than the cost of constructing a roundabout, and the addition of left turn lanes can easily be accommodated within the limits of the existing road right-of-way. The construction of a roundabout requires significantly more up-front capital expenditure and cannot be accommodated within the existing road right-of-way.

Hospital Intersection

Left turn lanes are not warranted for the eastbound and westbound approaches at the Hospital intersection. The construction of right turn lanes on the northbound and southbound approaches will allow through and left turning vehicles to queue separately from the through and right turning vehicles, thus reducing the delay to those movements. The “do-nothing” option would maintain the existing conditions into the future indefinitely.

An all-way stop was investigated, however it was found to be not warranted. Traffic lights are also not warranted.

City Hall Intersection

An eastbound left turn lane was investigated at the City Hall intersection. It is not warranted.

The “do-nothing” option would maintain the existing conditions into the future indefinitely.

High School Intersection

An eastbound left turn lane was investigated at the High Scholl intersection. It was found that a 15 metre left turn lane is warranted.

The “do-nothing” option would maintain the existing conditions into the future indefinitely.

Mid-Block Locations

A standard crosswalk design should be developed and implemented across the entire City. This design should be based on MUTCD standards.

Other Recommendations

The MUTCD states that “Uniformity and simplicity in design, position and application are of the greatest importance in aiding recognition.” The expectation of drivers is that all road signs are designed in a consistent manner with identical symbols and identical written instructions located at the same place on the panel for road signs addressing similar circumstances. The City should develop sign design standards, particularly with respect to the order of languages on a sign. This will allow drivers to obtain the relevant information more quickly, and therefore increase safety.

To ease circulation and prevent left turn conflicts at the High School intersection, it is recommended that the west driveway should be designated as exit only and the east driveway should be designated as entrance only.

Illumination at crosswalks should be reviewed for visibility of pedestrian by oncoming road traffic.

D. Costs

Four Corners Intersection

The estimated cost for labour and materials to install traffic lights at the Four Corners intersection is in the order of \$250,000. The estimated cost for labour and equipment for the construction of left turn lanes, subject to detail design, is in the order of \$200,000. The cost for the pavement markings, including mobilization costs, is in the order of \$15,000.

Hospital Intersection

The estimated cost for labour, materials, and pavement markings for the construction of right turn lanes at the Hospital intersection is in the order of \$80,000. The final cost is subject to detail design.

High School Intersection

The estimated cost for labour, materials, and pavement markings for the construction of left turn lanes at the High School intersection is in the order of \$50,000. The final cost is subject to detail design.

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1. INTRODUCTION

The City of Iqaluit (City) is the capital of the Territory of Nunavut. Though Iqaluit has long been the administrative centre of the eastern arctic territories, the City has experienced increased growth in recent years due to the recently established territorial government. With a growing population of over 7,250, and an increasing vehicle ownership rate, the traffic volumes in the City are steadily climbing. In order to address the existing congestion and mitigate potential future problems, an analysis of traffic movements at key intersections in the Core Area has been undertaken.

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- Niaqunngusiaq Road at Kangiq & Iniq Drive (City Hall intersection)
- Niaqunngusiaq Road at Saputi Road (High School intersection)
- Niaqunngusiaq Road at Queen Elizabeth II Way / Hospital Driveway (Hospital intersection)

The study area and intersections are illustrated in **Exhibit 1**.

1.1 Background

Several studies have been conducted in the Core Area in the past six years. These studies made the following recommendations regarding the intersections reviewed as part of this study:

Qikiqtani General Hospital Traffic Impact Assessment, July 2003

- Installation of traffic lights or a single lane roundabout by 2020
- Realignment of the Hospital intersection to improve sight lines
- Delay installation of traffic lights as long as possible
- Implement travel demand management strategies such as staggered work hours, brown-bag lunch programs, and active transportation

Core Area and Capital District Redevelopment Plan, July 2004

- Establish a snowmobile trail system to minimize conflicts with vehicles and pedestrians
- Develop a Snowmobile Courtesy Policy

Transportation and Urban Design Study, December 2005

- Construct a by-pass road parallel to Federal Road
- Re-align the Niaqunngusiaq Road so that through traffic continues onto the by-pass road
- Construct a westbound left turn lane at the Hospital intersection
- Negotiate establishing a postal sub-station away from the Core Area
- Undertake a Transportation Master Plan
- Install pedestrian access improvements along Niaqunngusiaq Road and to the Four Corners intersection
- Widen pavement surface on Niaqunngusiaq Road
- Signage should adhere to MUTCD standards
- Relocate crosswalk at Arctic College to the High School intersection
- Provide enhanced pedestrian crossings on each leg of the Four Corners intersection

Nunavut Court of Justice Building Pre-Feasibility Study, April 2003

- No transportation issues were raised with respect to the chosen Court of Justice Building site

Iqaluit Pedestrian Walkways Phase I – Core Area, October 2004

- Install mosaic paving at the Four Corners intersection
- Create a walkway surface with existing soil treated with an aggregate binder
- Install wooden bollards with reflective strips to delineate pedestrian areas

1.2 Site Visit

A visit of the study area was conducted from Monday, July 27, 2009 to Friday, July 31, 2009. As part of the visit the study area was observed and detailed notes were taken of the

operations. A photo library was established to illustrate each intersection studied. The links between the intersections were also observed. The dates of the turning movement counts are summarized in **Table 1** and can be found in **Appendix A**.

Table 1: Turning Movement Counts

| Intersection | Surveyor | Date |
|--------------|-----------------|--------------------------|
| Four Corners | Sharon Cranston | Wednesday, July 29, 2009 |
| City Hall | Sharon Cranston | Tuesday, July 28, 2009 |
| High School | Simon Plourde | Wednesday, July 29, 2009 |
| Hospital | Sharon Cranston | Thursday, July 30, 2009 |

1.3 Data Sources

The data used as the basis for the analyses included in this report are from three primary sources:

- The GIS data provided by the City of Iqaluit
- Site observations undertaken by the project team
- *Qikiqtani General Hospital Traffic Impact Assessment* (July 2003)

2. ISSUES PAPER

2.1 Introduction

As part of the site visit, extensive site observations were made. The observations detailed the existing conditions to establish an accurate traffic model. The observations also encompassed behaviour and trends that are unique to Iqaluit. It is important to understand the nature of traffic patterns so that solutions can be tailored to most effectively serve the City's needs. The items of concern or those that could create transportation problems in the future are detailed below. Where appropriate, analysis and warrants were conducted to quantify the needs and demands of the transportation system.

2.2 Transportation Characteristics

2.2.1 Driver Behaviour

Many drivers at 2-way stop controlled intersections were observed to require a larger gap than would normally be accepted in more densely populated areas. The requirement for a larger gap reduces the capacity of the movement and can create queues. The intersections were able to operate relatively smoothly due to drivers with the right-of-way stopping and allowing drivers from the side street to proceed. Though this behaviour is courteous and allows the intersection to operate at an acceptable level of service, it does not conform to the rules of the road and should not be relied upon for smooth operation of the intersection.

Drivers do not always stop decisively at all-way stop intersections. Some drivers stop far back from the intersection, and some slow almost to a stop, but continue to creep forward. The result can be confusing to other drivers, which causes them to hesitate and be unsure of who has the right-of-way. This impedes the operation of the intersection and creates additional delay.

2.2.2 Traffic Composition

The traffic consisted of passenger vehicles, all terrain vehicles (ATVs), asphalt trucks, water trucks, single unit trucks, construction equipment, and large transport trucks. The ATVs travelled at the same speed, with similar acceleration, and for the same purposes as passenger vehicles. As such, the ATVs were included in the passenger vehicle volumes. The asphalt trucks and some of the construction equipment are part of a road construction program that is active during the summer months only on a temporary basis. This program has been in effect for the summer of 2008 and the summer of 2009. The sewage and water transportation trucks are an integral part of the utility services in the City and will continue to operate indefinitely. Single unit trucks are a common and integral part of the traffic volume. Large transport trucks are not common. The maximum observed number of large trucks during a peak period was 4: two trucks departing loaded and returning empty. The timing of large truck transportation is dependant of the arrival of the barges and the tides.

2.2.3 Existing Traffic Patterns

The observed traffic patterns were highly peaked. Traffic was observed in 15 minute intervals. The peaks were noted to last for less than these intervals. Due to the compact nature of the City, employees are able to arrive at their places of work in a short period of time. Although there is some dispersion during the AM and PM peak periods from varying start and end times, the peaking characteristics are highly pronounced at the beginning and end of the lunch hour (from 12:00 to 1:00 PM).

In order to accurately model the existing traffic patterns experienced in the City, peak hour factors were calculated. The peak hour factors were derived based on the peak hourly volumes and the peak 15 minute volumes observed. For each intersection during each peak period, the following equation was applied:

$$\text{Peak Hour Factor} = \text{Peak Hour Volume} / 4 \times \text{Peak 15 Minute Volume}$$

Where:

- Peak Hour Factor is a measure of the distribution of traffic over a one hour period
- Peak Hour Volume is the maximum observed volume in four consecutive 15 minute periods during a peak period expressed in vehicles per hour
- Peak 15 Minute Volume is the maximum observed 15 minute volume during the peak hour expressed in vehicles per 15 minutes

The peak hour factors obtained and used in the capacity analysis ranged from 0.89 to 0.66 and are summarized in **Table 2**.

Table 2: Peak Hour Factors Based on Observed Traffic

| Intersection | AM Peak | Mid-day Peak | PM Peak |
|--------------|---------|--------------|---------|
| Four Corners | 0.84 | 0.83 | 0.89 |
| City Hall | n/a | n/a | 0.66 |
| High School | n/a | n/a | 0.74 |
| Hospital | 0.85 | 0.73 | 0.70 |

2.2.4 Pavement Markings

No stop bars or pavement markings of any kind were observed at any of the study intersections. A stop bar was noted at the Road to Nowhere. Stop bars would clarify the appropriate location to stop at all-way stop intersections. This would reduce driver confusion and assist drivers in determining who has the right-of-way.

2.2.5 Signage

The speed limit in the urban area is 40 km/h. School Zones have a reduced speed limit of 30 km/h. There are no signs posted in the vicinity of the High School indicating that the area is a School Zone, and the 30 km/h speed limit signs do not have any tabs indicating a speed transition (i.e. “Begins” tab).

The signing practices must be consistent to ensure quick and easy message comprehension by drivers. The MUTCD states that “Uniformity and simplicity in design, position and application are of the greatest importance in aiding recognition.” For example, the order of languages on speed limit signs should be consistent throughout the City and should be consistent with other bilingual signage. Based on discussions with the Government of Nunavut, MUTCD has not been formally adopted, however it is used as the basis of the driver’s manual and driver’s test.

2.3 Traffic Light Warrant

A warrant is an objective justification tool for a traffic measure. Capacity analysis is a numerical model that quantifies and estimates the capacity and delay of a traffic system. The purpose of the capacity analysis is as a planning tool, and the warrant is a policy tool.

To evaluate the need for traffic lights at the Four Corners intersection and the Hospital intersection, the TAC *Canadian Traffic Signal Warrant Matrix Procedure* (Procedure) was used. The Procedure was developed based on safety, operational, physical, strategic, and special considerations.

Based on discussions with City staff, the AM peak and mid-day peak periods were adjusted to more accurately reflect the peak periods in Iqaluit. The AM peak period observed was 7:30 AM to 9:30 AM and the mid-day peak period observed was 11:30 AM to 1:30 PM. The Traffic Signal Warrant Matrix for both the Four Corners intersection and the Hospital intersection can be found in **Appendix B**.

The warrant process is based on a point system. Each factor is accorded points based on the impact on traffic operations. A total of 100 or more points constitute a warrant. The Four Corners intersection has a total of 139 points and the Hospital intersection has a total of 47 points.

The Four Corners intersection clearly warrants traffic lights. When taking into consideration the unique nature of Iqaluit traffic patterns, the Hospital intersection still does not warrant a traffic light.

Based on 5-year and 10-year horizon volumes, the Hospital intersection has 60 and 75 points respectively. Though traffic lights are not necessary for these horizon years, based on local driver behaviour, traffic lights may be installed at the City’s discretion.

2.4 Left Turn Lane Warrants

Left turn lane warrants are designed to determine whether a left turn lane is required for a free-flowing movement. The warrants are not designed for stop-controlled approaches or traffic lights.

Left turn lane warrants were undertaken for the City Hall and High School intersections using the warrant procedure outlined in the *Geometric Design Standards for Ontario Highways* (MTO), as referenced in the *Geometric Design Guide for Canadian Roads* (TAC). The warrant is based on the advancing volume, opposing volume, and the percentage of vehicles turning left. Based on the observed PM peak traffic volumes a left turn lane is not warranted at the City Hall intersection, however a 15 metre eastbound left turn lane is warranted at the High School intersection. Left turn lane warrants are included in **Appendix C**.

Left turn lanes are not warranted at the Hospital intersection during any time period for either the eastbound or westbound directions.

2.5 Capacity Analysis

In order to establish existing traffic operations and verify the feasibility of the proposed improvements, a traffic model was developed using the Synchro 6 software package, which performs a capacity analysis at each intersection. Capacity analysis is a quantitative representation of traffic operations and patterns under both existing volumes with observed conditions and projected volumes with proposed improvements. The traffic model used to create the capacity analysis is calibrated to best represent the traffic characteristics noted in the field.

It was reported that higher queues and traffic volumes are experienced during the winter months than the summer months. The variance in traffic volumes is attributed to seasonal behaviour, such as walking, and some residents depart on fishing and hunting trips during the warm weather. A winter multiplication factor was considered to accommodate for this variance. The *Qikiqtani General Hospital Traffic Impact Assessment* includes traffic counts at the Four Corners intersection and the Hospital intersection from June and July 2002 and January 2003. The comparison of consecutive seasons should render any growth negligible. The result of the comparison was noticeably higher volumes at the Hospital intersection during the winter, but lower volume at the Four Corners intersection during the winter. Since the data was both limited and contradictory, a reasonable trend could not be established as a basis for analysis. As a result, a winter multiplication factor was not applied.

2.5.1 Intersection Operations Methodology

Intersection operations at the study area intersections noted in **Section 2** of this report were assessed using the software program Synchro 6, Traffic Signal Coordination Software (“Synchro 6”), which employs the widely used methodology from the *Highway Capacity Manual (HCM 2000)* published by the Transportation Research Board of the U.S. National Research Council. Synchro 6 can analyze both signalized and unsignalized intersections in a road corridor or network, taking into account the spacing, interaction, queues, and operations between intersections.

The signalized intersection analysis considers two separate measures of performance:

- The capacity of the intersection movements, which is based on a volume to capacity ratio
- The level of service, indicated by a letter, which is based on the control delay per vehicle for the various movements through the intersection and overall.

The unsignalized intersection analysis considers two separate measures of performance:

- The capacity of the critical intersection movements, which is based on a volume to capacity ratio
- The level of service for the critical movements, indicated by a letter, which is based on the average control delay per vehicle for the various critical movements within the intersection.

The most desirable level of service is ‘A’, with each subsequent level of service regarded as worse due to incrementally increased delay. The delay in seconds associated with each level of service, as defined in the Highway Capacity Manual, 2000, is summarized in **Table 3**.

Table 3: Level of Service Definitions

| Level of Service | Signalized Intersection Delay (seconds) | Unsignalized Intersection Delay (seconds) |
|------------------|---|---|
| A | ≤ 10 | ≤ 10 |
| B | > 10 and ≤ 20 | > 10 and ≤ 15 |
| C | > 20 and ≤ 35 | > 15 and ≤ 25 |
| D | > 35 and ≤ 55 | > 25 and ≤ 35 |
| E | > 55 and ≤ 80 | > 35 and ≤ 50 |
| F | > 80 | > 50 |

2.5.2 Existing Conditions

Based on the counts noted in **Table 1** and site observations, a Synchro model was developed to represent the existing geometry and traffic control devices illustrated in **Exhibit 2**, and existing traffic volumes illustrated in **Table 4**, summarizing the existing traffic operations. Detailed Synchro worksheets can be found in **Appendix D**.

Table 4: 2009 Existing Unsignalized Intersection Operations

| Intersection & Movement | Weekday AM Peak Hour | | Weekday Mid-day Peak Hour | | Weekday PM Peak Hour | |
|-------------------------------------|----------------------|------|---------------------------|------|----------------------|------|
| | LOS | v/c | LOS | v/c | LOS | v/c |
| Four Corners Intersection | | | | | | |
| Eastbound left, through, and right | B | 0.43 | C | 0.61 | C | 0.58 |
| Westbound left, through, and right | C | 0.63 | C | 0.62 | C | 0.62 |
| Northbound left, through, and right | C | 0.53 | C | 0.63 | C | 0.52 |
| Southbound left, through, and right | B | 0.45 | B | 0.48 | C | 0.59 |
| City Hall Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.01 |
| Westbound through and right | | | | | A | 0.24 |
| Southbound left and right | | | | | C | 0.22 |
| High School Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.08 |
| Westbound through and right | | | | | A | 0.22 |
| Southbound left and right | | | | | C | 0.26 |
| Hospital Intersection | | | | | | |
| Eastbound left, through, and right | A | 0.01 | A | 0.01 | A | 0.01 |
| Westbound left, through, and right | A | 0.05 | A | 0.05 | A | 0.05 |
| Northbound left, through, and right | C | 0.24 | D | 0.42 | D | 0.56 |
| Southbound left, through, and right | B | 0.04 | C | 0.08 | C | 0.13 |

LOS – Level of Service v/c – volume to capacity

The volume to capacity ratio (v/c) indicates how much of the capacity on an approach is being used by traffic. The Level Of Service (LOS) is a measure of delay experienced by drivers. With the exception of the northbound approach of the Hospital intersection, all approaches have a LOS 'C' or better. All intersections in the study area have reserve capacity (i.e. v/c less than 1.0) and can accommodate greater traffic volumes without any improvements to the intersections. However, the delay experienced by drivers for the northbound approach at the Hospital intersection is approaching 30 seconds, based on the traffic model. This delay is a mathematical measure, not an observation. The actual delay experienced by drivers may be greater due to the highly peaked nature of the traffic flows and conservative driving behaviour observed.

2.5.3 5-Year Horizon

For the 5-year horizon, it has been assumed that the Four Corners intersection will have traffic lights and left turn lanes on every approach. It has also been assumed that the Hospital intersection will have right turn lanes on the northbound and southbound approaches.

Based on a comparison of the observed traffic volumes, summer 2002 traffic volumes, and discussions with City staff, a 2.5% per annum growth rate has been confirmed as representative of the growth that continues to be experienced by the City. The 5-year horizon volumes are illustrated in **Exhibit 4**.

Table 5 and **Table 6** summarize the capacity analyses for the four study intersections. Detailed Synchro worksheets can be found in **Appendix E**.

Table 5: 2014 Horizon Signalized Intersection Operations

| Intersection & Movement | Weekday AM Peak Hour | | Weekday Mid-day Peak Hour | | Weekday PM Peak Hour | |
|----------------------------------|----------------------|------|---------------------------|------|----------------------|------|
| | LOS | v/c | LOS | v/c | LOS | v/c |
| Four Corners Intersection | | | | | | |
| Overall | B | | B | | B | |
| Eastbound left | B | 0.11 | B | 0.13 | B | 0.06 |
| Eastbound through and right | A | 0.37 | B | 0.53 | B | 0.59 |
| Westbound left | B | 0.18 | B | 0.21 | B | 0.31 |
| Westbound through and right | B | 0.59 | B | 0.51 | B | 0.49 |
| Northbound left | B | 0.29 | B | 0.40 | B | 0.35 |
| Northbound through and right | B | 0.43 | B | 0.43 | A | 0.36 |
| Southbound left | B | 0.42 | B | 0.42 | C | 0.54 |
| Southbound through and right | B | 0.25 | B | 0.24 | B | 0.36 |

LOS – Level of Service v/c – volume to capacity

Table 6: 2014 Horizon Unsignalized Intersection Operations

| Intersection & Movement | Weekday AM Peak Hour | | Weekday Mid-day Peak Hour | | Weekday PM Peak Hour | |
|------------------------------------|----------------------|------|---------------------------|------|----------------------|------|
| | LOS | v/c | LOS | v/c | LOS | v/c |
| City Hall Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.02 |
| Westbound through and right | | | | | A | 0.27 |
| Southbound left and right | | | | | C | 0.28 |
| High School Intersection | | | | | | |
| Eastbound left | | | | | A | 0.09 |
| Eastbound through | | | | | A | 0.35 |
| Westbound through and right | | | | | A | 0.25 |
| Southbound left and right | | | | | C | 0.35 |
| Hospital Intersection | | | | | | |
| Eastbound left, through, and right | A | 0.01 | A | 0.01 | A | 0.01 |
| Westbound left, through, and right | A | 0.06 | A | 0.05 | A | 0.04 |
| Northbound left and through | C | 0.29 | D | 0.35 | D | 0.29 |
| Northbound right | A | 0.03 | B | 0.05 | B | 0.19 |
| Southbound left and through | C | 0.03 | C | 0.06 | C | 0.09 |
| Southbound right | B | 0.02 | B | 0.02 | A | 0.01 |

LOS – Level of Service v/c – volume to capacity

The Four Corners intersection will operate at a level of service ‘B’ during all peak periods for the 5-year horizon. The northbound through and left turn lane will operate at a level of service ‘D’ during the mid-day and PM peak periods. The volume to capacity ratios indicate that the intersection has substantial reserve capacity to accommodate further traffic growth.

2.5.4 10-Year Horizon

Similar to the 5-year horizon analysis, the Four Corners intersection has been assumed to have traffic lights with left turn lanes on every approach. The northbound and southbound right turn lanes have been assumed at the Hospital intersection. As in the 5-year horizon analysis, a 2.5% per annum growth rate was applied. The 10-year horizon volumes are illustrated in **Exhibit 5**.

Table 7 and **Table 8** summarize the capacity analysis for the four study intersections. Detailed Synchro worksheets can be found in **Appendix F**.

Table 7: 2019 Horizon Signalized Intersection Operations

| Intersection & Movement | Weekday AM Peak Hour | | Weekday Mid-day Peak Hour | | Weekday PM Peak Hour | |
|----------------------------------|----------------------|------|---------------------------|------|----------------------|------|
| | LOS | v/c | LOS | v/c | LOS | v/c |
| Four Corners Intersection | | | | | | |
| Overall | B | | B | | B | |
| Eastbound left | B | 0.14 | B | 0.15 | B | 0.08 |
| Eastbound through and right | B | 0.41 | B | 0.59 | B | 0.65 |
| Westbound left | B | 0.21 | B | 0.24 | B | 0.38 |
| Westbound through and right | B | 0.65 | B | 0.57 | B | 0.55 |
| Northbound left | B | 0.32 | B | 0.45 | B | 0.40 |
| Northbound through and right | B | 0.48 | B | 0.48 | A | 0.40 |
| Southbound left | B | 0.49 | B | 0.48 | C | 0.62 |
| Southbound through and right | B | 0.27 | B | 0.26 | B | 0.40 |

LOS – Level of Service v/c – volume to capacity

Table 8: 2019 Horizon Unsignalized Intersection Operations

| Intersection & Movement | Weekday AM Peak Hour | | Weekday Mid-day Peak Hour | | Weekday PM Peak Hour | |
|------------------------------------|----------------------|------|---------------------------|------|----------------------|------|
| | LOS | v/c | LOS | v/c | LOS | v/c |
| City Hall Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.02 |
| Westbound through and right | | | | | A | 0.30 |
| Southbound left and right | | | | | D | 0.37 |
| High School Intersection | | | | | | |
| Eastbound left | | | | | A | 0.10 |
| Eastbound through | | | | | A | 0.39 |
| Westbound through and right | | | | | A | 0.27 |
| Southbound left and right | | | | | D | 0.44 |
| Hospital Intersection | | | | | | |
| Eastbound left, through, and right | A | 0.01 | A | 0.01 | A | 0.01 |
| Westbound left, through, and right | A | 0.06 | A | 0.06 | A | 0.05 |
| Northbound left and through | D | 0.37 | E | 0.45 | D | 0.38 |
| Northbound right | A | 0.04 | B | 0.06 | B | 0.23 |
| Southbound left and through | C | 0.04 | C | 0.07 | D | 0.13 |
| Southbound right | B | 0.03 | B | 0.02 | A | 0.02 |

LOS – Level of Service v/c – volume to capacity

The Four Corners intersection will operate at a level of service ‘B’ during all peak periods for the 10-year horizon. There volume to capacity ratios indicate that the intersection has substantial reserve capacity to accommodate further traffic growth. The southbound approaches at the City Hall intersection and the High School intersect will operate at a level of service ‘D’. The northbound left and through during the AM and PM peak periods and the southbound left and through during the PM peak at the Hospital intersection will also operate at a level of service ‘D’. The northbound left and through will operate at a level of service ‘E’ during the mid-day peak. These movements are not high volume and have low volume to capacity ratios.

2.5.5 Do Nothing

The above analysis assumes that the recommended intersection improvements are implemented. The “Do Nothing” option assumes that the status quo is maintained indefinitely. Based on the volumes illustrated in **Exhibit 4** and **Exhibit 5**, and the existing lane configurations, an analysis of unimproved traffic operations was undertaken. **Table 9** and **Table 10** summarize the unimproved traffic operations. Detailed Synchro worksheets can be found in **Appendix G**.

Table 9: 2014 Unimproved Unsignalized Intersection Operations

| Intersection & Movement | Weekday AM Peak Hour | | Weekday Mid-day Peak Hour | | Weekday PM Peak Hour | |
|-------------------------------------|----------------------|------|---------------------------|------|----------------------|------|
| | LOS | v/c | LOS | v/c | LOS | v/c |
| Four Corners Intersection | | | | | | |
| Eastbound left, through, and right | C | 0.53 | C | 0.74 | D | 0.83 |
| Westbound left, through, and right | C | 0.77 | D | 0.76 | E | 0.86 |
| Northbound left, through, and right | C | 0.67 | D | 0.78 | D | 0.75 |
| Southbound left, through, and right | C | 0.55 | C | 0.60 | E | 0.84 |
| City Hall Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.02 |
| Westbound through and right | | | | | A | 0.27 |
| Southbound left and right | | | | | C | 0.28 |
| High School Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.09 |
| Westbound through and right | | | | | A | 0.25 |
| Southbound left and right | | | | | C | 0.35 |
| Hospital Intersection | | | | | | |
| Eastbound left, through, and right | A | 0.01 | A | 0.01 | A | 0.01 |
| Westbound left, through, and right | A | 0.06 | A | 0.05 | A | 0.04 |
| Northbound left, through, and right | C | 0.32 | C | 0.40 | C | 0.48 |
| Southbound left, through, and right | B | 0.05 | C | 0.08 | C | 0.11 |

LOS – Level of Service v/c – volume to capacity

Typical thresholds for improvements are level of service E and / or volume to capacity ratio of 0.85. These measures indicate noticeable delay and limited reserve capacity. Situations that reduce capacity, such as inclement weather, could result in congestion. The Four Corners intersection exceeds both of these thresholds during the PM peak period. All other intersections will operate within reasonable parameters.

Table 10: 2019 Unimproved Unsignalized Intersection Operations

| Intersection & Movement | Weekday AM Peak Hour | | Weekday Mid-day Peak Hour | | Weekday PM Peak Hour | |
|-------------------------------------|----------------------|------|---------------------------|------|----------------------|------|
| | LOS | v/c | LOS | v/c | LOS | v/c |
| Four Corners Intersection | | | | | | |
| Eastbound left, through, and right | C | 0.65 | F | 1.00 | F | 1.00 |
| Westbound left, through, and right | E | 0.93 | F | 1.00 | F | 1.06 |
| Northbound left, through, and right | D | 0.81 | F | 0.96 | F | 0.92 |
| Southbound left, through, and right | C | 0.67 | D | 0.73 | F | 1.03 |
| City Hall Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.02 |
| Westbound through and right | | | | | A | 0.30 |
| Southbound left and right | | | | | D | 0.37 |
| High School Intersection | | | | | | |
| Eastbound left and through | | | | | A | 0.10 |
| Westbound through and right | | | | | A | 0.27 |
| Southbound left and right | | | | | D | 0.44 |
| Hospital Intersection | | | | | | |
| Eastbound left, through, and right | A | 0.01 | A | 0.01 | A | 0.01 |
| Westbound left, through, and right | A | 0.06 | A | 0.06 | A | 0.05 |
| Northbound left, through, and right | D | 0.40 | D | 0.51 | D | 0.61 |
| Southbound left, through, and right | C | 0.07 | C | 0.09 | C | 0.14 |

LOS – Level of Service v/c – volume to capacity

During the Mid-day and PM peak periods, the Four Corners intersection experiences volume to capacity ratios of 1.00 or more, which indicates that the expected traffic volumes exceed capacity. When the volumes are greater than the available capacity, the queue lengths would continue to grow. Since the analysis is performed on a 60 minute analysis period, congestion would last for more than an hour during the Mid-day and PM peak periods. All other intersections will operate within reasonable parameters.

2.6 Roundabouts

As an alternative to traffic lights, roundabouts were considered at the Four Corners intersection and the Hospital intersection. In addition to operational benefits, a roundabout would generally be expected to:

- Result in lower injury collision rates (30 % to 90%) compared to a signalized intersection
- Slow traffic through the roundabout “intersection”, allowing drivers more time to react to potential conflicts
- Reduce the severity of damage to vehicles in collisions, compared to the type of accidents that occur at signalized intersections (i.e. rear-end and sideswipe collision as opposed to right angle collisions)
- Reduce negative environmental impacts because of lower delays resulting in lower fuel consumption and emissions
- Offer opportunities for improved aesthetics and streetscaping treatments.

For roundabout analysis, RODEL software was utilized to assess the roundabout operations. This modelling software is generally accepted by the transportation industry. When running

RODEL for an existing intersection, it is always better to use the actual geometric parameters, however, at the time of preparing this report, actual geometric parameters were not available. As such, default parameters were used. The RODEL analysis is summarized in **Table 11** and the detailed analysis can be found in **Appendix G**.

Table 11: 2009 Existing Level of Service and Average Delay

| Approaches | AM Peak Hour | | Mid-day Peak Hour | | PM Peak Hour | |
|----------------------------------|--------------|---------------|-------------------|---------------|--------------|---------------|
| | LOS | Average Delay | LOS | Average Delay | LOS | Average Delay |
| Four Corners Intersection | | | | | | |
| Overall | A | 3.8 (s) | A | 3.9 (s) | A | 3.9 (s) |
| Southbound | | 0.06 (min) | | 0.06 (min) | | 0.06 (min) |
| Eastbound | | 0.06 (min) | | 0.06 (min) | | 0.07 (min) |
| Northbound | | 0.06 (min) | | 0.07 (min) | | 0.06 (min) |
| Westbound | | 0.07 (min) | | 0.07 (min) | | 0.06 (min) |
| Hospital Intersection | | | | | | |
| Overall | A | 3.5 (s) | A | 3.6 (s) | A | 3.6 (s) |
| Southbound | | 0.05 (min) | | 0.05 (min) | | 0.05 (min) |
| Eastbound | | 0.05 (min) | | 0.06 (min) | | 0.06 (min) |
| Northbound | | 0.05 (min) | | 0.05 (min) | | 0.06 (min) |
| Westbound | | 0.06 (min) | | 0.07 (min) | | 0.05 (min) |

LOS – level of service

Based on the above analysis, there will be no delay or queuing issues at the roundabouts. Should roundabouts be installed, there will be no operational concerns.

There is no roundabout warrant available to evaluate the need for a roundabout. Typically roundabouts are examined as an alternative when a need for improved traffic control is previously identified. The Four Corners intersection has been identified as requiring improved traffic control, and the roundabout would be a feasible alternative to traffic lights. The Hospital intersection did not meet the all-way stop warrant or the traffic light warrant. Though drivers experience some difficulty making northbound and southbound left turn manoeuvres during peak periods, the overall intersection operations are acceptable.

2.7 Pedestrian Features

Pedestrian walkways, crosswalks, and the associated road signs and pavement markings, are collectively referred to as pedestrian ‘facilities’ or ‘features’ for the purposes of this report. Within the study area, five crosswalks are signed. These crosswalks are located at the north and east approaches of the City Hall intersection, the college driveway, the emergency entrance to the hospital, and the west approach of the Hospital intersection. Of the two crosswalks located at the City Hall intersection, one is only signed in the westbound direction and one is located at a stop sign and only signed in the southbound direction. The signs at

many of the remaining crosswalks are not the same in both directions of travel. White rectangles, yellow diamonds, and fluorescent yellow-green diamonds were noted to indicate the crosswalk locations. It is important that a consistent and complete message be presented to drivers.

The signage used for crosswalks in the City is not consistent. Most of the signs are not compliant with the *Manual for Uniform Traffic Control Devices in Canada* (MUTCD) standards as updated by the Transportation Association of Canada in 2008. The MUTCD requires that the white rectangular crosswalk sign be located at the crossing location (Section A6). The sign should be located facing both directions on both sides of the road and accompanied by pavement markings. The signs are not required for signalized intersections or stop-controlled approaches at intersections. The yellow diamond should be used to indicate a crosswalk is ahead, particularly in areas of low visibility. The fluorescent yellow-green background should only be used for school crosswalk and school zone signs.

The *Transportation and Urban Design Study*, December 2005, recommends the use of fluorescent yellow-green sheeting for rectangular crosswalk signs. Though this combination does not conform to MUTCD standards, it would be more visible against snow, which is the predominant condition in Iqaluit. To mitigate liability concerns, any deviations from MUTCD standards should be acknowledged and detailed in legislation.

2.8 Snowmobile Features

Snowmobile ‘facilities’ or features consist of designated trails and road crossings for the purposes of this report. Snowmobile features were not clearly marked. One cautionary sign was present in the study area near the Justice Building. This sign indicates that snowmobiles may be crossing the roadway.

Snowmobiles tend to avoid operating on the roadway due to the sand placed for passenger vehicles. The result is operators take the most direct route between buildings and along pedestrian paths to their destinations.

Many recommendations have been made by previous studies with respect to segregating and regulating snowmobile traffic from pedestrian and vehicular traffic. In particular a Snowmobile Courtesy Policy and a Snowmobile Trail Network have been considered. Both ideas would increase pedestrian and traffic safety in the Core Area.

Since the study was undertaken during July, it was not possible to make winter observations specifically for this study. As a result, the previous solutions are recommended in principal based on the previous reports and conversations with City staff.

2.9 Collision Analysis

The RCMP provided collision data from January 1, 2006 to July 31, 2009 for the study area. The collision data was provided by adjacent address and type of occurrence.

The collision data included any reported collisions on the link, whether they occurred on the road right-of-way or on adjacent private property. The collision data also did not make it clear which collisions occurred within the intersection. As a result, it was not possible to determine a collision rate for each intersection.

In total, 27 collisions were reported for the entire study area for the 3.5-year period. Of these collisions, there were no fatalities, 2 injury collisions, 13 reportable property damage collisions, and 12 non-reportable property damage collisions.

3. DRAFT SOLUTIONS

3.1 Four Corners Intersection

There are two potential solutions to help improve traffic control at the Four Corners intersection, in addition to a “do-nothing” option:

- The installation of traffic lights with left hand turn lanes at every approach; and
- The construction of a roundabout.

3.1.1 Traffic Lights

Based on observed traffic volumes, traffic lights are warranted under existing conditions. Due to the volume of left turning vehicles, both existing and projected, left turn lanes should also be constructed in conjunction with the installation of traffic lights at this intersection.

It should be recognized that if traffic lights are installed at this intersection there will be maintenance issues that will need to be addressed. A proposed traffic light maintenance protocol is included in **Section 3.1.1.2** of this report.

As part of the installation of signals, a public education campaign should be undertaken to familiarize drivers with the new form of traffic control. As an example, the Ontario Driver’s Handbook has the following description of proper driver behaviour at traffic lights:

“At a controlled intersection where you face a green light, drive carefully through the intersection at a steady speed. If the light has been green for a while, be prepared to stop when it turns yellow. However, if you are already so close that you cannot stop safely, drive through the intersection with caution. Where you face a red light, come to a complete stop and wait until the light turns green.” (Controlled Intersections)

The public education campaign should include instructions for pedestrians, particularly to ensure pedestrians cross at the crosswalk locations and not diagonally across the intersection. As an example, the Ontario Driver’s Handbook has the following description of proper pedestrian behaviour at traffic lights:

“Pedestrian signals help pedestrians cross at intersections with traffic lights. The signal for pedestrians to walk is a white walking symbol. A flashing or steady orange hand symbol means pedestrians must not begin to cross.” (Pedestrian Signals)

3.1.1.1 Traffic Light Design

It is recommended that the traffic lights operate in a 2 phase, fixed time mode (i.e. the traffic lights will cycle continuously) with no special phases for left turns or other movements. In addition, it is recommended that the traffic lights not be put into a night time flash operation

as studies have shown that night flash operation has resulted in an increase in collisions. It is also recommended that no underground conduit be installed in conjunction with the traffic lights. Rather it is recommended that overhead wiring be installed.

As the City already maintains a stock of wooden hydro poles, it is recommended that wood poles be used in the installation. This will result in quicker pole replacement should a pole be struck by an errant vehicle.

In addition, due to the climatic conditions, it is recommended that incandescent traffic bulbs be installed as opposed to LED bulbs that are used in southern climates. The LED bulbs may not operate properly in temperatures lower than -40° C.

Appendix H is the recommended traffic light controller specifications that take into account the unique climatic conditions in Iqaluit.

It is recommended that the operation of the traffic lights, including peak hour turning movement counts, be reviewed after a period of 4 weeks in order that the traffic light timings may be adjusted as the flow of traffic through the intersection may have altered after the installation of the traffic lights.

Until such time as traffic lights are installed at the Hospital intersection, there is no need to install any interconnection between the Four Corners intersection and the Hospital intersection. If traffic lights are installed at the Hospital intersection, at some point in the future, interconnection can be provided via overhead cables on the existing service poles between the two intersections. It will also be necessary to purchase a “Master” controller for the Hospital intersection that will control the interconnection between the two traffic lights.

3.1.1.2 Traffic Light Maintenance

Due to the complex nature of the proposed traffic light controller and related equipment, a properly trained and certified technician or electrician will be required to maintain the traffic lights.

If the City approves the installation of traffic lights at this intersection, the City should consider tendering for a maintenance contract for the traffic lights. Such a tender should include a required minimum response time (suggest 24 hours from time of notification of maintenance work being required). This would allow interested firms from the Ottawa and Yellowknife areas to be in a position to respond to the maintenance request as there are daily flights into Iqaluit from those areas.

It is suggested that City staff be trained to put the traffic lights into a “Flashing” operation should a failure occur. The lights should be programmed to go into an All-Way Flashing Red operation which would reflect an All-Way Stop condition until such time as the traffic lights can be returned to normal operation. In the event of a power failure and no displays being present, the City should immediately install a temporary All-Way Stop by use of Stop signs

until the traffic lights are repaired. It will also be necessary to replace all traffic light lamps annually and to have the conflict monitor tested every six months.

To assist in the repair of the traffic signals, the City should maintain a minimum inventory of traffic light equipment to hasten the maintenance repair schedule. As a minimum, it is suggested that the City maintain the following equipment in inventory at a City facility:

- One traffic light signal head
- One pedestrian signal head
- Spare traffic light lamps to replace burnt out lamps.

The actual parts inventory, to be stored in the City, should be confirmed through discussions with whomever the City enters into a maintenance contract.

3.1.1.3 Pavement Markings

As part of the intersection design, pavement markings will be required to delineate the lanes and indicate crosswalks and stop bars. Though the pavement markings will be obscured during the months when snow cover is on the road, drivers will become accustomed to the locations during the summer months. It is recommended that durable pavement markings (methyl methacrylate) be installed to reduce maintenance requirements and the need to repaint the markings every year. Durable markings should last for a period of 5-years before reapplication will be required.

To remind drivers of proper lane designations, signage should be displayed on each approach. The appropriate signage consists of a white arrow on a black background. This sign may require a by-law to be enforceable.

The proposed revised intersection geometrics are illustrated in **Exhibit 6**.

3.1.1.4 Cost

3.1.1.4.1 Traffic Lights

The cost to install traffic lights at this intersection is estimated to be in the order of \$250,000. These costs include labour, equipment, shipping costs, expenses, training of staff, turn-on of traffic lights, etc.

3.1.1.4.2 Left Turn Lanes

The cost to construct left turn lanes at this intersection is estimated to be in the order of \$200,000, including labour, equipment, material, relocation of a steel access vault, etc. Actual costs will be subject to a detail design being undertaken.

3.1.1.4.3 Durable Pavement Markings

The cost to install methyl methacrylate pavement markings at the Four Corners intersection is estimated at \$15,000, including, labour, materials, expenses, shipping, etc. This cost includes the one-time mobilization costs. Cost estimates for the remaining intersections assume that this cost is previously covered and includes pavement markings in the construction costs for left turn lanes.

3.1.2 Roundabout

Based on the analysis, a roundabout would provide sufficient capacity to accommodate all traffic at the Four Corners intersection. A roundabout has a higher capital cost and lower maintenance cost than traffic lights. To fit a roundabout at the Four Corners intersection, some property would have to be acquired, as illustrated in **Exhibit 7**. A small single lane roundabout with a truck apron would be the preferred design.

Typically roundabouts are considered to be safer than other types of intersection controls. A roundabout must be negotiated at a lower speed, which reduces the severity of any collisions that occur. Also, due to the geometry of the approaches, collisions occur at lower angles, and therefore are less likely to cause injury. Operationally, a roundabout provides constant access to vehicles in all directions making all movements. This reduces emissions due to stopping, accelerating, and idling. Maintenance of a roundabout is equivalent to any other roadway. No special skills are required because there is no special equipment.

Due to the geometric nature of roundabouts, they can act as a gateway and urban design feature. A roundabout at this location could incorporate the mosaic paving recommended for the Four Corners intersection in the *Iqaluit Pedestrian Walkways Phase I – Core Area* report.

The cost to construct a single lane roundabout at this intersection would likely be in excess of \$1,000,000.

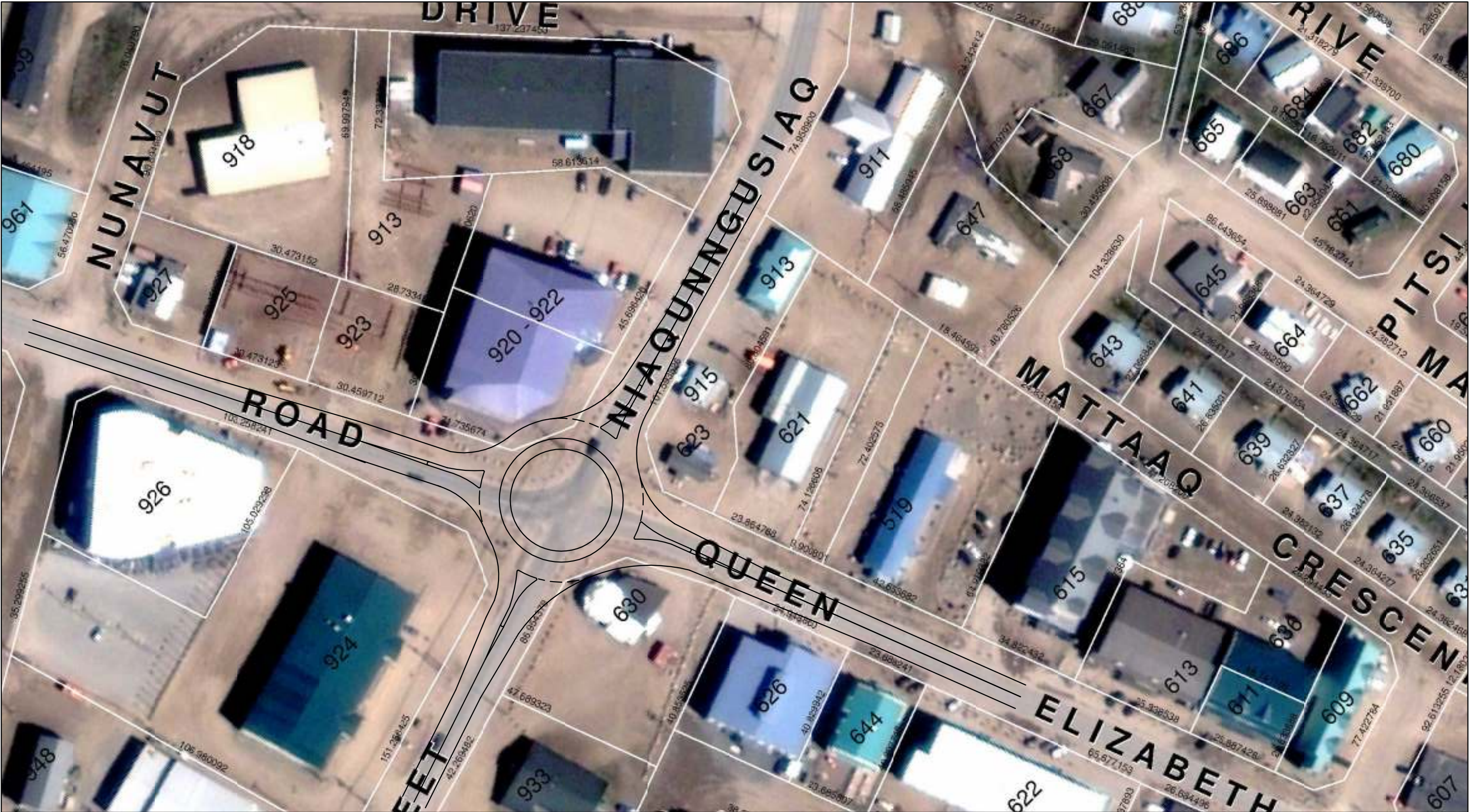


Exhibit 7
Four Corners Intersection Roundabout Alternative

Scale: 1:1000

August 2009

3.1.3 Do Nothing

The “Do Nothing” option would maintain the status quo indefinitely. This option has no direct cost associated with it; however it can exacerbate existing congestion. If no improvements are implemented within the 5 year horizon, the Four Corners intersection will experience increase delay and will approach capacity. By the 10 year horizon the intersection will be congested during the Mid-day and PM peak periods.

3.2 Hospital Intersection

3.2.1 Exclusive Turn Lanes

Left turn lane warrants were conducted for eastbound and westbound left turn lanes during each peak period. The warrants are based on the total traffic volume in each direction and the percentage of left turning vehicles. Eastbound and westbound left turn lanes were not warranted for any scenario and therefore are not recommended.

Northbound and southbound right turn lanes were examined as well. The purpose of right turn lanes on the side approaches would be to allow right turning vehicles to discharge separately while left turning and through vehicles wait for sufficient gaps in traffic to complete the manoeuvre. Northbound and southbound right turn lanes are recommended. The proposed left turn lanes are illustrated in **Exhibit 8**.



3.2.1.1 Cost

The cost to construct these left turn lanes is estimated to be in the order of \$80,000, including labour, equipment, materials, pavement markings, etc. Actual costs will be subject to a detail design being undertaken.

3.2.2 Left Turn Prohibition

A northbound left turn prohibition was examined. Should this left turn movement be prohibited at the Hospital intersection, traffic would likely re-route to the Four Corners intersection or infiltrate into the residential neighbourhood to the east of the intersection, both of which are undesirable scenarios. As a result, a left turn prohibition is not recommended.

3.2.3 All-way Stop

Recently the Hospital intersection was changed from an all-way stop to a two-way stop. An all-way stop warrant was undertaken for the Hospital intersection to determine if reverting to an all-way stop would operate better than the current two-way stop. In the absence of a national standard, the *Ontario Traffic Manual Book 5* method was used. The warrant considers four measures:

1. total intersection volume
2. minor street volume
3. average experienced delay
4. traffic split between the main street and minor street.

The Hospital intersection satisfies the first criteria only. As a result, an all-way stop is not recommended.

3.2.4 Traffic Lights

Based on the traffic light warrant, traffic lights are not required under existing conditions. For the 10-year horizon, assuming a continued growth rate of 2.5% per annum, the warrant is 75% satisfied. At a consistent growth rate, the traffic lights would be warranted within a 20 year horizon. Since the warrant is developed for the entire country, and Iqaluit has unique driving behaviour, it would be prudent to re-examine the Hospital intersection as the 10-year horizon approaches to determine if traffic lights would be desirable despite not meeting the warrant criteria. It is important to understand that the traffic light warrant is not a complete justification, but is a tool to aide in the decision making process.

3.2.5 Roundabout

As previously discussed, a roundabout is considered as an option when improved intersection control is examined. Since traffic lights, all-way stops, and left turn lanes are not warranted at the Hospital intersection, it is clear that improved traffic control is not necessary. The analysis shows that a roundabout would improve traffic operations, however the cost of installing the roundabout does not justify the level of improvement.

It is not possible to accommodate a roundabout on the existing available property. Due to property constraints, a roundabout is not feasible at this time.

3.2.6 Do Nothing

The “Do Nothing” option would maintain the status quo indefinitely. This option has no direct cost associated with it. If no improvements are implemented, the Hospital intersection will operate within acceptable parameters. The intersection will experience increased delay and will have lower reserve capacity.

3.3 City Hall Intersection

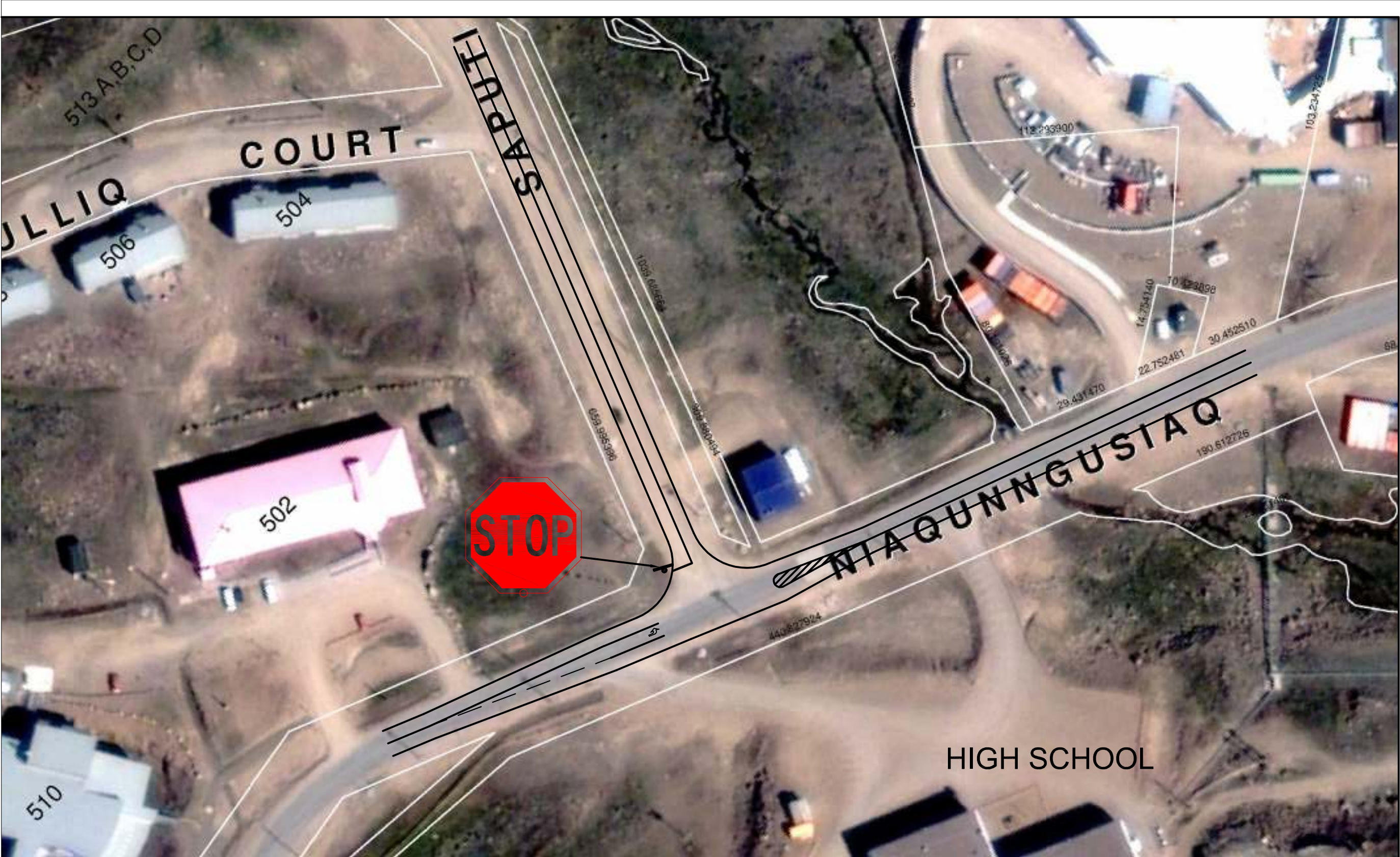
An eastbound left turn lane was analyzed for the City Hall intersection. The warrant is based on the total volume in the eastbound and westbound directions and the percentage of left turning vehicles. Based on the analysis, a left turn lane is not warranted for this intersection.

3.4 High School Intersection

An eastbound left turn lane was analyzed for the High School intersection. The warrant is based on the total volume in the eastbound and westbound directions and the percentage of left turning vehicle. Based on the analysis, a 15 metre eastbound left turn lane is warranted. The proposed left turn lane is illustrated in **Exhibit 9**.

3.4.1 Do Nothing

The “Do Nothing” option would maintain the status quo indefinitely. This option has no direct cost associated with it. If no improvements are implemented, the High School intersection will operate within acceptable parameters. The intersection will experience increased delay and will have lower reserve capacity.



3.4.2 Cost

The cost to construct this left turn lane is estimated to be in the order of \$50,000, including labour, equipment, materials, pavement markings, etc. Actual costs will be subject to a detail design being undertaken.

3.5 Mid-Block Locations

A standard crosswalk design should be established by the City based on MUTCD standards and local conditions. The standard should be applied to all existing crosswalk locations, and pedestrians should be encouraged to cross only at the marked crossing locations and at intersections through a public education campaign. Pedestrians and drivers should be educated to understand that a pedestrian has right-of-way in a crosswalk or at an intersection, however elsewhere a vehicle has right-of-way.

3.6 Other Recommendations

3.6.1 Signage

The City should develop signage guidelines to establish language priority on signs. It is important that signage be consistent to reduce the glance recognition time. The MUTCD states that “Uniformity and simplicity in design, position and application are of the greatest importance in aiding recognition.” Drivers’ eyes will quickly learn where to look on a sign for the information in their language of choice. If all signs are created independently, as is currently the case, drivers must first determine where the information they seek is, then process it. This increases the amount of time required to process the sign.

3.6.2 High School Entrances

For ease of circulation, it is recommended that the west driveway for the high school be designated as an exit only and the east driveway be designated as an entrance only. This would improve on-site circulation and prevent congestion at the proposed left turn lane on Niaqunngusiaq Road. This designation would be made through signage on site and at the driveways.

3.6.3 Illumination

The illumination at crosswalks should be reviewed. It is important that pedestrians have a safe and visible place to cross the street. As part of an overall review of crosswalk safety and standards, the overhead street lights at each crosswalk location should be evaluated and deficiencies identified.

4. PUBLIC CONSULTATION

As part of the planning process, public consultation was undertaken. The first phase of the consultation was to display the boards in the NorthMart from 3:30 to 6:30 PM on September 21, 2009. City and consultant team staff members were on hand to answer questions. The formal public consultation meeting took place from 7:00 to 9:00 PM on September 21, 2009, in the lobby of the Curling Rink. The meeting was organized in an open house format. Comments were collected from the public at both sites.

Notice of the public consultation was posted by the City in both English and Inuktitut. The display boards, handouts, and comment sheets were also provided in both languages.

The attendees at the public consultation voiced strong support for improvements at the Four Corners intersection. The majority of the support was for traffic lights, with some residents expressing a preference for a roundabout, several for environmental reasons. There were some residents that would prefer a traffic light at the Hospital intersection as well as at the Four Corners intersection. The remainder of the recommendations were supported by attendees at the public consultations.

On September 22, 2009, the findings of the report were presented to City Council. The information presented at the council presentation mirrored the public consultations. Input from members of the public was incorporated into the presentation.

5. RECOMMENDATIONS

The traffic operations and trends have been reviewed for the Four Corners, City Hall, High School, and Hospital intersections. Based on the analysis and assessment completed herein, the following road improvements are recommended:

- Traffic Lights at the Four Corners intersection
- Exclusive left turn lanes for all approaches at the Four Corners intersections
- A 15 metre eastbound exclusive left turn lane at the High School intersection
- Northbound and Southbound exclusive right turn lanes at the Hospital intersection

In addition, it is recommended that signage standards and crosswalk standards be developed and applied to create consistent and safe conditions throughout the City of Iqaluit. The west entrance to the High School should be designated as an exit only, and the east entrance should be designated as an entrance only. This will ease on-site operations and prevent left turn conflicts with the High School intersection. The illumination at crosswalks should be reviewed for pedestrian visibility.

Appendix A

Turning Movement Counts

File Name: Z:\Count Program\Count Data\5510 Iqaluit\Four Corners.ppd

Start Date: 29/07/2009

Start Time: 7:30:00 AM

Site Code: 00000001

Comment 1: Four Corners Intersection

Comment 2:

Comment 3:

Comment 4:

| | Southbound | | | | | Westbound | | | | | Northbound | | | | | Eastbound | | | | |
|------------|------------|------|------|------|--|-----------|------|------|------|--|------------|------|------|------|--|-----------|------|------|------|--|
| Start Time | Right | Thru | Left | Peds | | Right | Thru | Left | Peds | | Right | Thru | Left | Peds | | Right | Thru | Left | Peds | |
| 07:30 AM | 4 | 12 | 13 | 2 | | 15 | 12 | 2 | 4 | | 2 | 12 | 14 | 2 | | 14 | 11 | 2 | 2 | |
| 07:45 AM | 2 | 10 | 15 | 0 | | 34 | 23 | 5 | 2 | | 13 | 20 | 21 | 1 | | 10 | 16 | 2 | 0 | |
| 08:00 AM | 3 | 16 | 15 | 0 | | 34 | 27 | 6 | 0 | | 8 | 17 | 8 | 5 | | 10 | 20 | 3 | 3 | |
| 08:15 AM | 6 | 22 | 23 | 3 | | 40 | 34 | 13 | 6 | | 12 | 26 | 19 | 1 | | 6 | 21 | 6 | 15 | |
| 08:30 AM | 8 | 14 | 33 | 2 | | 32 | 48 | 7 | 5 | | 7 | 44 | 19 | 4 | | 20 | 32 | 6 | 8 | |
| 08:45 AM | 4 | 19 | 18 | 2 | | 28 | 30 | 16 | 8 | | 19 | 21 | 18 | 2 | | 19 | 21 | 5 | 5 | |
| 09:00 AM | 2 | 12 | 22 | 0 | | 28 | 19 | 12 | 2 | | 12 | 22 | 18 | 2 | | 20 | 21 | 6 | 2 | |
| 09:15 AM | 0 | 19 | 12 | 1 | | 16 | 16 | 11 | 1 | | 8 | 12 | 18 | 0 | | 17 | 12 | 4 | 4 | |
| 09:30 AM | | | | | | | | | | | | | | | | | | | | |
| Peak Hour | 20 | 67 | 96 | 7 | | 128 | 131 | 48 | 21 | | 50 | 113 | 74 | 9 | | 65 | 95 | 23 | 30 | |
| 11:30 AM | 3 | 18 | 15 | 6 | | 14 | 21 | 16 | 7 | | 13 | 18 | 18 | 0 | | 14 | 22 | 1 | 8 | |
| 11:45 AM | 1 | 25 | 53 | 7 | | 22 | 27 | 19 | 11 | | 9 | 24 | 23 | 1 | | 35 | 36 | 3 | 5 | |
| 12:00 PM | 2 | 24 | 44 | 11 | | 14 | 27 | 16 | 14 | | 16 | 9 | 19 | 1 | | 26 | 39 | 0 | 20 | |
| 12:15 PM | 1 | 17 | 10 | 2 | | 7 | 24 | 10 | 6 | | 19 | 9 | 12 | 2 | | 24 | 23 | 1 | 5 | |
| 12:30 PM | 1 | 10 | 14 | 6 | | 12 | 25 | 10 | 4 | | 4 | 15 | 27 | 1 | | 25 | 27 | 4 | 5 | |
| 12:45 PM | 3 | 14 | 24 | 2 | | 28 | 33 | 14 | 15 | | 13 | 37 | 24 | 2 | | 15 | 30 | 11 | 12 | |
| 01:00 PM | 3 | 25 | 30 | 6 | | 24 | 50 | 11 | 14 | | 14 | 42 | 23 | 1 | | 24 | 38 | 8 | 16 | |
| 01:15 PM | 5 | 21 | 28 | 7 | | 23 | 25 | 11 | 7 | | 16 | 21 | 30 | 3 | | 29 | 41 | 7 | 3 | |
| 01:30 PM | | | | | | | | | | | | | | | | | | | | |
| Peak Hour | 12 | 70 | 96 | 21 | | 87 | 133 | 46 | 40 | | 47 | 115 | 104 | 7 | | 93 | 136 | 30 | 36 | |
| 04:00 PM | 3 | 21 | 27 | 5 | | 14 | 18 | 15 | 5 | | 9 | 13 | 25 | 1 | | 25 | 30 | 3 | 4 | |
| 04:15 PM | 2 | 13 | 22 | 0 | | 29 | 20 | 10 | 1 | | 9 | 15 | 21 | 3 | | 35 | 24 | 2 | 11 | |
| 04:30 PM | 4 | 27 | 12 | 3 | | 16 | 27 | 7 | 10 | | 9 | 22 | 17 | 0 | | 26 | 25 | 5 | 6 | |
| 04:45 PM | 2 | 35 | 40 | 2 | | 31 | 22 | 14 | 13 | | 18 | 25 | 19 | 2 | | 18 | 36 | 6 | 5 | |
| 05:00 PM | 1 | 35 | 38 | 6 | | 16 | 35 | 24 | 8 | | 23 | 25 | 22 | 10 | | 19 | 48 | 4 | 20 | |
| 05:15 PM | 2 | 31 | 29 | 3 | | 22 | 36 | 13 | 7 | | 16 | 11 | 29 | 0 | | 25 | 49 | 2 | 10 | |
| 05:30 PM | 2 | 18 | 24 | 4 | | 19 | 32 | 16 | 16 | | 13 | 8 | 17 | 3 | | 32 | 24 | 3 | 7 | |
| 05:45 PM | 7 | 16 | 16 | 8 | | 28 | 32 | 16 | 4 | | 16 | 16 | 18 | 7 | | 28 | 35 | 5 | 10 | |
| 06:00 PM | | | | | | | | | | | | | | | | | | | | |
| Peak Hour | 7 | 119 | 131 | 15 | | 88 | 125 | 67 | 44 | | 70 | 69 | 87 | 15 | | 94 | 157 | 15 | 42 | |

File Name: Z:\Count Program\Count Data\5510 Iqaluit\City Hall.ppd

Start Date: 28/07/2009

Start Time: 4:00:00 PM

Site Code: 00000002

Comment 1: City Hall Intersection

Comment 2:

Comment 3:

Comment 4:

| | Southbound | | | | Westbound | | | | Northbound | | | | Eastbound | | | |
|------------|------------|------|------|------|-----------|------|------|------|------------|------|------|------|-----------|------|------|------|
| Start Time | Right | Thru | Left | Peds | Right | Thru | Left | Peds | Right | Thru | Left | Peds | Right | Thru | Left | Peds |
| 04:00 PM | 5 | 82 | 0 | 0 | 0 | 0 | 0 | 22 | 0 | 73 | 2 | 2 | 2 | 0 | 4 | 3 |
| 04:15 PM | 3 | 61 | 0 | 1 | 0 | 0 | 0 | 6 | 0 | 54 | 2 | 1 | 2 | 0 | 3 | 1 |
| 04:30 PM | 3 | 48 | 0 | 2 | 0 | 0 | 0 | 5 | 0 | 56 | 3 | 0 | 1 | 0 | 1 | 5 |
| 04:45 PM | 5 | 64 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 94 | 4 | 1 | 3 | 0 | 9 | 5 |
| 05:00 PM | 6 | 75 | 0 | 2 | 0 | 0 | 0 | 4 | 0 | 160 | 2 | 6 | 4 | 0 | 21 | 16 |
| 05:15 PM | 2 | 65 | 0 | 1 | 0 | 0 | 0 | 5 | 0 | 81 | 1 | 3 | 0 | 0 | 2 | 6 |
| 05:30 PM | 3 | 53 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 48 | 1 | 0 | 2 | 0 | 4 | 4 |
| 05:45 PM | 2 | 73 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 44 | 0 | 4 | 2 | 0 | 2 | 3 |
| 06:00 PM | | | | | | | | | | | | | | | | |
| Peak Hour | 16 | 252 | 0 | 5 | 0 | 0 | 0 | 15 | 0 | 391 | 10 | 10 | 8 | 0 | 33 | 32 |

Comment 4:

[illegible]

File Name: Z:\Count Program\Count Data\5510 Iqaluit\Hospital.ppd

Start Date: 30/07/2009

Start Time: 7:30:00 AM

Site Code: 00000004

Comment 1: Hospital Intersection

Comment 2:

Comment 3:

Comment 4:

| | Southbound | | | | Westbound | | | | Northbound | | | | Eastbound | | | |
|------------|------------|------|------|------|-----------|------|------|------|------------|------|------|------|-----------|------|------|------|
| Start Time | Right | Thru | Left | Peds | Right | Thru | Left | Peds | Right | Thru | Left | Peds | Right | Thru | Left | Peds |
| 07:30 AM | 0 | 2 | 0 | 0 | 1 | 26 | 6 | 0 | 6 | 1 | 7 | 1 | 3 | 16 | 1 | 3 |
| 07:45 AM | 1 | 0 | 0 | 6 | 2 | 54 | 2 | 2 | 7 | 1 | 8 | 6 | 10 | 19 | 2 | 2 |
| 08:00 AM | 1 | 1 | 0 | 1 | 1 | 59 | 14 | 2 | 6 | 1 | 10 | 4 | 14 | 24 | 2 | 5 |
| 08:15 AM | 6 | 2 | 1 | 3 | 11 | 85 | 14 | 0 | 5 | 0 | 17 | 7 | 19 | 28 | 2 | 5 |
| 08:30 AM | 2 | 0 | 1 | 0 | 4 | 101 | 18 | 3 | 3 | 2 | 12 | 3 | 23 | 27 | 4 | 5 |
| 08:45 AM | 1 | 1 | 0 | 4 | 2 | 65 | 7 | 0 | 5 | 2 | 10 | 5 | 15 | 40 | 1 | 3 |
| 09:00 AM | 0 | 3 | 1 | 1 | 1 | 35 | 4 | 0 | 5 | 3 | 9 | 1 | 14 | 23 | 2 | 2 |
| 09:15 AM | 1 | 3 | 0 | 0 | 1 | 25 | 11 | 2 | 2 | 2 | 12 | 4 | 11 | 22 | 2 | 1 |
| 09:30 AM | | | | | | | | | | | | | | | | |
| Peak Hour | 10 | 4 | 2 | 8 | 18 | 310 | 53 | 5 | 19 | 5 | 49 | 19 | 71 | 119 | 9 | 18 |
| | | | | | | | | | | | | | | | | |
| 11:30 AM | 5 | 3 | 2 | 3 | 1 | 26 | 5 | 1 | 8 | 0 | 17 | 5 | 11 | 34 | 3 | 5 |
| 11:45 AM | 7 | 6 | 1 | 0 | 2 | 42 | 7 | 1 | 16 | 3 | 14 | 2 | 28 | 81 | 0 | 6 |
| 12:00 PM | 7 | 2 | 1 | 2 | 4 | 26 | 8 | 1 | 19 | 0 | 9 | 3 | 23 | 151 | 5 | 3 |
| 12:15 PM | 3 | 0 | 1 | 0 | 1 | 21 | 8 | 1 | 11 | 0 | 6 | 0 | 11 | 29 | 3 | 0 |
| 12:30 PM | 2 | 0 | 2 | 3 | 1 | 40 | 5 | 0 | 12 | 1 | 7 | 4 | 11 | 25 | 0 | 1 |
| 12:45 PM | 5 | 2 | 0 | 4 | 9 | 115 | 16 | 3 | 7 | 4 | 16 | 3 | 26 | 47 | 1 | 3 |
| 01:00 PM | 1 | 1 | 2 | 3 | 4 | 119 | 16 | 3 | 6 | 4 | 18 | 4 | 22 | 43 | 5 | 6 |
| 01:15 PM | 0 | 2 | 1 | 0 | 0 | 46 | 12 | 4 | 4 | 0 | 12 | 1 | 17 | 36 | 3 | 1 |
| 01:30 PM | | | | | | | | | | | | | | | | |
| Peak Hour | 8 | 5 | 5 | 10 | 14 | 320 | 49 | 10 | 29 | 9 | 53 | 12 | 76 | 151 | 9 | 11 |
| | | | | | | | | | | | | | | | | |
| 04:00 PM | 3 | 3 | 3 | 2 | 1 | 16 | 6 | 0 | 16 | 6 | 18 | 2 | 8 | 27 | 4 | 1 |
| 04:15 PM | 4 | 3 | 1 | 2 | 1 | 38 | 6 | 0 | 10 | 1 | 9 | 4 | 11 | 35 | 1 | 5 |
| 04:30 PM | 3 | 2 | 0 | 0 | 1 | 39 | 12 | 0 | 13 | 0 | 13 | 0 | 17 | 46 | 4 | 7 |
| 04:45 PM | 3 | 6 | 3 | 0 | 0 | 35 | 8 | 2 | 13 | 2 | 10 | 0 | 19 | 61 | 6 | 1 |
| 05:00 PM | 4 | 2 | 3 | 1 | 2 | 43 | 8 | 2 | 27 | 0 | 14 | 5 | 29 | 138 | 1 | 2 |
| 05:15 PM | 0 | 0 | 0 | 1 | 0 | 47 | 11 | 4 | 30 | 0 | 14 | 8 | 10 | 60 | 1 | 9 |
| 05:30 PM | 1 | 1 | 1 | 0 | 1 | 47 | 8 | 0 | 14 | 1 | 13 | 3 | 17 | 49 | 0 | 6 |
| 05:45 PM | 0 | 0 | 1 | 5 | 0 | 45 | 7 | 5 | 6 | 1 | 20 | 3 | 6 | 42 | 0 | 1 |
| 06:00 PM | | | | | | | | | | | | | | | | |
| Peak Hour | 8 | 9 | 7 | 2 | 3 | 172 | 35 | 8 | 84 | 3 | 51 | 16 | 75 | 308 | 8 | 18 |

Appendix B

Traffic Signal Warrants



City of Iqaluit - Traffic Signal Warrant Analysis

Main Street (name) **unngusaiq Road / Mivvik St**

Side Street (name) **al Road / Queen Elizabeth II**

Quadrant / Int # **Four Corners**

for Warrant Calculation
Results, please hit 'Page
Down'

CHECK SHEET

Comments

Direction (EW or NS) **EW**

Direction (EW or NS) **NS**

Enter Comments about the
analysis here.

Road Authority:

City of Iqaluit

City:

City of Iqaluit

Analysis Date:

2009 Aug 04, Tue

Count Date:

2009 Jul 29, Wed

Date Entry Format:

(yyyy-mm-dd)

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|---|----|---------|---------|---------|----------|---------|---------|------------------------|--------------------|
| unngusaiq Road / Mivvik St | WB | | | | 1 | | | 1,000 | 1 |
| unngusaiq Road / Mivvik St | EB | | | | 1 | | | 1,000 | 1 |
| al Road / Queen Elizabeth II | NB | | | | 1 | | | | |
| al Road / Queen Elizabeth II | SB | | | | 1 | | | | |
| al Road / Queen Elizabeth II Way NB right turns significantly impeded by through movements? (y/n) | | | | | | y | | | |
| al Road / Queen Elizabeth II Way SB right turns significantly impeded by through movements? (y/n) | | | | | | y | | | |

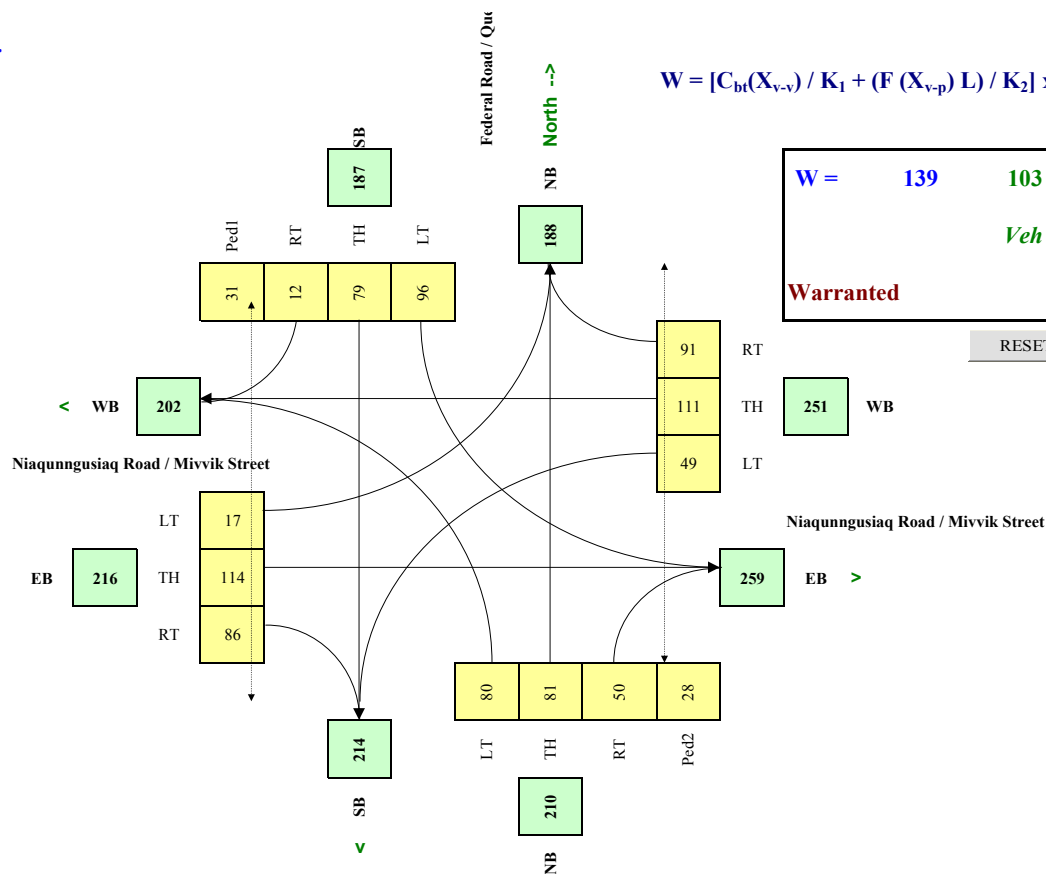
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|------------------------------|----|-----------------|------------|-----------------|---------------|
| unngusaiq Road / Mivvik St | EW | 40 | 2.8% | n | 0.0 |
| al Road / Queen Elizabeth II | NS | | 5.1% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 7,000 |
| Central Business District | (y/n) | y |

| Set Peak Hours | | | | | | | | | | | | | Ped1 NS | Ped2 NS | Ped3 EW | Ped4 EW |
|-----------------------|-----|-----|-----|-----|-----|----|-----|-----|-----|----|-----|-----|------------|------------|------------|------------|
| Traffic Input | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| 7:30 - 8:30 | 62 | 75 | 35 | 66 | 60 | 15 | 26 | 96 | 123 | 13 | 68 | 40 | 20 | 12 | 5 | 9 |
| 8:30 - 9:30 | 73 | 99 | 46 | 85 | 64 | 14 | 46 | 113 | 104 | 21 | 86 | 76 | 19 | 16 | 5 | 8 |
| 11:30 - 12:30 | 72 | 60 | 57 | 122 | 84 | 7 | 61 | 99 | 57 | 5 | 120 | 99 | 38 | 38 | 26 | 4 |
| 12:30 - 13:30 | 104 | 115 | 47 | 96 | 70 | 12 | 46 | 133 | 87 | 30 | 136 | 93 | 36 | 40 | 21 | 7 |
| 16:00 - 17:00 | 82 | 75 | 45 | 101 | 96 | 11 | 46 | 87 | 90 | 16 | 115 | 104 | 26 | 29 | 10 | 6 |
| 17:00 - 18:00 | 86 | 60 | 68 | 107 | 100 | 12 | 69 | 135 | 85 | 14 | 156 | 104 | 47 | 35 | 21 | 20 |
| Total (6-hour peak) | 479 | 484 | 298 | 577 | 474 | 71 | 294 | 663 | 546 | 99 | 681 | 516 | 186 | 170 | 88 | 54 |
| Average (6-hour peak) | 80 | 81 | 50 | 96 | 79 | 12 | 49 | 111 | 91 | 17 | 114 | 86 | 31 | 28 | 15 | 9 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$



| | | | |
|-----------|-----|-----|-----|
| W = | 139 | 103 | 36 |
| | | Veh | Ped |
| Warranted | | | |

RESET SHEET



City of Iqaluit - Traffic Signal Warrant Analysis

Main Street (name) **Niaqunngusiaq Road**
Side Street (name) **Queen Elizabeth II Way / Hospital**
Quadrant / Int # **Hospital**
CHECK SHEET

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Speed changes to the east of the intersection**

Road Authority: **City of Iqaluit**
City: **City of Iqaluit**
Analysis Date: **2009 Aug 04, Tue**
Count Date: **2009 Jul 30, Thu**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|-----------------------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqunngusiaq Road | WB | | | | 1 | | | 1,000 | 1 |
| Niaqunngusiaq Road | EB | | | | 1 | | | 1,000 | 1 |
| Queen Elizabeth II Way / Hospital | NB | | | | 1 | | | | |
| Queen Elizabeth II Way / Hospital | SB | | | | 1 | | | | |

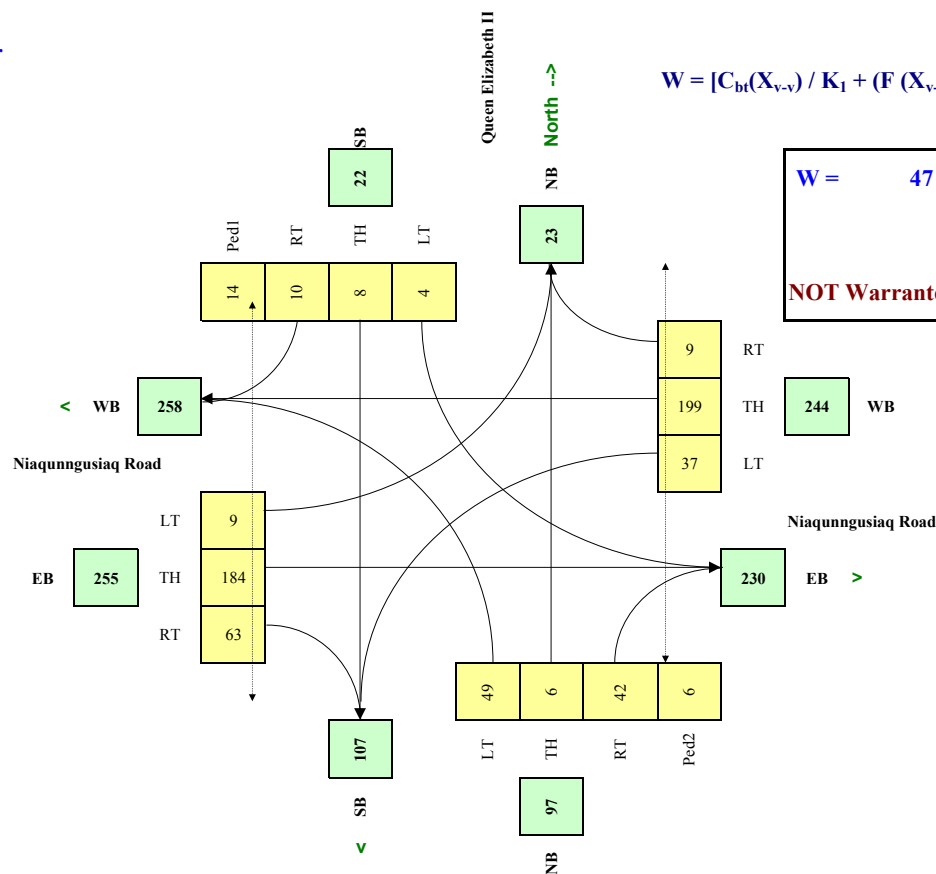
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|-----------------------------------|----|--------------|---------|--------------|------------|
| Niaqunngusiaq Road | EW | 30 | 1.8% | n | 0.0 |
| Queen Elizabeth II Way / Hospital | NS | | 0.8% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 7,000 |
| Central Business District | (y/n) | y |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|-----------------------|-----|----|-----|----|----|----|-----|-------|----|----|-------|-----|--------|--------|--------|--------|
| Traffic Input | NB | | | SB | | | WB | | | EB | | | NS | NS | EW | EW |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| 7:30 - 8:30 | 42 | 3 | 24 | 1 | 5 | 8 | 36 | 224 | 15 | 7 | 87 | 46 | 15 | 4 | 10 | 18 |
| 8:30 - 9:30 | 43 | 9 | 15 | 2 | 7 | 4 | 40 | 226 | 8 | 9 | 112 | 63 | 11 | 5 | 5 | 13 |
| 11:30 - 12:30 | 46 | 3 | 54 | 5 | 11 | 22 | 28 | 115 | 8 | 11 | 295 | 73 | 14 | 4 | 5 | 10 |
| 12:30 - 13:30 | 53 | 9 | 29 | 5 | 5 | 8 | 49 | 320 | 14 | 9 | 151 | 76 | 11 | 10 | 10 | 12 |
| 16:00 - 17:00 | 50 | 9 | 52 | 7 | 14 | 13 | 32 | 128 | 3 | 15 | 169 | 55 | 14 | 2 | 4 | 6 |
| 17:00 - 18:00 | 61 | 2 | 77 | 5 | 3 | 5 | 34 | 182 | 3 | 2 | 289 | 62 | 18 | 11 | 7 | 19 |
| Total (6-hour peak) | 295 | 35 | 251 | 25 | 45 | 60 | 219 | 1,195 | 51 | 53 | 1,103 | 375 | 83 | 36 | 41 | 78 |
| Average (6-hour peak) | 49 | 6 | 42 | 4 | 8 | 10 | 37 | 199 | 9 | 9 | 184 | 63 | 14 | 6 | 7 | 13 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$



W = 47 35 12
Veh Ped
NOT Warranted

RESET SHEET



City of Iqaluit - Traffic Signal Warrant Analysis

Main Street (name) **Niaqunngusiaq Road**
Side Street (name) **Queen Elizabeth II Way / Hospital**
Quadrant / Int # **Hospital 5 Year Horizon**
CHECK SHEET

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Speed changes to the east of the intersection**

Road Authority: **City of Iqaluit**
City: **City of Iqaluit**
Analysis Date: **2009 Aug 12, Wed**
Count Date: **2009 Jul 30, Thu**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|--|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqunngusiaq Road | WB | | | | 1 | | | 1,000 | 1 |
| Niaqunngusiaq Road | EB | | | | 1 | | | 1,000 | 1 |
| Queen Elizabeth II Way / Hospital | NB | | | | 1 | | | | |
| Queen Elizabeth II Way / Hospital | SB | | | | 1 | | | | |
| Queen Elizabeth II Way / Hospital NB right turns significantly impeded by through movements? (y/n) | | | | | | y | | | |
| Queen Elizabeth II Way / Hospital SB right turns significantly impeded by through movements? (y/n) | | | | | | y | | | |

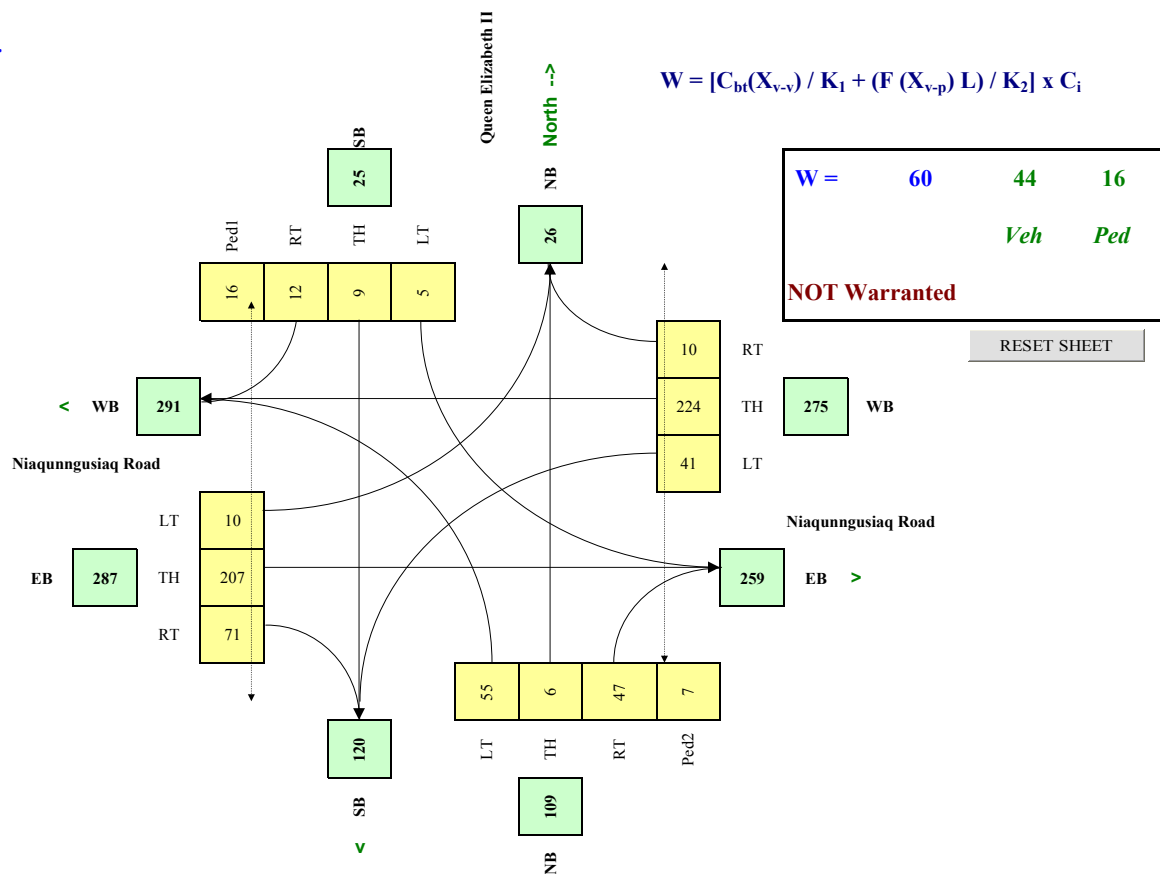
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|-----------------------------------|----|--------------|---------|--------------|------------|
| Niaqunngusiaq Road | EW | 30 | 1.8% | n | 0.0 |
| Queen Elizabeth II Way / Hospital | NS | | 0.8% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 7,000 |
| Central Business District | (y/n) | y |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|-----------------------|-----|----|-----|----|----|----|-----|-------|----|----|-------|-----|--------|--------|--------|--------|
| Traffic Input | NB | | | SB | | | WB | | | EB | | | NS | NS | EW | EW |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| 7:30 - 8:30 | 47 | 3 | 27 | 1 | 6 | 9 | 41 | 252 | 17 | 8 | 98 | 52 | 17 | 5 | 11 | 20 |
| 8:30 - 9:30 | 48 | 10 | 17 | 2 | 8 | 5 | 45 | 254 | 9 | 10 | 126 | 71 | 12 | 6 | 6 | 15 |
| 11:30 - 12:30 | 52 | 3 | 61 | 6 | 12 | 25 | 32 | 129 | 9 | 12 | 332 | 82 | 16 | 5 | 6 | 11 |
| 12:30 - 13:30 | 60 | 10 | 33 | 6 | 6 | 9 | 55 | 360 | 16 | 10 | 170 | 86 | 12 | 11 | 11 | 14 |
| 16:00 - 17:00 | 56 | 10 | 59 | 8 | 16 | 15 | 36 | 144 | 3 | 17 | 190 | 62 | 16 | 2 | 5 | 7 |
| 17:00 - 18:00 | 69 | 2 | 87 | 6 | 3 | 6 | 38 | 205 | 3 | 2 | 325 | 70 | 20 | 12 | 8 | 21 |
| Total (6-hour peak) | 332 | 38 | 284 | 29 | 51 | 69 | 247 | 1,344 | 57 | 59 | 1,241 | 423 | 93 | 41 | 47 | 88 |
| Average (6-hour peak) | 55 | 6 | 47 | 5 | 9 | 12 | 41 | 224 | 10 | 10 | 207 | 71 | 16 | 7 | 8 | 15 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





City of Iqaluit - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiaq Road**
Side Street (name) **Queen Elizabeth II Way / Hospital**
Quadrant / Int # **Hospital 10 Year Hoizon**
for Warrant Calculation
Results, please hit 'Page
Down'

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Speed changes to the east of the intersection**

Road Authority: **City of Iqaluit**
City: **City of Iqaluit**
Analysis Date: **2009 Aug 12, Wed**
Count Date: **2009 Jul 30, Thu**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|--|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiaq Road | WB | | | | 1 | | | 1,000 | 1 |
| Niaqungusiaq Road | EB | | | | 1 | | | 1,000 | 1 |
| Queen Elizabeth II Way / Hospital | NB | | | | 1 | | | | |
| Queen Elizabeth II Way / Hospital | SB | | | | 1 | | | | |
| Queen Elizabeth II Way / Hospital NB right turns significantly impeded by through movements? (y/n) | | | | | | y | | | |
| Queen Elizabeth II Way / Hospital SB right turns significantly impeded by through movements? (y/n) | | | | | | y | | | |

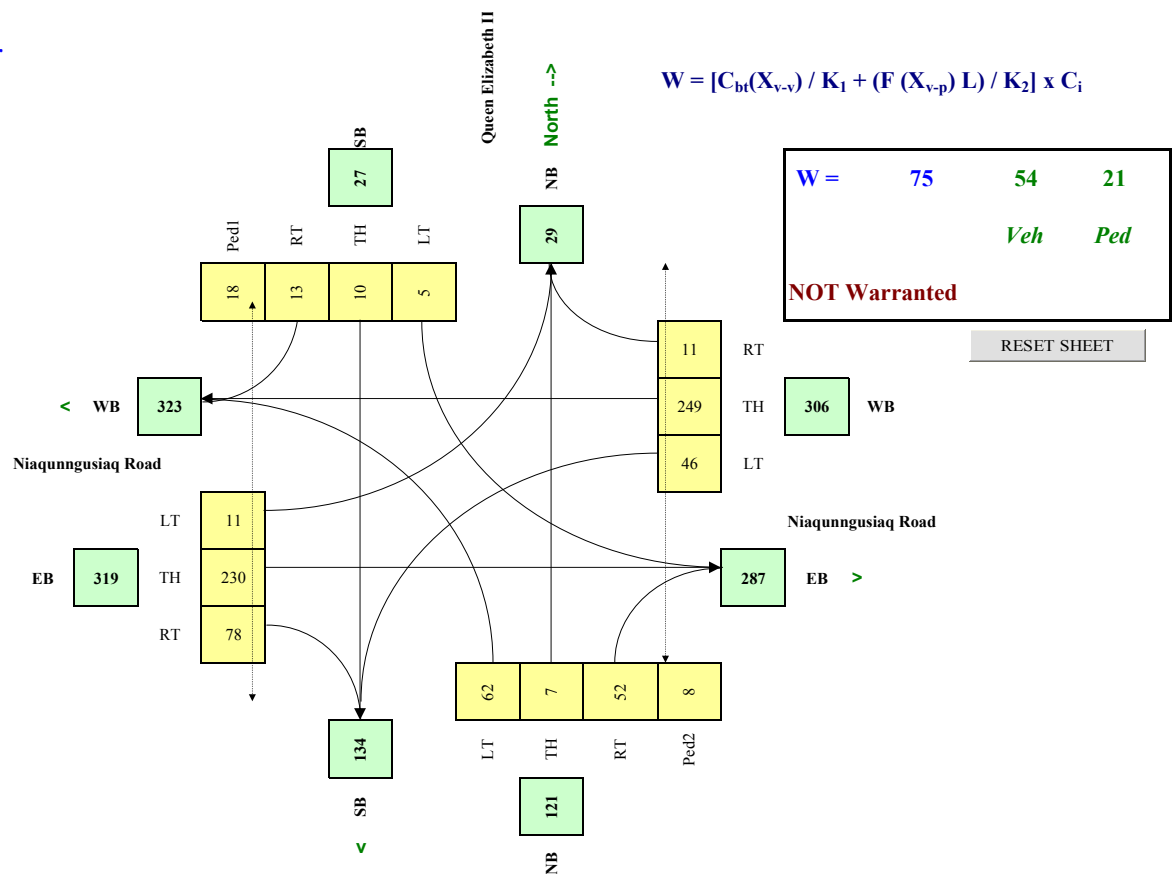
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|-----------------------------------|----|--------------|---------|--------------|------------|
| Niaqungusiaq Road | EW | 30 | 1.8% | n | 0.0 |
| Queen Elizabeth II Way / Hospital | NS | | 0.8% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 7,000 |
| Central Business District | (y/n) | y |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|-----------------------|-----|----|-----|----|----|----|-----|-------|----|----|-------|-----|--------|--------|--------|--------|
| | NB | | | SB | | | WB | | | EB | | | NS | NS | EW | EW |
| Traffic Input | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| 7:30 - 8:30 | 53 | 4 | 30 | 1 | 6 | 10 | 45 | 280 | 19 | 9 | 109 | 58 | 19 | 5 | 13 | 23 |
| 8:30 - 9:30 | 54 | 11 | 19 | 3 | 9 | 5 | 50 | 283 | 10 | 11 | 140 | 79 | 14 | 6 | 6 | 16 |
| 11:30 - 12:30 | 58 | 4 | 68 | 6 | 14 | 28 | 35 | 144 | 10 | 14 | 369 | 91 | 18 | 5 | 6 | 13 |
| 12:30 - 13:30 | 66 | 11 | 36 | 6 | 6 | 10 | 61 | 400 | 18 | 11 | 189 | 95 | 14 | 13 | 13 | 15 |
| 16:00 - 17:00 | 63 | 11 | 65 | 9 | 18 | 16 | 40 | 160 | 4 | 19 | 211 | 69 | 18 | 3 | 5 | 8 |
| 17:00 - 18:00 | 76 | 3 | 96 | 6 | 4 | 6 | 43 | 228 | 4 | 3 | 361 | 78 | 23 | 14 | 9 | 24 |
| Total (6-hour peak) | 370 | 44 | 314 | 31 | 57 | 75 | 274 | 1,495 | 65 | 67 | 1,379 | 470 | 106 | 46 | 52 | 99 |
| Average (6-hour peak) | 62 | 7 | 52 | 5 | 10 | 13 | 46 | 249 | 11 | 11 | 230 | 78 | 18 | 8 | 9 | 17 |

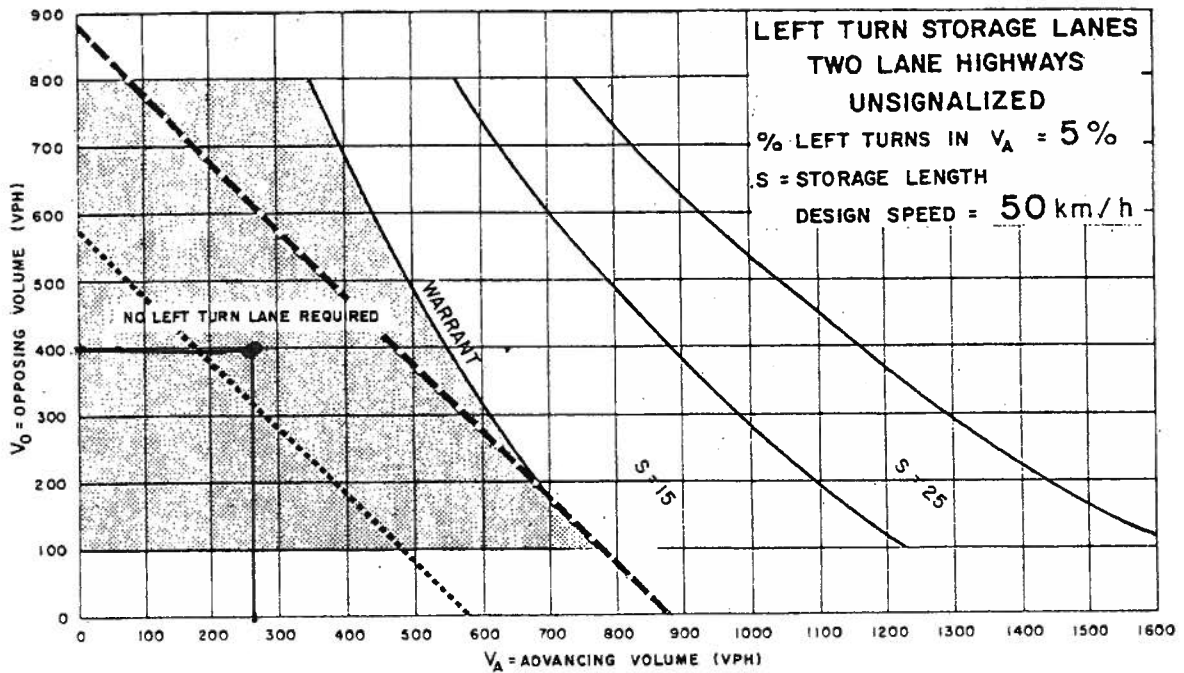
Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$



Appendix C

Left Turn Lane Warrants



--- TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL
AREAS OR URBAN AREAS WITH RESTRICTED FLOW

..... TRAFFIC SIGNALS MAY BE WARRANTED IN
"FREE FLOW" URBAN AREAS

$$V_A = 268$$

$$V_O = 401$$

$$LT \% = 2\%$$

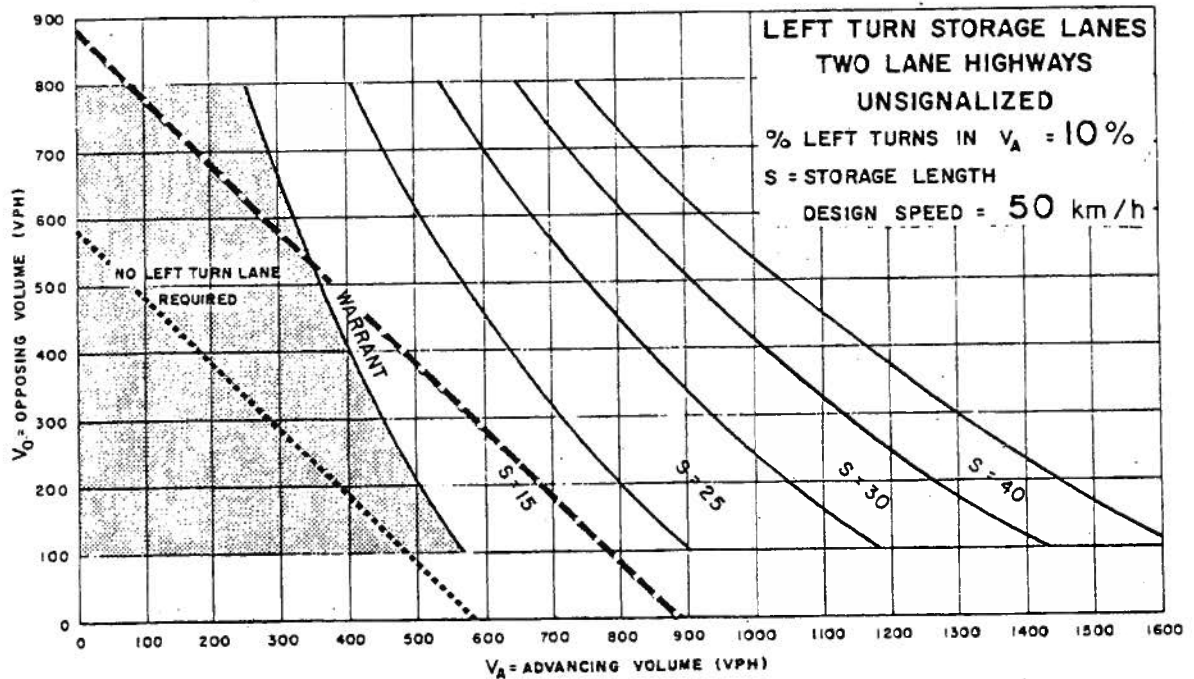
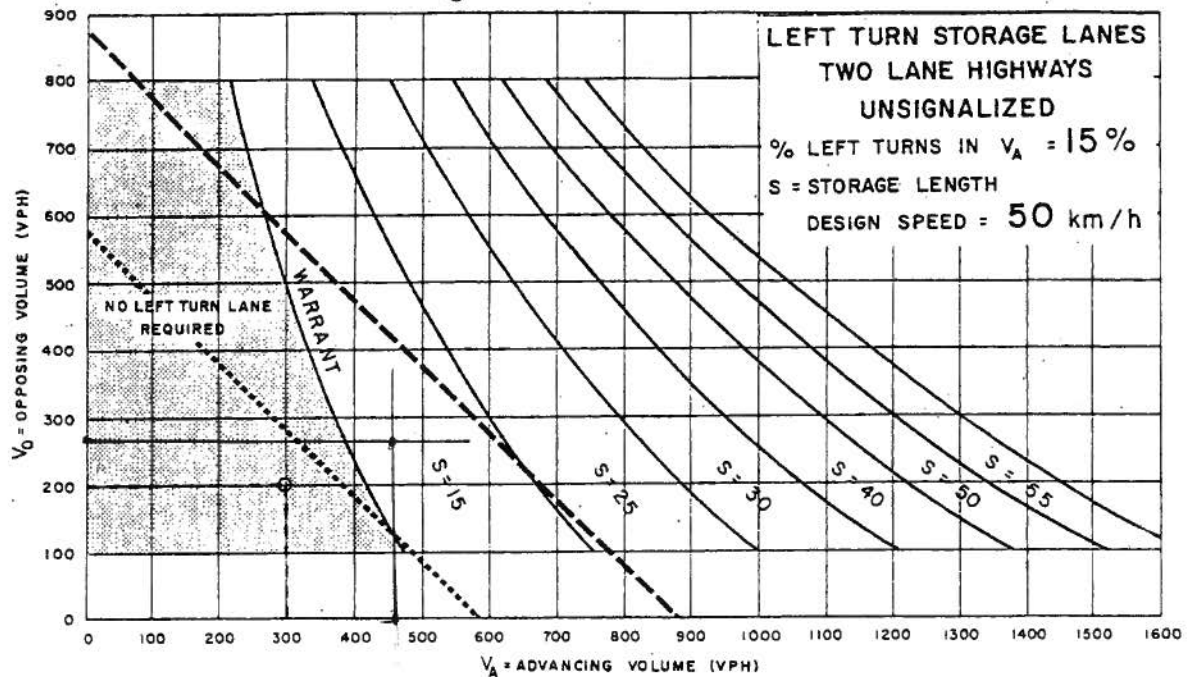


Figure EA-2



----- TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

..... TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

$$V_A = 459$$

$$V_0 = 275$$

$$LT\% = 15\%$$

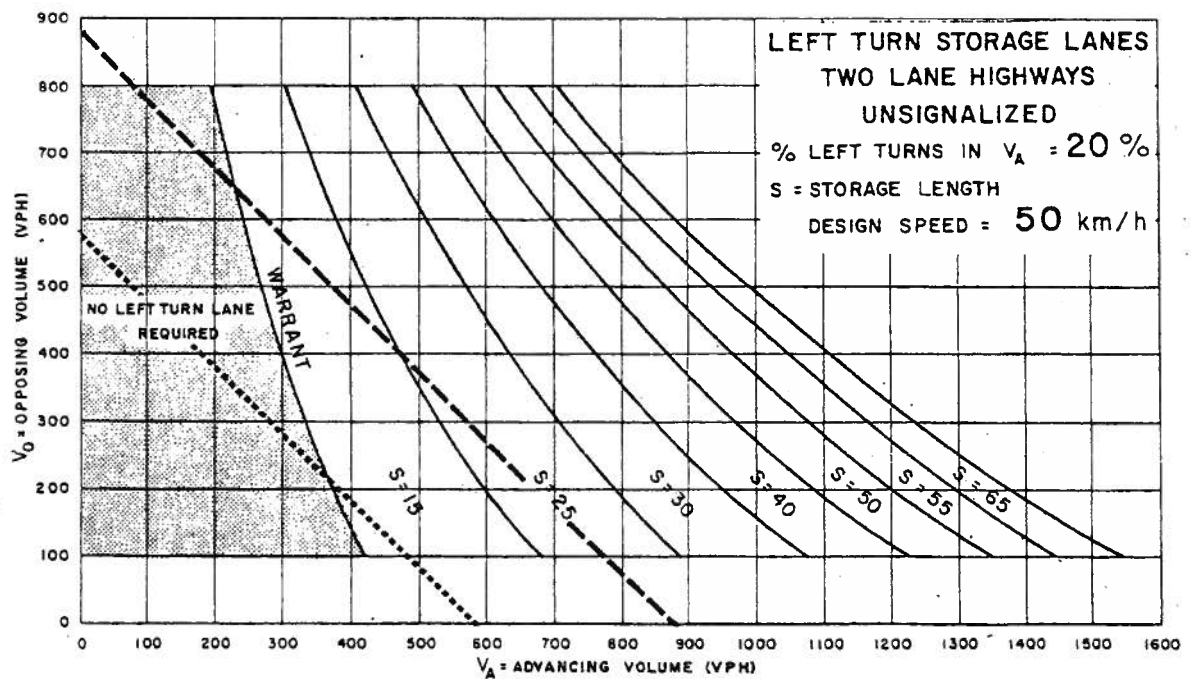
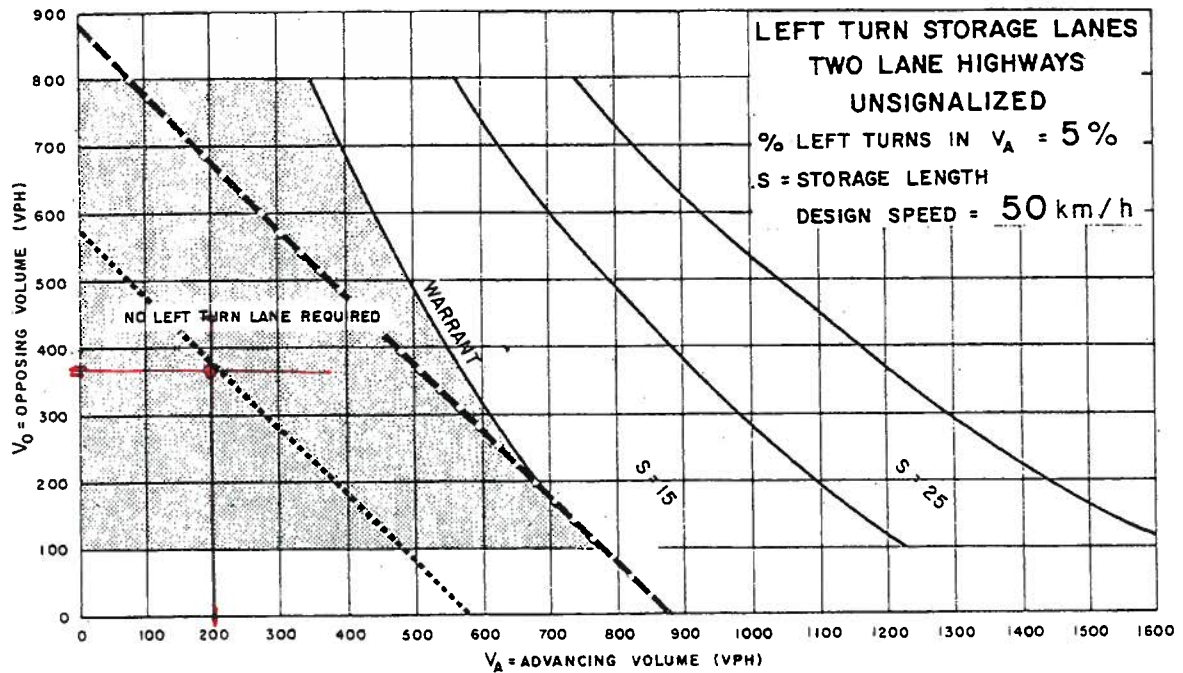


Figure EA-3



--- TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL
AREAS OR URBAN AREAS WITH RESTRICTED FLOW

..... TRAFFIC SIGNALS MAY BE WARRANTED IN
"FREE FLOW" URBAN AREAS

$$V_A = 199$$

$$V_0 = 381$$

$$LT\% = 4.5\%$$

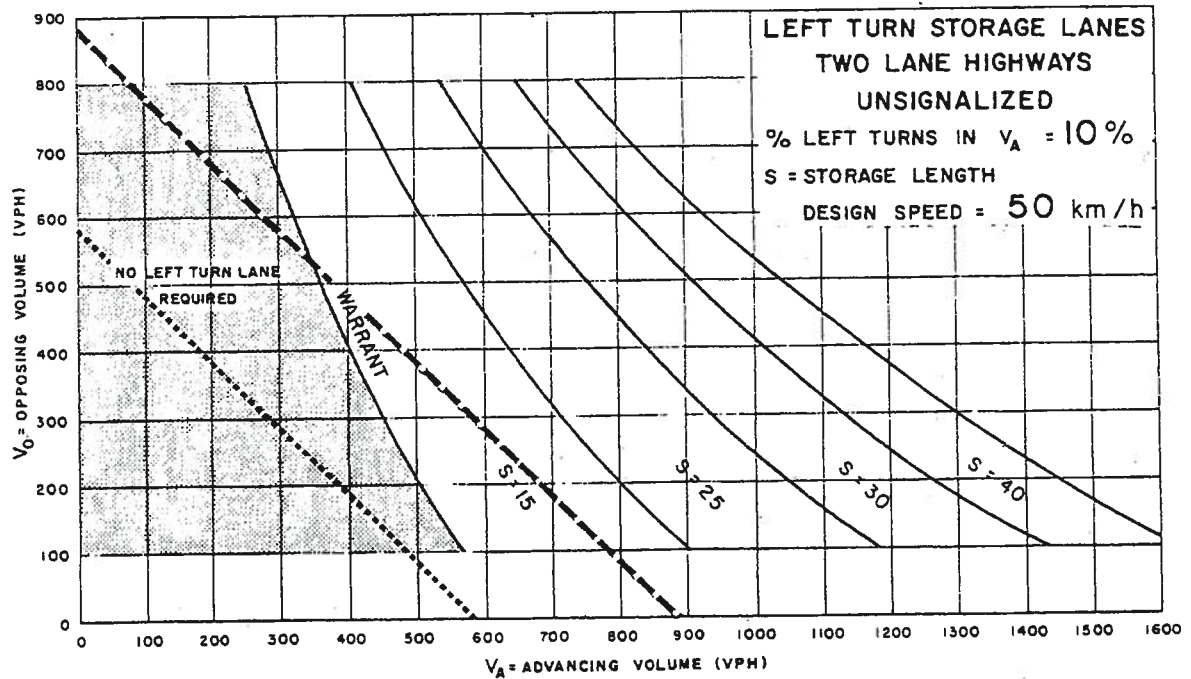
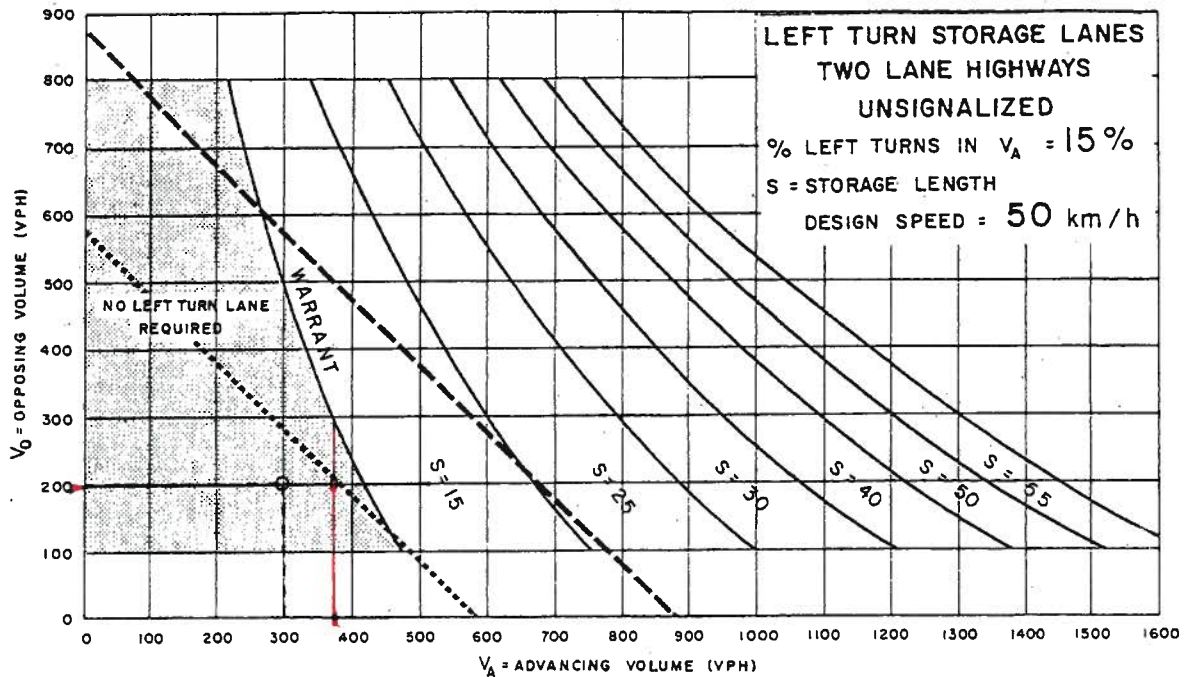


Figure EA-2



$V_A = 381$
 $V_0 = 199$
LT% = 14%

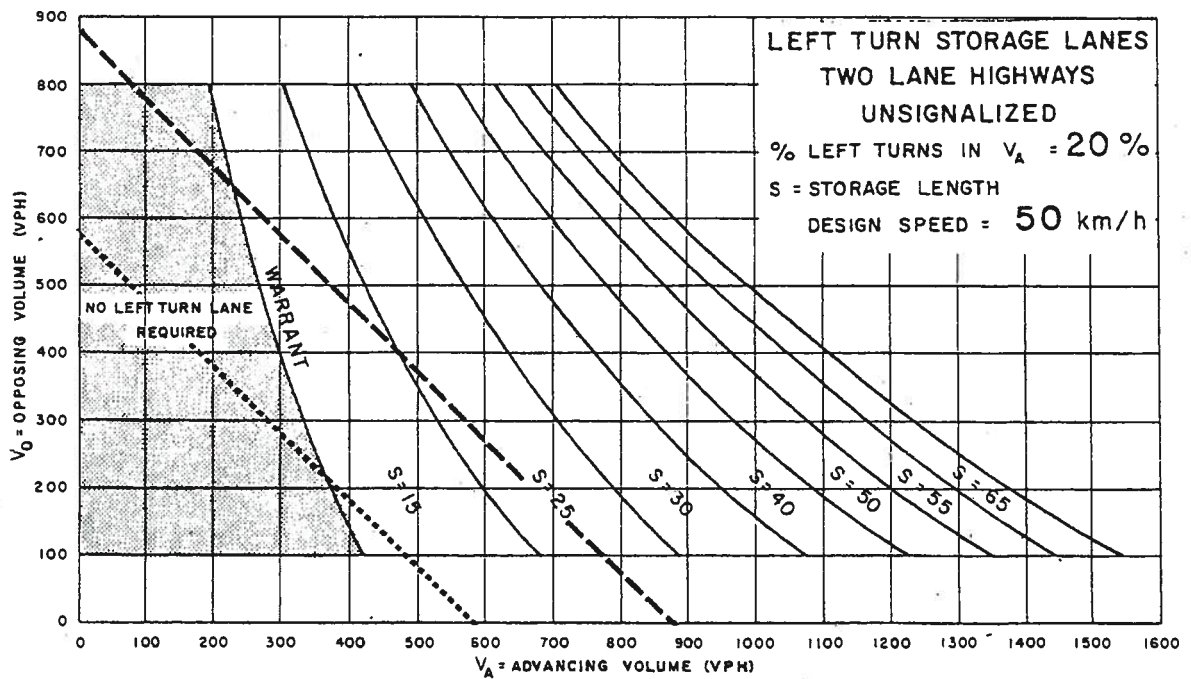
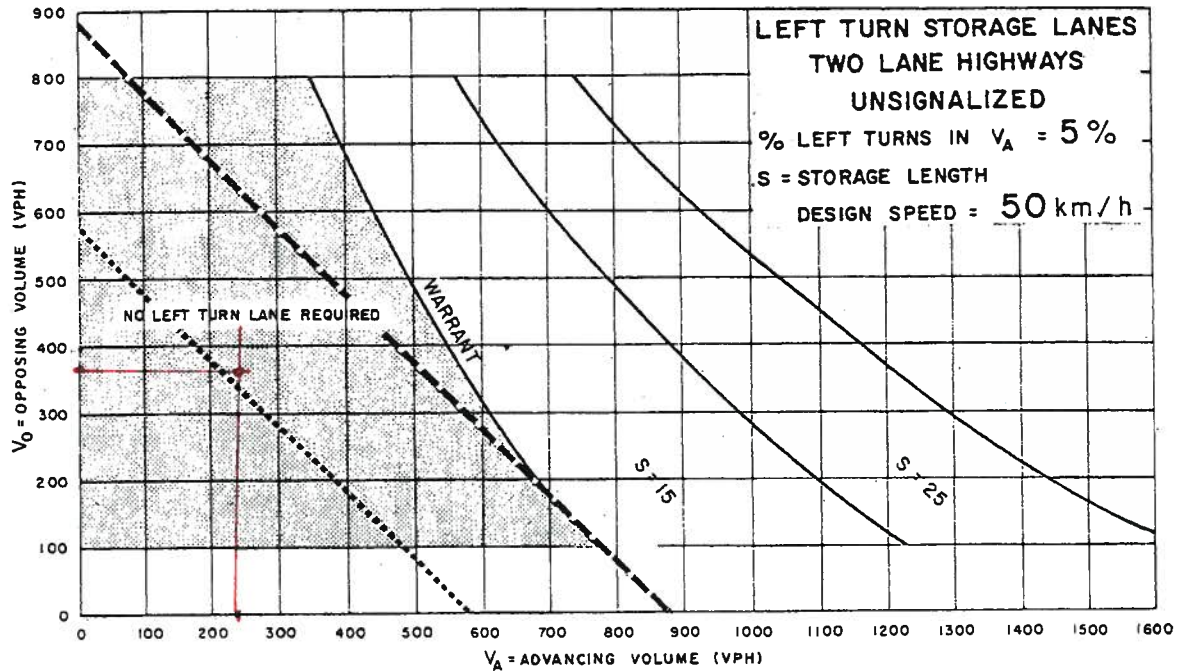


Figure EA-3



--- TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL
AREAS OR URBAN AREAS WITH RESTRICTED FLOW

..... TRAFFIC SIGNALS MAY BE WARRANTED IN
"FREE FLOW" URBAN AREAS

$V_A = 236$
 $V_0 = 383$
LT% = 4%

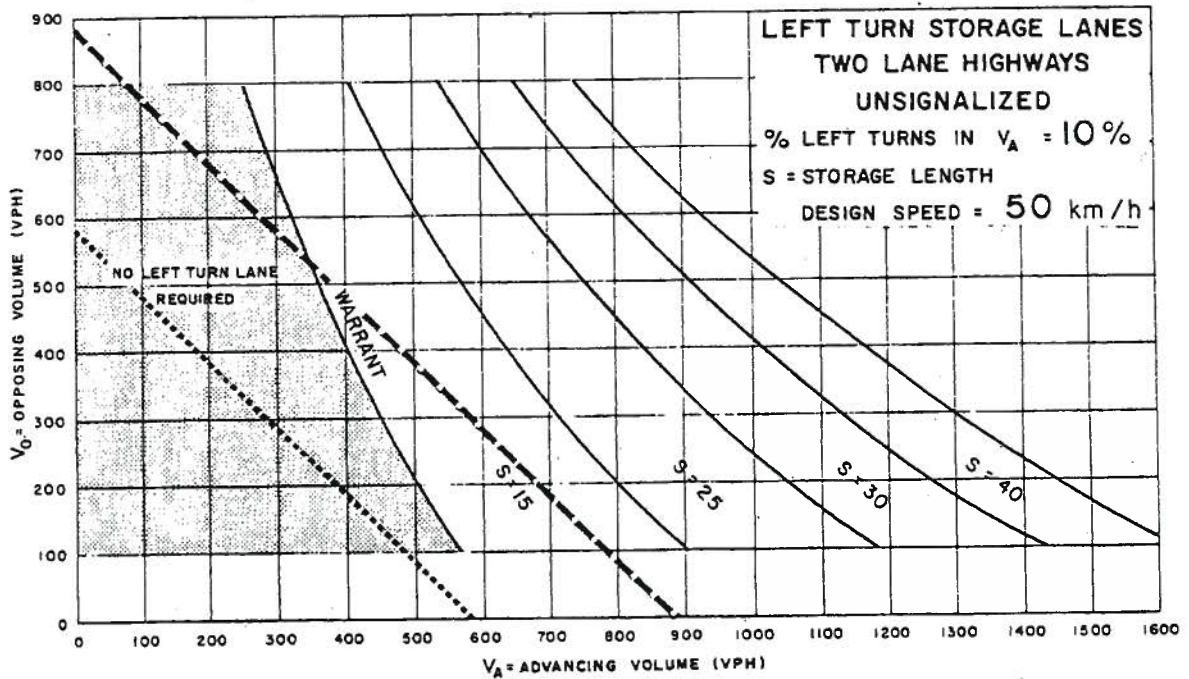


Figure EA-2

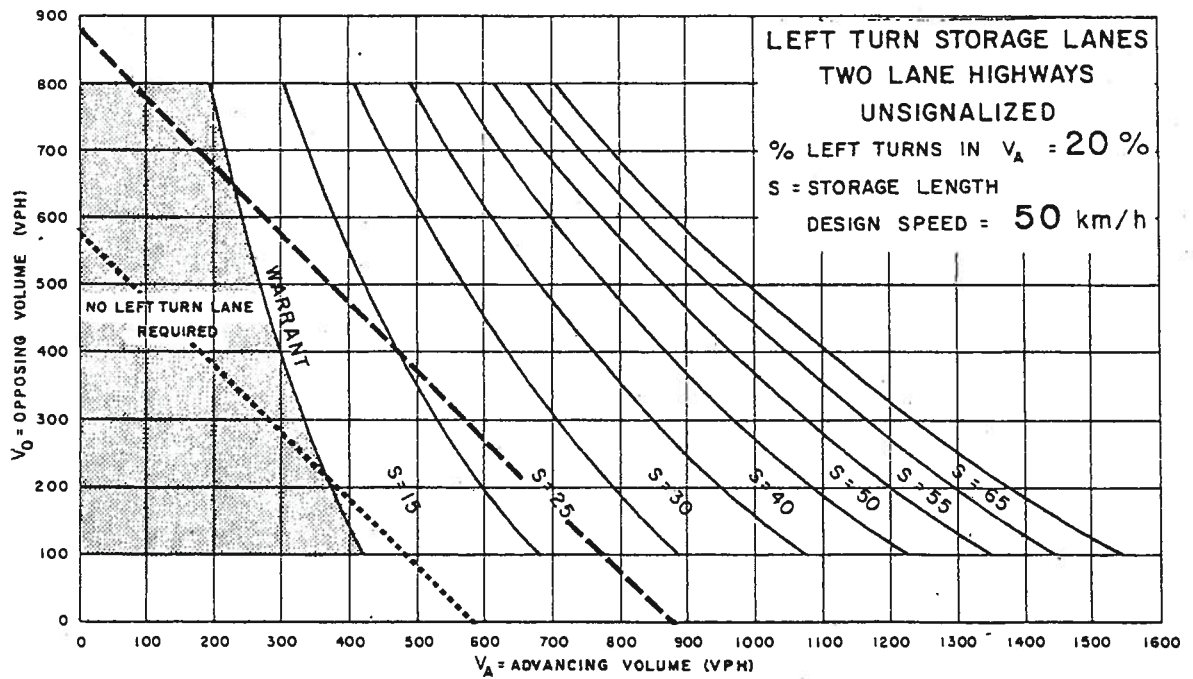
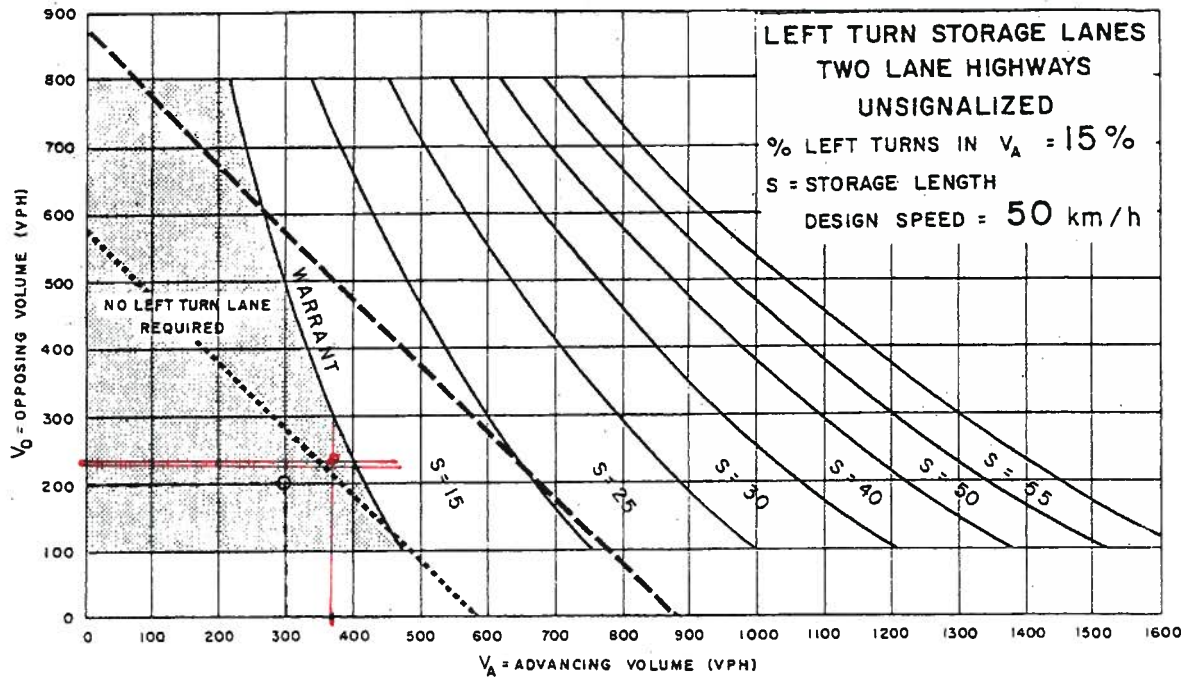
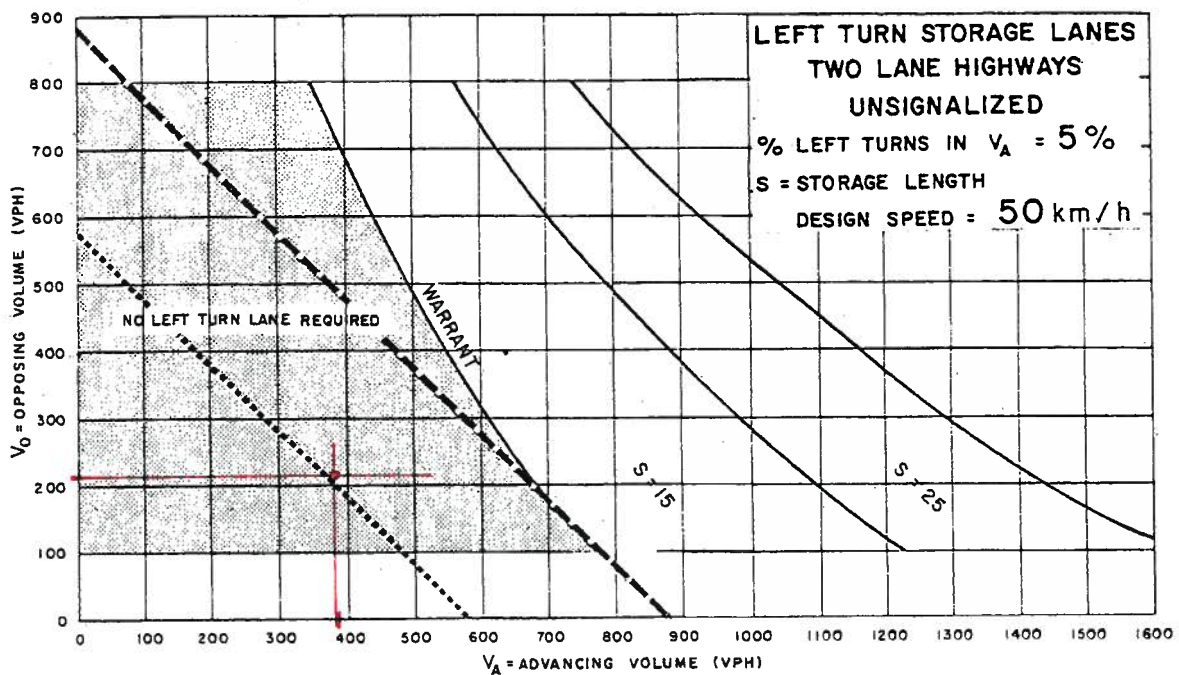


Figure EA-3

PM EB Hospital Intersection

AT-GRADE INTERSECTIONS

APPENDIX A



--- TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL AREAS OR URBAN AREAS WITH RESTRICTED FLOW

..... TRAFFIC SIGNALS MAY BE WARRANTED IN "FREE FLOW" URBAN AREAS

$V_A = 391$

$V_O = 210$

LT% = 2%

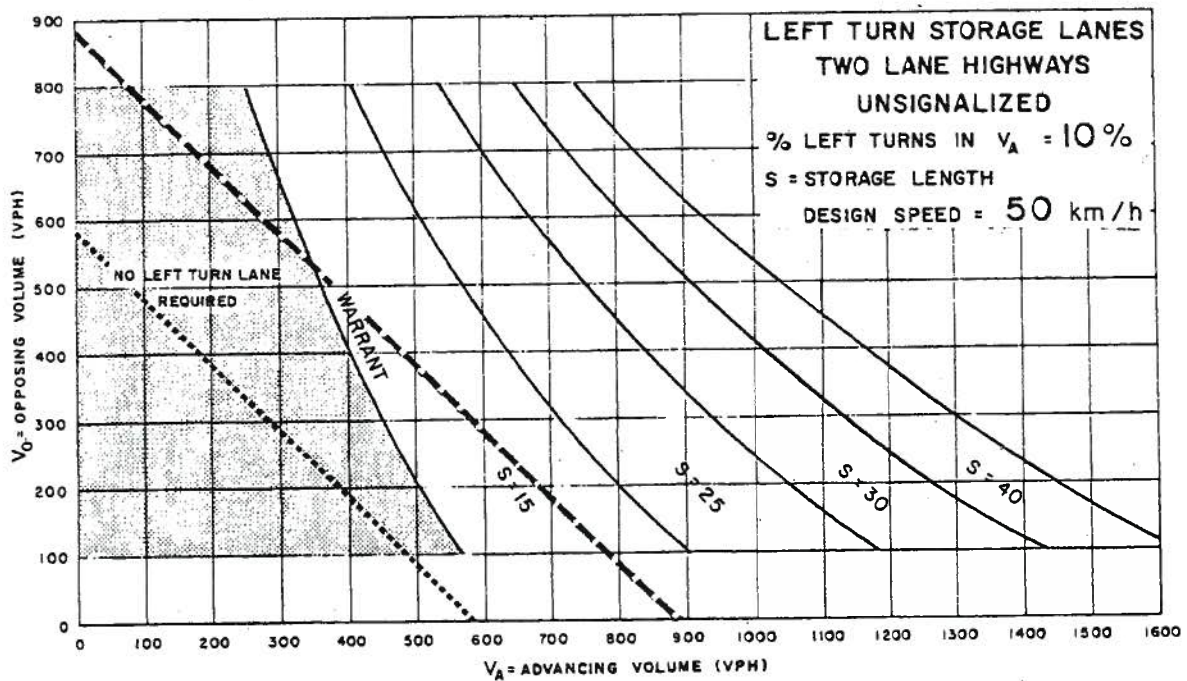


Figure EA-2

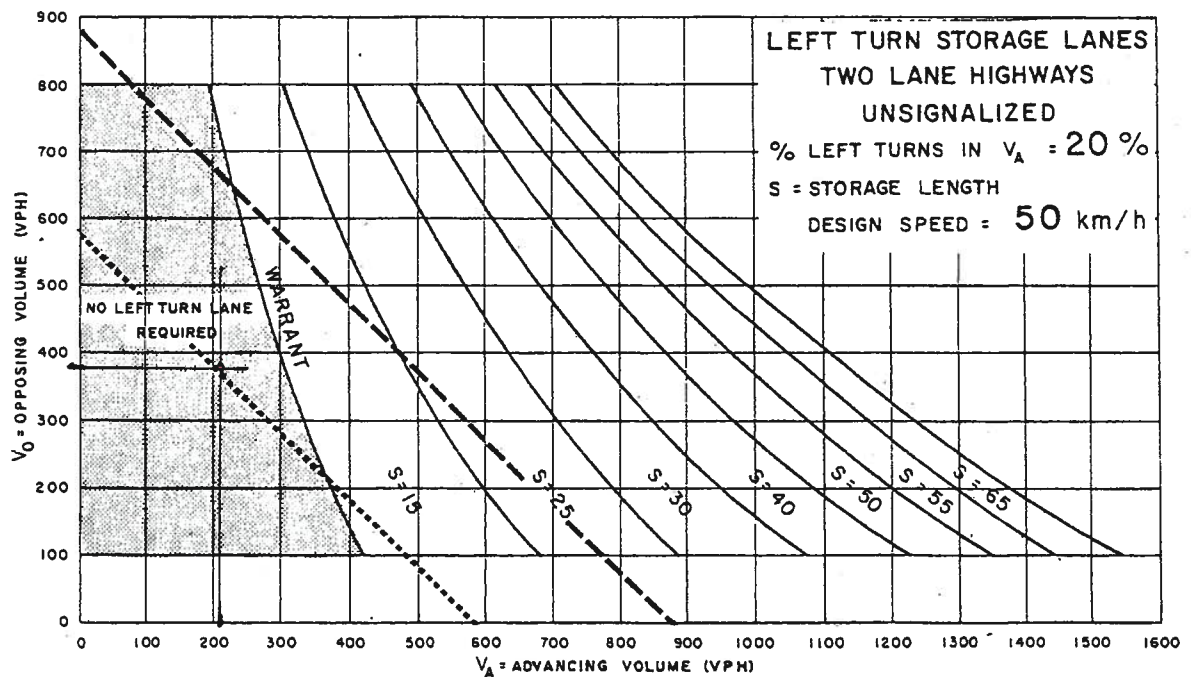
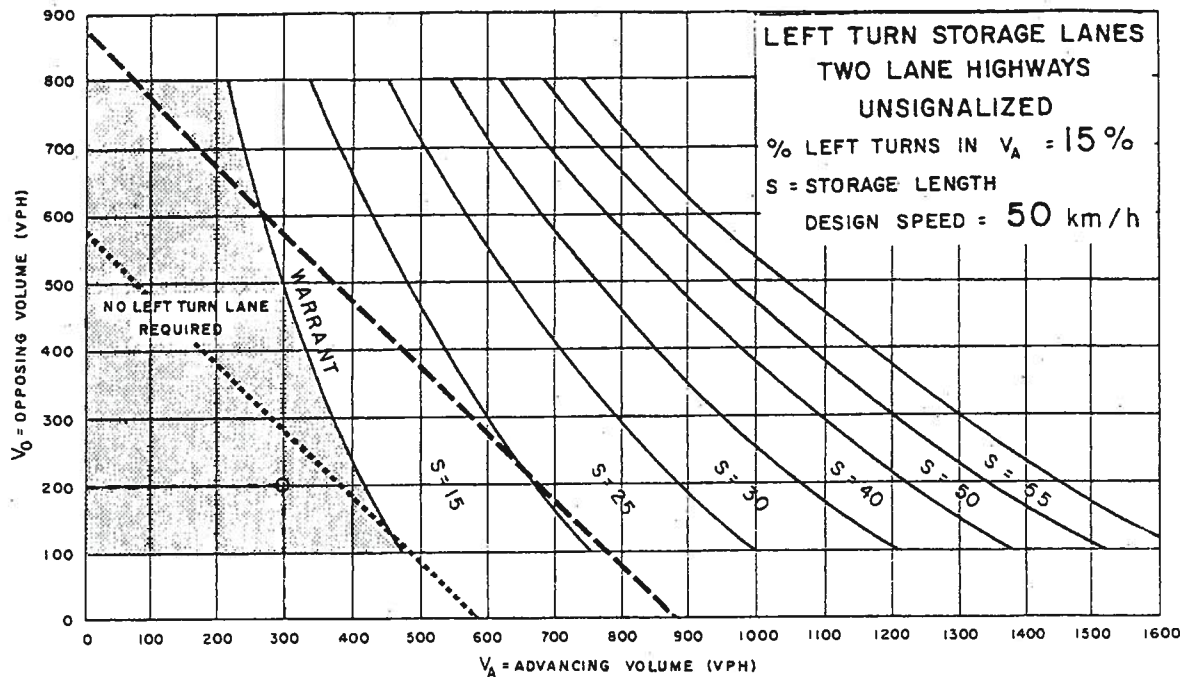


Figure EA-3

$$V_A = 210$$

$$V_0 = 391$$

$$LT\% = 17\%$$

















Appendix D

Existing Synchro Analysis

HCM Unsignalized Intersection Capacity Analysis

















1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
Existing AM

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Volume (vph) | 23 | 95 | 65 | 48 | 131 | 128 | 74 | 113 | 50 | 96 | 67 | 20 |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Hourly flow rate (vph) | 27 | 113 | 77 | 57 | 156 | 152 | 88 | 135 | 60 | 114 | 80 | 24 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 218 | 365 | 282 | 218 | | | | | | | | |
| Volume Left (vph) | 27 | 57 | 88 | 114 | | | | | | | | |
| Volume Right (vph) | 77 | 152 | 60 | 24 | | | | | | | | |
| Hadj (s) | -0.15 | -0.19 | 0.05 | 0.19 | | | | | | | | |
| Departure Headway (s) | 6.1 | 5.8 | 6.2 | 6.5 | | | | | | | | |
| Degree Utilization, x | 0.37 | 0.59 | 0.49 | 0.39 | | | | | | | | |
| Capacity (veh/h) | 511 | 582 | 528 | 487 | | | | | | | | |
| Control Delay (s) | 12.7 | 16.7 | 15.0 | 13.7 | | | | | | | | |
| Approach Delay (s) | 12.7 | 16.7 | 15.0 | 13.7 | | | | | | | | |
| Approach LOS | B | C | C | B | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 14.9 | | | | | | | | |
| HCM Level of Service | | | | B | | | | | | | | |
| Intersection Capacity Utilization | | | | 68.2% | ICU Level of Service | C | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |
| | | | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiaq Road & Hospital Driveway

















City of Iqaluit Traffic Signals Review
Existing AM

| | | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|--|
| |  |  |  |  |  |  |  |  |  |  |  |  | |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR | |
| Lane Configurations | |  | | |  | | |  | | |  | | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | | |
| Volume (veh/h) | 9 | 119 | 71 | 53 | 310 | 18 | 49 | 5 | 19 | 2 | 4 | 10 | |
| Peak Hour Factor | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | |
| Hourly flow rate (vph) | 11 | 140 | 84 | 62 | 365 | 21 | 58 | 6 | 22 | 2 | 5 | 12 | |
| Pedestrians | | 18 | | | 5 | | | 19 | | | 8 | | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | | |
| Percent Blockage | | 2 | | | 0 | | | 2 | | | 1 | | |
| Right turn flare (veh) | | | | | | | | | | | | | |
| Median type | | None | | | | | | | | None | | | |
| Median storage veh) | | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | | |
| vC, conflicting volume | 394 | | | 243 | | | 754 | 741 | 206 | 741 | 772 | 401 | |
| vC1, stage 1 conf vol | | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | | |
| vCu, unblocked vol | 394 | | | 243 | | | 754 | 741 | 206 | 741 | 772 | 401 | |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | |
| tC, 2 stage (s) | | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | |
| p0 queue free % | 99 | | | 95 | | | 80 | 98 | 97 | 99 | 98 | 98 | |
| cM capacity (veh/h) | 1168 | | | 1302 | | | 290 | 320 | 823 | 298 | 307 | 639 | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | | |
| Volume Total | 234 | 448 | 86 | 19 | | | | | | | | | |
| Volume Left | 11 | 62 | 58 | 2 | | | | | | | | | |
| Volume Right | 84 | 21 | 22 | 12 | | | | | | | | | |
| cSH | 1168 | 1302 | 351 | 452 | | | | | | | | | |
| Volume to Capacity | 0.01 | 0.05 | 0.24 | 0.04 | | | | | | | | | |
| Queue Length 95th (m) | 0.2 | 1.1 | 7.2 | 1.0 | | | | | | | | | |
| Control Delay (s) | 0.4 | 1.5 | 18.5 | 13.3 | | | | | | | | | |
| Lane LOS | A | A | C | B | | | | | | | | | |
| Approach Delay (s) | 0.4 | 1.5 | 18.5 | 13.3 | | | | | | | | | |
| Approach LOS | | | C | B | | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | | |
| Average Delay | | | 3.3 | | | | | | | | | | |
| Intersection Capacity Utilization | | | 69.4% | ICU Level of Service | | | | | | C | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | | |
| | | | | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis

















1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
Existing Mid-day

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Volume (vph) | 30 | 136 | 93 | 46 | 133 | 87 | 104 | 115 | 47 | 96 | 70 | 12 |
| Peak Hour Factor | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| Hourly flow rate (vph) | 36 | 164 | 112 | 55 | 160 | 105 | 125 | 139 | 57 | 116 | 84 | 14 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 312 | 320 | 320 | 214 | | | | | | | | |
| Volume Left (vph) | 36 | 55 | 125 | 116 | | | | | | | | |
| Volume Right (vph) | 112 | 105 | 57 | 14 | | | | | | | | |
| Hadj (s) | -0.15 | -0.14 | 0.06 | 0.18 | | | | | | | | |
| Departure Headway (s) | 6.3 | 6.3 | 6.6 | 7.0 | | | | | | | | |
| Degree Utilization, x | 0.55 | 0.56 | 0.58 | 0.41 | | | | | | | | |
| Capacity (veh/h) | 510 | 517 | 504 | 449 | | | | | | | | |
| Control Delay (s) | 16.8 | 17.2 | 18.3 | 14.8 | | | | | | | | |
| Approach Delay (s) | 16.8 | 17.2 | 18.3 | 14.8 | | | | | | | | |
| Approach LOS | C | C | C | B | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 17.0 | | | | | | | | |
| HCM Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | | 64.9% | ICU Level of Service | C | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |
| | | | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiq Road & Hospital Driveway

















City of Iqaluit Traffic Signals Review
Existing Mid-day

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Volume (veh/h) | 9 | 151 | 76 | 49 | 320 | 14 | 53 | 9 | 29 | 5 | 5 | 8 |
| Peak Hour Factor | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 |
| Hourly flow rate (vph) | 12 | 207 | 104 | 67 | 438 | 19 | 73 | 12 | 40 | 7 | 7 | 11 |
| Pedestrians | | 11 | | | 10 | | | 12 | | | 10 | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | |
| Percent Blockage | | 1 | | | 1 | | | 1 | | | 1 | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | None | | | | | | | | None | | | |
| Median storage veh | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 468 | | | 323 | | | 903 | 897 | 281 | 932 | 940 | 469 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 468 | | | 323 | | | 903 | 897 | 281 | 932 | 940 | 469 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 95 | | | 68 | 95 | 95 | 97 | 97 | 98 |
| cM capacity (veh/h) | 1095 | | | 1224 | | | 230 | 258 | 748 | 209 | 244 | 588 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 323 | 525 | 125 | 25 | | | | | | | | |
| Volume Left | 12 | 67 | 73 | 7 | | | | | | | | |
| Volume Right | 104 | 19 | 40 | 11 | | | | | | | | |
| cSH | 1095 | 1224 | 299 | 310 | | | | | | | | |
| Volume to Capacity | 0.01 | 0.05 | 0.42 | 0.08 | | | | | | | | |
| Queue Length 95th (m) | 0.3 | 1.3 | 15.0 | 2.0 | | | | | | | | |
| Control Delay (s) | 0.4 | 1.6 | 25.4 | 17.6 | | | | | | | | |
| Lane LOS | A | A | D | C | | | | | | | | |
| Approach Delay (s) | 0.4 | 1.6 | 25.4 | 17.6 | | | | | | | | |
| Approach LOS | | | D | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 4.6 | | | | | | | | | |
| Intersection Capacity Utilization | 73.7% | | ICU Level of Service | | D | | | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis

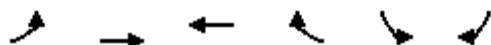
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
Existing PM

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Volume (vph) | 15 | 157 | 94 | 67 | 125 | 88 | 87 | 69 | 70 | 131 | 119 | 7 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 |
| Hourly flow rate (vph) | 17 | 176 | 106 | 75 | 140 | 99 | 98 | 78 | 79 | 147 | 134 | 8 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 299 | 315 | 254 | 289 | | | | | | | | |
| Volume Left (vph) | 17 | 75 | 98 | 147 | | | | | | | | |
| Volume Right (vph) | 106 | 99 | 79 | 8 | | | | | | | | |
| Hadj (s) | -0.16 | -0.05 | -0.07 | 0.13 | | | | | | | | |
| Departure Headway (s) | 6.3 | 6.4 | 6.6 | 6.6 | | | | | | | | |
| Degree Utilization, x | 0.52 | 0.56 | 0.46 | 0.53 | | | | | | | | |
| Capacity (veh/h) | 512 | 512 | 487 | 487 | | | | | | | | |
| Control Delay (s) | 16.1 | 17.1 | 15.1 | 17.0 | | | | | | | | |
| Approach Delay (s) | 16.1 | 17.1 | 15.1 | 17.0 | | | | | | | | |
| Approach LOS | C | C | C | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | 16.4 | | | | | | | | | |
| HCM Level of Service | | | C | | | | | | | | | |
| Intersection Capacity Utilization | | | 85.1% | ICU Level of Service | | E | | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |

HCM Unsignalized Intersection Capacity Analysis 2: Niagunngusiaq Road & Kangiq & Iniq Drive

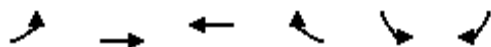
City of Iqaluit Traffic Signals Review
Existing PM



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↰ | ↰ | | ↰ | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 10 | 391 | 252 | 16 | 33 | 8 |
| Peak Hour Factor | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 |
| Hourly flow rate (vph) | 15 | 592 | 382 | 24 | 50 | 12 |
| Pedestrians | | 32 | 15 | | 5 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | 1.2 | | 1.2 | |
| Percent Blockage | | 3 | 1 | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 411 | | | | 1037 | 431 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 411 | | | | 1037 | 431 |
| tC, single (s) | 4.2 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.3 | | | | 3.5 | 3.3 |
| p0 queue free % | 99 | | | | 80 | 98 |
| cM capacity (veh/h) | 1101 | | | | 251 | 609 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 608 | 406 | 62 | | | |
| Volume Left | 15 | 0 | 50 | | | |
| Volume Right | 0 | 24 | 12 | | | |
| cSH | 1101 | 1700 | 283 | | | |
| Volume to Capacity | 0.01 | 0.24 | 0.22 | | | |
| Queue Length 95th (m) | 0.3 | 0.0 | 6.2 | | | |
| Control Delay (s) | 0.4 | 0.0 | 21.3 | | | |
| Lane LOS | A | | C | | | |
| Approach Delay (s) | 0.4 | 0.0 | 21.3 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 1.4 | | | |
| Intersection Capacity Utilization | | 58.4% | | ICU Level of Service | | B |
| Analysis Period (min) | | 15 | | | | |

HCM Unsignalized Intersection Capacity Analysis 3: Niagunngusiaq Road & Saputi Road

















City of Iqaluit Traffic Signals Review
Existing PM



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↶ | ↷ | | ↶ | ↷ |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 69 | 390 | 249 | 26 | 28 | 49 |
| Peak Hour Factor | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 |
| Hourly flow rate (vph) | 93 | 527 | 336 | 35 | 38 | 66 |
| Pedestrians | | | 1 | | | |
| Lane Width (m) | | | 3.7 | | | |
| Walking Speed (m/s) | | | 1.2 | | | |
| Percent Blockage | | | 0 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 372 | | | | 1069 | 354 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 372 | | | | 1069 | 354 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.3 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.4 |
| p0 queue free % | 92 | | | | 83 | 90 |
| cM capacity (veh/h) | 1198 | | | | 228 | 681 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 620 | 372 | 104 | | | |
| Volume Left | 93 | 0 | 38 | | | |
| Volume Right | 0 | 35 | 66 | | | |
| cSH | 1198 | 1700 | 395 | | | |
| Volume to Capacity | 0.08 | 0.22 | 0.26 | | | |
| Queue Length 95th (m) | 1.9 | 0.0 | 7.9 | | | |
| Control Delay (s) | 2.0 | 0.0 | 17.3 | | | |
| Lane LOS | A | | C | | | |
| Approach Delay (s) | 2.0 | 0.0 | 17.3 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 2.8 | | | |
| Intersection Capacity Utilization | | 73.5% | | ICU Level of Service | | D |
| Analysis Period (min) | | 15 | | | | |

HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiaq Road & Hospital Driveway

City of Iqaluit Traffic Signals Review
Existing PM





















| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Volume (veh/h) | 8 | 308 | 75 | 35 | 172 | 3 | 51 | 3 | 84 | 7 | 9 | 8 |
| Peak Hour Factor | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 |
| Hourly flow rate (vph) | 11 | 440 | 107 | 50 | 246 | 4 | 73 | 4 | 120 | 10 | 13 | 11 |
| Pedestrians | | 18 | | | 8 | | | 16 | | | 2 | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | |
| Percent Blockage | | 2 | | | 1 | | | 1 | | | 0 | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | None | | | | | | | | None | | | |
| Median storage veh | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 252 | | | 563 | | | 916 | 884 | 518 | 996 | 936 | 268 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 252 | | | 563 | | | 916 | 884 | 518 | 996 | 936 | 268 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 95 | | | 67 | 98 | 78 | 94 | 95 | 99 |
| cM capacity (veh/h) | 1323 | | | 1004 | | | 221 | 266 | 548 | 163 | 248 | 762 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total | 559 | 300 | 197 | 34 | | | | | | | | |
| Volume Left | 11 | 50 | 73 | 10 | | | | | | | | |
| Volume Right | 107 | 4 | 120 | 11 | | | | | | | | |
| cSH | 1323 | 1004 | 350 | 267 | | | | | | | | |
| Volume to Capacity | 0.01 | 0.05 | 0.56 | 0.13 | | | | | | | | |
| Queue Length 95th (m) | 0.2 | 1.2 | 25.1 | 3.3 | | | | | | | | |
| Control Delay (s) | 0.3 | 1.9 | 27.8 | 20.5 | | | | | | | | |
| Lane LOS | A | A | D | C | | | | | | | | |
| Approach Delay (s) | 0.3 | 1.9 | 27.8 | 20.5 | | | | | | | | |
| Approach LOS | | | D | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 6.3 | | | | | | | | | |
| Intersection Capacity Utilization | | | 66.6% | ICU Level of Service | | | | | C | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |

Appendix E

5-year Horizon Synchro Analysis













Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
5 Year Horizon AM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  | |  |  | |  |  | |  |  | |
| Ideal Flow (vphpl) | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ped Bike Factor | 0.99 | 0.99 | | 0.99 | 0.98 | | 0.95 | 0.98 | | 0.97 | 0.98 | |
| Frt | | 0.939 | | | 0.926 | | | 0.954 | | | 0.965 | |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1254 | 1192 | 0 | 1254 | 1178 | 0 | 1217 | 1142 | 0 | 1205 | 1092 | 0 |
| Flt Permitted | 0.474 | | | 0.614 | | | 0.682 | | | 0.601 | | |
| Satd. Flow (perm) | 621 | 1192 | 0 | 800 | 1178 | 0 | 832 | 1142 | 0 | 741 | 1092 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 75 | | | 107 | | | 46 | | | 27 | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Link Speed (k/h) | | 40 | | | 40 | | | 40 | | | 40 | |
| Link Distance (m) | | 125.6 | | | 251.6 | | | 256.7 | | | 126.4 | |
| Travel Time (s) | | 11.3 | | | 22.6 | | | 23.1 | | | 11.4 | |
| Volume (vph) | 26 | 107 | 73 | 54 | 147 | 144 | 83 | 127 | 56 | 108 | 75 | 23 |
| Confl. Peds. (#/hr) | 7 | | 9 | 9 | | 7 | 30 | | 21 | 21 | | 30 |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 0% | 2% | 3% | 0% | 2% | 2% | 3% | 11% | 2% | 4% | 16% | 10% |
| Adj. Flow (vph) | 31 | 127 | 87 | 64 | 175 | 171 | 99 | 151 | 67 | 129 | 89 | 27 |
| Lane Group Flow (vph) | 31 | 214 | 0 | 64 | 346 | 0 | 99 | 218 | 0 | 129 | 116 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 2 | | | 6 | | | 8 | | | 4 | |
| Permitted Phases | 2 | | | 6 | | | 8 | | | 4 | | |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | |
| Total Split (s) | 31.0 | 31.0 | 0.0 | 31.0 | 31.0 | 0.0 | 29.0 | 29.0 | 0.0 | 29.0 | 29.0 | 0.0 |
| Total Split (%) | 51.7% | 51.7% | 0.0% | 51.7% | 51.7% | 0.0% | 48.3% | 48.3% | 0.0% | 48.3% | 48.3% | 0.0% |
| Maximum Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Act Effct Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Actuated g/C Ratio | 0.45 | 0.45 | | 0.45 | 0.45 | | 0.42 | 0.42 | | 0.42 | 0.42 | |
| v/c Ratio | 0.11 | 0.37 | | 0.18 | 0.59 | | 0.29 | 0.43 | | 0.42 | 0.25 | |
| Control Delay | 10.9 | 9.2 | | 11.5 | 13.2 | | 14.5 | 13.0 | | 17.6 | 10.7 | |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | |
| Total Delay | 10.9 | 9.2 | | 11.5 | 13.2 | | 14.5 | 13.0 | | 17.6 | 10.7 | |
| LOS | B | A | | B | B | | B | B | | B | B | |
| Approach Delay | | 9.4 | | | 12.9 | | | 13.4 | | | 14.3 | |
| Approach LOS | | A | | | B | | | B | | | B | |
| Queue Length 50th (m) | 1.9 | 9.0 | | 4.0 | 17.4 | | 6.9 | 12.4 | | 9.6 | 5.9 | |
| Queue Length 95th (m) | 5.7 | 19.4 | | 9.6 | 35.1 | | 15.1 | 24.9 | | 20.4 | 13.8 | |
| Internal Link Dist (m) | | 101.6 | | | 227.6 | | | 232.7 | | | 102.4 | |

Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
5 Year Horizon AM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Turn Bay Length (m) | | | | | | | | | | | | |
| Base Capacity (vph) | 279 | 578 | | 360 | 589 | | 347 | 503 | | 309 | 471 | |
| Starvation Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Spillback Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Storage Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Reduced v/c Ratio | 0.11 | 0.37 | | 0.18 | 0.59 | | 0.29 | 0.43 | | 0.42 | 0.25 | |

Intersection Summary

Area Type: CBD

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.59

Intersection Signal Delay: 12.6





Intersection LOS: B

Intersection Capacity Utilization 65.1%

ICU Level of Service C



















Analysis Period (min) 15

Splits and Phases: 1: Mivvik Street & Federal Road

| | |
|--|--|
|  ø2 |  ø4 |
| 31 s | 29 s |
|  ø6 |  ø8 |
| 31 s | 29 s |





















HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiaq Road & Hospital Driveway

City of Iqaluit Traffic Signals Review
5 Year Horizon AM

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | |  |  | |  |  | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Volume (veh/h) | 10 | 134 | 80 | 60 | 349 | 20 | 55 | 6 | 21 | 2 | 5 | 11 |
| Peak Hour Factor | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Hourly flow rate (vph) | 12 | 158 | 94 | 71 | 411 | 24 | 65 | 7 | 25 | 2 | 6 | 13 |
| Pedestrians | | 18 | | | 5 | | | 19 | | | 8 | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | |
| Percent Blockage | | 2 | | | 0 | | | 2 | | | 1 | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage veh | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 442 | | | 271 | | | 845 | 831 | 229 | 833 | 866 | 448 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 442 | | | 271 | | | 845 | 831 | 229 | 833 | 866 | 448 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 94 | | | 74 | 97 | 97 | 99 | 98 | 98 |
| cM capacity (veh/h) | 1121 | | | 1272 | | | 248 | 281 | 799 | 255 | 268 | 601 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | |
| Volume Total | 264 | 505 | 65 | 32 | 2 | 19 | | | | | | |
| Volume Left | 12 | 71 | 65 | 0 | 2 | 0 | | | | | | |
| Volume Right | 94 | 24 | 0 | 25 | 0 | 13 | | | | | | |
| cSH | 1121 | 1272 | 248 | 567 | 255 | 433 | | | | | | |
| Volume to Capacity | 0.01 | 0.06 | 0.26 | 0.06 | 0.01 | 0.04 | | | | | | |
| Queue Length 95th (m) | 0.2 | 1.3 | 7.7 | 1.4 | 0.2 | 1.0 | | | | | | |
| Control Delay (s) | 0.5 | 1.6 | 24.6 | 11.7 | 19.3 | 13.7 | | | | | | |
| Lane LOS | A | A | C | B | C | B | | | | | | |
| Approach Delay (s) | 0.5 | 1.6 | 20.3 | | 14.3 | | | | | | | |
| Approach LOS | | | C | | B | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 3.6 | | | | | | | | | |
| Intersection Capacity Utilization | | | 73.7% | | ICU Level of Service | | | | D | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |













Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
5 Year Horizon Midday

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  | |  |  | |  |  | |  |  | |
| Ideal Flow (vphpl) | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ped Bike Factor | 0.99 | 0.99 | | 0.99 | 0.99 | | 0.95 | 0.98 | | 0.97 | 0.99 | |
| Frt | | 0.939 | | | 0.941 | | | 0.956 | | | 0.977 | |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1254 | 1192 | 0 | 1254 | 1201 | 0 | 1217 | 1144 | 0 | 1205 | 1107 | 0 |
| Flt Permitted | 0.526 | | | 0.514 | | | 0.685 | | | 0.603 | | |
| Satd. Flow (perm) | 688 | 1192 | 0 | 671 | 1201 | 0 | 835 | 1144 | 0 | 743 | 1107 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 75 | | | 71 | | | 42 | | | 17 | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Link Speed (k/h) | | 40 | | | 40 | | | 40 | | | 40 | |
| Link Distance (m) | | 125.6 | | | 251.6 | | | 256.7 | | | 126.4 | |
| Travel Time (s) | | 11.3 | | | 22.6 | | | 23.1 | | | 11.4 | |
| Volume (vph) | 34 | 153 | 105 | 52 | 150 | 98 | 117 | 129 | 53 | 108 | 79 | 14 |
| Confl. Peds. (#/hr) | 7 | | 9 | 9 | | 7 | 30 | | 21 | 21 | | 30 |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 0% | 2% | 3% | 0% | 2% | 2% | 3% | 11% | 2% | 4% | 16% | 10% |
| Adj. Flow (vph) | 40 | 182 | 125 | 62 | 179 | 117 | 139 | 154 | 63 | 129 | 94 | 17 |
| Lane Group Flow (vph) | 40 | 307 | 0 | 62 | 296 | 0 | 139 | 217 | 0 | 129 | 111 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 2 | | | 6 | | | 8 | | | 4 | |
| Permitted Phases | 2 | | | 6 | | | 8 | | | 4 | | |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | |
| Total Split (s) | 31.0 | 31.0 | 0.0 | 31.0 | 31.0 | 0.0 | 29.0 | 29.0 | 0.0 | 29.0 | 29.0 | 0.0 |
| Total Split (%) | 51.7% | 51.7% | 0.0% | 51.7% | 51.7% | 0.0% | 48.3% | 48.3% | 0.0% | 48.3% | 48.3% | 0.0% |
| Maximum Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Act Effct Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Actuated g/C Ratio | 0.45 | 0.45 | | 0.45 | 0.45 | | 0.42 | 0.42 | | 0.42 | 0.42 | |
| v/c Ratio | 0.13 | 0.53 | | 0.21 | 0.51 | | 0.40 | 0.43 | | 0.42 | 0.24 | |
| Control Delay | 11.1 | 12.9 | | 12.3 | 12.5 | | 16.6 | 13.2 | | 17.6 | 11.4 | |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | |
| Total Delay | 11.1 | 12.9 | | 12.3 | 12.5 | | 16.6 | 13.2 | | 17.6 | 11.4 | |
| LOS | B | B | | B | B | | B | B | | B | B | |
| Approach Delay | | 12.7 | | | 12.5 | | | 14.5 | | | 14.7 | |
| Approach LOS | | B | | | B | | | B | | | B | |
| Queue Length 50th (m) | 2.4 | 16.6 | | 3.9 | 15.8 | | 10.2 | 12.7 | | 9.6 | 6.3 | |
| Queue Length 95th (m) | 6.9 | 32.2 | | 9.7 | 30.9 | | 21.0 | 25.2 | | 20.4 | 14.0 | |
| Internal Link Dist (m) | | 101.6 | | | 227.6 | | | 232.7 | | | 102.4 | |

Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
5 Year Horizon Midday

| |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Turn Bay Length (m) | | | | | | | | | | | | |
| Base Capacity (vph) | 310 | 578 | | 302 | 580 | | 348 | 501 | | 310 | 471 | |
| Starvation Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Spillback Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Storage Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Reduced v/c Ratio | 0.13 | 0.53 | | 0.21 | 0.51 | | 0.40 | 0.43 | | 0.42 | 0.24 | |

Intersection Summary

Area Type: CBD

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.53

Intersection Signal Delay: 13.5





Intersection LOS: B

Intersection Capacity Utilization 62.8%

ICU Level of Service B





















Analysis Period (min) 15

Splits and Phases: 1: Mivvik Street & Federal Road

| | |
|---|---|
|  ø2 |  ø4 |
| 31 s | 29 s |
|  ø6 |  ø8 |
| 31 s | 29 s |





















HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiaq Road & Hospital Driveway

City of Iqaluit Traffic Signals Review
5 Year Horizon Midday

| | | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|--|
| |  |  |  |  |  |  |  |  |  |  |  |  | |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR | |
| Lane Configurations | |  | | |  | |  |  | |  |  | | |
| Sign Control | | Free | | | Free | | | Stop | |  |  | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | | 0% | |
| Volume (veh/h) | 10 | 170 | 86 | 55 | 360 | 16 | 60 | 10 | 33 | 6 | 6 | 9 | |
| Peak Hour Factor | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | |
| Hourly flow rate (vph) | 12 | 200 | 101 | 65 | 424 | 19 | 71 | 12 | 39 | 7 | 7 | 11 | |
| Pedestrians | | 18 | | | 5 | | | 19 | | | 8 | | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | | |
| Percent Blockage | | 2 | | | 0 | | | 2 | | | 1 | | |
| Right turn flare (veh) | | | | | | | | | | | | | |
| Median type | | None | | | | | | | | None | | | |
| Median storage veh | | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | | |
| vC, conflicting volume | 450 | | | 320 | | | 888 | 873 | 275 | 894 | 914 | 459 | |
| vC1, stage 1 conf vol | | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | | |
| vCu, unblocked vol | 450 | | | 320 | | | 888 | 873 | 275 | 894 | 914 | 459 | |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 | |
| tC, 2 stage (s) | | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 | |
| p0 queue free % | 99 | | | 95 | | | 70 | 96 | 95 | 97 | 97 | 98 | |
| cM capacity (veh/h) | 1113 | | | 1220 | | | 232 | 266 | 753 | 224 | 252 | 593 | |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | | |
| Volume Total | 313 | 507 | 71 | 51 | 7 | 18 | | | | | | | |
| Volume Left | 12 | 65 | 71 | 0 | 7 | 0 | | | | | | | |
| Volume Right | 101 | 19 | 0 | 39 | 0 | 11 | | | | | | | |
| cSH | 1113 | 1220 | 232 | 528 | 224 | 385 | | | | | | | |
| Volume to Capacity | 0.01 | 0.05 | 0.30 | 0.10 | 0.03 | 0.05 | | | | | | | |
| Queue Length 95th (m) | 0.2 | 1.3 | 9.4 | 2.4 | 0.7 | 1.1 | | | | | | | |
| Control Delay (s) | 0.4 | 1.5 | 27.1 | 12.5 | 21.6 | 14.8 | | | | | | | |
| Lane LOS | A | A | D | B | C | B | | | | | | | |
| Approach Delay (s) | 0.4 | 1.5 | 21.0 | | 16.8 | | | | | | | | |
| Approach LOS | | | C | | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | | |
| Average Delay | | | 4.0 | | | | | | | | | | |
| Intersection Capacity Utilization | | | 77.3% | ICU Level of Service | | | | D | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | | |
| | | | | | | | | | | | | | |













Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
5 Year Horizon PM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  | |  |  | |  |  | |  |  | |
| Ideal Flow (vphpl) | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ped Bike Factor | 0.99 | 0.99 | | 0.99 | 0.99 | | 0.96 | 0.97 | | 0.97 | 1.00 | |
| Frt | | 0.944 | | | 0.938 | | | 0.925 | | | 0.991 | |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1254 | 1200 | 0 | 1254 | 1197 | 0 | 1217 | 1113 | 0 | 1205 | 1126 | 0 |
| Flt Permitted | 0.536 | | | 0.483 | | | 0.650 | | | 0.638 | | |
| Satd. Flow (perm) | 701 | 1200 | 0 | 631 | 1197 | 0 | 796 | 1113 | 0 | 785 | 1126 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 65 | | | 77 | | | 94 | | | 6 | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Link Speed (k/h) | | 40 | | | 40 | | | 40 | | | 40 | |
| Link Distance (m) | | 125.6 | | | 251.6 | | | 256.7 | | | 126.4 | |
| Travel Time (s) | | 11.3 | | | 22.6 | | | 23.1 | | | 11.4 | |
| Volume (vph) | 17 | 177 | 106 | 75 | 141 | 99 | 98 | 78 | 79 | 147 | 134 | 8 |
| Confl. Peds. (#/hr) | 7 | | 9 | 9 | | 7 | 30 | | 21 | 21 | | 30 |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 0% | 2% | 3% | 0% | 2% | 2% | 3% | 11% | 2% | 4% | 16% | 10% |
| Adj. Flow (vph) | 20 | 211 | 126 | 89 | 168 | 118 | 117 | 93 | 94 | 175 | 160 | 10 |
| Lane Group Flow (vph) | 20 | 337 | 0 | 89 | 286 | 0 | 117 | 187 | 0 | 175 | 170 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 2 | | | 6 | | | 8 | | | 4 | |
| Permitted Phases | 2 | | | 6 | | | 8 | | | 4 | | |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | |
| Total Split (s) | 31.0 | 31.0 | 0.0 | 31.0 | 31.0 | 0.0 | 29.0 | 29.0 | 0.0 | 29.0 | 29.0 | 0.0 |
| Total Split (%) | 51.7% | 51.7% | 0.0% | 51.7% | 51.7% | 0.0% | 48.3% | 48.3% | 0.0% | 48.3% | 48.3% | 0.0% |
| Maximum Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Act Effct Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Actuated g/C Ratio | 0.45 | 0.45 | | 0.45 | 0.45 | | 0.42 | 0.42 | | 0.42 | 0.42 | |
| v/c Ratio | 0.06 | 0.59 | | 0.31 | 0.49 | | 0.35 | 0.36 | | 0.54 | 0.36 | |
| Control Delay | 10.1 | 14.8 | | 14.5 | 11.8 | | 15.8 | 8.6 | | 20.6 | 14.3 | |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | |
| Total Delay | 10.1 | 14.8 | | 14.5 | 11.8 | | 15.8 | 8.6 | | 20.6 | 14.3 | |
| LOS | B | B | | B | B | | B | A | | C | B | |
| Approach Delay | | 14.5 | | | 12.5 | | | 11.4 | | | 17.5 | |
| Approach LOS | | B | | | B | | | B | | | B | |
| Queue Length 50th (m) | 1.2 | 20.5 | | 5.9 | 14.5 | | 8.4 | 6.2 | | 13.8 | 11.8 | |
| Queue Length 95th (m) | 4.1 | 38.1 | | 13.9 | 28.8 | | 17.9 | 16.0 | | 28.0 | 22.4 | |
| Internal Link Dist (m) | | 101.6 | | | 227.6 | | | 232.7 | | | 102.4 | |

Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
5 Year Horizon PM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Turn Bay Length (m) | | | | | | | | | | | | |
| Base Capacity (vph) | 315 | 576 | | 284 | 581 | | 332 | 519 | | 327 | 473 | |
| Starvation Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Spillback Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Storage Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Reduced v/c Ratio | 0.06 | 0.59 | | 0.31 | 0.49 | | 0.35 | 0.36 | | 0.54 | 0.36 | |

Intersection Summary

Area Type: CBD

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.59

Intersection Signal Delay: 14.0





Intersection LOS: B

Intersection Capacity Utilization 68.6%

ICU Level of Service C

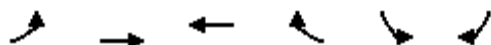
Analysis Period (min) 15

Splits and Phases: 1: Mivvik Street & Federal Road

| | |
|---|---|
|  ø2 |  ø4 |
| 31 s | 29 s |
|  ø6 |  ø8 |
| 31 s | 29 s |

HCM Unsignalized Intersection Capacity Analysis 2: Niagunngusiq Road & Kangiq & Iniq Drive

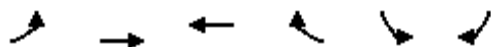
City of Iqaluit Traffic Signals Review
5 Year Horizon PM



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↰ | ↰ | | ↰ | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 11 | 440 | 284 | 18 | 37 | 9 |
| Peak Hour Factor | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 |
| Hourly flow rate (vph) | 17 | 667 | 430 | 27 | 56 | 14 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | 252 | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 458 | | | | 1144 | 444 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 458 | | | | 1144 | 444 |
| tC, single (s) | 4.2 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.3 | | | | 3.5 | 3.3 |
| p0 queue free % | 98 | | | | 74 | 98 |
| cM capacity (veh/h) | 1062 | | | | 220 | 618 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 683 | 458 | 70 | | | |
| Volume Left | 17 | 0 | 56 | | | |
| Volume Right | 0 | 27 | 14 | | | |
| cSH | 1062 | 1700 | 251 | | | |
| Volume to Capacity | 0.02 | 0.27 | 0.28 | | | |
| Queue Length 95th (m) | 0.4 | 0.0 | 8.3 | | | |
| Control Delay (s) | 0.4 | 0.0 | 24.7 | | | |
| Lane LOS | A | | C | | | |
| Approach Delay (s) | 0.4 | 0.0 | 24.7 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 1.7 | | | |
| Intersection Capacity Utilization | | 57.0% | | ICU Level of Service | | B |
| Analysis Period (min) | | 15 | | | | |

HCM Unsignalized Intersection Capacity Analysis 3: Niagunngusiaq Road & Saputi Road



















City of Iqaluit Traffic Signals Review
5 Year Horizon PM



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|
| Lane Configurations | | | | | | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 78 | 439 | 280 | 29 | 32 | 55 |
| Peak Hour Factor | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 |
| Hourly flow rate (vph) | 105 | 593 | 378 | 39 | 43 | 74 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage (veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 418 | | | | 1202 | 398 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 418 | | | | 1202 | 398 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.3 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.4 |
| p0 queue free % | 91 | | | | 77 | 88 |
| cM capacity (veh/h) | 1152 | | | | 187 | 643 |
| Direction, Lane # | EB 1 | EB 2 | WB 1 | SB 1 | | |
| Volume Total | 105 | 593 | 418 | 118 | | |
| Volume Left | 105 | 0 | 0 | 43 | | |
| Volume Right | 0 | 0 | 39 | 74 | | |
| cSH | 1152 | 1700 | 1700 | 339 | | |
| Volume to Capacity | 0.09 | 0.35 | 0.25 | 0.35 | | |
| Queue Length 95th (m) | 2.3 | 0.0 | 0.0 | 11.5 | | |
| Control Delay (s) | 8.4 | 0.0 | 0.0 | 21.2 | | |
| Lane LOS | A | | | C | | |
| Approach Delay (s) | 1.3 | | 0.0 | 21.2 | | |
| Approach LOS | | | | C | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 2.7 | | | |
| Intersection Capacity Utilization | | | 47.8% | | ICU Level of Service | A |
| Analysis Period (min) | | | 15 | | | |

HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiaq Road & Hospital Driveway

City of Iqaluit Traffic Signals Review
5 Year Horizon PM





















| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | |  |  | |  |  | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Volume (veh/h) | 9 | 347 | 84 | 39 | 194 | 3 | 57 | 3 | 95 | 8 | 10 | 9 |
| Peak Hour Factor | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Hourly flow rate (vph) | 11 | 408 | 99 | 46 | 228 | 4 | 67 | 4 | 112 | 9 | 12 | 11 |
| Pedestrians | | 18 | | | 5 | | | 19 | | | 8 | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | |
| Percent Blockage | | 2 | | | 0 | | | 2 | | | 1 | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage veh | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 240 | | | 526 | | | 854 | 829 | 482 | 927 | 877 | 256 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 240 | | | 526 | | | 854 | 829 | 482 | 927 | 877 | 256 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 96 | | | 73 | 99 | 81 | 95 | 96 | 99 |
| cM capacity (veh/h) | 1330 | | | 1024 | | | 245 | 285 | 577 | 187 | 268 | 770 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | |
| Volume Total | 518 | 278 | 67 | 115 | 9 | 22 | | | | | | |
| Volume Left | 11 | 46 | 67 | 0 | 9 | 0 | | | | | | |
| Volume Right | 99 | 4 | 0 | 112 | 0 | 11 | | | | | | |
| cSH | 1330 | 1024 | 245 | 559 | 187 | 387 | | | | | | |
| Volume to Capacity | 0.01 | 0.04 | 0.27 | 0.21 | 0.05 | 0.06 | | | | | | |
| Queue Length 95th (m) | 0.2 | 1.1 | 8.2 | 5.8 | 1.2 | 1.4 | | | | | | |
| Control Delay (s) | 0.2 | 1.8 | 25.2 | 13.1 | 25.3 | 14.9 | | | | | | |
| Lane LOS | A | A | D | B | D | B | | | | | | |
| Approach Delay (s) | 0.2 | 1.8 | 17.5 | | 18.0 | | | | | | | |
| Approach LOS | | | C | | C | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 4.4 | | | | | | | | | |
| Intersection Capacity Utilization | | | 65.3% | ICU Level of Service | | | C | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |

Appendix F

10-year Horizon Synchro Analysis













Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
10 Year Horizon AM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  | |  |  | |  |  | |  |  | |
| Ideal Flow (vphpl) | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ped Bike Factor | 0.99 | 0.99 | | 0.99 | 0.98 | | 0.95 | 0.98 | | 0.97 | 0.98 | |
| Frt | | 0.939 | | | 0.926 | | | 0.954 | | | 0.965 | |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1254 | 1192 | 0 | 1254 | 1178 | 0 | 1217 | 1142 | 0 | 1205 | 1092 | 0 |
| Flt Permitted | 0.435 | | | 0.587 | | | 0.674 | | | 0.572 | | |
| Satd. Flow (perm) | 570 | 1192 | 0 | 765 | 1178 | 0 | 823 | 1142 | 0 | 706 | 1092 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 74 | | | 106 | | | 46 | | | 30 | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Link Speed (k/h) | | 40 | | | 40 | | | 40 | | | 40 | |
| Link Distance (m) | | 125.6 | | | 251.6 | | | 256.7 | | | 126.4 | |
| Travel Time (s) | | 11.3 | | | 22.6 | | | 23.1 | | | 11.4 | |
| Volume (vph) | 29 | 119 | 81 | 60 | 164 | 160 | 93 | 141 | 63 | 120 | 84 | 25 |
| Confl. Peds. (#/hr) | 7 | | 9 | 9 | | 7 | 30 | | 21 | 21 | | 30 |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 0% | 2% | 3% | 0% | 2% | 2% | 3% | 11% | 2% | 4% | 16% | 10% |
| Adj. Flow (vph) | 35 | 142 | 96 | 71 | 195 | 190 | 111 | 168 | 75 | 143 | 100 | 30 |
| Lane Group Flow (vph) | 35 | 238 | 0 | 71 | 385 | 0 | 111 | 243 | 0 | 143 | 130 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 2 | | | 6 | | | 8 | | | 4 | |
| Permitted Phases | 2 | | | 6 | | | 8 | | | 4 | | |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | |
| Total Split (s) | 31.0 | 31.0 | 0.0 | 31.0 | 31.0 | 0.0 | 29.0 | 29.0 | 0.0 | 29.0 | 29.0 | 0.0 |
| Total Split (%) | 51.7% | 51.7% | 0.0% | 51.7% | 51.7% | 0.0% | 48.3% | 48.3% | 0.0% | 48.3% | 48.3% | 0.0% |
| Maximum Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Act Effct Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Actuated g/C Ratio | 0.45 | 0.45 | | 0.45 | 0.45 | | 0.42 | 0.42 | | 0.42 | 0.42 | |
| v/c Ratio | 0.14 | 0.41 | | 0.21 | 0.65 | | 0.32 | 0.48 | | 0.49 | 0.27 | |
| Control Delay | 11.4 | 10.1 | | 12.0 | 15.5 | | 15.2 | 14.2 | | 19.8 | 10.9 | |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | |
| Total Delay | 11.4 | 10.1 | | 12.0 | 15.5 | | 15.2 | 14.2 | | 19.8 | 10.9 | |
| LOS | B | B | | B | B | | B | B | | B | B | |
| Approach Delay | | 10.3 | | | 15.0 | | | 14.5 | | | 15.6 | |
| Approach LOS | | B | | | B | | | B | | | B | |
| Queue Length 50th (m) | 2.1 | 10.9 | | 4.5 | 21.7 | | 7.9 | 14.6 | | 11.0 | 6.8 | |
| Queue Length 95th (m) | 6.3 | 22.6 | | 10.7 | 42.1 | | 16.8 | 28.7 | | 23.4 | 15.1 | |
| Internal Link Dist (m) | | 101.6 | | | 227.6 | | | 232.7 | | | 102.4 | |

Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
10 Year Horizon AM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Turn Bay Length (m) | | | | | | | | | | | | |
| Base Capacity (vph) | 257 | 577 | | 344 | 588 | | 343 | 503 | | 294 | 473 | |
| Starvation Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Spillback Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Storage Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Reduced v/c Ratio | 0.14 | 0.41 | | 0.21 | 0.65 | | 0.32 | 0.48 | | 0.49 | 0.27 | |

Intersection Summary

Area Type: CBD

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.65

Intersection Signal Delay: 14.0





Intersection LOS: B

Intersection Capacity Utilization 70.5%

ICU Level of Service C

Analysis Period (min) 15



















Splits and Phases: 1: Mivvik Street & Federal Road

| | |
|--|--|
|  ø2 |  ø4 |
| 31 s | 29 s |
|  ø6 |  ø8 |
| 31 s | 29 s |

HCM Unsignalized Intersection Capacity Analysis





















4: Niagunngusiaq Road & Hospital Driveway

City of Iqaluit Traffic Signals Review
10 Year Horizon AM

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | |  |  | |  |  | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Volume (veh/h) | 11 | 149 | 89 | 66 | 388 | 23 | 61 | 6 | 24 | 3 | 5 | 13 |
| Peak Hour Factor | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Hourly flow rate (vph) | 13 | 175 | 105 | 78 | 456 | 27 | 72 | 7 | 28 | 4 | 6 | 15 |
| Pedestrians | | 18 | | | 5 | | | 19 | | | 8 | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | |
| Percent Blockage | | 2 | | | 0 | | | 2 | | | 1 | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 492 | | | 299 | | | 934 | 919 | 252 | 924 | 958 | 496 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 492 | | | 299 | | | 934 | 919 | 252 | 924 | 958 | 496 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 94 | | | 66 | 97 | 96 | 98 | 97 | 97 |
| cM capacity (veh/h) | 1075 | | | 1242 | | | 213 | 247 | 776 | 218 | 235 | 565 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | |
| Volume Total | 293 | 561 | 72 | 35 | 4 | 21 | | | | | | |
| Volume Left | 13 | 78 | 72 | 0 | 4 | 0 | | | | | | |
| Volume Right | 105 | 27 | 0 | 28 | 0 | 15 | | | | | | |
| cSH | 1075 | 1242 | 213 | 543 | 218 | 406 | | | | | | |
| Volume to Capacity | 0.01 | 0.06 | 0.34 | 0.06 | 0.02 | 0.05 | | | | | | |
| Queue Length 95th (m) | 0.3 | 1.5 | 10.7 | 1.6 | 0.4 | 1.2 | | | | | | |
| Control Delay (s) | 0.5 | 1.7 | 30.3 | 12.1 | 21.8 | 14.4 | | | | | | |
| Lane LOS | A | A | D | B | C | B | | | | | | |
| Approach Delay (s) | 0.5 | 1.7 | 24.3 | | 15.4 | | | | | | | |
| Approach LOS | | | C | | C | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 4.2 | | | | | | | | | |
| Intersection Capacity Utilization | | | 79.8% | | | ICU Level of Service | | | | D | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |













Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
10 Year Horizon Midday

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  | |  |  | |  |  | |  |  | |
| Ideal Flow (vphpl) | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ped Bike Factor | 0.99 | 0.99 | | 0.99 | 0.99 | | 0.95 | 0.98 | | 0.97 | 0.99 | |
| Frt | | 0.939 | | | 0.941 | | | 0.956 | | | 0.978 | |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1254 | 1192 | 0 | 1254 | 1201 | 0 | 1217 | 1144 | 0 | 1205 | 1109 | 0 |
| Flt Permitted | 0.493 | | | 0.480 | | | 0.678 | | | 0.575 | | |
| Satd. Flow (perm) | 646 | 1192 | 0 | 627 | 1201 | 0 | 827 | 1144 | 0 | 710 | 1109 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 75 | | | 72 | | | 42 | | | 18 | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Link Speed (k/h) | | 40 | | | 40 | | | 40 | | | 40 | |
| Link Distance (m) | | 125.6 | | | 251.6 | | | 256.7 | | | 126.4 | |
| Travel Time (s) | | 11.3 | | | 22.6 | | | 23.1 | | | 11.4 | |
| Volume (vph) | 38 | 170 | 116 | 58 | 166 | 109 | 130 | 144 | 59 | 120 | 88 | 15 |
| Confl. Peds. (#/hr) | 7 | | 9 | 9 | | 7 | 30 | | 21 | 21 | | 30 |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 0% | 2% | 3% | 0% | 2% | 2% | 3% | 11% | 2% | 4% | 16% | 10% |
| Adj. Flow (vph) | 45 | 202 | 138 | 69 | 198 | 130 | 155 | 171 | 70 | 143 | 105 | 18 |
| Lane Group Flow (vph) | 45 | 340 | 0 | 69 | 328 | 0 | 155 | 241 | 0 | 143 | 123 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 2 | | | 6 | | | 8 | | | 4 | |
| Permitted Phases | 2 | | | 6 | | | 8 | | | 4 | | |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | |
| Total Split (s) | 31.0 | 31.0 | 0.0 | 31.0 | 31.0 | 0.0 | 29.0 | 29.0 | 0.0 | 29.0 | 29.0 | 0.0 |
| Total Split (%) | 51.7% | 51.7% | 0.0% | 51.7% | 51.7% | 0.0% | 48.3% | 48.3% | 0.0% | 48.3% | 48.3% | 0.0% |
| Maximum Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Act Effct Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Actuated g/C Ratio | 0.45 | 0.45 | | 0.45 | 0.45 | | 0.42 | 0.42 | | 0.42 | 0.42 | |
| v/c Ratio | 0.15 | 0.59 | | 0.24 | 0.57 | | 0.45 | 0.48 | | 0.48 | 0.26 | |
| Control Delay | 11.5 | 14.5 | | 13.1 | 13.9 | | 17.8 | 14.4 | | 19.7 | 11.6 | |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | |
| Total Delay | 11.5 | 14.5 | | 13.1 | 13.9 | | 17.8 | 14.4 | | 19.7 | 11.6 | |
| LOS | B | B | | B | B | | B | B | | B | B | |
| Approach Delay | | 14.1 | | | 13.8 | | | 15.7 | | | 16.0 | |
| Approach LOS | | B | | | B | | | B | | | B | |
| Queue Length 50th (m) | 2.8 | 19.9 | | 4.4 | 18.8 | | 11.7 | 14.8 | | 11.0 | 7.1 | |
| Queue Length 95th (m) | 7.5 | 37.5 | | 11.0 | 35.8 | | 23.8 | 28.8 | | 23.3 | 15.3 | |
| Internal Link Dist (m) | | 101.6 | | | 227.6 | | | 232.7 | | | 102.4 | |

Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
10 Year Horizon Midday

| |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Turn Bay Length (m) | | | | | | | | | | | | |
| Base Capacity (vph) | 291 | 578 | | 282 | 580 | | 345 | 501 | | 296 | 473 | |
| Starvation Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Spillback Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Storage Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Reduced v/c Ratio | 0.15 | 0.59 | | 0.24 | 0.57 | | 0.45 | 0.48 | | 0.48 | 0.26 | |

Intersection Summary

Area Type: CBD

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.59

Intersection Signal Delay: 14.8





Intersection LOS: B

Intersection Capacity Utilization 68.3%

ICU Level of Service C



















Analysis Period (min) 15

Splits and Phases: 1: Mivvik Street & Federal Road

| | |
|--|--|
|  ø2 |  ø4 |
| 31 s | 29 s |
|  ø6 |  ø8 |
| 31 s | 29 s |





















HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiaq Road & Hospital Driveway

City of Iqaluit Traffic Signals Review
10 Year Horizon Midday

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | |  |  | |  |  | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Volume (veh/h) | 11 | 189 | 95 | 61 | 400 | 18 | 66 | 11 | 36 | 6 | 6 | 10 |
| Peak Hour Factor | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Hourly flow rate (vph) | 13 | 222 | 112 | 72 | 471 | 21 | 78 | 13 | 42 | 7 | 7 | 12 |
| Pedestrians | | 18 | | | 5 | | | 19 | | | 8 | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | |
| Percent Blockage | | 2 | | | 0 | | | 2 | | | 1 | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage veh | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 500 | | | 353 | | | 981 | 966 | 302 | 991 | 1012 | 507 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 500 | | | 353 | | | 981 | 966 | 302 | 991 | 1012 | 507 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 94 | | | 61 | 94 | 94 | 96 | 97 | 98 |
| cM capacity (veh/h) | 1067 | | | 1186 | | | 198 | 233 | 727 | 188 | 219 | 557 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | |
| Volume Total | 347 | 564 | 78 | 55 | 7 | 19 | | | | | | |
| Volume Left | 13 | 72 | 78 | 0 | 7 | 0 | | | | | | |
| Volume Right | 112 | 21 | 0 | 42 | 0 | 12 | | | | | | |
| cSH | 1067 | 1186 | 198 | 485 | 188 | 352 | | | | | | |
| Volume to Capacity | 0.01 | 0.06 | 0.39 | 0.11 | 0.04 | 0.05 | | | | | | |
| Queue Length 95th (m) | 0.3 | 1.5 | 13.2 | 2.9 | 0.9 | 1.3 | | | | | | |
| Control Delay (s) | 0.4 | 1.7 | 34.4 | 13.4 | 24.9 | 15.8 | | | | | | |
| Lane LOS | A | A | D | B | C | C | | | | | | |
| Approach Delay (s) | 0.4 | 1.7 | 25.7 | | 18.3 | | | | | | | |
| Approach LOS | | | D | | C | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 4.7 | | | | | | | | | |
| Intersection Capacity Utilization | | | 83.8% | | ICU Level of Service | | | | | E | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |













Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
10 Year Horizon PM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  |  | |  |  | |  |  | |  |  | |
| Ideal Flow (vphpl) | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 | 1450 |
| Total Lost Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Turning Speed (k/h) | 24 | | 14 | 24 | | 14 | 24 | | 14 | 24 | | 14 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Ped Bike Factor | 0.99 | 0.99 | | 0.99 | 0.99 | | 0.96 | 0.97 | | 0.97 | 1.00 | |
| Frt | | 0.944 | | | 0.938 | | | 0.924 | | | 0.991 | |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1254 | 1200 | 0 | 1254 | 1197 | 0 | 1217 | 1111 | 0 | 1205 | 1126 | 0 |
| Flt Permitted | 0.504 | | | 0.447 | | | 0.637 | | | 0.614 | | |
| Satd. Flow (perm) | 660 | 1200 | 0 | 585 | 1197 | 0 | 781 | 1111 | 0 | 756 | 1126 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 66 | | | 77 | | | 105 | | | 6 | |
| Headway Factor | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 | 1.13 |
| Link Speed (k/h) | | 40 | | | 40 | | | 40 | | | 40 | |
| Link Distance (m) | | 125.6 | | | 251.6 | | | 256.7 | | | 126.4 | |
| Travel Time (s) | | 11.3 | | | 22.6 | | | 23.1 | | | 11.4 | |
| Volume (vph) | 19 | 196 | 118 | 84 | 156 | 110 | 109 | 86 | 88 | 164 | 149 | 9 |
| Confl. Peds. (#/hr) | 7 | | 9 | 9 | | 7 | 30 | | 21 | 21 | | 30 |
| Peak Hour Factor | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 |
| Heavy Vehicles (%) | 0% | 2% | 3% | 0% | 2% | 2% | 3% | 11% | 2% | 4% | 16% | 10% |
| Adj. Flow (vph) | 23 | 233 | 140 | 100 | 186 | 131 | 130 | 102 | 105 | 195 | 177 | 11 |
| Lane Group Flow (vph) | 23 | 373 | 0 | 100 | 317 | 0 | 130 | 207 | 0 | 195 | 188 | 0 |
| Turn Type | Perm | | | Perm | | | Perm | | | Perm | | |
| Protected Phases | | 2 | | | 6 | | | 8 | | | 4 | |
| Permitted Phases | 2 | | | 6 | | | 8 | | | 4 | | |
| Minimum Split (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | |
| Total Split (s) | 31.0 | 31.0 | 0.0 | 31.0 | 31.0 | 0.0 | 29.0 | 29.0 | 0.0 | 29.0 | 29.0 | 0.0 |
| Total Split (%) | 51.7% | 51.7% | 0.0% | 51.7% | 51.7% | 0.0% | 48.3% | 48.3% | 0.0% | 48.3% | 48.3% | 0.0% |
| Maximum Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | |
| All-Red Time (s) | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | | 0.5 | 0.5 | |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Walk Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | |
| Flash Dont Walk (s) | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | | 11.0 | 11.0 | |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Act Effct Green (s) | 27.0 | 27.0 | | 27.0 | 27.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Actuated g/C Ratio | 0.45 | 0.45 | | 0.45 | 0.45 | | 0.42 | 0.42 | | 0.42 | 0.42 | |
| v/c Ratio | 0.08 | 0.65 | | 0.38 | 0.55 | | 0.40 | 0.40 | | 0.62 | 0.40 | |
| Control Delay | 10.4 | 16.8 | | 16.4 | 13.2 | | 16.9 | 8.9 | | 24.8 | 15.0 | |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | |
| Total Delay | 10.4 | 16.8 | | 16.4 | 13.2 | | 16.9 | 8.9 | | 24.8 | 15.0 | |
| LOS | B | B | | B | B | | B | A | | C | B | |
| Approach Delay | | 16.4 | | | 14.0 | | | 12.0 | | | 20.0 | |
| Approach LOS | | B | | | B | | | B | | | B | |
| Queue Length 50th (m) | 1.4 | 24.2 | | 6.9 | 17.4 | | 9.6 | 6.9 | | 16.1 | 13.3 | |
| Queue Length 95th (m) | 4.5 | 44.3 | | 16.1 | 33.5 | | 20.1 | 17.5 | | 32.8 | 25.0 | |
| Internal Link Dist (m) | | 101.6 | | | 227.6 | | | 232.7 | | | 102.4 | |

Lanes, Volumes, Timings
1: Mivvik Street & Federal Road

City of Iqaluit Traffic Signals Review
10 Year Horizon PM

| |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Turn Bay Length (m) | | | | | | | | | | | | |
| Base Capacity (vph) | 297 | 576 | | 263 | 581 | | 325 | 524 | | 315 | 473 | |
| Starvation Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Spillback Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Storage Cap Reductn | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | |
| Reduced v/c Ratio | 0.08 | 0.65 | | 0.38 | 0.55 | | 0.40 | 0.40 | | 0.62 | 0.40 | |

Intersection Summary

Area Type: CBD

Cycle Length: 60

Actuated Cycle Length: 60

Offset: 0 (0%), Referenced to phase 2:EBTL and 6:WBTL, Start of Green

Natural Cycle: 40

Control Type: Pretimed

Maximum v/c Ratio: 0.65

Intersection Signal Delay: 15.7





Intersection LOS: B

Intersection Capacity Utilization 74.6%

ICU Level of Service D

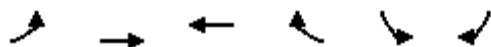
Analysis Period (min) 15

Splits and Phases: 1: Mivvik Street & Federal Road

| | |
|--|--|
|  ø2 |  ø4 |
| 31 s | 29 s |
|  ø6 |  ø8 |
| 31 s | 29 s |

HCM Unsignalized Intersection Capacity Analysis 2: Niagunngusiaq Road & Kangiq & Iniq Drive

City of Iqaluit Traffic Signals Review
10 Year Horizon PM

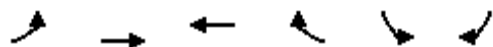






| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↶ | ↶ | | ↶ | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 13 | 489 | 315 | 20 | 41 | 10 |
| Peak Hour Factor | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 |
| Hourly flow rate (vph) | 20 | 741 | 477 | 30 | 62 | 15 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | 252 | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 508 | | | | 1273 | 492 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 508 | | | | 1273 | 492 |
| tC, single (s) | 4.2 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.3 | | | | 3.5 | 3.3 |
| p0 queue free % | 98 | | | | 66 | 97 |
| cM capacity (veh/h) | 1017 | | | | 183 | 581 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 761 | 508 | 77 | | | |
| Volume Left | 20 | 0 | 62 | | | |
| Volume Right | 0 | 30 | 15 | | | |
| cSH | 1017 | 1700 | 211 | | | |
| Volume to Capacity | 0.02 | 0.30 | 0.37 | | | |
| Queue Length 95th (m) | 0.4 | 0.0 | 12.0 | | | |
| Control Delay (s) | 0.5 | 0.0 | 31.5 | | | |
| Lane LOS | A | | D | | | |
| Approach Delay (s) | 0.5 | 0.0 | 31.5 | | | |
| Approach LOS | | | D | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 2.1 | | | |
| Intersection Capacity Utilization | | 63.6% | | ICU Level of Service | | B |
| Analysis Period (min) | | 15 | | | | |

HCM Unsignalized Intersection Capacity Analysis

3: Niagunngusiaq Road & Saputi Road



















City of Iqaluit Traffic Signals Review
10 Year Horizon PM



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|---|---|---|------|---|------|
| Lane Configurations |  |  |  | |  | |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Volume (veh/h) | 86 | 488 | 311 | 33 | 35 | 61 |
| Peak Hour Factor | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 |
| Hourly flow rate (vph) | 116 | 659 | 420 | 45 | 47 | 82 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | | | | None | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 465 | | | | 1334 | 443 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 465 | | | | 1334 | 443 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.3 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.4 |
| p0 queue free % | 90 | | | | 69 | 86 |
| cM capacity (veh/h) | 1107 | | | | 153 | 607 |
| Direction, Lane # | EB 1 | EB 2 | WB 1 | SB 1 | | |
| Volume Total | 116 | 659 | 465 | 130 | | |
| Volume Left | 116 | 0 | 0 | 47 | | |
| Volume Right | 0 | 0 | 45 | 82 | | |
| cSH | 1107 | 1700 | 1700 | 292 | | |
| Volume to Capacity | 0.10 | 0.39 | 0.27 | 0.44 | | |
| Queue Length 95th (m) | 2.7 | 0.0 | 0.0 | 16.5 | | |
| Control Delay (s) | 8.6 | 0.0 | 0.0 | 26.8 | | |
| Lane LOS | A | | | D | | |
| Approach Delay (s) | 1.3 | | 0.0 | 26.8 | | |
| Approach LOS | | | | D | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 3.3 | | | |
| Intersection Capacity Utilization | | | 52.3% | | ICU Level of Service | A |
| Analysis Period (min) | | | 15 | | | |
| | | | | | | |

HCM Unsignalized Intersection Capacity Analysis 4: Niagunngusiaq Road & Hospital Driveway

City of Iqaluit Traffic Signals Review
10 Year Horizon PM

| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | |  |  | |  |  | |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Volume (veh/h) | 10 | 385 | 94 | 44 | 215 | 4 | 64 | 4 | 105 | 9 | 11 | 10 |
| Peak Hour Factor | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Hourly flow rate (vph) | 12 | 453 | 111 | 52 | 253 | 5 | 75 | 5 | 124 | 11 | 13 | 12 |
| Pedestrians | | 18 | | | 5 | | | 19 | | | 8 | |
| Lane Width (m) | | 3.7 | | | 3.7 | | | 3.7 | | | 3.7 | |
| Walking Speed (m/s) | | 1.2 | | | 1.2 | | | 1.2 | | | 1.2 | |
| Percent Blockage | | 2 | | | 0 | | | 2 | | | 1 | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | | | | | | | None | | | None | |
| Median storage (veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 266 | | | 583 | | | 946 | 920 | 532 | 1029 | 973 | 281 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 266 | | | 583 | | | 946 | 920 | 532 | 1029 | 973 | 281 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 99 | | | 95 | | | 64 | 98 | 77 | 93 | 94 | 98 |
| cM capacity (veh/h) | 1301 | | | 976 | | | 208 | 250 | 540 | 150 | 233 | 746 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | NB 2 | SB 1 | SB 2 | | | | | | |
| Volume Total | 575 | 309 | 75 | 128 | 11 | 25 | | | | | | |
| Volume Left | 12 | 52 | 75 | 0 | 11 | 0 | | | | | | |
| Volume Right | 111 | 5 | 0 | 124 | 0 | 12 | | | | | | |
| cSH | 1301 | 976 | 208 | 518 | 150 | 346 | | | | | | |
| Volume to Capacity | 0.01 | 0.05 | 0.36 | 0.25 | 0.07 | 0.07 | | | | | | |
| Queue Length 95th (m) | 0.2 | 1.3 | 11.8 | 7.4 | 1.7 | 1.7 | | | | | | |
| Control Delay (s) | 0.3 | 2.0 | 31.8 | 14.2 | 30.7 | 16.2 | | | | | | |
| Lane LOS | A | A | D | B | D | C | | | | | | |
| Approach Delay (s) | 0.3 | 2.0 | 20.7 | | 20.6 | | | | | | | |
| Approach LOS | | | C | | C | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Average Delay | | | 5.1 | | | | | | | | | |
| Intersection Capacity Utilization | | | 71.6% | ICU Level of Service | | | C | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |
| | | | | | | | | | | | | |

Appendix G

RODEL Analysis

```

*****
*
*      6:8:09                      IQALUIT 4 CORNERS                      4
*
*****
*
* E      (m)      4.50      4.50      4.50      4.50      * TIME PERIOD      min      90
* L'     (m)      30.00     30.00     30.00     30.00     * TIME SLICE      min      15
* V      (m)      3.50      3.50      3.50      3.50     * RESULTS PERIOD  min      15 75
* RAD    (m)      20.00     20.00     20.00     20.00     * TIME COST      $/hr     15.00
* PHI    (d)      25.00     25.00     25.00     25.00     * FLOW PERIOD    min      15 75
* DIA    (m)      45.00     45.00     45.00     45.00     * FLOW TYPE      pcu/veh    VEH
* GRAD SEP      0          0          0          0        * FLOW PEAK      am/op/pm    AM
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL* FLOW RATIO *FLOW TIME*
*          *    *
* FEDERAL  *1.09*  20    67    96    0        *1.00*50*0.75 1.125 0.75*15 45 75
* MIVVIK   *1.02*  65    95    23    0        *1.00*50*0.75 1.125 0.75*15 45 75
* QE II    *1.06*  50   113    74    0        *1.00*50*0.75 1.125 0.75*15 45 75
* APEX     *1.02* 128   131    48    0        *1.00*50*0.75 1.125 0.75*15 45 75
*          *    *
*          *    *
*          *    *
*          *    *
*****
*
* FLOW      veh      183      183      237      307
* CAPACITY  veh      1110     1205     1160     1208
* AVE DELAY mins    0.06     0.06     0.06     0.07
* MAX DELAY mins    0.08     0.07     0.08     0.09
* AVE QUEUE  veh      0          0          0          0
* MAX QUEUE  veh      0          0          0          0
*
*****

```

```

*****
*
* 6:8:09 IQALUIT 4 CORNERS 5
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm OP *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* FEDERAL *1.07* 12 70 96 0 *1.00*50*1.00 1.000 1.00*15 45 75 *
* MIVVIK *1.03* 93 136 30 0 *1.00*50*1.00 1.000 1.00*15 45 75 *
* QE II *1.05* 47 115 104 0 *1.00*50*1.00 1.000 1.00*15 45 75 *
* APEX *1.02* 87 133 46 0 *1.00*50*1.00 1.000 1.00*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 178 259 266 266 *
* CAPACITY veh 1114 1195 1145 1186 * AVDEL s 3.9 *
* AVE DELAY mins 0.06 0.06 0.07 0.07 * L O S A *
* MAX DELAY mins 0.06 0.06 0.07 0.07 * VEH HRS 1.1 *
* AVE QUEUE veh 0 0 0 0 * COST $ 15.8 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
* 6:8:09 IQALUIT 4 CORNERS 6
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm PM *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* FEDERAL *1.02* 7 119 131 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* MIVVIK *1.03* 94 157 15 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* QE II *1.03* 70 69 87 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* APEX *1.05* 88 125 67 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 257 266 226 280 *
* CAPACITY veh 1169 1139 1147 1198 * AVDEL s 3.9 *
* AVE DELAY mins 0.06 0.07 0.06 0.06 * L O S A *
* MAX DELAY mins 0.08 0.09 0.08 0.08 * VEH HRS 1.1 *
* AVE QUEUE veh 0 0 0 0 * COST $ 16.7 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
* 6:8:09 IQALUIT 4 CORNERS 7
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm AM *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* FEDERAL *1.09* 20 67 96 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* MIVVIK *1.02* 65 95 23 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* QE II *1.06* 50 113 74 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* APEX *1.02* 128 131 48 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 183 183 237 307 *
* CAPACITY veh 980 1066 1027 1069 * AVDEL s 4.4 *
* AVE DELAY mins 0.07 0.07 0.07 0.08 * L O S A *
* MAX DELAY mins 0.10 0.09 0.10 0.10 * VEH HRS 1.1 *
* AVE QUEUE veh 0 0 0 0 * COST $ 16.7 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
* 6:8:09 IQALUIT 4 CORNERS 8
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm OP *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* FEDERAL *1.07* 12 70 96 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* MIVVIK *1.03* 93 136 30 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* QE II *1.05* 47 115 104 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* APEX *1.02* 87 133 46 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 178 259 266 266 *
* CAPACITY veh 982 1057 1010 1047 * AVDEL s 4.6 *
* AVE DELAY mins 0.07 0.07 0.08 0.08 * L O S A *
* MAX DELAY mins 0.07 0.08 0.08 0.08 * VEH HRS 1.2 *
* AVE QUEUE veh 0 0 0 0 * COST $ 18.6 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
* 6:8:09 IQALUIT 4 CORNERS 9
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm PM *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U) *FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* FEDERAL *1.02* 7 119 131 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* MIVVIK *1.03* 94 157 15 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* QE II *1.03* 70 69 87 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* APEX *1.05* 88 125 67 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 257 266 226 280 *
* CAPACITY veh 1030 1001 1009 1063 * AVDEL s 4.6 *
* AVE DELAY mins 0.08 0.08 0.08 0.08 * L O S A *
* MAX DELAY mins 0.10 0.11 0.10 0.10 * VEH HRS 1.3 *
* AVE QUEUE veh 0 0 0 0 * COST $ 19.7 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
* 6:8:09 IQALUIT HOSPITAL 1
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm AM *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U) *FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* HOSPITAL *1.00* 10 4 2 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* APEX *1.04* 71 119 9 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* QE II *1.00* 19 5 49 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* APEX *1.01* 18 310 53 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 16 199 73 381 *
* CAPACITY veh 1122 1273 1281 1308 * AVDEL s 3.5 *
* AVE DELAY mins 0.05 0.05 0.05 0.06 * L O S A *
* MAX DELAY mins 0.07 0.07 0.06 0.08 * VEH HRS 0.7 *
* AVE QUEUE veh 0 0 0 0 * COST $ 9.9 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
*      6:8:09                      IQALUIT HOSPITAL                      2
*
*****
*
* E      (m)      4.50      4.50      4.50      4.50      * TIME PERIOD      min      90
* L'     (m)      30.00     30.00     30.00     30.00     * TIME SLICE       min      15
* V      (m)      3.50      3.50      3.50      3.50     * RESULTS PERIOD   min     15 75
* RAD    (m)      20.00     20.00     20.00     20.00     * TIME COST        $/hr    15.00
* PHI    (d)      25.00     25.00     25.00     25.00     * FLOW PERIOD      min     15 75
* DIA    (m)      45.00     45.00     45.00     45.00     * FLOW TYPE        pcu/veh   VEH
* GRAD SEP      0          0          0          0          * FLOW PEAK        am/op/pm   OP
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL* FLOW RATIO *FLOW TIME*
*      *      *
* HOSPITAL *1.00*      8      5      5 0      *1.00*50*1.00 1.000 1.00*15 45 75
* APEX      *1.03*     76    151     9 0      *1.00*50*1.00 1.000 1.00*15 45 75
* QE II     *1.02*     49     10     29 0      *1.00*50*1.00 1.000 1.00*15 45 75
* APEX      *1.02*     14    320     49 0      *1.00*50*1.00 1.000 1.00*15 45 75
*      *      *
*      *      *
*      *      *
*      *      *
*****
*
* FLOW      veh      18      236      88      383
* CAPACITY  veh      1128     1285     1237     1304
* AVE DELAY mins     0.05     0.06     0.05     0.07
* MAX DELAY mins     0.05     0.06     0.05     0.07
* AVE QUEUE  veh      0          0          0          0
* MAX QUEUE  veh      0          0          0          0
*
*****

```

```

*****
*
* 6:8:09 IQALUIT HOSPITAL 3
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm PM *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U) *FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* HOSPITAL *1.00* 8 9 7 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* APEX *1.02* 75 308 8 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* QE II *1.01* 84 3 51 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* APEX *1.02* 3 172 35 0 *1.00*50*0.75 1.125 0.75*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 24 391 138 210 *
* CAPACITY veh 1209 1302 1159 1296 * AVDEL s 3.6 *
* AVE DELAY mins 0.05 0.06 0.06 0.05 * L O S A *
* MAX DELAY mins 0.06 0.08 0.07 0.07 * VEH HRS 0.8 *
* AVE QUEUE veh 0 0 0 0 * COST $ 11.4 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
*      6:8:09                      IQALUIT HOSPITAL                      4
*
*****
*
* E      (m)      4.50      4.50      4.50      4.50      * TIME PERIOD      min      90
* L'     (m)      30.00     30.00     30.00     30.00     * TIME SLICE       min      15
* V      (m)      3.50      3.50      3.50      3.50     * RESULTS PERIOD   min     15 75
* RAD    (m)      20.00     20.00     20.00     20.00     * TIME COST        $/hr    15.00
* PHI    (d)      25.00     25.00     25.00     25.00     * FLOW PERIOD      min     15 75
* DIA    (m)      45.00     45.00     45.00     45.00     * FLOW TYPE        pcu/veh   VEH
* GRAD SEP      0          0          0          0         * FLOW PEAK        am/op/pm   AM
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL* FLOW RATIO *FLOW TIME*
*      *      *
* HOSPITAL *1.00* 10      4      2      0      *1.00*85*0.75 1.125 0.75*15 45 75
* APEX      *1.04* 71     119     9      0      *1.00*85*0.75 1.125 0.75*15 45 75
* QE II     *1.00* 19      5      49     0      *1.00*85*0.75 1.125 0.75*15 45 75
* APEX      *1.01* 18     310     53     0      *1.00*85*0.75 1.125 0.75*15 45 75
*      *      *
*      *      *
*      *      *
*      *      *
*****
*
* FLOW      veh      16      199      73      381
* CAPACITY  veh      980     1136     1139     1168
* AVE DELAY mins     0.06     0.06     0.06     0.07
* MAX DELAY mins     0.08     0.08     0.07     0.10
* AVE QUEUE  veh      0          0          0          0
* MAX QUEUE  veh      0          0          0          1
*
*****

```

```

*****
*
* 6:8:09 IQALUIT HOSPITAL 5
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm OP *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U) *FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* HOSPITAL *1.00* 8 5 5 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* APEX *1.03* 76 151 9 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* QE II *1.02* 49 10 29 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* APEX *1.02* 14 320 49 0 *1.00*85*1.00 1.000 1.00*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 18 236 88 383 *
* CAPACITY veh 986 1147 1097 1164 * AVDEL s 4.2 *
* AVE DELAY mins 0.06 0.07 0.06 0.08 * L O S A *
* MAX DELAY mins 0.06 0.07 0.06 0.08 * VEH HRS 0.9 *
* AVE QUEUE veh 0 0 0 0 * COST $ 12.8 *
* MAX QUEUE veh 0 0 0 0 *
*
*****

```

```

*****
*
* 6:8:09 IQALUIT HOSPITAL 6
*
*****
*
* E (m) 4.50 4.50 4.50 4.50 * TIME PERIOD min 90 *
* L' (m) 30.00 30.00 30.00 30.00 * TIME SLICE min 15 *
* V (m) 3.50 3.50 3.50 3.50 * RESULTS PERIOD min 15 75 *
* RAD (m) 20.00 20.00 20.00 20.00 * TIME COST $/hr 15.00 *
* PHI (d) 25.00 25.00 25.00 25.00 * FLOW PERIOD min 15 75 *
* DIA (m) 45.00 45.00 45.00 45.00 * FLOW TYPE pcu/veh VEH *
* GRAD SEP 0 0 0 0 * FLOW PEAK am/op/pm PM *
*
*****
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U) *FLOF*CL* FLOW RATIO *FLOW TIME*
* * * * * * * * * *
* HOSPITAL *1.00* 8 9 7 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* APEX *1.02* 75 308 8 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* QE II *1.01* 84 3 51 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* APEX *1.02* 3 172 35 0 *1.00*85*0.75 1.125 0.75*15 45 75 *
* * * * * * * * * *
* * * * * * * * * *
* * * * * * * * * *
*****
*
* FLOW veh 24 391 138 210 *
* CAPACITY veh 1067 1163 1019 1157 * AVDEL s 4.2 *
* AVE DELAY mins 0.06 0.08 0.07 0.06 * L O S A *
* MAX DELAY mins 0.07 0.10 0.09 0.08 * VEH HRS 0.9 *
* AVE QUEUE veh 0 1 0 0 * COST $ 13.3 *
* MAX QUEUE veh 0 1 0 0 *
*
*****

```

Appendix H

Traffic Light Controller Specifications

Introduction

The following specification describes the minimum requirements for a fully actuated/fixed-time, solid state, digital microprocessor based controller assembly for installation at the Four Corners Intersection in the City of Iqaluit.

The traffic controller assembly shall consist of a digital controller unit, signal conflict monitor, load switches, filters, flasher, flash transfer relays, connection wiring harnesses and other miscellaneous equipment in a complete and fully wired aluminum weatherproof cabinet.

This installation will be a two phase vehicle and pedestrian control system operating in a fixed-time mode. No detection equipment is required.

The supplier shall program the controller unit with timing data to be provided at time of procurement.

All equipment furnished under this specification must be current production equipment and of recent manufacturer, identical models of which are field operational.

Traffic Signal Controller

The traffic signal controller unit shall meet the latest version of NEMA TS-2 specifications in addition to the other requirements addressed in this specification.

The controller shall be a NEMA TS-2 Type 2, provided with the A, B, C and D connectors.

The intersection controller units shall be capable of up to 8-phase operation, however it will operate as a two phase fixed-time controller for this installation.

Volume density and pedestrian timing shall be provided for all phases.

All controller timing parameters shall be fully programmable from the front panel keyboard, and memory storage features shall be non-volatile under power-off conditions for at least thirty (30) days.

Locking, non-locking, and maximum recall detection mode for vehicle detectors and pedestrian recall shall be programmable per phase.

A metal case suitable for shelf mounting shall be provided to house the controller unit.

All modules shall utilize digital timing in the control logic and shall utilize line frequency as a base reference.

A communications module shall provide a RS-232-C interface suitable for connection to a wireless radio for future interconnect.

Conflict Monitor

A conflict monitor shall be provide to detect the presence of conflicting green, yellow, or walk signal voltages on the AC field terminals (full or 1/2 wave) between any two or more non-compatible channels and initiate a All Red flashing operation.

Conflicts shall always be considered a non-correcting failure.

In addition, the conflict monitor shall initiate flashing operation as a result of over-current protection operation, absence of AC+ to the monitor, or a failure of the monitor or controller power supply.

The conflict monitor shall provide an internal "watch dog" circuit to monitor the central processor unit. If the processor fails to periodically cycle the monitor, then flashing operation shall result.

The conflict monitor shall pre-programmed by the supplier for this operation.

Cabinet Assembly

The controller unit and auxiliary equipment shall be housed in an aluminum Type M cabinet.

All surfaces of the cabinet shall be clean, free of holes or blemishes, smooth without burrs and with exterior corners rounded. The cabinet shall be suitability primed and painted. Medium Gray in colour.

All cabinet doors shall incorporate hinges and hinge pins utilizing stainless steel. Fastening of hinges to doors and cabinets shall be made using stainless steel pop-rivets or stainless steel nuts and bolts.

A thermostatically controlled fan shall be provided near the top of the cabinet for summer ventilation and screened against the entrance of dust and foreign. A secure cover shall be provide to close the fan opening during winter.

The fan thermostat shall be adjustable from 20 °C to 50 °C.

A replaceable filter and vent cover for the incoming air shall be provided in the lower portion of the main door.

A thermostatically controlled industrial-quality air circulation heater shall be installed to keep the cabinet above 0 °C with an outside temperature of -50 °C. The heater shall be thermostatically controlled.

The interior of the cabinet shall fully insulated with high quality, non-combustible material.

A convenience outlet and trouble lamp receptacle shall be furnished within the cabinet.

The cabinet shall contain an internal test panel, located behind the 'police panel', which shall have switches as follows:

- Detector test pushbuttons for vehicle and pedestrian phase [future use].
- Stop Time-Run switch with Manual Advance pushbutton.
- Cabinet Light On - Off switch.
- Flash On-Off Switch
- Signals On-Off switch

A small door-in-door panel (police panel) shall have the following switches installed..

- Switch for automatic/manual operation with a manual cord consisting of six feet of rubber insulated cord and a weatherproof normally open momentary contact.
- Switch for automatic/flashing operation.
- Switch for signals only "on" and "off".

Back Panel

A back panel shall be provided which is attached to the rear wall of the cabinet and contain load switches, flashers, flash transfer relay, and terminal facilities.

Eight load switch bases shall be provided and wired to accommodate the four phase signal operation, two programmable overlaps and two concurrent pedestrian indications.

Four load switched shall be provided for phases 2 and 4 vehicle and pedestrian operation.

All load switch bases shall also be identified as to the phase or operation for which they are programmed.

A solid state two-circuit flasher with two transfer relays shall be furnished and completely wired.

The flasher shall conform to NEMA. The flasher shall be equipped with LED indicators representative of the flasher outputs.

Transfer relays shall be rated at 20 amps per circuit. Flash transfer relays shall be so wired as to be de-energized for flashing operation and shall be in close proximity to load relays, flashers, and field terminals.

A power distribution panel shall be located on the right side wall of the cabinet. The distribution panel shall be cover with a protective clear 'Lexan' material to prevent accidental touching of 'live' conductors.

The power distribution panel shall contain provisions for the connection of the incoming AC service, a main cabinet circuit breaker, a radio interference line filter , a lightning arrestor and a mercury buss relay to control the AC power to the signal heads.

All conductors, including spares, from the controller unit, conflict monitor, load switches and all other auxiliary equipment shall be terminated on interface terminal blocks in the cabinet and be identified.

All terminal connections shall be marked with a number and NEMA function. All labeling must be silk screen or permanent labels.

Instructions

One set of complete schematics and maintenance manual including detailed theory of operation, of the controller unit, monitor and auxiliary equipment shall be supplied with the controller assembly.

The supplier shall provide on-site 'turn-on' inspection service and training for local personnel in the operation and maintenance of the equipment.

The supplier shall provide a check-list for quarterly, semi-annually, annual checks to be performed [such as vent and fan cover replacements, operational checks, and conflict monitor checks]

Warranty

The complete control and auxiliary equipment shall carry a two (2) year guarantee from the date of delivery against any imperfections in workmanship or materials.

**Welcome
to the
Traffic Light Signal Controls
Public Information Centre**

**Welcome
to the
Traffic Light Signal Controls
Public Information Centre**

Project Purpose Project Purpose

In order to address the existing congestion and mitigate potential future problems, an analysis of traffic movements at key intersections in the Core Area has been undertaken.

Studies undertaken include:

- Intersection Counts
- Site Investigations
- Traffic Light Studies
- Roundabout Studies
- All-way Stop Studies
- Left Turn Lane Studies

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Intersections studied include:

- Four Corners Intersection
- City Hall Intersection
- High School Intersection
- Hospital Intersection

Intersections studied include:

- Four Corners Intersection
- City Hall Intersection
- High School Intersection
- Hospital Intersection

Issues Identified Issues Identified

Traffic Lights Studies

Four Corners Intersection: Lights needed

Hospital Intersection: Lights not needed

All-way Stop Studies

Hospital Intersection: All-way Stop not needed

Left Turn Lane Studies

City Hall Intersection: Left turn lane not needed

High School Intersection: Eastbound left turn lane
needed

Traffic Lights Studies

Four Corners Intersection: Lights needed

Hospital Intersection: Lights not needed

All-way Stop Studies

Hospital Intersection: All-way Stop not needed

Left Turn Lane Studies

City Hall Intersection: Left turn lane not needed

High School Intersection: Eastbound left turn lane
needed

Issues Identified Continued Issues Identified Continued

Crosswalks

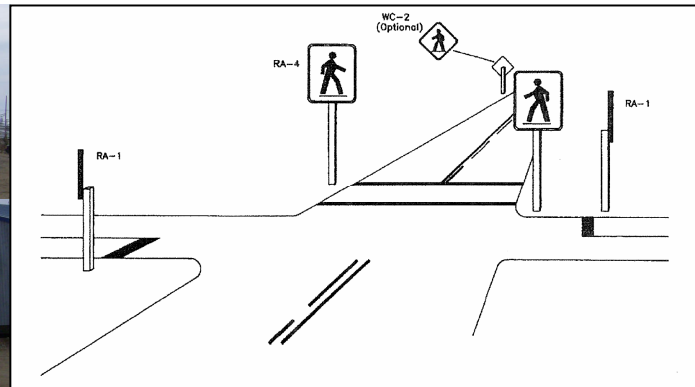
Not designed to Manual of Uniform Traffic Control Devices for Canada standards.



Mid-block crosswalk across Queen Elizabeth II Way
Mid-block crosswalk across Queen Elizabeth II Way

Crosswalks

Not designed to Manual of Uniform Traffic Control Devices for Canada standards.



TAC standard crosswalk design
TAC standard crosswalk design

Sign Standards

Sign design elements, such as language order and wording, must be consistent for all signs.



Existing Speed Limit signs have different language orders and different words in Inuktitut

Existing Speed Limit signs have different language orders and different words in Inuktitut

Sign Standards

Sign design elements, such as language order, must be consistent for all signs.

Transportation Trends

- Drivers hesitate at stop signs
- Pedestrians cross intersection diagonally
- ATVs drive in mixed traffic
- Traffic concentrated during short periods of time

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- Drivers hesitate at stop signs
- Pedestrians cross intersection diagonally
- ATVs drive in mixed traffic
- Traffic concentrated during short periods of time

Four Corners Intersection

Traffic Lights

Approximate Cost: \$465,000

Four Corners Intersection

Traffic Lights

Approximate Cost: \$465,000



Roundabout

Approximate Cost: \$1,000,000+

Roundabout

Approximate Cost: \$1,000,000+



Draft Solutions Continued Draft Solutions Continued

Hospital Intersection

Northbound and Southbound left
turn lanes

Approximate Cost: \$80,000

Hospital Intersection

Northbound and Southbound left
turn lanes

Approximate Cost: \$80,000



High School Intersection

Eastbound left turn lane

Approximate Cost: \$50,000

High School Intersection

Eastbound left turn lane

Approximate Cost: \$50,000



Recommendations and Next Steps

Recommendations:

- Install Traffic Lights at Four Corners Intersection
- Install Northbound and Southbound left turn lanes at Hospital Intersection
- Install Eastbound left turn lane at High School Intersection
- Develop crosswalk standards
- Develop uniform signage standards

Next Steps:

- Council Presentation
- Council Approval
- Detail Design

Recommendations:

- Install Traffic Lights at Four Corners Intersection
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- Develop uniform signage standards

Next Steps:

- Council Presentation
- Council Approval
- Detail Design

**Traffic Study – Nunavut Arctic
College: Iqaluit Campus**



Prepared for:
Government of Nunavut:
Community and Government
Services

Prepared by:
Stantec Consulting Ltd.

August 3, 2017

Sign-off Sheet

This document entitled Traffic Study – Nunavut Arctic College: Iqaluit Campus was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Government of Nunavut (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by 
(signature)

Lindsay Haskins, P.Eng. ENV SP

Reviewed by  Aug 3, 2017
(signature)

Patrick Wong, P.Eng.

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Introduction
August 3, 2017

1.0 INTRODUCTION

1.1 BACKGROUND

The Government of Nunavut (GN) has retained Stantec Consulting Ltd. (Stantec) to complete a Transportation Impact Assessment (TIA) for the expansion of Nunavut Arctic College (NAC) in Iqaluit, Nunavut. The expansion will include a new building located to the east of the existing building; construction will begin this summer and most likely open in 2020. The objective of the TIA is to analyze the impacts of the Arctic College Expansion Project on the adjacent roadways and intersections and identify any necessary improvements to accommodate both vehicular and pedestrian traffic.

1.2 SCOPE

Below is a summary of the tasks required to complete the TIA:

- Review background information including current enrollment numbers at the College;
- Collect traffic counts during the peak hours at the study intersections;
- Determine the expected trip generation for the College Expansion;
- Assume a trip distribution and trip assignment for both peak hours (based on existing traffic patterns obtained from the traffic counts);
- Add the new trips generated by the expansion to the projected background traffic volumes to determine total future traffic volumes at each horizon;
- Complete a signal warrant analysis at the study intersections for each horizon;
- Complete capacity analysis at the study intersections using Synchro Software;
- Recommend appropriate configurations for the study intersections and identify measures to mitigate unacceptable traffic impacts, if any; and,
- Review the existing pedestrian crossing location and consider the impacts of the College Expansion on pedestrian volumes and behaviours.

The analysis periods selected for this study are the weekday morning and afternoon peak hours as they are expected to represent the highest traffic volumes. The study horizons selected for analysis include:

- Existing Traffic Conditions (2017)
- Build Out Year (2020)
- 5-Year Post-Build Out Horizon (2025)
- 10-Year Post-Build Out Horizon (2030)



2.0 DEVELOPMENT SITE CONDITIONS

The NAC is located in Iqaluit, Nunavut, on the northwest corner of the intersection of Niaqunngusiariaq Road and Saputi Road. The site location is shown in **Figure 2-1**. The expansion will include 2,800 m² to the east of the existing building. The existing accesses along Niaqunngusiariaq Road will continue to provide access to the site.

2.1 TRANSPORTATION SYSTEM

The existing roadways in the study area are described below:

- **Saputi Road** – Two lane paved roadway with a speed limit of 40 km/h. Saputi Road connects traffic from a mixed density residential zone to the Capital District and Commercial Zones (Zoning By-law No. 704, 2014).
- **Niaqunngusiariaq Road** – Two lane paved roadway with a speed limit of 30 km/h east of Saputi Road and 40 km/h west of Saputi Road. Niaqunngusiariaq Road runs throughout the City, connecting to the downtown, the airport, and residential areas to the east. Niaqunngusiariaq Road is generally situated in a Public / Institutional zone (Zoning By-law No. 704, 2014).
- **Federal Road** – Two lane paved roadway that connects with Queen Elizabeth, Niaqunngusiariaq, and Mivvik Street at the Four Corners intersection. The speed limit on this roadway is 30 km/h. Federal Road services the North 40 area of Iqaluit, including the new Iqaluit Airport, Baffin Correction Centre, a rock quarry, and other industrial facilities. Federal Road is zoned to include Public / Institutional, Light - Heavy Industrial, and Industrial Extractive zones. There is also a portion zoned for Commercial and Business zones (Zoning By-law No. 704, 2014).

Study intersections adjacent to the development include the following:

- **Intersection #1: Saputi Road and Niaqunngusiariaq Road** – T-intersection that is stop-controlled in the southbound direction.
- **Intersection #2: College East Access and Niaqunngusiariaq Road** – T-intersection that serves as the entrance to the existing Nunavut Arctic College building.
- **Intersection #3: College West Access and Niaqunngusiariaq Road** – T-intersection that serves as the exit from the existing Nunavut Arctic College building.
- **Intersection #4: Four Corners** – All-directional intersection that is stop-controlled in all directions.

The roadway network and study intersections are shown on **Figure 2-2**, and photos of the study intersections are included in **Figures 2-3 and 2-4**.



Client/Project
NAC Expansion TIA
Government of Nunavut-CGS

August 2017

Figure No.
2-1

Title
Project Location



10160 - 112th Street
Edmonton AB



Client/Project
NAC Expansion TIA
Government of Nunavut-CGS

August 2017

Figure No.
2-2

Title
Study Area Roadways



10160 - 112th Street
Edmonton AB



Intersection #1 - looking northwest



Intersections #2/#3 - looking north



10160 - 112th Street
Edmonton AB

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NAC Expansion TIA
Government of Nunavut-CGS

Figure No.
2-3

Title
Site Photos



Intersection #4 - looking north



Intersection #4- looking west



10160 - 112th Street
Edmonton AB

Client/Project August 2017
NAC Expansion TIA
Government of Nunavut-CGS

Figure No.
2-4

Title
Site Photos

Development Site Conditions
August 3, 2017

2.2 BACKGROUND TRAFFIC

2.2.1 Existing Traffic Volumes

Turning movement counts were performed at the four study intersections from 7:00 – 9:00 AM and 4:00 – 6:00 PM over two weekdays between May 30 and June 1, 2017. NAC classes were running at this time, with the school year ending on June 6, 2017. The resulting traffic volumes from the two days were averaged to represent typical weekday volumes. From these counts, the AM peak hour was determined to be 8:00 – 9:00 AM and the PM peak hour was determined to be 4:30 - 5:30 PM. The traffic counts at the College accesses were used to determine the entering and exiting traffic only, with the Saputi Road counts used to determine through traffic to ensure volume balance along Niaqunngusiariaq Road. The resulting existing peak hour traffic volumes are shown in **Figure 2-5**.

The City of Iqaluit General Plan provides a medium population growth projection of 2.87% per year. This rate was applied to the existing traffic volumes to determine the future background traffic volumes for the 2020, 2025, and 2030 horizons along the study roadways.

2.2.1.1 Build-Out Year (2020) Background Traffic

Background traffic for the build-out year was calculated as 2017 existing traffic plus three years of growth at 2.87% per year.

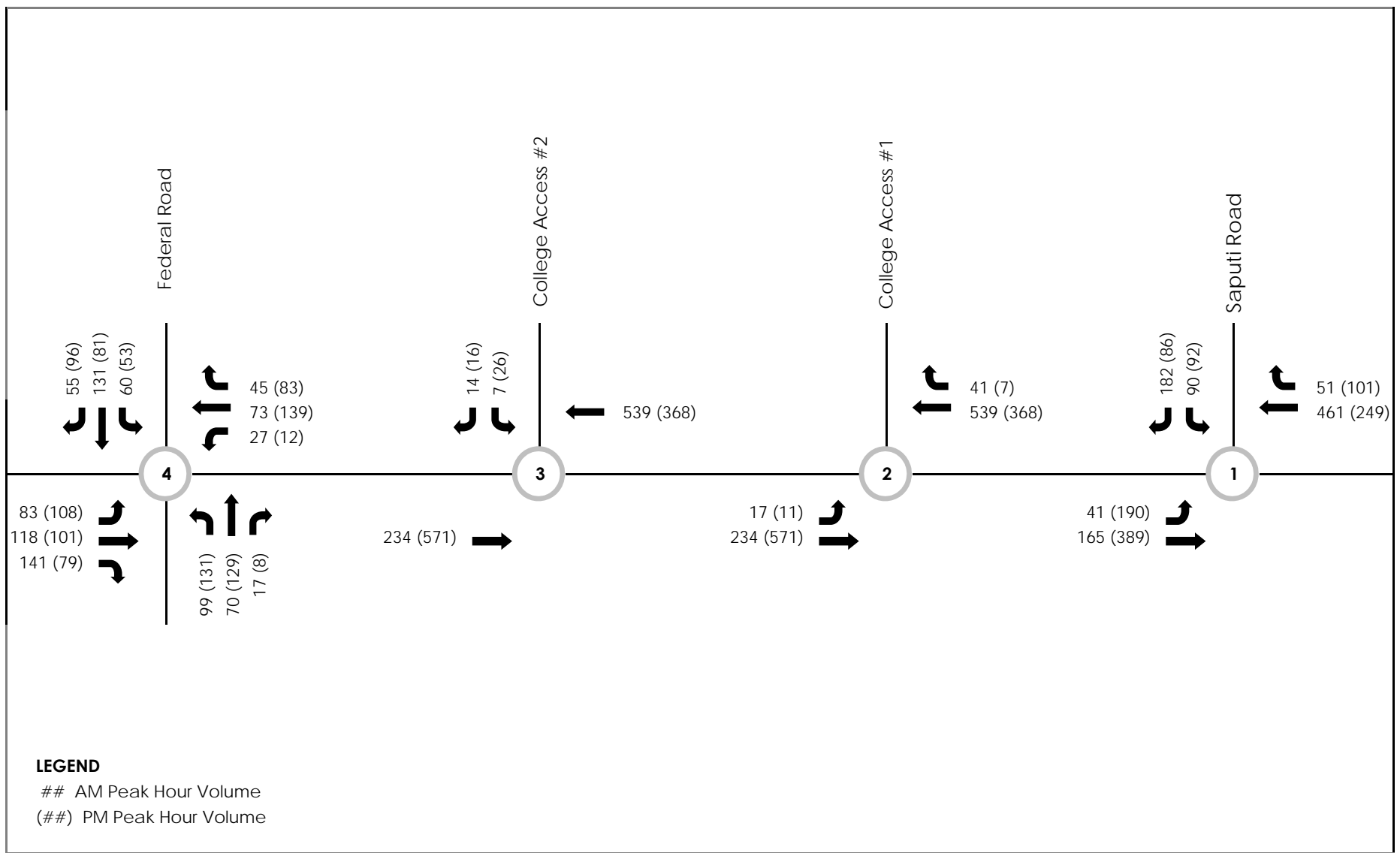
2.2.1.2 5-Year Post-Build-Out (2025) Background Traffic

Background traffic for the build-out year was calculated as 2017 existing traffic plus 8 years of growth at 2.87% per year.

2.2.1.3 10-Year Post-Build-Out (2030) Background Traffic

Background traffic for the build-out year was calculated as 2017 existing traffic plus 13 years of growth at 2.87% per year.

The background traffic volumes for each horizon are shown in **Figures 2-6 to 2-8**.



10160 - 112th Street
 Edmonton AB

Client/Project August 2017

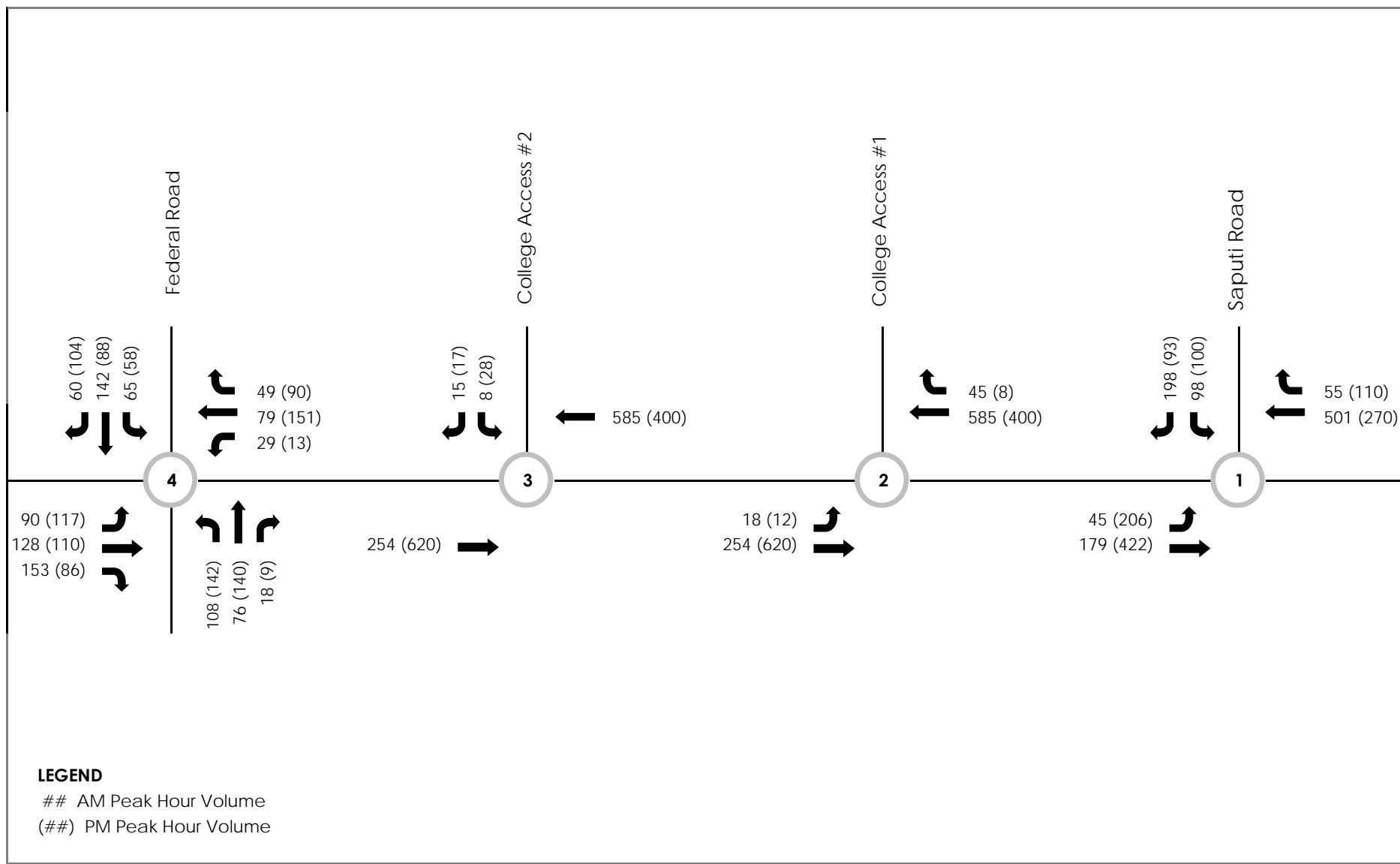
NAC Expansion TIA
 Government of Nunavut-CGS

Figure No.

2-5

Title

**Existing Traffic Volumes
 (2017)**



10160 - 112th Street
Edmonton AB

Client/Project
NAC Expansion TIA
Government of Nunavut-CGS

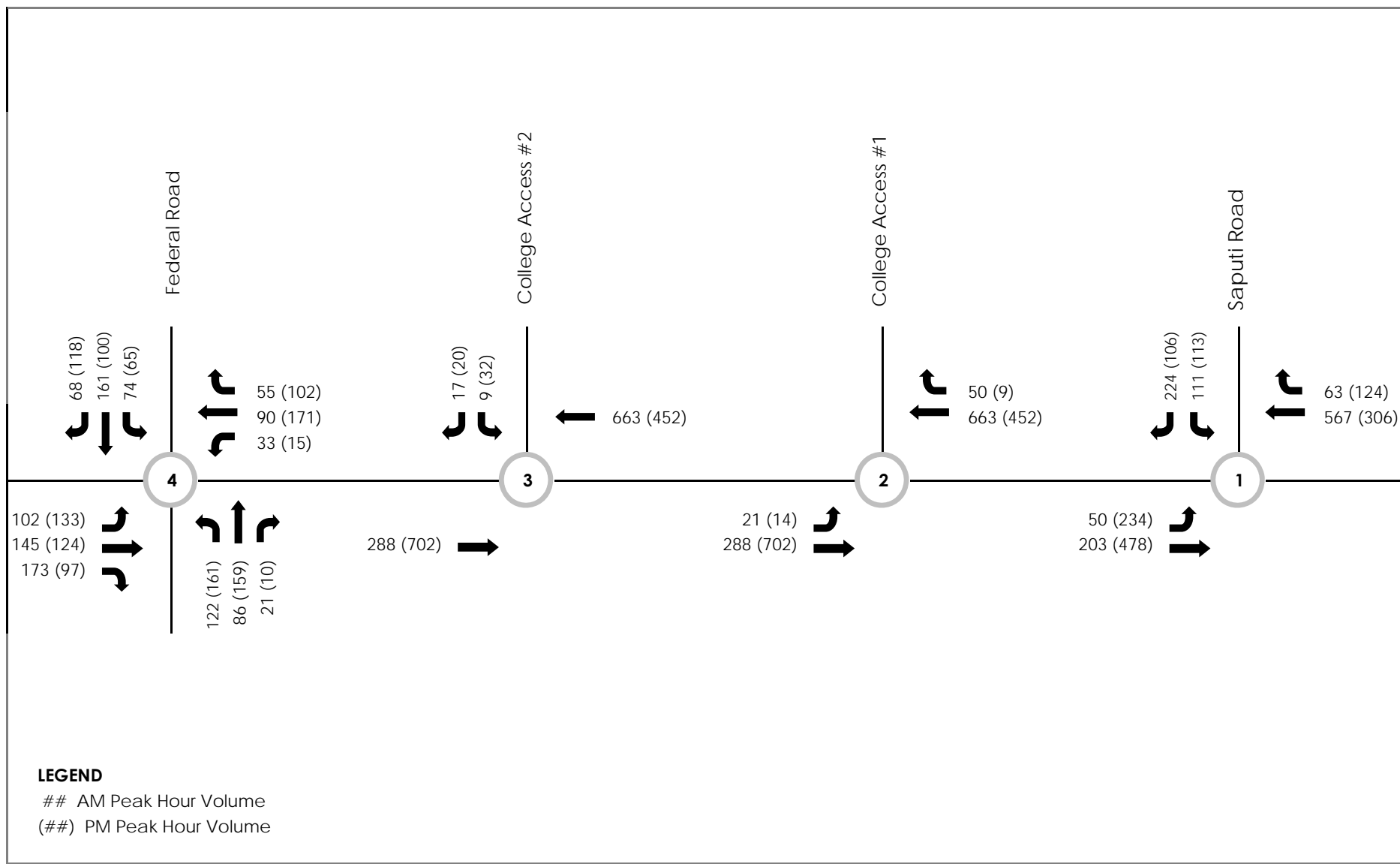
August 2017

Figure No.

2-6

Title

**Background Traffic Volumes
(2020)**



10160 - 112th Street
Edmonton AB

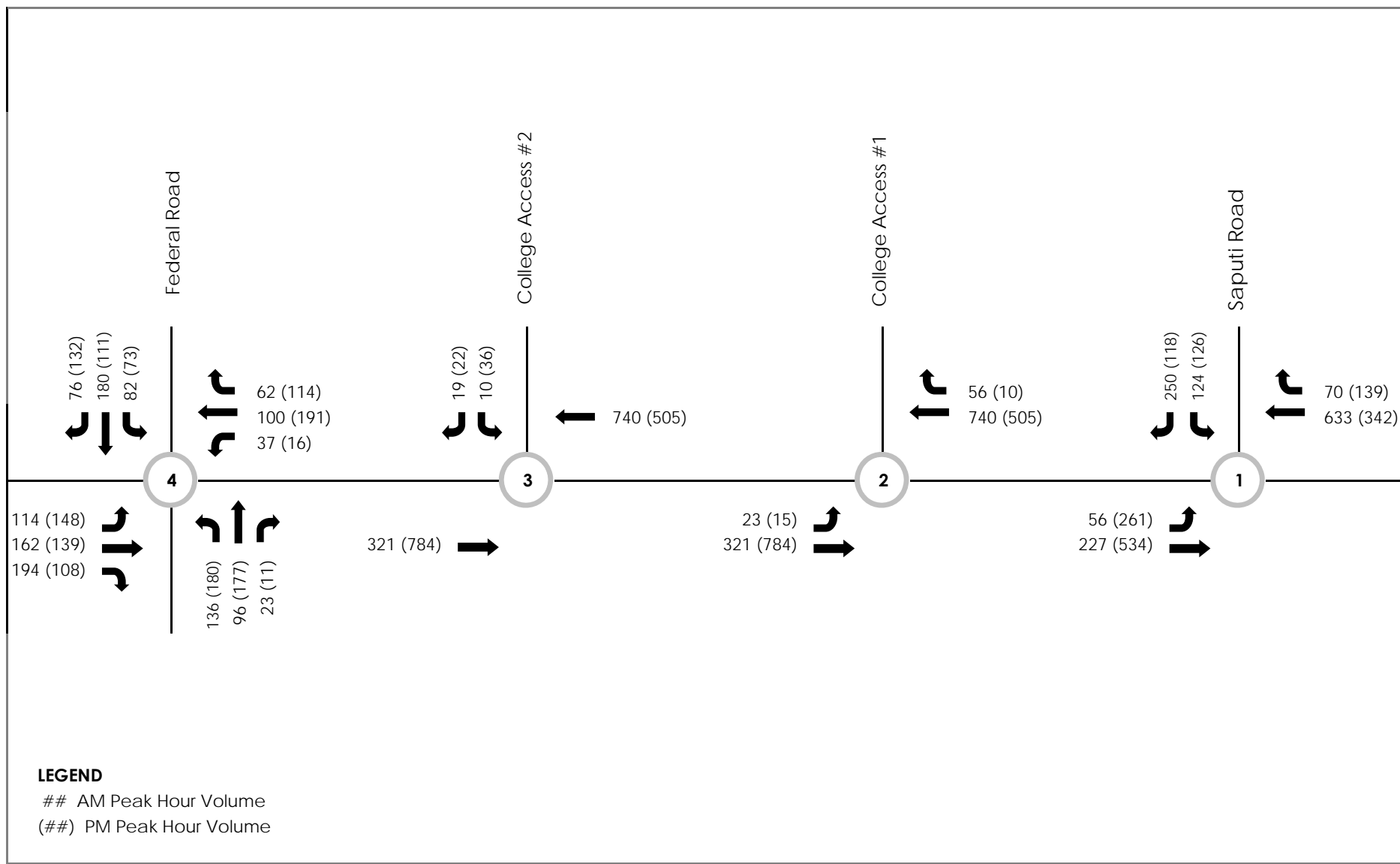
Client/Project August 2017
 NAC Expansion TIA
 Government of Nunavut-CGS

Figure No.

2-7

Title

**Background Traffic Volumes
(2025)**



10160 - 112th Street
 Edmonton AB

Client/Project August 2017
 NAC Expansion TIA
 Government of Nunavut-CGS

Figure No.

2-8

Title

**Background Traffic Volumes
 (2030)**

3.0 TRAFFIC CALCULATIONS

3.1 GENERATED TRAFFIC VOLUMES

3.1.1 Trip Generation

The NAC Iqaluit Campus currently has 302 full time students enrolled in courses as well as 50 staff members. However, it is understood that actual attendance numbers may be lower than reported. The proposed campus expansion will be able to accommodate up to 252 additional students and 40 additional staff in the new building. According to the 2015-16 Annual Report for the College, the Nunatta campus has yet to experience significant growth since 2012 and therefore does not anticipate meeting/reaching the full capacity of the building.

Stantec determined that a sensitivity analysis would be the best method to evaluate the impacts of potential student growth over time. The analysis will include a potential increase of 50% and 100% in both students and staff, representing the expected attendance scenario, and a full capacity scenario respectively.

The Institute of Transportation Engineers (ITE) Trip Generation Manual does not accurately represent the specific use of this site. Therefore, trip generation was estimated based on the current traffic volumes entering and exiting the College as determined from the traffic counts. This trip generation is summarized in **Table 3-1** below:

Table 3-1: NAC Trip Generation

| | AM Peak Hour | | PM Peak Hour | |
|------------------|--------------|-----|--------------|-----|
| | IN | OUT | IN | OUT |
| Existing Volumes | 58 | 21 | 18 | 42 |
| Additional 50% | 29 | 11 | 9 | 21 |
| Additional 100% | 58 | 21 | 18 | 42 |

3.1.2 Trip Distribution and Assignment

Trip distribution and assignment were based on the existing traffic distribution taken from the traffic counts. For distribution, trips were divided into entering from the east or west and exiting to the east or west along Niaqunngusariaq Road. The existing distribution patterns for these NAC trips are shown in **Table 3-2**.

Traffic Calculations
August 3, 2017

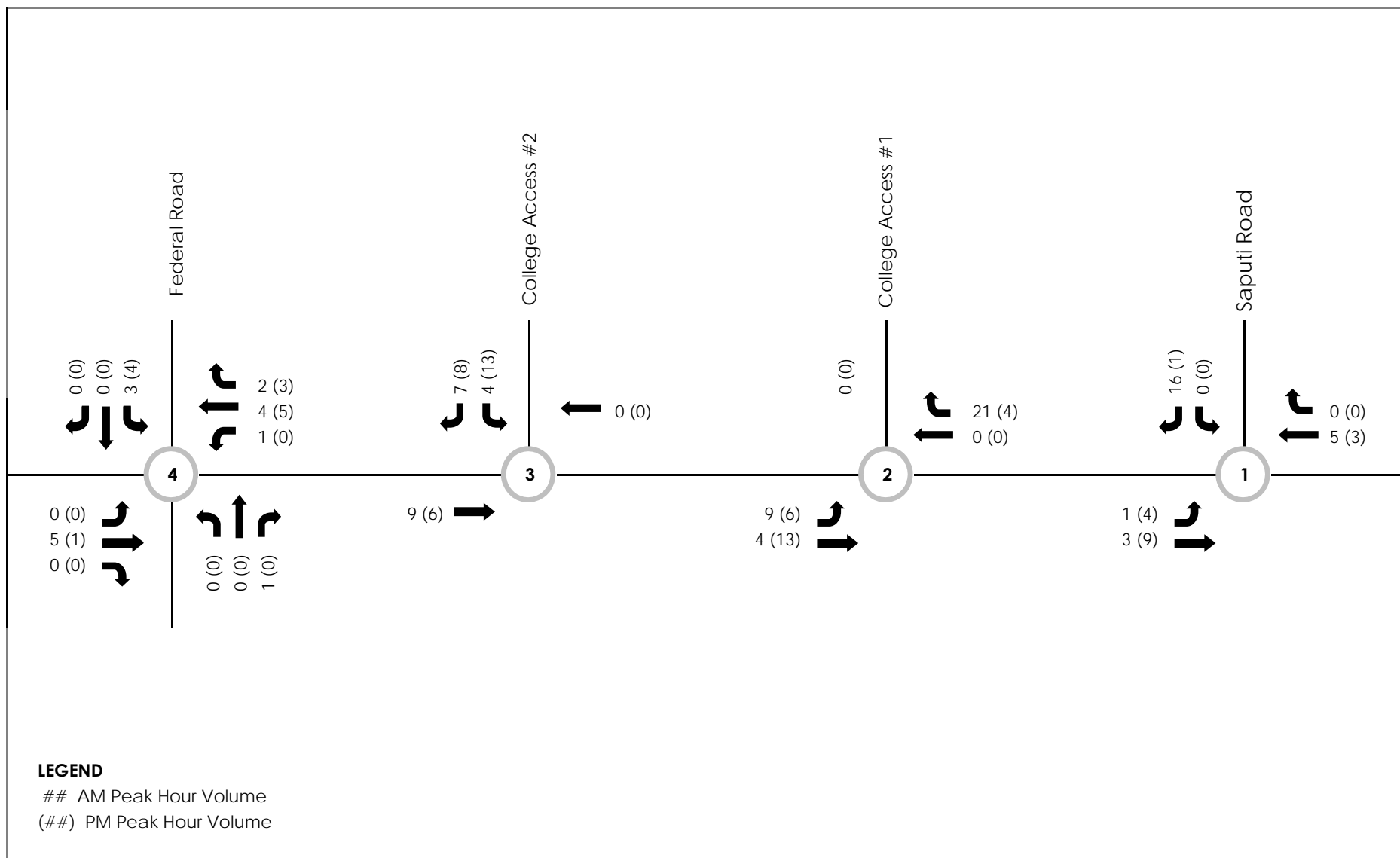
Table 3-2: NAC Existing Trip Distribution

| | AM Peak Hour | | PM Peak Hour | |
|--------------------------------|--------------|-----|--------------|-----|
| ENTERING (College Access East) | | | | |
| From West (EBL) | 17 | 29% | 11 | 61% |
| From East (WBR) | 41 | 71% | 7 | 39% |
| EXITING (College Access West) | | | | |
| To West (SBR) | 14 | 67% | 16 | 38% |
| To East (SBL) | 7 | 33% | 26 | 62% |

Downstream, the trips were assigned based on the existing turning movements at Saputi Road and Four Corners. The resulting generated trips are shown in **Figures 3-1 and 3-2**.

3.2 COMBINED TRAFFIC VOLUMES

The total combined traffic volumes were calculated by adding the generated trips to the background trips at each of the analysis horizons. The combined traffic volumes are shown in **Figures 3-3 to 3-8**.



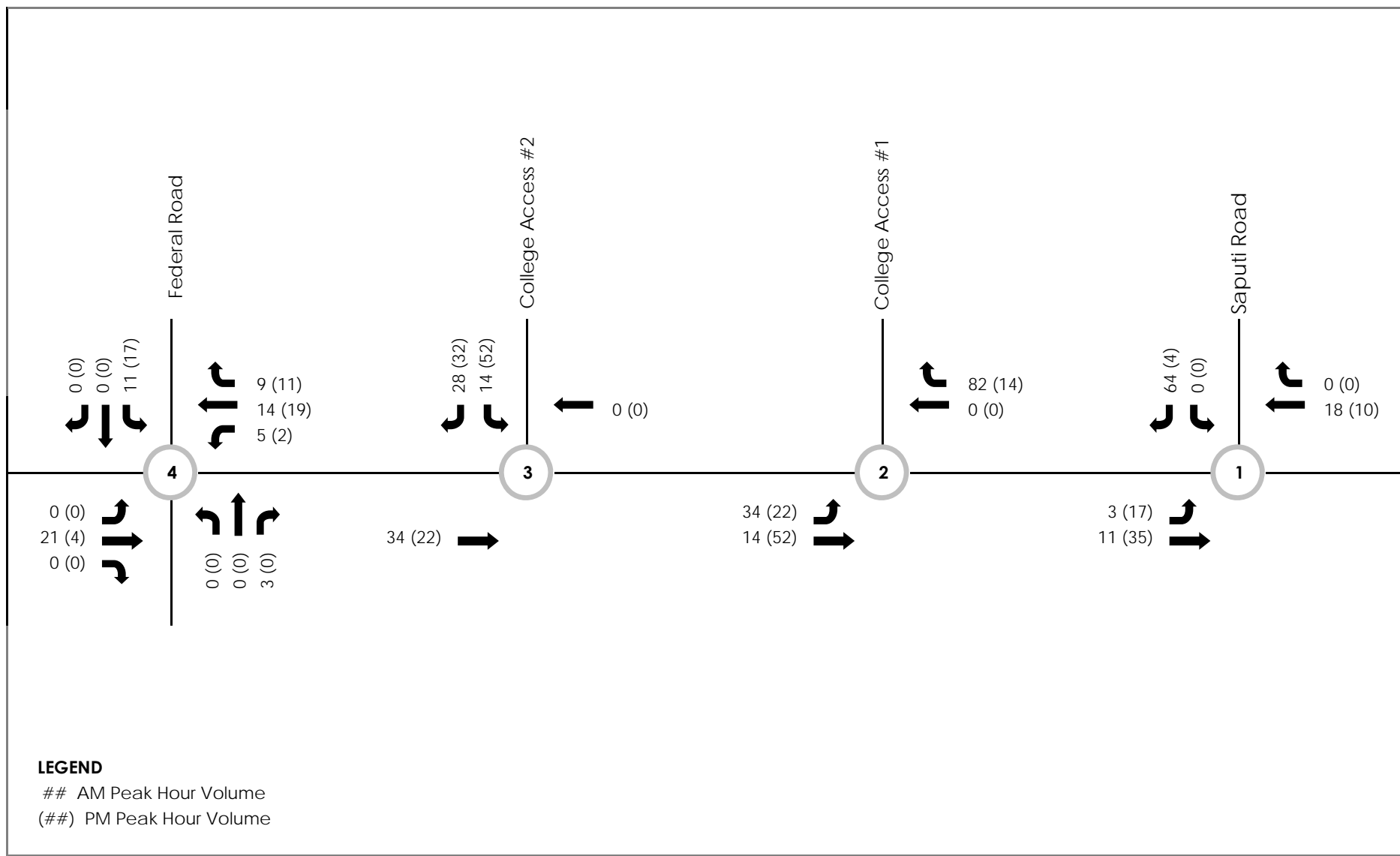
10160 - 112th Street
 Edmonton AB

Client/Project
 NAC Expansion TIA
 Government of Nunavut-CGS

August 2017

Figure No.
3-1

Title
**Site Generated Traffic
 50% Additional Trips**



10160 - 112th Street
 Edmonton AB

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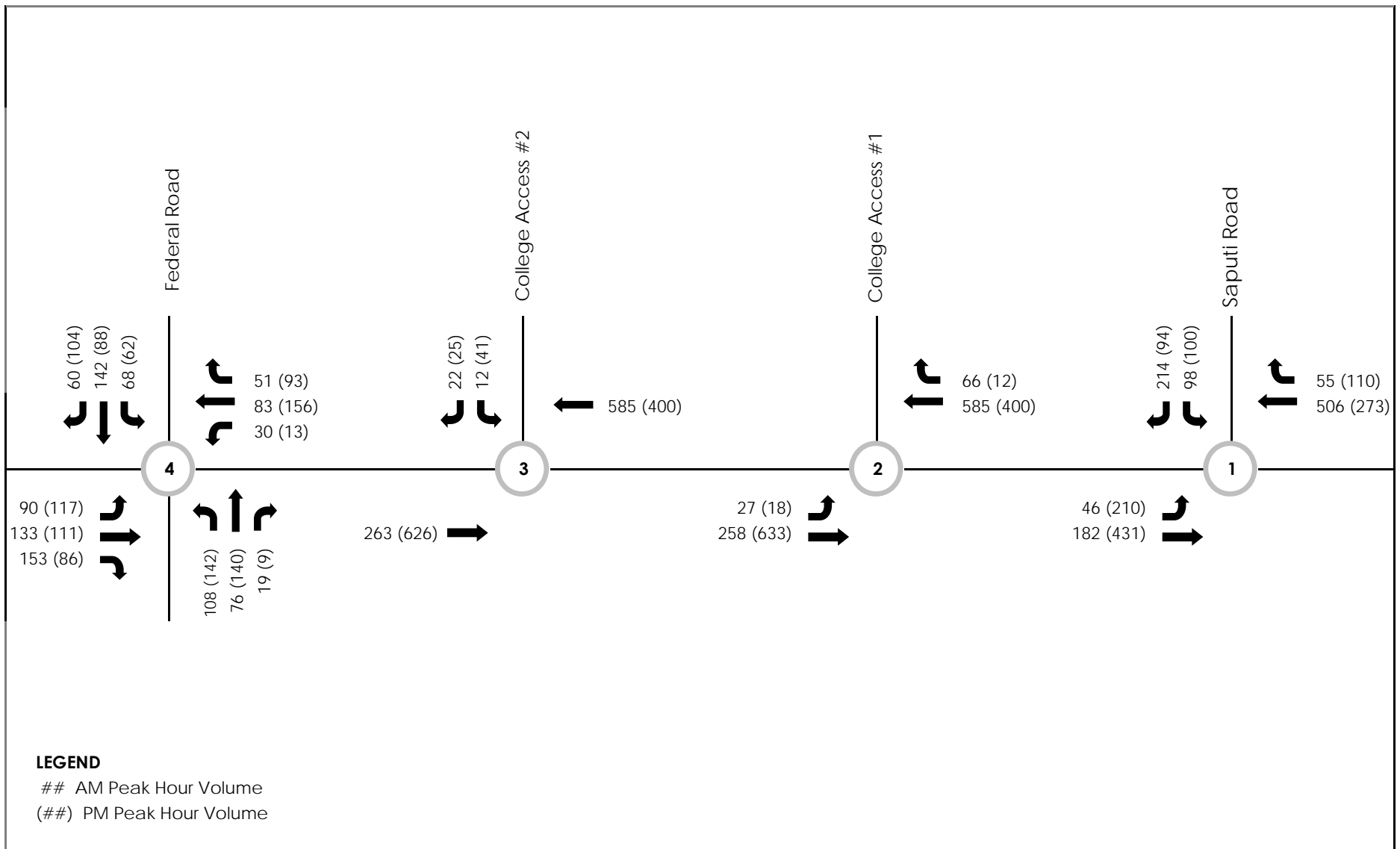
August 2017

Figure No.

3-2

Title

**Site Generated Traffic
 100% Additional Trips**



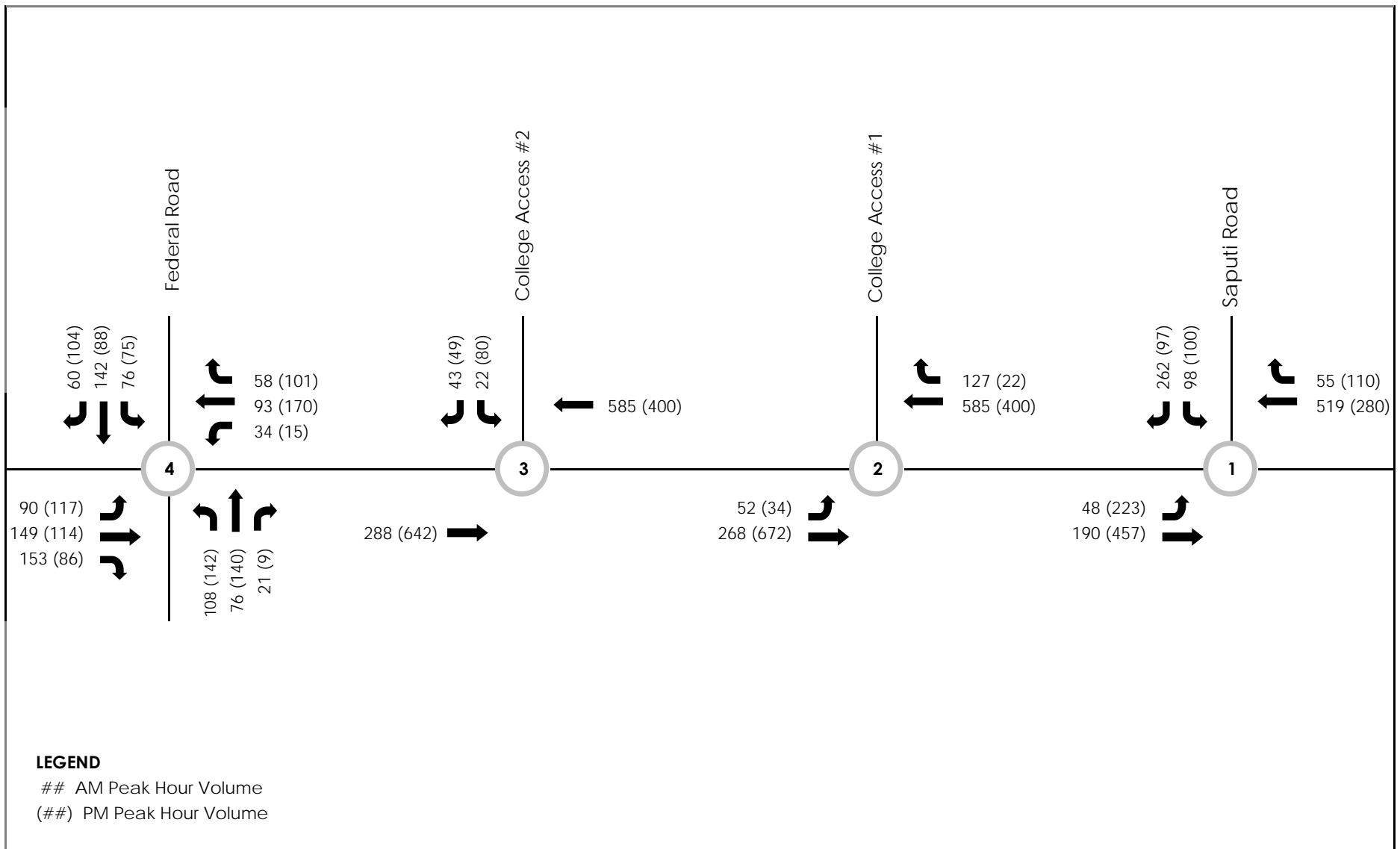
10160 - 112th Street
 Edmonton AB

Client/Project
 NAC Expansion TIA
 Government of Nunavut-CGS

August 2017

Figure No.
3-3

Title
**Total Projected Traffic
 2020 with 50% Additional Trips**



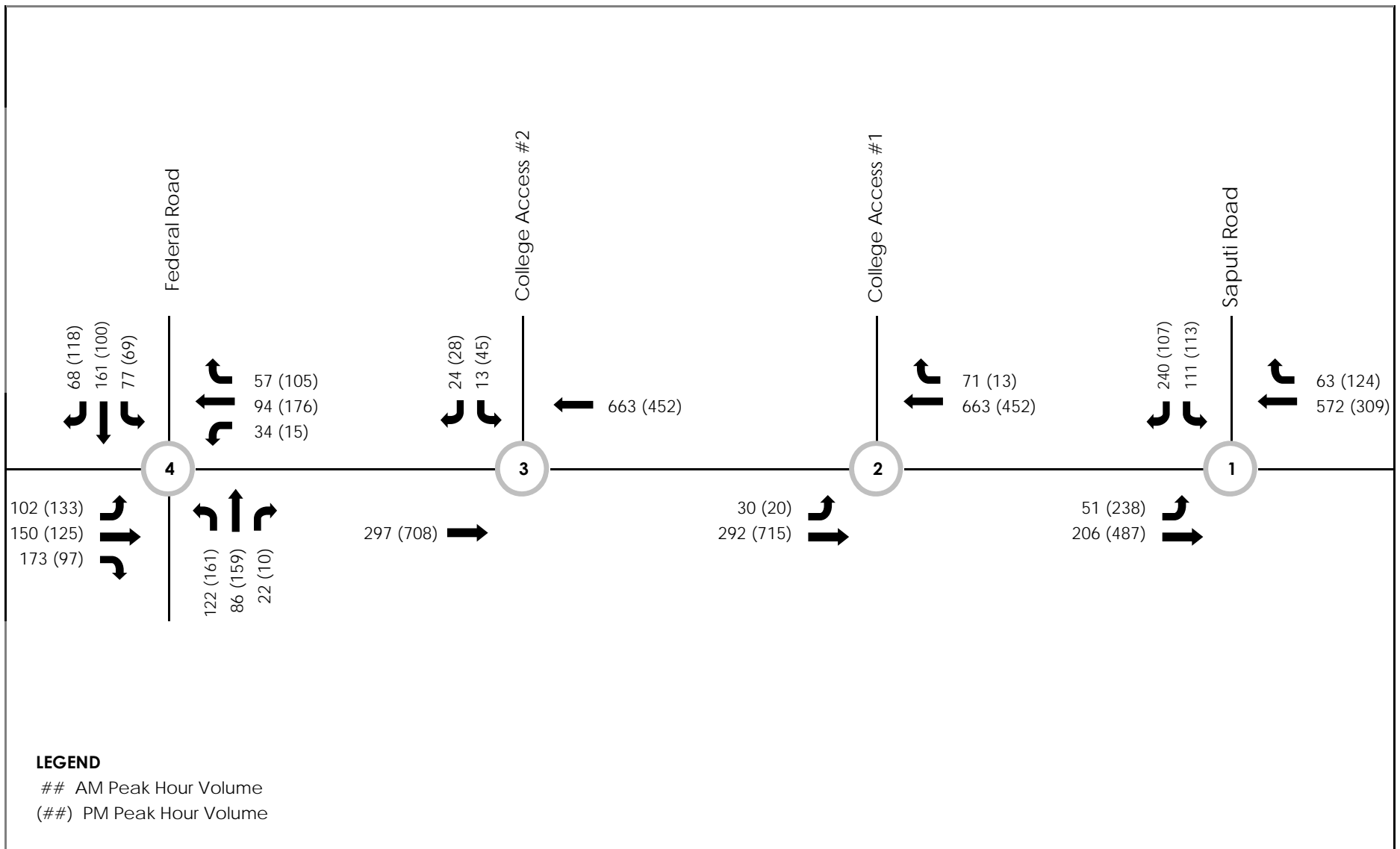
10160 - 112th Street
 Edmonton AB

Client/Project
 NAC Expansion TIA
 Government of Nunavut-CGS

August 2017

Figure No.
3-4

Title
**Total Projected Traffic
 2020 with 100% Additional Trips**



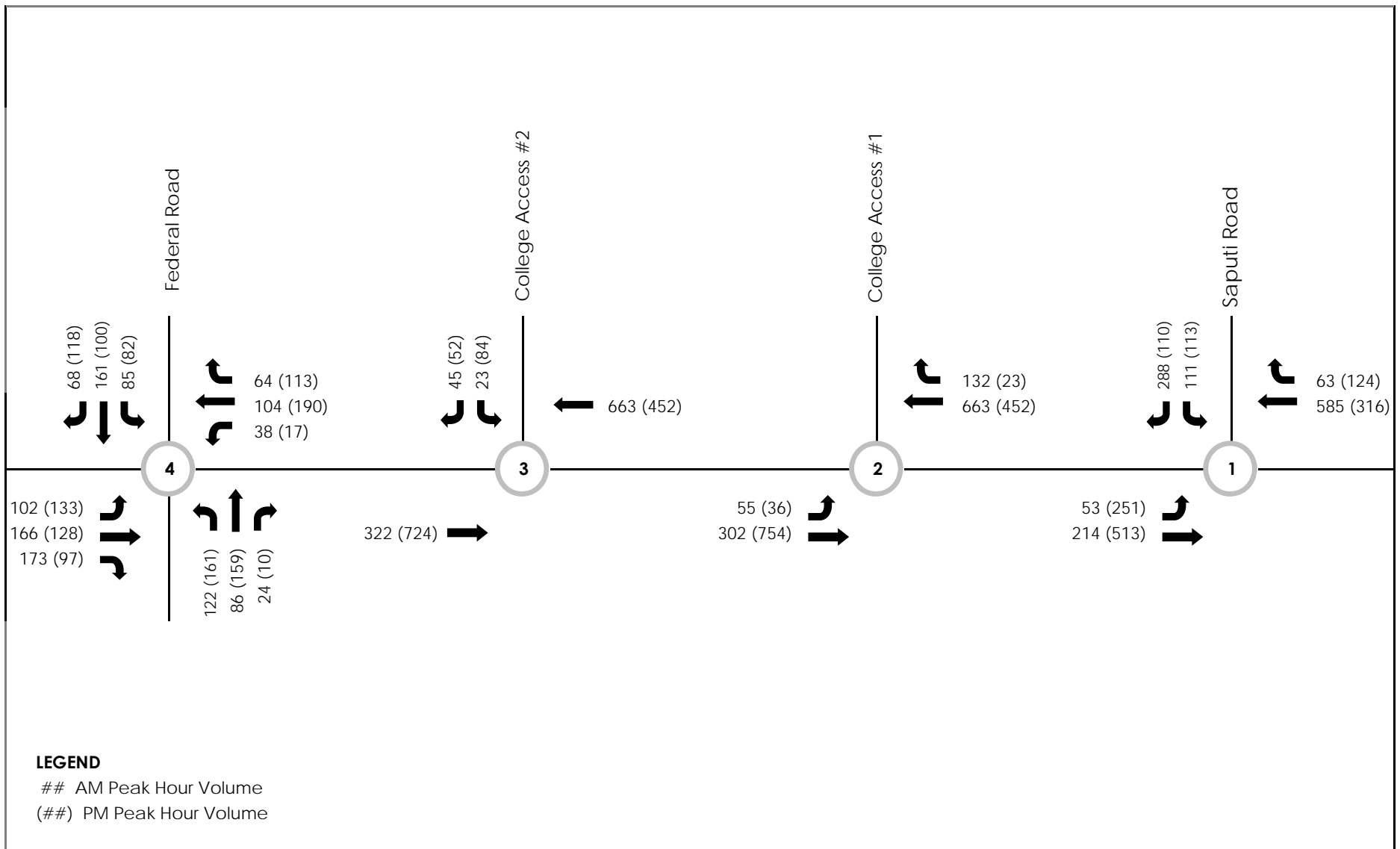
10160 - 112th Street
 Edmonton AB

Client/Project
 NAC Expansion TIA
 Government of Nunavut-CGS

August 2017

Figure No.
3-5

Title
**Total Projected Traffic
 2025 with 50% Additional Trips**



10160 - 112th Street
 Edmonton AB

Client/Project
 NAC Expansion TIA
 Government of Nunavut-CGS

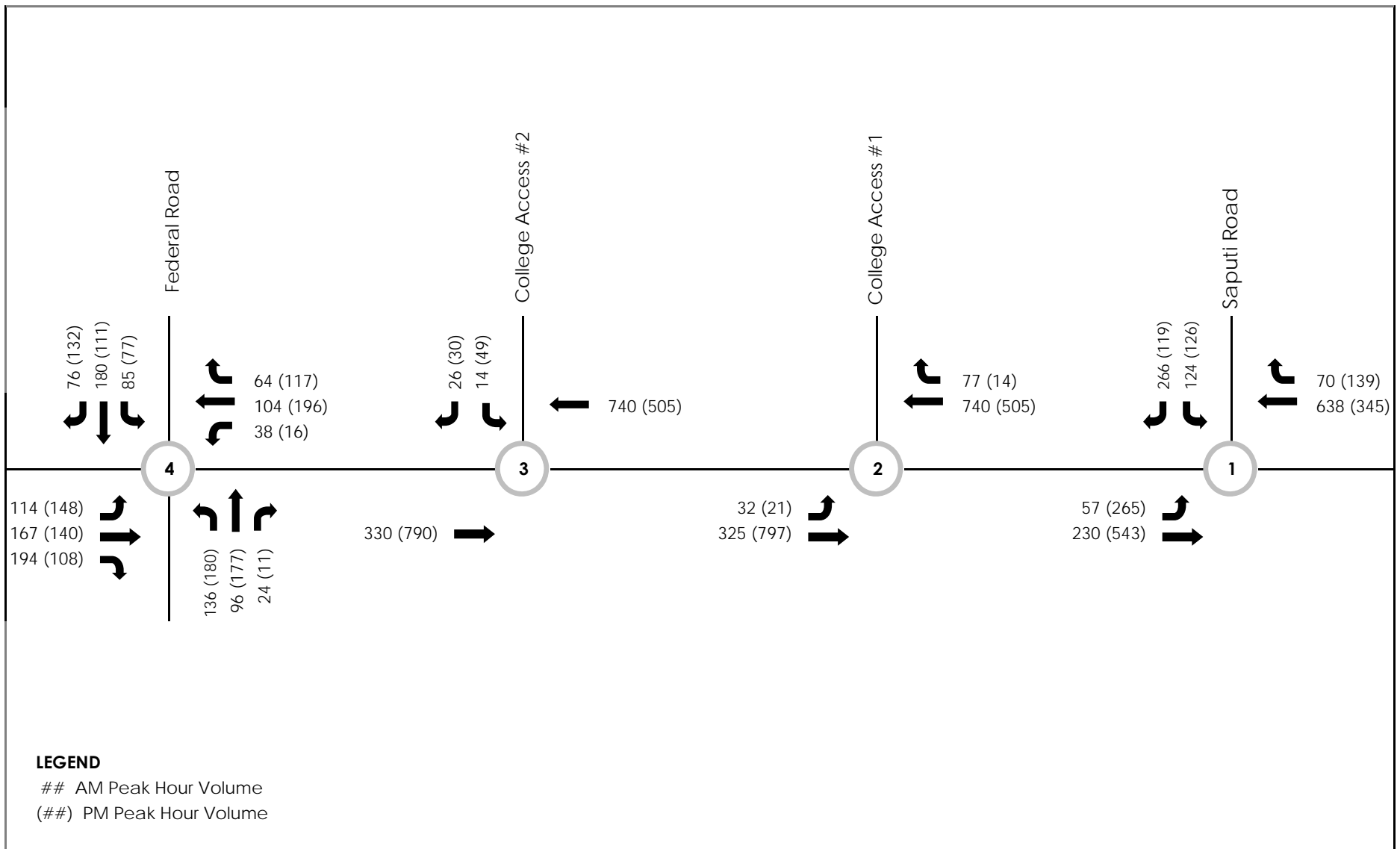
August 2017

Figure No.

3-6

Title

**Total Projected Traffic
 2025 with 100% Additional Trips**



10160 - 112th Street
 Edmonton AB

Client/Project August 2017

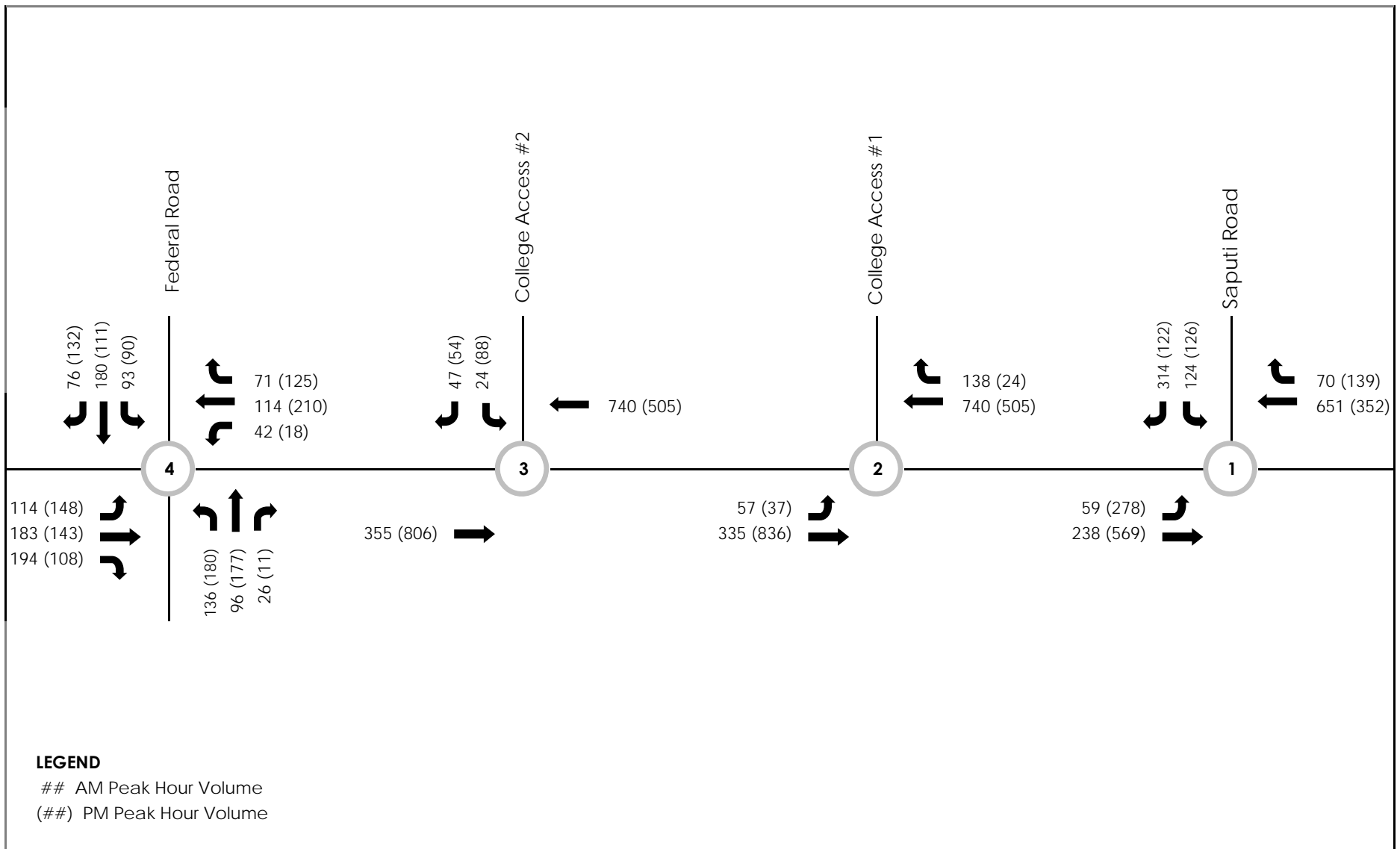
NAC Expansion TIA
 Government of Nunavut-CGS

Figure No.

3-7

Title

**Total Projected Traffic
 2030 with 50% Additional Trips**



10160 - 112th Street
 Edmonton AB

Client/Project August 2017

NAC Expansion TIA
 Government of Nunavut-CGS

Figure No.

3-8

Title

**Total Projected Traffic
 2030 with 100% Additional Trips**

4.0 INTERSECTION ANALYSIS

The assessment of the four study intersections consists of a Signal Warrant Analysis (SWA) and an Intersection Capacity Analysis (ICA).

The SWA will determine whether signalization is required at the study intersections, and the ICA will determine if the intersection can be expected to perform satisfactorily when subjected to the design volumes and what upgrades may be required, if any.

4.1 SIGNAL WARRANT ANALYSIS

The Signal Warrant Analysis was completed using Transportation Association of Canada's (TAC) Traffic Signal Analysis Spreadsheet. When the spreadsheet yields a W-value equal to or greater than 100 points, signalization is required. The analysis was completed for the Saputi Road and Four Corners intersections.

The warrant yielded the following results summarized in **Table 4.1** below. The full warrant sheets can be found in **Appendix B**.

Table 4.1: Signal Warrant Analysis Results

| Location | W-Score by Horizon | | |
|---------------------|--------------------|------------|------------|
| | Background | +50% | +100% |
| 2017 Horizon | | | |
| Saputi Road | 66 | - | - |
| Four Corners | 90 | - | - |
| 2020 Horizon | | | |
| Saputi Road | 78 | 80 | 84 |
| Four Corners | 106 | 109 | 112 |
| 2025 Horizon | | | |
| Saputi Road | 101 | 106 | 109 |
| Four Corners | 136 | 139 | 143 |
| 2030 Horizon | | | |
| Saputi Road | 119 | 122 | 125 |
| Four Corners | 155 | 159 | 163 |

According to the results:

- Signals are warranted at Four Corners at the 2020 horizon, with background traffic only.
- Signals are warranted at the Saputi Road intersection at the 2025 horizon with background traffic only.



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Although signalized are indicated as warranted at both study intersections, the City does not anticipate having these installed within the study horizons. The following traffic analysis therefore assumes unsignalized intersections as the base case.

4.2 INTERSECTION CAPACITY ANALYSIS

4.2.1 Analysis Criteria

Stantec completed intersection capacity analysis to determine whether the Level of Service (LOS) and the delays at the study intersections remain at an acceptable level once they are subjected to the design volumes. The traffic modeling software package of Synchro Studio 9 has been used to complete the intersection capacity analysis. The LOS for the intersection is based on the computed delays on each of the critical movements. LOS 'A' represents minimal delays and LOS 'F' represents a scenario with significant vehicular delays. **Table 4.2** shows LOS criteria for both signalized and unsignalized intersections as summarized in the Highway Capacity Manual.

Table 4.2: Level of Service Criteria

| Level of Service (LOS) | Delay Per Vehicle (s) | |
|------------------------|-----------------------|-------------|
| | Unsignalized | Signalized |
| A | ≤10 | ≤10 |
| B | >10 and ≤15 | >10 and ≤20 |
| C | >15 and ≤25 | >20 and ≤35 |
| D | >25 and ≤35 | >35 and ≤55 |
| E | >35 and ≤50 | >55 and ≤80 |
| F | >50 | >80 |

The volume to capacity (v/c) ratio indicates the level of congestion for a lane. A v/c ratio equal to or greater than 1.00 indicates that the lane is operating at or above capacity. For the purposes of this study, movements operating at LOS E and $v/c \geq 0.85$ will be flagged as critical movements.

The Synchro output reports for each horizon are included in **Appendix C**.

4.2.2 Analysis Results – Saputi Road

The results of the traffic analyses for the Saputi Road intersection are summarized in **Table 4.3**.

As shown, the southbound leg currently operates at LOS E in the PM peak hour, likely due to the higher eastbound and westbound traffic volumes, making it difficult for southbound vehicles to find a gap to make their turn.

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Intersection Analysis
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As background growth and development continue, the operations for this movement will continue to decline, with a $v/c > 1.0$ by the 2025 horizon. By the 2030 horizon, projected 95th percentile queues are over 150 m.

As shown in Section 4.1, signals are expected to be required at this intersection by the 2025 horizon; however, the traffic analysis suggests that they may be required sooner.

Signalized Intersection

The worst-case scenario (2030 horizon with 100% additional College trips) was analyzed with traffic signals; these results are shown in **Table 4.4**. As shown, an additional eastbound left turn lane is also required at this horizon. With these additions, the intersection is projected to operate at LOS C or better with all movements under threshold values.

4.2.3 Analysis Results – College Accesses

The results of the traffic analysis for the College Accesses are summarized in **Tables 4.5 and 4.6**.

As shown, the NAC accesses are projected to operate acceptably through all horizons. At the 2030 horizon with 100% additional College trips, the southbound (exiting) movement is projected to operate at an LOS E. However, the relatively low volumes, v/c of 0.5, and low 95th percentile queue length suggest that these conditions will be acceptable.

4.2.4 Analysis Results – Four Corners

The results of the traffic analysis for the Four Corners intersection are summarized in **Table 4.7**.

As shown, Four Corners is projected to continue operating with all movements at LOS C or better through the 2020 horizon. At the 2025 horizon, the northbound and eastbound movements will operate at LOS E, with all movements operating at LOS F at the 2030 horizon.

As shown in Section 4.1, signals are expected to be required at this intersection as early as the 2020 background horizon; however, the traffic analysis suggests that this may be able to be delayed until a later date.

Signalized Intersection

The worst-case scenario (2030 horizon with 100% additional College trips) was analyzed with traffic signals; these results are shown in **Table 4.8**. As shown, the intersection is projected to operate at LOS C or better with all movements under threshold values.

Table 4-3: Analysis Results - Saputi Road Intersection

| | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|---------------------------------------|------------------------|---|-----|----|---|---|------|------|---|----|------|-----|--|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| Intersection / Laning Characteristics | 1 | - | 1 | - | - | - | SH | 1 | - | - | 1 | SH | |
| Sign Control | Stop | - | - | - | - | - | - | Free | - | - | Free | - | |
| Existing Conditions | | | | | | | | | | | | | Overall Intersection Delay (s) 8 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 90 | - | 182 | - | - | - | 41 | 165 | - | - | 461 | 51 | Overall Intersection Delay (s) 10.2 |
| Volume/Capacity Ratio (v/c) | 0.66 | | | - | - | - | 0.05 | | - | - | 0.33 | | |
| Lane LOS | D | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 27.6 | | | - | - | - | 2.1 | | - | - | 0 | | |
| Queue Length 95th (m) | 35.9 | | | - | - | - | 1.1 | | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 10.2 |
| Volumes (veh/h) | 92 | - | 86 | - | - | - | 190 | 389 | - | - | 249 | 101 | |
| Volume/Capacity Ratio (v/c) | 0.74 | | | - | - | - | 0.18 | | - | - | 0.22 | | |
| Lane LOS | E | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 49.1 | | | - | - | - | 4.4 | | - | - | 0 | | |
| Queue Length 95th (m) | 39.6 | | | - | - | - | 5.1 | | - | - | 0 | | |
| 2020 Horizon, 50% Increase | | | | | | | | | | | | | Overall Intersection Delay (s) 13.1 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 98 | - | 214 | - | - | - | 46 | 182 | - | - | 506 | 55 | Overall Intersection Delay (s) 18 |
| Volume/Capacity Ratio (v/c) | 0.83 | | | - | - | - | 0.05 | | - | - | 0.36 | | |
| Lane LOS | E | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 44.4 | | | - | - | - | 2.2 | | - | - | 0 | | |
| Queue Length 95th (m) | 58.8 | | | - | - | - | 1.3 | | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 18 |
| Volumes (veh/h) | 100 | - | 94 | - | - | - | 210 | 431 | - | - | 273 | 110 | |
| Volume/Capacity Ratio (v/c) | 0.96 | | | - | - | - | 0.21 | | - | - | 0.25 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 96.9 | | | - | - | - | 4.8 | | - | - | 0 | | |
| Queue Length 95th (m) | 63.5 | | | - | - | - | 6 | | - | - | 0 | | |
| 2020 Horizon, 100% Increase | | | | | | | | | | | | | Overall Intersection Delay (s) 15.4 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 98 | - | 231 | - | - | - | 47 | 185 | - | - | 510 | 55 | Overall Intersection Delay (s) 20 |
| Volume/Capacity Ratio (v/c) | 0.88 | | | - | - | - | 0.05 | | - | - | 0.36 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 51.2 | | | - | - | - | 2.3 | | - | - | 0 | | |
| Queue Length 95th (m) | 67.3 | | | - | - | - | 1.3 | | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 20 |
| Volumes (veh/h) | 100 | - | 95 | - | - | - | 215 | 439 | - | - | 276 | 110 | |
| Volume/Capacity Ratio (v/c) | 1.0 | | | - | - | - | 0.22 | | - | - | 0.25 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 110.2 | | | - | - | - | 4.9 | | - | - | 0 | | |
| Queue Length 95th (m) | 68 | | | - | - | - | 6.2 | | - | - | 0 | | |
| 2025 Horizon, 50% Increase | | | | | | | | | | | | | Overall Intersection Delay (s) 28.6 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 111 | - | 240 | - | - | - | 51 | 206 | - | - | 572 | 63 | Overall Intersection Delay (s) 45.1 |
| Volume/Capacity Ratio (v/c) | 1.06 | | | - | - | - | 0.06 | | - | - | 0.41 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 99.6 | | | - | - | - | 2.4 | | - | - | 0 | | |
| Queue Length 95th (m) | 102.2 | | | - | - | - | 1.5 | | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 45.1 |
| Volumes (veh/h) | 113 | - | 107 | - | - | - | 238 | 487 | - | - | 309 | 124 | |
| Volume/Capacity Ratio (v/c) | 1.4 | | | - | - | - | 0.25 | | - | - | 0.28 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 264.3 | | | - | - | - | 5.5 | | - | - | 0 | | |
| Queue Length 95th (m) | 111.7 | | | - | - | - | 7.5 | | - | - | 0 | | |

| | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|------------------------------------|------------------------|---|-----|----|---|---|------|-----|---|----|------|-----|--|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| 2025 Horizon, 100% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 111 | - | 257 | - | - | - | 52 | 209 | - | - | 576 | 63 | Overall Intersection Delay (s) 34.8 |
| Volume/Capacity Ratio (v/c) | 1.12 | | | - | - | - | 0.06 | | - | - | 0.41 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 118 | | | - | - | - | 2.4 | | - | - | 0 | | |
| Queue Length 95th (m) | 115.5 | | | - | - | - | 1.6 | | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 113 | - | 108 | - | - | - | 243 | 495 | - | - | 312 | 124 | Overall Intersection Delay (s) 49.2 |
| Volume/Capacity Ratio (v/c) | 1.47 | | | - | - | - | 0.26 | | - | - | 0.28 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 292 | | | - | - | - | 5.6 | | - | - | 0 | | |
| Queue Length 95th (m) | 117 | | | - | - | - | 7.8 | | - | - | 0 | | |
| 2030 Horizon, 50% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 124 | - | 266 | - | - | - | 57 | 230 | - | - | 638 | 70 | Overall Intersection Delay (s) 59.9 |
| Volume/Capacity Ratio (v/c) | 1.35 | | | - | - | - | 0.07 | | - | - | 0.45 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 210.6 | | | - | - | - | 2.6 | | - | - | 0 | | |
| Queue Length 95th (m) | 161.6 | | | - | - | - | 1.8 | | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 126 | - | 119 | - | - | - | 265 | 543 | - | - | 345 | 139 | Overall Intersection Delay (s) 91.4 |
| Volume/Capacity Ratio (v/c) | 2.05 | | | - | - | - | 0.29 | | - | - | 0.31 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 552.7 | | | - | - | - | 6.4 | | - | - | 0 | | |
| Queue Length 95th (m) | 164.3 | | | - | - | - | 9.2 | | - | - | 0 | | |
| 2030 Horizon, 100% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 124 | - | 283 | - | - | - | 58 | 233 | - | - | 642 | 70 | Overall Intersection Delay (s) 69.3 |
| Volume/Capacity Ratio (v/c) | 1.42 | | | - | - | - | 0.08 | | - | - | 0.46 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 237.8 | | | - | - | - | 2.6 | | - | - | 0 | | |
| Queue Length 95th (m) | 178 | | | - | - | - | 1.9 | | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 126 | - | 120 | - | - | - | 270 | 551 | - | - | 348 | 139 | Overall Intersection Delay (s) 98.3 |
| Volume/Capacity Ratio (v/c) | 2.15 | | | - | - | - | 0.3 | | - | - | 0.31 | | |
| Lane LOS | F | | | - | - | - | A | | - | - | A | | |
| Control Delay (s) | 599.6 | | | - | - | - | 6.5 | | - | - | 0 | | |
| Queue Length 95th (m) | 169.6 | | | - | - | - | 9.6 | | - | - | 0 | | |

Table 4-4: Analysis Results - Saputi Road Intersection (SIGNALIZED)

| Intersection Location | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|---------------------------------------|------------------------|---|-----|----|---|---|------|------|---|----|------|-----|--|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| <u>2030 Horizon, 100% Increase</u> | | | | | | | | | | | | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Intersection / Laning Characteristics | 1 | - | 1 | - | - | - | 1 | 1 | - | - | 1 | SH | Overall Intersection Delay (s) 18.7 |
| Volumes (veh/h) | 126 | - | 120 | - | - | - | 270 | 551 | - | - | 348 | 139 | |
| Volume/Capacity Ratio (v/c) | 0.58 | | | - | - | - | 0.62 | 0.49 | - | - | 0.46 | | |
| Lane LOS | C | | | - | - | - | B | A | - | - | A | | |
| Control Delay (s) | 29.5 | | | - | - | - | 16.3 | 9.8 | - | - | 8.6 | | |
| Queue Length 95th (m) | 57 | | | - | - | - | 54.6 | 70.1 | - | - | 56.3 | | |

Table 4-5: Analysis Results - College East Access

| | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|---------------------------------------|------------------------|---|---|----|---|---|------|------|---|----|------|----|----------------------|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| Intersection / Laning Characteristics | - | - | - | - | - | - | SH | 1 | - | - | 1 | SH | |
| Sign Control | - | - | - | - | - | - | - | Free | - | - | Free | - | |
| Existing Conditions | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | - | - | - | - | - | - | 17 | 206 | - | - | 601 | 42 | Intersection |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.02 | - | - | - | 0.41 | - | Delay (s) |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | - | 0.2 |
| Control Delay (s) | - | - | - | - | - | - | 0.9 | - | - | - | 0 | - | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.5 | - | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | - | - | - | - | - | - | 13 | 579 | - | - | 327 | 8 | Intersection |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.01 | - | - | - | 0.21 | - | Delay (s) |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | - | 0.2 |
| Control Delay (s) | - | - | - | - | - | - | 0.3 | - | - | - | 0 | - | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.3 | - | - | - | 0 | - | |
| 2020 Horizon, 50% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | - | - | - | - | - | - | 27 | 228 | - | - | 653 | 67 | Intersection |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.04 | - | - | - | 0.46 | - | Delay (s) |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | - | 0.4 |
| Control Delay (s) | - | - | - | - | - | - | 1.4 | - | - | - | 0 | - | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.8 | - | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | - | - | - | - | - | - | 21 | 642 | - | - | 355 | 13 | Intersection |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.02 | - | - | - | 0.24 | - | Delay (s) |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | - | 0.3 |
| Control Delay (s) | - | - | - | - | - | - | 0.5 | - | - | - | 0 | - | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.5 | - | - | - | 0 | - | |
| 2020 Horizon, 100% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | - | - | - | - | - | - | 35 | 232 | - | - | 653 | 88 | Intersection |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.05 | - | - | - | 0.47 | - | Delay (s) |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | - | 0.5 |
| Control Delay (s) | - | - | - | - | - | - | 1.7 | - | - | - | 0 | - | |
| Queue Length 95th (m) | - | - | - | - | - | - | 1.1 | - | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | - | - | - | - | - | - | 27 | 655 | - | - | 355 | 17 | Intersection |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.03 | - | - | - | 0.24 | - | Delay (s) |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | - | 0.4 |
| Control Delay (s) | - | - | - | - | - | - | 0.7 | - | - | - | 0 | - | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.6 | - | - | - | 0 | - | |

| | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|---|------------------------|---|---|----|---|---|------|-----|---|----|------|-----|---------------------------------------|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| <u>2025 Horizon, 50% Increase</u> | | | | | | | | | | | | | Overall Intersection Delay (s) 0.4 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 30 | 257 | - | - | 739 | 73 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.04 | - | - | - | 0.52 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 1.5 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 1 | - | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 23 | 725 | - | - | 402 | 14 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.02 | - | - | - | 0.27 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 0.6 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.5 | - | - | - | 0 | | |
| <u>2025 Horizon, 100% Increase</u> | | | | | | | | | | | | | Overall Intersection Delay (s) 0.5 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 38 | 261 | - | - | 739 | 94 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.06 | - | - | - | 0.53 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 1.9 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 1.3 | - | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 29 | 738 | - | - | 402 | 18 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.03 | - | - | - | 0.27 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 0.8 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.7 | - | - | - | 0 | | |
| <u>2030 Horizon, 50% Increase</u> | | | | | | | | | | | | | Overall Intersection Delay (s) 0.4 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 32 | 287 | - | - | 825 | 79 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.05 | - | - | - | 0.58 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 1.6 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 1.2 | - | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 25 | 808 | - | - | 449 | 15 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.03 | - | - | - | 0.3 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 0.7 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.6 | - | - | - | 0 | | |
| <u>2030 Horizon, 100% Increase</u> | | | | | | | | | | | | | Overall Intersection Delay (s) 0.5 |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 40 | 291 | - | - | 825 | 100 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.06 | - | - | - | 0.59 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 2 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 1.5 | - | - | - | 0 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | - | - | - | - | - | - | 31 | 821 | - | - | 449 | 19 | |
| Volume/Capacity Ratio (v/c) | - | - | - | - | - | - | 0.03 | - | - | - | 0.3 | | |
| Lane LOS | - | - | - | - | - | - | A | - | - | - | A | | |
| Control Delay (s) | - | - | - | - | - | - | 0.9 | - | - | - | 0 | | |
| Queue Length 95th (m) | - | - | - | - | - | - | 0.8 | - | - | - | 0 | | |

Table 4-6: Analysis Results - College West Access

| | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|---------------------------------------|------------------------|------|----|----|---|---|----|------|---|----|------|---|----------------------|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| Intersection / Laning Characteristics | 1 | - | 1 | - | - | - | - | 1 | - | - | 1 | - | |
| Sign Control | Stop | - | - | - | - | - | - | Free | - | - | Free | - | |
| Existing Conditions | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | 8 | - | 15 | - | - | - | - | 215 | - | - | 601 | - | Intersection |
| Volume/Capacity Ratio (v/c) | | 0.06 | | - | - | - | - | 0.14 | - | - | 0.38 | - | Delay (s) |
| Lane LOS | | B | | - | - | - | - | A | - | - | A | - | 0.4 |
| Control Delay (s) | | 14.8 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 1.5 | | - | - | - | - | 0 | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | 26 | - | 16 | - | - | - | - | 566 | - | - | 327 | - | Intersection |
| Volume/Capacity Ratio (v/c) | | 0.13 | | - | - | - | - | 0.36 | - | - | 0.21 | - | Delay (s) |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | 0.7 |
| Control Delay (s) | | 16.8 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 3.3 | | - | - | - | - | 0 | - | - | 0 | - | |
| 2020 Horizon, 50% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | 13 | - | 24 | - | - | - | - | 243 | - | - | 653 | - | Intersection |
| Volume/Capacity Ratio (v/c) | | 0.11 | | - | - | - | - | 0.16 | - | - | 0.42 | - | Delay (s) |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | 0.6 |
| Control Delay (s) | | 16.3 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 2.8 | | - | - | - | - | 0 | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | 41 | - | 25 | - | - | - | - | 622 | - | - | 355 | - | Intersection |
| Volume/Capacity Ratio (v/c) | | 0.23 | | - | - | - | - | 0.4 | - | - | 0.23 | - | Delay (s) |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | 1.3 |
| Control Delay (s) | | 20.1 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 6.7 | | - | - | - | - | 0 | - | - | 0 | - | |
| 2020 Horizon, 100% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | 17 | - | 31 | - | - | - | - | 251 | - | - | 653 | - | Intersection |
| Volume/Capacity Ratio (v/c) | | 0.15 | | - | - | - | - | 0.16 | - | - | 0.42 | - | Delay (s) |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | 0.8 |
| Control Delay (s) | | 16.8 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 3.8 | | - | - | - | - | 0 | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall |
| Volumes (veh/h) | 54 | - | 33 | - | - | - | - | 628 | - | - | 355 | - | Intersection |
| Volume/Capacity Ratio (v/c) | | 0.31 | | - | - | - | - | 0.4 | - | - | 0.23 | - | Delay (s) |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | 1.8 |
| Control Delay (s) | | 21.9 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 9.8 | | - | - | - | - | 0 | - | - | 0 | - | |

| | | | | | | | | | | | | | |
|---|----|------|----|---|---|---|---|------|---|---|------|---|---------------------------------------|
| <u>2025 Horizon, 50% Increase</u> | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 14 | - | 26 | - | - | - | - | 273 | - | - | 739 | - | Overall Intersection Delay (s) 0.7 |
| Volume/Capacity Ratio (v/c) | | 0.14 | | - | - | - | - | 0.17 | - | - | 0.47 | - | |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 18.5 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 3.6 | | - | - | - | - | 0 | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 45 | - | 28 | - | - | - | - | 703 | - | - | 402 | - | Overall Intersection Delay (s) 1.5 |
| Volume/Capacity Ratio (v/c) | | 0.3 | | - | - | - | - | 0.45 | - | - | 0.26 | - | |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 24.7 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 9.4 | | - | - | - | - | 0 | - | - | 0 | - | |
| <u>2025 Horizon, 100% Increase</u> | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 18 | - | 33 | - | - | - | - | 281 | - | - | 739 | - | Overall Intersection Delay (s) 0.9 |
| Volume/Capacity Ratio (v/c) | | 0.18 | | - | - | - | - | 0.18 | - | - | 0.47 | - | |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 19.4 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 5 | | - | - | - | - | 0 | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 58 | - | 36 | - | - | - | - | 709 | - | - | 402 | - | Overall Intersection Delay (s) 2.2 |
| Volume/Capacity Ratio (v/c) | | 0.4 | | - | - | - | - | 0.45 | - | - | 0.26 | - | |
| Lane LOS | | D | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 27.8 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 13.6 | | - | - | - | - | 0 | - | - | 0 | - | |
| <u>2030 Horizon, 50% Increase</u> | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 15 | - | 29 | - | - | - | - | 304 | - | - | 825 | - | Overall Intersection Delay (s) 0.8 |
| Volume/Capacity Ratio (v/c) | | 0.18 | | - | - | - | - | 0.19 | - | - | 0.53 | - | |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 21.3 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 4.8 | | - | - | - | - | 0 | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 49 | - | 30 | - | - | - | - | 784 | - | - | 449 | - | Overall Intersection Delay (s) 1.9 |
| Volume/Capacity Ratio (v/c) | | 0.39 | | - | - | - | - | 0.5 | - | - | 0.29 | - | |
| Lane LOS | | D | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 31.6 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 13.3 | | - | - | - | - | 0 | - | - | 0 | - | |
| <u>2030 Horizon, 100% Increase</u> | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 19 | - | 36 | - | - | - | - | 312 | - | - | 825 | - | Overall Intersection Delay (s) 1 |
| Volume/Capacity Ratio (v/c) | | 0.23 | | - | - | - | - | 0.2 | - | - | 0.53 | - | |
| Lane LOS | | C | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 22.6 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 6.5 | | - | - | - | - | 0 | - | - | 0 | - | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 62 | - | 38 | - | - | - | - | 790 | - | - | 449 | - | Overall Intersection Delay (s) 2.8 |
| Volume/Capacity Ratio (v/c) | | 0.5 | | - | - | - | - | 0.51 | - | - | 0.29 | - | |
| Lane LOS | | E | | - | - | - | - | A | - | - | A | - | |
| Control Delay (s) | | 37.5 | | - | - | - | - | 0 | - | - | 0 | - | |
| Queue Length 95th (m) | | 19.3 | | - | - | - | - | 0 | - | - | 0 | - | |

Table 4-7: Analysis Results - Four Corners

| Intersection Location | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|---------------------------------------|------------------------|------|-----|-----|------|----|-----|------|-----|----|------|-----|--|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| Intersection / Laning Characteristics | SH | 1 | SH | SH | 1 | SH | SH | 1 | SH | SH | 1 | SH | |
| Sign Control | - | Stop | - | - | Stop | - | - | Stop | - | - | Stop | - | |
| Existing Conditions | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 60 | 131 | 55 | 99 | 70 | 17 | 83 | 118 | 141 | 27 | 73 | 45 | Overall Intersection Delay (s) 13.3 |
| Volume/Capacity Ratio (v/c) | | 0.43 | | | 0.34 | | | 0.56 | | | 0.26 | | |
| Lane LOS | | B | | | B | | | C | | | B | | |
| Control Delay (s) | | 13 | | | 12.1 | | | 15.1 | | | 10.9 | | |
| Queue Length 95th (m) | | 17 | | | 12 | | | 27 | | | 8 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 53 | 81 | 96 | 131 | 129 | 8 | 108 | 101 | 79 | 12 | 139 | 83 | Overall Intersection Delay (s) 15.0 |
| Volume/Capacity Ratio (v/c) | | 0.43 | | | 0.51 | | | 0.53 | | | 0.43 | | |
| Lane LOS | | B | | | C | | | C | | | B | | |
| Control Delay (s) | | 13.8 | | | 15.9 | | | 16 | | | 13.8 | | |
| Queue Length 95th (m) | | 17 | | | 23 | | | 25 | | | 18 | | |
| 2020 Horizon, 50% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 68 | 142 | 60 | 108 | 76 | 19 | 90 | 133 | 153 | 30 | 83 | 51 | Overall Intersection Delay (s) 15.3 |
| Volume/Capacity Ratio (v/c) | | 0.49 | | | 0.39 | | | 0.64 | | | 0.26 | | |
| Lane LOS | | B | | | B | | | C | | | B | | |
| Control Delay (s) | | 14.6 | | | 13.2 | | | 18.2 | | | 11.5 | | |
| Queue Length 95th (m) | | 21 | | | 14 | | | 35 | | | 8 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 63 | 88 | 104 | 142 | 140 | 9 | 117 | 111 | 86 | 13 | 156 | 93 | Overall Intersection Delay (s) 18.6 |
| Volume/Capacity Ratio (v/c) | | 0.52 | | | 0.6 | | | 0.63 | | | 0.53 | | |
| Lane LOS | | C | | | C | | | C | | | C | | |
| Control Delay (s) | | 16.8 | | | 19.9 | | | 20.3 | | | 17 | | |
| Queue Length 95th (m) | | 23 | | | 30 | | | 34 | | | 24 | | |
| 2020 Horizon, 100% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 70 | 142 | 60 | 108 | 76 | 20 | 90 | 138 | 153 | 32 | 87 | 54 | Overall Intersection Delay (s) 16.3 |
| Volume/Capacity Ratio (v/c) | | 0.51 | | | 0.4 | | | 0.67 | | | 0.33 | | |
| Lane LOS | | C | | | B | | | C | | | B | | |
| Control Delay (s) | | 15.6 | | | 13.8 | | | 19.9 | | | 12.5 | | |
| Queue Length 95th (m) | | 23 | | | 15 | | | 40 | | | 11 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 68 | 88 | 104 | 142 | 140 | 9 | 117 | 113 | 86 | 14 | 160 | 96 | Overall Intersection Delay (s) 19.4 |
| Volume/Capacity Ratio (v/c) | | 0.54 | | | 0.61 | | | 0.64 | | | 0.55 | | |
| Lane LOS | | C | | | C | | | C | | | C | | |
| Control Delay (s) | | 17.5 | | | 20.5 | | | 21.1 | | | 17.8 | | |
| Queue Length 95th (m) | | 25 | | | 33 | | | 36 | | | 26 | | |
| 2025 Horizon, 50% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 77 | 161 | 68 | 122 | 86 | 22 | 102 | 150 | 173 | 34 | 94 | 57 | Overall Intersection Delay (s) 22.8 |
| Volume/Capacity Ratio (v/c) | | 0.63 | | | 0.5 | | | 0.81 | | | 0.39 | | |
| Lane LOS | | C | | | C | | | D | | | B | | |
| Control Delay (s) | | 20.6 | | | 17 | | | 31.1 | | | 14.6 | | |
| Queue Length 95th (m) | | 33 | | | 22 | | | 62 | | | 14 | | |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Volumes (veh/h) | 70 | 100 | 118 | 161 | 159 | 10 | 133 | 125 | 97 | 15 | 176 | 105 | Overall Intersection Delay (s) 32.1 |
| Volume/Capacity Ratio (v/c) | | 0.68 | | | 0.79 | | | 0.83 | | | 0.7 | | |
| Lane LOS | | D | | | E | | | E | | | D | | |
| Control Delay (s) | | 26.3 | | | 35.3 | | | 38 | | | 27.1 | | |
| Queue Length 95th (m) | | 40 | | | 56 | | | 62 | | | 42 | | |

| Intersection Location | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|------------------------------------|------------------------|-----|-----|------|-----|----|------|-----|-----|------|-----|-----|--|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| 2025 Horizon, 100% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 24.1 |
| Volumes (veh/h) | 79 | 161 | 68 | 122 | 86 | 23 | 102 | 155 | 173 | 36 | 98 | 60 | |
| Volume/Capacity Ratio (v/c) | 0.64 | | | 0.51 | | | 0.83 | | | 0.42 | | | |
| Lane LOS | C | | | C | | | D | | | C | | | |
| Control Delay (s) | 21.4 | | | 17.5 | | | 33.6 | | | 15.2 | | | |
| Queue Length 95th (m) | 36 | | | 0 | | | 66 | | | 6 | | | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 35.8 |
| Volumes (veh/h) | 75 | 100 | 118 | 161 | 159 | 10 | 133 | 127 | 97 | 16 | 180 | 108 | |
| Volume/Capacity Ratio (v/c) | 0.72 | | | 0.82 | | | 0.86 | | | 0.74 | | | |
| Lane LOS | D | | | E | | | E | | | D | | | |
| Control Delay (s) | 29.5 | | | 38.8 | | | 42.7 | | | 30.7 | | | |
| Queue Length 95th (m) | 44 | | | 58 | | | 66 | | | 47 | | | |
| 2030 Horizon, 50% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 40.6 |
| Volumes (veh/h) | 85 | 180 | 76 | 136 | 96 | 24 | 114 | 167 | 194 | 38 | 104 | 64 | |
| Volume/Capacity Ratio (v/c) | 0.77 | | | 0.61 | | | 1.00 | | | 0.49 | | | |
| Lane LOS | D | | | C | | | F | | | C | | | |
| Control Delay (s) | 31.5 | | | 22.7 | | | 66.4 | | | 18.4 | | | |
| Queue Length 95th (m) | 57 | | | 33 | | | 110 | | | 22 | | | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 65.7 |
| Volumes (veh/h) | 78 | 111 | 132 | 180 | 177 | 11 | 148 | 140 | 108 | 16 | 196 | 117 | |
| Volume/Capacity Ratio (v/c) | 0.89 | | | 1.00 | | | 1.00 | | | 0.9 | | | |
| Lane LOS | F | | | F | | | F | | | F | | | |
| Control Delay (s) | 52.3 | | | 76.4 | | | 54.8 | | | 75.6 | | | |
| Queue Length 95th (m) | 72 | | | 97 | | | 98 | | | 76 | | | |
| 2030 Horizon, 100% Increase | | | | | | | | | | | | | |
| AM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 41.3 |
| Volumes (veh/h) | 87 | 180 | 76 | 136 | 96 | 25 | 114 | 172 | 194 | 40 | 108 | 67 | |
| Volume/Capacity Ratio (v/c) | 0.78 | | | 0.62 | | | 1.00 | | | 0.52 | | | |
| Lane LOS | D | | | C | | | F | | | C | | | |
| Control Delay (s) | 32.9 | | | 23.2 | | | 66.8 | | | 19.2 | | | |
| Queue Length 95th (m) | 58 | | | 34 | | | 110 | | | 24 | | | |
| PM PEAK HOUR | | | | | | | | | | | | | Overall Intersection Delay (s) 67.8 |
| Volumes (veh/h) | 83 | 111 | 132 | 180 | 177 | 11 | 148 | 142 | 108 | 17 | 200 | 120 | |
| Volume/Capacity Ratio (v/c) | 0.91 | | | 1.00 | | | 1.00 | | | 0.93 | | | |
| Lane LOS | F | | | F | | | F | | | F | | | |
| Control Delay (s) | 55.8 | | | 76.8 | | | 76 | | | 59.7 | | | |
| Queue Length 95th (m) | 76 | | | 96 | | | 98 | | | 81 | | | |

Table 4-8: Analysis Results - Four Corners (SIGNALIZED)

| Intersection Location | Intersection Movements | | | | | | | | | | | | Overall Intersection |
|---------------------------------------|------------------------|-----|-----|------|-----|----|------|-----|-----|------|-----|-----|--|
| | SB | | | NB | | | EB | | | WB | | | |
| | L | T | R | L | T | R | L | T | R | L | T | R | |
| <u>2030 Horizon, 100% Increase</u> | | | | | | | | | | | | | Overall Intersection Delay (s) 18.7 |
| PM PEAK HOUR | | | | | | | | | | | | | |
| Intersection / Laning Characteristics | SH | 1 | SH | SH | 1 | SH | SH | 1 | SH | SH | 1 | SH | |
| Volumes (veh/h) | 83 | 111 | 132 | 180 | 177 | 11 | 148 | 142 | 108 | 17 | 200 | 120 | |
| Volume/Capacity Ratio (v/c) | 0.54 | | | 0.77 | | | 0.77 | | | 0.48 | | | |
| Lane LOS | B | | | C | | | C | | | B | | | |
| Control Delay (s) | 12 | | | 26.1 | | | 23.7 | | | 11.3 | | | |
| Queue Length 95th (m) | 35.7 | | | 68.9 | | | 69.8 | | | 35.6 | | | |

Pedestrians
August 3, 2017

5.0 PEDESTRIANS

Pedestrian movements were counted in conjunction with the traffic counts for the study intersections. The resulting peak hour pedestrian volumes are shown in **Figure 5-1**.

As shown, the majority of pedestrians crossing Niaqunngusiariaq Road are doing so east of the College entrance where the existing crosswalk is located, indicating that it is located appropriately to meet the needs of the pedestrians. Field observations were that students tended to favour the north side of the road, generally travelling to and from the City Centre, with most pedestrians using the crosswalk if crossing, although some crossings to the west were observed as shown on the diagram. Another crosswalk is located at the Aquatic Centre to the west which pedestrians may use to cross Niaqunngusiariaq Road prior to reaching the College.

The crosswalk is currently marked with a single crossing sign in each direction. It is recommended that crossing signs be located on both sides of the road in both directions, with the crosswalk itself marked with paint lines across the roadway. Sample Design Guideline Drawings from the City of Red Deer are included in **Appendix D** illustrating the suggested use and placement of these signs.

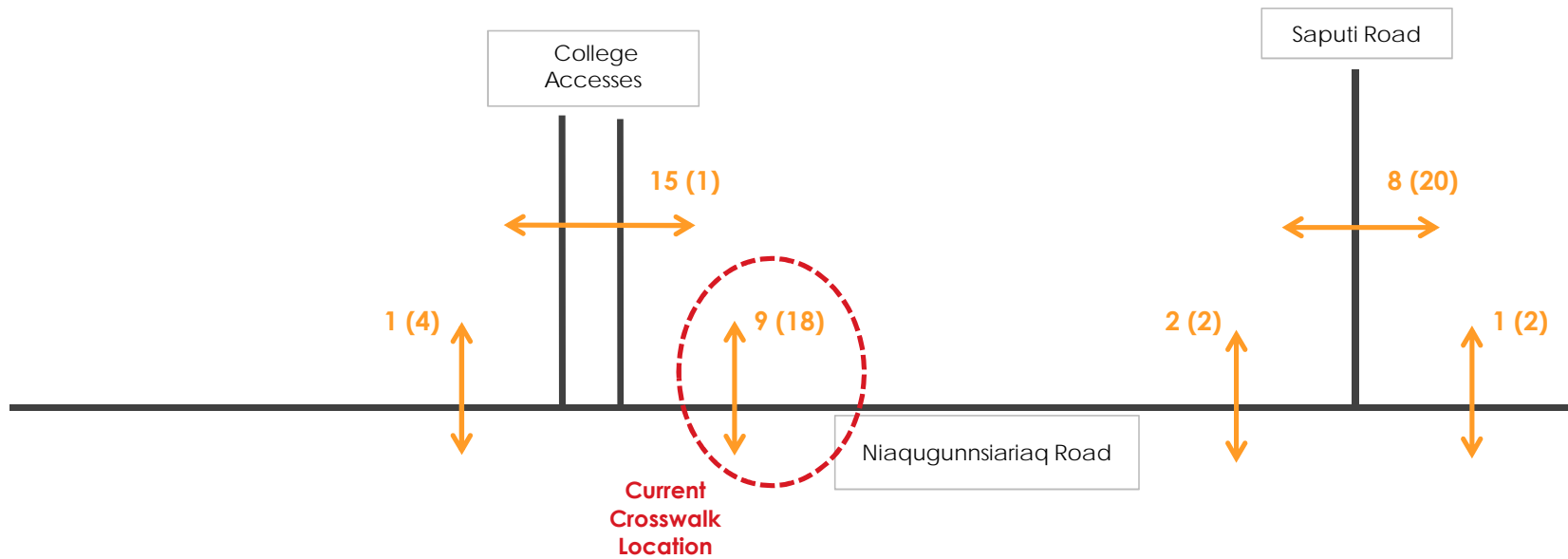
Approximately 20 pedestrians were observed to have crossed Saputi Road in the afternoon peak hour. The wait times for pedestrians at this intersection are short (< 30 s) as drivers tended to yield to pedestrian traffic. Most users crossed at the intersection, with some informal crossings up to 20 m north of the intersection, which were included in counts.

This movement is not protected with a crosswalk; however, the sight lines are clear and it is not likely to pose a risk to pedestrians. This location should be monitored for further increases in pedestrian volumes. If a traffic signal is installed at this location this will offer further accommodation for pedestrians.

Future Pedestrian Volumes

A significant increase in pedestrian traffic volumes is not expected due to the NAC expansion, as many students live directly above the college; however, some increase can be expected due to staff & students travelling beyond the campus. Additionally, a portion of the observed pedestrian volumes were not College-related and can be expected to increase at the same rate as the background automobile traffic. The projected pedestrian volumes for the 2030 horizon with 100% additional College trips are shown in **Figure 5.2**. These were included in the Synchro analysis and therefore their impact on traffic operations has been accounted for.

The highest projected volumes are around 30 pedestrians in the peak hour, representing approximately one pedestrian every two minutes. It is expected that wait times for these pedestrians will not increase, as drivers will continue to yield the right-of-way.



LEGEND

AM Peak Hour Volume
(##) PM Peak Hour Volume



10160 - 112th Street
Edmonton AB

Client/Project
NAC Expansion TIA
Government of Nunavut-CGS

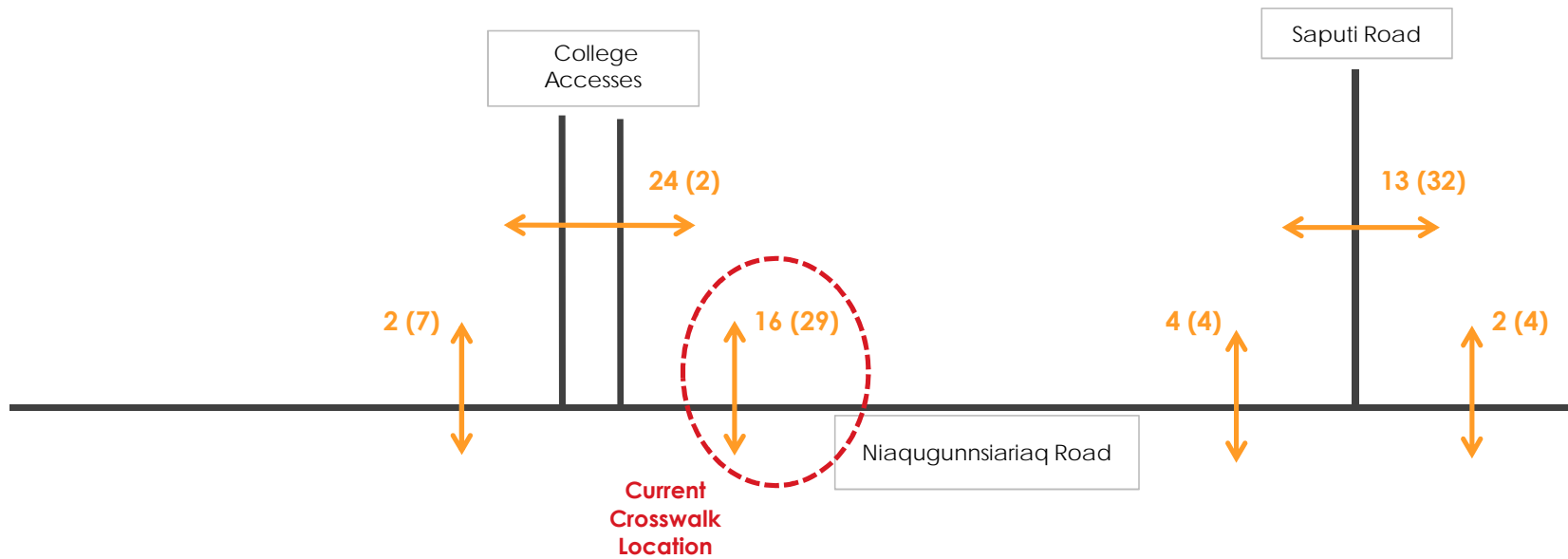
June 2017

Figure No.

5-1

Title

Existing Pedestrian Counts



LEGEND

AM Peak Hour Volume
 (##) PM Peak Hour Volume



10160 - 112th Street
 Edmonton AB

Client/Project
 NAC Expansion TIA
 Government of Nunavut-CGS

June 2017

Figure No.

5-2

Title

**Projected Pedestrian Volumes
 2030 with 100% Additional Trips**

Recommendations
August 3, 2017

6.0 RECOMMENDATIONS

Based on the analysis conducted, the improvements described below are recommended for the study intersections:

Saputi Road & Niaqunngusiariaq Road

Based on the signal warrant analysis, signals are recommended at this intersection at the 2025 horizon, triggered mainly by the projected background traffic growth. However, Synchro analysis suggests that they may be required sooner, around the 2020 horizon. Further, an eastbound left turn lane may be required in the long-term horizon, again, dependent on the background traffic volumes. Traffic volumes and operations should be monitored at this location to determine the appropriate timing for these improvements.

Four Corners

Based on the signal warrant analysis, signals are recommended at this intersection at the 2020 horizon, triggered mainly by the projected background traffic growth. However, Synchro analysis suggests that they may be able to be delayed until around the 2025 horizon. Traffic volumes and operations should be monitored at this location to determine the appropriate timing for this improvement.

College Accesses (East & West)

The NAC accesses are projected to continue operating acceptably through the 2030 horizon, and no further improvements are recommended.

Pedestrian Crossing

Based on the observed pedestrian volumes, the existing crosswalk seems to be in an appropriate location to service the needs of the College. Improved signage and pavement markings are recommended as illustrated in Appendix D.

Pedestrians crossing Saputi Road will be accommodated by the traffic signals recommended above. Until this point no further improvements are recommended.

August 3, 2017

Appendix A

TRAFFIC COUNT DATA

Intersection: Saputi Road & **Niaqunngusiariaq**
 (North/South Road) (East/West Road)

Date of Count:

RAW DATA

| Start Time | | Saputi Road Northbound | | | Saputi Road Southbound | | | Niaqunngusiariaq Eastbound | | | Niaqunngusiariaq Westbound | | | Total Vehicles in Intersection |
|------------|--------------|------------------------|---------|-------|------------------------|---------|-------|----------------------------|---------|-------|----------------------------|---------|-------|--------------------------------|
| | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 6:30 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 6:45 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 7:00 AM | cars | | | | 8.5 | | 7 | 3.5 | 21 | | | 22 | 1 | |
| | trucks/buses | | | | 0 | | 0 | 0 | 0.5 | | | 0.5 | 0 | |
| | total | 0 | 0 | 0 | 8.5 | | 7 | 3.5 | 21.5 | | 0 | 22.5 | 1 | 64 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 2.0% | | | 2.1% | | 1.6% |
| 7:15 AM | cars | | | | 4 | | 6 | 4 | 21.5 | | | 24 | 6.5 | |
| | trucks/buses | | | | 0.5 | | 0 | 0 | 1.5 | | | 0.5 | 0 | |
| | total | 0 | 0 | 0 | 4.5 | | 6 | 4 | 23 | | 0 | 24.5 | 6.5 | 68.5 |
| | % trucks | | #DIV/0! | | | 4.8% | | | 5.6% | | | 1.6% | | 3.6% |
| 7:30 AM | cars | | | | 8 | | 14.5 | 6.5 | 35.5 | | | 42.5 | 6.5 | |
| | trucks/buses | | | | 0 | | 0 | 0 | 1 | | | 0 | 0 | |
| | total | 0 | 0 | 0 | 8 | | 14.5 | 6.5 | 36.5 | | 0 | 42.5 | 6.5 | 114.5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 2.3% | | | 0.0% | | 0.9% |
| 7:45 AM | cars | | | | 15 | | 35 | 8.5 | 37.5 | | | 96 | 13 | |
| | trucks/buses | | | | 0 | | 1 | 0 | 0 | | | 1 | 0 | |
| | total | 0 | 0 | 0 | 15 | | 36 | 8.5 | 37.5 | | 0 | 97 | 13 | 207 |
| | % trucks | | #DIV/0! | | | 2.0% | | | 0.0% | | | 0.9% | | 1.0% |
| 8:00 AM | cars | | | | 25.5 | | 33 | 9.5 | 37 | | | 95.5 | 14 | |
| | trucks/buses | | | | 0 | | 0 | 0 | 3 | | | 1 | 0 | |
| | total | 0 | 0 | 0 | 25.5 | | 33 | 9.5 | 40 | | 0 | 96.5 | 14 | 218.5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 6.1% | | | 0.9% | | 1.8% |
| 8:15 AM | cars | | | | 28.5 | | 58 | 9 | 58.5 | | | 125.5 | 15 | |
| | trucks/buses | | | | 0 | | 1 | 1 | 2.5 | | | 1 | 0 | |
| | total | 0 | 0 | 0 | 28.5 | | 59 | 10 | 61 | | 0 | 126.5 | 15 | 300 |
| | % trucks | | #DIV/0! | | | 1.1% | | | 4.9% | | | 0.7% | | 1.8% |
| 8:30 AM | cars | | | | 20.5 | | 53 | 12 | 23 | | | 138 | 9 | |
| | trucks/buses | | | | 0 | | 0.5 | 0.5 | 3 | | | 2.5 | 0 | |
| | total | 0 | 0 | 0 | 20.5 | | 53.5 | 12.5 | 26 | | 0 | 140.5 | 9 | 262 |
| | % trucks | | #DIV/0! | | | 0.7% | | | 9.1% | | | 1.7% | | 2.5% |
| 8:45 AM | cars | | | | 13 | | 30.5 | 13 | 44 | | | 84 | 11.5 | |
| | trucks/buses | | | | 0.5 | | 0.5 | 0 | 2.5 | | | 1 | 0 | |
| | total | 0 | 0 | 0 | 13.5 | | 31 | 13 | 46.5 | | 0 | 85 | 11.5 | 200.5 |
| | % trucks | | #DIV/0! | | | 2.2% | | | 4.2% | | | 1.0% | | 2.2% |
| 9:00 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 9:15 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |

PEAK HOUR: 7:45-8:45 AM

987.5

| | | | | | | | | | | | | | | |
|------------------|----------------------|----------|----------|----------|-------------|----------|--------------|-------------|--------------|----------|----------|--------------|-----------|--------------|
| PEAK HOUR | cars | 0 | 0 | 0 | 89.5 | 0 | 179 | 39 | 156 | 0 | 0 | 455 | 51 | |
| 7:45-8:45 AM | trucks/buses | 0 | 0 | 0 | 0 | 0 | 2.5 | 1.5 | 8.5 | 0 | 0 | 5.5 | 0 | |
| | TOTAL VEHICLE | 0 | 0 | 0 | 89.5 | 0 | 181.5 | 40.5 | 164.5 | 0 | 0 | 460.5 | 51 | 987.5 |
| | % trucks | | #DIV/0! | | | 0.9% | | | 4.9% | | | 1.1% | | 1.8% |

Intersection: Saputi Road & **Niaqunngusiariaq**
 (North/South Road) (East/West Road)

Date of Count:

RAW DATA

| | | Saputi Road Northbound | | | Saputi Road Southbound | | | Niaqunngusiariaq Eastbound | | | Niaqunngusiariaq Westbound | | | Total Vehicles in Intersection |
|------------|--------------|------------------------|---------|-------|------------------------|---------|-------|----------------------------|---------|-------|----------------------------|---------|-------|--------------------------------|
| Start Time | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 3:30 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | total | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| | % trucks | | | | | | | | | | | | | |
| 3:45 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | total | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| | % trucks | | | | | | | | | | | | | |
| 4:00 PM | cars | | | | 13 | | 12 | 22.5 | 56.5 | | | 68.5 | 12 | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | | | 2.5 | 0 | |
| | total | | | | 13 | 0 | 12 | 22.5 | 57 | 0 | 0 | 71 | 12 | 187.5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 0.6% | | | 3.0% | | 1.6% |
| 4:15 PM | cars | | | | 0 | | 27.5 | 18 | 53.5 | | | 58 | 0 | |
| | trucks/buses | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 1.5 | | | 3.5 | 0 | |
| | total | | | | 0.5 | 0 | 27.5 | 18 | 55 | 0 | 0 | 61.5 | 0 | 162.5 |
| | % trucks | | #DIV/0! | | | 1.8% | | | 2.1% | | | 5.7% | | 3.4% |
| 4:30 PM | cars | | | | 15 | | 15.5 | 27.5 | 61.5 | | | 72.5 | 14 | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 2 | | | | 1 | 0 | |
| | total | | | | 15 | 0 | 16 | 28 | 63.5 | 0 | 0 | 73.5 | 14 | 210 |
| | % trucks | | #DIV/0! | | | 1.6% | | | 2.7% | | | 1.1% | | 1.9% |
| 4:45 PM | cars | | | | 16.5 | | 21 | 25.5 | 88.5 | | | 63.5 | 14 | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.5 | | | 1.5 | 0 | |
| | total | | | | 16.5 | 0 | 21 | 26.5 | 89 | 0 | 0 | 65 | 14 | 232 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 1.3% | | | 1.9% | | 1.3% |
| 5:00 PM | cars | | | | 18 | | 24.5 | 63 | 128.5 | | | 76 | 34.5 | |
| | trucks/buses | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 0.5 | | | 1 | 0 | |
| | total | | | | 18.5 | 0 | 24.5 | 63 | 129 | 0 | 0 | 77 | 34.5 | 346.5 |
| | % trucks | | #DIV/0! | | | 1.2% | | | 0.3% | | | 0.9% | | 0.6% |
| 5:15 PM | cars | | | | 27 | | 23.5 | 63.5 | 101.5 | | | 58 | 27.5 | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.5 | | | 1 | 0 | |
| | total | | | | 27 | 0 | 23.5 | 63.5 | 105 | 0 | 0 | 59 | 27.5 | 305.5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 2.1% | | | 1.2% | | 1.5% |
| 5:30 PM | cars | | | | 30 | | 16.5 | 36.5 | 66 | | | 46 | 24.5 | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 2 | 0 | |
| | total | | | | 30 | 0 | 16.5 | 36.5 | 66 | 0 | 0 | 48 | 24.5 | 221.5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 0.0% | | | 2.8% | | 0.9% |
| 5:45 PM | cars | | | | 25.5 | | 26.5 | 27.5 | 51.5 | | | 46 | 18 | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0.5 | |
| | total | | | | 25.5 | 0 | 26.5 | 27.5 | 51.5 | 0 | 0 | 46 | 18.5 | 195.5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | 0.0% | | | 0.8% | | 0.3% |
| 6:00 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | total | | | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| | % trucks | | | | | | | | | | | | | |
| 6:15 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | total | | | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| | % trucks | | | | | | | | | | | | | |

PEAK HOUR:

4:45-5:45 PM

1105.5

| | | | | | | | | | | | | | | |
|------------------|----------------------|----------|----------|----------|-----------|----------|-------------|--------------|------------|----------|----------|------------|--------------|---------------|
| PEAK HOUR | cars | 0 | 0 | 0 | 91.5 | 0 | 85.5 | 188.5 | 384.5 | 0 | 0 | 243.5 | 100.5 | |
| 4:45-5:45 PM | trucks/buses | 0 | 0 | 0 | 0.5 | 0 | 0 | 1 | 4.5 | 0 | 0 | 5.5 | 0 | |
| | TOTAL VEHICLE | 0 | 0 | 0 | 92 | 0 | 85.5 | 189.5 | 389 | 0 | 0 | 249 | 100.5 | 1105.5 |
| | % trucks | | #DIV/0! | | | 0.3% | | | 1.0% | | | 1.6% | | 1.0% |

Intersection: College East Access & Niaqunngusiariaq
 (North/South Road) (East/West Road)

Date of Count:

RAW DATA

| Start Time | | College East Access Northbound | | | College East Access Southbound | | | Niaqunngusiariaq Eastbound | | | Niaqunngusiariaq Westbound | | | Total Vehicles in Intersection |
|------------|--------------|--------------------------------|---------|-------|--------------------------------|---------|-------|----------------------------|---------|-------|----------------------------|---------|-------|--------------------------------|
| | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 6:30 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 6:45 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 7:00 AM | cars | | | | | | | 0 | | | | | 2 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | 0.0% | | 0.0% |
| 7:15 AM | cars | | | | | | | 1 | | | | | 3 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 4 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |
| 7:30 AM | cars | | | | | | | 1 | | | | | 2 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 3 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |
| 7:45 AM | cars | | | | | | | 1 | | | | | 1 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |
| 8:00 AM | cars | | | | | | | 2 | | | | | 5 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 5 | 7 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |
| 8:15 AM | cars | | | | | | | 6 | | | | | 11 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 11 | 17 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |
| 8:30 AM | cars | | | | | | | 6 | | | | | 18 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 18 | 24 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |
| 8:45 AM | cars | | | | | | | 3 | | | | | 8 | |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 8 | 11 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |
| 9:00 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 9:15 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |

PEAK HOUR: 8:00-9:00 AM

59

| | | | | | | | | | | | | | | |
|------------------|----------------------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|----------|----------|-----------|-----------|
| PEAK HOUR | cars | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 42 | |
| 8:00-9:00 AM | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | TOTAL VEHICLE | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 42 | 59 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | 0.0% |

Intersection: College East Access & Niaqunngusiariaq
 (North/South Road) (East/West Road)

Date of Count:

RAW DATA

| Start Time | | College East Access Northbound | | | College East Access Southbound | | | Niaqunngusiariaq Eastbound | | | Niaqunngusiariaq Westbound | | | Total Vehicles in Intersection |
|------------|--------------|--------------------------------|---------|-------|--------------------------------|---------|-------|----------------------------|---------|-------|----------------------------|---------|-------|--------------------------------|
| | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 3:30 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 3:45 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 4:00 PM | cars | | | | | | | 3 | | | | | 4 | 7 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 4 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |
| 4:15 PM | cars | | | | | | | 2 | | | | | 1 | 3 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |
| 4:30 PM | cars | | | | | | | 1 | | | | | 0 | 1 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | #DIV/0! | | |
| 4:45 PM | cars | | | | | | | 6 | | | | | 3 | 9 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 3 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |
| 5:00 PM | cars | | | | | | | 3 | | | | | 2 | 5 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |
| 5:15 PM | cars | | | | | | | 2 | | | | | 2 | 4 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |
| 5:30 PM | cars | | | | | | | 2 | | | | | 1 | 3 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |
| 5:45 PM | cars | | | | | | | 1 | | | | | 1 | 2 0.0% |
| | trucks/buses | | | | | | | 0 | | | | | 0 | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |
| 6:00 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 6:15 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |

PEAK HOUR:

4:45-5:45 PM

21

| | | | | | | | | | | | | | | |
|------------------|----------------------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|----------|----------|----------|-------------------|
| PEAK HOUR | cars | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 8 | 21 0.0% |
| 4:45-5:45 PM | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | TOTAL VEHICLE | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 8 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | 0.0% | | | 0.0% | | |

Intersection: College West Access & Niaqunngusiariaq
(North/South Road) (East/West Road)

Date of Count:

RAW DATA

| | | College West Access Northbound | | | College West Access Southbound | | | Niaqunngusiariaq Eastbound | | | Niaqunngusiariaq Westbound | | | Total Vehicles in Intersection |
|------------|--------------|--------------------------------|---------|-------|--------------------------------|---------|-------|----------------------------|---------|-------|----------------------------|---------|-------|--------------------------------|
| Start Time | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 6:30 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 6:45 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 7:00 AM | cars | | | | 1 | | 1 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 7:15 AM | cars | | | | 0 | | 2 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 7:30 AM | cars | | | | 2 | | 0 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 7:45 AM | cars | | | | 0 | | 0 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 8:00 AM | cars | | | | 0 | | 2 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 8:15 AM | cars | | | | 3 | | 5 | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 3 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 8:30 AM | cars | | | | 4 | | 5 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 8:45 AM | cars | | | | 1 | | 3 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 9:00 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 9:15 AM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |

PEAK HOUR: 8:00-9:00 AM

23

| | | | | | | | | | | | | | | |
|------------------|----------------------|----------|----------|----------|----------|----------|-----------|----------|----------|----------|----------|----------|----------|-----------|
| PEAK HOUR | cars | 0 | 0 | 0 | 8 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 8:00-9:00 AM | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | TOTAL VEHICLE | 0 | 0 | 0 | 8 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |

Intersection: College West Access & Niaqunngusiariaq
 (North/South Road) (East/West Road)

Date of Count:

RAW DATA

| Start Time | | College West Access Northbound | | | College West Access Southbound | | | Niaqunngusiariaq Eastbound | | | Niaqunngusiariaq Westbound | | | Total Vehicles in Intersection |
|------------|--------------|--------------------------------|---------|-------|--------------------------------|---------|-------|----------------------------|---------|-------|----------------------------|---------|-------|--------------------------------|
| | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 3:30 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 3:45 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 4:00 PM | cars | | | | 4 | | 4 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 4:15 PM | cars | | | | 0 | | 2 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 4:30 PM | cars | | | | 2 | | 3 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 4:45 PM | cars | | | | 7 | | 3 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 7 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 5:00 PM | cars | | | | 16 | | 7 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 16 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 5:15 PM | cars | | | | 1 | | 3 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 5:30 PM | cars | | | | 2 | | 3 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 5:45 PM | cars | | | | 3 | | 1 | | | | | | | |
| | trucks/buses | | | | 0 | | 0 | | | | | | | |
| | total | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |
| 6:00 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |
| 6:15 PM | cars | | | | | | | | | | | | | |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | #DIV/0! |

PEAK HOUR:

4:30-5:30 PM

42

| | | | | | | | | | | | | | | |
|----------------------------------|----------------------|----------|----------|----------|-----------|----------|-----------|----------|----------|----------|----------|----------|----------|-----------|
| PEAK HOUR 4:30-5:30 PM | cars | 0 | 0 | 0 | 26 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | TOTAL VEHICLE | 0 | 0 | 0 | 26 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| | % trucks | | #DIV/0! | | | 0.0% | | | #DIV/0! | | | #DIV/0! | | 0.0% |

Intersection: Federal Road/ Queen Eli & Niaqunngusiariaq
 (North/South Road) (East/West Road)

Date of Count:

RAW DATA

| | | Federal Road/ Queen Elizabeth Northbound | | | Federal Road/ Queen Elizabeth Southbound | | | Niaqunngusiariaq Eastbound | | | Niaqunngusiariaq Westbound | | | Total Vehicles in Intersection |
|------------|--------------|---|---------|-------|---|---------|-------|-------------------------------|---------|-------|-------------------------------|---------|-------|--------------------------------------|
| Start Time | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 6:30 AM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 6:45 AM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 7:00 AM | cars | 13 | 9 | 3 | 3 | 4 | 4 | 3 | 15 | 15 | 3 | 7 | 5 | 84 0.0% |
| | trucks/buses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | total | 13 | 9 | 3 | 3 | 4 | 4 | 3 | 15 | 15 | 3 | 7 | 5 | |
| | % trucks | | 0.0% | | | 0.0% | | | 0.0% | | | 0.0% | | |
| 7:15 AM | cars | 15 | 2 | 3 | 4 | 14 | 3 | 4 | 16 | 23 | 1 | 9 | 4 | 102 3.9% |
| | trucks/buses | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | total | 17 | 2 | 3 | 4 | 14 | 4 | 4 | 16 | 23 | 1 | 9 | 5 | |
| | % trucks | | 9.1% | | | 4.5% | | | 0.0% | | | 6.7% | | |
| 7:30 AM | cars | 14 | 4.5 | 3 | 2 | 5 | 6 | 6 | 11 | 7 | 1.5 | 16 | 6.5 | 86 4.1% |
| | trucks/buses | 1 | 0.5 | 0 | 0 | 0 | 0.5 | 0 | 0 | 1 | 0 | 0 | 0.5 | |
| | total | 15 | 5 | 3 | 2 | 5 | 6.5 | 6 | 11 | 8 | 1.5 | 16 | 7 | |
| | % trucks | | 6.5% | | | 3.7% | | | 4.0% | | | 2.0% | | |
| 7:45 AM | cars | 12 | 8 | 1.5 | 11 | 21.5 | 7.5 | 11.5 | 20.5 | 36 | 1.5 | 14.5 | 16 | 166.5 3.0% |
| | trucks/buses | 0.5 | 0 | 0 | 1 | 0.5 | 0 | 0 | 0.5 | 2 | 0 | 0.5 | 0 | |
| | total | 12.5 | 8 | 1.5 | 12 | 22 | 7.5 | 11.5 | 21 | 38 | 1.5 | 15 | 16 | |
| | % trucks | | 2.3% | | | 3.6% | | | 3.5% | | | 1.5% | | |
| 8:00 AM | cars | 25.5 | 15.5 | 2.5 | 12.5 | 21 | 11 | 15.5 | 27 | 34.5 | 4.5 | 17 | 7 | 201 3.7% |
| | trucks/buses | 2 | 0.5 | 0 | 0.5 | 0.5 | 1 | 0 | 0.5 | 1 | 0.5 | 0 | 1 | |
| | total | 27.5 | 16 | 2.5 | 13 | 21.5 | 12 | 15.5 | 27.5 | 35.5 | 5 | 17 | 8 | |
| | % trucks | | 5.4% | | | 4.3% | | | 1.9% | | | 5.0% | | |
| 8:15 AM | cars | 25.5 | 12 | 2 | 12.5 | 35 | 13 | 17.5 | 27 | 40 | 11 | 17 | 15 | 235 3.2% |
| | trucks/buses | 0.5 | 1 | 0.5 | 0 | 0 | 0.5 | 1 | 2 | 0 | 0 | 1.5 | 0.5 | |
| | total | 26 | 13 | 2.5 | 12.5 | 35 | 13.5 | 18.5 | 29 | 40 | 11 | 18.5 | 15.5 | |
| | % trucks | | 4.8% | | | 0.8% | | | 3.4% | | | 4.4% | | |
| 8:30 AM | cars | 18 | 17 | 7.5 | 21.5 | 36 | 14 | 26 | 31.5 | 30.5 | 7.5 | 21 | 11.5 | 248 2.4% |
| | trucks/buses | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 0.5 | 0 | 0 | 0.5 | 0 | |
| | total | 19 | 18 | 8.5 | 21.5 | 38 | 14 | 26 | 32 | 30.5 | 7.5 | 21.5 | 11.5 | |
| | % trucks | | 6.6% | | | 2.7% | | | 0.6% | | | 1.2% | | |
| 8:45 AM | cars | 24.5 | 22.5 | 2 | 12.5 | 35.5 | 15.5 | 22.5 | 29 | 33.5 | 3 | 15 | 9.5 | 232.5 3.2% |
| | trucks/buses | 1.5 | 0.5 | 1 | 0 | 1 | 0 | 0 | 0.5 | 1 | 0.5 | 1 | 0.5 | |
| | total | 26 | 23 | 3 | 12.5 | 36.5 | 15.5 | 22.5 | 29.5 | 34.5 | 3.5 | 16 | 10 | |
| | % trucks | | 5.8% | | | 1.6% | | | 1.7% | | | 6.8% | | |
| 9:00 AM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 9:15 AM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |

PEAK HOUR: 8:00-9:00 AM

916.5

| | | | | | | | | | | | | | | |
|------------------|----------------------|-------------|-----------|-------------|-------------|------------|-----------|-------------|------------|--------------|-----------|-----------|-----------|----------------------|
| PEAK HOUR | cars | 93.5 | 67 | 14 | 59 | 127.5 | 53.5 | 81.5 | 114.5 | 138.5 | 26 | 70 | 43 | 916.5 3.1% |
| 8:00-9:00 AM | trucks/buses | 5 | 3 | 2.5 | 0.5 | 3.5 | 1.5 | 1 | 3.5 | 2 | 1 | 3 | 2 | |
| | TOTAL VEHICLE | 98.5 | 70 | 16.5 | 59.5 | 131 | 55 | 82.5 | 118 | 140.5 | 27 | 73 | 45 | |
| | % trucks | | 5.7% | | | 2.2% | | | 1.9% | | | 4.1% | | |

Intersection: _____ & _____
 (North/South Road) (East/West Road)

Date of Count: _____

RAW DATA

| | | 0 Northbound | | | 0 Southbound | | | 0 Eastbound | | | 0 Westbound | | | Total Vehicles in Intersection |
|------------|--------------|-----------------|---------|-------|-----------------|---------|-------|----------------|---------|-------|----------------|---------|-------|-----------------------------------|
| Start Time | | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 3:30 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 3:45 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 4:00 PM | cars | 31.5 | 23.5 | 3.5 | 12 | 22 | 14 | 17 | 20.5 | 17.5 | 6 | 23 | 19.5 | 228.5 8.1% |
| | trucks/buses | 2 | 3.5 | 0.5 | 2 | 2 | 0.5 | 1.5 | 2 | 2 | 0.5 | 1 | 1 | |
| | total | 33.5 | 27 | 4 | 14 | 24 | 14.5 | 18.5 | 22.5 | 19.5 | 6.5 | 24 | 20.5 | |
| | % trucks | | 9.3% | | | 8.6% | | | 9.1% | | | 4.9% | | |
| 4:15 PM | cars | 17 | 27 | 2.5 | 24 | 19.5 | 13.5 | 19.5 | 22.5 | 15.5 | 3 | 27 | 19 | 220 4.5% |
| | trucks/buses | 1 | 2.5 | 0 | 0 | 0.5 | 1 | 0.5 | 2 | 0.5 | 0.5 | 1 | 0.5 | |
| | total | 18 | 29.5 | 2.5 | 24 | 20 | 14.5 | 20 | 24.5 | 16 | 3.5 | 28 | 19.5 | |
| | % trucks | | 7.0% | | | 2.6% | | | 5.0% | | | 3.9% | | |
| 4:30 PM | cars | 27 | 31.5 | 2 | 14 | 22 | 18.5 | 21 | 30 | 23 | 5 | 23.5 | 24.5 | 249 2.8% |
| | trucks/buses | 0.5 | 0.5 | 0 | 0.5 | 0 | 0 | 0.5 | 0.5 | 2.5 | 0 | 0 | 2 | |
| | total | 27.5 | 32 | 2 | 14.5 | 22 | 18.5 | 21.5 | 30.5 | 25.5 | 5 | 23.5 | 26.5 | |
| | % trucks | | 1.6% | | | 0.9% | | | 4.5% | | | 3.6% | | |
| 4:45 PM | cars | 39 | 26 | 1.5 | 16.5 | 19 | 20 | 24.5 | 22.5 | 21.5 | 3 | 39 | 19.5 | 256 1.6% |
| | trucks/buses | 1.5 | 0.5 | 0 | 0 | 0.5 | 0 | 0 | 0.5 | 0.5 | 0 | 0 | 0.5 | |
| | total | 40.5 | 26.5 | 1.5 | 16.5 | 19.5 | 20 | 24.5 | 23 | 22 | 3 | 39 | 20 | |
| | % trucks | | 2.9% | | | 0.9% | | | 1.4% | | | 0.8% | | |
| 5:00 PM | cars | 31 | 33.5 | 1 | 13 | 22.5 | 28 | 30 | 25 | 13.5 | 1.5 | 42.5 | 15.5 | 261 1.5% |
| | trucks/buses | 1 | 0.5 | 0 | 0 | 1 | 0 | 0 | 0 | 0.5 | 0 | 0.5 | 0.5 | |
| | total | 32 | 34 | 1 | 13 | 23.5 | 28 | 30 | 25 | 14 | 1.5 | 43 | 16 | |
| | % trucks | | 2.2% | | | 1.6% | | | 0.7% | | | 1.7% | | |
| 5:15 PM | cars | 31 | 35 | 2.5 | 8.5 | 15.5 | 29.5 | 32 | 22 | 16 | 2.5 | 33.5 | 20 | 252.5 1.8% |
| | trucks/buses | 0 | 1 | 0.5 | 0.5 | 0.5 | 0 | 0 | 0.5 | 1 | 0 | 0 | 0.5 | |
| | total | 31 | 36 | 3 | 9 | 16 | 29.5 | 32 | 22.5 | 17 | 2.5 | 33.5 | 20.5 | |
| | % trucks | | 2.1% | | | 1.8% | | | 2.1% | | | 0.9% | | |
| 5:30 PM | cars | 25.5 | 26 | 2 | 18.5 | 16.5 | 24 | 26.5 | 28.5 | 17.5 | 3 | 26 | 20.5 | 237 1.1% |
| | trucks/buses | 1 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | total | 26.5 | 26.5 | 2 | 18.5 | 16.5 | 24 | 26.5 | 28.5 | 18.5 | 3 | 26 | 20.5 | |
| | % trucks | | 2.7% | | | 0.0% | | | 1.4% | | | 0.0% | | |
| 5:45 PM | cars | 24.5 | 21.5 | 2 | 20.5 | 21 | 25.5 | 28.5 | 22 | 17 | 2 | 19.5 | 23.5 | 229 0.7% |
| | trucks/buses | 0 | 0 | 0 | 0 | 0.5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | total | 24.5 | 21.5 | 2 | 20.5 | 21.5 | 25.5 | 28.5 | 22 | 18 | 2 | 19.5 | 23.5 | |
| | % trucks | | 0.0% | | | 0.7% | | | 1.5% | | | 0.0% | | |
| 6:00 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |
| 6:15 PM | cars | | | | | | | | | | | | | 0 #DIV/0! |
| | trucks/buses | | | | | | | | | | | | | |
| | total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | % trucks | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | | #DIV/0! | | |

PEAK HOUR:

4:30-5:30 PM

1018.5

| | | | | | | | | | | | | | | |
|------------------|----------------------|------------|--------------|------------|-----------|-----------|-----------|------------|------------|-------------|-----------|------------|-----------|---------------|
| PEAK HOUR | cars | 128 | 126 | 7 | 52 | 79 | 96 | 107.5 | 99.5 | 74 | 12 | 138.5 | 79.5 | 1018.5 |
| 4:30-5:30 PM | trucks/buses | 3 | 2.5 | 0.5 | 1 | 2 | 0 | 0.5 | 1.5 | 4.5 | 0 | 0.5 | 3.5 | |
| | TOTAL VEHICLE | 131 | 128.5 | 7.5 | 53 | 81 | 96 | 108 | 101 | 78.5 | 12 | 139 | 83 | |
| | % trucks | | 2.2% | | | 1.3% | | 2.3% | | | | 1.7% | | |

August 3, 2017

Appendix B

SIGNAL WARRANT SHEETS



Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Saputi Road**
 Quadrant / Int # **1**
 for Warrant Calculation
 Results, please hit 'Page
 Down'

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**
 Comments **Existing Conditions (2017)**

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

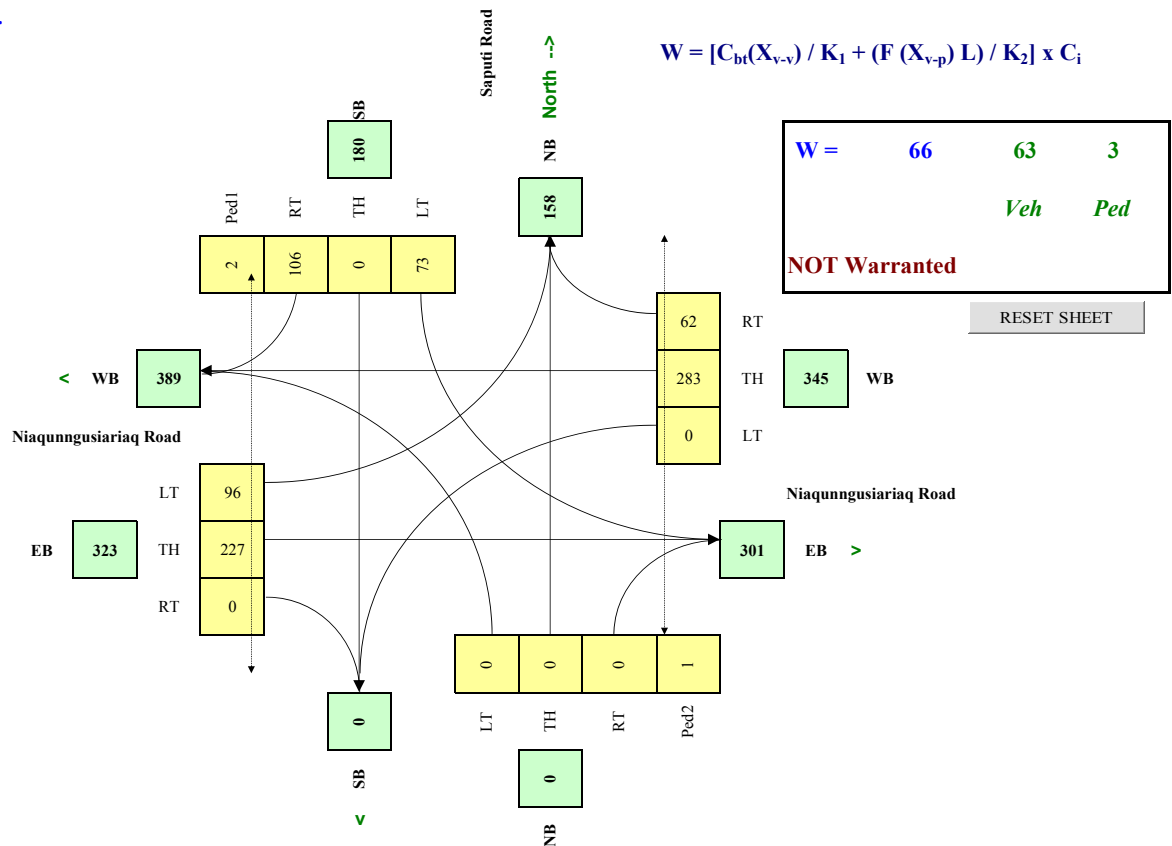
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 8,000 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 65 | 0 | 131 | 0 | 332 | 37 | 30 | 119 | 0 | 1.44 | 0.72 | 5.76 | 0 |
| | 0 | 0 | 0 | 90 | 0 | 182 | 0 | 461 | 51 | 41 | 165 | 0 | 2 | 1 | 8 | 0 |
| | 0 | 0 | 0 | 54 | 0 | 109 | 0 | 277 | 31 | 25 | 99 | 0 | 1.2 | 0.6 | 4.8 | 0 |
| | 0 | 0 | 0 | 55 | 0 | 52 | 0 | 149 | 61 | 114 | 233 | 0 | 1.2 | 1.2 | 12 | 0 |
| | 0 | 0 | 0 | 92 | 0 | 86 | 0 | 249 | 101 | 190 | 389 | 0 | 2 | 2 | 20 | 0 |
| | 0 | 0 | 0 | 85 | 0 | 79 | 0 | 229 | 93 | 175 | 358 | 0 | 1.84 | 1.84 | 18.4 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 441 | 0 | 639 | 0 | 1,697 | 373 | 574 | 1,363 | 0 | 10 | 7 | 69 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 73 | 0 | 106 | 0 | 283 | 62 | 96 | 227 | 0 | 2 | 1 | 11 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Saputi Road**
Quadrant / Int # **1**
CHECK SHEET

for Warrant Calculation
Results, please hit 'Page
Down'

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Background Conditions - 2020**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

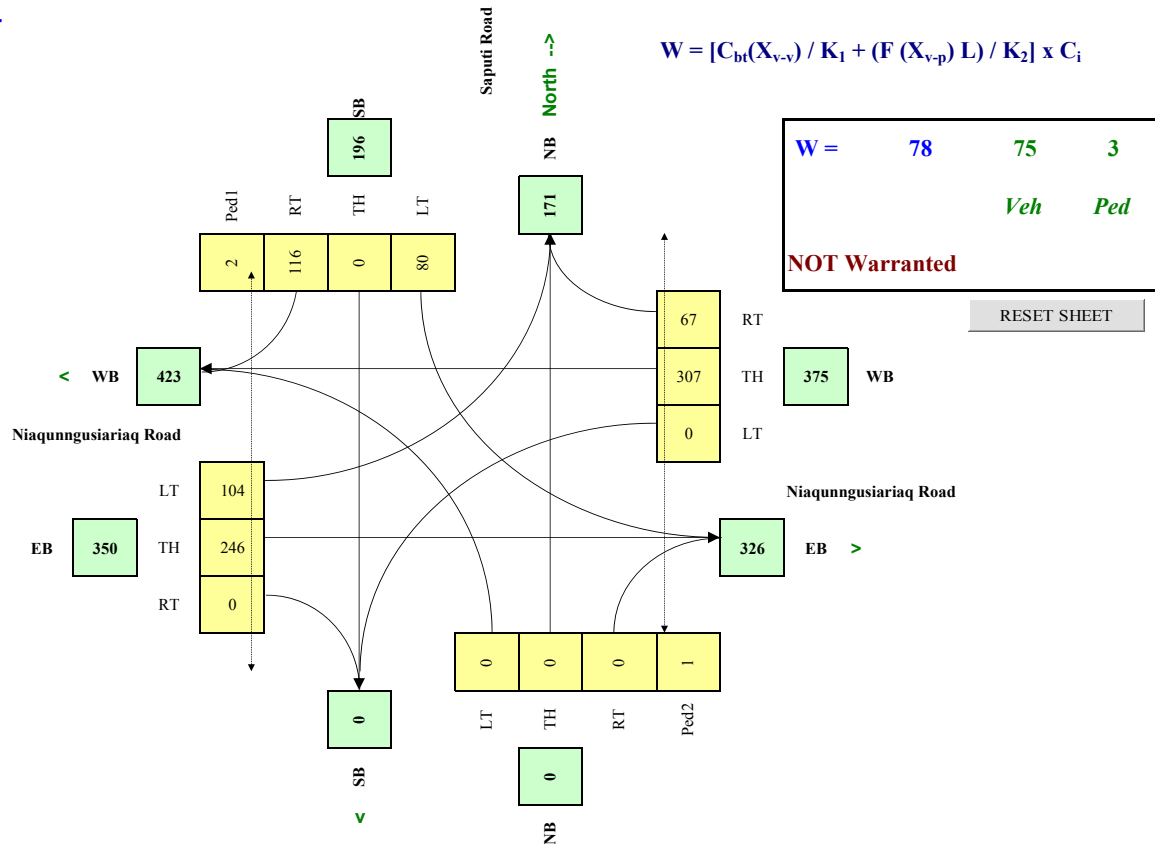
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 8,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 71 | 0 | 143 | 0 | 361 | 40 | 32 | 129 | 0 | 1.44 | 0.72 | 6.48 | 0 |
| | 0 | 0 | 0 | 98 | 0 | 198 | 0 | 501 | 55 | 45 | 179 | 0 | 2 | 1 | 9 | 0 |
| | 0 | 0 | 0 | 59 | 0 | 119 | 0 | 301 | 33 | 27 | 107 | 0 | 1.2 | 0.6 | 5.4 | 0 |
| | 0 | 0 | 0 | 60 | 0 | 56 | 0 | 162 | 66 | 124 | 253 | 0 | 1.2 | 1.2 | 13.2 | 0 |
| | 0 | 0 | 0 | 100 | 0 | 93 | 0 | 270 | 110 | 206 | 422 | 0 | 2 | 2 | 22 | 0 |
| | 0 | 0 | 0 | 92 | 0 | 86 | 0 | 248 | 101 | 190 | 388 | 0 | 1.84 | 1.84 | 20.24 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 479 | 0 | 694 | 0 | 1,843 | 405 | 624 | 1,479 | 0 | 10 | 7 | 76 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 80 | 0 | 116 | 0 | 307 | 67 | 104 | 246 | 0 | 2 | 1 | 13 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Saputi Road**
 Quadrant / Int # **1**
 for Warrant Calculation
 Results, please hit 'Page
 Down'

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**
 Comments **Full Build Out (2020) + 50%
 Additional Trips**

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: (yyyy-mm-dd)

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|------------------------|--------------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

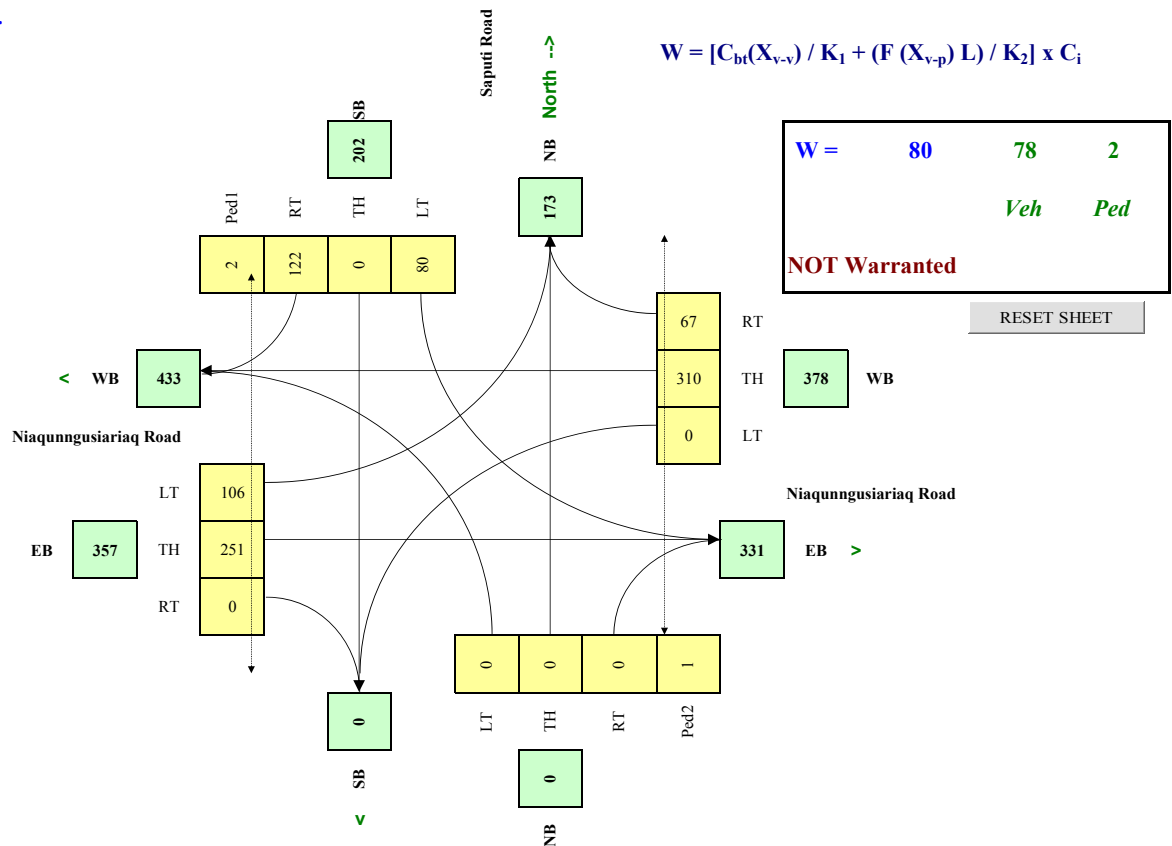
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 8,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|--|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 71 | 0 | 154 | 0 | 364 | 40 | 33 | 131 | 0 | | 1.44 | 0.72 | 7.2 | 0 |
| | 0 | 0 | 0 | 98 | 0 | 214 | 0 | 506 | 55 | 46 | 182 | 0 | | 2 | 1 | 10 | 0 |
| | 0 | 0 | 0 | 59 | 0 | 128 | 0 | 304 | 33 | 28 | 109 | 0 | | 1.2 | 0.6 | 6 | 0 |
| | 0 | 0 | 0 | 60 | 0 | 56 | 0 | 164 | 66 | 126 | 259 | 0 | | 1.2 | 1.2 | 14.4 | 0 |
| | 0 | 0 | 0 | 100 | 0 | 94 | 0 | 273 | 110 | 210 | 431 | 0 | | 2 | 2 | 24 | 0 |
| | 0 | 0 | 0 | 92 | 0 | 86 | 0 | 251 | 101 | 193 | 397 | 0 | | 1.84 | 1.84 | 22.08 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 479 | 0 | 733 | 0 | 1,862 | 405 | 636 | 1,508 | 0 | | 10 | 7 | 84 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 80 | 0 | 122 | 0 | 310 | 67 | 106 | 251 | 0 | | 2 | 1 | 14 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Saputi Road**
Quadrant / Int # **1**
CHECK SHEET

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Full Build Out (2020) + 100% Additional Trips**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

for Warrant Calculation Results, please hit 'Page Down'

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | Upstream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

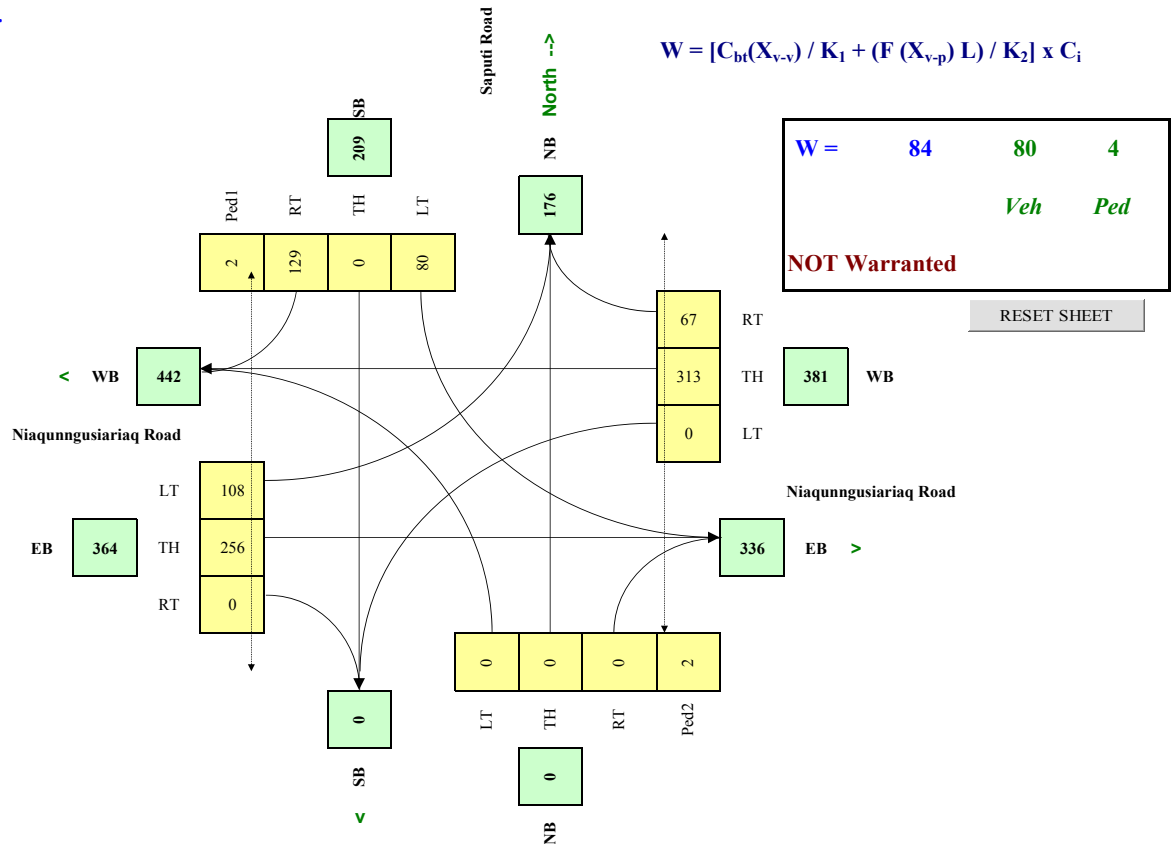
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 8,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|--|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 71 | 0 | 166 | 0 | 367 | 40 | 34 | 133 | 0 | | 2 | 1 | 8 | 0 |
| | 0 | 0 | 0 | 98 | 0 | 231 | 0 | 510 | 55 | 47 | 185 | 0 | | 3 | 1 | 11 | 0 |
| | 0 | 0 | 0 | 59 | 0 | 139 | 0 | 306 | 33 | 28 | 111 | 0 | | 2 | 1 | 7 | 0 |
| | 0 | 0 | 0 | 60 | 0 | 57 | 0 | 166 | 66 | 129 | 263 | 0 | | 2 | 2 | 16 | 0 |
| | 0 | 0 | 0 | 100 | 0 | 95 | 0 | 276 | 110 | 215 | 439 | 0 | | 3 | 3 | 27 | 0 |
| | 0 | 0 | 0 | 92 | 0 | 87 | 0 | 254 | 101 | 198 | 404 | 0 | | 3 | 3 | 25 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 479 | 0 | 775 | 0 | 1,879 | 405 | 651 | 1,535 | 0 | | 15 | 10 | 94 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 80 | 0 | 129 | 0 | 313 | 67 | 108 | 256 | 0 | | 2 | 2 | 16 | 0 |

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Saputi Road**
Quadrant / Int # **1**
CHECK SHEET

for Warrant Calculation
Results, please hit 'Page
Down'

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Background Conditions - 2025**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

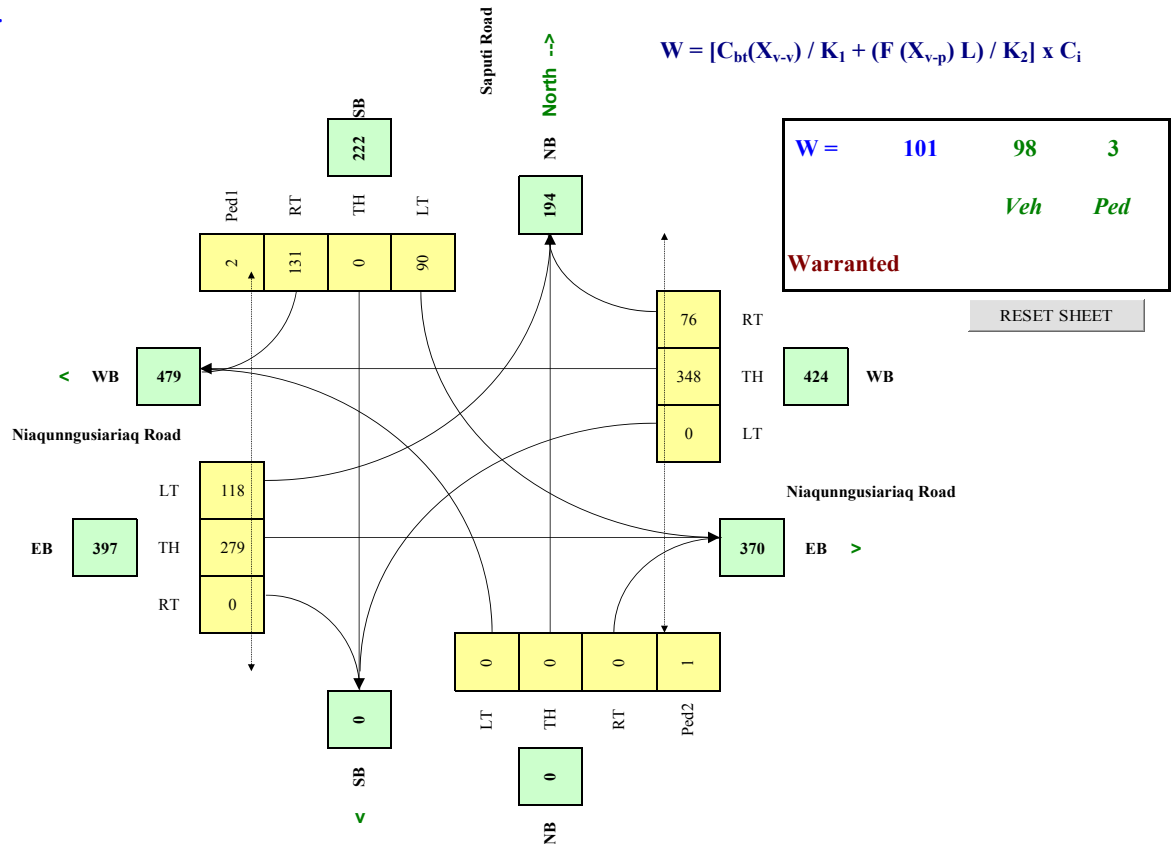
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 9,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 80 | 0 | 161 | 0 | 408 | 45 | 36 | 146 | 0 | 1 | 1 | 7 | 0 |
| | 0 | 0 | 0 | 111 | 0 | 224 | 0 | 567 | 63 | 50 | 203 | 0 | 2 | 1 | 10 | 0 |
| | 0 | 0 | 0 | 67 | 0 | 134 | 0 | 340 | 38 | 30 | 122 | 0 | 1 | 1 | 6 | 0 |
| | 0 | 0 | 0 | 68 | 0 | 64 | 0 | 184 | 74 | 140 | 287 | 0 | 1 | 1 | 15 | 0 |
| | 0 | 0 | 0 | 113 | 0 | 106 | 0 | 306 | 124 | 234 | 478 | 0 | 2 | 2 | 25 | 0 |
| | 0 | 0 | 0 | 104 | 0 | 98 | 0 | 282 | 114 | 215 | 440 | 0 | 2 | 2 | 23 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 542 | 0 | 787 | 0 | 2,087 | 459 | 706 | 1,676 | 0 | 10 | 7 | 86 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 90 | 0 | 131 | 0 | 348 | 76 | 118 | 279 | 0 | 2 | 1 | 14 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Saputi Road**
 Quadrant / Int # **1**
 for Warrant Calculation
 Results, please hit 'Page
 Down'

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**
 Comments **Full Build Out + 5 Years (2025) +
 50% Additional Trips**

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | Upstream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|------------------------|--------------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

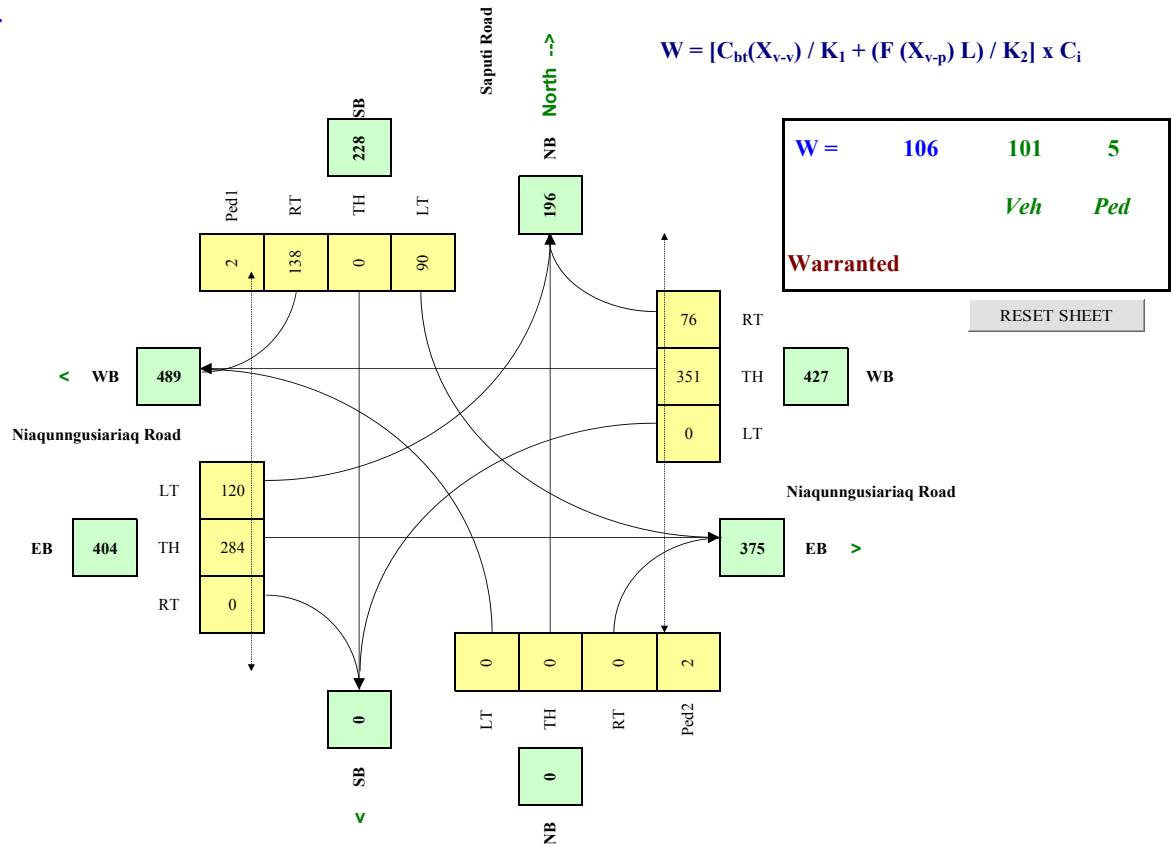
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 9,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|--|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 80 | 0 | 173 | 0 | 412 | 45 | 37 | 148 | 0 | | 2 | 1 | 8 | 0 |
| | 0 | 0 | 0 | 111 | 0 | 240 | 0 | 572 | 63 | 51 | 206 | 0 | | 3 | 1 | 11 | 0 |
| | 0 | 0 | 0 | 67 | 0 | 144 | 0 | 343 | 38 | 31 | 124 | 0 | | 2 | 1 | 7 | 0 |
| | 0 | 0 | 0 | 68 | 0 | 64 | 0 | 185 | 74 | 143 | 292 | 0 | | 2 | 2 | 16 | 0 |
| | 0 | 0 | 0 | 113 | 0 | 107 | 0 | 309 | 124 | 238 | 487 | 0 | | 3 | 3 | 26 | 0 |
| | 0 | 0 | 0 | 104 | 0 | 98 | 0 | 284 | 114 | 219 | 448 | 0 | | 3 | 3 | 24 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 542 | 0 | 826 | 0 | 2,106 | 459 | 718 | 1,705 | 0 | | 15 | 10 | 91 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 90 | 0 | 138 | 0 | 351 | 76 | 120 | 284 | 0 | | 2 | 2 | 15 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Saputi Road**
 Quadrant / Int # **1**
 for Warrant Calculation
 Results, please hit 'Page
 Down'

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**
 Comments **Full Build Out + 5 Years (2025) +
 100% Additional Trips**

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | Upstream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|------------------------|--------------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

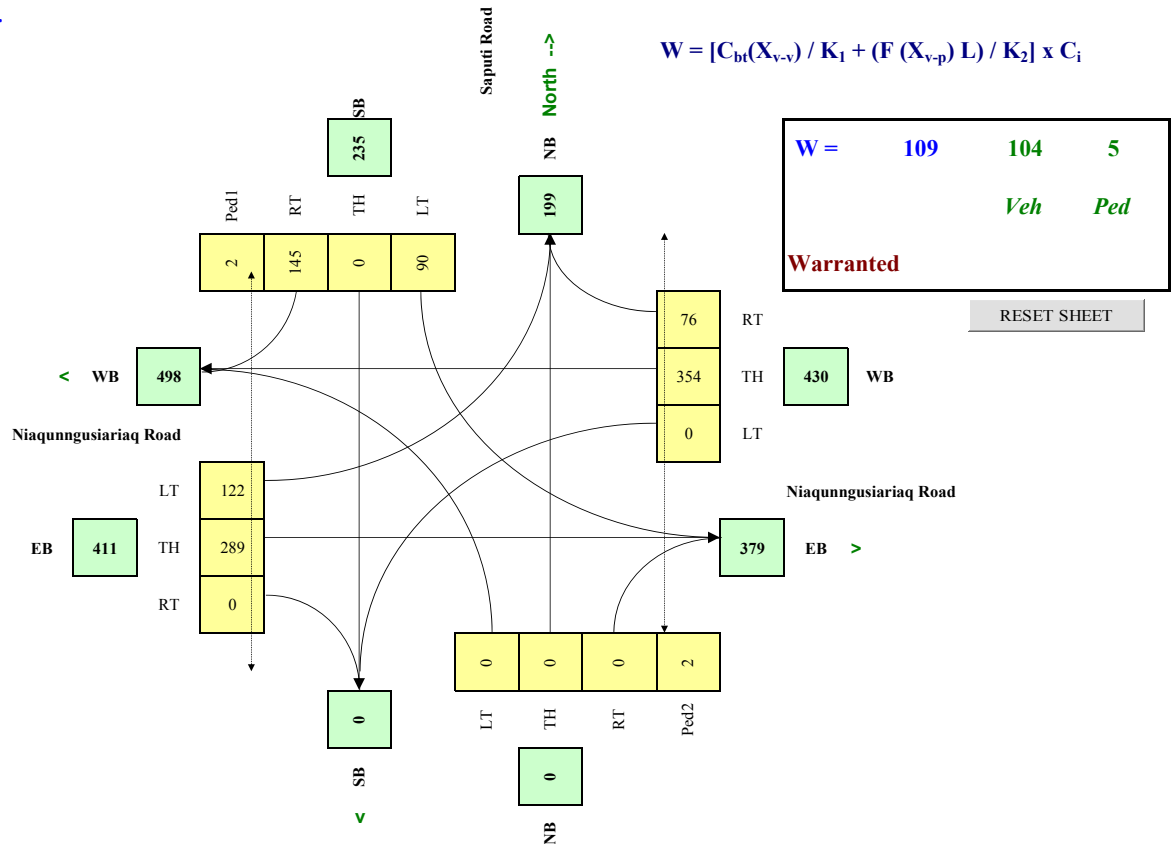
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 9,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 80 | 0 | 185 | 0 | 415 | 45 | 37 | 150 | 0 | 2 | 1 | 9 | 0 | 0 |
| | 0 | 0 | 0 | 111 | 0 | 257 | 0 | 576 | 63 | 52 | 209 | 0 | 3 | 1 | 12 | 0 | 0 |
| | 0 | 0 | 0 | 67 | 0 | 154 | 0 | 346 | 38 | 31 | 125 | 0 | 2 | 1 | 7 | 0 | 0 |
| | 0 | 0 | 0 | 68 | 0 | 65 | 0 | 187 | 74 | 146 | 297 | 0 | 2 | 2 | 17 | 0 | 0 |
| | 0 | 0 | 0 | 113 | 0 | 108 | 0 | 312 | 124 | 243 | 495 | 0 | 3 | 3 | 29 | 0 | 0 |
| | 0 | 0 | 0 | 104 | 0 | 99 | 0 | 287 | 114 | 224 | 455 | 0 | 3 | 3 | 27 | 0 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 542 | 0 | 868 | 0 | 2,123 | 459 | 733 | 1,732 | 0 | 15 | 10 | 101 | 0 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 90 | 0 | 145 | 0 | 354 | 76 | 122 | 289 | 0 | 2 | 2 | 17 | 0 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Saputi Road**
 Quadrant / Int # **1**

for Warrant Calculation
 Results, please hit 'Page
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CHECK SHEET

Comments

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**

Background Conditions - 2030

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: (yyyy-mm-dd)

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | Upstream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n)

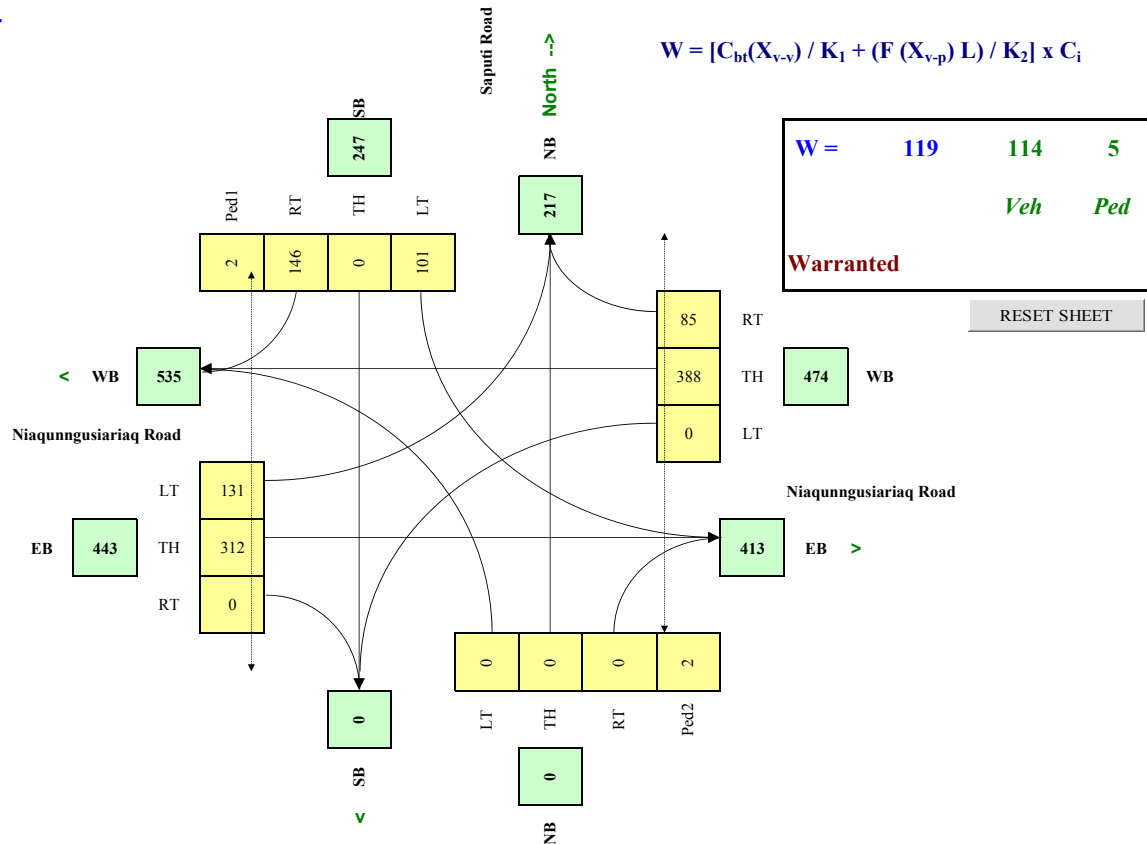
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|--------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 10,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 89 | 0 | 180 | 0 | 456 | 50 | 40 | 163 | 0 | 2 | 1 | 8 | 0 | |
| | 0 | 0 | 0 | 124 | 0 | 250 | 0 | 633 | 70 | 56 | 227 | 0 | 3 | 1 | 11 | 0 | |
| | 0 | 0 | 0 | 74 | 0 | 150 | 0 | 380 | 42 | 34 | 136 | 0 | 2 | 1 | 7 | 0 | |
| | 0 | 0 | 0 | 76 | 0 | 71 | 0 | 205 | 83 | 157 | 320 | 0 | 2 | 2 | 16 | 0 | |
| | 0 | 0 | 0 | 126 | 0 | 118 | 0 | 342 | 139 | 261 | 534 | 0 | 3 | 3 | 27 | 0 | |
| | 0 | 0 | 0 | 116 | 0 | 109 | 0 | 315 | 128 | 240 | 491 | 0 | 3 | 3 | 25 | 0 | |
| Total (6-hour peak) | 0 | 0 | 0 | 605 | 0 | 877 | 0 | 2,330 | 513 | 788 | 1,872 | 0 | 15 | 10 | 94 | 0 | |
| Average (6-hour peak) | 0 | 0 | 0 | 101 | 0 | 146 | 0 | 388 | 85 | 131 | 312 | 0 | 2 | 2 | 16 | 0 | |

Average 6-hour
 Peak Turning
 Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Saputi Road**
Quadrant / Int # **1**
CHECK SHEET

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Full Build Out +10 years (2030) + 50% Additional Trips**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

for Warrant Calculation Results, please hit 'Page Down'

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

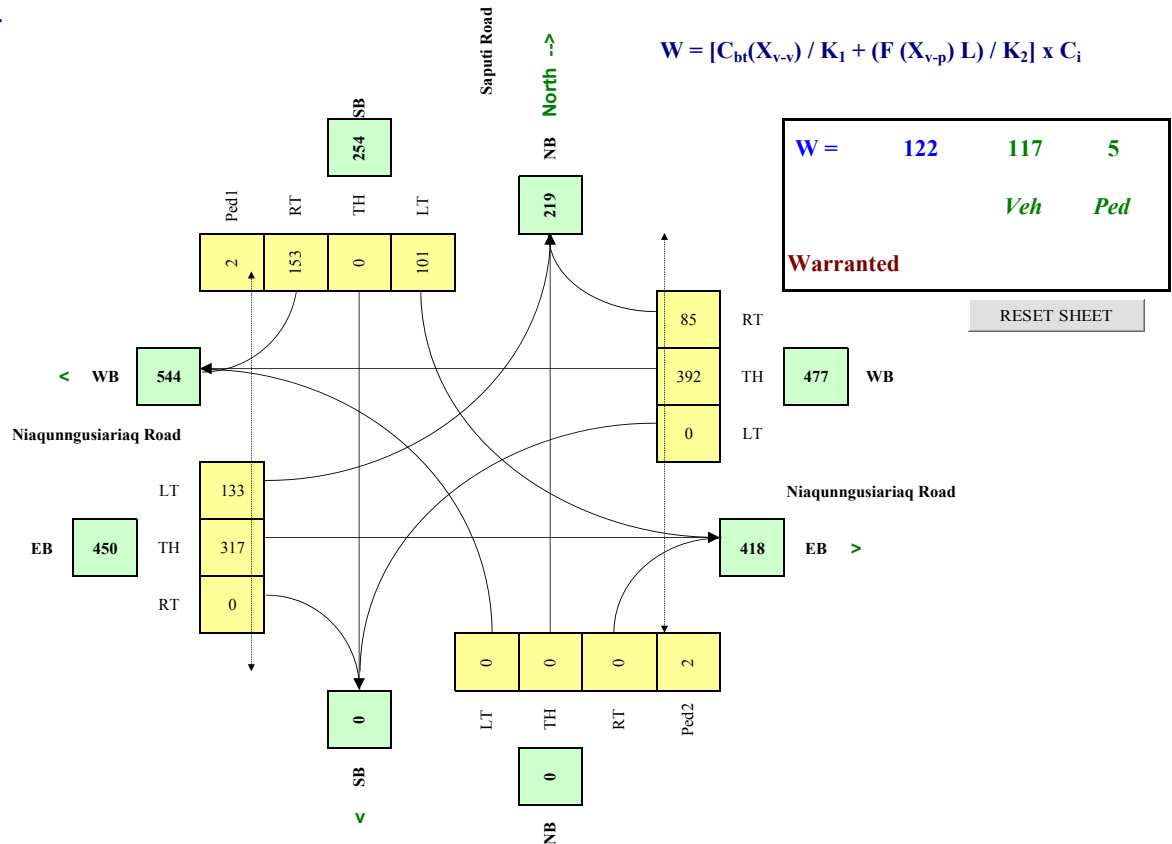
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|--------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 10,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 89 | 0 | 192 | 0 | 459 | 50 | 41 | 166 | 0 | 2 | 1 | 8 | 0 | |
| | 0 | 0 | 0 | 124 | 0 | 266 | 0 | 638 | 70 | 57 | 230 | 0 | 3 | 1 | 11 | 0 | |
| | 0 | 0 | 0 | 74 | 0 | 160 | 0 | 383 | 42 | 34 | 138 | 0 | 2 | 1 | 7 | 0 | |
| | 0 | 0 | 0 | 76 | 0 | 71 | 0 | 207 | 83 | 159 | 326 | 0 | 2 | 2 | 17 | 0 | |
| | 0 | 0 | 0 | 126 | 0 | 119 | 0 | 345 | 139 | 265 | 543 | 0 | 3 | 3 | 28 | 0 | |
| | 0 | 0 | 0 | 116 | 0 | 109 | 0 | 317 | 128 | 244 | 500 | 0 | 3 | 3 | 26 | 0 | |
| Total (6-hour peak) | 0 | 0 | 0 | 605 | 0 | 917 | 0 | 2,350 | 513 | 800 | 1,902 | 0 | 15 | 10 | 96 | 0 | |
| Average (6-hour peak) | 0 | 0 | 0 | 101 | 0 | 153 | 0 | 392 | 85 | 133 | 317 | 0 | 2 | 2 | 16 | 0 | |

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Saputi Road**
Quadrant / Int # **1**
CHECK SHEET

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Full Build Out +10 years (2030) + 100% Additional Trips**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | Upstream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | | 1 | | | 1 |
| Niaqungusiariaq Road | EB | | 1 | | | | | | 1 |
| Saputi Road | NB | | | | | | | | |
| Saputi Road | SB | | | | 1 | | | | |

Are the Saputi Road SB right turns significantly impeded by through movements? (y/n) **n**

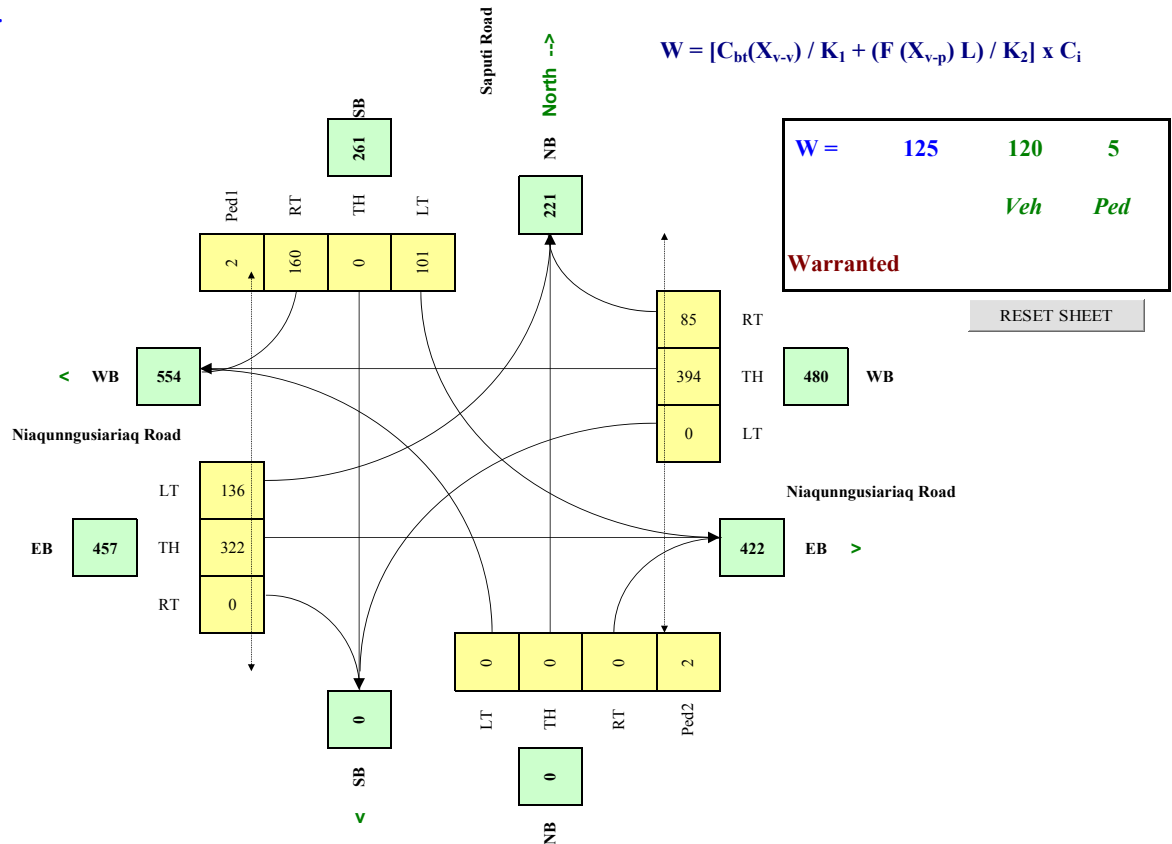
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 35 | 2.5% | n | |
| Saputi Road | NS | 40 | 1.0% | n | |

| Demographics | | |
|----------------------------------|-------|--------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | y |
| Metro Area Population | (#) | 10,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|----|----|----|-----|----|-----|----|-------|-----|-----|-------|----|----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 0 | 0 | 0 | 89 | 0 | 204 | 0 | 462 | 50 | 42 | 168 | 0 | 2 | 1 | 9 | 0 | 0 |
| | 0 | 0 | 0 | 124 | 0 | 283 | 0 | 642 | 70 | 58 | 233 | 0 | 3 | 2 | 12 | 0 | 0 |
| | 0 | 0 | 0 | 74 | 0 | 170 | 0 | 385 | 42 | 35 | 140 | 0 | 2 | 1 | 7 | 0 | 0 |
| | 0 | 0 | 0 | 76 | 0 | 72 | 0 | 209 | 83 | 162 | 331 | 0 | 2 | 2 | 19 | 0 | 0 |
| | 0 | 0 | 0 | 126 | 0 | 120 | 0 | 348 | 139 | 270 | 551 | 0 | 3 | 3 | 31 | 0 | 0 |
| | 0 | 0 | 0 | 116 | 0 | 110 | 0 | 320 | 128 | 248 | 507 | 0 | 3 | 3 | 29 | 0 | 0 |
| Total (6-hour peak) | 0 | 0 | 0 | 605 | 0 | 959 | 0 | 2,366 | 513 | 815 | 1,929 | 0 | 15 | 12 | 106 | 0 | 0 |
| Average (6-hour peak) | 0 | 0 | 0 | 101 | 0 | 160 | 0 | 394 | 85 | 136 | 322 | 0 | 2 | 2 | 18 | 0 | 0 |

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Federal Road**
 Quadrant / Int # **4**
 for Warrant Calculation
 Results, please hit 'Page
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Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**
 Comments **Existing Conditions (2017)**

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

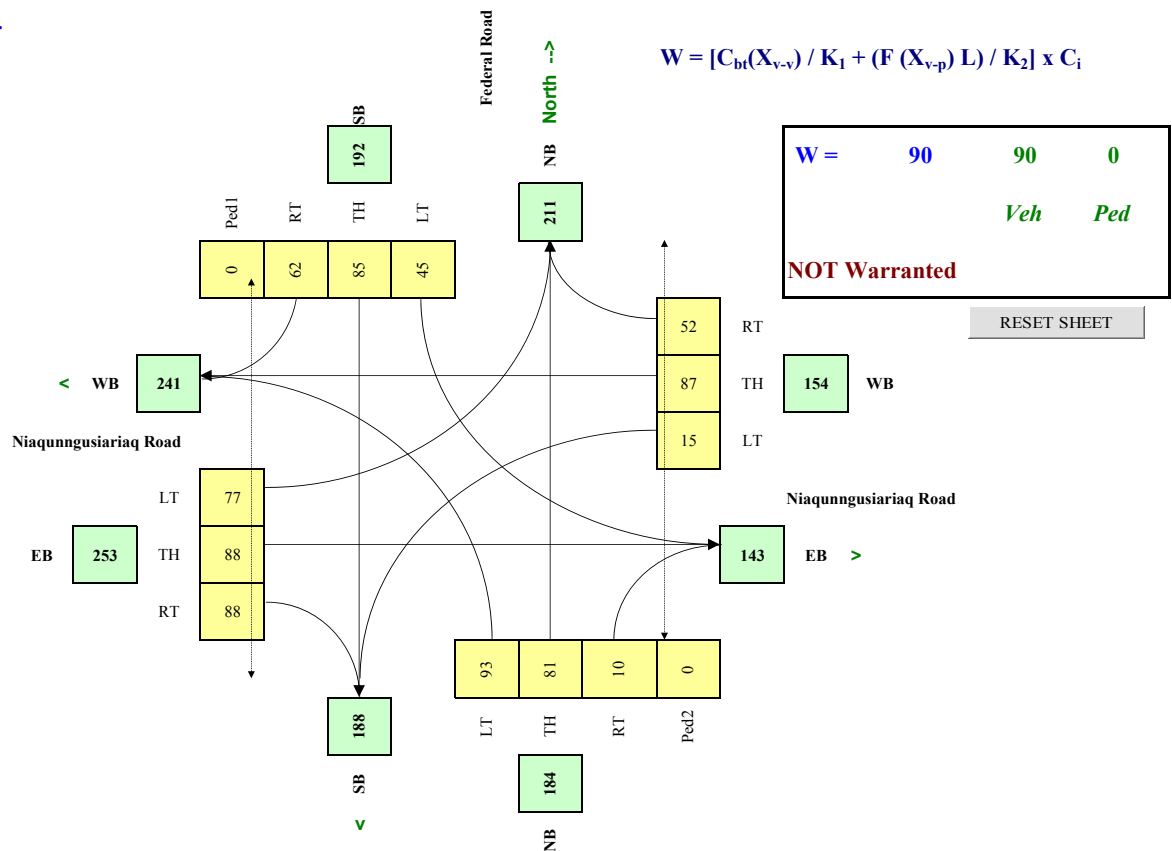
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 8,000 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|-----------------------|-----|-----|----|-----|-----|-----|----|-----|-----|-----|-----|-----|--|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| | 71 | 50 | 12 | 43 | 94 | 40 | 19 | 53 | 32 | 60 | 85 | 102 | | 0 | 0 | 0 | 0 |
| | 99 | 70 | 17 | 60 | 131 | 55 | 27 | 73 | 45 | 83 | 118 | 141 | | 0 | 0 | 0 | 0 |
| | 59 | 42 | 10 | 36 | 79 | 33 | 16 | 44 | 27 | 50 | 71 | 85 | | 0 | 0 | 0 | 0 |
| | 79 | 77 | 5 | 32 | 49 | 58 | 7 | 83 | 50 | 65 | 61 | 47 | | 0 | 0 | 0 | 0 |
| | 131 | 129 | 8 | 53 | 81 | 96 | 12 | 139 | 83 | 108 | 101 | 79 | | 0 | 0 | 0 | 0 |
| | 121 | 119 | 7 | 49 | 75 | 88 | 11 | 128 | 76 | 99 | 93 | 73 | | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 560 | 487 | 60 | 273 | 508 | 370 | 93 | 520 | 314 | 465 | 528 | 526 | | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 93 | 81 | 10 | 45 | 85 | 62 | 15 | 87 | 52 | 77 | 88 | 88 | | 0 | 0 | 0 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Federal Road**
 Quadrant / Int # **4**

for Warrant Calculation
 Results, please hit 'Page
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CHECK SHEET

Comments

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**

Background Conditions - 2020

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: (yyyy-mm-dd)

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

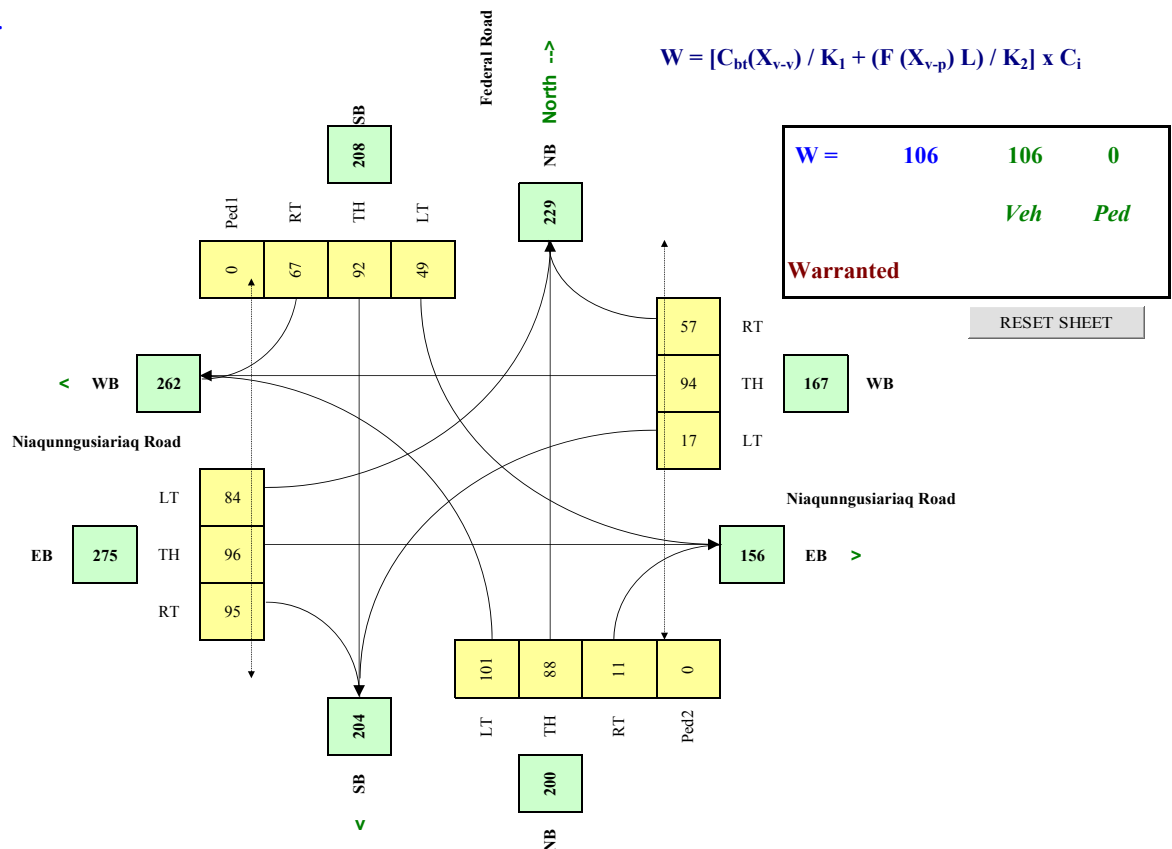
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 8,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| press 'Set Peak Hours' Button to set the peak hour periods | 78 | 55 | 13 | 47 | 102 | 43 | 21 | 57 | 35 | 65 | 92 | 110 | 0 | 0 | 0 | 0 |
| | 108 | 76 | 18 | 65 | 142 | 60 | 29 | 79 | 49 | 90 | 128 | 153 | 0 | 0 | 0 | 0 |
| | 65 | 46 | 11 | 39 | 85 | 36 | 17 | 47 | 29 | 54 | 77 | 92 | 0 | 0 | 0 | 0 |
| | 85 | 84 | 5 | 35 | 53 | 62 | 8 | 91 | 54 | 70 | 66 | 52 | 0 | 0 | 0 | 0 |
| | 142 | 140 | 9 | 58 | 88 | 104 | 13 | 151 | 90 | 117 | 110 | 86 | 0 | 0 | 0 | 0 |
| | 131 | 129 | 8 | 53 | 81 | 96 | 12 | 139 | 83 | 108 | 101 | 79 | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 608 | 529 | 64 | 297 | 551 | 401 | 100 | 564 | 340 | 504 | 574 | 572 | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 101 | 88 | 11 | 49 | 92 | 67 | 17 | 94 | 57 | 84 | 96 | 95 | 0 | 0 | 0 | 0 |

Average 6-hour
 Peak Turning
 Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Federal Road**
Quadrant / Int # **4**
CHECK SHEET

for Warrant Calculation
Results, please hit 'Page
Down'

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Full Build Out (2020) + 50%
Additional Trips**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|------------------------|--------------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

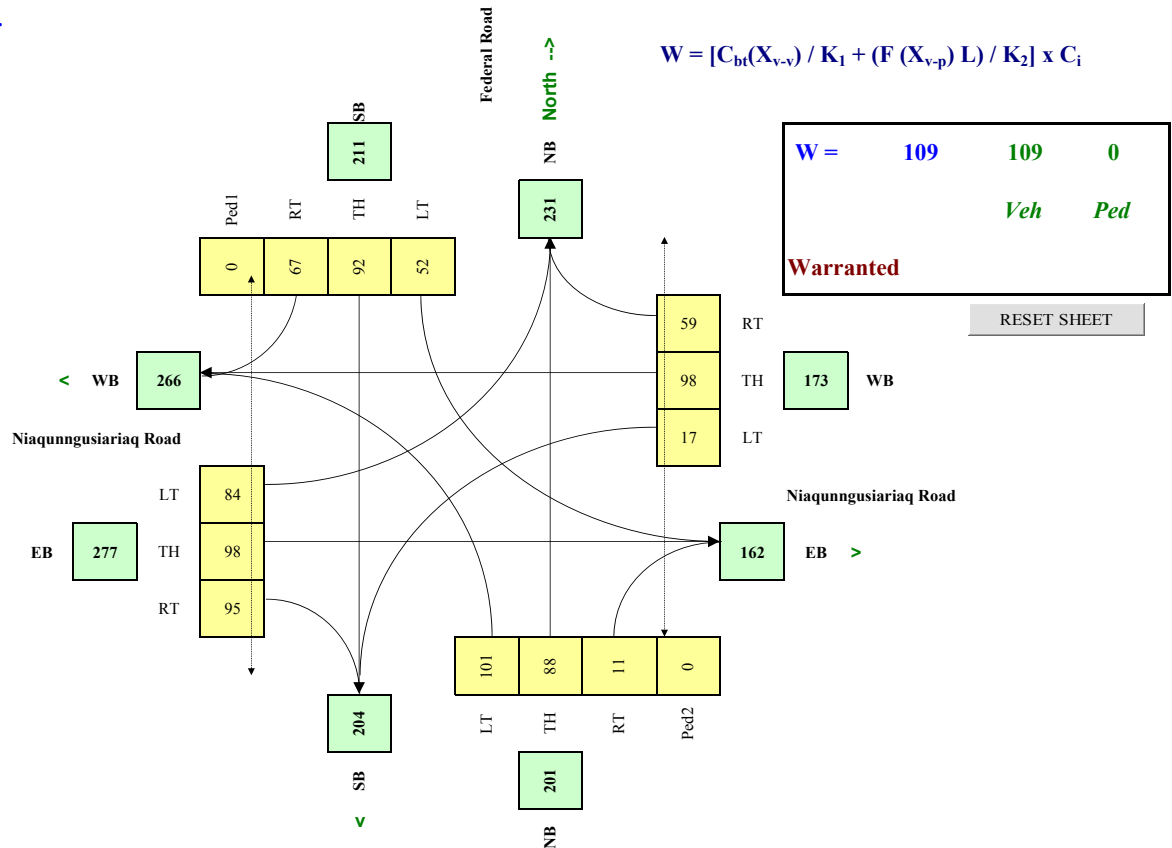
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 8,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| press 'Set Peak Hours' Button to set the peak hour periods | 78 | 55 | 14 | 49 | 102 | 43 | 22 | 60 | 37 | 65 | 96 | 110 | 0 | 0 | 0 | 0 |
| | 108 | 76 | 19 | 68 | 142 | 60 | 30 | 83 | 51 | 90 | 133 | 153 | 0 | 0 | 0 | 0 |
| | 65 | 46 | 11 | 41 | 85 | 36 | 18 | 50 | 31 | 54 | 80 | 92 | 0 | 0 | 0 | 0 |
| | 85 | 84 | 5 | 37 | 53 | 62 | 8 | 94 | 56 | 70 | 67 | 52 | 0 | 0 | 0 | 0 |
| | 142 | 140 | 9 | 62 | 88 | 104 | 13 | 156 | 93 | 117 | 111 | 86 | 0 | 0 | 0 | 0 |
| | 131 | 129 | 8 | 57 | 81 | 96 | 12 | 144 | 86 | 108 | 102 | 79 | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 608 | 529 | 67 | 314 | 551 | 401 | 102 | 586 | 353 | 504 | 588 | 572 | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 101 | 88 | 11 | 52 | 92 | 67 | 17 | 98 | 59 | 84 | 98 | 95 | 0 | 0 | 0 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Federal Road**
Quadrant / Int # **4**
CHECK SHEET

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Full Build Out (2020) + 100% Additional Trips**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

for Warrant Calculation
Results, please hit 'Page
Down'

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

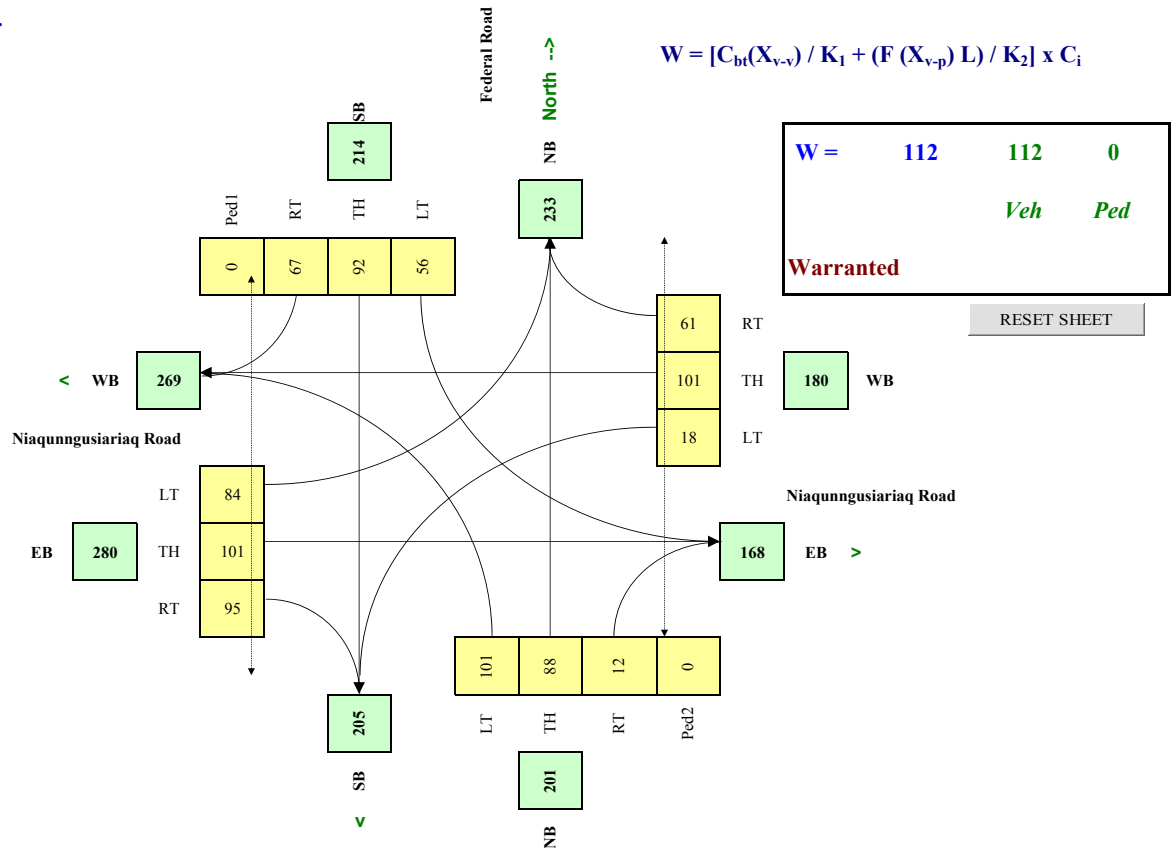
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 8,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | | | | | |
| press 'Set Peak Hours' Button to set the peak hour periods | 78 | 55 | 14 | 50 | 102 | 43 | 23 | 63 | 39 | 65 | 99 | 110 | | 0 | 0 | 0 | 0 |
| | 108 | 76 | 20 | 70 | 142 | 60 | 32 | 87 | 54 | 90 | 138 | 153 | | 0 | 0 | 0 | 0 |
| | 65 | 46 | 12 | 42 | 85 | 36 | 19 | 52 | 32 | 54 | 83 | 92 | | 0 | 0 | 0 | 0 |
| | 85 | 84 | 5 | 41 | 53 | 62 | 8 | 96 | 58 | 70 | 68 | 52 | | 0 | 0 | 0 | 0 |
| | 142 | 140 | 9 | 68 | 88 | 104 | 14 | 160 | 96 | 117 | 113 | 86 | | 0 | 0 | 0 | 0 |
| | 131 | 129 | 8 | 63 | 81 | 96 | 13 | 147 | 88 | 108 | 104 | 79 | | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 608 | 529 | 69 | 334 | 551 | 401 | 110 | 605 | 367 | 504 | 605 | 572 | | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 101 | 88 | 12 | 56 | 92 | 67 | 18 | 101 | 61 | 84 | 101 | 95 | | 0 | 0 | 0 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Federal Road**
 Quadrant / Int # **4**

for Warrant Calculation
 Results, please hit 'Page
 Down'

CHECK SHEET

Comments

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**

Background Conditions - 2025

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: (yyyy-mm-dd)

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

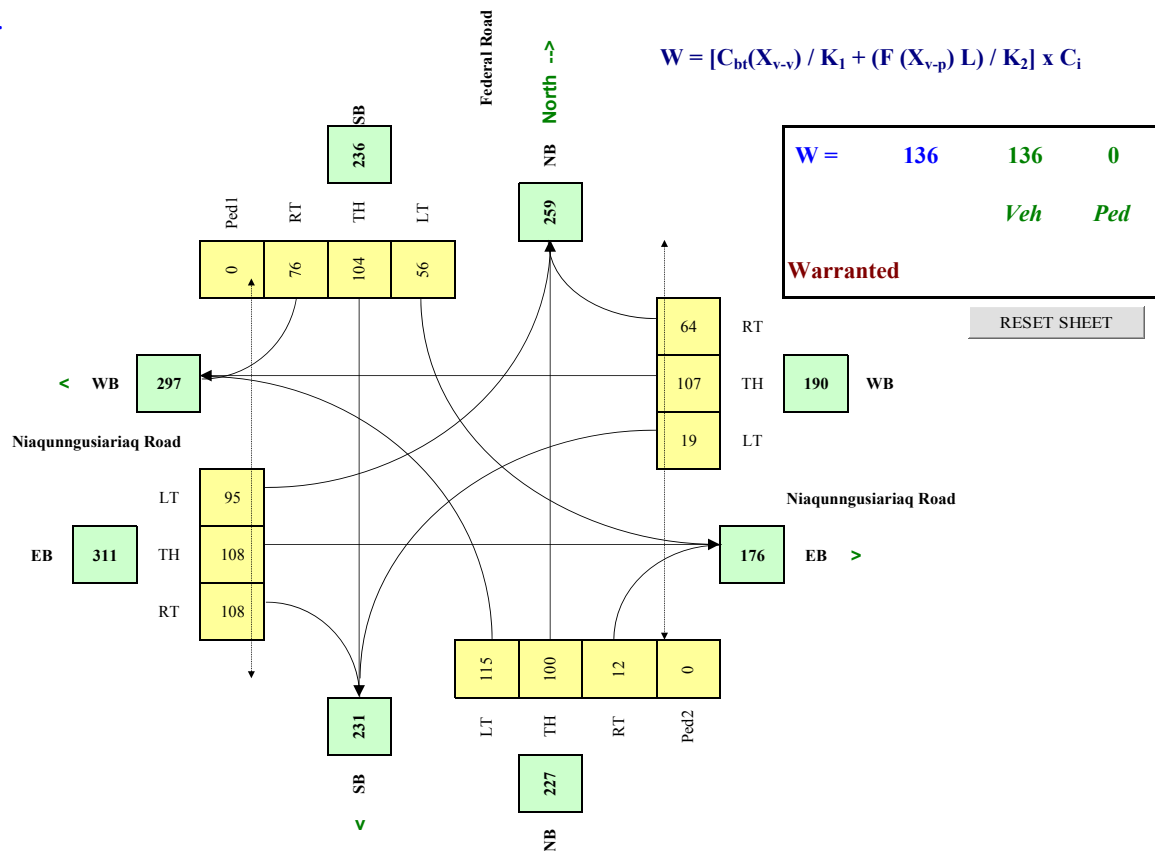
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 9,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| press 'Set Peak Hours' Button to set the peak hour periods | 88 | 62 | 15 | 53 | 116 | 49 | 24 | 65 | 40 | 73 | 104 | 125 | 0 | 0 | 0 | 0 |
| | 122 | 86 | 21 | 74 | 161 | 68 | 33 | 90 | 55 | 102 | 145 | 173 | 0 | 0 | 0 | 0 |
| | 73 | 52 | 13 | 44 | 97 | 41 | 20 | 54 | 33 | 61 | 87 | 104 | 0 | 0 | 0 | 0 |
| | 97 | 95 | 6 | 39 | 60 | 71 | 9 | 103 | 61 | 80 | 74 | 58 | 0 | 0 | 0 | 0 |
| | 161 | 159 | 10 | 65 | 100 | 118 | 15 | 171 | 102 | 133 | 124 | 97 | 0 | 0 | 0 | 0 |
| | 148 | 146 | 9 | 60 | 92 | 109 | 14 | 157 | 94 | 122 | 114 | 89 | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 689 | 600 | 74 | 335 | 626 | 455 | 114 | 640 | 385 | 572 | 649 | 646 | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 115 | 100 | 12 | 56 | 104 | 76 | 19 | 107 | 64 | 95 | 108 | 108 | 0 | 0 | 0 | 0 |

Average 6-hour
 Peak Turning
 Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Federal Road**
Quadrant / Int # **4**
CHECK SHEET

for Warrant Calculation
Results, please hit 'Page
Down'

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Full Build Out + 5 Years (2025) +
50% Additional Trips**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|------------------------|--------------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

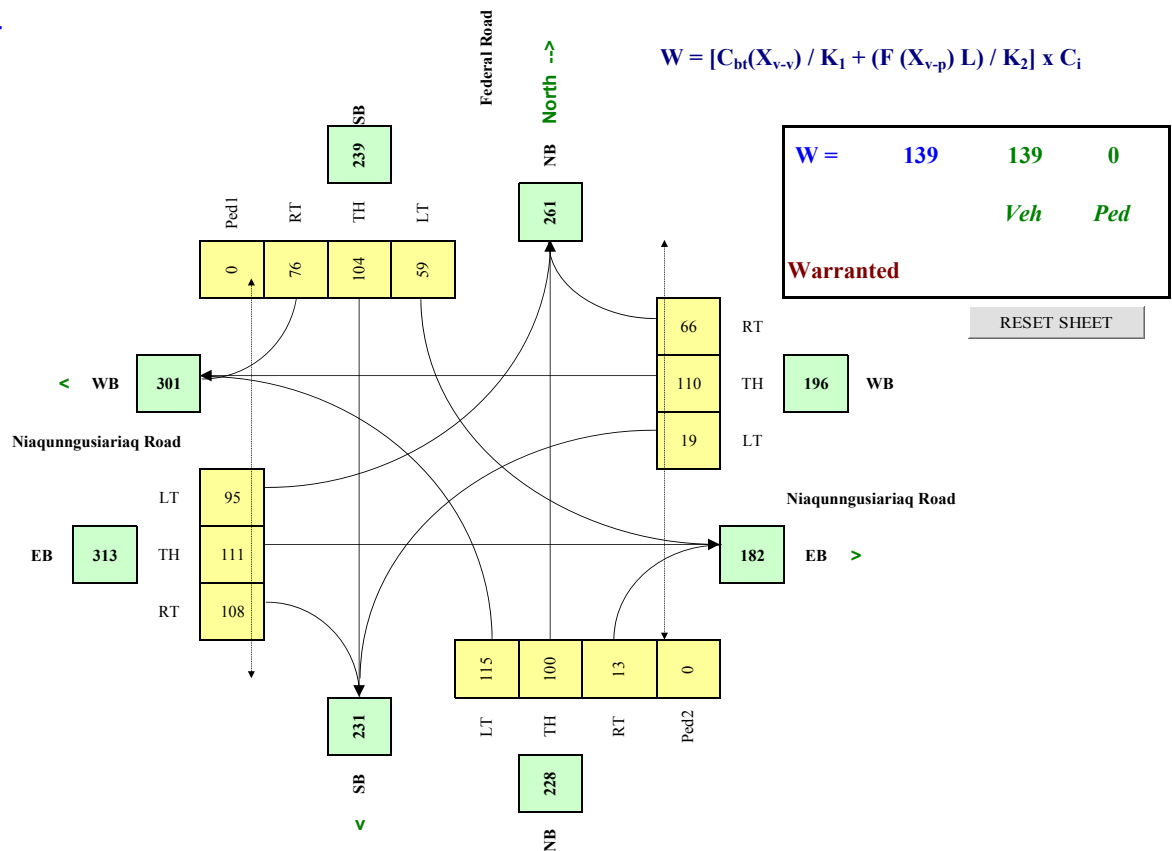
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|-------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 9,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| press 'Set Peak Hours' Button to set the peak hour periods | 88 | 62 | 16 | 55 | 116 | 49 | 24 | 68 | 41 | 73 | 108 | 125 | 0 | 0 | 0 | 0 |
| | 122 | 86 | 22 | 77 | 161 | 68 | 34 | 94 | 57 | 102 | 150 | 173 | 0 | 0 | 0 | 0 |
| | 73 | 52 | 13 | 46 | 97 | 41 | 20 | 56 | 34 | 61 | 90 | 104 | 0 | 0 | 0 | 0 |
| | 97 | 95 | 6 | 41 | 60 | 71 | 9 | 106 | 63 | 80 | 75 | 58 | 0 | 0 | 0 | 0 |
| | 161 | 159 | 10 | 69 | 100 | 118 | 15 | 176 | 105 | 133 | 125 | 97 | 0 | 0 | 0 | 0 |
| | 148 | 146 | 9 | 63 | 92 | 109 | 14 | 162 | 97 | 122 | 115 | 89 | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 689 | 600 | 76 | 353 | 626 | 455 | 117 | 662 | 397 | 572 | 663 | 646 | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 115 | 100 | 13 | 59 | 104 | 76 | 19 | 110 | 66 | 95 | 111 | 108 | 0 | 0 | 0 | 0 |

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$



Government of Nunavut - Traffic Signal Warrant Analysis

| | | | | | |
|---|-----------------------|--|--|--------------------|-----------------------|
| Main Street (name) | Niaqunggusiariaq Road | Direction (EW or NS) Direction (EW or NS) Comments | EW | Road Authority: | Government of Nunavut |
| Side Street (name) | Federal Road | | NS | City: | Iqaluit, Nunavut |
| Quadrant / Int # | 4 | | Full Build Out + 5 Years (2025) + 100% Additional Trips | Analysis Date: | 2017 Aug 02, Wed |
| for Warrant Calculation Results, please hit 'Page Down' | CHECK SHEET | | | Count Date: | 2017 May 30, Tue |
| | | | | Date Entry Format: | (yyyy-mm-dd) |

| Lane Configuration | | Exel LT | Th & LT | Through | Th+RT+LT | Th & RT | Exel RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

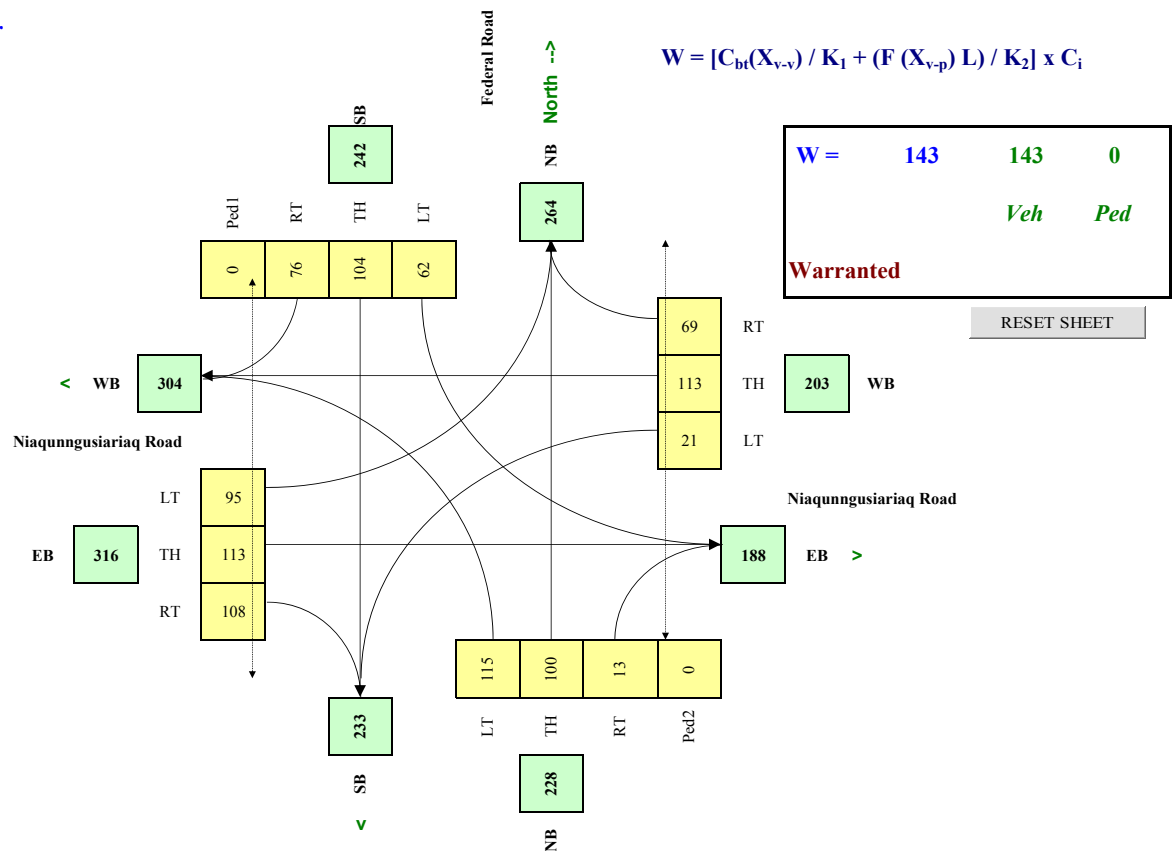
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|-----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqunngusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| | | |
|----------------------------------|-------|-------|
| Demographics | | |
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 9,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|---|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|------|
| Traffic Input | NB | | | SB | | | WB | | | EB | | | NS | NS | EW | EW | |
| press 'Set Peak Hours' Button to set the peak hour periods | L/T | Th | RT | L/T | Th | RT | L/T | Th | RT | L/T | Th | RT | W Side | E Side | N Side | S Side | |
| | 88 | 62 | 17 | 57 | 116 | 49 | 26 | 71 | 43 | 73 | 112 | 125 | 0 | 0 | 0 | 0 | |
| | 122 | 86 | 23 | 79 | 161 | 68 | 36 | 98 | 60 | 102 | 155 | 173 | 0 | 0 | 0 | 0 | |
| | 73 | 52 | 14 | 47 | 97 | 41 | 22 | 59 | 36 | 61 | 93 | 104 | 0 | 0 | 0 | 0 | |
| | 97 | 95 | 6 | 45 | 60 | 71 | 10 | 108 | 65 | 80 | 76 | 58 | 0 | 0 | 0 | 0 | |
| | 161 | 159 | 10 | 75 | 100 | 118 | 16 | 180 | 108 | 133 | 127 | 97 | 0 | 0 | 0 | 0 | |
| | 148 | 146 | 9 | 69 | 92 | 109 | 15 | 166 | 99 | 122 | 117 | 89 | 0 | 0 | 0 | 0 | |
| Total (6-hour peak) | 689 | 600 | 79 | 372 | 626 | 455 | 124 | 681 | 411 | 572 | 680 | 646 | 0 | 0 | 0 | 0 | |
| Average (6-hour peak) | 115 | 100 | 13 | 62 | 104 | 76 | 21 | 113 | 69 | 95 | 113 | 108 | 0 | 0 | 0 | 0 | |

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$





Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
Side Street (name) **Federal Road**
Quadrant / Int # **4**
CHECK SHEET

for Warrant Calculation
Results, please hit 'Page
Down'

Direction (EW or NS) **EW**
Direction (EW or NS) **NS**
Comments **Background Conditions - 2030**

Road Authority: **Government of Nunavut**
City: **Iqaluit, Nunavut**
Analysis Date: **2017 Aug 02, Wed**
Count Date: **2017 May 30, Tue**
Date Entry Format: **(yyyy-mm-dd)**

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

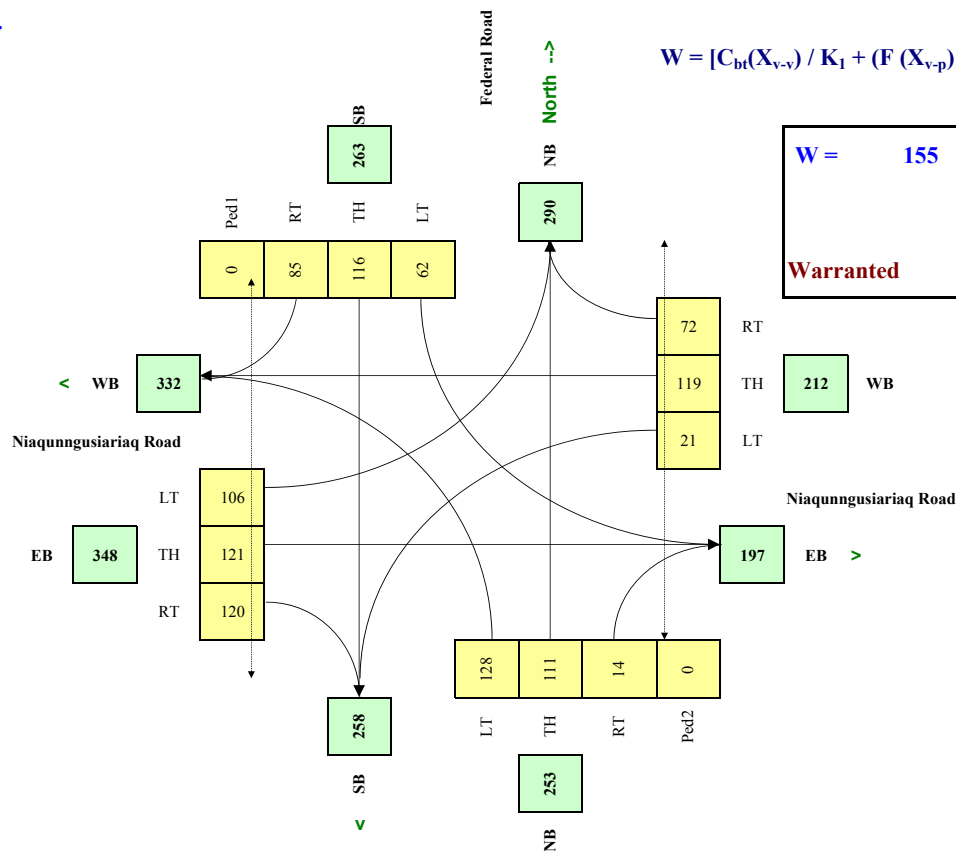
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|--------------|---------|--------------|------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|--------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 10,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| press 'Set Peak Hours' Button to set the peak hour periods | 98 | 69 | 17 | 59 | 130 | 55 | 27 | 72 | 45 | 82 | 117 | 140 | 0 | 0 | 0 | 0 |
| | 136 | 96 | 23 | 82 | 180 | 76 | 37 | 100 | 62 | 114 | 162 | 194 | 0 | 0 | 0 | 0 |
| | 82 | 58 | 14 | 49 | 108 | 46 | 22 | 60 | 37 | 88 | 97 | 116 | 0 | 0 | 0 | 0 |
| | 108 | 106 | 7 | 44 | 67 | 79 | 10 | 115 | 68 | 89 | 83 | 65 | 0 | 0 | 0 | 0 |
| | 180 | 177 | 11 | 73 | 111 | 132 | 16 | 191 | 114 | 148 | 139 | 108 | 0 | 0 | 0 | 0 |
| | 166 | 163 | 10 | 67 | 102 | 121 | 15 | 176 | 105 | 136 | 128 | 99 | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 769 | 669 | 81 | 374 | 697 | 509 | 126 | 713 | 431 | 637 | 726 | 722 | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 128 | 111 | 14 | 62 | 116 | 85 | 21 | 119 | 72 | 106 | 121 | 120 | 0 | 0 | 0 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$



W = 155 155 0
Veh Ped
Warranted

RESET SHEET



Government of Nunavut - Traffic Signal Warrant Analysis

Main Street (name) **Niaqungusiariaq Road**
 Side Street (name) **Federal Road**
 Quadrant / Int # **4**
 for Warrant Calculation
 Results, please hit 'Page
 Down'

Direction (EW or NS) **EW**
 Direction (EW or NS) **NS**
 Comments **Full Build Out + 10 Years (2030) +
 50% Additional Trips**

Road Authority: **Government of Nunavut**
 City: **Iqaluit, Nunavut**
 Analysis Date: **2017 Aug 02, Wed**
 Count Date: **2017 May 30, Tue**
 Date Entry Format: (yyyy-mm-dd)

| Lane Configuration | | Excl LT | Th & LT | Through | Th+RT+LT | Th & RT | Excl RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|------------------------|--------------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

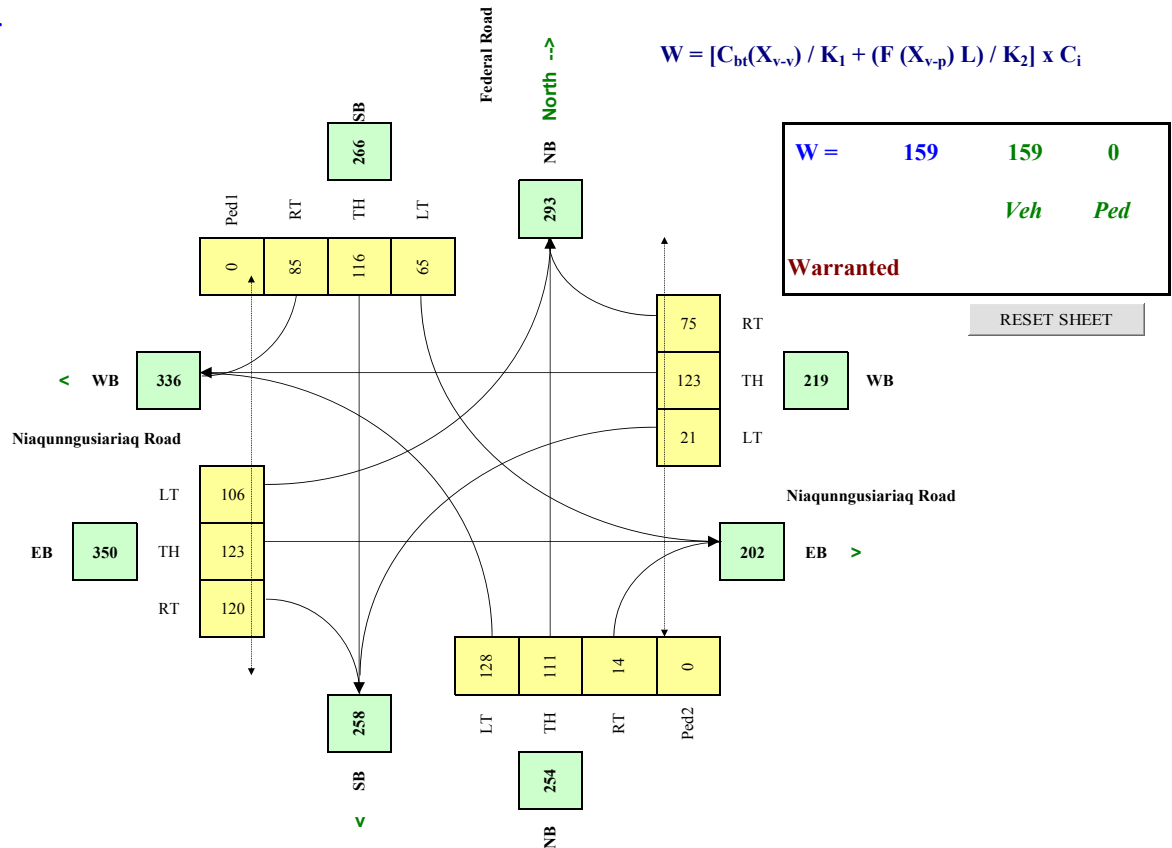
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqungusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| Demographics | | |
|----------------------------------|-------|--------|
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 10,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|--|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|
| Traffic Input | | | | | | | | | | | | | NS | NS | EW | EW |
| | NB | | | SB | | | WB | | | EB | | | W Side | E Side | N Side | S Side |
| | LT | Th | RT | LT | Th | RT | LT | Th | RT | LT | Th | RT | W Side | E Side | N Side | S Side |
| press 'Set Peak Hours' Button to set the peak hour periods | 98 | 69 | 17 | 61 | 130 | 55 | 27 | 75 | 48 | 82 | 120 | 140 | 0 | 0 | 0 | 0 |
| | 136 | 96 | 24 | 85 | 180 | 76 | 38 | 104 | 67 | 114 | 167 | 194 | 0 | 0 | 0 | 0 |
| | 82 | 58 | 14 | 51 | 108 | 46 | 23 | 62 | 40 | 88 | 100 | 116 | 0 | 0 | 0 | 0 |
| | 108 | 106 | 7 | 46 | 67 | 79 | 10 | 118 | 70 | 89 | 84 | 65 | 0 | 0 | 0 | 0 |
| | 180 | 177 | 11 | 77 | 111 | 132 | 16 | 196 | 117 | 148 | 140 | 108 | 0 | 0 | 0 | 0 |
| | 166 | 163 | 10 | 71 | 102 | 121 | 15 | 180 | 108 | 136 | 129 | 99 | 0 | 0 | 0 | 0 |
| Total (6-hour peak) | 769 | 669 | 83 | 391 | 697 | 509 | 128 | 735 | 450 | 637 | 740 | 722 | 0 | 0 | 0 | 0 |
| Average (6-hour peak) | 128 | 111 | 14 | 65 | 116 | 85 | 21 | 123 | 75 | 106 | 123 | 120 | 0 | 0 | 0 | 0 |

Average 6-hour
Peak Turning
Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$



Government of Nunavut - Traffic Signal Warrant Analysis

| | | | | | |
|---|-----------------------|---|--------------------|------------------|-----------------------|
| Main Street (name) | Niaqunggusiariaq Road | Direction (EW or NS) Direction (EW or NS) Comments Full Build Out + 10 Years (2030) + 100% Additional Trips | EW | Road Authority: | Government of Nunavut |
| Side Street (name) | Federal Road | | NS | City: | Iqaluit, Nunavut |
| Quadrant / Int # | 4 | | Analysis Date: | 2017 Aug 02, Wed | |
| for Warrant Calculation Results, please hit 'Page Down' | CHECK SHEET | | Count Date: | 2017 May 30, Tue | |
| | | | Date Entry Format: | (yyyy-mm-dd) | |

| Lane Configuration | | Exel LT | Th & LT | Through | Th+RT+LT | Th & RT | Exel RT | UpStream Signal (m) | # of Thru Lanes |
|----------------------|----|---------|---------|---------|----------|---------|---------|---------------------|-----------------|
| Niaqungusiariaq Road | WB | | | | 1 | | | | 1 |
| Niaqungusiariaq Road | EB | | | | 1 | | | | 1 |
| Federal Road | NB | | | | 1 | | | | |
| Federal Road | SB | | | | 1 | | | | |

Are the Federal Road NB right turns significantly impeded by through movements? (y/n)

Are the Federal Road SB right turns significantly impeded by through movements? (y/n)

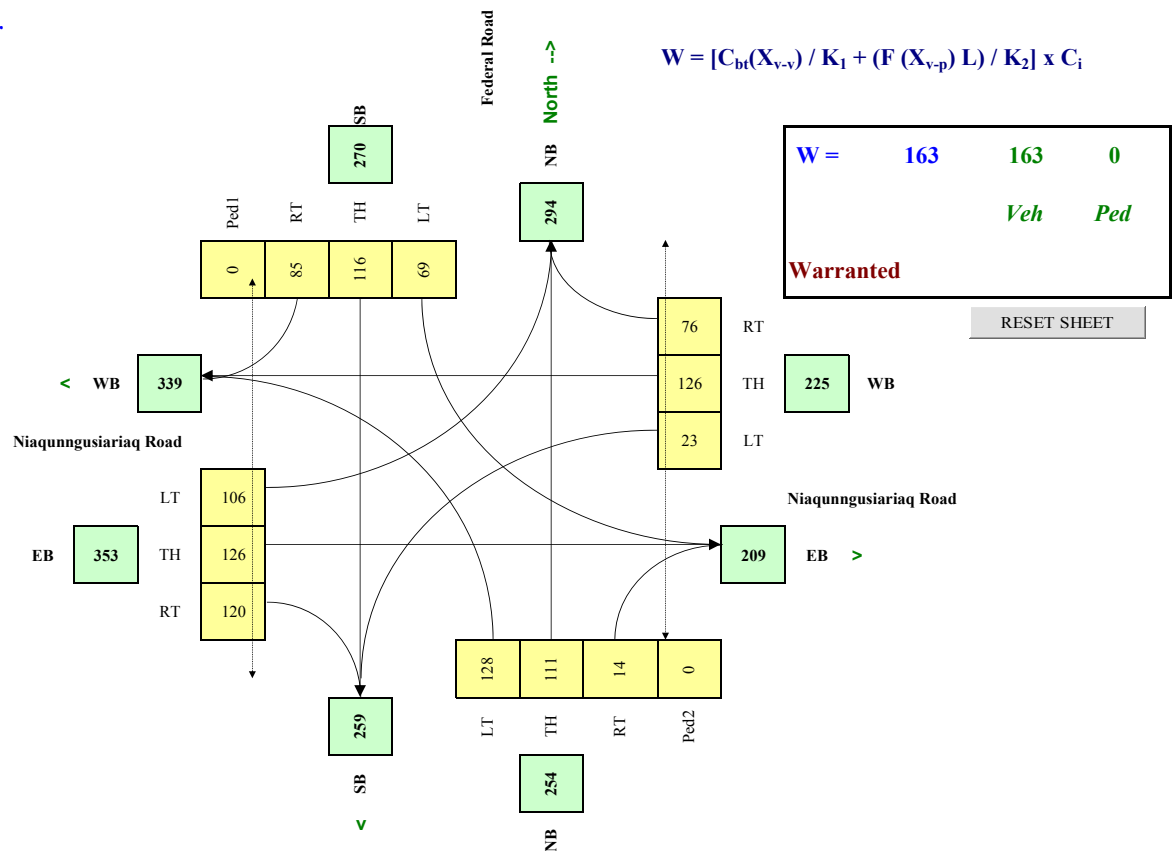
| Other input | | Speed (Km/h) | Truck % | Bus Rt (y/n) | Median (m) |
|-----------------------|----|-----------------|------------|-----------------|---------------|
| Niaqunngusiariaq Road | EW | 40 | 2.5% | y | |
| Federal Road | NS | 30 | 3.0% | n | |

| | | |
|----------------------------------|-------|--------|
| Demographics | | |
| Elem. School/Mobility Challenged | (y/n) | n |
| Senior's Complex | (y/n) | n |
| Pathway to School | (y/n) | n |
| Metro Area Population | (#) | 10,500 |
| Central Business District | (y/n) | n |

| Set Peak Hours | | | | | | | | | | | | | | Ped1 | Ped2 | Ped3 | Ped4 |
|---|-----|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|--------|--------|--------|------|
| Traffic Input | NB | | | SB | | | WB | | | EB | | | NS | NS | EW | EW | |
| press 'Set Peak Hours' Button to set the peak hour periods | L/T | Th | RT | L/T | Th | RT | L/T | Th | RT | L/T | Th | RT | W Side | E Side | N Side | S Side | |
| | 98 | 69 | 18 | 63 | 130 | 55 | 29 | 78 | 48 | 82 | 124 | 140 | 0 | 0 | 0 | 0 | |
| | 136 | 96 | 25 | 87 | 180 | 76 | 40 | 108 | 67 | 114 | 172 | 194 | 0 | 0 | 0 | 0 | |
| | 82 | 58 | 15 | 52 | 108 | 46 | 24 | 65 | 40 | 68 | 103 | 116 | 0 | 0 | 0 | 0 | |
| | 108 | 106 | 7 | 50 | 67 | 79 | 10 | 120 | 72 | 89 | 85 | 65 | 0 | 0 | 0 | 0 | |
| | 180 | 177 | 11 | 83 | 111 | 132 | 17 | 200 | 120 | 148 | 142 | 108 | 0 | 0 | 0 | 0 | |
| | 166 | 163 | 10 | 76 | 102 | 121 | 16 | 184 | 110 | 136 | 131 | 99 | 0 | 0 | 0 | 0 | |
| Total (6-hour peak) | 769 | 669 | 86 | 411 | 697 | 509 | 136 | 755 | 458 | 637 | 757 | 722 | 0 | 0 | 0 | 0 | |
| Average (6-hour peak) | 128 | 111 | 14 | 69 | 116 | 85 | 23 | 126 | 76 | 106 | 126 | 120 | 0 | 0 | 0 | 0 | |

Average 6-hour Peak Turning Movements

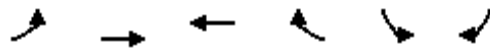
$$W = [C_{bt}(X_{v-v}) / K_1 + (F(X_{v-p}) L) / K_2] \times C_i$$






August 3, 2017

Appendix C

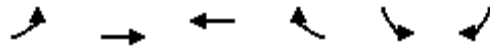
SYNCRHO OUTPUT REPORTS



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 41 | 165 | 461 | 51 | 90 | 182 |
| Future Volume (Veh/h) | 41 | 165 | 461 | 51 | 90 | 182 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 45 | 179 | 501 | 55 | 98 | 198 |
| Pedestrians | | 2 | 1 | | 8 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 1 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 564 | | | | 806 | 538 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 564 | | | | 806 | 538 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 95 | | | | 71 | 63 |
| cM capacity (veh/h) | 1000 | | | | 332 | 538 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 224 | 556 | 296 | | | |
| Volume Left | 45 | 0 | 98 | | | |
| Volume Right | 0 | 55 | 198 | | | |
| cSH | 1000 | 1700 | 446 | | | |
| Volume to Capacity | 0.05 | 0.33 | 0.66 | | | |
| Queue Length 95th (m) | 1.1 | 0.0 | 35.9 | | | |
| Control Delay (s) | 2.1 | 0.0 | 27.6 | | | |
| Lane LOS | A | | D | | | |
| Approach Delay (s) | 2.1 | 0.0 | 27.6 | | | |
| Approach LOS | | | D | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 8.0 | | | | |
| Intersection Capacity Utilization | | 64.7% | ICU Level of Service | | C | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

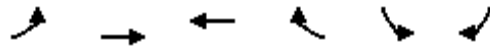
8/2/2017



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 17 | 206 | 601 | 42 | 0 | 0 |
| Future Volume (Veh/h) | 17 | 206 | 601 | 42 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 18 | 224 | 653 | 46 | 0 | 0 |
| Pedestrians | | | | | 15 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 714 | | | | 951 | 691 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 714 | | | | 951 | 691 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 98 | | | | 100 | 100 |
| cM capacity (veh/h) | 886 | | | | 282 | 445 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 242 | 699 | | | | |
| Volume Left | 18 | 0 | | | | |
| Volume Right | 0 | 46 | | | | |
| cSH | 886 | 1700 | | | | |
| Volume to Capacity | 0.02 | 0.41 | | | | |
| Queue Length 95th (m) | 0.5 | 0.0 | | | | |
| Control Delay (s) | 0.9 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.9 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.2 | | | | |
| Intersection Capacity Utilization | | 37.6% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
3: Niaqunngusariaq & College West Access

















8/2/2017

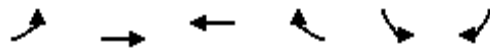





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 215 | 601 | 0 | 8 | 15 |
| Future Volume (Veh/h) | 0 | 215 | 601 | 0 | 8 | 15 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 234 | 653 | 0 | 9 | 16 |
| Pedestrians | | 1 | 9 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 1 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 653 | | | | 896 | 654 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 653 | | | | 896 | 654 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 97 | 97 |
| cM capacity (veh/h) | 934 | | | | 308 | 466 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 234 | 653 | 25 | | | |
| Volume Left | 0 | 0 | 9 | | | |
| Volume Right | 0 | 0 | 16 | | | |
| cSH | 1700 | 1700 | 393 | | | |
| Volume to Capacity | 0.14 | 0.38 | 0.06 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 1.5 | | | |
| Control Delay (s) | 0.0 | 0.0 | 14.8 | | | |
| Lane LOS | | | B | | | |
| Approach Delay (s) | 0.0 | 0.0 | 14.8 | | | |
| Approach LOS | | | B | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 0.4 | | | |
| Intersection Capacity Utilization | | 42.0% | | ICU Level of Service | A | |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

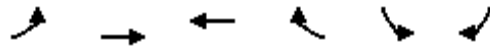
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 83 | 118 | 141 | 27 | 73 | 45 | 99 | 70 | 17 | 60 | 131 | 55 |
| Future Volume (vph) | 83 | 118 | 141 | 27 | 73 | 45 | 99 | 70 | 17 | 60 | 131 | 55 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 90 | 128 | 153 | 29 | 79 | 49 | 108 | 76 | 18 | 65 | 142 | 60 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 371 | 157 | 202 | 267 | | | | | | | | |
| Volume Left (vph) | 90 | 29 | 108 | 65 | | | | | | | | |
| Volume Right (vph) | 153 | 49 | 18 | 60 | | | | | | | | |
| Hadj (s) | -0.16 | -0.12 | 0.09 | -0.05 | | | | | | | | |
| Departure Headway (s) | 5.4 | 5.9 | 6.0 | 5.8 | | | | | | | | |
| Degree Utilization, x | 0.56 | 0.26 | 0.34 | 0.43 | | | | | | | | |
| Capacity (veh/h) | 623 | 528 | 533 | 571 | | | | | | | | |
| Control Delay (s) | 15.1 | 10.9 | 12.1 | 13.0 | | | | | | | | |
| Approach Delay (s) | 15.1 | 10.9 | 12.1 | 13.0 | | | | | | | | |
| Approach LOS | C | B | B | B | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 13.3 | | | | | | | | |
| Level of Service | | | | B | | | | | | | | |
| Intersection Capacity Utilization | | | | 53.0% | ICU Level of Service | A | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 190 | 389 | 249 | 101 | 92 | 86 |
| Future Volume (Veh/h) | 190 | 389 | 249 | 101 | 92 | 86 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 207 | 423 | 271 | 110 | 100 | 93 |
| Pedestrians | | 2 | 2 | | 20 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 2 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 401 | | | | 1185 | 348 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 401 | | | | 1185 | 348 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 82 | | | | 40 | 86 |
| cM capacity (veh/h) | 1135 | | | | 167 | 680 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 630 | 381 | 193 | | | |
| Volume Left | 207 | 0 | 100 | | | |
| Volume Right | 0 | 110 | 93 | | | |
| cSH | 1135 | 1700 | 262 | | | |
| Volume to Capacity | 0.18 | 0.22 | 0.74 | | | |
| Queue Length 95th (m) | 5.1 | 0.0 | 39.6 | | | |
| Control Delay (s) | 4.4 | 0.0 | 49.1 | | | |
| Lane LOS | A | | E | | | |
| Approach Delay (s) | 4.4 | 0.0 | 49.1 | | | |
| Approach LOS | | | E | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 10.2 | | | | |
| Intersection Capacity Utilization | | 71.5% | ICU Level of Service | C | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

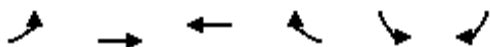


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 13 | 579 | 327 | 8 | 0 | 0 |
| Future Volume (Veh/h) | 13 | 579 | 327 | 8 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 14 | 629 | 355 | 9 | 0 | 0 |
| Pedestrians | | | | | 1 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 365 | | | | 1018 | 360 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 365 | | | | 1018 | 360 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 99 | | | | 100 | 100 |
| cM capacity (veh/h) | 1194 | | | | 260 | 684 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 643 | 364 | | | | |
| Volume Left | 14 | 0 | | | | |
| Volume Right | 0 | 9 | | | | |
| cSH | 1194 | 1700 | | | | |
| Volume to Capacity | 0.01 | 0.21 | | | | |
| Queue Length 95th (m) | 0.3 | 0.0 | | | | |
| Control Delay (s) | 0.3 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.3 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.2 | | | | |
| Intersection Capacity Utilization | | 44.2% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

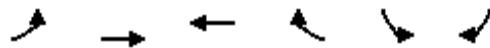





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 566 | 327 | 0 | 26 | 16 |
| Future Volume (Veh/h) | 0 | 566 | 327 | 0 | 26 | 16 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 615 | 355 | 0 | 28 | 17 |
| Pedestrians | | 4 | 18 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 2 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 355 | | | | 988 | 359 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 355 | | | | 988 | 359 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 90 | 98 |
| cM capacity (veh/h) | 1204 | | | | 269 | 683 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 615 | 355 | 45 | | | |
| Volume Left | 0 | 0 | 28 | | | |
| Volume Right | 0 | 0 | 17 | | | |
| cSH | 1700 | 1700 | 349 | | | |
| Volume to Capacity | 0.36 | 0.21 | 0.13 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 3.3 | | | |
| Control Delay (s) | 0.0 | 0.0 | 16.8 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 16.8 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 0.7 | | | |
| Intersection Capacity Utilization | | | 41.0% | ICU Level of Service | | A |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiarlaq

8/2/2017

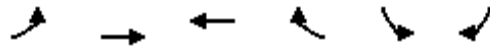
| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 108 | 101 | 79 | 12 | 139 | 83 | 131 | 129 | 8 | 53 | 81 | 96 |
| Future Volume (vph) | 108 | 101 | 79 | 12 | 139 | 83 | 131 | 129 | 8 | 53 | 81 | 96 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 117 | 110 | 86 | 13 | 151 | 90 | 142 | 140 | 9 | 58 | 88 | 104 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 313 | 254 | 291 | 250 | | | | | | | | |
| Volume Left (vph) | 117 | 13 | 142 | 58 | | | | | | | | |
| Volume Right (vph) | 86 | 90 | 9 | 104 | | | | | | | | |
| Hadj (s) | -0.06 | -0.17 | 0.11 | -0.17 | | | | | | | | |
| Departure Headway (s) | 6.1 | 6.2 | 6.4 | 6.2 | | | | | | | | |
| Degree Utilization, x | 0.53 | 0.44 | 0.51 | 0.43 | | | | | | | | |
| Capacity (veh/h) | 532 | 517 | 518 | 514 | | | | | | | | |
| Control Delay (s) | 16.0 | 13.8 | 15.9 | 13.8 | | | | | | | | |
| Approach Delay (s) | 16.0 | 13.8 | 15.9 | 13.8 | | | | | | | | |
| Approach LOS | C | B | C | B | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | 15.0 | | | | | | | | | |
| Level of Service | | | B | | | | | | | | | |
| Intersection Capacity Utilization | | | 67.3% | ICU Level of Service | | C | | | | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 46 | 182 | 506 | 55 | 98 | 214 |
| Future Volume (Veh/h) | 46 | 182 | 506 | 55 | 98 | 214 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 50 | 198 | 550 | 60 | 107 | 233 |
| Pedestrians | | 2 | 1 | | 10 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 1 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 620 | | | | 889 | 592 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 620 | | | | 889 | 592 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 95 | | | | 64 | 53 |
| cM capacity (veh/h) | 951 | | | | 294 | 500 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 248 | 610 | 340 | | | |
| Volume Left | 50 | 0 | 107 | | | |
| Volume Right | 0 | 60 | 233 | | | |
| cSH | 951 | 1700 | 410 | | | |
| Volume to Capacity | 0.05 | 0.36 | 0.83 | | | |
| Queue Length 95th (m) | 1.3 | 0.0 | 58.8 | | | |
| Control Delay (s) | 2.2 | 0.0 | 44.4 | | | |
| Lane LOS | A | | E | | | |
| Approach Delay (s) | 2.2 | 0.0 | 44.4 | | | |
| Approach LOS | | | E | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 13.1 | | | | |
| Intersection Capacity Utilization | | 70.9% | ICU Level of Service | C | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

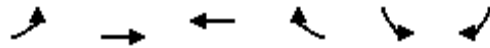


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↰ | ↰ | | | |
| Traffic Volume (veh/h) | 27 | 228 | 653 | 67 | 0 | 0 |
| Future Volume (Veh/h) | 27 | 228 | 653 | 67 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 29 | 248 | 710 | 73 | 0 | 0 |
| Pedestrians | | | | | 18 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 801 | | | | 1070 | 764 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 801 | | | | 1070 | 764 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 96 | | | | 100 | 100 |
| cM capacity (veh/h) | 822 | | | | 236 | 403 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 277 | 783 | | | | |
| Volume Left | 29 | 0 | | | | |
| Volume Right | 0 | 73 | | | | |
| cSH | 822 | 1700 | | | | |
| Volume to Capacity | 0.04 | 0.46 | | | | |
| Queue Length 95th (m) | 0.8 | 0.0 | | | | |
| Control Delay (s) | 1.4 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 1.4 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.4 | | | | |
| Intersection Capacity Utilization | | 41.9% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

8/2/2017



















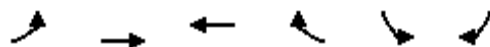
| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 243 | 653 | 0 | 13 | 24 |
| Future Volume (Veh/h) | 0 | 243 | 653 | 0 | 13 | 24 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 264 | 710 | 0 | 14 | 26 |
| Pedestrians | | 1 | 11 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 1 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 710 | | | | 985 | 711 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 710 | | | | 985 | 711 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 95 | 94 |
| cM capacity (veh/h) | 889 | | | | 272 | 433 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 264 | 710 | 40 | | | |
| Volume Left | 0 | 0 | 14 | | | |
| Volume Right | 0 | 0 | 26 | | | |
| cSH | 1700 | 1700 | 359 | | | |
| Volume to Capacity | 0.16 | 0.42 | 0.11 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 2.8 | | | |
| Control Delay (s) | 0.0 | 0.0 | 16.3 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 16.3 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 0.6 | | | |
| Intersection Capacity Utilization | | 44.7% | | ICU Level of Service | A | |
| Analysis Period (min) | | | 15 | | | |




NAC Expansion TIA - Synchro 9 Report

4: Federal Road & Niaqunngusiariaq

8/2/2017

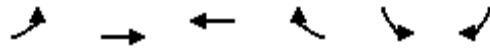
| | | | | | | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  |  |  |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 90 | 133 | 153 | 30 | 83 | 21 | 108 | 76 | 19 | 68 | 142 | 60 |
| Future Volume (vph) | 90 | 133 | 153 | 30 | 83 | 21 | 108 | 76 | 19 | 68 | 142 | 60 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 98 | 145 | 166 | 33 | 90 | 23 | 117 | 83 | 21 | 74 | 154 | 65 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 409 | 146 | 221 | 293 | | | | | | | | |
| Volume Left (vph) | 98 | 33 | 117 | 74 | | | | | | | | |
| Volume Right (vph) | 166 | 23 | 21 | 65 | | | | | | | | |
| Hadj (s) | -0.16 | -0.02 | 0.08 | -0.05 | | | | | | | | |
| Departure Headway (s) | 5.7 | 6.3 | 6.3 | 6.0 | | | | | | | | |
| Degree Utilization, x | 0.64 | 0.26 | 0.39 | 0.49 | | | | | | | | |
| Capacity (veh/h) | 606 | 487 | 514 | 552 | | | | | | | | |
| Control Delay (s) | 18.2 | 11.5 | 13.2 | 14.6 | | | | | | | | |
| Approach Delay (s) | 18.2 | 11.5 | 13.2 | 14.6 | | | | | | | | |
| Approach LOS | C | B | B | B | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | 15.3 | | | | | | | | | |
| Level of Service | | | C | | | | | | | | | |
| Intersection Capacity Utilization | | | 56.3% | ICU Level of Service | | | | | B | | | |
| Analysis Period (min) | | | 15 | | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|----------------------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 210 | 431 | 273 | 110 | 100 | 94 |
| Future Volume (Veh/h) | 210 | 431 | 273 | 110 | 100 | 94 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 228 | 468 | 297 | 120 | 109 | 102 |
| Pedestrians | | 2 | 2 | | 24 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 2 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 441 | | | | 1307 | 383 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 441 | | | | 1307 | 383 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 79 | | | | 20 | 84 |
| cM capacity (veh/h) | 1093 | | | | 136 | 648 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 696 | 417 | 211 | | | |
| Volume Left | 228 | 0 | 109 | | | |
| Volume Right | 0 | 120 | 102 | | | |
| cSH | 1093 | 1700 | 220 | | | |
| Volume to Capacity | 0.21 | 0.25 | 0.96 | | | |
| Queue Length 95th (m) | 6.0 | 0.0 | 63.5 | | | |
| Control Delay (s) | 4.8 | 0.0 | 96.9 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 4.8 | 0.0 | 96.9 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 18.0 | | | | |
| Intersection Capacity Utilization | | 77.5% | | ICU Level of Service | | D |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

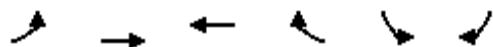


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 21 | 642 | 355 | 13 | 0 | 0 |
| Future Volume (Veh/h) | 21 | 642 | 355 | 13 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 23 | 698 | 386 | 14 | 0 | 0 |
| Pedestrians | | | | | 1 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 401 | | | | 1138 | 394 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 401 | | | | 1138 | 394 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 98 | | | | 100 | 100 |
| cM capacity (veh/h) | 1158 | | | | 218 | 655 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 721 | 400 | | | | |
| Volume Left | 23 | 0 | | | | |
| Volume Right | 0 | 14 | | | | |
| cSH | 1158 | 1700 | | | | |
| Volume to Capacity | 0.02 | 0.24 | | | | |
| Queue Length 95th (m) | 0.5 | 0.0 | | | | |
| Control Delay (s) | 0.5 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.5 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.3 | | | | |
| Intersection Capacity Utilization | | 54.1% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

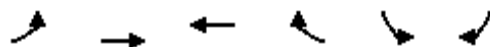





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 622 | 355 | 0 | 41 | 25 |
| Future Volume (Veh/h) | 0 | 622 | 355 | 0 | 41 | 25 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 676 | 386 | 0 | 45 | 27 |
| Pedestrians | | 5 | 22 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 2 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 386 | | | | 1084 | 391 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 386 | | | | 1084 | 391 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 81 | 96 |
| cM capacity (veh/h) | 1172 | | | | 235 | 654 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 676 | 386 | 72 | | | |
| Volume Left | 0 | 0 | 45 | | | |
| Volume Right | 0 | 0 | 27 | | | |
| cSH | 1700 | 1700 | 309 | | | |
| Volume to Capacity | 0.40 | 0.23 | 0.23 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 6.7 | | | |
| Control Delay (s) | 0.0 | 0.0 | 20.1 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 20.1 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 1.3 | | | |
| Intersection Capacity Utilization | | | 44.8% | ICU Level of Service | | A |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

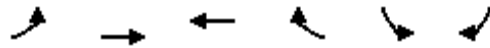
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 117 | 111 | 86 | 13 | 156 | 93 | 142 | 140 | 9 | 62 | 88 | 104 |
| Future Volume (vph) | 117 | 111 | 86 | 13 | 156 | 93 | 142 | 140 | 9 | 62 | 88 | 104 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 127 | 121 | 93 | 14 | 170 | 101 | 154 | 152 | 10 | 67 | 96 | 113 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 341 | 285 | 316 | 276 | | | | | | | | |
| Volume Left (vph) | 127 | 14 | 154 | 67 | | | | | | | | |
| Volume Right (vph) | 93 | 101 | 10 | 113 | | | | | | | | |
| Hadj (s) | -0.06 | -0.17 | 0.11 | -0.16 | | | | | | | | |
| Departure Headway (s) | 6.7 | 6.7 | 6.9 | 6.8 | | | | | | | | |
| Degree Utilization, x | 0.63 | 0.53 | 0.60 | 0.52 | | | | | | | | |
| Capacity (veh/h) | 497 | 480 | 471 | 475 | | | | | | | | |
| Control Delay (s) | 20.3 | 17.0 | 19.9 | 16.8 | | | | | | | | |
| Approach Delay (s) | 20.3 | 17.0 | 19.9 | 16.8 | | | | | | | | |
| Approach LOS | C | C | C | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 18.6 | | | | | | | | |
| Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | | 71.7% | ICU Level of Service | C | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 47 | 185 | 510 | 55 | 98 | 231 |
| Future Volume (Veh/h) | 47 | 185 | 510 | 55 | 98 | 231 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 51 | 201 | 554 | 60 | 107 | 251 |
| Pedestrians | | 3 | 1 | | 11 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 1 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 625 | | | | 899 | 598 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 625 | | | | 899 | 598 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 95 | | | | 63 | 49 |
| cM capacity (veh/h) | 946 | | | | 289 | 495 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 252 | 614 | 358 | | | |
| Volume Left | 51 | 0 | 107 | | | |
| Volume Right | 0 | 60 | 251 | | | |
| cSH | 946 | 1700 | 408 | | | |
| Volume to Capacity | 0.05 | 0.36 | 0.88 | | | |
| Queue Length 95th (m) | 1.3 | 0.0 | 67.3 | | | |
| Control Delay (s) | 2.3 | 0.0 | 51.2 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 2.3 | 0.0 | 51.2 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 15.4 | | | | |
| Intersection Capacity Utilization | | 72.5% | ICU Level of Service | C | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

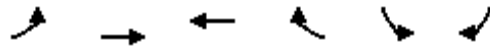


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 35 | 232 | 653 | 88 | 0 | 0 |
| Future Volume (Veh/h) | 35 | 232 | 653 | 88 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 38 | 252 | 710 | 96 | 0 | 0 |
| Pedestrians | | | | | 20 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 826 | | | | 1106 | 778 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 826 | | | | 1106 | 778 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 95 | | | | 100 | 100 |
| cM capacity (veh/h) | 805 | | | | 222 | 396 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 290 | 806 | | | | |
| Volume Left | 38 | 0 | | | | |
| Volume Right | 0 | 96 | | | | |
| cSH | 805 | 1700 | | | | |
| Volume to Capacity | 0.05 | 0.47 | | | | |
| Queue Length 95th (m) | 1.1 | 0.0 | | | | |
| Control Delay (s) | 1.7 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 1.7 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.5 | | | | |
| Intersection Capacity Utilization | | 45.1% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

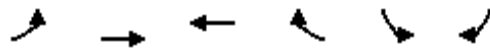





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 251 | 653 | 0 | 17 | 31 |
| Future Volume (Veh/h) | 0 | 251 | 653 | 0 | 17 | 31 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 273 | 710 | 0 | 18 | 34 |
| Pedestrians | | 1 | 12 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 1 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 710 | | | | 995 | 711 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 710 | | | | 995 | 711 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 93 | 92 |
| cM capacity (veh/h) | 889 | | | | 268 | 433 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 273 | 710 | 52 | | | |
| Volume Left | 0 | 0 | 18 | | | |
| Volume Right | 0 | 0 | 34 | | | |
| cSH | 1700 | 1700 | 357 | | | |
| Volume to Capacity | 0.16 | 0.42 | 0.15 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 3.8 | | | |
| Control Delay (s) | 0.0 | 0.0 | 16.8 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 16.8 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 0.8 | | | |
| Intersection Capacity Utilization | | 44.7% | | ICU Level of Service | | A |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiaruaq

8/2/2017

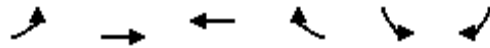
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 90 | 138 | 153 | 32 | 87 | 54 | 108 | 76 | 20 | 70 | 142 | 60 |
| Future Volume (vph) | 90 | 138 | 153 | 32 | 87 | 54 | 108 | 76 | 20 | 70 | 142 | 60 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 98 | 150 | 166 | 35 | 95 | 59 | 117 | 83 | 22 | 76 | 154 | 65 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 414 | 189 | 222 | 295 | | | | | | | | |
| Volume Left (vph) | 98 | 35 | 117 | 76 | | | | | | | | |
| Volume Right (vph) | 166 | 59 | 22 | 65 | | | | | | | | |
| Hadj (s) | -0.16 | -0.12 | 0.08 | -0.05 | | | | | | | | |
| Departure Headway (s) | 5.8 | 6.4 | 6.5 | 6.2 | | | | | | | | |
| Degree Utilization, x | 0.67 | 0.33 | 0.40 | 0.51 | | | | | | | | |
| Capacity (veh/h) | 576 | 489 | 489 | 529 | | | | | | | | |
| Control Delay (s) | 19.9 | 12.5 | 13.8 | 15.6 | | | | | | | | |
| Approach Delay (s) | 19.9 | 12.5 | 13.8 | 15.6 | | | | | | | | |
| Approach LOS | C | B | B | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 16.3 | | | | | | | | |
| Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | | 59.7% | ICU Level of Service | B | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 215 | 439 | 276 | 110 | 100 | 95 |
| Future Volume (Veh/h) | 215 | 439 | 276 | 110 | 100 | 95 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 234 | 477 | 300 | 120 | 109 | 103 |
| Pedestrians | | 3 | 1 | | 27 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 3 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 447 | | | | 1333 | 390 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 447 | | | | 1333 | 390 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 78 | | | | 16 | 84 |
| cM capacity (veh/h) | 1084 | | | | 130 | 639 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 711 | 420 | 212 | | | |
| Volume Left | 234 | 0 | 109 | | | |
| Volume Right | 0 | 120 | 103 | | | |
| cSH | 1084 | 1700 | 211 | | | |
| Volume to Capacity | 0.22 | 0.25 | 1.00 | | | |
| Queue Length 95th (m) | 6.2 | 0.0 | 68.0 | | | |
| Control Delay (s) | 4.9 | 0.0 | 110.2 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 4.9 | 0.0 | 110.2 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 20.0 | | | | |
| Intersection Capacity Utilization | | 78.6% | ICU Level of Service | D | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

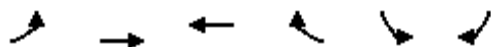


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↰ | ↰ | | | |
| Traffic Volume (veh/h) | 27 | 655 | 355 | 17 | 0 | 0 |
| Future Volume (Veh/h) | 27 | 655 | 355 | 17 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 29 | 712 | 386 | 18 | 0 | 0 |
| Pedestrians | | | | | 1 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 405 | | | | 1166 | 396 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 405 | | | | 1166 | 396 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 97 | | | | 100 | 100 |
| cM capacity (veh/h) | 1154 | | | | 209 | 653 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 741 | 404 | | | | |
| Volume Left | 29 | 0 | | | | |
| Volume Right | 0 | 18 | | | | |
| cSH | 1154 | 1700 | | | | |
| Volume to Capacity | 0.03 | 0.24 | | | | |
| Queue Length 95th (m) | 0.6 | 0.0 | | | | |
| Control Delay (s) | 0.7 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.7 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.4 | | | | |
| Intersection Capacity Utilization | | 59.7% | | ICU Level of Service | | B |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

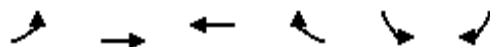





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 628 | 355 | 0 | 54 | 33 |
| Future Volume (Veh/h) | 0 | 628 | 355 | 0 | 54 | 33 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 683 | 386 | 0 | 59 | 36 |
| Pedestrians | | 5 | 24 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 2 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 386 | | | | 1093 | 391 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 386 | | | | 1093 | 391 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 75 | 94 |
| cM capacity (veh/h) | 1172 | | | | 232 | 654 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 683 | 386 | 95 | | | |
| Volume Left | 0 | 0 | 59 | | | |
| Volume Right | 0 | 0 | 36 | | | |
| cSH | 1700 | 1700 | 307 | | | |
| Volume to Capacity | 0.40 | 0.23 | 0.31 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 9.8 | | | |
| Control Delay (s) | 0.0 | 0.0 | 21.9 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 21.9 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 1.8 | | | |
| Intersection Capacity Utilization | | | 46.2% | ICU Level of Service | | A |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

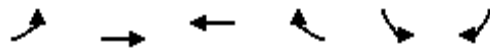
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 117 | 113 | 86 | 14 | 160 | 96 | 142 | 140 | 9 | 68 | 88 | 104 |
| Future Volume (vph) | 117 | 113 | 86 | 14 | 160 | 96 | 142 | 140 | 9 | 68 | 88 | 104 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 127 | 123 | 93 | 15 | 174 | 104 | 154 | 152 | 10 | 74 | 96 | 113 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 343 | 293 | 316 | 283 | | | | | | | | |
| Volume Left (vph) | 127 | 15 | 154 | 74 | | | | | | | | |
| Volume Right (vph) | 93 | 104 | 10 | 113 | | | | | | | | |
| Hadj (s) | -0.05 | -0.17 | 0.11 | -0.15 | | | | | | | | |
| Departure Headway (s) | 6.8 | 6.8 | 7.0 | 6.8 | | | | | | | | |
| Degree Utilization, x | 0.64 | 0.55 | 0.61 | 0.54 | | | | | | | | |
| Capacity (veh/h) | 491 | 476 | 465 | 469 | | | | | | | | |
| Control Delay (s) | 21.1 | 17.8 | 20.5 | 17.5 | | | | | | | | |
| Approach Delay (s) | 21.1 | 17.8 | 20.5 | 17.5 | | | | | | | | |
| Approach LOS | C | C | C | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 19.4 | | | | | | | | |
| Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | | 71.0% | ICU Level of Service | C | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 51 | 206 | 572 | 63 | 111 | 240 |
| Future Volume (Veh/h) | 51 | 206 | 572 | 63 | 111 | 240 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 55 | 224 | 622 | 68 | 121 | 261 |
| Pedestrians | | 3 | 1 | | 10 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 1 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 700 | | | | 1001 | 669 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 700 | | | | 1001 | 669 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 94 | | | | 52 | 42 |
| cM capacity (veh/h) | 888 | | | | 250 | 452 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 279 | 690 | 382 | | | |
| Volume Left | 55 | 0 | 121 | | | |
| Volume Right | 0 | 68 | 261 | | | |
| cSH | 888 | 1700 | 360 | | | |
| Volume to Capacity | 0.06 | 0.41 | 1.06 | | | |
| Queue Length 95th (m) | 1.5 | 0.0 | 102.2 | | | |
| Control Delay (s) | 2.4 | 0.0 | 99.6 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 2.4 | 0.0 | 99.6 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 28.6 | | | |
| Intersection Capacity Utilization | | | 78.8% | | ICU Level of Service | |
| Analysis Period (min) | | | 15 | | | |
| | | | D | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

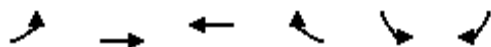


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 30 | 257 | 739 | 73 | 0 | 0 |
| Future Volume (Veh/h) | 30 | 257 | 739 | 73 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 33 | 279 | 803 | 79 | 0 | 0 |
| Pedestrians | | | | | 20 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 902 | | | | 1208 | 862 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 902 | | | | 1208 | 862 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 96 | | | | 100 | 100 |
| cM capacity (veh/h) | 754 | | | | 194 | 354 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 312 | 882 | | | | |
| Volume Left | 33 | 0 | | | | |
| Volume Right | 0 | 79 | | | | |
| cSH | 754 | 1700 | | | | |
| Volume to Capacity | 0.04 | 0.52 | | | | |
| Queue Length 95th (m) | 1.0 | 0.0 | | | | |
| Control Delay (s) | 1.5 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 1.5 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.4 | | | | |
| Intersection Capacity Utilization | | 46.8% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

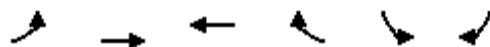





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 273 | 739 | 0 | 14 | 26 |
| Future Volume (Veh/h) | 0 | 273 | 739 | 0 | 14 | 26 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 297 | 803 | 0 | 15 | 28 |
| Pedestrians | | 1 | 12 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 1 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 803 | | | | 1112 | 804 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 803 | | | | 1112 | 804 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 93 | 93 |
| cM capacity (veh/h) | 821 | | | | 228 | 383 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 297 | 803 | 43 | | | |
| Volume Left | 0 | 0 | 15 | | | |
| Volume Right | 0 | 0 | 28 | | | |
| cSH | 1700 | 1700 | 310 | | | |
| Volume to Capacity | 0.17 | 0.47 | 0.14 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 3.6 | | | |
| Control Delay (s) | 0.0 | 0.0 | 18.5 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 18.5 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 0.7 | | | |
| Intersection Capacity Utilization | | | 49.2% | ICU Level of Service | A | |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

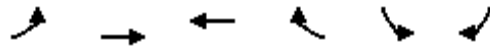
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 102 | 150 | 173 | 34 | 94 | 57 | 122 | 86 | 22 | 77 | 161 | 68 |
| Future Volume (vph) | 102 | 150 | 173 | 34 | 94 | 57 | 122 | 86 | 22 | 77 | 161 | 68 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 111 | 163 | 188 | 37 | 102 | 62 | 133 | 93 | 24 | 84 | 175 | 74 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 462 | 201 | 250 | 333 | | | | | | | | |
| Volume Left (vph) | 111 | 37 | 133 | 84 | | | | | | | | |
| Volume Right (vph) | 188 | 62 | 24 | 74 | | | | | | | | |
| Hadj (s) | -0.16 | -0.11 | 0.08 | -0.05 | | | | | | | | |
| Departure Headway (s) | 6.3 | 7.1 | 7.1 | 6.8 | | | | | | | | |
| Degree Utilization, x | 0.81 | 0.39 | 0.50 | 0.63 | | | | | | | | |
| Capacity (veh/h) | 544 | 442 | 440 | 487 | | | | | | | | |
| Control Delay (s) | 31.1 | 14.6 | 17.0 | 20.6 | | | | | | | | |
| Approach Delay (s) | 31.1 | 14.6 | 17.0 | 20.6 | | | | | | | | |
| Approach LOS | D | B | C | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 22.8 | | | | | | | | |
| Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | | 66.8% | ICU Level of Service | C | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|----------------------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 238 | 487 | 309 | 124 | 113 | 107 |
| Future Volume (Veh/h) | 238 | 487 | 309 | 124 | 113 | 107 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 259 | 529 | 336 | 135 | 123 | 116 |
| Pedestrians | | 3 | 1 | | 26 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 3 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 497 | | | | 1478 | 432 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 497 | | | | 1478 | 432 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 75 | | | | 0 | 81 |
| cM capacity (veh/h) | 1040 | | | | 101 | 605 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 788 | 471 | 239 | | | |
| Volume Left | 259 | 0 | 123 | | | |
| Volume Right | 0 | 135 | 116 | | | |
| cSH | 1040 | 1700 | 170 | | | |
| Volume to Capacity | 0.25 | 0.28 | 1.40 | | | |
| Queue Length 95th (m) | 7.5 | 0.0 | 111.7 | | | |
| Control Delay (s) | 5.5 | 0.0 | 264.3 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 5.5 | 0.0 | 264.3 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 45.1 | | | |
| Intersection Capacity Utilization | | | 86.3% | ICU Level of Service | | E |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

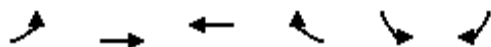


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 23 | 725 | 402 | 14 | 0 | 0 |
| Future Volume (Veh/h) | 23 | 725 | 402 | 14 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 25 | 788 | 437 | 15 | 0 | 0 |
| Pedestrians | | | | | 1 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 453 | | | | 1284 | 446 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 453 | | | | 1284 | 446 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 98 | | | | 100 | 100 |
| cM capacity (veh/h) | 1108 | | | | 178 | 613 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 813 | 452 | | | | |
| Volume Left | 25 | 0 | | | | |
| Volume Right | 0 | 15 | | | | |
| cSH | 1108 | 1700 | | | | |
| Volume to Capacity | 0.02 | 0.27 | | | | |
| Queue Length 95th (m) | 0.5 | 0.0 | | | | |
| Control Delay (s) | 0.6 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.6 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.4 | | | | |
| Intersection Capacity Utilization | | 60.1% | | ICU Level of Service | | B |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

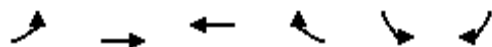





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 703 | 402 | 0 | 45 | 28 |
| Future Volume (Veh/h) | 0 | 703 | 402 | 0 | 45 | 28 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 764 | 437 | 0 | 49 | 30 |
| Pedestrians | | 5 | 24 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 2 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 437 | | | | 1225 | 442 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 437 | | | | 1225 | 442 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 75 | 95 |
| cM capacity (veh/h) | 1123 | | | | 193 | 612 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 764 | 437 | 79 | | | |
| Volume Left | 0 | 0 | 49 | | | |
| Volume Right | 0 | 0 | 30 | | | |
| cSH | 1700 | 1700 | 261 | | | |
| Volume to Capacity | 0.45 | 0.26 | 0.30 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 9.4 | | | |
| Control Delay (s) | 0.0 | 0.0 | 24.7 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 24.7 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 1.5 | | | |
| Intersection Capacity Utilization | | | 49.4% | ICU Level of Service | | A |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 133 | 125 | 97 | 15 | 176 | 105 | 161 | 159 | 10 | 69 | 100 | 118 |
| Future Volume (vph) | 133 | 125 | 97 | 15 | 176 | 105 | 161 | 159 | 10 | 69 | 100 | 118 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 145 | 136 | 105 | 16 | 191 | 114 | 175 | 173 | 11 | 75 | 109 | 128 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 386 | 321 | 359 | 312 | | | | | | | | |
| Volume Left (vph) | 145 | 16 | 175 | 75 | | | | | | | | |
| Volume Right (vph) | 105 | 114 | 11 | 128 | | | | | | | | |
| Hadj (s) | -0.05 | -0.17 | 0.11 | -0.16 | | | | | | | | |
| Departure Headway (s) | 7.7 | 7.8 | 8.0 | 7.9 | | | | | | | | |
| Degree Utilization, x | 0.83 | 0.70 | 0.79 | 0.68 | | | | | | | | |
| Capacity (veh/h) | 386 | 420 | 429 | 410 | | | | | | | | |
| Control Delay (s) | 38.0 | 27.1 | 35.3 | 26.3 | | | | | | | | |
| Approach Delay (s) | 38.0 | 27.1 | 35.3 | 26.3 | | | | | | | | |
| Approach LOS | E | D | E | D | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 32.1 | | | | | | | | |
| Level of Service | | | | D | | | | | | | | |
| Intersection Capacity Utilization | | | | 80.1% | ICU Level of Service | D | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

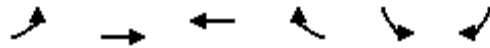


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 52 | 209 | 576 | 63 | 111 | 257 |
| Future Volume (Veh/h) | 52 | 209 | 576 | 63 | 111 | 257 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 57 | 227 | 626 | 68 | 121 | 279 |
| Pedestrians | | 3 | 1 | | 12 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 1 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 706 | | | | 1014 | 675 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 706 | | | | 1014 | 675 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 94 | | | | 50 | 38 |
| cM capacity (veh/h) | 882 | | | | 244 | 447 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 284 | 694 | 400 | | | |
| Volume Left | 57 | 0 | 121 | | | |
| Volume Right | 0 | 68 | 279 | | | |
| cSH | 882 | 1700 | 357 | | | |
| Volume to Capacity | 0.06 | 0.41 | 1.12 | | | |
| Queue Length 95th (m) | 1.6 | 0.0 | 115.5 | | | |
| Control Delay (s) | 2.4 | 0.0 | 118.0 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 2.4 | 0.0 | 118.0 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 34.8 | | | | |
| Intersection Capacity Utilization | | 80.3% | ICU Level of Service | D | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

2: Niaqunngusariaq & College East Access

8/2/2017

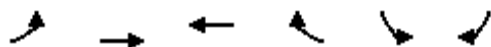


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 38 | 261 | 739 | 94 | 0 | 0 |
| Future Volume (Veh/h) | 38 | 261 | 739 | 94 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 41 | 284 | 803 | 102 | 0 | 0 |
| Pedestrians | | | | | 22 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 927 | | | | 1242 | 876 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 927 | | | | 1242 | 876 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 94 | | | | 100 | 100 |
| cM capacity (veh/h) | 737 | | | | 182 | 348 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 325 | 905 | | | | |
| Volume Left | 41 | 0 | | | | |
| Volume Right | 0 | 102 | | | | |
| cSH | 737 | 1700 | | | | |
| Volume to Capacity | 0.06 | 0.53 | | | | |
| Queue Length 95th (m) | 1.3 | 0.0 | | | | |
| Control Delay (s) | 1.9 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 1.9 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.5 | | | | |
| Intersection Capacity Utilization | | 49.1% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

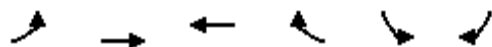





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 281 | 739 | 0 | 18 | 33 |
| Future Volume (Veh/h) | 0 | 281 | 739 | 0 | 18 | 33 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 305 | 803 | 0 | 20 | 36 |
| Pedestrians | | 1 | 13 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 1 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 803 | | | | 1121 | 804 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 803 | | | | 1121 | 804 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 91 | 91 |
| cM capacity (veh/h) | 821 | | | | 225 | 383 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 305 | 803 | 56 | | | |
| Volume Left | 0 | 0 | 20 | | | |
| Volume Right | 0 | 0 | 36 | | | |
| cSH | 1700 | 1700 | 306 | | | |
| Volume to Capacity | 0.18 | 0.47 | 0.18 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 5.0 | | | |
| Control Delay (s) | 0.0 | 0.0 | 19.4 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 19.4 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 0.9 | | | |
| Intersection Capacity Utilization | | | 49.2% | | ICU Level of Service | |
| Analysis Period (min) | | | 15 | | A | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiarlaq

8/2/2017

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 102 | 155 | 173 | 36 | 98 | 60 | 122 | 86 | 23 | 79 | 161 | 68 |
| Future Volume (vph) | 102 | 155 | 173 | 36 | 98 | 60 | 122 | 86 | 23 | 79 | 161 | 68 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 111 | 168 | 188 | 39 | 107 | 65 | 133 | 93 | 25 | 86 | 175 | 74 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 467 | 211 | 251 | 335 | | | | | | | | |
| Volume Left (vph) | 111 | 39 | 133 | 86 | | | | | | | | |
| Volume Right (vph) | 188 | 65 | 25 | 74 | | | | | | | | |
| Hadj (s) | -0.16 | -0.11 | 0.08 | -0.05 | | | | | | | | |
| Departure Headway (s) | 6.4 | 7.1 | 7.3 | 6.9 | | | | | | | | |
| Degree Utilization, x | 0.83 | 0.42 | 0.51 | 0.64 | | | | | | | | |
| Capacity (veh/h) | 539 | 442 | 448 | 479 | | | | | | | | |
| Control Delay (s) | 33.6 | 15.2 | 17.5 | 21.4 | | | | | | | | |
| Approach Delay (s) | 33.6 | 15.2 | 17.5 | 21.4 | | | | | | | | |
| Approach LOS | D | C | C | C | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 24.1 | | | | | | | | |
| Level of Service | | | | C | | | | | | | | |
| Intersection Capacity Utilization | | | | 66.7% | ICU Level of Service | | | | | | | C |
| Analysis Period (min) | | | | 15 | | | | | | | | |

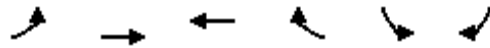


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|----------------------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 243 | 495 | 312 | 124 | 113 | 108 |
| Future Volume (Veh/h) | 243 | 495 | 312 | 124 | 113 | 108 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 264 | 538 | 339 | 135 | 123 | 117 |
| Pedestrians | | 3 | 1 | | 29 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 3 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 503 | | | | 1502 | 438 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 503 | | | | 1502 | 438 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 74 | | | | 0 | 80 |
| cM capacity (veh/h) | 1031 | | | | 97 | 599 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 802 | 474 | 240 | | | |
| Volume Left | 264 | 0 | 123 | | | |
| Volume Right | 0 | 135 | 117 | | | |
| cSH | 1031 | 1700 | 164 | | | |
| Volume to Capacity | 0.26 | 0.28 | 1.47 | | | |
| Queue Length 95th (m) | 7.8 | 0.0 | 117.0 | | | |
| Control Delay (s) | 5.6 | 0.0 | 292.0 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 5.6 | 0.0 | 292.0 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 49.2 | | | |
| Intersection Capacity Utilization | | | 87.3% | ICU Level of Service | | E |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report

2: Niaqunngusariaq & College East Access

8/2/2017

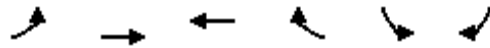


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 29 | 738 | 402 | 18 | 0 | 0 |
| Future Volume (Veh/h) | 29 | 738 | 402 | 18 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 32 | 802 | 437 | 20 | 0 | 0 |
| Pedestrians | | | | | 1 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 458 | | | | 1314 | 448 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 458 | | | | 1314 | 448 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 97 | | | | 100 | 100 |
| cM capacity (veh/h) | 1103 | | | | 169 | 611 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 834 | 457 | | | | |
| Volume Left | 32 | 0 | | | | |
| Volume Right | 0 | 20 | | | | |
| cSH | 1103 | 1700 | | | | |
| Volume to Capacity | 0.03 | 0.27 | | | | |
| Queue Length 95th (m) | 0.7 | 0.0 | | | | |
| Control Delay (s) | 0.8 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.8 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.5 | | | | |
| Intersection Capacity Utilization | | 65.7% | | ICU Level of Service | | C |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017






| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 709 | 402 | 0 | 58 | 36 |
| Future Volume (Veh/h) | 0 | 709 | 402 | 0 | 58 | 36 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 771 | 437 | 0 | 63 | 39 |
| Pedestrians | | 6 | 26 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 1 | 3 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 437 | | | | 1234 | 443 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 437 | | | | 1234 | 443 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 67 | 94 |
| cM capacity (veh/h) | 1123 | | | | 190 | 611 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 771 | 437 | 102 | | | |
| Volume Left | 0 | 0 | 63 | | | |
| Volume Right | 0 | 0 | 39 | | | |
| cSH | 1700 | 1700 | 258 | | | |
| Volume to Capacity | 0.45 | 0.26 | 0.40 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 13.6 | | | |
| Control Delay (s) | 0.0 | 0.0 | 27.8 | | | |
| Lane LOS | | | D | | | |
| Approach Delay (s) | 0.0 | 0.0 | 27.8 | | | |
| Approach LOS | | | D | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 2.2 | | | |
| Intersection Capacity Utilization | | | 51.0% | ICU Level of Service | A | |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

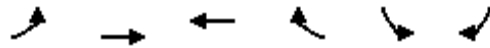
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 133 | 127 | 97 | 16 | 180 | 108 | 161 | 159 | 10 | 75 | 100 | 118 |
| Future Volume (vph) | 133 | 127 | 97 | 16 | 180 | 108 | 161 | 159 | 10 | 75 | 100 | 118 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 145 | 138 | 105 | 17 | 196 | 117 | 175 | 173 | 11 | 82 | 109 | 128 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 388 | 330 | 359 | 319 | | | | | | | | |
| Volume Left (vph) | 145 | 17 | 175 | 82 | | | | | | | | |
| Volume Right (vph) | 105 | 117 | 11 | 128 | | | | | | | | |
| Hadj (s) | -0.05 | -0.17 | 0.11 | -0.16 | | | | | | | | |
| Departure Headway (s) | 7.9 | 8.1 | 8.2 | 8.1 | | | | | | | | |
| Degree Utilization, x | 0.86 | 0.74 | 0.82 | 0.72 | | | | | | | | |
| Capacity (veh/h) | 388 | 413 | 419 | 404 | | | | | | | | |
| Control Delay (s) | 42.7 | 30.7 | 38.8 | 29.5 | | | | | | | | |
| Approach Delay (s) | 42.7 | 30.7 | 38.8 | 29.5 | | | | | | | | |
| Approach LOS | E | D | E | D | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 35.8 | | | | | | | | |
| Level of Service | | | | E | | | | | | | | |
| Intersection Capacity Utilization | | | | 79.4% | ICU Level of Service | D | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 57 | 230 | 638 | 70 | 124 | 266 |
| Future Volume (Veh/h) | 57 | 230 | 638 | 70 | 124 | 266 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 62 | 250 | 693 | 76 | 135 | 289 |
| Pedestrians | | 3 | 1 | | 11 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 1 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 780 | | | | 1117 | 745 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 780 | | | | 1117 | 745 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 93 | | | | 36 | 29 |
| cM capacity (veh/h) | 828 | | | | 210 | 408 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 312 | 769 | 424 | | | |
| Volume Left | 62 | 0 | 135 | | | |
| Volume Right | 0 | 76 | 289 | | | |
| cSH | 828 | 1700 | 314 | | | |
| Volume to Capacity | 0.07 | 0.45 | 1.35 | | | |
| Queue Length 95th (m) | 1.8 | 0.0 | 161.6 | | | |
| Control Delay (s) | 2.6 | 0.0 | 210.6 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 2.6 | 0.0 | 210.6 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 59.9 | | | | |
| Intersection Capacity Utilization | | 86.7% | ICU Level of Service | E | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

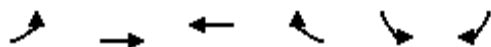


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 32 | 287 | 825 | 79 | 0 | 0 |
| Future Volume (Veh/h) | 32 | 287 | 825 | 79 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 35 | 312 | 897 | 86 | 0 | 0 |
| Pedestrians | | | | | 21 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 1004 | | | | 1343 | 961 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1004 | | | | 1343 | 961 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 95 | | | | 100 | 100 |
| cM capacity (veh/h) | 690 | | | | 159 | 311 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 347 | 983 | | | | |
| Volume Left | 35 | 0 | | | | |
| Volume Right | 0 | 86 | | | | |
| cSH | 690 | 1700 | | | | |
| Volume to Capacity | 0.05 | 0.58 | | | | |
| Queue Length 95th (m) | 1.2 | 0.0 | | | | |
| Control Delay (s) | 1.6 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 1.6 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.4 | | | | |
| Intersection Capacity Utilization | | 51.7% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

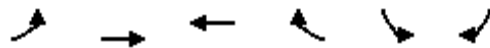





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|------|----------------------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 304 | 825 | 0 | 15 | 29 |
| Future Volume (Veh/h) | 0 | 304 | 825 | 0 | 15 | 29 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 330 | 897 | 0 | 16 | 32 |
| Pedestrians | | 1 | 13 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 1 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 897 | | | | 1240 | 898 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 897 | | | | 1240 | 898 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 92 | 91 |
| cM capacity (veh/h) | 757 | | | | 191 | 338 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 330 | 897 | 48 | | | |
| Volume Left | 0 | 0 | 16 | | | |
| Volume Right | 0 | 0 | 32 | | | |
| cSH | 1700 | 1700 | 269 | | | |
| Volume to Capacity | 0.19 | 0.53 | 0.18 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 4.8 | | | |
| Control Delay (s) | 0.0 | 0.0 | 21.3 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 21.3 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 0.8 | | | |
| Intersection Capacity Utilization | | | 53.7% | | ICU Level of Service | |
| Analysis Period (min) | | | 15 | | A | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

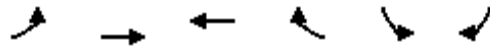
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 114 | 167 | 194 | 38 | 104 | 64 | 136 | 96 | 24 | 85 | 180 | 76 |
| Future Volume (vph) | 114 | 167 | 194 | 38 | 104 | 64 | 136 | 96 | 24 | 85 | 180 | 76 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 124 | 182 | 211 | 41 | 113 | 70 | 148 | 104 | 26 | 92 | 196 | 83 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 517 | 224 | 278 | 371 | | | | | | | | |
| Volume Left (vph) | 124 | 41 | 148 | 92 | | | | | | | | |
| Volume Right (vph) | 211 | 70 | 26 | 83 | | | | | | | | |
| Hadj (s) | -0.16 | -0.12 | 0.08 | -0.05 | | | | | | | | |
| Departure Headway (s) | 7.1 | 7.9 | 7.9 | 7.5 | | | | | | | | |
| Degree Utilization, x | 1.00 | 0.49 | 0.61 | 0.77 | | | | | | | | |
| Capacity (veh/h) | 517 | 417 | 433 | 462 | | | | | | | | |
| Control Delay (s) | 66.4 | 18.4 | 22.7 | 31.5 | | | | | | | | |
| Approach Delay (s) | 66.4 | 18.4 | 22.7 | 31.5 | | | | | | | | |
| Approach LOS | F | C | C | D | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 40.6 | | | | | | | | |
| Level of Service | | | | E | | | | | | | | |
| Intersection Capacity Utilization | | | | 73.9% | ICU Level of Service | D | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 265 | 543 | 345 | 139 | 126 | 119 |
| Future Volume (Veh/h) | 265 | 543 | 345 | 139 | 126 | 119 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 288 | 590 | 375 | 151 | 137 | 129 |
| Pedestrians | | 3 | 1 | | 28 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 3 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 554 | | | | 1646 | 482 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 554 | | | | 1646 | 482 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 71 | | | | 0 | 77 |
| cM capacity (veh/h) | 988 | | | | 75 | 567 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 878 | 526 | 266 | | | |
| Volume Left | 288 | 0 | 137 | | | |
| Volume Right | 0 | 151 | 129 | | | |
| cSH | 988 | 1700 | 130 | | | |
| Volume to Capacity | 0.29 | 0.31 | 2.05 | | | |
| Queue Length 95th (m) | 9.2 | 0.0 | 164.3 | | | |
| Control Delay (s) | 6.4 | 0.0 | 552.7 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 6.4 | 0.0 | 552.7 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 91.4 | | | | |
| Intersection Capacity Utilization | | 95.0% | ICU Level of Service | F | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

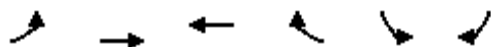


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↰ | ↰ | | | |
| Traffic Volume (veh/h) | 25 | 808 | 449 | 15 | 0 | 0 |
| Future Volume (Veh/h) | 25 | 808 | 449 | 15 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 27 | 878 | 488 | 16 | 0 | 0 |
| Pedestrians | | | | | 1 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 505 | | | | 1429 | 497 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 505 | | | | 1429 | 497 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 97 | | | | 100 | 100 |
| cM capacity (veh/h) | 1060 | | | | 145 | 573 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 905 | 504 | | | | |
| Volume Left | 27 | 0 | | | | |
| Volume Right | 0 | 16 | | | | |
| cSH | 1060 | 1700 | | | | |
| Volume to Capacity | 0.03 | 0.30 | | | | |
| Queue Length 95th (m) | 0.6 | 0.0 | | | | |
| Control Delay (s) | 0.7 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.7 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.4 | | | | |
| Intersection Capacity Utilization | | 66.0% | | ICU Level of Service | | C |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

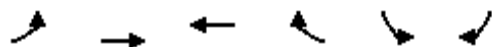





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 784 | 449 | 0 | 49 | 30 |
| Future Volume (Veh/h) | 0 | 784 | 449 | 0 | 49 | 30 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 852 | 488 | 0 | 53 | 33 |
| Pedestrians | | 6 | 25 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 1 | 2 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 488 | | | | 1365 | 494 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 488 | | | | 1365 | 494 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 67 | 94 |
| cM capacity (veh/h) | 1075 | | | | 158 | 572 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 852 | 488 | 86 | | | |
| Volume Left | 0 | 0 | 53 | | | |
| Volume Right | 0 | 0 | 33 | | | |
| cSH | 1700 | 1700 | 219 | | | |
| Volume to Capacity | 0.50 | 0.29 | 0.39 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 13.3 | | | |
| Control Delay (s) | 0.0 | 0.0 | 31.6 | | | |
| Lane LOS | | | D | | | |
| Approach Delay (s) | 0.0 | 0.0 | 31.6 | | | |
| Approach LOS | | | D | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 1.9 | | | |
| Intersection Capacity Utilization | | | 54.3% | ICU Level of Service | | A |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

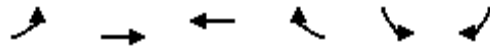
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 148 | 140 | 108 | 16 | 196 | 117 | 180 | 177 | 11 | 78 | 111 | 132 |
| Future Volume (vph) | 148 | 140 | 108 | 16 | 196 | 117 | 180 | 177 | 11 | 78 | 111 | 132 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 161 | 152 | 117 | 17 | 213 | 127 | 196 | 192 | 12 | 85 | 121 | 143 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 430 | 357 | 400 | 349 | | | | | | | | |
| Volume Left (vph) | 161 | 17 | 196 | 85 | | | | | | | | |
| Volume Right (vph) | 117 | 127 | 12 | 143 | | | | | | | | |
| Hadj (s) | -0.05 | -0.17 | 0.11 | -0.16 | | | | | | | | |
| Departure Headway (s) | 9.0 | 9.1 | 9.2 | 9.1 | | | | | | | | |
| Degree Utilization, x | 1.00 | 0.90 | 1.00 | 0.89 | | | | | | | | |
| Capacity (veh/h) | 430 | 390 | 400 | 382 | | | | | | | | |
| Control Delay (s) | 75.6 | 54.8 | 76.4 | 52.3 | | | | | | | | |
| Approach Delay (s) | 75.6 | 54.8 | 76.4 | 52.3 | | | | | | | | |
| Approach LOS | F | F | F | F | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 65.7 | | | | | | | | |
| Level of Service | | | | F | | | | | | | | |
| Intersection Capacity Utilization | | | | 88.0% | ICU Level of Service | E | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|----------------------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 58 | 233 | 642 | 70 | 124 | 283 |
| Future Volume (Veh/h) | 58 | 233 | 642 | 70 | 124 | 283 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 63 | 253 | 698 | 76 | 135 | 308 |
| Pedestrians | | 3 | 2 | | 12 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 1 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 786 | | | | 1129 | 751 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 786 | | | | 1129 | 751 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 92 | | | | 34 | 24 |
| cM capacity (veh/h) | 823 | | | | 205 | 405 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 316 | 774 | 443 | | | |
| Volume Left | 63 | 0 | 135 | | | |
| Volume Right | 0 | 76 | 308 | | | |
| cSH | 823 | 1700 | 312 | | | |
| Volume to Capacity | 0.08 | 0.46 | 1.42 | | | |
| Queue Length 95th (m) | 1.9 | 0.0 | 178.0 | | | |
| Control Delay (s) | 2.6 | 0.0 | 237.8 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 2.6 | 0.0 | 237.8 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 69.3 | | | |
| Intersection Capacity Utilization | | | 88.1% | ICU Level of Service | | E |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

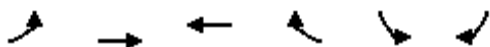


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↰ | ↰ | | | |
| Traffic Volume (veh/h) | 40 | 291 | 825 | 100 | 0 | 0 |
| Future Volume (Veh/h) | 40 | 291 | 825 | 100 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 43 | 316 | 897 | 109 | 0 | 0 |
| Pedestrians | | | | | 23 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 1029 | | | | 1376 | 974 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 1029 | | | | 1376 | 974 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 94 | | | | 100 | 100 |
| cM capacity (veh/h) | 675 | | | | 150 | 305 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 359 | 1006 | | | | |
| Volume Left | 43 | 0 | | | | |
| Volume Right | 0 | 109 | | | | |
| cSH | 675 | 1700 | | | | |
| Volume to Capacity | 0.06 | 0.59 | | | | |
| Queue Length 95th (m) | 1.5 | 0.0 | | | | |
| Control Delay (s) | 2.0 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 2.0 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.5 | | | | |
| Intersection Capacity Utilization | | 53.1% | | ICU Level of Service | | A |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017

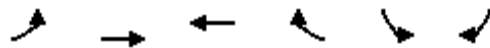





| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 312 | 825 | 0 | 19 | 36 |
| Future Volume (Veh/h) | 0 | 312 | 825 | 0 | 19 | 36 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 339 | 897 | 0 | 21 | 39 |
| Pedestrians | | 2 | 14 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 0 | 1 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 897 | | | | 1250 | 899 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 897 | | | | 1250 | 899 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 89 | 88 |
| cM capacity (veh/h) | 757 | | | | 188 | 337 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 339 | 897 | 60 | | | |
| Volume Left | 0 | 0 | 21 | | | |
| Volume Right | 0 | 0 | 39 | | | |
| cSH | 1700 | 1700 | 264 | | | |
| Volume to Capacity | 0.20 | 0.53 | 0.23 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 6.5 | | | |
| Control Delay (s) | 0.0 | 0.0 | 22.6 | | | |
| Lane LOS | | | C | | | |
| Approach Delay (s) | 0.0 | 0.0 | 22.6 | | | |
| Approach LOS | | | C | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 1.0 | | | |
| Intersection Capacity Utilization | | 54.1% | | ICU Level of Service | A | |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

8/2/2017

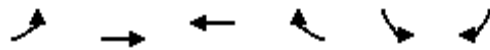
| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 114 | 172 | 194 | 40 | 108 | 67 | 136 | 96 | 25 | 87 | 180 | 76 |
| Future Volume (vph) | 114 | 172 | 194 | 40 | 108 | 67 | 136 | 96 | 25 | 87 | 180 | 76 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 124 | 187 | 211 | 43 | 117 | 73 | 148 | 104 | 27 | 95 | 196 | 83 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 522 | 233 | 279 | 374 | | | | | | | | |
| Volume Left (vph) | 124 | 43 | 148 | 95 | | | | | | | | |
| Volume Right (vph) | 211 | 73 | 27 | 83 | | | | | | | | |
| Hadj (s) | -0.16 | -0.12 | 0.08 | -0.05 | | | | | | | | |
| Departure Headway (s) | 7.1 | 8.0 | 8.0 | 7.6 | | | | | | | | |
| Degree Utilization, x | 1.00 | 0.52 | 0.62 | 0.78 | | | | | | | | |
| Capacity (veh/h) | 522 | 415 | 429 | 459 | | | | | | | | |
| Control Delay (s) | 66.8 | 19.2 | 23.2 | 32.9 | | | | | | | | |
| Approach Delay (s) | 66.8 | 19.2 | 23.2 | 32.9 | | | | | | | | |
| Approach LOS | F | C | C | D | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 41.3 | | | | | | | | |
| Level of Service | | | | E | | | | | | | | |
| Intersection Capacity Utilization | | | | 73.8% | ICU Level of Service | D | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|---|---|------|---|------|
| Lane Configurations | |  |  | |  | |
| Traffic Volume (veh/h) | 270 | 551 | 348 | 139 | 126 | 120 |
| Future Volume (Veh/h) | 270 | 551 | 348 | 139 | 126 | 120 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 293 | 599 | 378 | 151 | 137 | 130 |
| Pedestrians | | 3 | 2 | | 31 | |
| Lane Width (m) | | 3.7 | 3.7 | | 3.7 | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | 1.1 | |
| Percent Blockage | | 0 | 0 | | 3 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 560 | | | | 1672 | 488 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 560 | | | | 1672 | 488 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 70 | | | | 0 | 77 |
| cM capacity (veh/h) | 980 | | | | 72 | 561 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 892 | 529 | 267 | | | |
| Volume Left | 293 | 0 | 137 | | | |
| Volume Right | 0 | 151 | 130 | | | |
| cSH | 980 | 1700 | 124 | | | |
| Volume to Capacity | 0.30 | 0.31 | 2.15 | | | |
| Queue Length 95th (m) | 9.6 | 0.0 | 169.6 | | | |
| Control Delay (s) | 6.5 | 0.0 | 599.6 | | | |
| Lane LOS | A | | F | | | |
| Approach Delay (s) | 6.5 | 0.0 | 599.6 | | | |
| Approach LOS | | | F | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 98.3 | | | | |
| Intersection Capacity Utilization | | 96.0% | ICU Level of Service | F | | |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report
2: Niaqunngusariaq & College East Access

8/2/2017

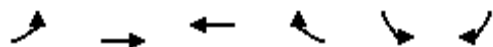


| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|-------|------|----------------------|------|------|
| Lane Configurations | | ↰ | ↰ | | | |
| Traffic Volume (veh/h) | 31 | 821 | 449 | 19 | 0 | 0 |
| Future Volume (Veh/h) | 31 | 821 | 449 | 19 | 0 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 34 | 892 | 488 | 21 | 0 | 0 |
| Pedestrians | | | | | 2 | |
| Lane Width (m) | | | | | 0.0 | |
| Walking Speed (m/s) | | | | | 1.1 | |
| Percent Blockage | | | | | 0 | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 511 | | | | 1460 | 500 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 511 | | | | 1460 | 500 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 97 | | | | 100 | 100 |
| cM capacity (veh/h) | 1054 | | | | 137 | 570 |
| Direction, Lane # | EB 1 | WB 1 | | | | |
| Volume Total | 926 | 509 | | | | |
| Volume Left | 34 | 0 | | | | |
| Volume Right | 0 | 21 | | | | |
| cSH | 1054 | 1700 | | | | |
| Volume to Capacity | 0.03 | 0.30 | | | | |
| Queue Length 95th (m) | 0.8 | 0.0 | | | | |
| Control Delay (s) | 0.9 | 0.0 | | | | |
| Lane LOS | A | | | | | |
| Approach Delay (s) | 0.9 | 0.0 | | | | |
| Approach LOS | | | | | | |
| Intersection Summary | | | | | | |
| Average Delay | | 0.6 | | | | |
| Intersection Capacity Utilization | | 71.6% | | ICU Level of Service | | C |
| Analysis Period (min) | | 15 | | | | |

NAC Expansion TIA - Synchro 9 Report

3: Niaqunngusariaq & College West Access

















8/2/2017



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|-----------------------------------|------|------|-------|----------------------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↘ | |
| Traffic Volume (veh/h) | 0 | 790 | 449 | 0 | 62 | 38 |
| Future Volume (Veh/h) | 0 | 790 | 449 | 0 | 62 | 38 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 859 | 488 | 0 | 67 | 41 |
| Pedestrians | | 6 | 28 | | | |
| Lane Width (m) | | 3.7 | 3.7 | | | |
| Walking Speed (m/s) | | 1.1 | 1.1 | | | |
| Percent Blockage | | 1 | 3 | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 488 | | | | 1375 | 494 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 488 | | | | 1375 | 494 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 57 | 93 |
| cM capacity (veh/h) | 1075 | | | | 156 | 572 |
| Direction, Lane # | EB 1 | WB 1 | SB 1 | | | |
| Volume Total | 859 | 488 | 108 | | | |
| Volume Left | 0 | 0 | 67 | | | |
| Volume Right | 0 | 0 | 41 | | | |
| cSH | 1700 | 1700 | 215 | | | |
| Volume to Capacity | 0.51 | 0.29 | 0.50 | | | |
| Queue Length 95th (m) | 0.0 | 0.0 | 19.3 | | | |
| Control Delay (s) | 0.0 | 0.0 | 37.5 | | | |
| Lane LOS | | | E | | | |
| Approach Delay (s) | 0.0 | 0.0 | 37.5 | | | |
| Approach LOS | | | E | | | |
| Intersection Summary | | | | | | |
| Average Delay | | | 2.8 | | | |
| Intersection Capacity Utilization | | | 55.6% | ICU Level of Service | | B |
| Analysis Period (min) | | | 15 | | | |

NAC Expansion TIA - Synchro 9 Report
4: Federal Road & Niaqunngusiariaq

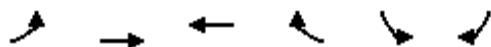
8/2/2017

| |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 148 | 142 | 108 | 17 | 200 | 120 | 180 | 177 | 11 | 83 | 111 | 132 |
| Future Volume (vph) | 148 | 142 | 108 | 17 | 200 | 120 | 180 | 177 | 11 | 83 | 111 | 132 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 161 | 154 | 117 | 18 | 217 | 130 | 196 | 192 | 12 | 90 | 121 | 143 |
| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 | | | | | | | | |
| Volume Total (vph) | 432 | 365 | 400 | 354 | | | | | | | | |
| Volume Left (vph) | 161 | 18 | 196 | 90 | | | | | | | | |
| Volume Right (vph) | 117 | 130 | 12 | 143 | | | | | | | | |
| Hadj (s) | -0.05 | -0.17 | 0.11 | -0.16 | | | | | | | | |
| Departure Headway (s) | 9.1 | 9.1 | 9.3 | 9.2 | | | | | | | | |
| Degree Utilization, x | 1.00 | 0.93 | 1.00 | 0.91 | | | | | | | | |
| Capacity (veh/h) | 432 | 380 | 400 | 382 | | | | | | | | |
| Control Delay (s) | 76.0 | 59.7 | 76.8 | 55.8 | | | | | | | | |
| Approach Delay (s) | 76.0 | 59.7 | 76.8 | 55.8 | | | | | | | | |
| Approach LOS | F | F | F | F | | | | | | | | |
| Intersection Summary | | | | | | | | | | | | |
| Delay | | | | 67.8 | | | | | | | | |
| Level of Service | | | | F | | | | | | | | |
| Intersection Capacity Utilization | | | | 87.5% | ICU Level of Service | E | | | | | | |
| Analysis Period (min) | | | | 15 | | | | | | | | |

NAC Expansion TIA - Synchro 9 Report

1: Niaqunngusiariaq & Saputi

8/2/2017



| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|-------------------------|-------|-------|-------|------|-------|------|
| Lane Configurations | | | | | | |
| Traffic Volume (vph) | 270 | 551 | 348 | 139 | 126 | 120 |
| Future Volume (vph) | 270 | 551 | 348 | 139 | 126 | 120 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Satd. Flow (prot) | 1789 | 1883 | 1760 | 0 | 1692 | 0 |
| Flt Permitted | 0.399 | | | | 0.975 | |
| Satd. Flow (perm) | 730 | 1883 | 1760 | 0 | 1688 | 0 |
| Right Turn on Red | | | | Yes | | Yes |
| Satd. Flow (RTOR) | | | 46 | | 51 | |
| Link Speed (k/h) | | 40 | 30 | | 40 | |
| Link Distance (m) | | 60.3 | 251.8 | | 297.7 | |
| Travel Time (s) | | 5.4 | 30.2 | | 26.8 | |
| Confl. Peds. (#/hr) | 31 | | | 31 | 2 | 3 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 293 | 599 | 529 | 0 | 267 | 0 |
| Turn Type | Perm | NA | NA | | Prot | |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | | | |
| Minimum Split (s) | 22.5 | 22.5 | 22.5 | | 22.5 | |
| Total Split (s) | 63.0 | 63.0 | 63.0 | | 27.0 | |
| Total Split (%) | 70.0% | 70.0% | 70.0% | | 30.0% | |
| Yellow Time (s) | 3.5 | 3.5 | 3.5 | | 3.5 | |
| All-Red Time (s) | 1.0 | 1.0 | 1.0 | | 1.0 | |
| Lost Time Adjust (s) | 0.0 | 0.0 | 0.0 | | 0.0 | |
| Total Lost Time (s) | 4.5 | 4.5 | 4.5 | | 4.5 | |
| Lead/Lag | | | | | | |
| Lead-Lag Optimize? | | | | | | |
| Act Effct Green (s) | 58.5 | 58.5 | 58.5 | | 22.5 | |
| Actuated g/C Ratio | 0.65 | 0.65 | 0.65 | | 0.25 | |
| v/c Ratio | 0.62 | 0.49 | 0.46 | | 0.58 | |
| Control Delay | 16.3 | 9.8 | 8.6 | | 29.5 | |
| Queue Delay | 0.0 | 0.0 | 0.0 | | 0.0 | |
| Total Delay | 16.3 | 9.8 | 8.6 | | 29.5 | |
| LOS | B | A | A | | C | |
| Approach Delay | | 11.9 | 8.6 | | 29.5 | |
| Approach LOS | | B | A | | C | |
| Queue Length 50th (m) | 26.4 | 47.4 | 36.4 | | 32.6 | |
| Queue Length 95th (m) | 54.6 | 70.1 | 56.3 | | 57.0 | |
| Internal Link Dist (m) | | 36.3 | 227.8 | | 273.7 | |
| Turn Bay Length (m) | | | | | | |
| Base Capacity (vph) | 474 | 1223 | 1160 | | 461 | |
| Starvation Cap Reductn | 0 | 0 | 0 | | 0 | |
| Spillback Cap Reductn | 0 | 0 | 0 | | 0 | |
| Storage Cap Reductn | 0 | 0 | 0 | | 0 | |
| Reduced v/c Ratio | 0.62 | 0.49 | 0.46 | | 0.58 | |

Intersection Summary

Area Type: Other

NAC Expansion TIA - Synchro 9 Report

1: Niaqunngusiariaq & Saputi

8/2/2017

Cycle Length: 90

Actuated Cycle Length: 90

Offset: 0 (0%), Referenced to phase 2: and 6:SBL, Start of Green

Natural Cycle: 60

Control Type: Pretimed

Maximum v/c Ratio: 0.62

Intersection Signal Delay: 13.7

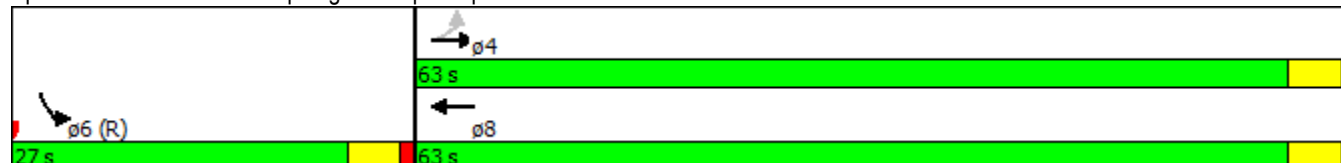
Intersection LOS: B

















Intersection Capacity Utilization 68.8%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Niaqunngusiariaq & Saputi



| |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------|---|---|---|---|---|---|--|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | |  | | |  | | |  | | |  | |
| Traffic Volume (vph) | 148 | 142 | 108 | 17 | 200 | 120 | 180 | 177 | 11 | 83 | 111 | 132 |
| Future Volume (vph) | 148 | 142 | 108 | 17 | 200 | 120 | 180 | 177 | 11 | 83 | 111 | 132 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Satd. Flow (prot) | 0 | 1781 | 0 | 0 | 1789 | 0 | 0 | 1831 | 0 | 0 | 1757 | 0 |
| Flt Permitted | | 0.719 | | | 0.972 | | | 0.671 | | | 0.839 | |
| Satd. Flow (perm) | 0 | 1304 | 0 | 0 | 1743 | 0 | 0 | 1259 | 0 | 0 | 1493 | 0 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 45 | | | 68 | | | 4 | | | 83 | |
| Link Speed (k/h) | | 40 | | | 40 | | | 30 | | | 30 | |
| Link Distance (m) | | 253.4 | | | 433.7 | | | 225.4 | | | 225.6 | |
| Travel Time (s) | | 22.8 | | | 39.0 | | | 27.0 | | | 27.1 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 432 | 0 | 0 | 365 | 0 | 0 | 400 | 0 | 0 | 354 | 0 |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Minimum Split (s) | 22.5 | 22.5 | | 22.5 | 22.5 | | 22.5 | 22.5 | | 22.5 | 22.5 | |
| Total Split (s) | 25.0 | 25.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | | 25.0 | 25.0 | |
| Total Split (%) | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | |
| Yellow Time (s) | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | | 3.5 | 3.5 | |
| All-Red Time (s) | 1.0 | 1.0 | | 1.0 | 1.0 | | 1.0 | 1.0 | | 1.0 | 1.0 | |
| Lost Time Adjust (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Total Lost Time (s) | | 4.5 | | | 4.5 | | | 4.5 | | | 4.5 | |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Act Effct Green (s) | | 20.5 | | | 20.5 | | | 20.5 | | | 20.5 | |
| Actuated g/C Ratio | | 0.41 | | | 0.41 | | | 0.41 | | | 0.41 | |
| v/c Ratio | | 0.77 | | | 0.48 | | | 0.77 | | | 0.54 | |
| Control Delay | | 23.7 | | | 11.3 | | | 26.1 | | | 12.0 | |
| Queue Delay | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Total Delay | | 23.7 | | | 11.3 | | | 26.1 | | | 12.0 | |
| LOS | | C | | | B | | | C | | | B | |
| Approach Delay | | 23.7 | | | 11.3 | | | 26.1 | | | 12.0 | |
| Approach LOS | | C | | | B | | | C | | | B | |
| Queue Length 50th (m) | | 27.9 | | | 17.8 | | | 28.7 | | | 16.4 | |
| Queue Length 95th (m) | | #69.8 | | | 35.6 | | | #68.9 | | | 35.7 | |
| Internal Link Dist (m) | | 229.4 | | | 409.7 | | | 201.4 | | | 201.6 | |
| Turn Bay Length (m) | | | | | | | | | | | | |
| Base Capacity (vph) | | 561 | | | 754 | | | 518 | | | 661 | |
| Starvation Cap Reductn | | 0 | | | 0 | | | 0 | | | 0 | |
| Spillback Cap Reductn | | 0 | | | 0 | | | 0 | | | 0 | |
| Storage Cap Reductn | | 0 | | | 0 | | | 0 | | | 0 | |
| Reduced v/c Ratio | | 0.77 | | | 0.48 | | | 0.77 | | | 0.54 | |
| Intersection Summary | | | | | | | | | | | | |
| Area Type: | Other | | | | | | | | | | | |
| Cycle Length: 50 | | | | | | | | | | | | |

NAC Expansion TIA - Synchro 9 Report

4: Federal Road & Niaqunngusiariaq

8/2/2017

Actuated Cycle Length: 50

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 45

Control Type: Pretimed

Maximum v/c Ratio: 0.77

Intersection Signal Delay: 18.7

Intersection LOS: B

Intersection Capacity Utilization 88.8%

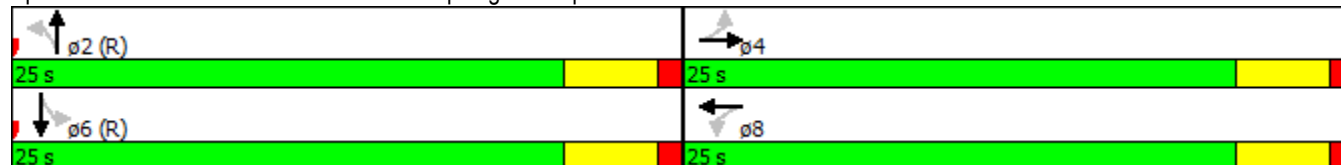
ICU Level of Service E

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

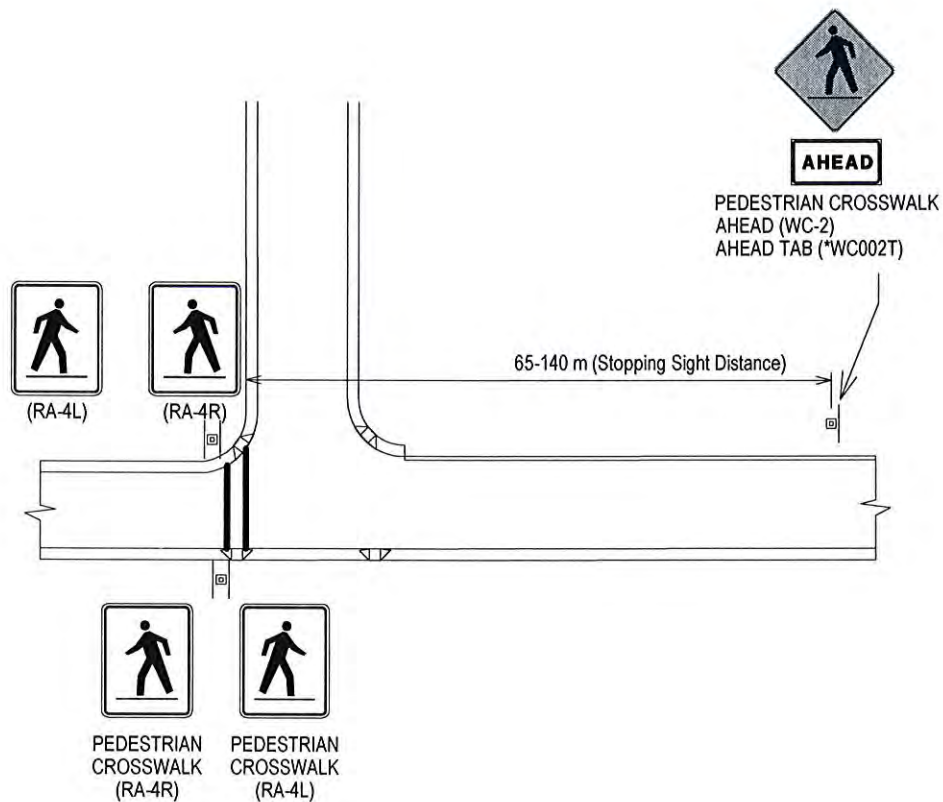
Splits and Phases: 4: Federal Road & Niaqunngusiariaq



August 3, 2017

Appendix D

PEDESTRIAN CROSSING GUIDELINES



RA-4 Sign Placement Priority:

1. Mount RA-4R just in advance of the ramp for the nearest lane of approaching motorists, with RA-4L facing the opposite direction.
2. Mount RA-4R just after the ramp when required to minimize offset and improve visibility, with RA-4L facing the opposite direction.

WC-2 Sign and Ahead Tab Placement:


1. Mount at stopping sight distance from the nearest crosswalk line, if the RA-4 signs are not visible at that distance.

Height:

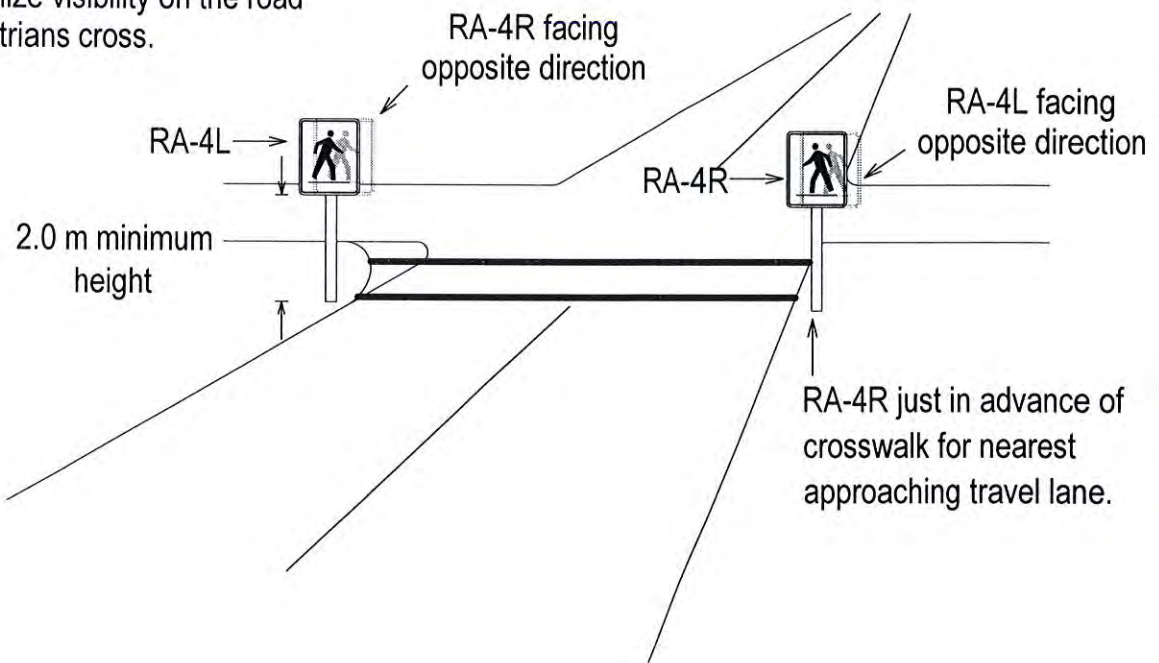
1. Lowest sign should be at least 2.0 m high. 2.0 m to 3.0 m is the ideal sign height.


Offset:

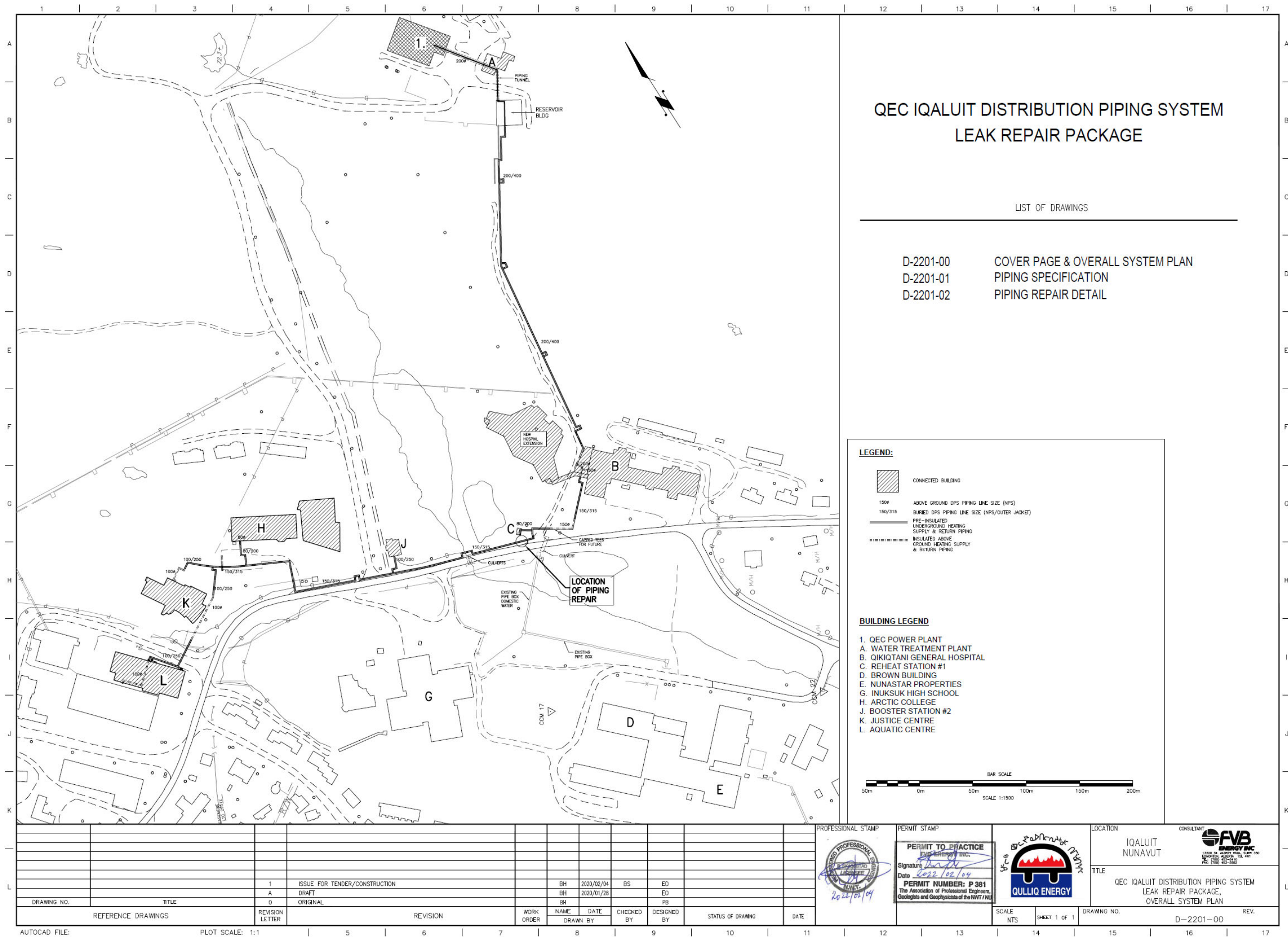
1. Lateral placement should be 0.3 m to 2.0 m from face of curb.

| | | | THE CITY OF RED DEER ENGINEERING DEPARTMENT | | |
|-----|------|----------|--|--|---|
| | | | DRAWN BY: | DESIGN GUIDELINE DRAWINGS SIGN PLACEMENT PEDESTRIAN CROSSWALK WARNING SIGN PLACEMENT | APPROVED BY: |
| | | | R.S. | |  |
| | | | DATE: | | ENGINEER |
| | | | APR. 2016 | | DRAWING NO. |
| | | | SCALE: | | 8.54 |
| | | | N.T.S. | | |
| NO. | DATE | REVISION | | | |

If the offset from the face of curb is too large before the crosswalk, place signs just after the crosswalk. Target offset 0.3 m to 2.0 m to maximize visibility on the road pedestrians cross.



| | | | | | | |
|-----|------|----------|--|---|---|---------------------|
| | | | THE CITY OF RED DEER ENGINEERING DEPARTMENT | | | |
| | | | DRAWN BY: R.S. | DESIGN GUIDELINE DRAWINGS SIGN PLACEMENT | APPROVED BY:  | |
| | | | DATE: APR. 2016 | | PEDESTRIAN CROSSWALK SIGNS FOR LOCAL AND COLLECTOR (UNDIVIDED) ROADS | ENGINEER |
| | | | SCALE: N.T.S. | | | DRAWING NO. 8.55 |
| NO. | DATE | REVISION | | | | |



QEC IQALUIT DISTRIBUTION PIPING SYSTEM
LEAK REPAIR PACKAGE

LIST OF DRAWINGS

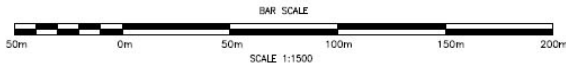
| | |
|-----------|----------------------------------|
| D-2201-00 | COVER PAGE & OVERALL SYSTEM PLAN |
| D-2201-01 | PIPING SPECIFICATION |
| D-2201-02 | PIPING REPAIR DETAIL |

LEGEND:

| | |
|---------|--|
| | CONNECTED BUILDING |
| 150W | ABOVE GROUND DPS PIPING LINE SIZE (NPS) |
| 150/315 | BURIED DPS PIPING LINE SIZE (NPS/OUTER JACKET) |
| | PPE-INSULATED UNDERGROUND HEATING SUPPLY & RETURN PIPING |
| | INSULATED ABOVE GROUND HEATING SUPPLY & RETURN PIPING |

BUILDING LEGEND

- 1. QEC POWER PLANT
- A. WATER TREATMENT PLANT
- B. OIKIQTANI GENERAL HOSPITAL
- C. REHEAT STATION #1
- D. BROWN BUILDING
- E. NUNASTAR PROPERTIES
- G. INUKSUK HIGH SCHOOL
- H. ARCTIC COLLEGE
- J. BOOSTER STATION #2
- K. JUSTICE CENTRE
- L. AQUATIC CENTRE



| DRAWING NO. | TITLE | REVISION LETTER | REVISION | WORK ORDER | NAME | DATE | CHECKED BY | DESIGNED BY | STATUS OF DRAWING | DATE |
|--------------------|-------|-----------------|-------------------------------|------------|------|------------|------------|-------------|-------------------|------|
| | | 1 | ISSUE FOR TENDER/CONSTRUCTION | | BH | 2020/02/04 | BS | ED | | |
| | | A | DRAFT | | BH | 2020/01/28 | | ED | | |
| | | O | ORIGINAL | | BH | | | PB | | |
| REFERENCE DRAWINGS | | | | | | | | | | |

PROFESSIONAL STAMP



PERMIT STAMP



LOCATION

IQALUIT
NUNAVUT

CONSULTANT



TITLE

QEC IQALUIT DISTRIBUTION PIPING SYSTEM
LEAK REPAIR PACKAGE,
OVERALL SYSTEM PLAN

SCALE

NTS

SHEET 1 OF 1

DRAWING NO.

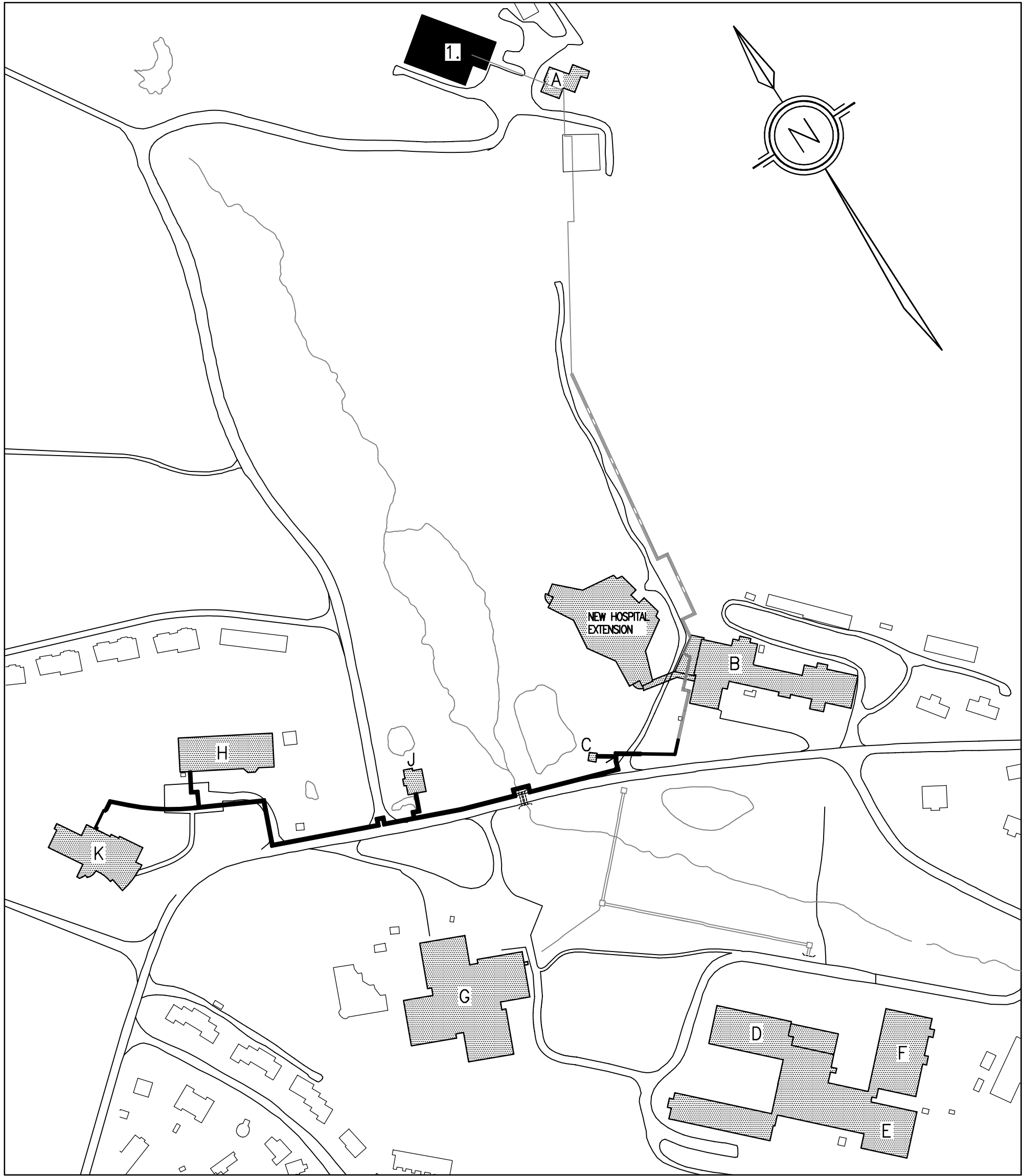
D-2201-00

REV.

AUTOCAD FILE:

PLOT SCALE: 1:1

IQALUIT, NUNAVUT EXTENSION OF RESIDUAL HEATING DISTRIBUTION SYSTEM AND ENERGY TRANSFER STATIONS



LIST OF DRAWINGS

| | |
|--------------|--|
| D-7307-01 | Distribution Plan, Keyplan |
| D-7307-02 | Distribution Plan + Profile, No. 1 |
| D-7307-03 | Distribution Plan + Profile, No. 2 |
| D-7307-04 | Distribution Plan + Profile, No. 3 |
| D-7307-05 | Distribution Plan + Profile, No. 4 |
| D-7307-06 | Distribution Piping Out Of Hospital |
| D-7307-07 | Gully In Front Of Hospital And Future Branch Connection |
| D-7307-08 | Justice Centre |
| D-7307-09 | Typical Details, No.1 |
| D-7307-10 | Typical Details, No.2 |
| ETS-7307-000 | Legend and General Notes |
| ETS-7307-001 | Control and Meter Architecture |
| ETS-7307-002 | Typical Installation Details |
| ETS-7307-003 | Hanger and Support Details |
| ETS-7307-100 | Building 'K' - Justice Building P + ID |
| ETS-7307-101 | Building 'K' - Justice Building Piping Layout and Sections |
| ETS-7307-102 | Building 'H' - Arctic College P + ID |
| ETS-7307-103 | Building 'H' - Arctic College Piping Layout and Sections |
| ETS-7307-104 | Building 'J' - Booster Station P + ID |
| ETS-7307-105 | Building 'J' - Booster Station Piping Layout and Sections |
| ETS-7307-106 | Building 'C' - Reheat Station P + ID |
| ETS-7307-107 | Building 'C' - Reheat Station Piping Layout and Sections |

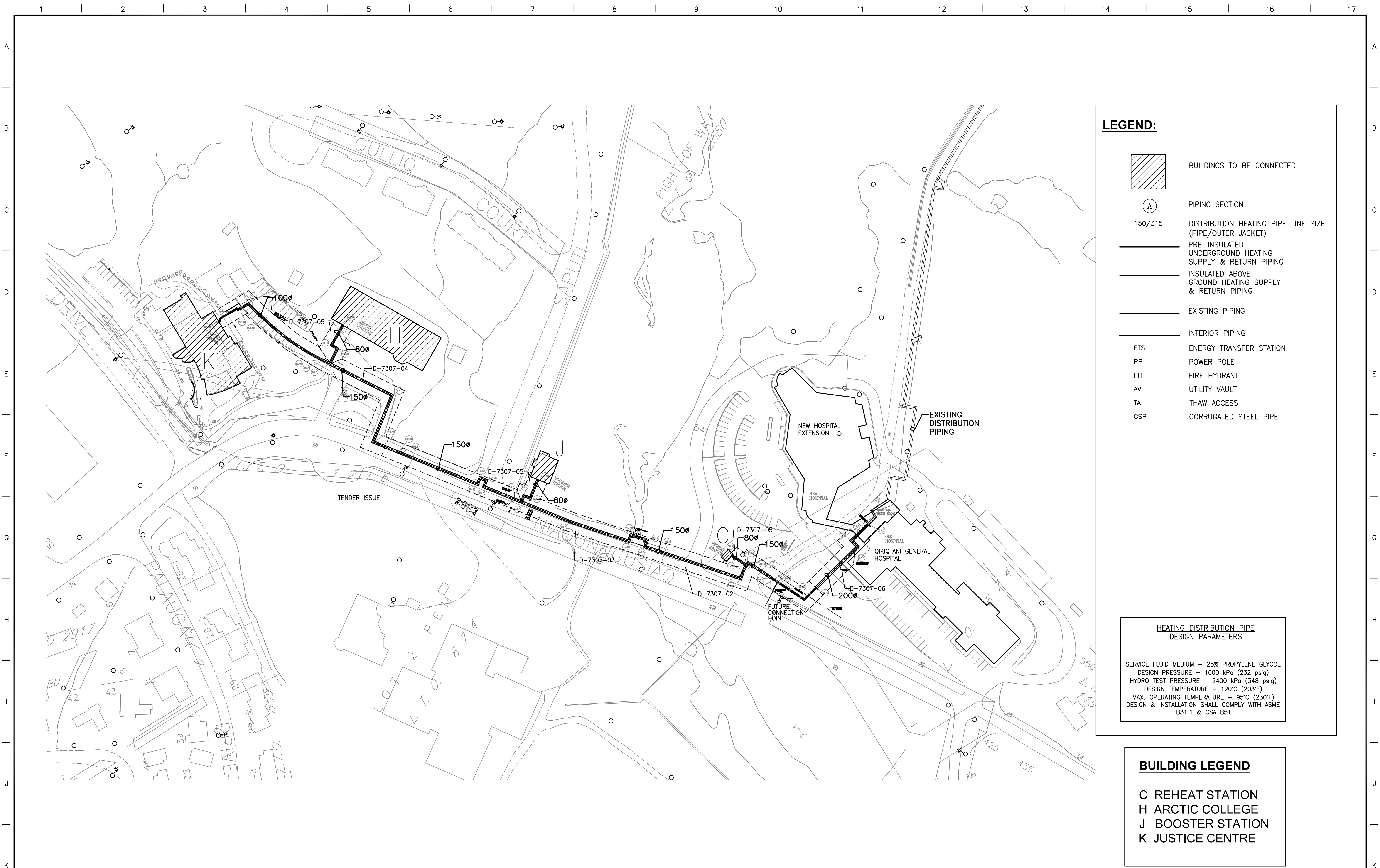
ISSUED FOR TENDER
APRIL 11, 2008

CONSULTANT



13220 ST. ALBERT TRAIL, SUITE 350
EDMONTON, ALBERTA T5L 4W1
TEL: (780) 453-3410
FAX: (780) 453-3682

SET NO: _____



LEGEND:

BUILDINGS TO BE CONNECTED

PIPING SECTION

150/315 DISTRIBUTION HEATING PIPE LINE SIZE (PIPE/OUTER JACKET)

PRE-INSULATED UNDERGROUND HEATING SUPPLY & RETURN PIPING

INSULATED ABOVE GROUND HEATING SUPPLY & RETURN PIPING

EXISTING PIPING

INTERIOR PIPING

ENERGY TRANSFER STATION

POWER POLE

FIRE HYDRANT

UTILITY VAULT

THAW ACCESS

CORRUGATED STEEL PIPE

HEATING DISTRIBUTION PIPE DESIGN PARAMETERS

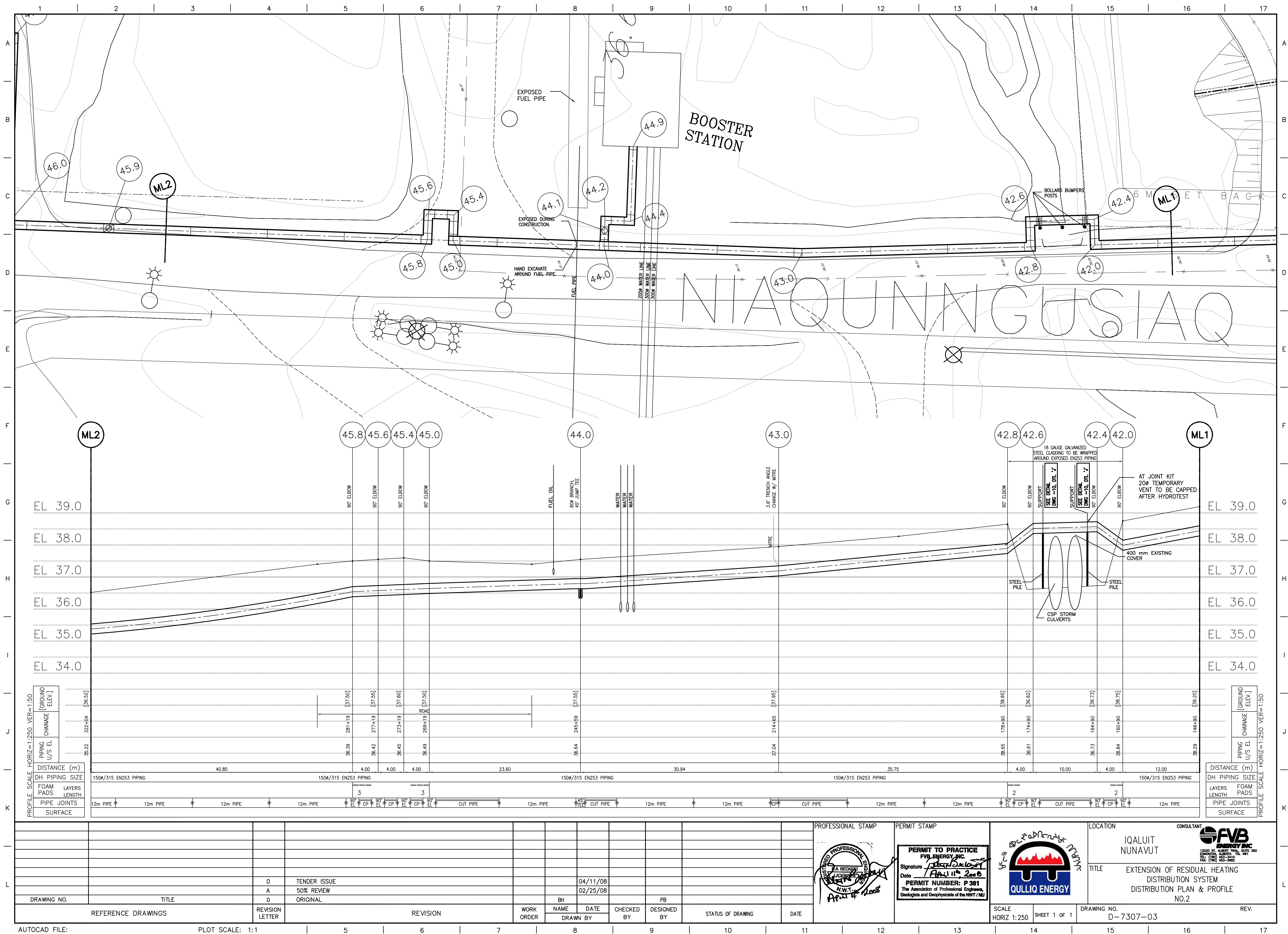
SERVICE FLUID MEDIUM – 25% PROPYLENE GLYCOL
DESIGN PRESSURE – 1600 kPa (232 psig)
HYDRO TEST PRESSURE – 2400 kPa (348 psig)
DESIGN TEMPERATURE – 120°C (203°F)
MAX. OPERATING TEMPERATURE – 95°C (203°F)
DESIGN & INSTALLATION SHALL COMPLY WITH ASME B31.1 & CSA B51

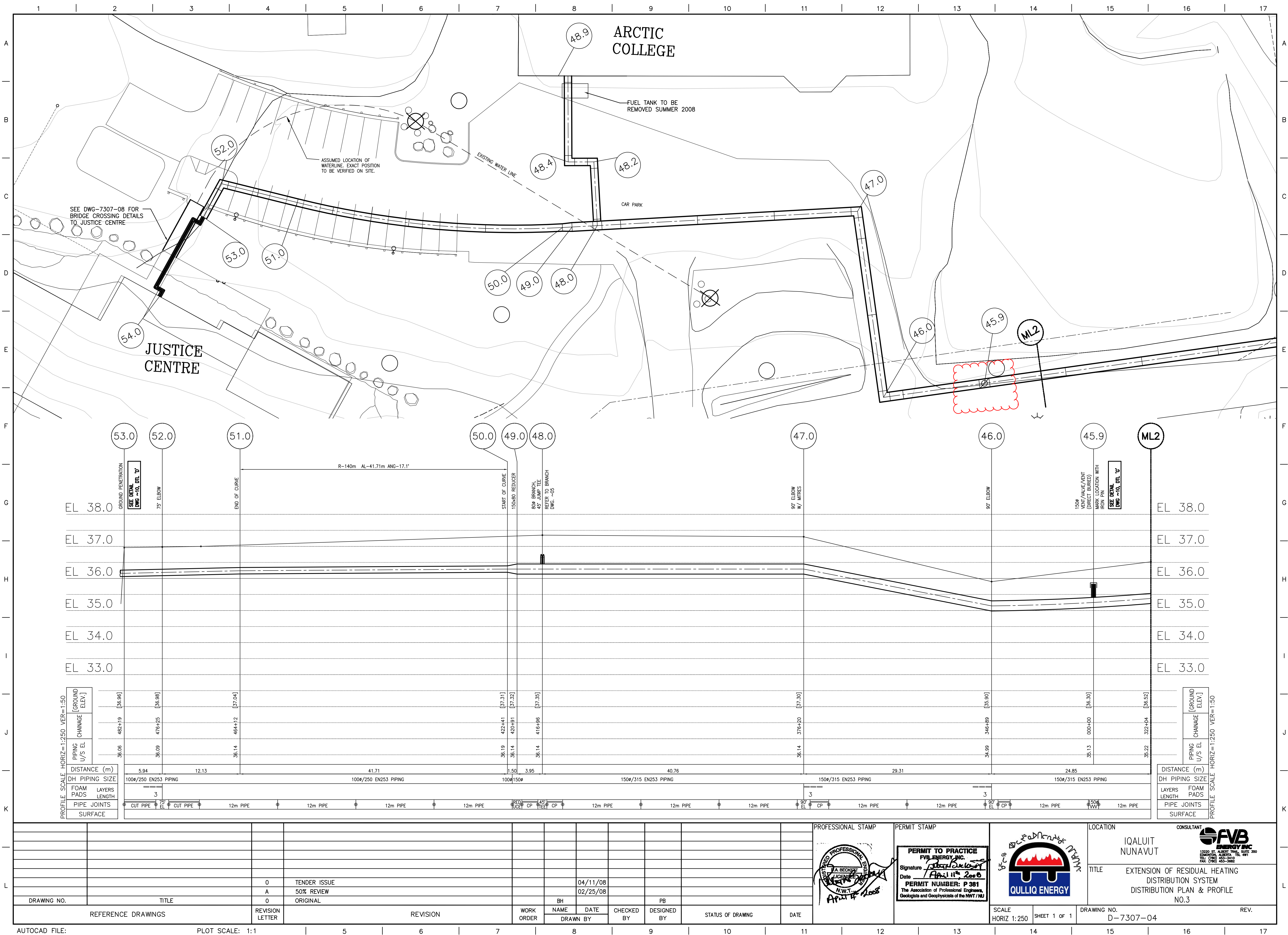
BUILDING LEGEND

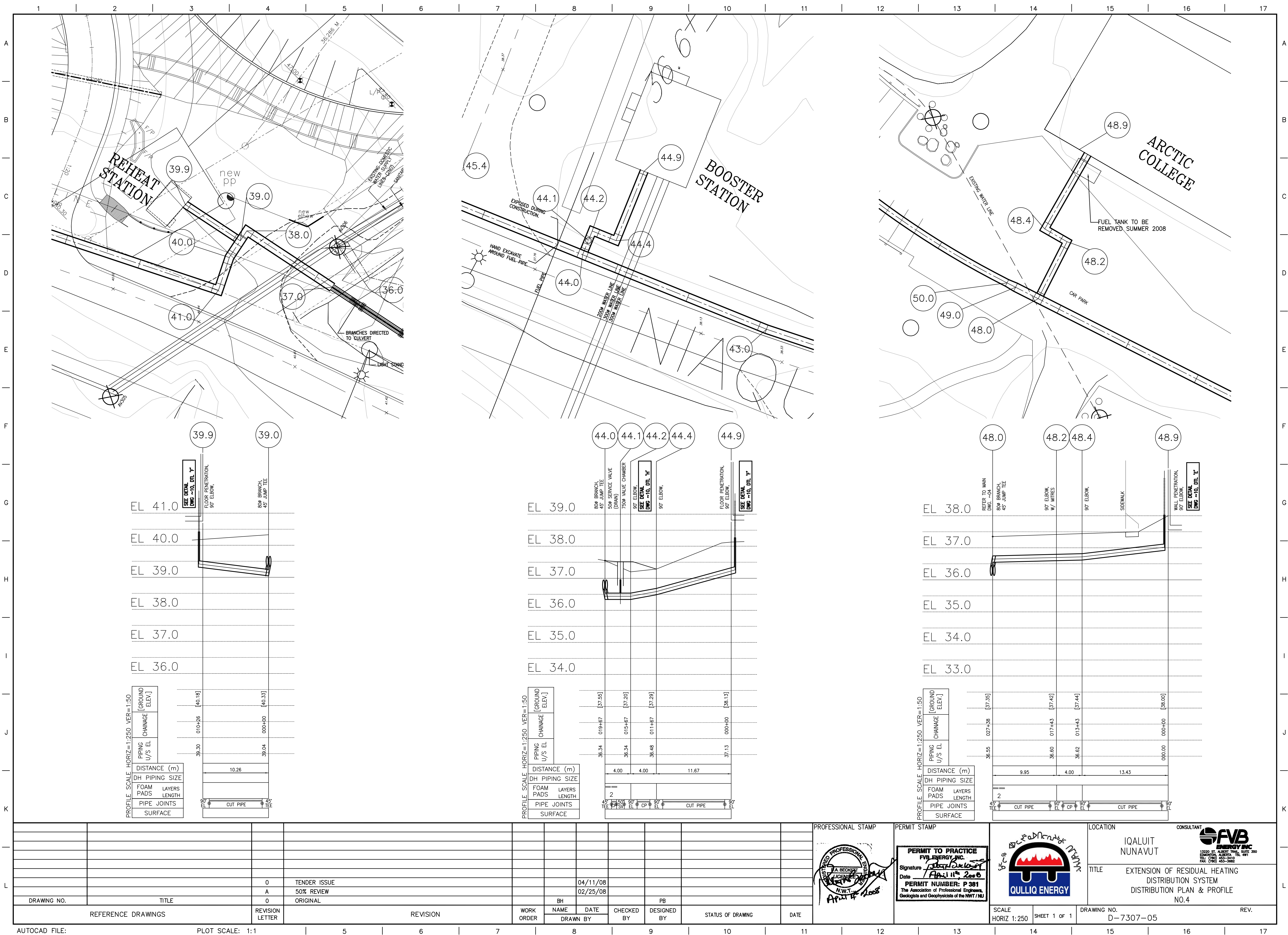
C REHEAT STATION
H ARCTIC COLLEGE
J BOOSTER STATION
K JUSTICE CENTRE

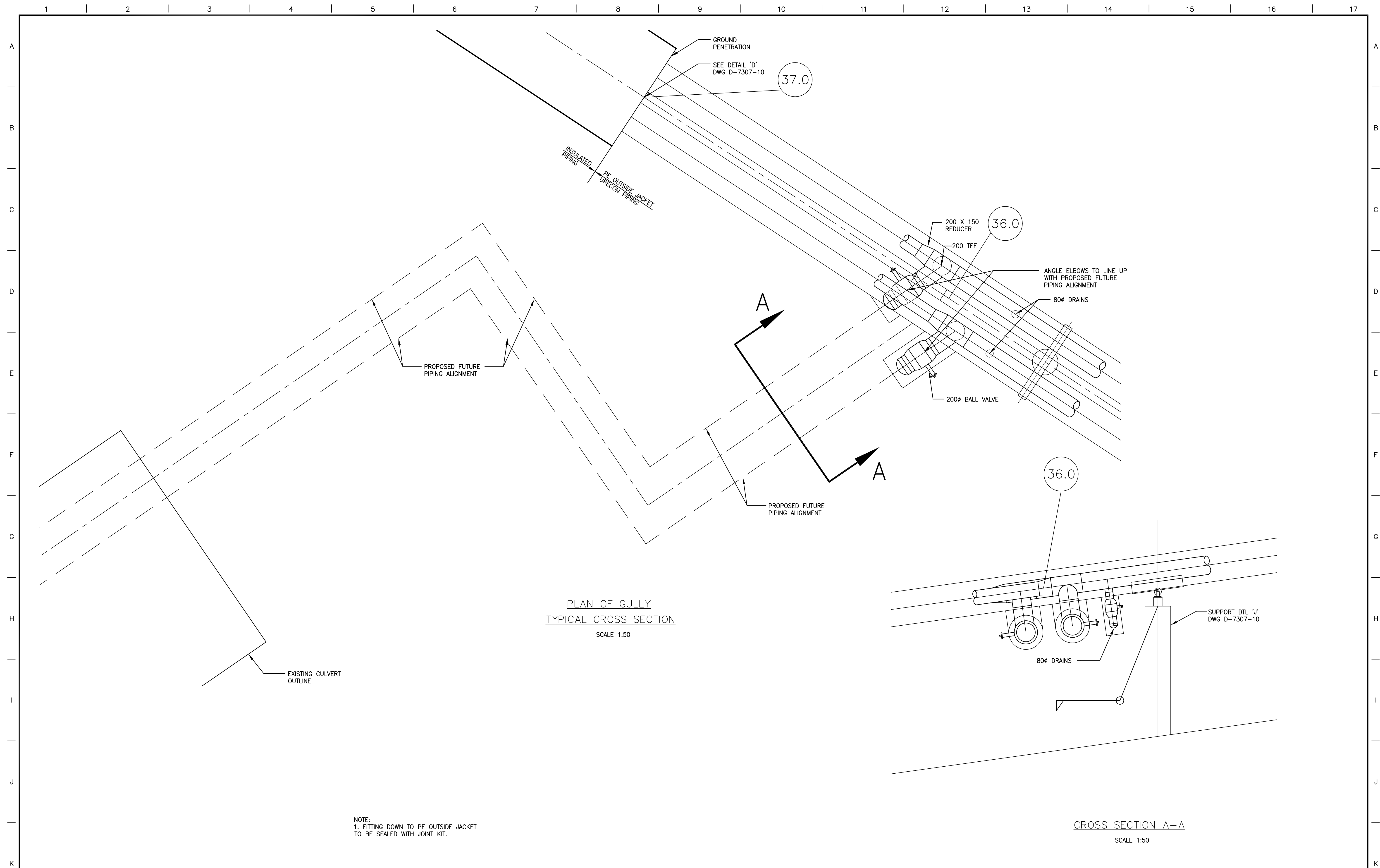
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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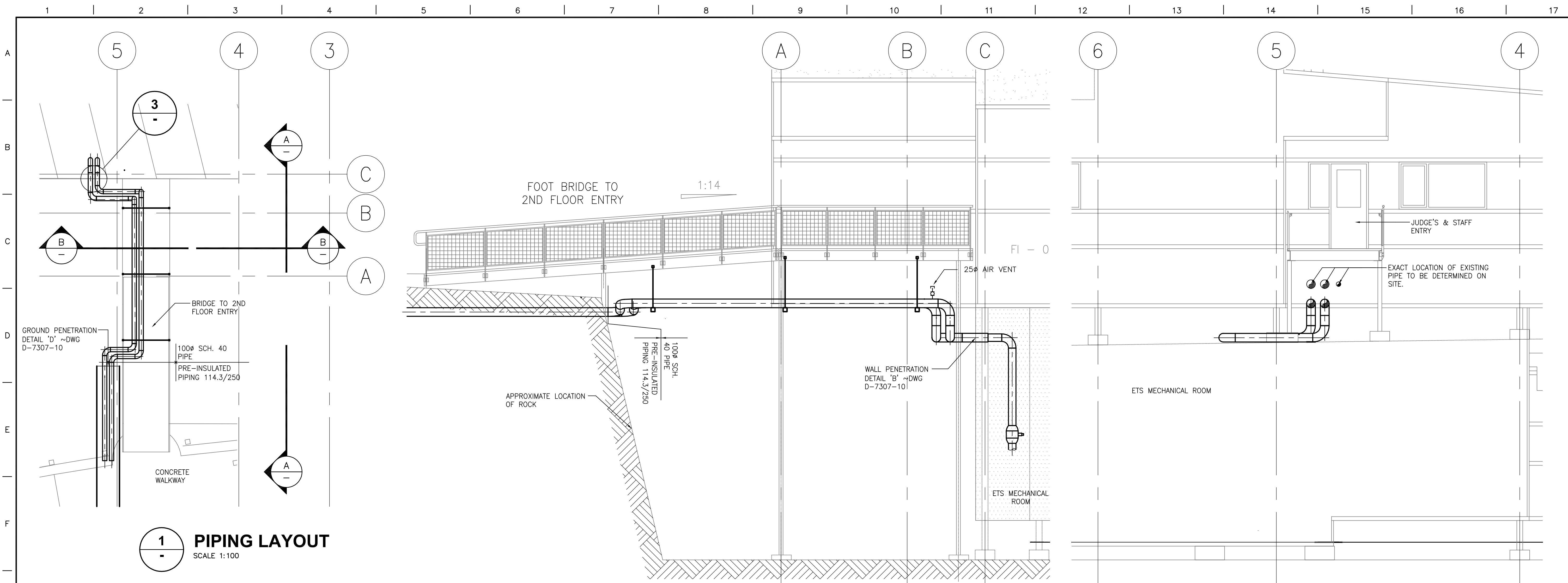








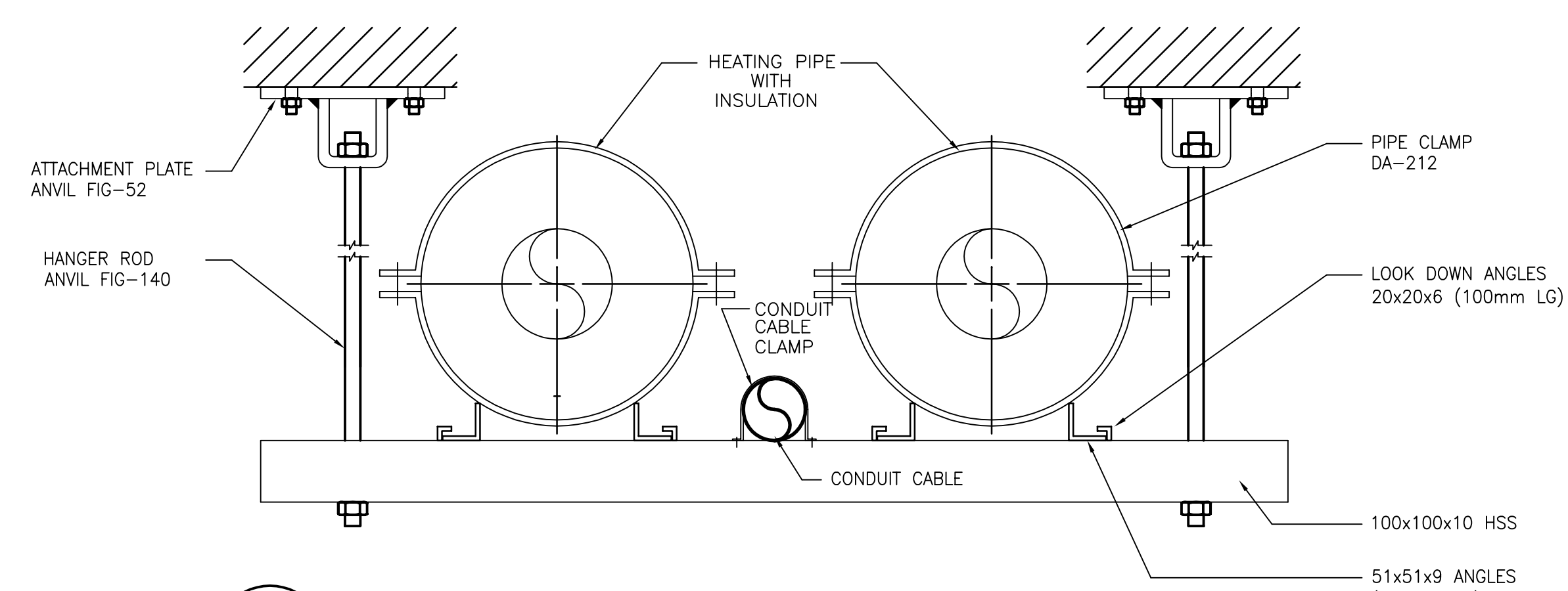
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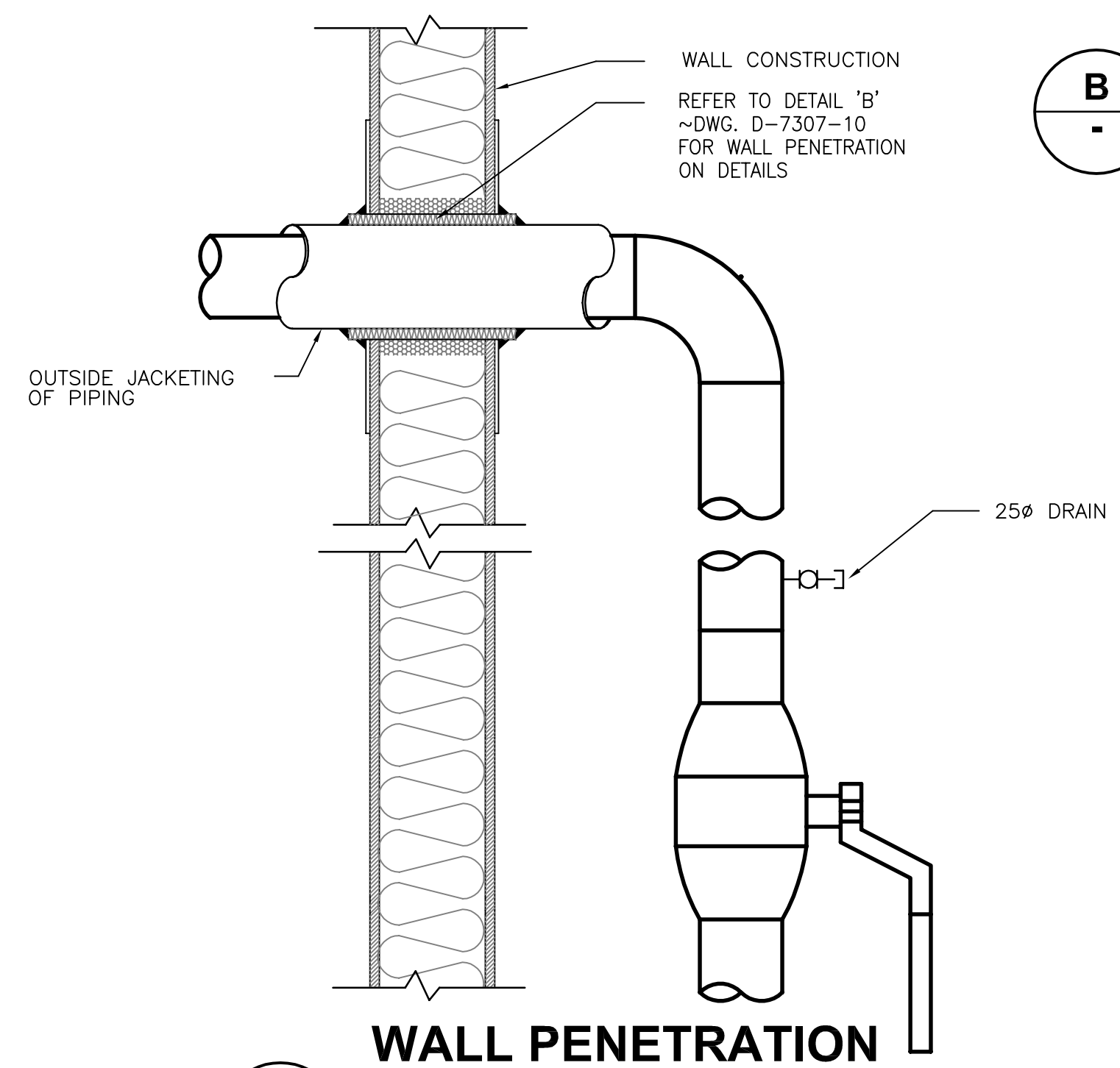
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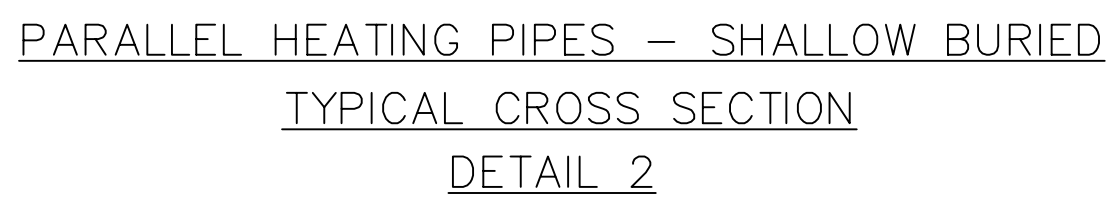
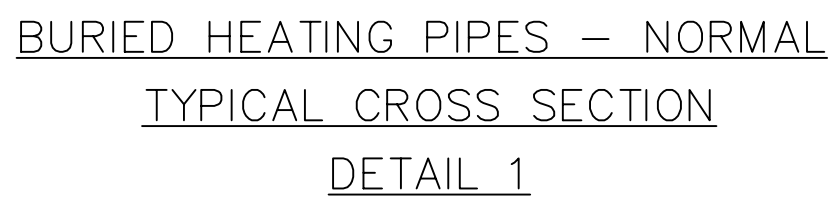



3 WALL PENETRATION DETAIL
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NOTES:


1. - ALL REINSTATEMENT TO MEET SPECIFICATION & LOCAL AUTHORITY REQUIREMENTS.
 - REINSTATE GRADE TO MATCH EXISTING CONDITIONS.
2. - INSTALL WARNING TAPES ABOVE PIPES.
3. - EXCAVATION SIDES AS PER OCCUPATIONAL HEALTH AND SAFETY STANDARDS.
4. - APPROVED SELECTED BACK FILL MATERIAL FROM EXCAVATION & APPROVED SOURCES.
5. - APPROVED SAND BEDDING AND SURROUND COMPACTED TO 95% STANDARD PROCTOR DENSITY (SPD) AS PER SPECIFICATION.
6. - 4 #18 TWISTED PAIR SHIELDED & ARMoured SHIELDED ARMoured CABLE.
7. - PRE-INSULATED HEATING PIPE - 600mm MINIMUM COVER. (EN 253 SERIES 3 BY LOGSTOR)



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| <p>PROFESSIONAL STAMP</p>  <p><i>F.A. Beckert</i> <i>Nov 11th 2008</i></p> | <p>PERMIT STAMP</p> <p>PERMIT TO PRACTICE PVE ENERGY INC.</p> <p>Signature <i>F.A. Beckert</i> Date <i>April 11th 2008</i></p> <p>PERMIT NUMBER: P 381 The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU</p> |
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DETAIL 'A'
HOSPITAL GROUND PENETRATION
— TYPICAL —
NTS

DETAIL 'B'
TYPICAL WALL PENETRATION
FOR PIPES THRU INSULATED
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DETAIL 'D'
DISTRIBUTION PIPING GROUND PENETRATION
— TYPICAL —
NTS

NOTES DETAILS A, E, F, D:

1. ALL WELDED JOINTS FROM PRE-INSULATED (THIN-WALL) PIPING TO SCH40 (STANDARD) WALL PIPING, GRIND SCH40 PIPE AT 1:3 RATIO TILL WALL MATCHES PRE-INSULATED (THIN-WALL) PIPE WALL. REF: PIPE WELDING SPECIFICATION SECTION 15051 PAR. 3.1 TO B 3.1.1.
2. ALL PIPING PASSING UNDER BUILDING SHALL ENTER OR EXIT GROUND UNDER THE BUILDING.
3. WRAP EMT SHREK HOT MELT TAPE FROM PRE-INSULATED JACKET UNDER ALUMINUM CLADDING. ALUMINUM CLADDING TO BE SUPPLIED BY CONTRACTOR.
4. NO WELDING SHALL TAKE PLACE UNDER BUILDINGS.

DETAIL 'E'
GROUND PENETRATION AT ARTIC COLLEGE
— TYPICAL —
NTS

DETAIL 'F'
GROUND PENETRATION UNDER BUILDING
— TYPICAL —
NTS

DETAIL 'J'
ABOVE GROUND RACK TYPE SUPPORT
NTS

DETAIL 'G'
DIRECT BURIED HEATING ISOLATION
VALVE & VENT ASSEMBLY ACCESS
— TYPICAL —
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DETAIL 'H'
50Ø VENT ASSEMBLY ACCESS
- TYPICAL -
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DETAIL 'I'
BURIED END CAP DETAIL
— TYPICAL —
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17

GENERAL NOTES FOR INTERIOR PIPING

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE INSTALLATION, START UP, AND COMMISSIONING OF THE OWNER SUPPLIED EQUIPMENT.

2. ABSOLUTELY NO FLUSHING THROUGH HEAT EXCHANGERS OR ENERGY METERS ON THE PRIMARY OR SECONDARY SYSTEM.

3. ABSOLUTELY NO WELDING TO THE HEAT EXCHANGER UNITS.

4. THE GENERAL CONTRACTOR WILL PROVIDE FOR THE INSTALLATION OF THE HEAT EXCHANGER CONCRETE HOUSEKEEPING PADS (INDICATED IN LAYOUT DRAWING). FOR LIFTING THE HEAT EXCHANGERS ONTO THE PADS THE GENERAL CONTRACTOR IS ALSO RESPONSIBLE.

5. THE DESIGN AND INSTALLATION OF THE DISTRICT HEATING AND DISTRICT COOLING (PRIMARY) PIPING SHALL COMPLY WITH THE ASME B31.1 CODE FOR POWER PIPING AND CSA B51.

6. THE DESIGN AND INSTALLATION OF THE BUILDING (SECONDARY) SIDE HEATING AND COOLING PIPING SHALL COMPLY WITH THE APPLICABLE CODE (BY OTHERS).

7. CONTRACTOR TO ENSURE THAT THE SPECIFIED STRAINER MESH SIZE IS INSTALLED PRIOR TO START-UP. FLUSH STRAINER TO BE USED.

8. PERFORM HYDROSTATIC TESTING ON ALL PIPING AT 1.5 x MAXIMUM OPERATING PRESSURE.

9. FOR A COMPLETE DESCRIPTION OF ALL PIPE FITTINGS AND VALVES REFER TO CONTRACT SPECIFICATION.

10. INSTALL MANUAL AIR VENTS AT ALL HIGH POINTS AND DRAIN VALVES AT ALL LOW POINTS. REFER TO SECTION 15010 FOR PROPER VENT AND VALVE INSTALLATION PROCEDURES.

11. PIPE PRESSURE RELIEF VALVES DOWN TO WITHIN 150mm OF THE FLOOR.

12. COORDINATE LOCATION OF PIPING INSTALLATION WITH THE OTHER TRADES TO AVOID INTERFERENCES.

13. MAKE ALLOWANCES FOR FIELD RUNNING OF PIPE TO AVOID OTHER PIPING, DUCTWORK LIGHTING, UTILITIES ETC. ROUTING IS SHOWN AS A GUIDELINE ONLY.

14. COORDINATE THE LOCATION OF THE ELECTRICAL SUPPLY FOR THE CONTROLS WITH OTHER TRADES.

15. THE OUTDOOR AIR TEMPERATURE (OAT) SENSOR INSTALLATION SHALL BE BY CONTRACTOR. SENSOR (OAT) TO BE LOCATED IN A SHADED AREA WITH NO DIRECT SUN EXPOSURE (PREFERABLY ON A NORTH FACING WALL). INSTALLATION OF CONDUIT FOR OUTDOOR AMBIENT TEMPERATURE (OAT) SENSOR TO THE ETS ROOM IS BY CONTRACTOR.

16. VERIFY FINAL LOCATION OF THE OUTDOOR SENSOR WITH CONSULTANT.

17. CONTROL PANELS TO BE MOUNTED AS IDENTIFIED ON THE PLAN LAYOUT DRAWING, OR AS COORDINATED WITH CONSULTANT.

18. CONNECT ELECTRICAL POWER DEDICATED EXISTING ELECTRICAL PANEL WITHIN THE MECHANICAL ROOM.

19. RUN WIRE TO FIELD DEVICES, AND FOR WIRING THE CONTROL PANEL TERMINATIONS.

20. ALL ELECTRICAL AND CONDUIT CABLING SHALL BE INSTALLED IN EMT CONDUIT (MIN. 20mmø) AND AS PER SPECIFICATION.

21. INSTALL PIPE SUPPORTS TO CONFORM WITH MAXIMUM SUPPORT SPAN AND LOAD TABLE. EXCEPTION: SUPPORTS FOR EQUIPMENT AND HEAT EXCHANGER OUTLETS.

22. SUPPORT PIPING IMMEDIATELY AT HEAT EXCHANGER OUTLETS VIA STANCHIONS OR HANGERS. PROVIDE ADDITIONAL SUPPORT FOR EQUIPMENT (i.e. STRAINER, CONTROL VALVE, FLOWMETER ETC.)

23. ALL HANGER AND SUPPORT FIGURE NUMBERS REFER TO THE ANVIL (FORMERLY GRINNELL) PRODUCT CATALOG.

24. INSTALLATION AND WIRING OF TEMPERATURE SENSORS AND THERMOSENSORS IS ALSO INDICATED IN THIS CONTRACT. SECONDARY SIDE CONTRACTOR WILL PROVIDE 1/2" (OR 3/4") THREDOLETS FOR INSTALLATION OF THE SENSORS.

25. ALL DRAWINGS TO BE READ IN CONJUNCTION WITH CONSTRUCTION SPECIFICATIONS.

26. DENOTES EQUIPMENT SUPPLIED BY OWNER AND INSTALLED BY THE CONTRACTOR.

INSTRUMENTATION LEGEND

| | |
|--|--|
| | BALANCING VALVE |
| | DIFFERENTIAL PRESSURE SENSOR/TRANSMITTER |
| | DIFFERENTIAL PRESSURE SWITCH |
| | FLOW METER |
| | FLOW METER INDICATOR & TRANSMITTER |
| | CONTROL VALVE |
| | PRESSURE INDICATOR |
| | PRESSURE TRANSMITTER |
| | TEMPERATURE ELEMENT |
| | TEMPERATURE INDICATOR |
| | TEMPERATURE SWITCH |
| | TEMPERATURE TRANSMITTER |
| | PRESSURE SAFETY/RELIEF VALVE |
| | PRESSURE REGULATING VALVE |
| | ENERGY METER |
| | VARIABLE FREQUENCY DRIVE |
| | PLANT CONTROLLER |
| | EQUIPMENT CONTROLLER |

PRIMARY PIPING

| | |
|-----|-------------------------|
| DHS | DISTRICT HEATING SUPPLY |
| DHR | DISTRICT HEATING RETURN |
| DCS | DISTRICT COOLING SUPPLY |
| DCR | DISTRICT COOLING RETURN |

SECONDARY PIPING

| | |
|------|---------------------------|
| HWS | CUSTOMER HEATING SUPPLY |
| HWR | CUSTOMER HEATING RETURN |
| CWS | CUSTOMER COOLING SUPPLY |
| CWR | CUSTOMER COOLING RETURN |
| DHWS | DOMESTIC HOT WATER SUPPLY |
| DHWR | DOMESTIC HOT WATER RETURN |

DISTRICT HEATING PRIMARY DISTRIBUTION PIPE DESIGN PARAMETERS

SERVICE FLUID MEDIUM – 25% PROPYLENE GLYCOL
DESIGN PRESSURE – 1600kPa (232psig)
HYDRO TEST PRESSURE – 2400kPa (348psig)
DESIGN TEMPERATURE – 120°C (248°F)
OVERPRESSURE PROTECTION –
AT THE DISTRICT ENERGY PLANT
DESIGN & INSTALLATION SHALL COMPLY WITH ASME B31.1 & CSA B51

SYMBOLS

| | |
|--|--|
| | SOLENOID VALVE; MOTORIZED VALVE |
| | CONTROL VALVE |
| | GLOBE VALVE |
| | BALL VALVE |
| | BUTTERFLY VALVE |
| | GATE VALVE |
| | CHECK VALVE |
| | THREE WAY VALVE |
| | NEEDLE VALVE |
| | CAP |
| | REDUCER |
| | FLEX CONNECTION |
| | COUPLING |
| | STRAINER |
| | TRAP |
| | CATHODIC ISOLATION FLANGES |
| | FLANGE |
| | UNION |
| | INSULATION |
| | TRANSFORMER |
| | SWITCH |
| | FLOW METER |
| | PUMP |
| | FLOW ARROW |
| | TIE-IN POINT |
| | PIPE BREAK |
| | DRAIN |
| | PRESSURE RELIEF/SAFETY VALVE |
| | AUTO AIR VENT |
| | VACUUM BREAKER |
| | MANUAL AIR VENT |
| | BASKET STRAINER |
| | MANUAL BALANCING VALVE C/W PRESS. TAPS |
| | FLOOR DRAIN |
| | HOSE COUPLING |
| | MECH. FLOAT AIR VENT |
| | PLUG VALVE |
| | PRESSURE REGULATOR |
| | SPECTACLE BLIND |
| | STARTUP STRAINER |
| | SWITCH |
| | THERMOSTATIC AIR VENT |
| | UNION CONNECTION |
| | VACUUM BREAKER |
| | VENT |

PROCESS LEGEND

| | |
|-----|----------------------------|
| AAV | AUTOMATIC AIR VENT |
| BF | BUTTERFLY VALVE |
| BL | BALL VALVE |
| CK | CHECK VALVE |
| ESV | EMERGENCY SHUTOFF VALVE |
| FC | FAIL CLOSE |
| FE | FLOW ELEMENT |
| FO | FAIL OPEN |
| FS | FLOW SWITCH; L=LOW, H=HIGH |
| GA | GATE VALVE |
| GL | GLOBE VALVE |
| HX | HEAT EXCHANGER |
| LCV | LEVEL CONTROL VALVE |
| LG | LEVEL GAUGE |
| M | ELECTRIC MOTOR |
| MOV | MOTOR OPERATED VALVE |
| NC | NORMALLY CLOSED |
| NO | NORMALLY OPEN |
| P | PUMP |
| PL | PLUG VALVE |
| PS | PRESSURE SWITCH |
| S | SENSOR |
| ST | STRAINER |
| SV | SOLENOID VALVE |
| TCV | TEMPERATURE CONTROL VALVE |
| TW | THERMOWELL |
| VSH | VIBRATION SWITCH |

EQUIPMENT TAGGING CONVENTION

HX – * 1

SEQUENCE NUMBER

BUILDING IDENTIFICATION

(AS PER PROCESS LEGEND)

INSTRUMENTATION TAGGING CONVENTION

DEVICE TYPE
(AS PER PROCESS LEGEND)

SEQUENCE NUMBER

BUILDING IDENTIFICATION

LINE NUMBERING CONVENTION

(100-DHS-001-50)

INSULATION THICKNESS

LINE NUMBER

SERVICE

DHS – DISTRICT HEATING SUPPLY
DHR – DISTRICT HEATING RETURN

NOMINAL PIPE SIZE

PROCESS LEGEND

HX – *1

HEX

EQUIPMENT TAG
(AS PER EQUIPMENT TAG CONVENTION)

EQUIPMENT TAG
HEX – HEAT EXCHANGER
P – PUMP
CV – CONTROL VALVE

DRAWING NO.

TITLE

0

ISSUED FOR TENDER

A

ISSUED FOR 50% REVIEW

0

ORIGINAL

REFERENCE DRAWINGS

REVISION LETTER

REVISION

WORK ORDER

NAME

DATE

DRAWN BY

CHECKED BY

DESIGNED BY

STATUS OF DRAWING

DATE

PROFESSIONAL STAMP

PERMIT STAMP

SCALE

N.T.S.

SHEET 1 OF --

DRAWING NO.

ETS-7307-000

REV.

LOCATION

IQALUIT NUNAVUT

TITLE

EXTENSION OF RESIDUAL HEATING ENERGY TRANSFER STATION LEGEND AND GENERAL NOTES

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AUTOCAD FILE:

D-5281-06

PLOT SCALE: 1:1

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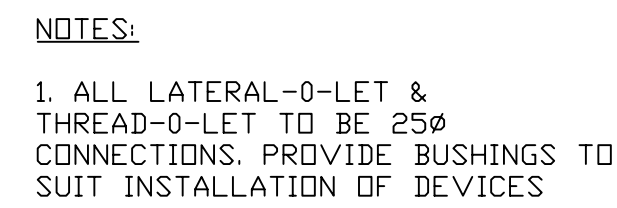
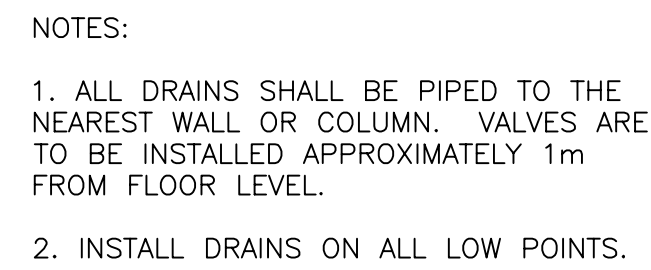
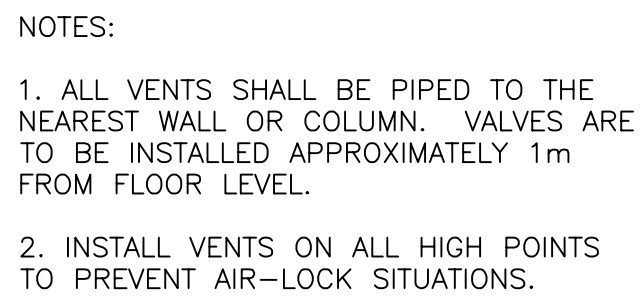
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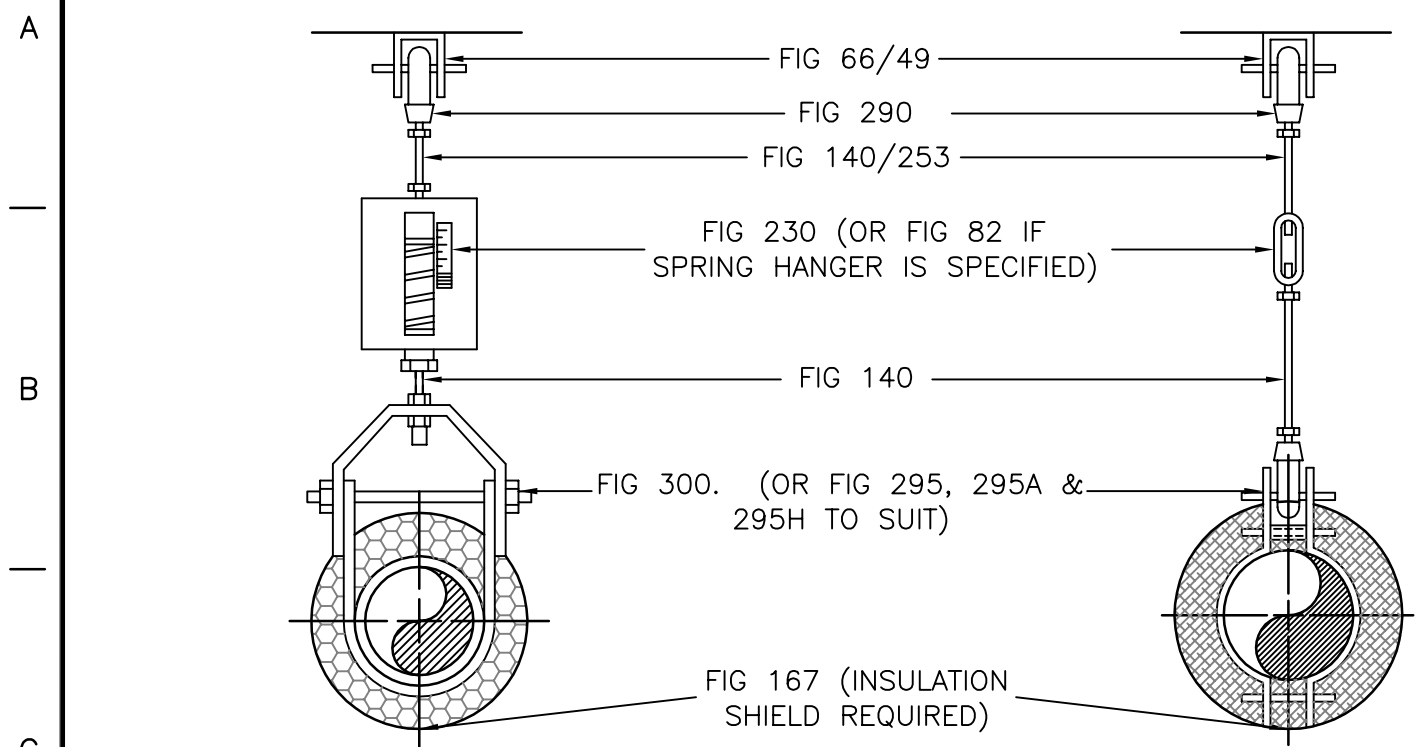
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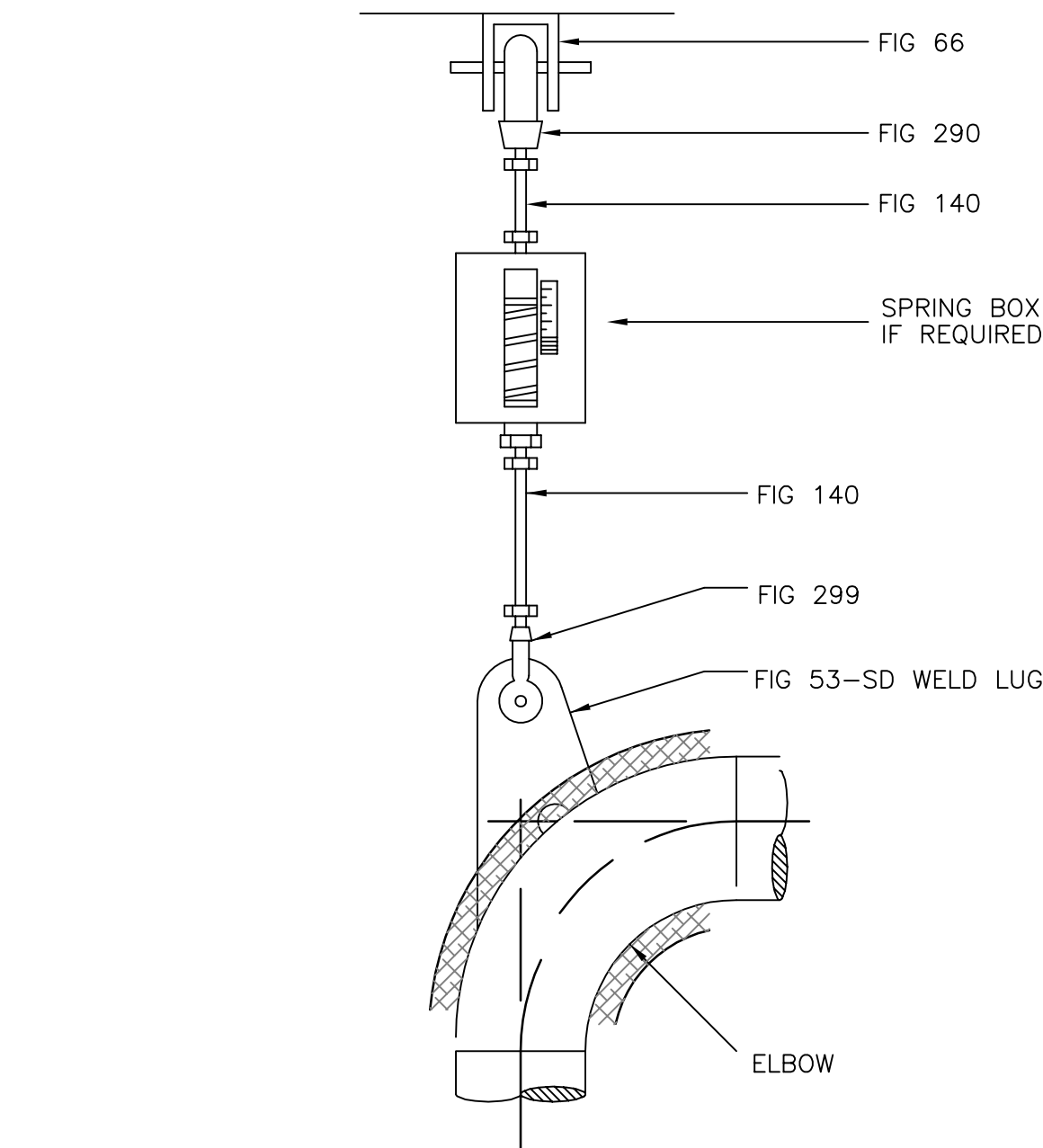
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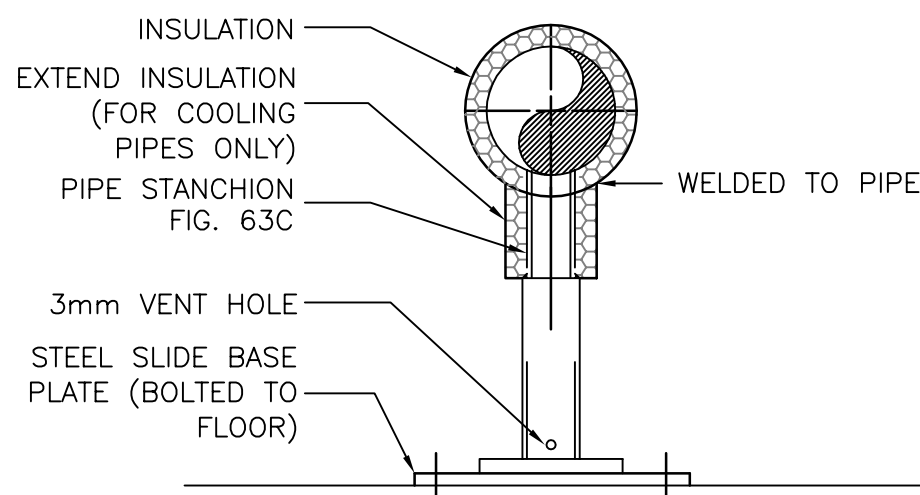
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TYPICAL SPRING HANGER SUPPORT (DISTRICT HEATING)
SCALE: NTS



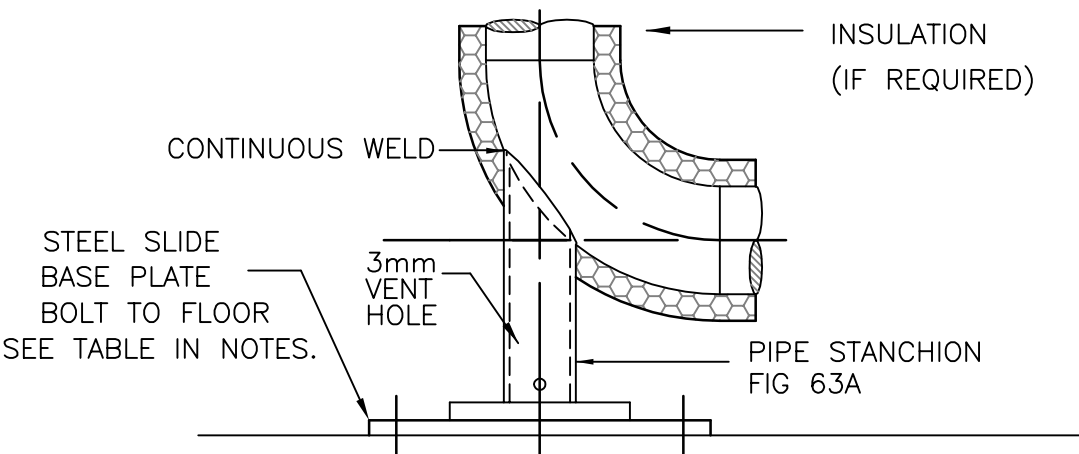
TYPICAL PIPING SUPPORT LUGGED ELBOW ROD HANGER
SCALE: NTS



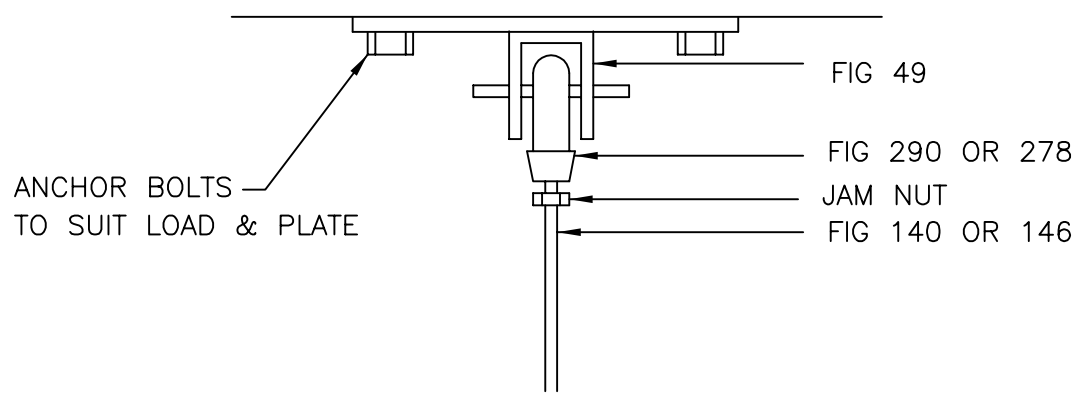
| Stanchion Size* | Base Plate Size* |
|-----------------|------------------|
| 250 | 450x450x12 |
| 200 | 350x350x9 |
| 150 | 250x250x9 |
| 125 | 250x250x9 |
| 100 | 200x200x9 |
| 80 | 200x200x9 |
| 50 | 150x150x9 |

*all dimensions are in millimeters

TYPICAL HORIZONTAL STANCHION W/ TYP STANCHION SCHEDULE
SCALE: NTS

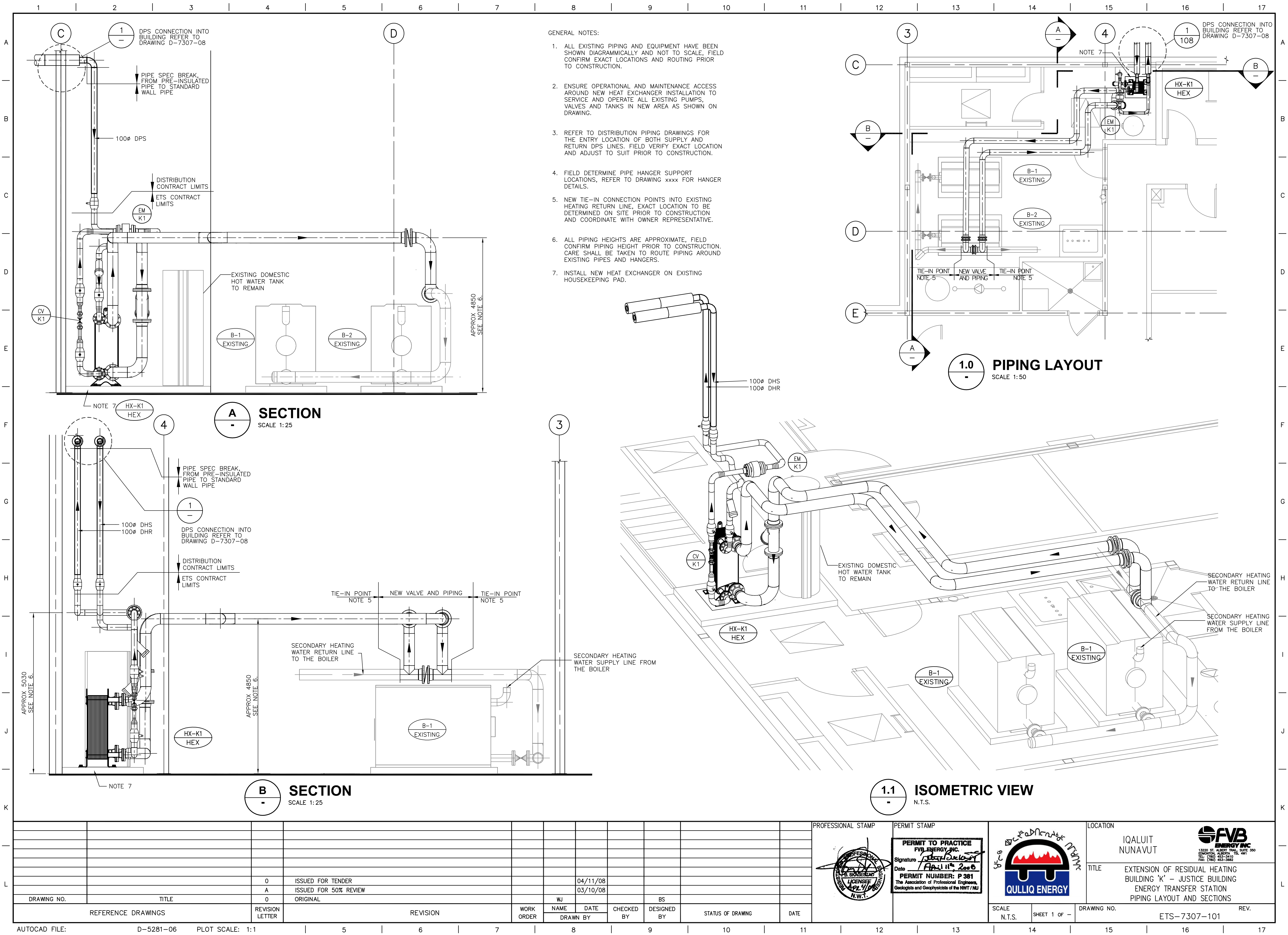


TYPICAL STANCHION ON ELBOW
SCALE: NTS

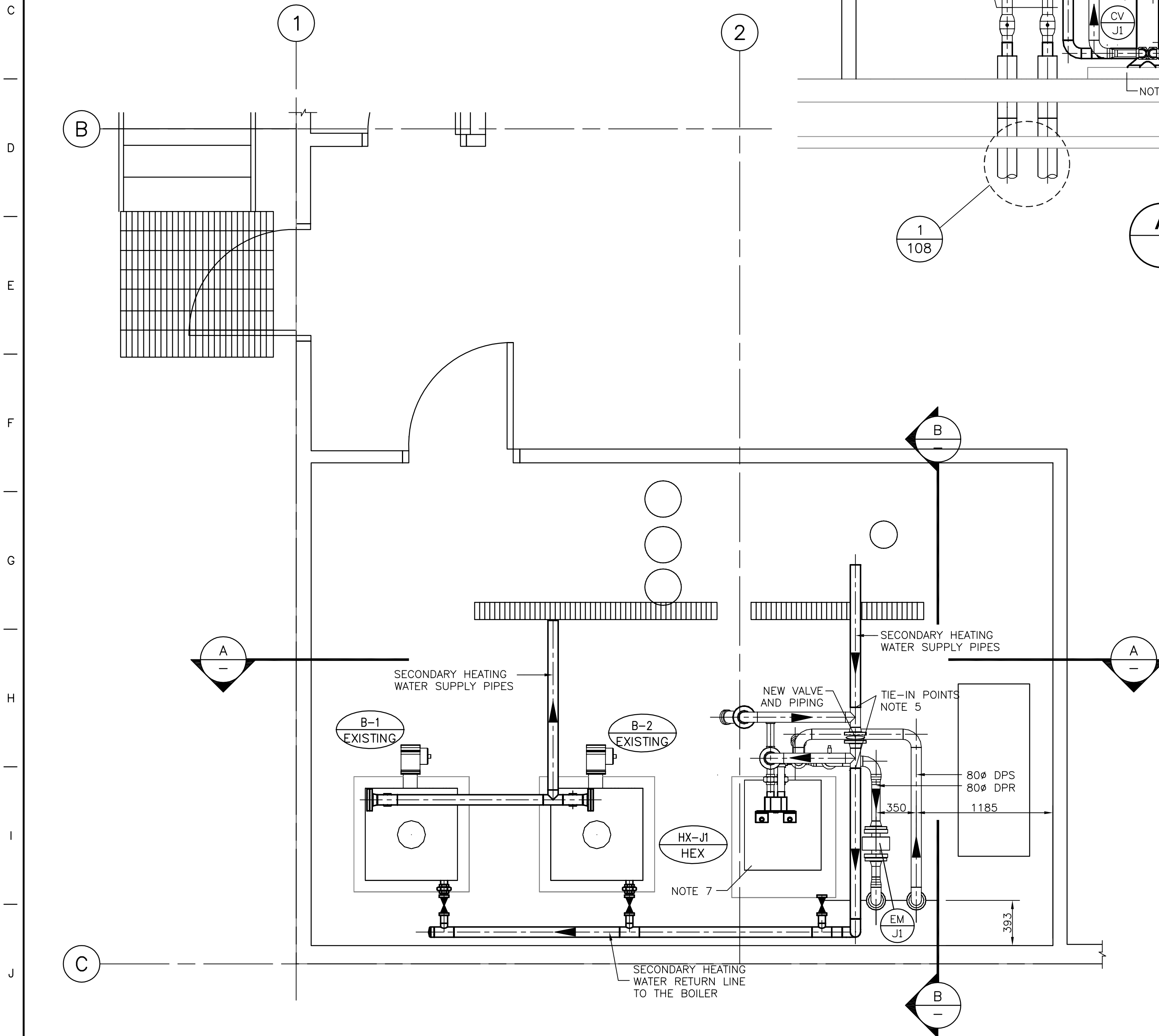


TYPICAL CONNECTION TO CEILING
SCALE: NTS

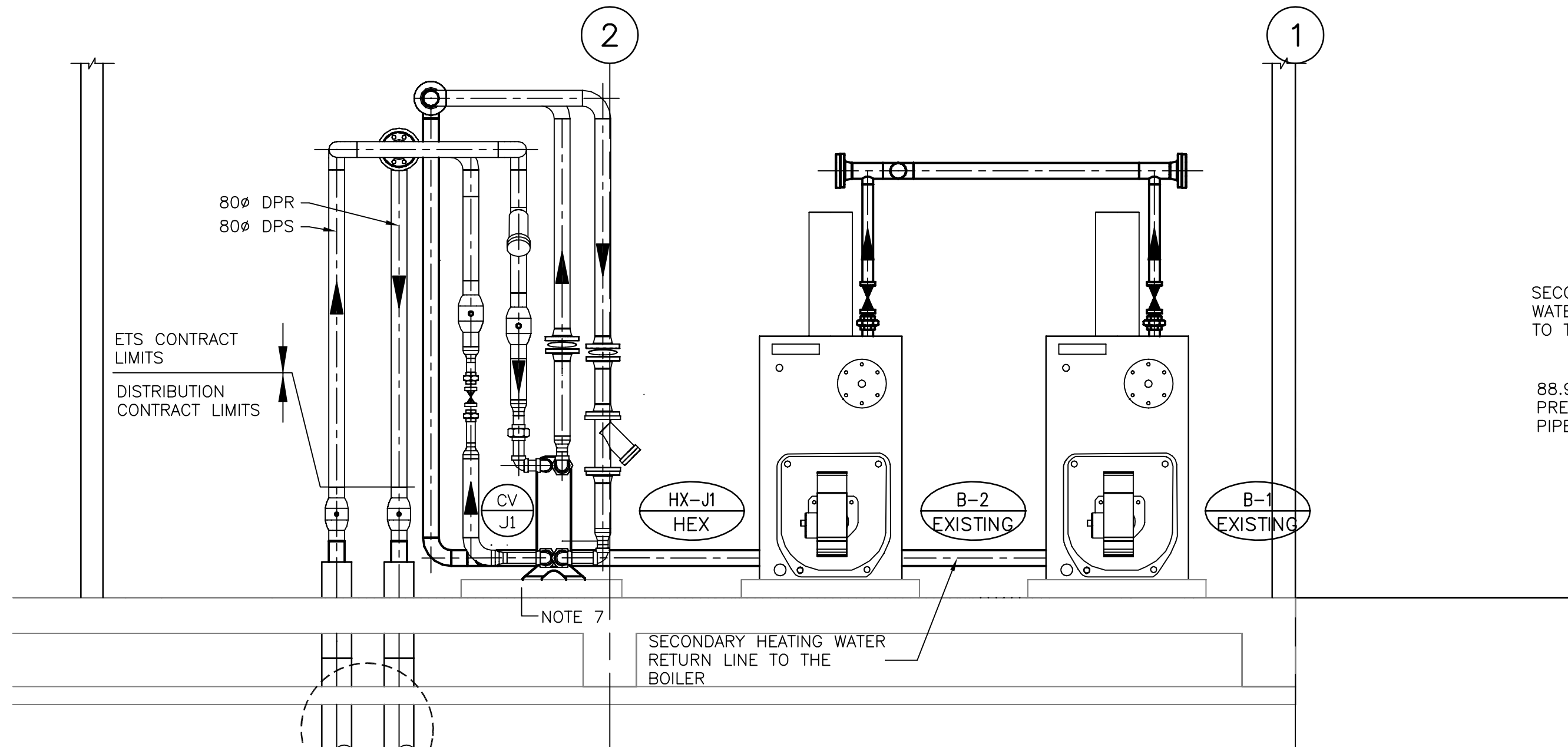
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| DRAWING NO. | | TITLE | | REVISION LETTER | | REVISION | | WORK ORDER | | NAME | | DATE | | CHECKED BY | | DESIGNED BY | | STATUS OF DRAWING | | DATE | | PROFESSIONAL STAMP | | PERMIT STAMP | | LOCATION | | TITLE | | SCALE | | SHEET 1 OF - | | DRAWING NO. | | REV. | |
| | | | | 0 | | ISSUED FOR TENDER | | | | | | 04/11/08 | | | | | | | | | | FVB ENERGY INC. | | PERMIT TO PRACTICE | | IQALUIT NUNAVUT | | EXTENSION OF RESIDUAL HEATING ENERGY TRANSFER STATION HANGER AND SUPPORT DETAILS | | N.T.S. | | ETS-7307-003 | | | | | |
| | | | | A | | ISSUED FOR 50% REVIEW | | | | | | 03/10/08 | | | | | | | | | | Signature: [Signature] | | Date: April 11th, 2008 | | 13020 ST. ALBERT TOWN, SUITE 350 EDMONTON, ALBERTA T5L 4V1 TEL: (780) 453-3445 FAX: (780) 453-3446 | | | | | | | | | | | |
| | | | | 0 | | ORIGINAL | | | | | | | | | | | | | | | | QULLIQ ENERGY | | | | | | | | | | | | | | | |



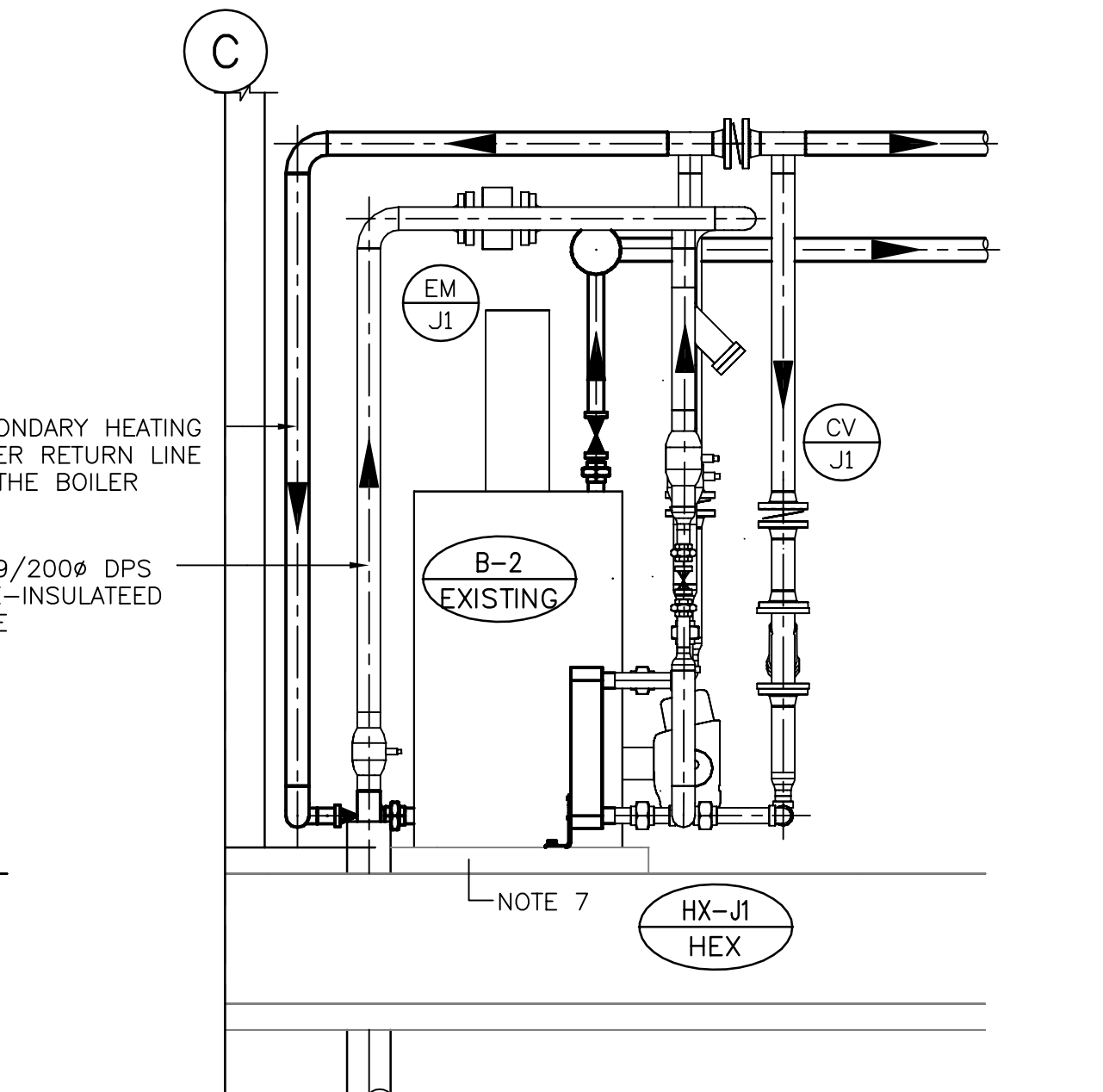
- GENERAL NOTES:
1. ALL EXISTING PIPING AND EQUIPMENT HAVE BEEN SHOWN DIAGRAMMATICALLY AND NOT TO SCALE, FIELD CONFIRM EXACT LOCATIONS AND ROUTING PRIOR TO CONSTRUCTION.
 2. ENSURE OPERATIONAL AND MAINTENANCE ACCESS AROUND NEW HEAT EXCHANGER INSTALLATION TO SERVICE AND OPERATE ALL EXISTING PUMPS, VALVES AND TANKS IN NEW AREA AS SHOWN ON DRAWING.
 3. REFER TO DISTRIBUTION PIPING DRAWINGS FOR THE ENTRY LOCATION OF BOTH SUPPLY AND RETURN DPS LINES. FIELD VERIFY EXACT LOCATION AND ADJUST TO SUIT PRIOR TO CONSTRUCTION.
 4. FIELD DETERMINE PIPE HANGER SUPPORT LOCATIONS, REFER TO DRAWING ETS-7307-003 FOR HANGER DETAILS.
 5. NEW TIE-IN CONNECTION POINTS INTO EXISTING HEATING RETURN LINE, EXACT LOCATION TO BE DETERMINED ON SITE PRIOR TO CONSTRUCTION AND COORDINATE WITH OWNER REPRESENTATIVE.
 6. ALL PIPING HEIGHTS ARE APPROXIMATE, FIELD CONFIRM PIPING HEIGHT PRIOR TO CONSTRUCTION. CARE SHALL BE TAKEN TO ROUTE PIPING AROUND EXISTING PIPES AND HANGERS.
 7. INSTALL NEW HEAT EXCHANGER ON XXXXXX HOUSEKEEPING PAD.



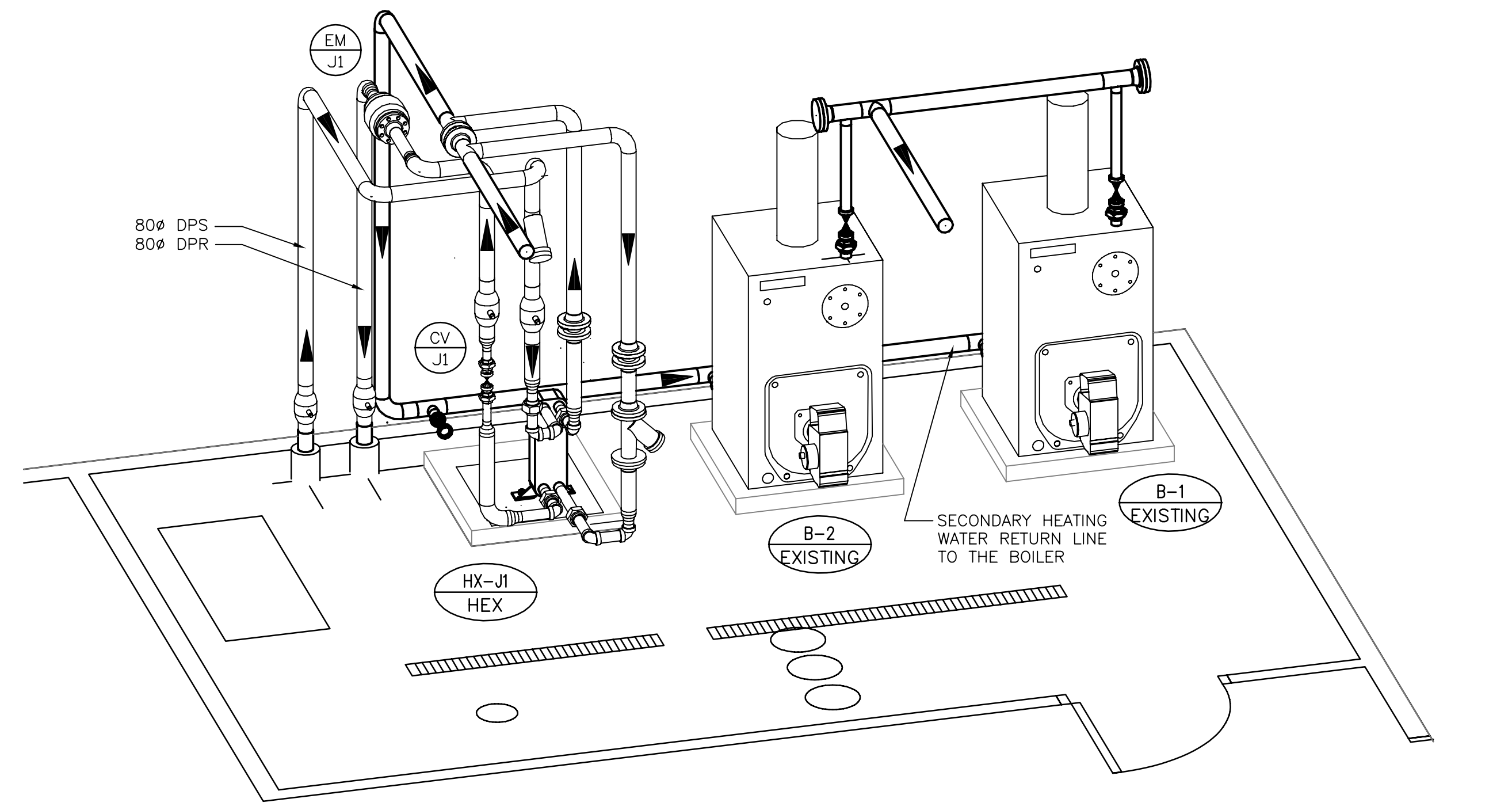
3.0 PIPING LAYOUT
SCALE 1:25



A SECTION
SCALE 1:25

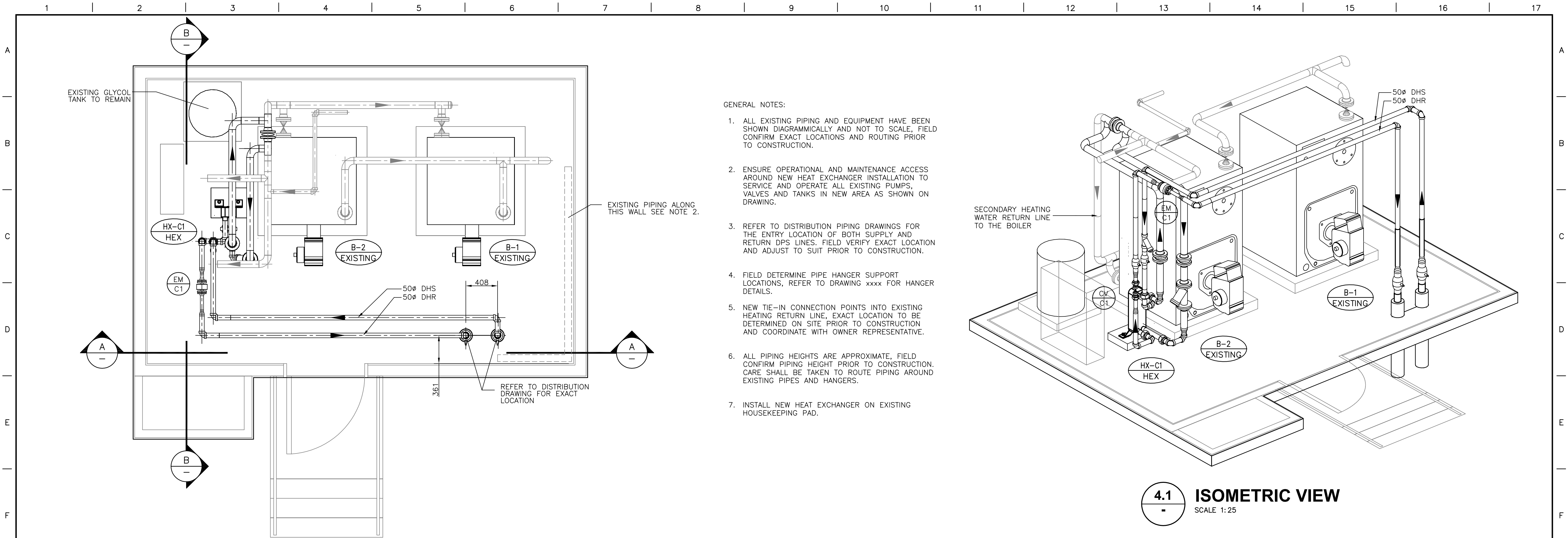


B SECTION
SCALE 1:25



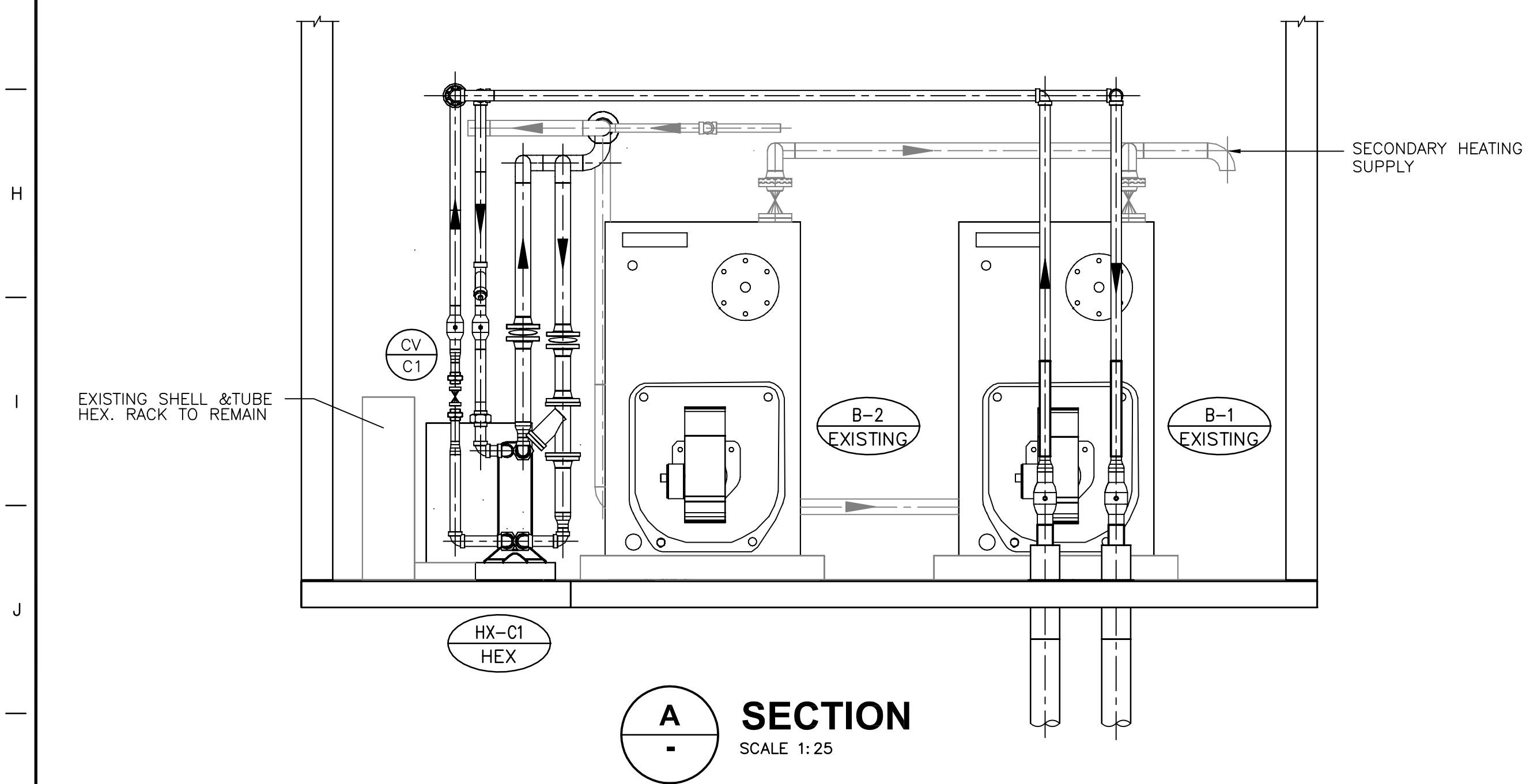
3.1 ISOMETRIC VIEW
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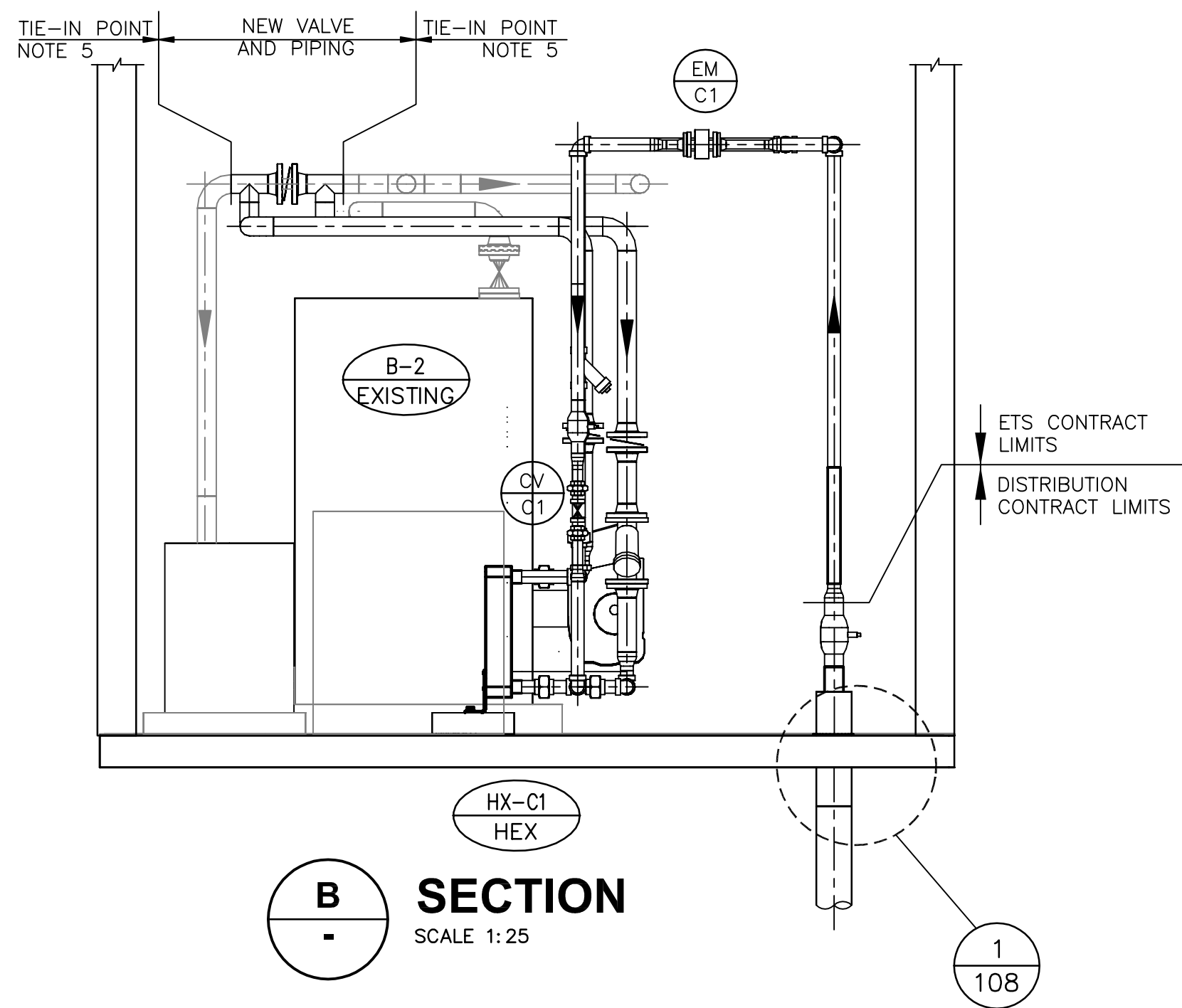


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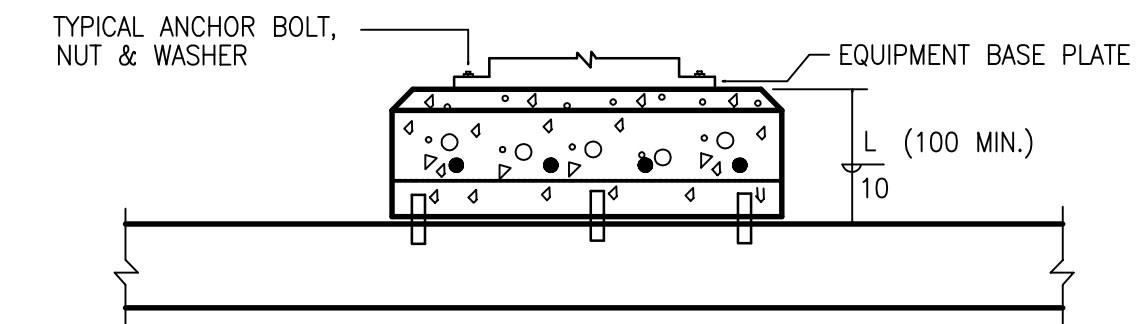
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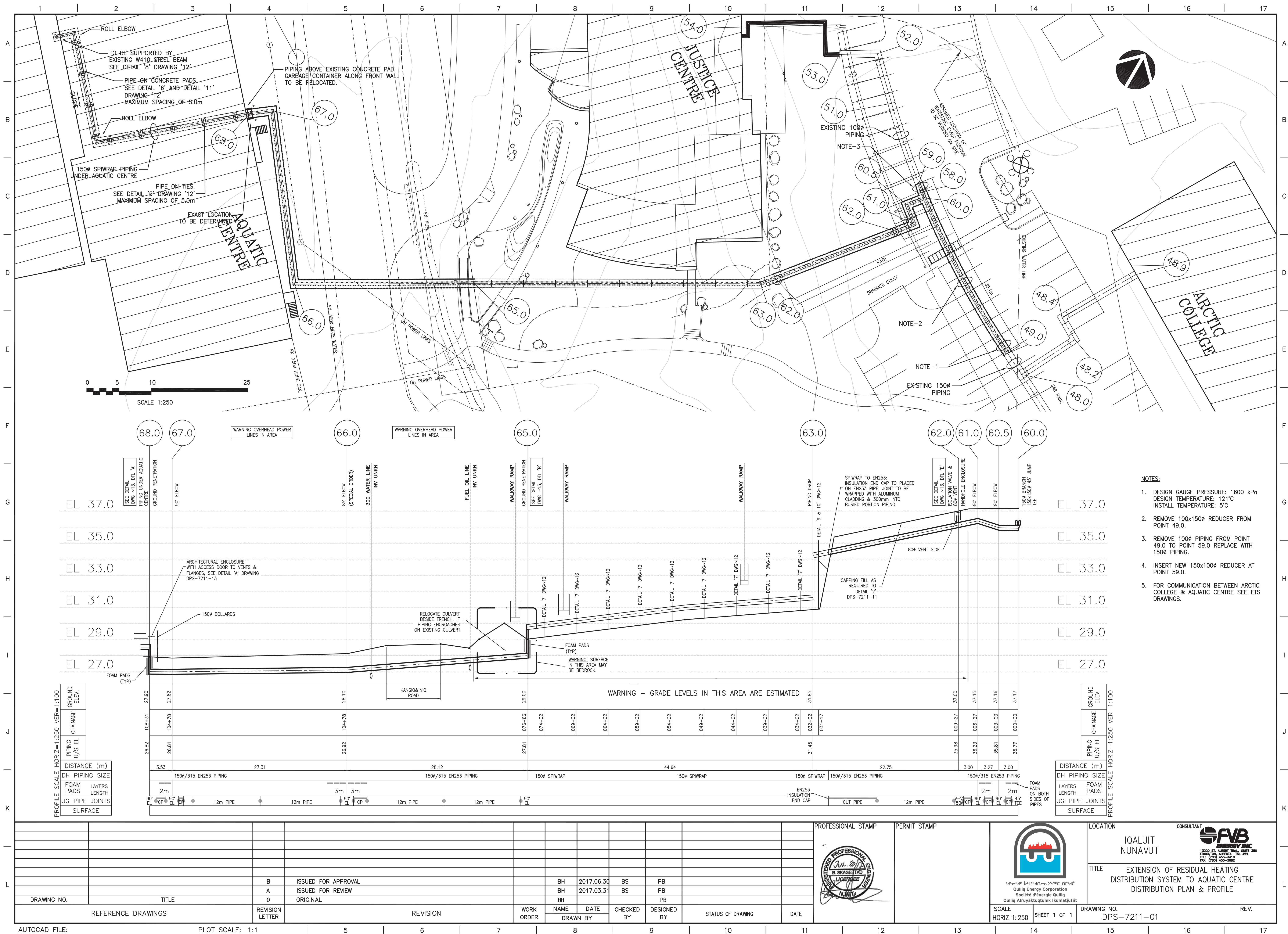
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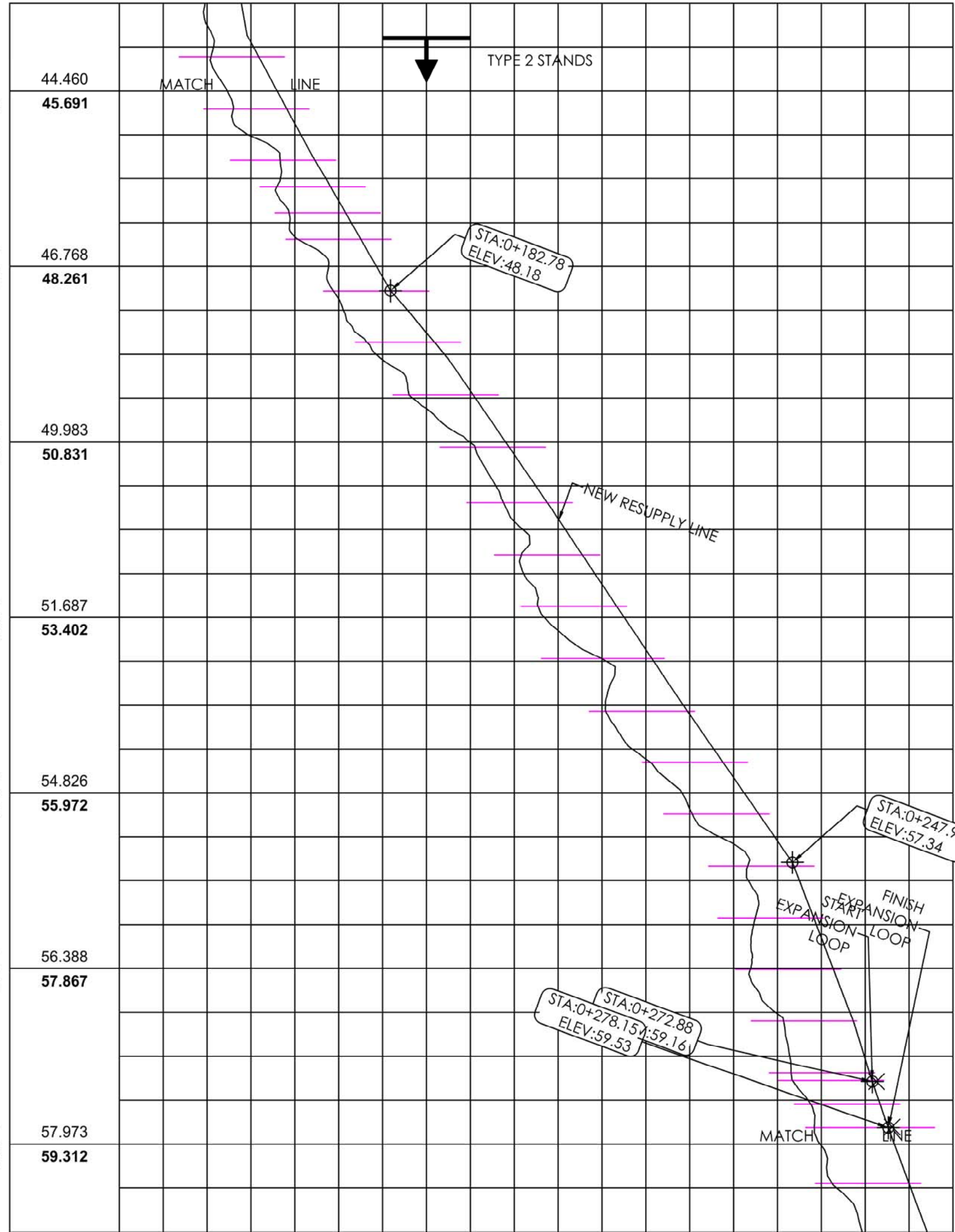
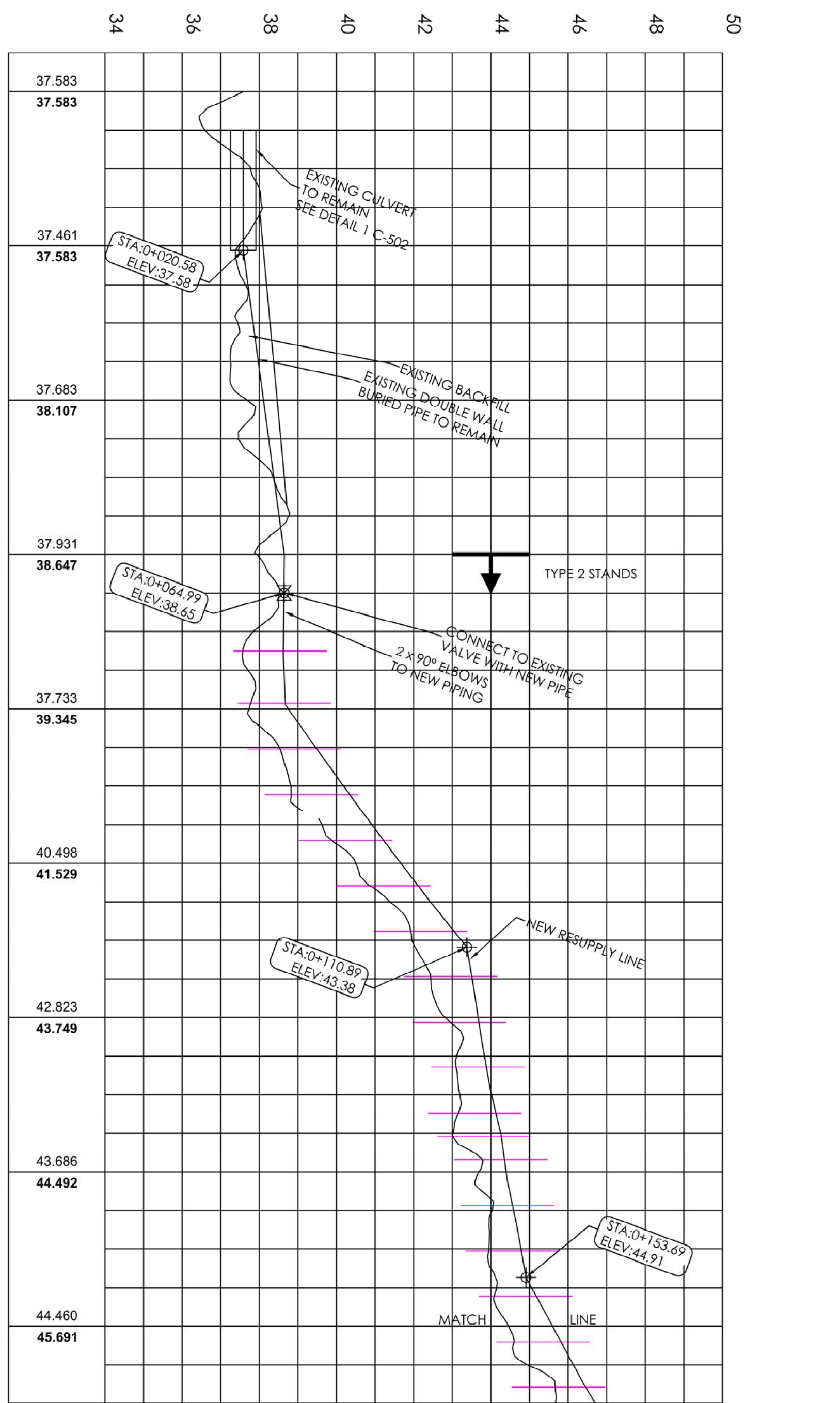
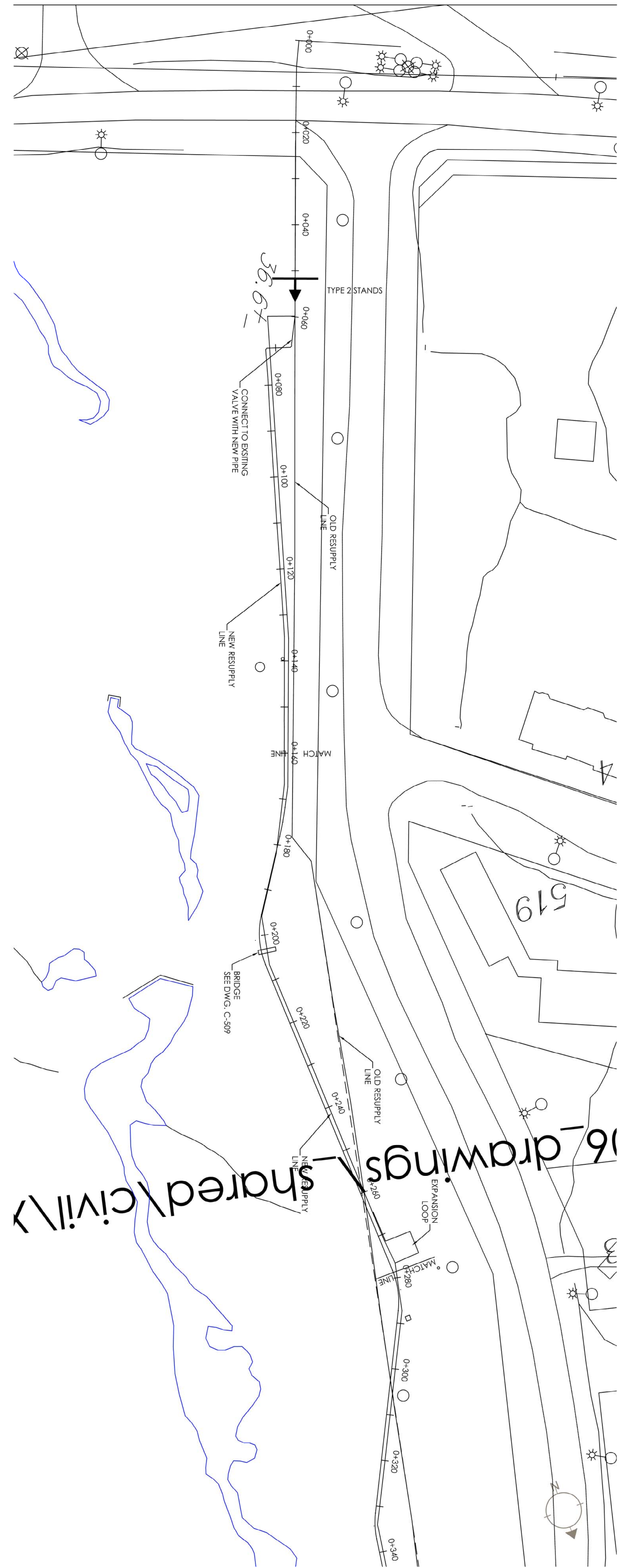
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| C. ISSUED FOR CONSTRUCTION | NK | WO | 17/12/08 |
| B. ISSUED FOR 80% SUBMISSION | NK | WO | 17/10/08 |
| A. ISSUED FOR 50% SUBMISSION | NK | WO | 17/09/08 |
| Issued | By | Appd. | YY/MM/DD |

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Client/Project

INUKSHUK CONSTRUCTION LIMITED

QEC IQALUIT FUEL PIPE REPLACEMENT

IQALUIT, NU

RESUPPLY LINE
PLAN & PROFILE

| | | |
|-------------|-------|----------|
| Project No. | Scale | Revision |
| 144902535 | 1:500 | |

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|-------------|---------|----------|
| Drawing No. | Sheet | Revision |
| C-201 | 1 of 14 | D/0 |

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- Legend
- MAJOR CONTOUR
 - MINOR CONTOUR
 - HYDROLOGY
 - OLD RESUPPLY LINE
 - NEW RESUPPLY LINE
 - PIPE SUPPORT

| Revision | | By | Appd. |
|----------------------------|--|----|-------|
| D. RECORD DRAWING | | DS | WO |
| C. ISSUED FOR CONSTRUCTION | | NK | WO |
| S. ISSUED FOR SUBMITTAL | | NK | WO |
| A. ISSUED FOR SUBMITTAL | | NK | WO |

| Issued | | By | Appd. |
|----------------------------|--|----|-------|
| D. RECORD DRAWING | | DS | WO |
| C. ISSUED FOR CONSTRUCTION | | NK | WO |
| S. ISSUED FOR SUBMITTAL | | NK | WO |
| A. ISSUED FOR SUBMITTAL | | NK | WO |

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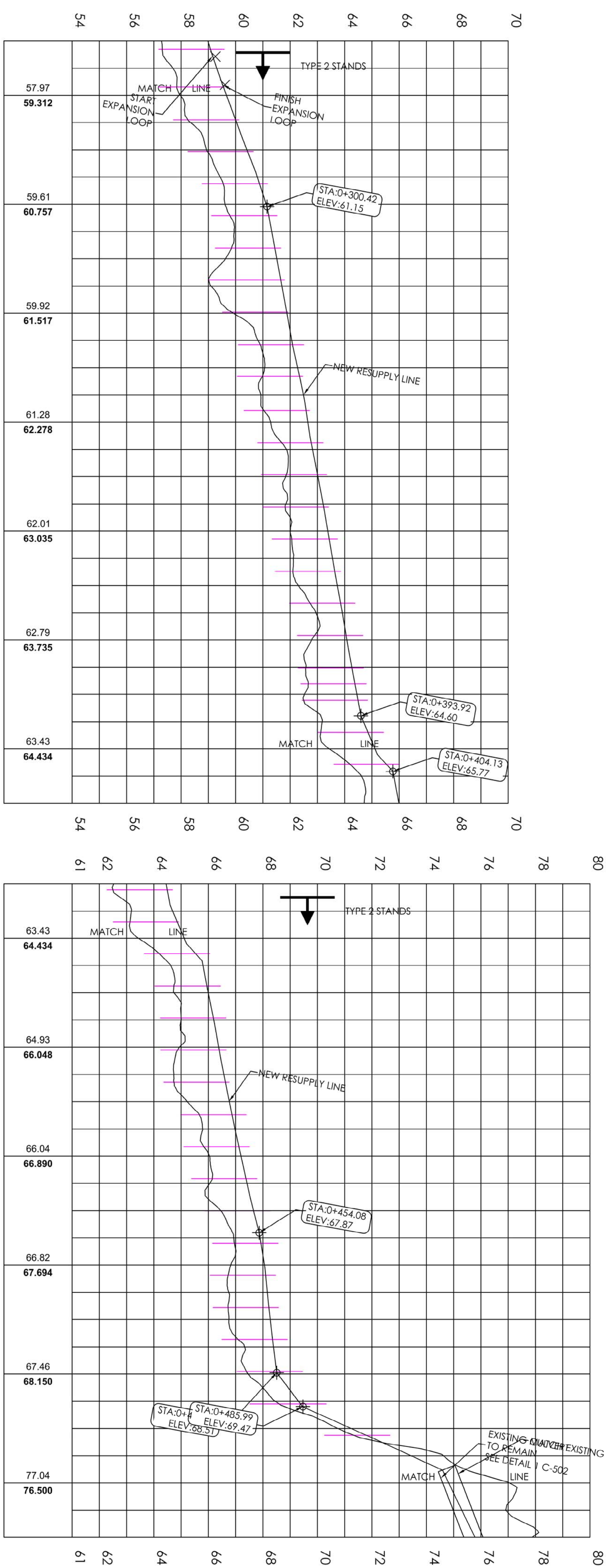
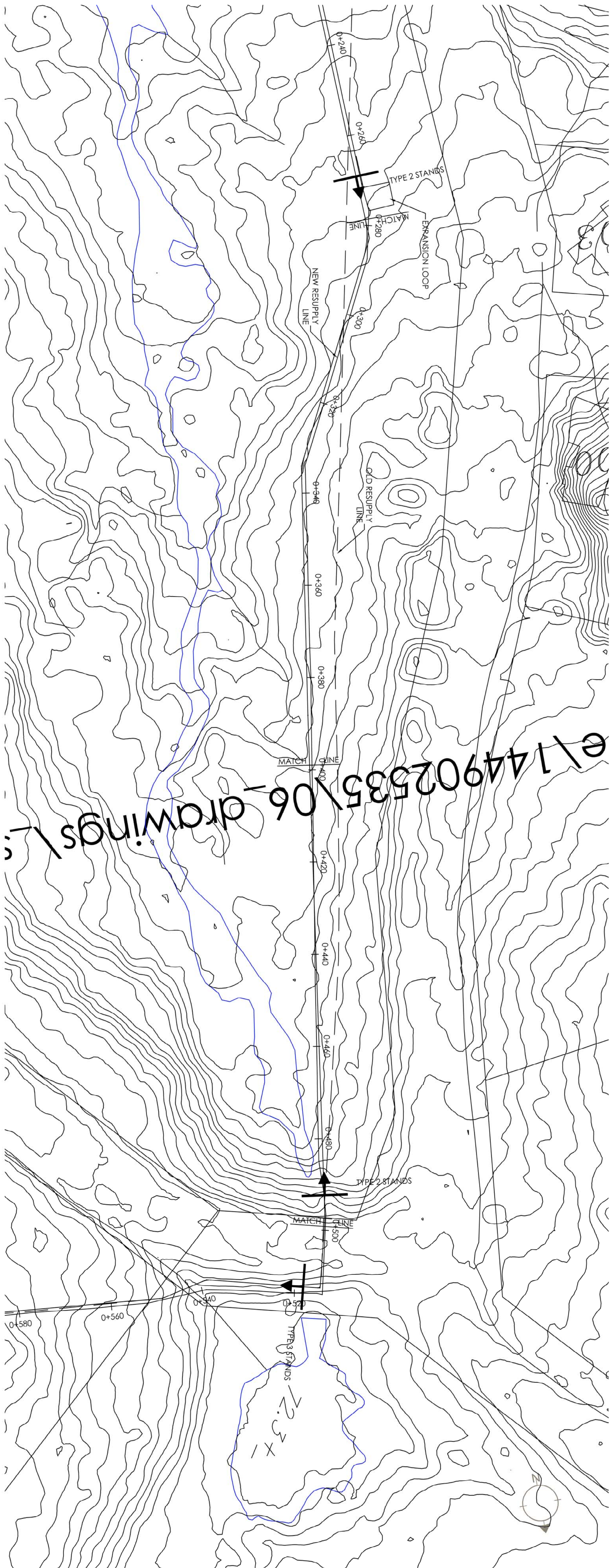
QEC IQALUIT FUEL PIPE REPLACEMENT

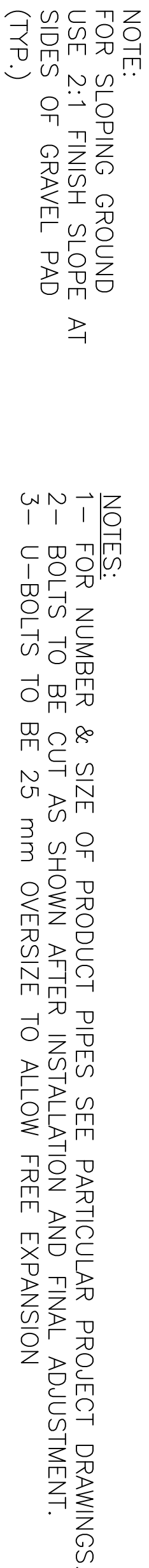
IQALUIT, NU

Title
RESUPPLY LINE
PLAN & PROFILE

| Project No. | Scale |
|-------------|-------|
| 144902535 | 1:500 |

| Drawing No. | Sheet | Revision |
|-------------|---------|----------|
| C-202 | 2 of 14 | D/0 |





2 OFFICIAL FILE
C501 SCALE: 1:7500



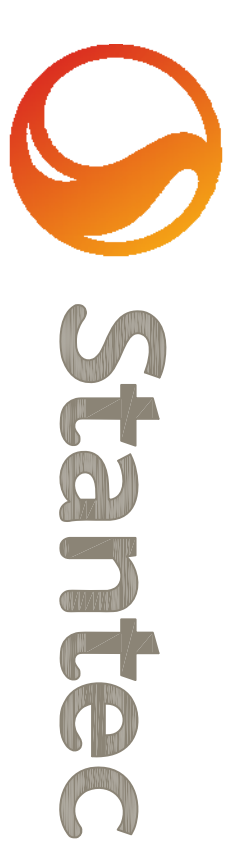
NOTE:
FINISH:
SHOP SANDBLASTED TO SP6 AND PRIMED WITH ONE COAT RED
OXIDE PRIMER SW29 @ 1.5-2MIL DFT
SITE PAINT WITH TWO TOP COATS OF SHERWIN WILLIAMS INDUSTRIAL
ENAMEL #BS4

Permit-Seal

INUKSHUK CONSTRUCTION LIMITED

PIPE SUPPORTS

C-501 4 of 14



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| D RECORD DRAWING | DS | WO | 18.12.06 | |
| C ISSUED FOR CONSTRUCTION | NL | WO | 17.12.04 | |
| B ISSUED FOR 90% SUBMISSION | NL | WO | 17.10.03 | |
| A ISSUED FOR 50% SUBMISSION | NL | WO | 17.09.14 | |
| Issued | By | App'd | TYM:MD | |

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QEC IGALUIT FUEL PIPE REPLACEMENT

IGALUIT, NU

Title
PIPE SUPPORTS

| | |
|-------------|----------|
| Project No. | Scale |
| 144902535 | 1:5000 |
| Drawing No. | Sheet |
| C-502 | 5 of 14 |
| | Revision |
| | D/0 |



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Notes

1. PROVIDE PRESSURE RELIEF TOWARD THE TANK FOR ALL IN LINE PIPELINE VALVES

[illegible]

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QEC IQALUIT FUEL PIPE REPLACEMENT

IGALUIT, NU

PIPELINE DETAILS

| | | |
|-------------|---------|----------|
| Project No. | Scale | |
| 144902335 | NTS | |
| Drawing No. | Sheet | Revision |
| C-504 | 7 of 14 | D/0 |



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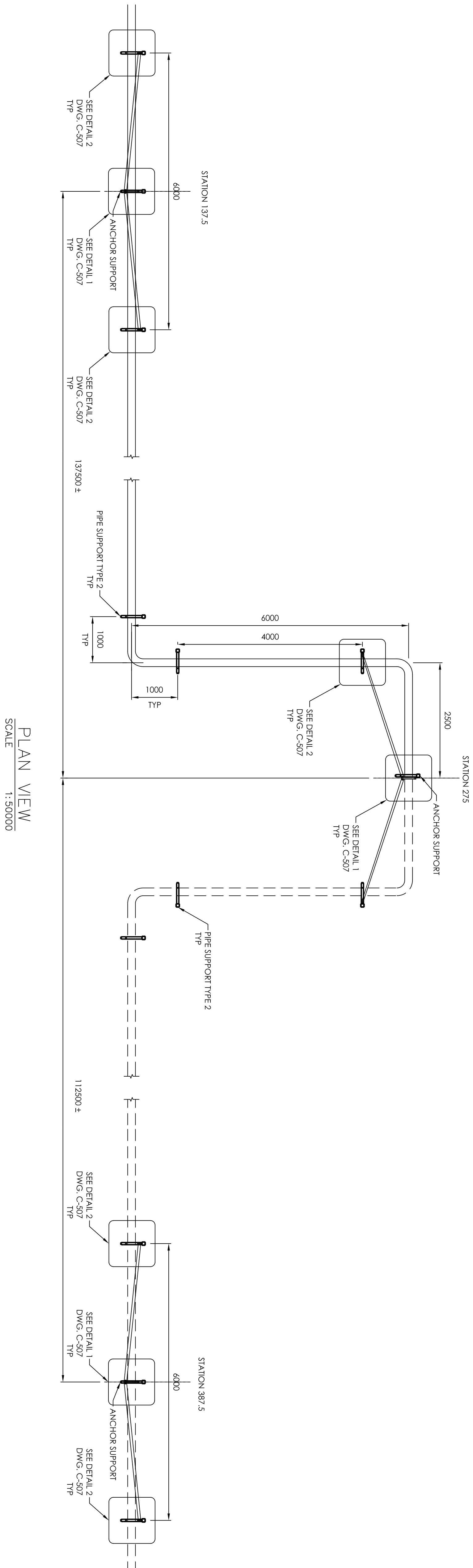
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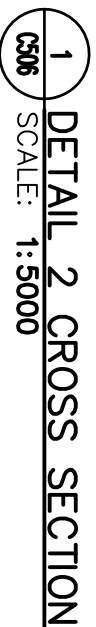
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QEC IGALUIT FUEL PIPE REPLACEMENT

IGALUIT, NU

EXPANSION LOOP

| | | |
|-------------|---------|----------|
| Project No. | Scale | |
| 144902535 | 1:50000 | |
| Drawing No. | Sheet | Revision |
| C-506 | 9 of 14 | D/0 |



C-507 10 of 14 D/0

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Notes

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Record Drawing

incorporated herein as a result.

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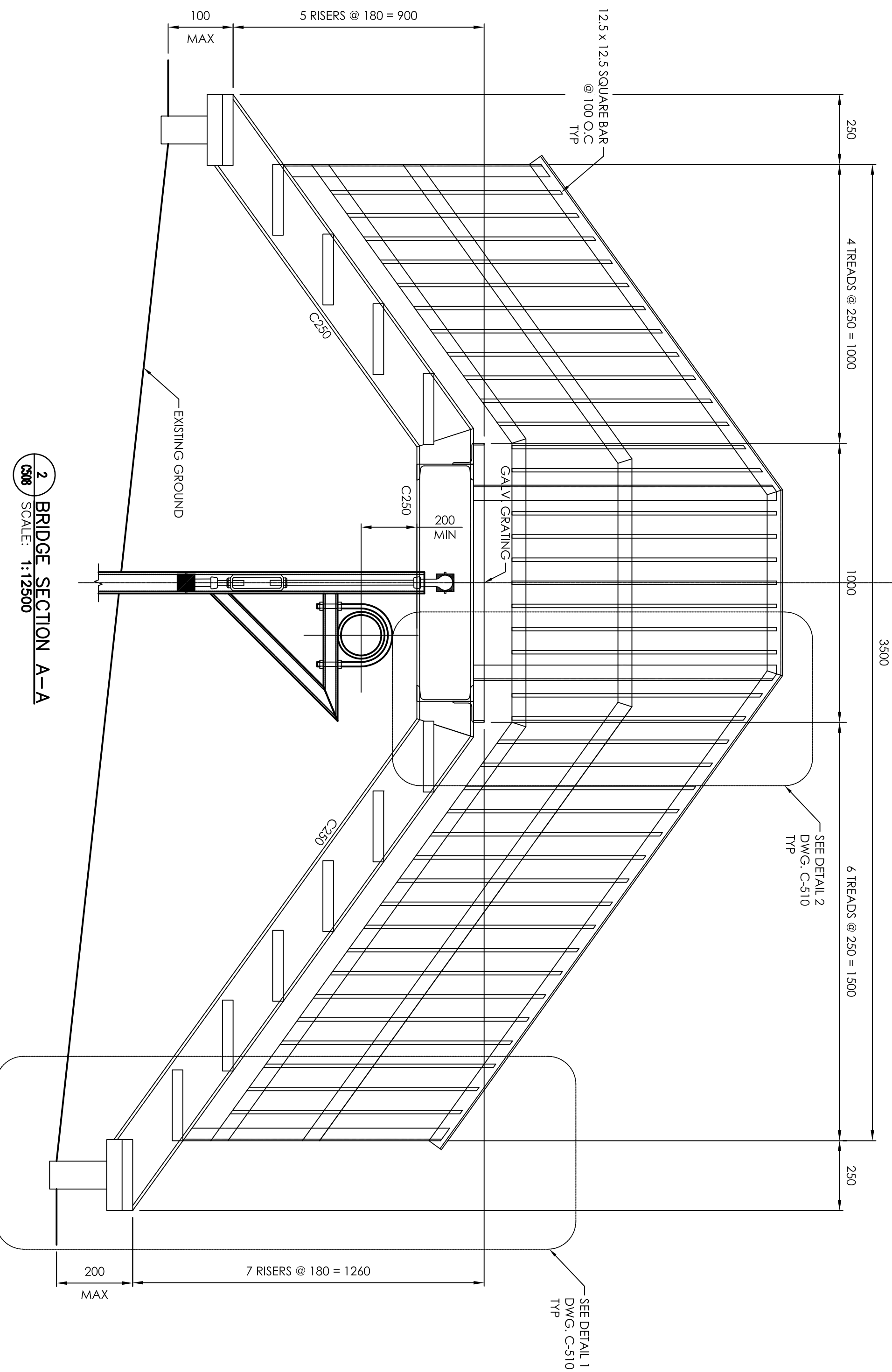
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QEC IGALUI FUEL PIPE REPLACEMENT

IGALUI, NU

BRIDGE

CCC

[illegible]

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|-----------|---------|
| 144902535 | 1:12500 |
|-----------|---------|



3 SECTION B-B
CS09 SCALE: 1:12500

| | | |
|-------|----------|-----|
| C-510 | 13 of 14 | D/O |
|-------|----------|-----|



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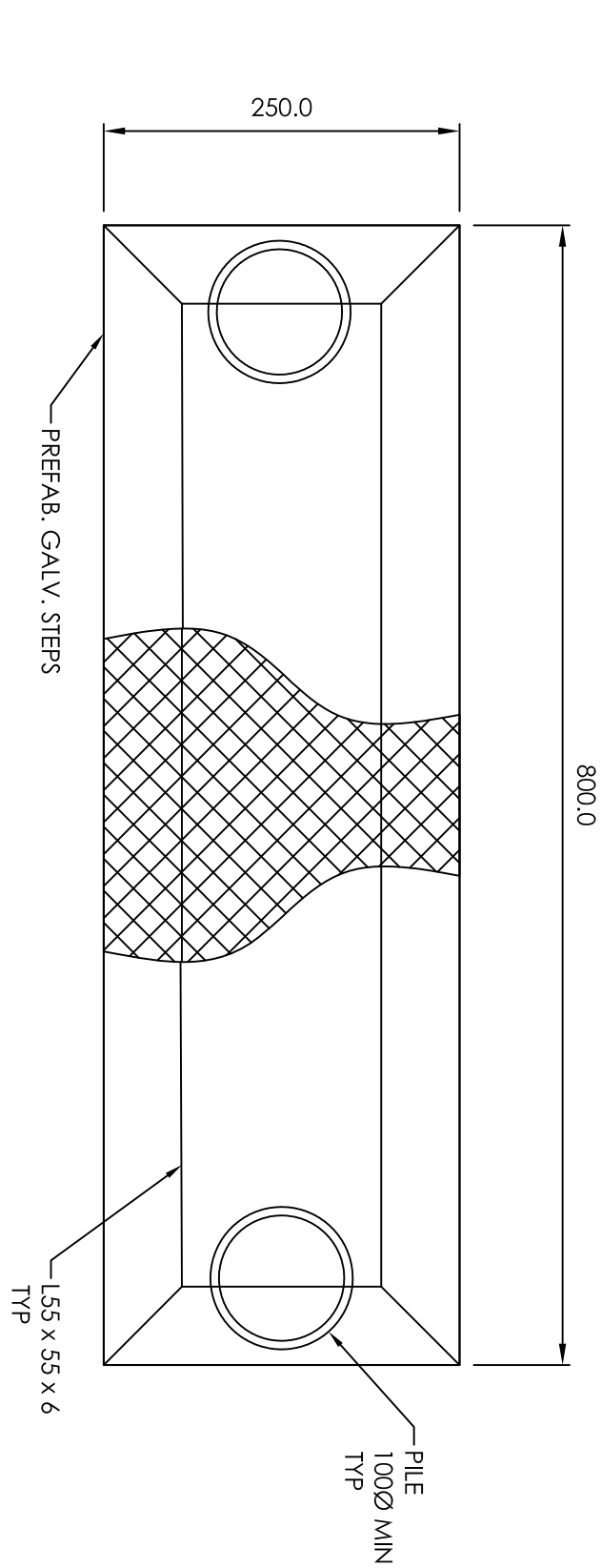
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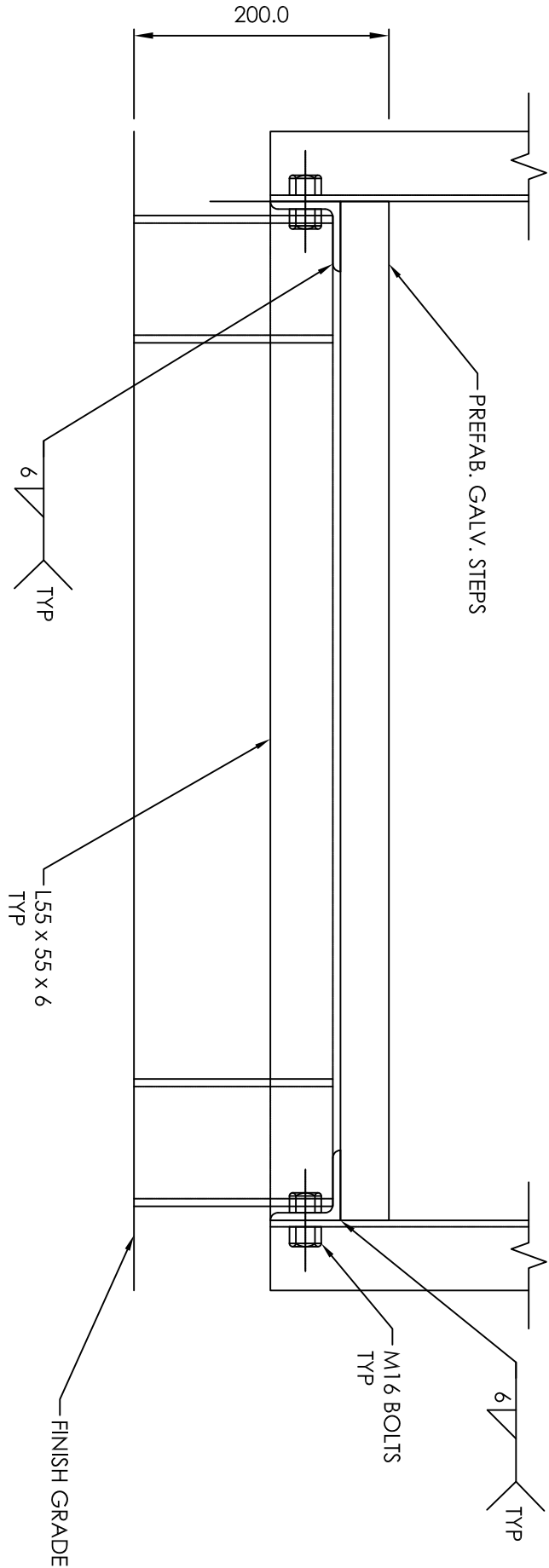
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1
C510

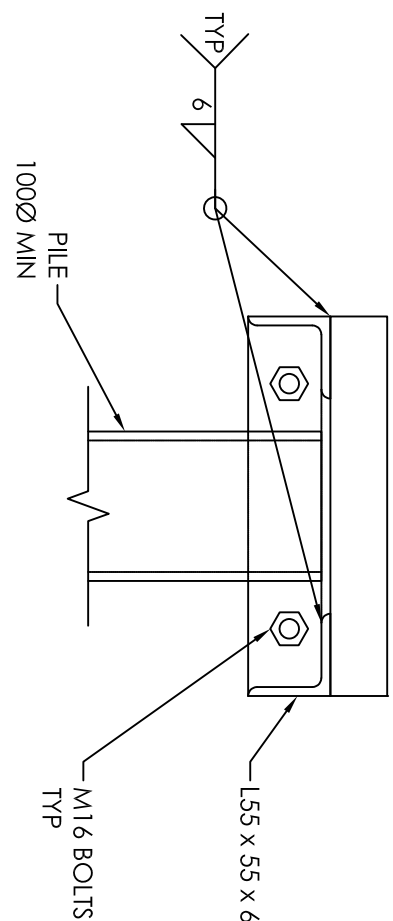
DETAIL
SCALE: 1:5000



2
CS10

DETAIL

SCALE: 1:50000



3
C510

DETAIL

SCALE: 1:5000

[illegible]

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QEC IGALUIT FUEL PIPE REPLACEMENT

IGALUIT, NU

title
BRIDGE DETAILS

| | | |
|-------------|----------|----------|
| Project No. | Scale | |
| 144902535 | 1:5000 | |
| Drawing No. | Sheet | Revision |
| C-511 | 14 of 14 | D/0 |

