SCHEDULE 18

TECHNICAL REQUIREMENTS

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100.0 GENERAL

100.1 INTRODUCTION

References to section numbers in this Schedule are to section numbers of the Technical Requirements unless expressed otherwise.

This Section covers the general technical requirements applicable to all design, construction and operations of the Infrastructure.

The information in the Technical Requirements is organized as follows:

- Section 100 – General;
- Section 200 – Project Specifics;
- Section 300 – Design and Construction - New Infrastructure;
- Section 400 – Operations - New Infrastructure and Existing Infrastructure;
- Section 500 – Handback Requirements;
- Appendix A – Drawings;
- Appendix B – Select Department Standard Drawings and Reference Tables;
- Appendix C – Reporting Summary;
- Appendix D - *Historical Resources Act* (Alberta) Clearance Letters;
- Appendix E - Guide Signing for New Infrastructure;
- Appendix F – List of Acronyms;
- Appendix G – Alberta Infrastructure Land Lease Summary and Drawings;
- Appendix H – Automatic Traffic Recorder ("**ATR**") Specifications;
- Appendix I – Road Weather Information System - Drawing 18-I-01; and
- Appendix J - Traffic Modeling and Traffic Signal Guidelines (Packages A-I).

In the event of any conflict or inconsistency between the Sections/Appendices, such conflict or inconsistency shall be resolved on the basis of the wording in the higher up in the following list:

- Sections 100.1 and 200, including Appendices A, B, D, E, F, G, H, I, and J;
- Sections 300, 400 and 500; and
- Section 100.2 and Appendix C.

References to any standards, publications, policies, guidelines or other requirements in the Technical Requirements (the "**Standards**"), are to the Standards that existed as of the deadline for the submission of SR Package 2 (as set out in the Request for Proposals issued by the Department for the DBFO Agreement), unless otherwise specified.

Any Standards written by the Department, including without limitation Department Standard Drawings, can be found (or the location of where they can be found) on the Department's website. Subject to the foregoing paragraph, the Contractor shall use the latest revision for the

Standard Drawings referred to in this Schedule 18. Standard Drawings referenced in the text of this Schedule 18 are listed in Part 1 of Appendix B.

100.1.1 DEFINITIONS

In this Schedule 18 (Technical Requirements), capitalized terms shall have the corresponding meaning as set out in section 1.1 of the DBFO Agreement (as defined below) and the following expressions shall have the following meanings (and where applicable their plurals have corresponding meanings):

"As-Built Construction Reports" has the meaning as set out in Section 300.3.3;

"Bare Pavement" means the travel lanes, and walkway/pathways being free of snow, packed snow, frost and ice;

"Bridge Design Code" has the meaning as set out in Section 300.5.1.1;

"bridge structures" include bridges, bridge size culverts (1.5 metre diameter or larger), retaining walls, and overhead and cantilevered sign structures that form the Infrastructure;

"Bridge Welding Code" has the meaning as set out in Section 300.5.1.1;

"C-D" means collector-distributor;

"CNR" means Canadian National Railway Company;

"Contractor's Engineer" means a Professional Engineer or engineers that are employed by or retained by the Contractor for the carrying out of the Project and the O&M;

"County" means Strathcona County;

"CPR" means Canadian Pacific Railway Company;

"DBFO Agreement" means the Agreement to Design, Build, Finance and Operate Northeast Anthony Henday Drive, Edmonton between Her Majesty the Queen in right of Alberta and the Contractor, as defined therein, to which agreement this Schedule 18 (Technical Requirements) is attached;

"Department" means the Province, as represented by the Minister of Transportation, or its expressly authorized representatives or agents. The Department or Alberta Transportation was formerly known as Alberta Infrastructure and Transportation and so references to Alberta Infrastructure and Transportation are to the Department;

"Department of Infrastructure" means the Province, as represented by the Minister of Infrastructure;

"Detailed Designs" means the plans, specifications and drawings that the Contractor is required to provide pursuant to section 5.9 of the DBFO Agreement;

"Design Engineer" has the meaning as set out in Section 100.2.1.1;

"Design Guidelines for Bridge Culverts" has the meaning as set out in Section 300.5.1.1;

"Drafting Guidelines" has the meaning as set out in Section 300.5.1.1;

"Elevated Directional Ramps" means the Systems Ramps at freeway to freeway interchanges which will result in a third vertical level of traffic movement were the Systems Ramp placed at the centre of an interchange. The limits of a particular Elevated Directional Ramp are considered to be from the exit gore from one freeway mainline to the entrance gore of another freeway mainline;

"Existing O&M Payment" has the meaning as set out in section 2 of Schedule 14 (Payment Schedule) to the DBFO Agreement;

"Functional Plan" means the Northeast Edmonton Ring Road, Functional Planning Study – Final Report dated January 2010, the North East Edmonton Ring Road - Advanced Functional Plan - Bridge Planning Summary Report dated March 2010, and the North East Edmonton Ring Road - Advanced Functional Plan - Bridge Planning Summary Report Volume 2 dated May 2011, all prepared by ISL Engineering and Land Services Ltd.;

"Highway Geometric Design Guide" has the meaning as set out in Section 200.2.2;

"Infrastructure" means the New Infrastructure and the Existing Infrastructure;

"In-Service Roads" has the meaning as set out in Section 200.3.10 (Operation and Maintenance of In-Service Roads During Construction Period);

"Local Authority" means The City of Edmonton or the County, as applicable;

"Mainline" means both Anthony Henday Drive and Highway 16 within the Project Limits;

"MASH" means *AASHTO Manual for Assessing Safety Hardware (2009);*

"Ministerial Consent" the written consent of the Department of Infrastructure pursuant to section 5(2) of *Edmonton Restricted Development Area Regulations* (AR 287/74, as amended) or section 5(1) of *Sherwood Park West Restricted Development Area Regulations* (AR 45/74, as amended), as applicable;

"New O&M Payment" has the meaning as set out in section 2 of Schedule 14 (Payment Schedule) to the DBFO Agreement;

"Professional Engineer" means an individual who holds a certificate of registration to engage in the practice of engineering under the *Engineering, Geological and Geophysical Professions Act*, R.S.A. 2000, c. E-11, or any replacement legislation;

"Project Limits" means the limits of the Project as identified in Drawings 18-A-3.01 to 18-A-3.09, to the extent allowable by the directional arrows set out in such Drawings.

"Province" means Her Majesty the Queen in right of Alberta;

"Reclamation Certificate" means a reclamation certificate for disturbed lands as required by the *Environmental Protection and Enhancement Act* (Alberta), R.S.A. 2000, c. E-12, or any replacement legislation;

"Record Drawings" has the meaning as set out in Section 300.3.3.6;

"Roadside Design Guide" has the meaning as set out in Section 200.2.2;

"roadways" include all mainline lanes and shoulders, interchange ramps, crossroads and other roads that form the Infrastructure, as well as the associated drainage systems, lighting, signage, signals, markings, landscaping, fencing and other appurtenances, excluding bridge structures;

"Schedule of Lane Closures" has the meaning as set out in Section 400.1.6;

"Service Roads" has the meaning provided in Section 200.2.3.18;

"Stage 1" means the initial configuration of the New Infrastructure as described in the Functional Plan (year 2041) and as modified and further detailed in the Technical Requirements;

"Standard Drawing" means one of the standard design drawings developed by the Department and made known (in part via posting on the Department's website) to the road design/build/operate industry in Alberta, some of which are listed in Part 1 of Appendix B;

"Storm Event" means a period of time of continuous precipitation and/or condensation and/or wind causing the formation of snow and/or ice on the roadway surface;

"Systems Ramps" means the ramps carrying traffic from freeway to freeway and the limits are considered to be from the exit gore from one freeway mainline to the entrance gore of another freeway mainline;

"TAC Geometric Design Guide" has the meaning as set out in Section 200.2.2;

"Third Party Leased Lands" has the meaning as set out in Section 200.3.4.1;

"Ultimate Stage" means the planned final configuration of the New Infrastructure as described in the Functional Plan and as modified and further detailed in the Technical

Requirements; and

"Witness Point" means a point of time in the construction process when it would be unreasonably onerous or impossible, to confirm conformance to the Technical Requirements of either materials or workmanship once work proceeds past this point.

Appendix F contains a list of acronyms frequently used within the Technical Requirements.

Words and abbreviations which are not defined in the Technical Requirements or the DBFO Agreement and which have well known technical or trade meanings and which are used in the Technical Requirements are used in accordance with such recognized meanings.

Standard units of measurement may be abbreviated in the Technical Requirements.

100.2 MANAGEMENT SYSTEMS AND PLANS

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Contractor's Construction Schedule and the Contractor's Management Systems and Plans to comply with the Technical Requirements.

100.2.1 QUALITY MANAGEMENT SYSTEM

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Quality Management System (the "**QMS**"), as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement.

The QMS shall be consistent with all of the requirements of the *ISO 9001* and shall cover all activities, products and services related to the Project and the O&M, prior to the execution of these activities, products and services. The Contractor shall make all QMS records available to the Department for inspection and review. The Contractor shall provide the Department with a copy of any or all quality records when requested within 48 hours of the request. The QMS shall address all stages of the Project and the O&M, specifically:

- Design;
- Construction; and
- Operations, including maintenance and rehabilitation.

The QMS shall stipulate how compliance with the Technical Requirements and the Contractor's Management Systems and Plans is ensured. During all stages of the Project and the O&M, work shall not be started on any component of the work until after the QMS has been completed and implemented for that component of the work. All records from the QMS for design, construction, operation, and maintenance, including all audits, shall be maintained and retained by the Contractor until the expiry of two years after the end of the Term or until otherwise agreed to in writing by the Department.

Quality managers for each of the overall project, design and construction components shall be named in the QMS. Substitutions for the quality managers named in the QMS shall be subject to the Department's review and approval. The QMS shall require that all quality managers possess certification as quality professionals from appropriate certifying bodies, or have successfully completed training courses in the quality discipline. As a minimum, these courses shall include a two day introductory course to ISO 9001, and a one week External or Lead Auditor course based on ISO 9001. In addition, the QMS shall require that the quality manager for the design component ("**Design Quality Manager**") shall be a Professional Engineer with at least five years of experience within the past 10 years overseeing the design of major urban freeways, and that the quality manager for the overall project ("**Project Quality Manager**") and the quality manager for construction ("**Construction Quality Manager**") each have at least five years of experience within the past 10 years as quality managers on major highway and bridge construction projects.

The QMS shall require that the Design Quality Manager and Construction Quality Manager shall report directly to the Project Quality Manager, who shall be part of senior management of the Contractor and independent of the construction process.

The QMS shall require that the Construction Quality Manager have a minimum of five qualified and experienced field staff individuals, who are independent of the production process, and who report directly to the Construction Quality Manager. Materials testing personnel, and quality control staff dedicated to precast girder fabrication, are not considered within this minimum number of field staff. The field staff shall have appropriate technical qualifications and a minimum of three years relevant experience, including not less than one year of cold weather construction experience.

Within 30 days of signing of the DBFO Agreement, or at a date mutually agreed between the Contractor and the Department, the Contractor shall convene a meeting to discuss and agree on document management procedures to be implemented on the Project. Within six months of the first meeting, the Contractor shall convene a second meeting with the Department to review the effectiveness of the document management measures based on feedback from all parties, and to implement any agreed upon procedural changes.

Within 60 days of signing of the DBFO Agreement, or at a date mutually agreed between the Contractor and the Department, the Contractor shall convene a meeting to discuss and confirm the Department's layout requirements for bridge design drawings and to confirm shop drawing submission requirements.

The QMS shall include, but not be limited to:

100.2.1.1 Design

The QMS shall require all designs, drawings, specifications and similar documents, for all aspects of the Project and the O&M, to be stamped and signed by Professional Engineers (the "**Design Engineer**") in accordance with *Association of Professional Engineers, Geologists, and*

Geophysicists of Alberta (APEGGA) Practice Standard for Authenticating Professional Documents V2.0.

The QMS shall require two levels of design checks as listed below:

(a) The QMS shall require all design work, including supplier designs, to be checked by a qualified Professional Engineer (the "**Check Engineer**"). The Check Engineer may be employed by the same legal entity doing the design work, provided the Check Engineer was not involved in that component of the design work. The Check Engineer shall stamp and sign all applicable design reports, drawings and specifications.

(b) The QMS shall require all bridge structure design work, including supplier designs, to be reviewed by a qualified, independent Professional Engineer (the "**Review Engineer**") selected by the Contractor but approved by the Department, acting reasonably, within 30 days of signing of the DBFO Agreement. The Review Engineer shall be employed by a legal entity that is not carrying out any design work for the Project, and that is at arm's length from and completely independent of the Contractor and any entity carrying out any design or design checking work for the Project. The design review for bridge structures done by the Review Engineer shall include, but not be limited to, the following:

- Complete review of the design data drawings and re-analysis of all aspects of the original design including hydrotechnical, geotechnical, geometric and operational safety components;
- Complete review and re-analysis of all aspects of the original structural design, preferably (but not essentially) by a methodology other than that used in the original design to ensure that the design parameters are relevant, the structural system is sound and the structural members are appropriately sized and detailed;
- Ensuring that the engineering drawings and construction specifications accurately convey the requirements of the original design; and
- Ensuring the completeness, integrity and accuracy of all aspects of the engineering drawings and construction specifications.

Without limitation, all engineering designs shall have received the design checks required by this Section 100.2.1.1, prior to submission for the Department's review. In addition to the relevant design, and at the same time the Contractor submits the engineering designs to the Department for review, the Contractor shall provide to the Province a certificate signed by the Design Engineer, the Check Engineer or the Review Engineer certifying that the design was prepared in accordance with the Technical Requirements.

If a non-conformance in the design is determined at any time, including after construction, the Contractor shall undertake the necessary modifications to ensure the as-built New Infrastructure is in accordance with the Project Requirements.

100.2.1.2 Construction

The QMS shall provide for ensuring that the as-built New Infrastructure is in conformance with the requirements of the Detailed Design and construction specifications developed for the New Infrastructure. The Contractor shall implement a methodology to verify compliance of the construction with the design requirements. Changes made to the design during construction shall be stamped and signed by the Design Engineer.

The QMS shall require that a qualified Professional Engineer be designated to each component of construction (the "**Field Review Engineer**"), to ensure that the construction of their respective component conforms to the Detailed Designs and to the Technical Requirements, and that each Field Review Engineer stamps a certificate stating that the construction component for which they have been designated responsibility has been built according to the Detailed Designs and the Technical Requirements. Field Review Engineers shall report directly to the Project Quality Manager.

Specifically for MSE walls, the QMS shall require that the supplier have full time representation on site during MSE wall construction and during any ground improvement measures below the wall, and that the MSE wall designer be given the responsibility of Field Review Engineer for all MSE walls, including all associated surface and subsurface drainage measures.

Witness Points shall be identified in the QMS, and the Department shall be given sufficient notice of all upcoming Witness Points to allow auditing of the work.

The QMS shall require that notice for concrete pours for the following Business Day be provided by email to the Department before noon of the previous Business Day, and shall identify the estimated time, location and element to be poured. The QMS shall further require that on the day of the pour, not less than two hours notice be given to the Department by email indicating the actual pour time, and notice be given to the Department by email as soon as practicable after the pour confirming that all work is complete.

The QMS shall require that a completed checklist be signed off by the Contractor's quality control staff, and that this checklist be on site and available to the Department not less than two hours prior to the planned delivery of concrete. At least one quality control field staff member shall be on site for the full duration of all concrete pours.

For all construction materials and products, the QMS shall detail the testing and acceptance program, including, but not limited to, the following:

- Material property or characteristics to be measured or inspected;
- Test methods and reference standards;
- Testing frequency;
- Inspection criteria and frequency; and
- Criteria for product acceptance/rejection.

The QMS shall require that monthly fabrication schedules be provided to the Department for the fabrication of all steel work and precast concrete work, and that updates to these are provided weekly if and when changes are made to them.

The QMS shall require that pre-construction meetings be held prior to:

- Fabrication of precast concrete elements;
- Fabrication of structural steel elements, including sign structures and bridgerail;
- Construction of MSE walls; and
- Concrete deck pours.

The QMS shall require the Contractor to conduct pre-construction meetings after the relevant shop drawings have been reviewed in accordance with Schedule 5 (Design and Plan Certification Process and Review Procedure) to the DBFO Agreement, but before fabrication commences. The Contractor shall provide notice to the Department by email at least one week prior to the meeting so that the Department may attend. The meeting shall be held at the fabricator's plant and the Contractor shall ensure that the plant superintendent and plant manager responsible for the work and any manufacturer's representative directly involved in the specialized work are in attendance.

The QMS shall require that complete testing/inspection reports be prepared for the Project and the O&M, including all test results and inspection activities for all grade, subbase, base and surfacing materials, bridge structures, curb and gutter, sidewalks, drainage items, lighting, signals, signage, pavement markings, and other appurtenances.

100.2.1.3 Operations

The QMS shall provide for ensuring that the Project and the O&M conform to the Project Requirements and the O&M Requirements respectively, as well as operating consistently with adjoining roadways.

The Contractor shall update annually during the Operating Period, the plans detailing the inspection, operation, maintenance, and New Infrastructure rehabilitation activities that will be conducted during the upcoming year to ensure that all requirements in the DBFO Agreement are met. The plans shall include information on scheduling, traffic management and communications with stakeholders.

Non-conforming inspection, operation, maintenance and rehabilitation will be considered unacceptable and the Contractor shall undertake the necessary modifications to ensure conformance with the Technical Requirements.

100.2.1.4 Audits

100.2.1.4.1 Internal Audit

The Contractor shall undertake QMS Internal Audits, as per *ISO 9001 Element 8.2.2*, during design, construction and operation, during the Construction Period and the Operating Period. The auditor shall follow the guidelines for *Auditing Management Systems, ISO 19011*, as amended or substituted from time to time. The audit shall, at a minimum, ensure that all input requirements are adhered to and that the QMS is implemented and in compliance with the requirements of *ISO 9001*, as amended or substituted from time to time, customer requirements and applicable regulatory standards. All elements shall be audited at least once per year.

All QMS deficiencies identified by the internal QMS auditor during the audit must be addressed and corrective measures implemented by the Contractor. The Contractor shall communicate the results of all audits to the Department.

100.2.1.4.2 External Audit

In addition to the internal audits, the Contractor shall undertake QMS external audits during the design, construction and operation during the Construction Period and the Operating Period.

These external audits shall be conducted by an independent QMS auditor certified by an accredited auditors' registration body such as International Register for Certificated Auditors ("**IRCA**"), Registrar Accreditation Board ("**RAB**"), National Quality Institute ("**NQI**"), or other equivalent body. The auditor shall also be qualified to audit the scope of the QMS. The audit process shall follow the guidelines for *Auditing Management Systems*, *ISO 19011*, as amended or substituted from time to time. The audit shall, at a minimum, ensure that all input requirements are adhered to and that the QMS is implemented and in compliance with the requirements of the *ISO 9001* standard, as amended or substituted from time to time, customer requirements and applicable regulatory standards. A full system audit shall be completed within one year of the Execution of the DBFO Agreement and thereafter at least once per year during the Construction Period and the Operating Period.

All QMS deficiencies identified by the external QMS auditor during the audit shall be addressed and corrective measures implemented by the Contractor within 30 days of completion of the audit. The results of the audit shall be documented and shall be submitted by the Contractor to the Department within seven days of audit completion. Evidence of the correction of any deficiencies identified in the audit shall be submitted by the Contractor to the Department within 30 days of completion of the audit.

If an external audit has not been completed within the specified time, Payment Adjustments of $2,400/week or any partial week, for the first four weeks and $6,000/week or any partial week, thereafter shall apply until so completed.

If any deficiencies identified by the external QMS auditor have not been corrected within the specified time, Payment Adjustments of $6,000/week or any partial week, for the first four weeks and $12,000/week or any partial week, thereafter shall apply until corrected.

100.2.2 ENVIRONMENTAL MANAGEMENT SYSTEM

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Environmental Management System (the "**EMS**"), as attached in Schedule 4 (Contractor's Management Systems and Plan) to the DBFO Agreement.

The EMS shall be consistent with all of the requirements of *ISO 14001* and shall cover all activities, products and services related to the Project and the O&M prior to the execution of these activities, products and services. The EMS shall address all stages of the Project and the O&M, specifically:

- Design;
- Construction; and
- Operations, including maintenance and rehabilitation.

The Contractor shall develop, implement, and maintain and shall monitor update, and manage, during the Construction Period, an ECO Plan in accordance with all requirements of the *Environmental Construction Operations* ("**ECO**") *Plan Framework – Alberta Transportation/The City of Calgary/The City Of Edmonton – 2011 Edition* as part of the EMS and subject to section 5.5 (Contractor's Designs, Plans and Schedule) of the DBFO Agreement. The ECO Plan shall include written procedures and drawings addressing the environmental mitigation and protection issues relevant to the construction activities being performed by the Contractor within the TUC and the Road Right of Way, and for all water crossings within the Project Limits. Items that shall be incorporated into the ECO Plan include, but are not limited to, the following:

- Compliance with environmental regulatory requirements;
- Topsoil handling including storage and replacement;
- Borrow excavations;
- Dust control;
- Erosion and sediment control during and after construction;
- Vegetation clearing, establishment and management (including weed control);
- Impacts to water bodies and monitoring activities; and
- Spill Management Plan. One of the requirements of the Spill Management Plan is for the Contractor to report all spills within the Project Limits to the relevant authorities forthwith, and also to the Department within 24 hours of the occurrence.

The Contractor shall develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period a Road Salt Management Plan in accordance with all requirements of the *Environment Canada - Code Of Practice For the Environmental Management Of Road Salts* as part of the EMS and subject to section 5.5 (Contractor's Designs, Plans and Schedule) of the DBFO Agreement.

The Contractor shall develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period an Animal-Vehicle Collision ("**AVC**") Monitoring Plan that records the locations, dates and type of animal species involved of all AVCs as part of the EMS and subject to section 5.5 (Contractor's Designs, Plans and Schedule) of the DBFO Agreement.

The EMS shall stipulate how compliance with all applicable laws and all the requirements in the DBFO Agreement (including without limiting the generality of the foregoing the technical requirements/commitments in the Functional Plan), is ensured. During all stages of the Project and the O&M, work shall not be started on any component of the work until after the EMS has been completed for that component of the work. The EMS shall be fully implemented to meet all the requirements of *ISO 14001* no later than 365 days after Execution of the DBFO Agreement and shall be verified by an external audit. The EMS shall include, but not necessarily be limited to the following:

100.2.2.1 Monitoring and Inspection Programs

The EMS shall provide for documented environmental monitoring and inspection programs that verify compliance with all the requirements. The documented programs shall include a description of:

- The scoping of the monitoring and/or inspection programs;
- Frequency of inspection and/or monitoring events and rationale for frequency;
- Listing of applicable performance requirement criteria (may include legislative requirements);
- Methodologies;
- Reporting; and
- The responsibilities and requirements for conducting inspections, monitoring programs, reporting results and follow-up actions.

100.2.2.2 Internal Audit

The Contractor shall undertake internal EMS audits, as per *ISO 14001 Element 4.5.5*, on a regular basis and in any event at least once per year during the design, construction and operation, during the Construction Period and the Operating Period. The auditor shall follow the current guidelines for *Auditing Management Systems*, *ISO 19011*, as amended or substituted from time to time. The audit shall, at a minimum, ensure that all input requirements are adhered to and that the EMS is implemented and in compliance with the requirements of *ISO 14001*, customer requirements and applicable regulatory and other requirements. All elements shall be audited at least once per year.

All internal audit results must be addressed, corrected and implemented by the Contractor. The results of the audit shall be documented and shall be submitted by the Contractor to the Department within seven days of audit completion. Evidence of the correction of any deficiencies identified in the audit shall be submitted by the Contractor to the Department within 30 days of completion of the audit.

100.2.2.3 External Audit

In addition to the internal audits, the Contractor shall undertake EMS external audits during design, construction and operations, during the Construction Period and the Operating Period.

These external audits must be conducted by an independent EMS auditor certified by an accredited auditors’ registration body. The auditor must also be qualified to audit the scope of the EMS. The audit process shall follow the current guidelines for *Auditing Management Systems*, *ISO 19011*, as amended or substituted from time to time. The audit shall, at a minimum, ensure that all the input requirements are adhered to and that the EMS is implemented and in compliance with the requirements of *ISO 14001*, customer requirements and applicable legal and other requirements. A full system audit shall be completed within one year of the Execution of the DBFO Agreement and thereafter at least once per year during the Construction Period and the Operating Period.

The results of the audit shall be documented and shall be submitted by the Contractor to the Department within seven days of audit completion. All EMS deficiencies identified by the external EMS auditor during the audit shall be addressed and corrective measures implemented by the Contractor, to the extent reasonable and practicable as determined by the Department acting reasonably, within 30 days of the completion of the audit. Evidence of the correction of any deficiencies identified in the audit shall be submitted by the Contractor to the Department within 30 days of completion of the audit.

If an external audit has not been completed within the specified time, Payment Adjustments of $2,400/week or any partial week, for the first four weeks and $6,000/week or any partial week, thereafter shall apply until completed.

If any deficiencies identified by the external EMS auditor have not been corrected within the specified time, Payment Adjustments of $6,000/week or any partial week, for the first four weeks and $12,000/week or any partial week, thereafter shall apply until corrected.

100.2.3 HANDLING OF QMS/EMS NON-CONFORMANCE

Non-conformance of required outputs may be a deficiency in the characteristics, documentation or procedures that makes the quality of a product, activity or service unacceptable or not according to specified requirements and any other known acceptance criteria.

In all instances, the Contractor shall review and inspect remedial work and sign-off all the non-conformance reports whether the non-conformance is identified by the Department, the Contractor, or otherwise. All remedial work shall be at the Contractor’s expense.

The Contractor shall maintain an up-to-date register of all non-conformance reports indicating their current status. A copy of all non-conformance reports shall be provided to the Department within one week of occurrence and the Contractor shall update the Department on the status of outstanding non-conformance reports on a weekly basis.

Design or construction works identified as non-conforming by the Department shall be treated as non-conforming works within the Contractor’s QMS. The Contractor’s remedies to non-conforming works reports generated as a result of the Department’s audits shall be proposed to the Department. The Contractor is required to respond to the non-conforming works report with a remedy or alternative which requires review and approval by the Department acting reasonably. Failure of the Contractor to respond to non-conformances with a reasonable plan for remedy or alternative action within 14 calendar days shall result in a Payment Adjustment of

$5,000 per occurrence.

Non-conforming construction works will be considered unacceptable and the Contractor shall undertake the necessary modifications to ensure the as-built New Infrastructure conforms to the requirements of the Detailed Designs and Technical Requirements. Work without documentation to conclusively demonstrate conformance and which cannot be verified by non-destructive testing will be considered non-conforming. In the event of the foregoing sentence, the Contractor shall be responsible for all costs associated with any testing that may be required to confirm the Technical Requirements have been met.

Any audits that identify a meaningful discrepancy between the state of the work and its representation on the Contractor's signed-off checklist shall be subject to a Payment Adjustment of $2,000 per occurrence.

All deficiencies identified during the daily activity, inspections, audits and/or reviews (internal or external) must be addressed, and corrective measures must be implemented by the Contractor. The Contractor shall submit the results of all the corrective actions and disposition of all non-conformities to the Department.

100.2.4 PROJECT SCHEDULE

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Contractor's Construction Schedule.

During the construction of the Project, the Contractor shall provide the Department with Contractor's Construction Schedules that are sufficiently detailed to give the Department a minimum of two working days advance notice of all significant construction and fabrication activities.

100.2.5 TRAFFIC MANAGEMENT PLAN

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Traffic Management Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement. The Traffic Management Plan for specific components of the Project or the O&M, as applicable, shall be reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project or the O&M, as applicable.

100.2.6 SAFETY PLAN

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Safety Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement. The Safety Plan for a specific component of the Project or the O&M, as applicable, shall be reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project or the O&M, as applicable.

100.2.7 PUBLIC COMMUNICATION STRATEGIES

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Public Communication Strategies, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement. The Public Communication Strategies for a specific component of the Project or the O&M, as applicable, shall be reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project or the O&M, as applicable.

The Contractor shall be responsible for all public communications, which shall include but not be limited to, public presentations and construction update open houses, public advertisements and mail drops, project website development, project phone hotlines, handling public complaints, etc.

Any direct contact the Contractor makes with the media or Local Authority elected officials shall be subject to the prior review and approval of the Department. This shall include media releases, interviews, advertisements, etc.

The Contractor shall maintain comprehensive records of all communications activities including documentation of the information presented, the audience, relevant dates, etc.

If the Contractor proposes major deviations from the Functional Plan or approved plans, at any time after Execution of the DBFO Agreement until the end of the Term, and is deemed to be meeting the Technical Requirements, the Contractor shall in any event proceed through a public consultation process to obtain public approval/acceptance of such deviations including undertaking the following:

- defining who the stakeholders are;
- developing a communication plan that includes the defined stakeholders as participants;
- determining a process and mechanism on how public acceptance is to be determined, measured, and obtained;
- seeking and obtaining acceptance of the communication plan and approval process from the Department; and
- potentially seeking and obtaining approval from the Local Authority and meeting the Local Authority design standards for the deviation.

100.2.8 CONSTRUCTION MANAGEMENT PLAN

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the

Operating Period, the Construction Management Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement. The Construction Management Plan for a specific component of the Project or the O&M, as applicable, shall be reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure) prior to the start of that component of the Project or the O&M, as applicable.

100.2.9 OPERATION AND MAINTENANCE PLAN

Subject to section 5.5 of the DBFO Agreement, the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Operation and Maintenance Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement.

The Operation and Maintenance Plan shall be finalized prior to the date which is two month's after Execution of the DBFO Agreement and with the exception of the snow clearing and ice control portion of the plan (the "**Snow Clearing and Ice Control Plan**") and the preferential bridge deck icing control portion of the plan (the "**Preferential Bridge Deck Icing Plan**"), shall be updated annually prior to the start of each calendar year.

The Snow Clearing and Ice Control Plan and Preferential Bridge Deck Icing Plan shall be updated annually and reviewed in accordance with Schedule 5 (Design and Plan Certification Process and Review Procedure) prior to September 15 of each year.

Traffic Availability shall not be achieved until after the Operation and Maintenance Plan for the calendar year in which Traffic Availability is to occur has been reviewed in accordance with Schedule 5 (Design and Plan Certification Process and Review Procedure).

The Contractor shall ensure that it addresses in the Operation and Maintenance Plan all of the components necessary for the safe and efficient operation of the Infrastructure and the In-Service Roads. It may also be necessary for the Contractor to modify its operations to address deficiencies not specifically identified in the Technical Requirements but which are required for the safety of the travelling public or are recognized by the industry as a normal industry practice.

The Preferential Bridge Deck Icing Plan shall be reasonably designed to prevent preferential bridge deck icing from occurring on the PBD Bridges (as defined in Section 200.2.16 (Preferential Bridge Deck Icing)).

100.2.9.1 Payment Adjustments

If the Contractor fails to develop and provide the Department with an updated Operations and Maintenance Plan (with the exception of the Snow Clearing and Ice Control Plan and Preferential Bridge Deck Icing Plan) by the start of each calendar year, the Payment Adjustment shall be $1,200/week or any partial week, until it is submitted.

If the Contractor fails to develop and provide the Department with an updated Snow Clearing and Ice Control Plan and Preferential Bridge Deck Icing Plan by September 15 of each year, the

Payment Adjustment shall be $6,000/week or any partial week, for the first four weeks and then $12,000/week or any partial week, thereafter until it is submitted.

100.2.10 INFRASTRUCTURE WHOLELIFE MANAGEMENT PLAN

Subject to section 5.5 of the DBFO Agreement and in accordance with Section 100.2.1.3 (Quality Management System – Operations), the Contractor shall further develop, implement, and maintain and shall monitor, update, and manage, during the Construction Period and the Operating Period, the Infrastructure Wholelife Management Plan, as attached in Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement.

The Infrastructure Wholelife Management Plan shall be reviewed in accordance with Schedule 5 (Design and Plan Certification Process and Review Procedure) prior to Traffic Availability and shall be updated annually prior to the start of each calendar year.

Traffic will not be allowed on the New Infrastructure until after the initial Infrastructure Wholelife Management Plan has been reviewed in accordance with Schedule 5 (Design and Plan Certification Process and Review Procedure).

100.2.10.1 Payment Adjustments

If the Contractor fails to develop and provide the Department with an updated Infrastructure Wholelife Management Plan by the start of each calendar year, the Payment Adjustment shall be $1,200/week or any partial week, until it is submitted.

100.3 DEPARTMENT REVIEW

The Contractor shall make all design, construction and operations documentation relating to the design, construction, operation and performance of the Infrastructure available to the Department for the Department's review, measurement and observation purposes.

200.0 PROJECT SPECIFICS

200.1 INFRASTRUCTURE LIMITS

200.1.1 NEW INFRASTRUCTURE

The New Infrastructure consists of the northeast portion of Anthony Henday Drive, generally described as the portion southeast from Manning Drive (Highway 15) to Whitemud Drive, the portion along Highway 16 from east of the North Saskatchewan River to east of the Sherwood Drive interchange, and the portion of Sherwood Park Freeway from 34 Street NW to Anthony Henday Drive. The New Infrastructure is set out in Schedule 13 (New Infrastructure) to the DBFO Agreement.

The New Infrastructure shall also include existing roadways, existing grading and related appurtenances (such as drainage works, lighting, and signage) located within the Project Limits, including, but not limited to, the following components:

- Portions of 17 Street NW at Sherwood Park Freeway;
- Portions of Sherwood Park Freeway;
- Portions of Baseline Road;
- Portions of 18 Street/Victoria Trail;
- Portions of Manning Drive;
- Portions of 130 Avenue;
- Portions of 153 Avenue;
- Portions of Broadmoor Boulevard;
- Portions of Sherwood Drive;
- Portions of Whitemud Drive;
- Portions of Highway 16/Yellowhead Trail; and
- Portions of Anthony Henday Drive/Highway 216.

Highway 16 within the City of Edmonton is also known as Yellowhead Trail, Highway 15 is also known as Manning Drive and Anthony Henday Drive is also known as Highway 216. Any references to Yellowhead Trail, Manning Drive and Anthony Henday Drive shall mean Highway 16, Highway 15 and Highway 216 respectively; and vice versa.

The Anthony Henday Drive alignment is within the TUC, whereas the Highway 16 and Sherwood Park Freeway alignments are within provincial road right-of-way boundaries. Unless otherwise specified, the Project Limits will be the boundary of the TUC or provincial road right-of-way boundary, except where the New Infrastructure must extend beyond the boundary of the TUC or provincial road right-of-way boundary to tie into the adjacent existing roadways, in which case the New Infrastructure located outside of the TUC or provincial road right-of-way boundary will be considered within the Project Limits.

200.1.1.1 New Infrastructure Limits - Interim Restrictions

As of Execution of the DBFO Agreement, the Province is still in the process of acquiring some properties required for the construction of the New Infrastructure. Such properties are known as "**To Be Acquired Lands**" and such term is defined in the second paragraph of section 4 of Schedule 12 (Lands). Unless otherwise authorized in advance and in writing by the Department, the Contractor shall not enter upon the To Be Acquired Lands until the To Be Acquired Lands have been transferred to the Department, which will be by August 15, 2012 with the exception of the property with short legal description NW 8-53-23-4, which will be transferred by April 1, 2013. In addition, the property with short legal description Plan 4558TR, Lot K will not be available to the Contractor until June 30, 2013 and the property with short legal description Plan 7520635, Block 5, Lot R3 will not be available to the Contractor until May 1, 2013.

200.1.2 EXISTING INFRASTRUCTURE

Existing Infrastructure includes the existing bridge structures at:

- Whitemud Drive over Anthony Henday Drive (Department Bridge File Numbers BF81157E-1 and BF81157W-2);
- 34th Street over Sherwood Park Freeway (Department Bridge File Number BF76094-1); and
- Sherwood Park Freeway over the CNR tracks east of the City boundary (Department Bridge File Numbers BF76093E-1 and BF76093W-2).

as set out in Schedule 8 (Existing Infrastructure) to the DBFO Agreement.

200.2 DESIGN AND CONSTRUCTION OF NEW INFRASTRUCTURE

200.2.1 GENERAL

The Contractor is responsible for the design, construction, operation, maintenance and rehabilitation of the New Infrastructure which includes, but is not limited to, a multi-lane roadway, connecting roadways, crossroads, interchanges, bridge structures and associated infrastructure.

The design and construction requirements of the Department with respect to the location, function, stages and interconnection of the New Infrastructure are identified in the Functional Plan and further defined in the Technical Requirements.

The requirements of the Department for the New Infrastructure are consistent with staged project delivery of components of the Functional Plan, as generally described below:

- Construction of Anthony Henday Drive from Manning Drive to south of Whitemud Drive;
- Construction of Highway 16 from east of the North Saskatchewan River to east of Sherwood Drive interchange;
- Anthony Henday Drive interchanges, flyovers and river crossings at the following locations generally within the TUC as further described in Section 200.2.3.6 (Interchanges and Grade Separations) and Section 200.2.3.7 (Other Crossings):
    - Manning Drive (partially constructed as part of the Northwest Anthony Henday Drive project);

  - 18 Street/Victoria Trail;
  - 153 Avenue;
  - North Saskatchewan River;
  - 130 Avenue;
  - Yellowhead Trail;
  - Petroleum Way;
  - Baseline Road;
  - Sherwood Park Freeway; and
  - Portions of Whitemud Drive.
- Highway 16 interchanges at the following locations generally within the provincial road right-of-way boundaries:
  - Portions of 17 Street NW/Hayter Road;
  - Broadmoor Boulevard;
  - Sherwood Drive; and
  - Portions of Clover Bar Road.
- 17 Street NW/Sherwood Park Freeway interchange;
- CNR grade separations of CN Rail Coronado Subdivision, Vegreville Subdivision, and Wainwright Subdivision;
- CPR grade separations of the CP Rail Meridian Spur Line and Willingdon Subdivision;
- CNR grade separations of the CN Rail Clover Bar Yard; and
- Modifications at the CNR grade separations of CN Rail Camrose Subdivision and Camrose/Wainwright Subdivision Connection.

Stage 1 shall include grading of the mainline, interchanges and crossroads to the Ultimate Stage, with exceptions as noted in Section 200.2.3 (Design Specifics). Stage 1 shall also include the construction of embankments for Ultimate Stage ramps, construction of Ultimate Stage retaining walls and construction of Ultimate Stage bridge embankments.

Prior to Traffic Availability, the Contractor will be required to design and construct Service Roads at the following locations as further described in Section 200.2.3.18 (Service Roads):

- 167 Avenue;
- 130 Avenue;
- 17 Street NW/115 Avenue;
- CNR Clover Bar Yards/Hayter Road;
- Petroleum Way;
- 76 Avenue/Meridian Street;
- Sherwood Park Freeway;
- Yellowhead Trail; and
- Broadmoor Boulevard.

The Local Authority will assume responsibility for Service Roads upon opening of the particular Service Road to traffic in accordance with section 5.18 of the DBFO Agreement.

The design of all crossroad elements, including ramps and intersections shall be supported by traffic simulation in accordance with Section 300.4.1.2.1 (Traffic Simulation) using Synchro/Sim Traffic software for the following interchanges:

  - 153 Avenue;
  - 130 Avenue;
  - Baseline Road;
  - 17 Street NW at Sherwood Park Freeway;
  - Broadmoor Boulevard; and
  - Sherwood Drive.

200.2.2 GEOMETRIC DESIGN

The following design guides shall form the basis for the geometric design, and the order of hierarchy of these guides, unless specifically indicated otherwise, shall be consistent with the numeric order presented:

1. *Alberta Transportation Highway Geometric Design Guide* and any applicable Alberta Transportation *Design Bulletins* (the **"Highway Geometric Design Guide"**)*;*
2. *Alberta Infrastructure and Transportation Roadside Design Guide, November 2007* and any applicable Alberta Transportation *Design Bulletins* (the **"Roadside Design Guide"**)*;*
3. *Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads* (the **"TAC Geometric Design Guide"**)*;*
4. *The City of Edmonton Design and Construction Standards; and*
5. *Strathcona County Engineering Servicing Standards.*

In addition, the design shall meet the following requirements:

- The Mainline is to be designed as a rural, barrier-free, illuminated, high speed, free-flow, fully access controlled facility;
- All interchange ramp exits and entrances are to be located on the right-hand side, and no left-hand exit or entrance ramps will be permitted;
- No left hand side (median) lane additions or lane drops will be permitted on Anthony Henday Drive or Highway 16;
- The use of a Diverging Diamond Interchange ("**DDI**") design concept for interchanges is prohibited;
- Roundabouts are not permitted at ramp terminals;
- Two-lane entrance ramp design shall follow the guidance shown in the publication *A Policy on Geometric Design of Highways and Streets 2004* (pages 856 to 859) by AASHTO; the parallel design as shown in Exhibit 10-76-B should be used;
- Two-lane exit ramp design shall generally follow the guidance shown in the publication *A Policy on Geometric Design of Highways and Streets 2004* (page 859 to 860) by AASHTO; the tapered design as shown in Exhibit 10-77-A should be used;
- Only one exit ramp per direction is to be provided at freeway to freeway interchanges; that is, consecutive exits for two different directions are to be combined into a single exit or from a C-D road, except for westbound Sherwood Park Freeway at the interchange with Anthony Henday Drive. The following interchanges are considered freeway to freeway interchanges:
  - Anthony Henday Drive/Manning Drive;
  - Anthony Henday Drive/Yellowhead Trail (Highway 16); and

  - Anthony Henday Drive/Sherwood Park Freeway.
- Stormwater drainage is to be accommodated with open surface ditch drainage, roadway culverts, stormwater management facilities and/or grass or other emergent vegetation as per Section 6A.3 Grassed Swales, of the *Stormwater Management Guidelines for the Province of Alberta*, with check dams where volumetric and water quality controls are required, and concrete pond outflow control facilities and discharge sewers;
- Interchange exit terminals shall provide appropriate decision sight distance required for the design speed of the Mainline at Mainline terminals, and as required for the design speed of the crossroad for crossroad terminals;
- Alignment of crossroads which exist on tangent within the Project Limits shall remain on tangent in Stage 1 unless the Department has granted the Contractor prior written consent to allow a curvilinear alignment to address the following:
  - land constraints; or
  - to complement natural topography; or
  - to facilitate the staged delivery of the Ultimate Stage;
- Transition from rural freeway standards to arterial standards (curb and gutter), where applicable, is to occur at the arterial end of interchange ramps connecting to the crossroads;
- Lane balance shall be provided in Stage 1 and shall be maintained for subsequent staging up to the Ultimate Stage;
- The use of combinations of inter-related minimum design criteria is not acceptable;
- All Elevated Directional Ramps shall be designed to accommodate two lanes, with the exception of the directional ramp carrying northbound Anthony Henday Drive onto westbound Yellowhead Trail;
- The existing vertical geometry on Yellowhead Trail from the North Saskatchewan River to the 17 Street NW road crossing shall generally follow the existing geometric profile;
- The existing vertical geometry on Sherwood Park Freeway from 500 m east of the CN structures to the west Project Limits shall generally follow the existing geometric profile;
- Design Speed and Radii:
  - Mainline .... 110 km/h
  - Crossroad (expressways)...90 km/h
  - Crossroad (arterials) ....70 km/h
  - C-D road .... 80 km/h
  - Directional ramp – freeway to freeway (main level)............................... 80 km/h
  - Elevated Directional Ramp – freeway to freeway, with the exception of lateral stopping sight distance .... 80 km/h
  - Minimum radii of Elevated Directional Ramps ....340 m
  - Directional ramp – entering crossroad.............Match Design Speed of Crossroad
  - Loop ramp off Mainline, crossroads and C-D roads .... 50 km/h
  - Minimum radii of loop ramp off Mainline, crossroads and C-D roads............90 m
  - Other directional ramps entering freeway (at gore) ....90 km/h
  - WB-SB directional ramp at Yellowhead Trail/Anthony Henday Drive......90 km/h
  - Ramps entering and exiting freeways, use running speed at entrance and exit gores as outlined in the Highway Geometric Design Guide.

Exceptions to design criteria:

- o Sherwood Park Freeway west of 17 Street NW .... 110 km/h
- o Sherwood Park Freeway under the 17 Street structure .... 110 km/h
- o Sherwood Park Freeway east of 17 Street NW to the TUC boundary ..... 90 km/h
- o Manning Drive... 90 km/h
- o Whitemud Drive .... 90 km/h
- o Baseline Road... 80 km/h
- o Curved portion of the EB-SB ramp at Yellowhead Trail and the 115 Avenue Service Road.. 45 km/h
- o Curved portion of the NB-EB ramp at Yellowhead Trail and the 115 Avenue Service Road.. 50 km/h
- o Notwithstanding the above, no loop ramp shall have a radius less than that shown on the Appendix A Drawings.

- **Posted Speed:** The posted speed shall be 10 km/h less than the design speed.

- **Vertical Grades:**
  - o Mainline .... 3.0% Max.
  - o Directional ramps, C-D roads, and other cross roads (90 km/h) .... 4.0% Max.
  - o Directional ramps, C-D roads, and other cross roads (80 km/h) .... 4.5% Max.
  - o Ramps
    - ▪ On ramps.. 6.0% Max.
    - ▪ Off ramps .... 4.0% Max.
  - o Crossroads (design speed 70 km/h)
    - ▪ Interchanges .... 4.0% Max.
    - ▪ Flyovers .... 5.0% Max.
    - ▪ Urban cross-sections (curb & gutter)...0.6% Min.
  - o Bridge deck longitudinal grade .... 3.0% Max.

- **Exceptions to bridge deck longitudinal grade criteria:**
  - o Anthony Henday Drive NB-WB bridge structure at Yellowhead Trail over Yellowhead Trail WB-NB ramp to Hayter Road, as shown on Drawing 18-A-5.15 in Appendix A .... 4.5% Max.
  - o Sherwood Park Freeway EB-NB ramp bridge structure over Anthony Henday Drive, as shown on Drawing 18-A-5.03 in Appendix A .... 3.6% Max.
  - o Anthony Henday Drive NB-WB Elevated Directional Ramp bridge structure over Yellowhead Trail, as shown on Drawing 18-A-5.12 in Appendix A .... 4.3% Max.

- **K Values:**
  The K values shall meet or exceed the values shown in the following table:

Design Speed (Km/h)	Crest K Factor	Sag K Factor
120	190	92
110	141	78
100	98	63

Design Speed (Km/h)	Crest K Factor	Sag K Factor
90	66	51
80	45	40
70	29	31
60	17	22
50	10	15
45	7	12

- **Exceptions to K-Value:**
  - The sag curve on the eastbound to southbound ramp at Yellowhead Trail, which shall be greater than or equal to a sag K factor of 36; and
  - The crest curve on the southbound to westbound ramp at Yellowhead Trail, which shall be greater than or equal to a crest K factor of 29.

- **Vertical Curves:**
- Minimum length of sag and crest vertical curves:
  - i. On Mainline and Sherwood Park Freeway .... 300 m
  - ii. On directional ramps, C-D roads and other roads (design speed = 90 km/h) .... 250 m
  - iii. On Elevated Direction Ramps, directional ramps, C-D roads and other roads (design speed = 80 km/h) .... 200 m
  - iv. On other roads (design speed = 70 km/h) .... 150 m

- Minimum distance between crest and sag vertical Points of Intersection (“**PI**”):
  - i. On Mainline and other roads (design speed = 110 km/h) .... 500 m
  - ii. On directional ramps, C-D roads and other roads (design speed = 90 km/h) .... 400 m
  - iii. On directional ramps, C-D roads and other roads (design speed = 80 km/h) .... 300 m
  - iv. On other roads (design speed = 70 km/h) .... 250 m

- **Exceptions to Vertical Curves:**
  - On Sherwood Park Freeway at 17 Street distance between sag and crest Points of Intersection .... 325 m
  - On Sherwood Park Freeway at EB-SB ramp to Anthony Henday Drive distance between sag and crest Points of Intersection .... 235 m
  - On Sherwood Park Freeway at EB-SB ramp at Anthony Henday Drive length of sag vertical curve .... 160 m
  - On Anthony Henday Drive NB-EB ramp at Sherwood Park Freeway length of crest vertical curve .... 190 m
  - On Yellowhead Trail WB-NB ramp at Anthony Henday Drive distance between sag and crest Points of Intersection .... 235 m

- **Superelevation:**
  - All roads and bridges (e max) .... 0.06 m/m

- Bridges shall not be on spiral curve or superelevation transition

- **Exceptions to spiral curve or superelevation transition on bridges:**
  - Anthony Henday Drive NB-WB at Yellowhead Trail over Yellowhead Trail WB-NB ramp to Hayter Road, as shown on Drawing 18-A-5.15 in Appendix A;
  - Anthony Henday Drive SB-EB ramp to Broadmoor Boulevard over Yellowhead Trail WB-SB ramp along CPR, as shown on Drawing 18-A-5.16 in Appendix A;
  - Victoria Trail over Anthony Henday Drive;
  - Yellowhead Trail EB ramp to Broadmoor Boulevard over Yellowhead Trail WB-SB ramp and CPR, as shown on Drawing 18-A-5.18 in Appendix A; and
  - Anthony Henday Drive WB over CNR Coronado, as shown on Drawing 18-A-5.34 in Appendix A.

- **Ramp Terminals Along Mainline, Freeways and C-D Lanes:**
  - Direct taper design as per Figures E-1.1, E.-1.2, E-1.3 of the Highway Geometric Design Guide for both exit and entrance terminals.
  - A two-lane exit shall be used for all-ramps with design year traffic volumes of 1500 vph or higher.
    1. Exceptions to two-lane exit design criteria:
    2. Manning Drive SB-EB directional ramp shall be a one-lane exit in Stage 1;
    3. NB-EB/WB ramp at Anthony Henday Drive and 153 Avenue shall be a one-lane exit in Stage 1; and
    4. SB-WB directional ramp at Anthony Henday Drive and Sherwood Park Freeway shall be a one-lane ramp in Stage 1 and Ultimate Stage.

- **Weaving Distance:**
  - The absolute minimum weaving distance between consecutive Systems Ramps and all other ramps shall be no less than 800 metres in all cases.
  - The absolute minimum weaving distance between all other ramps shall be no less than 600 m in all cases.
  - Weaving sections are not permitted on Systems Ramps.
  - The weave distances shall be measured in accordance with the Highway Geometric Design Guide.

- **Exceptions to Weaving Distance:**
  - Weaving distance on Sherwood Park Freeway between Anthony Henday Drive and 17 Street NW in the westbound direction shall be at least 675 m in Stage 1 and 640 m in the Ultimate Stage;
  - Weaving distance on Sherwood Park Freeway between 17 Street NW and Anthony Henday Drive in the eastbound direction shall be at least 545 m in Stage 1 and 550 m in the Ultimate Stage;
  - Weaving distance on Yellowhead Trail between Broadmoor Boulevard and Anthony Henday Drive in the westbound direction shall be at least 575 m in Stage 1 and 540 m in the Ultimate Stage;

- Weaving distance in Stage 1 on Anthony Henday Drive between Yellowhead Trail and 130 Avenue shall be at least 700 m in the northbound direction; and
- Weaving distance on Yellowhead Trail between the ramp entrance from the 17 Street industrial area and the ramp exit to Broadmoor Boulevard in the eastbound direction shall be at least 565 m in Stage 1 and the Ultimate Stage.

- **Lane Widths:**
  - Mainline, Sherwood Park Freeway, Whitemud Drive, Baseline Road.... 3.7 m
  - C-D road - 1 Lane........ 4.8 m
    - 2 Lanes .... 3.7 m
  - Ramp - 1 Lane........ 4.8 m
    - 2 Lanes .... 3.7 m
  - Crossroads ....(Refer to Appendix A Drawings 18-A-4.02 to 18-A-4.04).
  - Directional ramps
    - 2 lanes........ 3.7 m
    - 1 lane .... 4.8 m

- **Shoulder Widths:**
  - Mainline
    - Inside (4 and 6 Basic Lanes)........ 2.5 m
    - Inside (8 and 10 Basic Lanes)........ 3.0 m
    - Outside........ 3.0 m

Notwithstanding the foregoing all Stage 1 shoulders on Anthony Henday Drive that will become a future traffic lane shall be 3.7 m wide, except on bridge structures.

- Elevated Directional Ramps
  - Inside .... 2.5 m
  - Outside........ 3.0 m
- Directional ramps
  - Inside (1 lane) .... 1.0 m
  - Outside (1 lane) .... 2.5 m
  - Inside (2 lanes)........ 2.5 m
  - Outside (2 lanes) .... 3.0 m
- C-D road
  - Inside (1 Lane)........ 1.0 m
  - Outside (1 Lane) .... 2.5 m
  - Inside (2 Lanes) .... 2.5 m
  - Outside (2 Lanes)........ 3.0 m
- Ramp
  - Inside (1 Lane) .... 1.0 m
  - Outside (1 Lane) .... 2.5 m
  - Inside (2 Lanes) .... 2.0 m
  - Outside (2 Lanes)........ 3.0 m
- Crossroads .... (Refer to Drawings in Appendix A)

Notwithstanding the shoulder widths stated above, wider shoulders may be required to satisfy shy distance requirements or stopping sight distance requirements on bridge structures. In no case shall the shoulder be wider than 3.5 m.

- **Exceptions to Shoulder Widths:**
    - All shoulders on Yellowhead Trail shall be 3.0 m in Stage 1 and the Ultimate Stage, except for the section of Yellowhead Trail between the North Saskatchewan River and 17 Street NW where the inside shoulder width shall not be less than 2.5 m.

- **Median Width** (as defined in the Highway Geometric Design Guide)**:**
    - Ultimate Stage Mainline .... 23.2 m
    - Stage 1 Mainline .... no less than 23.2 m

Please note that although the Drawings in Appendix A may illustrate a narrower median in certain locations, the Contractor is required to provide the Median Width indicated above. The Contractor shall construct all ramp gores in their Ultimate Stage location in Stage 1. The Contractor shall also design and construct the Mainline to avoid crown shifts at the Ultimate Stage widening.

- **Outer Separation for C-D roads in a multiple interchange configuration shall be as follows:**
    - 17.0 m minimum single interchange, no transfer lane
    - 20.0 m minimum multiple interchanges, no transfer lane
    - 30.0 m minimum multiple interchanges, with transfer lane(s)

Outer separation is measured from outer edge of travel lane on the mainline to inner edge of travel lane on the C-D road.

- **Exceptions to Outer Separation:**
    - The separation in Stage 1 and the Ultimate Stage between Anthony Henday Drive mainline and the existing northbound and southbound C-D roads at Whitemud Drive shall be at least 16.3 metres (to match existing separation);
    - The separation in the Ultimate Stage between westbound Yellowhead Trail and the WB-SB ramp to Anthony Henday Drive SB shall be at least 18.5 metres;
    - The separation in Stage 1 and the Ultimate Stage between eastbound Yellowhead Trail and the C-D road connecting Broadmoor Boulevard and Sherwood Drive shall be at least 20.0 metres; and
    - The separation in Stage 1 and the Ultimate Stage between westbound Anthony Henday Drive and the westbound C-D road shall be at least 14.4 metres between the Manning Drive entrance and exit loop ramps.

- **Outer Separation**
    - The separation in Stage 1 and the Ultimate Stage between the WB-SB and

NB-EB Systems Ramps at Yellowhead Trail and Anthony Henday Drive shall be no less than 17.0 metres.

- **Pedestrian Walk and Multi-Use Trails:**
  - Width of Multi-Use Trail
    - On grade ....3.0 m
    - On bridges and along retaining structures............................. 4.2 m

    (The 4.2 m width of Multi-Use Trail allows for 0.6 m shy distance to the barrier and/or railing on each side.)
  - Width of Pedestrian Walk
    - On grade and structures ....2.5 m
  - Height of Bridge barrier and/or Railing on bridge and downslope retaining structures outside of Multi-Use Trail and Pedestrian Walk ....1.4 m.
  - Multi-Use Trail and Pedestrian Walk on bridge structures and downslope retaining structures shall be separated from the traffic lanes by a barrier.

  Note: The requirements for the pedestrian crossing and trail connections at the North Saskatchewan River crossing are listed in Section 200.2.3.6.4 (North Saskatchewan River Crossing).

- **Slopes** (*All slope ratios are expressed in horizontal:vertical. All references to slope requirements mean that no slopes shall be steeper than those listed below)*:
  - Pavement Structure Sideslopes
    - Mainline, system connectors, and directional ramps 6:1
    - C-D roads, ramps, and crossroads...5:1
  - Subgrade Sideslopes
    - Mainline and System Connector
      - Fill 0 - 2.5 m...6:1
      - Fill 2.5 - 3.0 m .... Slope Variable, Toe at 15 m Fixed
      - Fill 3.0 - 4.0 m...5:1
      - Fill 4.0 - 5.0 m .... Slope Variable, Toe at 20 m Fixed
      - Fill Over 5.0 m 4:1
    - Crossroads, C-D roads and ramps
      - Fill 0 - 4.0 m...5:1
      - Fill 4.0 - 5.0 m .... Slope Variable, Toe at 20 m Fixed
      - Fill Over 5.0 ....4:1
    - Bridge approaches
      - Sideslopes at bridge locations with guardrail 3:1
    - Service Roads
      - All cases 4:1
  - Bridge Headslopes ....No steeper than 2:1
  - Ditch Backslopes (Top of backslopes to be rounded)
    - Height 0.0 - 3.0 m...5:1
    - Height 3.0 - 5.0 m.............Slope Variable, Toe at 15 m Fixed

- Height Over 5.0 m:
  Slope inclination shall be determined based on the results of a geotechnical investigation and slope stability analyses such that a minimum long term factor of safety of 1.3 is attained, but no steeper than 3:1

- Berms within the Road Right of Way .... No steeper than 3:1
- Berms within the TUC but outside the Road Right of Way………………………No steeper than 6:1 *
  (* unless otherwise approved in writing and in advance by the Department of Infrastructure)
- Slopes in front of retaining walls that are nominally parallel to the roadway 3:1

- **Width of Ditch** *(Ditches shall be rounded.)*: ………………………3.0 m Min. (before rounding)

- **Vertical Clearances** *(Allowance to be made during design for all future pavement overlays proposed prior to end of the Term)*: `
  - Roadway - underside of superstructure to top of roadway........................5.51 m Min.
  - Roadway - underside of straddle bent to top of roadway............................6.00 m Min.
  - Roadway – underside of High Load Corridor superstructure to top of roadway ....9.14 m Min.
  - Railway over roadway - underside of superstructure to top of roadway....5.51 m Min.
  - Sign structures – roadway surface to underside of sign panel.....................6.0 m Min.
  - Pedestrian overpass - underside of superstructure to top of roadway...........** m Min.

  (** the greater of 6.0 m and 0.6 m higher than the nearest road bridges over approaching traffic in either direction)
  - Roadway over railway - underside of superstructure to top of rail...........7.01 m Min.
  - High Load Corridor roadway - to high voltage power lines (69 kV and greater) ....11.4 m Min.
    (The Contractor shall confirm clearance requirements with power line utility and obtain confirmation in writing.)
  - Roadway – to high voltage power lines:
    - >22 kV to 50 kV ....6.04 m Min.
    - >50 kV to 90 kV .... 6.7 m Min.
    - >90 kV to 120 kV .... 6.9 m Min.
    - >120 kV to 150 kV .... 7.3 m Min.
    - >150 kV to 200 kV .... 7.8 m Min.

    (The Contractor shall confirm clearance requirements with the Alberta Electrical Utility Code and the power line utility and obtain confirmation in writing.)

- **Horizontal Clearances:**
  - Edge of shoulder to toe of bridge headslope .... 3.0 m Min.
  - Edge of Ultimate Stage travel lane to face of bridge substructure element, retaining walls, existing or relocated power poles and towers, cantilevered sign support structures and overhead sign support structures shall be equal to or greater than the clear zone as specified in the Roadside Design Guide. Use of guardrail/barrier to reduce clear zone dimensions is only permitted on the raised medians of crossroads with a design speed of 80 km/h or less and on Service Roads.
  - Edge of travel lane to face of bridge barrier or guardrail

  - Shall not exceed 3.5 m.
- Back of guardrail to solid object
  - Distance to meet manufacturer's recommendation for design deflection at each design speed.
- Clear zone calculations for parclo entrance ramps adjacent to bridges shall be based on the directional ramp standard of 90 km/h.
- Clear zone calculations for entrance and exit ramp tapers adjacent to bridges shall be based on the design speed of the adjacent roadway from which the taper is developed.
- Clear zone calculations for slopes in front of bridge piers, power poles, towers, cantilevered and overhead sign structure supports and retaining walls that are nominally parallel to the roadway shall be based on 'fill slopes' values.
- The distance from face of barrier to a continuous feature (e.g. MSE wall) shall be equal to or greater than the applicable zone of intrusion as identified in the Roadside Design Guide, Section H5.4.4.
- For loop ramps with design speed less than 60 km/h and with a curve radius of less than 100 m, the curve modification factor shall be factor shall be 1.5.

- **Horizontal Clearance exceptions:**
  - Shy distance along the existing bridge on the south side of the ramp carrying Hayter Road onto WB Yellowhead Trail at CNR rail crossing - Camrose Subdivision at Mile 0.16; shy distance shall be no less than 1.0 metres from the edge of driving lane to face of barrier at the north pier;
  - Shy distance alongside the existing bridge on the south side of the ramp carrying Hayter Road onto WB Yellowhead Trail at CNR rail crossing - Camrose/Wainwright Subdivision connection; shy distance shall be no less than 1.0 metres from edge of driving lane to face of barrier at the north pier;
  - The tangent eastbound portion of the EB-NB ramp at the Anthony Henday Drive/Yellowhead Trail interchange shall have a design speed of 90 km/h for the purpose of clear zone calculations to substructure elements of the NB, SB, and NB-WB bridge structures;
  - The curved section of the EB-NB loop ramp from Yellowhead Trail to Anthony Henday Drive shall be 50 km/h for the purpose of clear zone calculations to substructure elements of the NB-WB ramp over the EB-NB loop ramp bridge structure. Additional clearance may be required to meet decision sight distance requirements and roadside design requirements, as listed in the Roadside Design Guide*:* and
  - For clear zone calculation purposes, the design speed for the exit taper leading to the loop ramp to Broadmoor Boulevard shall be 90 km/h. Additional allowance may be required to meet decision sight distance requirements.

- **Clear Zone Exceptions**
  - Continuous concrete barrier/retaining wall is required alongside the existing bridge piers at CNR Mile 0.26 Camrose Subdivision; the minimum clear zone dimension shall be 3.6 metres from the edge of driving lane to face of barrier/retaining wall at pier 1, and 4.3 metres from the edge of driving lane to face of barrier/retaining wall

at pier 2;

- Continuous concrete barrier/retaining wall is required alongside the existing bridge pier on the north side of Yellowhead Trail WB at CNR rail crossing – Camrose Subdivision at Mile 0.16; the minimum clear zone dimension shall be 3.0 metres from the edge of driving lane to the face of barrier/retaining wall at pier 1;
- Continuous concrete barrier/retaining wall is required alongside the existing bridge pier on the south side of the ramp carrying Hayter Road on to WB Yellowhead Trail at CNR rail crossing – Camrose Subdivision at Mile 0.16; the minimum clear zone dimension shall be 1.0 metre from the edge of driving lane to the face of barrier/retaining wall at pier 1;
- Continuous concrete barrier/retaining wall is required alongside the existing bridge piers on Yellowhead Trail WB at CNR Rail crossing – Camrose/Wainwright Subdivision Connection; the minimum clear zone dimension shall be 3.0 metres from the edge of driving lane to face of barrier/retaining wall at pier 1, and 3.0 metres from the edge of driving lane to face of barrier/retaining wall at pier 2;
- Continuous concrete barrier/retaining wall is required alongside the existing bridge pier on the south side of the ramp carrying Hayter Road on to WB Yellowhead Trail at CNR Rail crossing – Camrose/Wainwright Subdivision Connection; the minimum clear zone dimension shall be 1.0 metre from the edge of driving lane to face of barrier/retaining wall at pier 1;
- Continuous concrete barrier/retaining wall is required alongside the existing bridge piers on Yellowhead Trail WB at 17 Street NW; the minimum clear zone dimension shall be 3.3 metres from the edge of driving lane to face of barrier/retaining wall at pier 1, and 4.5 metres from the edge of driving lane to face of barrier/retaining wall at pier 2;
- Continuous concrete barrier/retaining wall is required alongside the existing bridge piers on the ramp carrying Hayter Road on to WB Yellowhead Trail at 17 Street NW; the minimum clear zone dimension shall be 1.8 metres from the edge of driving lane to face of barrier/retaining wall at pier 2, and 2.5 metres from the edge of driving lane to face of barrier/retaining wall at abutment 2;
- Continuous concrete barrier/retaining wall is required alongside the existing bridge piers on Yellowhead Trail EB at 17 Street NW; the minimum clear zone dimension shall be 3.3 metres from the edge of driving lane to face of barrier/retaining wall at pier 1, and 4.3 metres from the edge of driving lane to face of barrier/retaining wall at pier 2;
- Median barrier permitted at overhead sign structure in the median between EB and WB Sherwood Park Freeway, east of Anthony Henday Drive;
- Median barrier permitted at overhead sign structure on Yellowhead Trail WB at Hayter Road exit (along Yellowhead Trail EB and WB);
- Barriers are permitted on Yellowhead Trail EB and WB and Hayter Road onramp at 17 Street NW, CNR's crossing - Camrose Mile 0.16 Subdivision, Camrose Mile 0.26 Subdivision, and Camrose/Wainwright Subdivision Connection. All existing guardrail at these locations shall be removed and replaced as required as part of the New Infrastructure;
- Median barrier is permitted at the existing overhead sign structure in the median between EB and WB Sherwood Park Freeway, east of Anthony Henday Drive; and

  - Median barrier is permitted at overhead sign structure in the median of Yellowhead Trail WB at Hayter Road exit to protect from EB and WB traffic.

- **Roadside Design**

- Roadside barriers that are not located on bridges or on top of retaining walls shall meet the following criteria:

  - If the design speed is 100 km/h or greater..TL-4
  - If the design speed is less than 100 km/h TL-3

- The longitudinal traffic barrier systems shall be selected based on the guidance in section H3.2.3.1 of the Roadside Design Guide.
- Concrete barriers may be used at bridge locations on crossroads. Vehicular traffic barriers on structures shall be rigid barriers and shall meet, the requirements of Performance Level 2 (TL-4) or higher as defined by the Bridge Design Code, except that Performance Level 3 (TL-5) barriers shall be provided on all of the following structures:
  - All structures carrying the Mainline;
  - All structures located on Elevated Directional Ramps;

- Bicycle barriers meeting the requirements of the Bridge Design Code shall be provided in locations where sidewalks and multi-use trails are located adjacent to and on the high side of a retaining wall.

- Energy attenuator systems for guardrail approach terminals shall pass all required tests for a Test Level 3 (TL-3) for terminals and redirective crash cushions of the *AASHTO Manual for Assessing Safety Hardware (2009)* ("**MASH**");

- Transitions to Bridge barriers - The transitions to bridge barriers shall pass all required tests for a Test Level 4 (TL-4) of *MASH*;

- Roadway set-back distances from oil and gas wells shall be compliant with Energy Resources Conservation Board (or its successor) regulations and guidelines and shall address both the current operating status of the wells (which may include abandoned, decommissioned, or active wells) and the potential future operating status;

- Longitudinal rumble strips on either shoulder or centreline shall not be used; and

- Where curbs are used to control roadway surface drainage and are combined with a roadside barrier, the provisions in the Roadside Design Guide shall apply except as modified below:
  - Curbs shall be mountable type and shall only be used in combination with W-beam strong post barrier systems (with steel or wood posts) or standard Department approach rail transitions;
  - Curbs shall not be used on the mainline roadways.

- **Stopping Sight Distance ("SSD"):**
  - Horizontal - Meet or exceed the Highway Geometric Design Guide values for lateral clearance on horizontal curves for stopping sight distance (Figure B-3.9b); and
  - Horizontal – In the case of curves at bridge and/or guardrail locations, meet or exceed the Highway Geometric Design Guide for lateral clearance on horizontal curves for stopping sight distance (Figure B-3.9b) with shoulder width not to exceed 3.5 m.

- **Decision Sight Distance**:
  - Anthony Henday Drive, Whitemud Drive, Sherwood Park Freeway, Manning Drive, Yellowhead Trail mainline - interchange exit terminals - decision sight distance shall be based on a driver's eye height of 1.05 m and an object height of 0.0 m at the physical gore. Decision sight distance shall be provided appropriate to the applicable design speed.
  - Crossroads - interchange exit terminals - decision sight distance shall be based on a driver's eye height of 1.05 m and an object height of 0.38 m at the physical gore. Decision sight distance shall be provided appropriate to the applicable design speed and shall exceed the upper values for vertical stopping sight distance requirements listed in the TAC Geometric Design Guide by 25%.
  - Directional Ramps and C-D roads – interchange exit terminals – decision sight distance shall be based on a driver's eye height of 1.05 m and an object height of 0.0 m at the physical gore. Decision sight distance shall be provided for the applicable design speed.

- **Exceptions to Decision Sight Distance:**
  - Decision sight distance for the exit ramp from Yellowhead Trail EB C-D road to the Yellowhead Trail EB-SB directional ramp to Anthony Henday Drive and the Anthony Henday Drive SB-EB directional ramp exit to the connector ramp to Broadmoor Boulevard shall exceed vertical stopping sight distance TAC Geometric Design Guide upper value requirements by 25%.

- **Horizontal and Vertical Alignments –Mainline:**
  - The Contractor shall design the mainline horizontal and vertical alignment to avoid any perceived roller coaster or kinked curve appearance, and shall ensure that the alignment complements the existing topography.

- **Exceptions to horizontal alignment:**
  - Anthony Henday Drive SB-WB ramp at Yellowhead Trail – design speed = 70 km/h
  - Anthony Henday Drive NB-WB Elevated Directional Ramp at Yellowhead Trail R = Minimum 318.5(design speed = 80 km/h);
  - Sherwood Park Freeway loop ramps - design speed = 45 km/h;
  - Baseline Road loop ramps - design speed = 45 km/h;
  - 17 Street NW ramp to Yellowhead Trail WB – R = 60;

- 153 Avenue loop ramps - Design Speed = 45 km/h; and
- Yellowhead Trail WB-SB loop ramp at Broadmoor Boulevard - design speed = 45 km/h;

- **Exceptions to taper length:**
  - The taper length of the ramp carrying Hayter Road on to westbound Yellowhead Trail shall be 310 m, ending at the approach slab of the existing North Saskatchewan River bridge structure.

- **Horizontal and Vertical Alignments – Crossroads:**
  - Vertical Alignment – K values specified above shall be used as a minimum.
  - Horizontal Alignment at intersection shall follow TAC Geometric Design Guide section 2.3.
  - Transition between two-lane / four-lane Roadways at Intersections – follow TAC Geometric Design Guide in designing two-lane / four-lane transitions, with the parallel lane length calculated based on the value of the design domain (TAC Geometric Design Guide section 2.3.9).
  - Turn Bay Length at Intersection – The length of a Left or Right Turn Bay shall satisfy both deceleration and storage requirements below:
    - Measurement of turn bay length is from the point where the turn bay lane width is 3.0 m to the stopline at the end of the turn bay.
    - Deceleration requirements:

Design Speed of Roadway	Minimum Length of Deceleration Lane including Taper, L_d
60 km/h	90 m
70 km/h	110 m
80 km/h	130 m
90 km/h	150 m
100 km/h	170 m
110 km/h	185 m
120 km/h	200 m

    - Storage requirements – to be determined based on results of simulation analysis. The length of the turn bay shall be designed so that either the queue in the through lane will not block the turn bays, or the queue in the turn bays will not spill out of the turn bay and block the adjacent through lane.

  - Turn Bay/Taper Length Leading into a Loop Ramp or Free-Flow Right Turn Roadway – The length of a Turn Bay/Taper shall satisfy both deceleration and storage requirements below:
    - Measurement of turn bay length is from the point where the turn bay lane width is 3.0 m to the start of the controlling radius of the turning roadway
    - Deceleration requirements:

Design Speed of Roadway	Minimum Length of Deceleration Lane including Taper, L_d				
	Design Speed of Turning Roadway Curve (km/h)				
	40	45	50	55	60
60 km/h	70 m	65 m	55 m	50 m	n/a
70 km/h	90 m	85 m	75 m	70 m	60 m
80 km/h	105 m	100 m	95 m	90 m	80 m
90 km/h	125 m	120 m	115 m	110 m	100 m
100 km/h	145 m	140 m	135 m	130 m	120 m
110 km/h	160 m	155 m	150 m	145 m	140 m
120 km/h	180 m	175 m	170 m	165 m	155 m

- Storage requirements – to be determined based on results of simulation analysis. The length of the turn bay shall be designed so that either the queue in the through lane will not block the turn bays, or the queue in the turn bays will not spill out of the turn bay and block the adjacent through lane.

  - Curves shall be introduced at all through-lane deflections in the vicinity of ramp intersections along crossroads (deflections exceeding one degree). Curves shall be long enough to avoid the appearance of a kink but not so short as to require superelevation.
  - Spiral curves shall be introduced at both ends of all ramp curves.

- **Number of Ramp Approach Lanes at Intersection:**
  - For crossroads with cross-section of four lanes or more, the ramp intersection approach shall have two lanes to permit double left turn movements from the ramp.

- **Medians:**
  - Except in locations where exceptions to median width have been identified elsewhere in this Section 200.2.2, the Contractor shall design the roadway to ensure median barriers are not required on the Mainline. Medians on crossroads shall be the raised type except along Whitemud Drive, Sherwood Park Freeway and Manning Drive.
  - All single bridge piers located in the medians of Anthony Henday Drive, Highway 16, Sherwood Park Freeway, and Petroleum Way shall be centered in the Ultimate Stage median.

- **Intersections:**

  At-grade intersections shall be designed to accommodate a WB-36 design vehicle as identified in the *Alberta Transportation Highway Geometric Design Guide* except for the design of the Service Roads intersections, in which case the WB-21 shall be the design vehicle. Intersection design shall use *desirable* standards from design guides and bulletins as an absolute minimum. At intersections where dual left turn movements are required, the WB-36 design vehicle shall be accommodated on the outside lane and the WB-21 design vehicle shall be accommodated on the inside lane.

- **Exceptions to design vehicle standards:**
  - The 121 Avenue Service Road intersection with Broadmoor Boulevard shall be designed to accommodate a WB-36 design vehicle.

- **Exceptions to intersection spacing:**
  - On 17 Street NW the spacing between 77 Avenue and Sherwood Park Freeway NB-EB ramp taper shall be no less than 240 metres;
  - On Baseline Road the spacing between Ordze Crescent and the beginning of taper of the WB-NB ramp shall be no less than 105 metres;
  - On 130 Avenue the distance between the NB ramp and the east intersection for the Edmonton Waste Management Centre access shall be no less than 335 metres;
  - On 153 Avenue the intersection with 18 Street shall be no less than 385 metres from the intersection at the SB ramp;
  - On Broadmoor Boulevard the intersection with Strathmoor Drive shall be no less than 320 metres from the EB ramp intersection; and
  - On Broadmoor Boulevard the intersection with 121 Avenue NE shall be no less than 220 metres from the WB ramp intersection.

200.2.3 DESIGN SPECIFICS

Additional location specific guidelines have been developed to provide additional directions for Stage 1 construction. These guidelines are intended to ensure specific key elements are addressed in the New Infrastructure.

200.2.3.1 Local Authority Responsibilities

Each Local Authority is responsible for the design and construction of all roadway connections of the crossroads that are outside of the Project Limits but within the Local Authority's respective corporate limits, except as otherwise provided elsewhere in Section 200 (Project Specifics). The Contractor is responsible for the coordination of road closures and removal of roads in the TUC or within the Project Limits with the Local Authority.

200.2.3.2 Intentionally Deleted

200.2.3.3 Roadway Mainline

Stage 1 construction shall include the construction of any Ultimate Stage retaining walls to accommodate Ultimate Stage bridge structure fills at the abutments.

Anthony Henday Drive:

Stage 1 construction shall include Ultimate Stage subgrade for the mainline and auxiliary lanes, bridge structure fills, and associated loops and ramps, unless noted otherwise in this Section 200.2.3 (Design Specifics). Stage 1 paving shall include lane configuration as shown on Drawings 18-A-3.01 to 18-A-3.12 and 18-A-4.01 to 18-A-4.04 in Appendix A.

Stage 1 shall include the design and construction of Anthony Henday Drive mainline from west of Manning Drive to south of Whitemud Drive, with paving of three lanes in each direction, unless otherwise shown on the Drawings in Appendix A. Future expansion from 6 basic lanes to 10 basic lanes will generally be to the median side as shown in Drawings 18-A-3.01 to 18-A-3.12 and 18-A-4.01 to 18-A-4.04 in Appendix A. All Mainline bridges shall be designed to accommodate the Ultimate Stage laning configuration.

Subject to Section 200.2.3.23 (Detours), the Contractor shall ensure that public traffic on the existing portion of Anthony Henday Drive is allowed to operate unimpeded within the Project Limits throughout the Construction Period.

Highway 16 (Yellowhead Trail):

Stage 1 construction shall include Ultimate Stage subgrade for the mainline and auxiliary lanes, bridge structure fills, and associated loops and ramps, unless noted otherwise in this Section 200.2.3 (Design Specifics). Stage 1 paving shall include the lane configuration as shown on the Drawings in Appendix A.

Stage 1 shall include the design and construction of Highway 16 Mainline from east of the North Saskatchewan River to east of Sherwood Drive, with paving of three lanes in each direction, unless otherwise shown on Drawings 18-A-3.01 to 18-A-3.12 and 18-A-4.01 to 18-A-4.04 in Appendix A. Future expansion from 6 basic lanes to 8 basic lanes will be to the outside as shown in Drawings 18-A-3.01 to 18-A-3.12 and 18-A-4.01 to 18-A-4.04 in Appendix A. All Mainline bridges shall be designed to accommodate the Ultimate Stage laning configuration.

Subject to Section 200.2.3.23 (Detours), the Contractor shall ensure that public traffic on Highway 16 is allowed to operate unimpeded within the Project Limits throughout the Construction Period.

Maintenance cross-overs in the median of the Mainline or between the Mainline, C-D roads or ramps are not permitted.

200.2.3.4 Crossroads

Roadways crossing the Mainline shall be designed and constructed in accordance with the Geometric Design standards presented in Section 200.2.2. At transition locations for roadway connections beyond the Project Limits the roadways shall meet the current standards of the Local Authority. Crossroads to be constructed in Stage 1 are:

- Manning Drive;
- 18 Street/Victoria Trail;
- 153 Avenue;
- 130 Avenue;
- Baseline Road/101 Avenue;
- Sherwood Park Freeway;
- 17 Street NW at Sherwood Park Freeway;

- o Broadmoor Boulevard at Highway 16; and
- o Sherwood Drive at Highway 16.

The Contractor shall consult with and coordinate its work with each Local Authority, as appropriate, regarding timing and tie-ins of the crossroads at the Project Limits. The Contractor shall grade all crossroads to the Ultimate Stage configuration unless noted otherwise in this Section 200.2.3 (Design Specifics). Crossroads shall be paved to the Stage 1 configuration up to the Project Limits and then transitioned beyond the Project Limits to match the crossroad section that is in place on April 1, 2015. These transitions must meet current Local Authority standards or be as specified in the typical cross sections in Appendix A for the crossroad and shall be deemed Service Roads for the purposes of section 5.18 of the DBFO Agreement except the warranty period shall only be one year.

Unless otherwise specified, the Contractor shall ensure that public traffic on existing cross roads within the Project Limits continues to operate unimpeded and in accordance with Section 200.2.3.23 (Detours) within the Project Limits until Traffic Availability.

All existing roadway lighting and traffic signals on crossroads to be reconstructed in Stage 1 shall be replaced as part of the New Infrastructure. The Contractor shall verify that design and construction of the New Infrastructure will not compromise the integrity of the operation of the existing roadway lighting and traffic signals infrastructure outside the Project Limits. The Contractor shall ensure that areas within the Project Limits that operate with roadway lighting and/or traffic signals will continue to have lighting/signals during the Construction Period.

Drawings 18-A-3.01 to 18-A-3.12 and 18-A-4.01 to 18-A-4.04 in Appendix A inclusive show the requirements for major arterial crossroads. Multi-use trails and pedestrian walks requirements shall be as shown on Bridge Information Drawings in Appendix A for individual crossroads. Multi-use trails and pedestrian walks off bridge structures shall extend to the Project Limits and shall match the dimensions and material of Multi-use trails and pedestrian walks at the Project Limits on July 1, 2015. Generally, the alignment of Multi-use trails and pedestrian walks off structures shall be parallel to and offset from the centreline of the crossroad.

Para-curb ramps shall be constructed at all pedestrian crossings. These ramps shall be in accordance with the standards required by the Local Authority for the design and construction of roads within the Local Authority.

Approach nose treatments for islands and medians shall be in accordance with the standards required by the Local Authority for the design and construction of roads within the Local Authority.

Curbs installed on crossroads with design speed exceeding 70 km/h shall be mountable curbs.

200.2.3.5 Bridge Sections

Bridge information Drawings 18-A-5.01 through 18-A-5.38 inclusive included in Appendix A identify deck cross-section, shoulder and sidewalk configurations, and key plan for all New

Infrastructure bridge structures.

The design of bridge structures, where applicable, shall be in accordance with the recommendations as listed in Alberta Transportation's *Design Bulletin #45, Use of Retaining Wall Structures for Bridges and Roadways in Active Watercourse Environments.* All bridge structures shall be constructed to enable widening of the structure to accommodate the Ultimate Stage laning configuration on the bridge structure. Bridges constructed to span roadways shall be constructed in Stage 1 to span the Ultimate Stage laning configuration of the underpassing roadway at those locations.

The Contractor shall be responsible for demolition and removal of existing bridge structures as shown on Drawings 18-A-5.01 to 18-A-5.38 in Appendix A. For further clarity, the existing bridge structures requiring demolition and removal are:

- Anthony Henday Drive/Meridian Street over Yellowhead Trail;
- Anthony Henday Drive over CPR Willingdon Subdivision and Yellowhead Trail WB to Anthony Henday Drive SB ramp;
- Yellowhead Trail over CPR Willingdon Subdivision and Yellowhead Trail WB to Anthony Henday Drive SB ramp;
- Petroleum Way (multi-plate steel/soil arch structure);
- Baseline Road;
- Sherwood Park Freeway;
- 76 Avenue on Sherwood Park Freeway;
- 17 Street NW at Sherwood Park Freeway;
- Broadmoor Boulevard; and
- Bridge size culverts (tributary to Gold Bar Creek).

The Contractor shall complete the demolition of each bridge structure in accordance with Section 200.2.3.24 (Demolition).

All bridges shall be evaluated for permit vehicle configurations as shown in drawings SK-2 through SK-8 inclusive in Appendix B. These permit vehicles shall be evaluated as Permit-Single Trip (PS) vehicles in accordance with section 14 of the Bridge Design Code. The outcome of the Contractor's evaluation shall be the maximum gross vehicle weight (GVW) that the bridge can carry for each permit vehicle configuration, and this information shall be indicated on the bridge drawings in a concise format consistent with the Department's *Engineering Drafting Guidelines for Highway and Bridge Projects*, and also this information shall be presented to the Department in a separate summary report as part of the As-Built Construction Reports. It should be noted that these permit vehicles do not meet the requirements for the simplified methods of analysis for live load as outlined in section 5 of the Bridge Design Code.

200.2.3.6 Interchanges and Grade Separations

Stage 1 construction shall include Ultimate Stage subgrade for all grade separations and interchanges unless noted otherwise in this Section 200.2.3 (Design Specifics). Stage 1 paving shall include lane configuration as shown on Drawings 18-A-3.01 to 18-A-3.12 in Appendix A.

The Contractor shall ensure that traffic on existing roadways and interchanges operates unimpeded and in accordance with Section 200.2.3.23 (Detours) within the Project Limits throughout the Construction Period. The public use of an existing road during the Construction Period shall be considered a detour and is subject to the requirements of Section 200.2.3.23 (Detours).

Where the Ultimate Stage grading might otherwise interfere with the construction or operation of Stage 1, the balance of earth material required to complete the Ultimate Stage grading shall be stockpiled in an appropriate location in close proximity to the interchange for future use. All stockpiled material shall be topsoiled and seeded in accordance with Section 200.2.9 (Topsoil and Seeding). In locations where Ultimate Stage interchange construction is not required as part of the Project, design submissions for the Ultimate Stage interchange are required to support bridge structure design and grading design.

- Paving
  The surface of all pavement structures in the New Infrastructure shall tie smoothly to the existing pavement structures at all Project Limits. In the event that the pavement structure for the New Infrastructure differs from that of the existing pavement, grading surfaces shall be transitioned to match seamlessly at Project Limits.

- Retaining Structures
  The Contractor is responsible for all retaining structures necessary for grading of all New Infrastructure within the Project Limits, including those associated with the Contractor's bridge design.

  All retaining wall structures shall have barriers or railings along the top edge. Barrier placement and construction shall be in accordance with safe roadside design practices as established in the Roadside Design Guide, and Section 300.5 (Bridge Structures). Where a special situation is not covered by the Roadside Design Guide, provisions in the TAC Geometric Design Guide shall be used.

- Bridges
  All bridge structures shall be designed and constructed to the Ultimate Stage opening, lane arrangement, clearance box, clear zone requirements and grading, unless shown otherwise in Drawings 18-A-5.01 to 18-A-5.38 inclusive in Appendix A. The Contractor is responsible for the design and construction of all bridge structures associated with interchanges and grade separations.

- Hazard Protection
  The Contractor is responsible for the design and construction of all required hazard protection for the Contractor's constructed roadway and bridge structure elements.

- Signage
  The Contractor is responsible for the design, supply, and installation of all required signage for the Contractor's constructed roadway and bridge structure elements.

- Roadway Lighting
  The Contractor is responsible for design and installation of all required roadway lighting for the Contractor's constructed roadway and bridge structure elements.

  The Contractor shall design and construct the power feeds to provide separate circuits to the street lights and traffic signals that are part of the Service Roads or outside the Project Limits, in order to clearly demarcate areas of responsibility between the Local Authority and the Province.

  All existing roadway lighting at the proposed interchanges in Stage 1 construction shall be replaced as part of the New Infrastructure. The Contractor shall provide written notice to the appropriate Local Authority that existing roadway lighting hardware has been removed and will be available for pick up for a period of three months. The Contractor shall be responsible for disposal of remaining components after this three month period has elapsed.

  The Contractor shall verify that the design and construction of the New Infrastructure will not compromise the integrity of the operation of the existing roadway lighting infrastructure outside the Project Limits.

- Pavement Markings
  The Contractor is responsible for design and construction of all required pavement markings for the New Infrastructure roadway and bridge structure elements.

  On roadways with design speed less than or equal to 70 km/h, urban pavement marking arrows shall be used in accordance with Figures TCS-C-401.1, TCS-C-405 and TCS-C-405.1 of the Department's *Highway Pavement Marking Guide* (March 2003). On roadways with a design speed greater than 70 km/h, rural pavement marking arrows shall be used in accordance with Figure TCS-C-401 of the Department's *Highway Pavement Marking Guide* (March 2003).

- Walks and Multi-use Trails
  The Contractor shall be responsible for the design and construction of all walks and multi-use trails to conform to the relevant Local Authority's specifications.

200.2.3.6.1 Manning Drive Interchange

The Manning Drive interchange was constructed as a three-legged systems interchange (north, west and south legs) as part of the Northwest Anthony Henday Drive project, and was completed in October 2011. Some of the grading for the addition of the east leg of the interchange has been completed for conversion of the interchange to a fully directional, four legged systems interchange. The Contractor's choice to use fills placed as part of the Northwest Anthony Henday Drive project is at the Contractor's risk. The Contractor will be required to construct the remaining structures and roadway elements as shown on Drawing 18-A-3.07 and bridge Drawings 18-A-5.35 to 18-A-5.38 in Appendix A.

Stage 1 of the Northeast Anthony Henday Drive project includes the completion of the following elements:

- SB-EB Elevated Directional ramp (three structures);
- NB-EB directional ramp;
- WB-NB directional ramp;
- WB C-D road;
- WB-SB loop ramp; and
- Mainline (EB and WB).

200.2.3.6.2 18 Street/Victoria Trail Flyover

Victoria Trail is a future four-lane divided arterial crossroad in the City road network which will be grade separated from Anthony Henday Drive in the vicinity of the existing 18 Street road right of way. Ultimately the City network includes a light rail transit line ("**LRT**") parallel to and on the west side of Victoria Trail. The horizontal alignment of Victoria Trail and future LRT has not been finalized at this time, but planning level of detail is provided in Drawing 18-A-3.07 in Appendix A.

If the Contractor elects to design and construct bridge structure(s) to carry Anthony Henday Drive over Victoria Trail, the Contractor shall design and construct a grade separation to accommodate the future LRT line under Anthony Henday Drive as New Infrastructure. The Contractor is required to confirm the location and clearance box for this grade separation with the City. Catenary lines are not permitted to be attached to any bridge element at the grade separation.

Victoria Trail is classified as an arterial with a 70 km/h design speed. Stage 1 shall include the construction of the east half of the bridge structure, with design to accommodate the Ultimate Stage four-lane configuration.

Stage 1 construction shall also include the design and construction of the east half of the Ultimate Stage 4-lane arterial, and a 3.0 m multi-use trail on the east side of Victoria Trail within the Project Limits.

18 Street shall remain and open to public traffic throughout the Construction Period. The intersection at 167 Avenue and 18 Street shall remain fully operational throughout the Construction Period. Construction shall be staged to maintain local access to the properties north and south of Anthony Henday Drive serviced by 18 Street, 167 Avenue, and Fort Road at all times throughout the Construction Period.

The extension of the existing Victoria Trail from 153 Avenue to the south TUC boundary may be completed by the City prior to Traffic Availability. The Contractor shall construct the crossing to tie into the existing 18 Street, including relocation of the existing access and fence/gate serviced by the connecting roadway south of the TUC as shown on Drawing 18-A-3.07 in Appendix A, at the Project Limits unless the extension of Victoria Trail to the south TUC boundary is completed by April 15, 2015, in which case the Contractor shall construct the crossing to tie into Victoria Trail and a turnaround on 18 Street south of Anthony Henday Drive.

200.2.3.6.3 153 Avenue Interchange

153 Avenue is classified as an arterial with a 70 km/h design speed. The Contractor shall design and construct an Ultimate Stage grade-separated service interchange at 153 Avenue, as part of the New Infrastructure. The work includes the design and construction of the bridge structure at 153 Avenue in its Ultimate Stage configuration. The Contractor shall construct a multi-use trail along the south side of 153 Avenue within the Project Limits and install signalized ramp terminal intersections.

Pre-grading will be required for the two-lane ramp required in the Ultimate Stage at the west intersection. The 153 Avenue interchange structure shall also be designed to accommodate the future paving of the loop ramp to two lanes.

Traffic signals are required at both intersections.

Construction of the 153 Avenue interchange will require the closure of the existing 153 Avenue within the TUC. The new alignment of 153 Avenue as shown on Drawing 18-A-3.06 in Appendix A within the Project Limits will replace the split intersection that includes portions of 18 Street. The cul-de-sacs shall be located on 153 Avenue so as to not impact existing local accesses to the properties along the existing 153 Avenue.

At the east Project Limit, the Contractor shall design and construct a Tee-intersection with Meridian Street. The Contractor shall design the Tee-intersection to facilitate turn movements as shown on Drawing 18-A-3.12 in Appendix A. The intersection design shall satisfy the at-grade signalized intersection design requirements and design traffic volumes as outlined in Packages D and E of Appendix J.

The City may widen 153 Avenue between Victoria Trail and 18 Street to four lanes prior to Traffic Availability. The existing two-lane roadway to the west will become the future eastbound lanes when expansion on the north side is complete. At the west Project Limit, the Contractor shall construct the four-lane arterial section to align with the future four-lane cross section. If the City does not confirm by August 15, 2016 that the expansion of 153 Avenue will be complete and open to traffic by Traffic Availability, the Contractor shall supply and install TL-3 precast concrete barriers to provide a protective barrier between the eastbound lanes and westbound lanes, and provide temporary transition to match existing 153 Avenue cross section at the west Project Limits. The at-grade intersection at 18 Street shall function as all-directional at Traffic Availability.

The Contractor shall ensure that public traffic is provided access across the TUC throughout the Construction Period in accordance with Section 200.2.3.23 (Detours).

200.2.3.6.4 North Saskatchewan River Crossing

The Contractor shall design two bridge structures to carry the northbound and southbound Mainline across the North Saskatchewan River. The Contractor shall produce complete but separate designs for both Stage 1 and Ultimate Stage construction, but Stage 1 designs shall include bridge piers and pier caps to accommodate the Ultimate Stage superstructures. The Ultimate Stage shall be designed as a widening of Stage 1, and designed such that the widening can be achieved without any future in-channel construction, and without closing down more than one lane of traffic during peak traffic periods or more than two lanes of traffic at any other time. In the event that the design necessitates the Stage 1 superstructure being strengthened to accommodate the Ultimate Stage widening, all measures that will be required for this future strengthening shall be incorporated into Stage 1, including all measures that are required for future post-tensioning. Both Stage 1 and Ultimate Stage designs shall include drainage details. The Contractor shall construct two bridge structures to carry the Stage 1 northbound and southbound Mainline across the North Saskatchewan River, but with bridge piers and pier caps to accommodate the Ultimate Stage superstructure as illustrated on Drawing 18-A-5.30 in Appendix A. Pier caps shall be constructed from HPC concrete, and the tops of the pier caps shall be protected with a waterproofing membrane. Notwithstanding the Section 300.5.2.10 restrictions on abutment seat height above grade, bridge abutments for the North Saskatchewan River bridges may be proportioned without a limit on the height of abutment seat above grade.

The bridge design shall meet the following requirements:

- Minimum freeboard to Ultimate Stage bridges: 1 m at south end, 2 m at north end
- Minimum design high water elevation 618.0 m
- Substructure design ice loading to be determined in accordance with the Bridge Design Code clause 3.12
- The minimum ice loading condition that shall be considered shall have an effective ice strength based on situation (b) (700kPa) (as described in section 3.12.2.1 of the Bridge Design Code) with a thickness of 1.0 m and a design high ice elevation of 613.5 m
- Minimum longitudinal grade on the bridge 1.0%
- No river piers to be located within 15 m of the north toe of slope

The Contractor shall address all environmental issues in its Environmental Management System and shall have a fully comprehensive ECO Plan for construction at this site. The Contractor is responsible for obtaining all necessary environmental permits, including obtaining approval from Department of Fisheries and Oceans and Transport Canada, which will include without limitation Fisheries Act Authorizations and Navigable Waters Act Approvals.

The Contractor will be responsible for ensuring that these approvals remain valid, that conditions are adhered to, and that any other approvals required for the New Infrastructure are obtained and are adhered to.

The following contacts have been provided:

Allen Cadenhead
Navigable Waters Protection Officer
Transport Canada
Marine - Winnipeg

9700 Jasper Avenue NW
Edmonton, AB T5J 4E6
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Brandi Mogge
Fish Habitat Biologist
Fisheries and Oceans Canada
Alberta District - Edmonton Office
1028 Parsons Road
Edmonton, AB T6X 0N5
Brandi.mogge@dfo-mpo.gc.ca

The North Saskatchewan River valley serves the purpose of a corridor for the passage of wildlife in both an upstream and downstream direction. The Contractor's design shall not inhibit wildlife passage along this corridor. A dedicated wildlife passage shall be provided at both the north and south bridge abutments. The passage on the north and south abutments shall be at elevation 613.0 m or higher. The passages shall be level and have a smooth walking surface (e.g. no riprap or large boulders). The minimum wildlife passage clearance boxes shall be 4.0 m wide and 4.0 m high on the north and south side abutments.

The southbound bridge structure shall include the design and construction of an underslung pedestrian crossing, with a minimum 4.2 m clear width and a minimum 3.2 m vertical clearance, with the same freeboard requirements as the road bridges. The roadway surface elevation of the northbound roadway bridge shall be at a similar elevation to the southbound roadway bridge, as if both structures had underslung pedestrian bridges. The pedestrian bridge deck shall have a 2% crowned surface, pedestrian/cyclist railing on continuous curbs and provision for drainage.

The roadway bridge and underslung pedestrian bridge shall be designed to fulfill minimum vertical clearance requirements for the Ultimate Stage. The Contractor shall design the pedestrian bridge so that resonance will not occur under any combinations of vehicle, wind and pedestrian loading, and so that any load induced vibration will not have a significant effect on the comfort of pedestrians. The design shall identify dynamic "tuning" measures that could be taken if the design intent is not initially achieved.

Public security shall be a consideration in the design of the pedestrian bridge.

The Contractor's design shall include lighting in accordance with Illuminating Engineering Society of North America document RP-8-00 based on high pedestrian conflict level on the bridge and at the openings. The Contractor shall also ensure that sightlines are unobstructed on the bridge and at both ends.

At each end of the bridge the Contractor shall fabricate and install a well illuminated and clearly visible sign with the text:

"ANTHONY HENDAY DRIVE
NORTHEAST

NORTH SASKATCHEWAN RIVER
PEDESTRIAN BRIDGE”

The text shall be in 50 mm high black letters in Helvetica style on white high intensity grade reflective background. The sign shall be 1220 mm wide by 610 mm long on treated timber posts set with bottom of sign 1600 mm above grade.

On the south bank, the Contractor shall design and construct a 4 m wide paved pathway, 230 m long, with a minimum vertical clearance of 3.6 m under the structures. The pathway shall be parallel to the North Saskatchewan River, located as shown on Appendix A Drawing 18-A-5.30 and shall connect the river valley trail system and provide access for maintenance vehicles. The width between railings or other obstacles either side of this pathway shall not be less than 4.2 m in any location. Contrary to what is shown on Drawing 18-A-5.30 for the extent of the pathway on the north bank of the river, the Contractor shall grade a 5 m wide pathway on the north bank, with a minimum vertical clearance of 3.6 m under the structures, but this pathway shall extend from the north end of the pedestrian bridge to locations on the tops of bank both east and west of the river bridges. The 5 m width of pathway shall include a minimum 0.6 m wide drainage swale on the up-slope side of the pathway, and a drainage collection system to prevent erosion of the pathway and bank. The layout and construction of this pathway shall minimize disturbance to the existing north river bank slope. It shall be constructed entirely within the TUC and the end of pathway locations shall be approximately 10 m north of the top of riverbank and not less than 10 m beyond the top of the proposed roadway cut slope on either side of Anthony Henday Drive. The pathway may be constructed with switchbacks, but with tangent sections not less than 30 m long between the pedestrian bridge and road elevations, and not less than 50 m long from road to top of bank elevations. At both ends of the pedestrian bridge, the junction with the pathway shall accommodate an “Autoturn” P-vehicle making the turn between pathway and pedestrian bridge. A portion of the pathway extension at the north end of the pedestrian bridge shall be paved from the end of the pedestrian bridge to 10 m on both sides of centreline of the pedestrian bridge. The pathway design shall meet the requirements of the TAC Geometric Design Guide, section 3.3 Streetscaping and section 3.4 Bikeways but with a maximum grade of 5%. At the locations of the switchbacks, the grading shall not exceed 3.0%. The pathway shall be located on the wildlife side of the wildlife fence.

200.2.3.6.5 130 Avenue Interchange

130 Avenue is classified as an arterial with a 70 km/h design speed. The Stage 1 construction includes the design and construction as part of the New Infrastructure of the north half of the Ultimate Stage bridge structure as shown on the Drawings in Appendix A. Stage 1 also includes the design and construction of the grade separated interchange including all ramps, ramp terminal intersections and a multi-use trail along the south side of 130 Avenue within the Project Limits.

Stage 1 construction at the 130 Avenue interchange will require the closure of the existing 130 Avenue within the TUC. The Contractor shall design and construct a new access to 130 Avenue.

Construction of Anthony Henday Drive will impact the existing Meridian Street roadway. The Contractor shall ensure that access to the Edmonton Waste Management Centre, gravel operations and other affected properties within the interchange is maintained at all times throughout the Construction Period. The existing access immediately south of 130 Avenue and west of Anthony Henday Drive shall be maintained until the new Service Road is operational. Meridian Street up to 137 Avenue shall be kept open until July 31, 2012. Access across the TUC, from the existing business at the north end of Meridian Street to the west side of the TUC, on the approximate westbound extension of 137 Avenue, shall be kept open until July 31, 2012. The Contractor shall provide temporary detour roads where required in accordance with the requirements of Section 200.2.3.23 (Detours). Any existing roadways or ramps that the Contractor does not incorporate into the Stage 1 design shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration).

The 130 Avenue interchange shall be in the Ultimate Stage configuration at the end of the Term. Regardless of the interchange configuration constructed at Traffic Availability, the Ultimate Stage bridge structure shall include four through lanes (not including ramp taper lanes), and be constructed in accordance with the timelines below. Additionally, the bridge structure shall be designed such that the Department can effectively widen the structure to allow up to six through lanes.

The Contractor is required to supply and install traffic signals at both ramp intersections at or before the Ultimate Stage interchange is constructed.

A 2.5 m side walk is required on the south side for Stage 1 and the Ultimate Stage.

The Contractor shall design and build the Ultimate Stage bridge structure and roadway configuration within the Project Limits applicable to 130 Avenue (the “**Future 130 Avenue Construction**”) no later than the earlier of (the “**Future 130 Avenue Construction Deadline**”) the following:

- the date that is the second occurrence of the date July 15 after written notification by the City to the Contractor that expansion of 130 Avenue to four continuous main lanes east of the TUC will commence; or
- the date that is 25 years after the Traffic Availability Target Date.

If the Contractor fails to complete the Future 130 Avenue Construction on or before the Future 130 Avenue Construction Deadline, double the Payment Adjustments set out in Section 400.1.6 (Lane Closure) shall apply as if the Future 130 Avenue Construction had been completed but the would be constructed lanes were subject to a Lane Closure (as defined in Section 400.1.6) for 24 hours per day. The measurement of lane kilometres shall be rounded up to full kilometres for each direction of traffic. The foregoing Payment Adjustments shall continue to accrue until such time as the Contractor completes the Future 130 Avenue Construction.

200.2.3.6.6 Yellowhead Trail Interchange

A new major, free-flow systems interchange is required to replace the existing service interchange of Highway 16 with Highway 216/Meridian Street.

The New Infrastructure shall include but not be limited to the design and construction of:

- Mainline SB-NB lanes and structures;
- Mainline EB-WB lanes and structures;
- Elevated Directional Ramp NB-WB;
- Elevated Directional Ramp SB-EB;
- Basketweave structures;
- Interchange ramps; and
- Local accesses.

The traffic volumes stated in the Functional Plan shall be used for the purpose of analysis using an appropriate simulation method with the exception of the following:

- Figure P3368-4018 of the Functional Plan states that the volumes exiting the industrial area east of 17 Street are 620 vph and 100 vph in the a.m. and p.m. peak hours respectively. The volumes to be used in the Contractor's design are 620 vph and 1170 vph in the a.m. and p.m. peak hours respectively.
- Figure P3368-4018 of the Functional Plan states that the eastbound Yellowhead Trail p.m. peak hour volume is 5670 vph. The volume to be used in the Contractor's design is 5760 vph for the p.m. peak hour on eastbound Yellowhead Trail immediately east of Anthony Henday Drive.
- Figure P3368-4014 of the Functional Plan states that the long term northbound left turn movement at the east ramp intersection of Baseline Road and Anthony Henday Drive a.m. peak hour volume is 500 vph and p.m. peak hour volume is 800 vph. The volumes to be used in the Contractor's design are 800 vph for the a.m. peak hour and 500 vph for the p.m. peak hour for the northbound left turn movement at the east ramp intersection of Baseline Road and Anthony Henday Drive.

The close proximity of Anthony Henday Drive to Broadmoor Boulevard requires that the SB-EB and EB Broadmoor Boulevard movements be grade separated from the NB-EB and WB-SB movements. The design speed of the SB-EB Elevated Directional Ramp and connection to Broadmoor Boulevard shall be no less than 80 km/h.

Access to Hayter Road from WB Highway 16 is to be grade separated from the NW-WB and SB-WB ramps. The design speed of the WB connector to Hayter Road shall be no less than 80 km/h.

Access from the 17 Street industrial area in the southwest quadrant of the interchange shall be grade separated from the EB to NB/SB ramp.

The Contractor shall keep direct access to Meridian Street from Yellowhead Trail until such time the grade separation carrying traffic across Yellowhead Trail is open to public traffic. Access from the industrial area located in the southwest quadrant of the Yellowhead Trail interchange to EB Highway 16 shall be grade separated from the EB-SB/NB ramp.

Construction shall be staged to maintain access to the areas serviced by the following roadway connections:

- EB Yellowhead Trail right-in-right-out to 17 Street NW;
- Service Road connections to 116 Avenue NW, 17 Street NW and Yellowhead Trail;
- WB Yellowhead Trail right-in-right-out to Hayter Road;
- Hayter Road access to CNR Clover Bar Yard and the industrial area to the north of Yellowhead Trail and east of Anthony Henday Drive; and
- Yellowhead Trail access to and from Anthony Henday Drive.

An access to a pump station belonging to the City exists off of the westbound lanes of Highway 16 (east of the North Saskatchewan River crossing) as shown on Drawing 18-A-3.08 in Appendix A. This access is to remain in its current location during the Construction Period and the Operating Period. The Contractor shall install a gate in accordance with the County's standard drawing STD-55 (Steel Pipe Gate) in *Strathcona County's Open Space Development Standards (OSDS) Manual* (2006) approximately 30 metres from the edge of roadway.

Any existing roadways or ramps that the Contractor does not incorporate into the Stage 1 design shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration).

200.2.3.6.7 17 Street NW over Yellowhead Trail

There are existing grade separated structures carrying 17 Street NW over both eastbound and westbound Yellowhead Trail which are to be incorporated into the Contractor's Stage 1 Detailed Design.

Westbound Yellowhead Trail and the associated one-lane directional ramp from Hayter Road shall be grade separated from 17 Street NW. The Contractor is required to design and construct retaining walls at the existing piers to allow for the construction of additional lanes. Barriers will be permitted at this location.

CNR will be undertaking modifications to their structures at the Camrose Subdivision and Camrose/Wainwright Subdivision Connection prior to the Traffic Availability Target Date. If the work required to the CNR Camrose Subdivision and Camrose/Wainwright Subdivision Connection-rail structures is not complete and the site vacated by June 1, 2015, the Contractor is required to construct a temporary tie-in of the directional ramp to Yellowhead Trail, to carry traffic under the main span of the rail structure. Refer to Section 200.2.3.7.6 for a more detailed description of the railway work involved at the CNR Wye structures.

Eastbound Yellowhead Trail shall be grade separated from 17 Street NW. The Contractor is required to design and construct retaining walls at the existing piers to allow for the construction of additional lanes. Barriers will be permitted at this location.

200.2.3.6.8 Anthony Henday Drive over Petroleum Way

The Contractor shall design and construct bridge structure(s) as New Infrastructure to:

- Grade separate Anthony Henday Drive mainline from Petroleum Way;
- Grade separate the directional ramp carrying WB Yellowhead Trail onto SB Anthony Henday Drive from Petroleum Way; and

- Grade separate the directional ramp carrying NB Anthony Henday Drive onto EB Yellowhead Trail from Petroleum Way.

The Contractor will be responsible for the demolition and removal of the existing arch bridge culvert structure (Alberta Transportation Bridge File #BF77416) at this location. The Contractor shall complete demolition of each bridge structure in accordance with Section 200.2.3.24 (Demolition).

Petroleum Way is defined as a Service Road and details of the underpassing roadway is included in Section 200.2.3.18.6 (Petroleum Way Service Road).

200.2.3.6.9 Baseline Road

The existing interchange at Baseline Road shall be replaced in its entirety with a new interchange. The Contractor shall design and construct the interchange to its Stage 1 configuration as shown on Drawing 18-A-3.04 in Appendix A within the Project Limits. Baseline Road is classified as an expressway with a design speed of 80 km/h.

The Contractor shall design and construct bridge structures as shown on Drawing 18-A-5.06 in Appendix A to grade separate the following:

- Directional loop ramp carrying EB Baseline Road onto NB Anthony Henday Drive;
- Directional loop ramp carrying WB Baseline Road onto SB Anthony Henday Drive; and
- Baseline Road from Anthony Henday Drive.

The horizontal curve radii on Baseline Road within the Project Limits shall be no less than the radii on the existing alignment. The loop ramp structures are considered to be on C-D roads and shall meet the C-D separation requirements for the Stage 1 and Ultimate Stage. The Contractor will be required to convert the stop controlled ramp terminal intersections to signalized intersections for the Stage 1 interchange design. The WB-SB and EB-NB movements shall remain free-flow during construction. Dual left turn movements are required at the intersections and shall be designed in accordance with Section 200.2.2 (Geometric Design).

The Contractor shall construct the bridge structures to span the Ultimate Stage Mainline with the Ultimate Stage median width and clear zone requirements.

The Contractor will be responsible for demolition and removal of the existing bridge structures that grade separate Baseline Road from Anthony Henday Drive in accordance with Section 200.2.3.24 (Demolition). The Contractor shall remove all existing earth stockpiles within the NE and SW quadrants of the existing interchange. Any existing roadways or ramps that the Contractor does not incorporate into the Stage 1 design shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration).

200.2.3.6.10 Sherwood Park Freeway Interchange

The existing cloverleaf interchange at Sherwood Park Freeway shall be replaced in its entirety with a new interchange. The Contractor shall design and construct the interchange to its Stage 1 configuration as shown on Drawing 18-A-3.03 in Appendix A within the TUC. The loop ramps shall be designed and constructed to the Ultimate Stage configuration. Horizontal and vertical geometry and all grading performed in Stage 1 shall facilitate the addition of lanes in the Ultimate Stage.

The Contractor shall design and construct bridge structures to grade separate the following:

- Elevated Directional Ramp carrying EB Sherwood Park Freeway onto NB Anthony Henday Drive; and
- Sherwood Park Freeway from Anthony Henday Drive.

The Contractor shall address all environmental issues in its Environmental Management System and shall have a fully comprehensive ECO Plan for construction at these sites. The Contractor is responsible for obtaining all necessary environmental permits. Any existing roadways or ramps that the Contractor does not incorporate into the Stage 1 design shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration).

The Contractor shall also design and construct an access road as part of the New Infrastructure on the east side of Anthony Henday Drive, south of Sherwood Park Freeway. The access road south of Sherwood Park Freeway shall connect from the extension of Fountain Creek Boulevard north to the cul-de-sac turnaround as shown on Drawing 18-A-3.02 in Appendix A. This access road is deemed to be New Infrastructure. This access road shall be constructed in accordance with the typical section for a Gravelled Service Road as shown on Drawing 18-A-4.04 in Appendix A.

200.2.3.6.11 17 Street NW/Sherwood Park Freeway Interchange

The existing half diamond interchange at 17 Street NW and Sherwood Park Freeway shall be replaced in its entirety with a new diamond interchange. The Contractor shall design and construct the interchange to meet the requirements of the Ultimate Stage configuration. The New Infrastructure shall include the design and construction of all roadways, and directional ramps within the Project Limits as shown on Drawing 18-A-3.03 in Appendix A. The Contractor shall design and construct a bridge structure to grade separate 17 Street NW from the Sherwood Park Freeway.

Construction shall be staged to maintain access to the areas serviced by the existing interchange at 17 Street NW and Sherwood Park Freeway throughout the Construction Period.

The Contractor will be responsible for demolition and removal of the existing bridge structure that grade separates 17 Street NW from Sherwood Park Freeway in accordance with Section 200.2.3.24 (Demolition).

The Contractor shall supply and install traffic signals at both ramp terminal intersections.

Any existing roadways or ramps that the Contractor does not incorporate into the Stage 1 design shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration).

200.2.3.6.12 East Half 34 Street NW/Sherwood Park Freeway Interchange

The existing east half of the diamond interchange at 34 Street NW and Sherwood Park Freeway shall be rehabilitated in its entirety to meet the Technical Requirements and the handback conditions at the end of the Operating Period. The Contractor may design and construct all rehabilitation work to match the vertical and horizontal geometry, lane and shoulder widths, crossfall, sideslopes, and laning configuration, of the existing interchange. The Contractor is not required to replace existing overhead sign structures.

Rehabilitation shall include improvement of all roadways and ramps to meet the requirements in Section 400.4.3 (Smoothness) and Section 400.4.4 (Rutting). All guardrail, roadway lighting, traffic signals with swivel bases, concrete curb and gutter, concrete islands, and minor signs within the Project Limits as shown on Drawing 18-A-3.03A in Appendix A shall be replaced with new materials.

The Contractor shall verify the rehabilitation of the New Infrastructure will not compromise the integrity of the operation of the existing roadway lighting and traffic signals infrastructure outside the Project Limits. The Contractor shall ensure that areas within the Project Limits that operate with roadway lighting and/or traffic signals will continue to have lighting/signals during the Construction Period.

Construction shall be staged to maintain access to the areas serviced by the existing interchange at 34 Street NW and Sherwood Park Freeway throughout the Construction Period.

200.2.3.6.13 Whitemud Drive Interchange

The existing cloverleaf interchange at Whitemud Drive/Anthony Henday Drive requires modification on Whitemud Drive to add an additional lane on the SB-WB ramp, as shown on Drawing 18-A-3.01 in Appendix A. The existing interchange shall be resurfaced in its entirety to meet the Technical Requirements in Section 400.4.3 (Smoothness) and Section 400.4.4 (Rutting). The Contractor may design and construct all resurfacing work to match the existing high mast lighting on Whitemud Drive, vertical and horizontal geometry, lane and shoulder widths, crossfall, sideslopes, and laning configuration of the existing interchange. The Contractor is not required to replace existing guardrail, minor signs, and overhead sign structures within the existing interchange as shown on Drawing 18-A-3.01, with the exception of regular maintenance requirements (i.e. damaged guardrail, signs, etc.).

The work shall include realignment of the SB C-D road to south of the exit gore to the SB-WB ramp. The Contractor shall design and construct such modifications.

The Contractor shall perform grading work to remove existing high ground conditions within and outside the loop ramp to C-D road connections in all four quadrants of the existing interchange to improve sight lines. The grading work shall result in slopes no steeper than 6:1 within the interchange footprint, with the exception of the bridge approach fills. The Contractor is required to topsoil and seed all disturbed areas according to Section 200.2.9 (Topsoil and Seeding).

The Contractor shall stockpile embankment material on site for the future construction of the Elevated Directional Ramp.

200.2.3.6.14 Broadmoor Boulevard / Yellowhead Trail Interchange

The existing parclo interchange at Broadmoor Boulevard and Highway 16 shall be replaced in its entirety according to Drawing 18-A-3.08 in Appendix A. The Contractor shall design and construct the interchange to meet the requirements of the Stage 1 configuration. The Contractor shall design and construct the subgrade between the ramp terminal intersections to accommodate an additional northbound lane and a total of six lanes in the Ultimate Stage. The New Infrastructure shall include the design and construction of all roadways, loop ramps, and ramps within the Project Limits. The Contractor shall design and construct a bridge structure to grade separate Broadmoor Boulevard from the Highway 16 mainline to accommodate the Ultimate Stage widening of Broadmoor Boulevard to the east.

The Contractor is responsible for installing traffic signals at the ramp terminal intersections.

Construction shall be staged to maintain access to the areas serviced by Broadmoor Boulevard and Highway 16 throughout the Construction Period.

The Contractor will be responsible for demolition and removal of the existing bridge structure that grade separates Broadmoor Boulevard from Highway 16 in accordance with Section 200.2.3.24 (Demolition).

Any existing roadways or ramps that the Contractor does not incorporate into the Stage 1 design shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration).

200.2.3.6.15 Sherwood Drive / Yellowhead Trail Interchange

The existing right-in-right-out intersection at Sherwood Drive and Yellowhead Trail shall be replaced by an interchange design and constructed by the Contractor to meet the requirements of the Ultimate Stage configuration. The New Infrastructure shall include the design and construction of all roadways, and directional ramps within the Project Limits as shown on the Drawings in Appendix A. The Contractor shall design and construct a bridge structure to grade separate Sherwood Drive on a tangent alignment for Sherwood Drive from the Yellowhead Trail mainline.

The Contractor is responsible for installing traffic signals at the ramp terminal intersections.

Construction shall be staged to maintain access to the areas serviced by Sherwood Drive and Yellowhead Trail throughout the Construction Period.

Any existing roadways or ramps that the Contractor does not incorporate into the Ultimate Stage design shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration).

200.2.3.6.16 Clover Bar Road / Yellowhead Trail Interchange

The existing WB on ramp from Clover Bar Road to Yellowhead Trail shall be modified to meet the minimum weave distance requirements of the Stage 1 configuration.

200.2.3.7 Other Crossings

Stage 1 construction shall include Ultimate Stage subgrade for all other crossings unless noted otherwise in this Section 200.2.3 (Design Specifics). Stage 1 paving shall include lane configuration as shown on Drawings 18-A-3.01 to 18-A-3.12 in Appendix A.

The Contractor shall ensure that traffic on existing roadways at other crossings operates at the standards as defined in Section 200.2.3.23 (Detours) through the Project Limits throughout the Construction Period.

- Paving
  All pavement structures in the New Infrastructure shall tie to the existing pavement at all Project Limits. In the event that the pavement structure for the New Infrastructure differs from that of the existing pavement, grading surfaces shall be transitioned to match seamlessly at Project Limits.

- Retaining Structures
  The Contractor is responsible for all retaining structures necessary for grading of all New Infrastructure within the Project Limits, including those associated with the Contractor's bridge design.

  All retaining wall structures shall have barriers or railings along the top edge. Barrier placement and construction shall be in accordance with safe roadside design practices as established in the Roadside Design Guide and in Section 300.5 (Bridge Structures). Where a special situation is not covered by the Roadside Design Guide, provisions in the TAC Geometric Design Guide shall be used.

- Bridges
  The Contractor is responsible for the design and construction of all bridge structures associated with other crossings.

- Hazard Protection
  The Contractor is responsible for the design and construction of all required hazard protection for the Contractor's constructed roadway and bridge structure elements.

- Signage
  The Contractor is responsible for the design, supply, and installation of all required signage for the Contractor's constructed roadway and bridge structure elements.

- Roadway Lighting
  The Contractor is responsible for design and installation of all required roadway lighting for the Contractor's constructed roadway and bridge structure elements.

The Contractor shall design and construct the power feeds to provide separate circuits to the street lights and traffic signals that are part of the Service Roads or outside the Project Limits, in order to clearly demarcate areas of responsibility between the Local Authority and the Province.

All existing roadway lighting at the proposed interchanges in Stage 1 construction shall be replaced as part of the New Infrastructure. The Contractor shall provide written notice to the Local Authority that existing roadway lighting hardware has been removed and will be available for pick up for a period of three months. The Contractor shall be responsible for disposal of remaining components after this three month period has elapsed.

The Contractor shall verify that design and construction of the New Infrastructure will not compromise the integrity of the operation of the existing roadway lighting infrastructure outside the Project Limits.

- Pavement Markings
  The Contractor is responsible for design and construction of all required pavement markings for the New Infrastructure roadway and bridge structure elements.

  On roadways with design speed less than or equal to 70 km/h, urban pavement marking arrows shall be used in accordance with Figures TCS-C-401.1, TCS-C-405 and TCS-C-405.1 of the Department's *Highway Pavement Marking Guide* (March 2003). On roadways with a design speed greater than 70 km/h, rural pavement marking arrows shall be used in accordance with Figure TCS-C-401 of the Department's *Highway Pavement Marking Guide* (March 2003).

- Walks and Multi-use Trails
  The Contractor shall be responsible for the design and construction of all walks and multi-use trails to conform to the relevant Local Authority specifications.

200.2.3.7.1 76 Avenue / Sherwood Park Freeway Flyover

The Contractor shall be responsible for demolition and removal of the existing flyover bridge structure and associated roadway approaches. Demolition and removal of the structure shall be staged with construction of the New Infrastructure at the Sherwood Park Freeway / Anthony Henday Drive interchange and modifications to the existing 76 Avenue Service Road. Construction shall be staged to maintain access to the areas serviced by 76 Avenue and Sherwood Park Freeway at all times. The Contractor shall restore drainage patterns as required.

The Contractor shall complete the demolition and removal of the bridge structure in accordance with Section 200.2.3.24 (Demolition).

200.2.3.7.2 CNR Rail Crossing – CN Mile 0.85 Coronado Subdivision

The Canadian National Railway Company ("**CNR**") grade separation at CNR Mile 0.85 Coronado Subdivision rail line crosses Anthony Henday Drive mainline approximately 1000 metres east of Manning Drive, as shown on Drawing 18-A-3.07 in Appendix A. The Contractor shall design and construct the bridge structure(s) to grade separate Anthony Henday Drive from CNR – CNR Mile 0.85 Coronado Subdivision. The ultimate alignment of the CNR track shall be in the same vertical and horizontal alignment as the existing alignment.

The grade separation at this location may be achieved by designing and constructing road bridge structure(s) to carry Anthony Henday Drive over the CNR track, or by designing and constructing a rail bridge structure to carry the CNR track over Anthony Henday Drive. Should the Contractor elect to carry the railway over the road, the Contractor is responsible for the design and construction of the rail structure, and must use a pre-approved design consultant as per Section 200.2.11 (Railways), and the applicable Existing Railway Agreement would require an amendment.

Within the TUC the Coronado Subdivision is a single track with no provision for expansion. Should the Contractor elect to carry the CNR track over Anthony Henday Drive, the grade separated structure shall be constructed to span the Ultimate Stage mainline lanes and ramps of Anthony Henday Drive.

200.2.3.7.3 CNR Rail Crossing – CN Mile 123.50 Vegreville Subdivision

The CNR grade separation at CNR Mile 123.50 Vegreville Subdivision rail line crosses Anthony Henday Drive mainline approximately 800 metres east of the CNR Coronado Subdivision crossing, as shown on Drawing 18-A-3.07 in Appendix A. The Contractor shall design and construct the bridge structure(s) to grade separate Anthony Henday Drive from CNR – CNR Mile 123.50 Vegreville Subdivision. The ultimate alignment of the CNR track shall be in the same vertical and horizontal alignment as the existing alignment.

The grade separation at this location may be achieved by designing and constructing road bridge structure(s) to carry Anthony Henday Drive over the CNR track, or by designing and constructing a rail bridge structure to carry the CNR track over Anthony Henday Drive. Should the Contractor elect to carry the railway over the road, the Contractor is responsible for the design and construction of the rail structure, and must use a pre-approved design consultant as per Section 200.2.11 (Railways), and the applicable Existing Railway Agreement would require an amendment.

Within the TUC the Vegreville Subdivision is a single track with no provision for expansion. Should the Contractor elect to carry the CNR track over Anthony Henday Drive the grade separated structure shall be constructed to span the Ultimate Stage mainline lanes of Anthony Henday Drive.

200.2.3.7.4 CNR Rail Crossings – CNR Mile 259.21 Wainwright Subdivision (CNR Clover Bar Yard); CPR Rail Crossing – Industrial Spur at CPR Mile 1.51 Meridian Spur; off CPR Mile 163.40 Scotford Subdivision

The Anthony Henday Drive shall be grade separated from seven railway lines oriented E-W and located north of Highway 16. The bridge structures are required to grade separate six CNR tracks (CN Mile 259.21 Wainwright Subdivision) and one Canadian Pacific Railway Company ("**CPR**") industrial spur track (CPR Mile 1.51 Meridian Spur, off CPR Mile 163.40 Scotford Subdivision). The Contractor shall design and construct the bridge structures to grade separate the Anthony Henday Drive from the CNR and CPR railway tracks as shown on Drawing 18-A-3.08 and 18-A-5.28 in Appendix A.

Within the TUC, the CNR Wainwright Subdivision also known as the CNR Clover Bar Yard, is currently six tracks.

The construction sequencing at this location is intricate and will require close coordination with CNR and CPR. CPR has informed the Department that it will relocate at its cost the Meridian Spur track and associated switching facilities to the location shown on Drawing 18-A-3.11 in Appendix A. The Contractor shall confirm the exact location of the relocated Meridian Spur track with CPR. CNR and CPR have informed the Department that they will dismantle and remove at their cost the existing at-grade crossings at Meridian Street, including the crossing surface and grade crossing warning system. The Contractor shall remove the road approaches to the crossing and reinstate the entire existing crossing area to establish grading, drainage and landscape to match the surrounding elements, as required.

The Contractor shall design and construct a 2.5 m wide maintenance road (off-track roadway) as shown on Drawings 18-A-3.11 and 18-A-5.28 in Appendix A. The maintenance road shall be designed and constructed to the standards required by CNR.

The CNR Clover Bar Yard is located north of Highway 16, is approximately 1 km in length and 120 m in width, and comprised of multiple tracks. Southeast of the grade separation of CNR's Clover Bar Yard and CPR's Meridian Spur track is CNR's team track facility which is used for loading and unloading rail cars. The Contractor shall provide unhindered and continuous public access to the team track facility during construction. The Contractor will be required to relocate the existing access to this team track facility from Meridian Street to an easterly extension from Hayter Road as shown on Drawing 18-A-3.11 in Appendix A. The Contractor shall coordinate construction and timing of the public access relocation with CNR.

The Contractor shall coordinate with CNR and CPR regarding the design and construction of the grade separation.

The main contact for the CNR Clover Bar Yard is:

Rick Maze, Trainmaster
Office: 780-473-0078
Cell: 780-991-2096
Email: rick.maze@cn.ca

The main contact for the CNR team track facility is:

Katrina Phaneuf

CN Supply Chain Solutions
Office: 905-803-3648
Cell: 416-476-7106
Email: katrina.phaneuf@cn.ca

The main contact for CPR is:

Larry Pereira, Project Engineer
Suite 700, Gulf Canada Square
401 - 9 Avenue SW
Calgary, AB T2P 4Z4
Telephone: 403-319-6344
Email: larry_pereira@cpr.ca

200.2.3.7.5 CPR Rail Crossings – CPR Miles 164.59, 164.65, 164.70, 165.13, 165.18 Willingdon Subdivision

The Contractor shall design and construct grade separations, including the bridge structures, for the following crossings as shown on Drawing 18-A-3.08, 18-A-5.08, 18-A-5.09, 18-A-5.16, 18-A-5.17 and 18-A-5.18 in Appendix A:

- Anthony Henday Drive mainline from CPR – CPR Mile 165.18 Willingdon Subdivision and the directional ramp carrying westbound Yellowhead Trail onto southbound Anthony Henday Drive;
- Yellowhead Trail mainline from both CPR – CPR Mile 164.59 Willingdon Subdivision and the directional ramp carrying westbound Yellowhead Trail onto southbound Anthony Henday Drive;
- the Elevated Directional Ramp carrying southbound Anthony Henday Drive onto eastbound Yellowhead Trail from CPR – CPR Mile 164.70 Willingdon Subdivision and the directional ramps carrying westbound Yellowhead Trail onto southbound Anthony Henday Drive and northbound Anthony Henday Drive onto eastbound Yellowhead Trail;
- the directional ramp carrying eastbound Yellowhead Trail onto Broadmoor Boulevard from both CPR – CPR Mile 164.65 Willingdon Subdivision and the directional ramps carrying westbound Yellowhead Trail onto southbound Anthony Henday Drive and northbound Anthony Henday Drive onto eastbound Yellowhead Trail; and
- the Elevated Directional Ramp carrying northbound Anthony Henday Drive onto westbound Yellowhead Trail from the CPR – CPR Mile 165.13 Willingdon Subdivision.

CPR's yard is immediately west of the CPR Mile 165.20 Willingdon Subdivision crossing southbound Anthony Henday Drive. Within the TUC, the Willingdon Subdivision is currently three tracks with no plans for future expansion.

The Contractor shall be responsible for demolition and removal of all existing bridge structures at these locations. The Contractor shall obtain all required permits and approvals for demolition from CPR and the Department. The Contractor shall complete the Demolition (as defined in Section 200.2.3.24) of each bridge structure in accordance with Section 200.2.3.24 (Demolition).

200.2.3.7.6 CNR Rail Crossing – Camrose / Wainwright Subdivision Connection; CNR Rail Crossing – Camrose Subdivision at CNR Mile 0.16; 17 Street NW

Westbound Yellowhead Trail and the one-lane on-ramp from Hayter Road will continue to be grade separated from CNR Mile 0.16 Camrose Subdivision, the Subdivision Connection between Camrose and Wainwright, and 17 Street NW. The Department has commissioned CNR to design and re-construct the north end span opening of both railway structures on westbound Yellowhead Trail, including retaining walls or headslope as required, to allow for the on-ramp from Hayter Road to be tapered onto WB Yellowhead Trail prior to the river structure. The Contractor is required to construct the directional ramp and associated taper, including barriers as required, onto Yellowhead Trail after CNR has completed their work on the rail structures. The Contractor will not be permitted to work inside the CNR work zone while CNR is performing the substructure and superstructure work.

If the work required to the rail structures is not complete and the site vacated by June 1, 2015, the Contractor is required to construct a temporary tie-in of the directional ramp to Yellowhead Trail, to carry traffic under the main span of the rail structure. During operation of this temporary tie-in posted speed of this section of Yellowhead Trail will be temporarily reduced to 80 km/h.

200.2.3.7.7 CNR Rail Crossing – CNR Mile 0.26 Camrose Subdivision

Eastbound Yellowhead Trail is currently grade separated from CNR Mile 0.26 Camrose Subdivision. The requirement for additional laning under the structure requires the Contractor to design and construct retaining walls, including guardrail/barriers as required, at the existing piers of the CNR Mile 0.26 Camrose Subdivision structure, as shown on Drawing 18-A-5.23 in Appendix A.

200.2.3.7.8 Sherwood Park Freeway/Anthony Henday Drive Interchange Bridge Culvert Crossings

Three bridge culverts carrying a tributary to Gold Bar Creek are presently adjacent to the Sherwood Park Freeway interchange. Stage 1 construction shall include the removal and replacement of each of the culverts with equivalent or better infrastructure to convey the expected 1:100 year high flows. The culverts are generally described as:

<u>Alberta Transportation Bridge File 76108:</u>
There is one 1.83 m diameter CSP bridge culvert and one 0.76 m diameter CSP bridge culvert which cross Anthony Henday Drive approximately 500 metres north of Sherwood Park Freeway. The Contractor shall design and construct the replacement culverts to a design discharge of 6 m^3/s under surcharged conditions, and shall operate in conjunction with the required storage

within the TUC outlined in Section 200.2.5 (Drainage).

Alberta Transportation Bridge File 76422:
There are two 1.118 m x 1.829 m CSP arch bridge culverts which cross Sherwood Park Freeway approximately 500 metres east of 17 Street NW. The Contractor shall design and construct the replacement culverts to a design discharge of 6 m^3/s according to Alberta Transportation's *Design Guidelines for Bridge Size Culverts*.

Alberta Transportation Bridge File 02036:
There is one 1.724 m x 1.901 m elliptical bridge culvert which crosses 17 Street NW south of the ramp terminal on the south side of the 17th Street/Sherwood Park Freeway Interchange. The Contractor shall design and construct the replacement culverts to a design discharge of 7.5 m^3/s according to Alberta Transportation's *Design Guidelines for Bridge Size Culverts*.

To repeat, the Contractor shall obtain all necessary environmental approvals/permits for the design and construction of this part of the New Infrastructure.

The Contractor will be responsible for demolition and removal of the existing bridge structures that grade separate Sherwood Park Freeway from Anthony Henday Drive in accordance with Section 200.2.3.24 (Demolition).

200.2.3.8 Intentionally Deleted

200.2.3.9 Intentionally Deleted

200.2.3.10 Intentionally Deleted

200.2.3.11 Intentionally Deleted

200.2.3.12 Intentionally Deleted

200.2.3.13 Intentionally Deleted

200.2.3.14 Intentionally Deleted

200.2.3.15 Intentionally Deleted

200.2.3.16 Intentionally Deleted

200.2.3.17 Intentionally Deleted

200.2.3.18 Service Roads

The Contractor shall design and construct the service roads as set out in this Section 200.2.3.18 and as detailed in the applicable Drawing in Appendix A (the "**Service Roads**"). The Service Roads are roadways and intersections to be designed and constructed by the Contractor and turned over to the Local Authority for operation and maintenance. The Contractor shall match the relevant Local Authority's standards for such Service Road construction.

The Contractor shall ensure that traffic on existing roadways and intersections continues to operate at the existing standards and level of service throughout construction. Any Service Roads required to replace an existing access shall be completed and open to public traffic prior to removing existing access roads from service. The Contractor shall be responsible for removal, and coordination of any required road removals and closures in the TUC and within the Project Limits with the Local Authority.

The Contractor is responsible for the design and construction of all permanent signage, pavement markings, lighting and signalization of the Service Roads, but for all traffic signals associated with the Service Roads, the Contractor shall contract with the Local Authority for the design and construction of such traffic signals.

Prior to opening of a particular Service Road to traffic in accordance with section 5.18 of the DBFO Agreement and the resulting hand-over of the particular Service Road to the Local Authority, the Contractor shall invite the Local Authority to attend the final project inspection for all infrastructure that will become the Local Authority's responsibility.

200.2.3.18.1 167 Avenue Service Roads

Prior to Traffic Availability, the Contractor shall design and construct two Service Road connections on the south side and north side of Anthony Henday Drive to connect the existing 167 Avenue to Fort Road, as shown on Drawing 18-A-3.07 in Appendix A. The south side Service Road connection shall have a design speed of 50 km/h and the north side Service Road connection shall have a design speed of 60 km/h. Access to the properties on Fort Road, south of 167 Avenue shall be provided at all times; therefore, this Service Road connection must be open to traffic prior to removal of the access from 167 Avenue. This Service Road shall be designed and constructed in accordance with the typical section for a "Paved Service Road, Local Residential", as shown on Drawing 18-A-4.04 in Appendix A. The Local Authority for these Service Roads is the City.

In addition, the Contractor shall also construct two 6 m wide gravel Service Roads from 167 Avenue to the grade separations at Coronado and Vegreville Subdivisions as shown on Drawing 18-A-3.07 in Appendix A. These two Service Roads shall be constructed with a centerline crown, 3% crossfall and 4:1 sideslops. These two Service Roads shall be constructed prior to 167 Avenue becoming discontinuous through the TUC. The Contractor is required to provide and install steel pipe gates equivalent to the County standard drawing STD-55 at both of these Service Road entrances from 167 Avenue.

Two at-grade railway crossings are present on 167 Avenue and are complete with lights and bells. No modifications to the existing railway crossings are required in the construction of these Service Roads.

The Contractor shall keep 167 Avenue connected from 26 Street to Fort Road and Fort Road connected from 167 Avenue to the north for as long as reasonably practical to allow for traffic pattern adjustments and to provide N-S access to properties north and south of Anthony Henday

Drive.

200.2.3.18.2 130 Avenue Service Roads

Prior to Traffic Availability, the Contractor shall design and construct two Service Roads in the immediate vicinity of 130 Avenue as shown on Drawing 18-A-3.05 in Appendix A. These Service Roads shall have a design speed of 70 km/h. The Local Authority for the Service Roads at 130 Avenue is the City.

The Contractor shall construct Service Roads running north and south from the intersection on 130 Avenue west of Anthony Henday Drive. These Service Roads shall be designed and constructed in accordance with the typical section for a "Paved Service Road, Industrial Collector", as shown on Drawing 18-A-4.04 in Appendix A. The Service Road south of 130 Avenue shall be constructed within the Road Right of Way. An unofficial access from Meridian Street is currently in operation and will be impacted by the construction of this Service Road. The existing connection to Meridian Street must remain in operation until public access is provided from the Service Road. The Service Road north of 130 Avenue will require partial construction outside the TUC. In order to maintain access to private land, this Service Road shall be constructed and open for use by public traffic prior to closing the access from Meridian Street.

The Department will be constructing an alternative access road for the Edmonton Waste Management Centre that runs northerly from 130 Avenue on the east side of Anthony Henday Drive. Construction of the alternative access road is schedule for October 2013 completion. The Contractor shall be responsible for design and construction of the permanent connection from 130 Avenue to match the alignment and grade of the access road. The Contractor is responsible for ensuring that the Edmonton Waste Management Centre has uninterrupted public access throughout the Construction Period and the Operating Period. The access from 130 Avenue shall be fully operational prior to the closure of the access from Meridian Street. Upon closure of the access from Meridian Street, the Contractor shall obliterate the access road in accordance with Section 200.4.12 (Roadway Obliteration). The Contractor shall relocate the existing Edmonton Waste Management Centre entrance sign at Meridian Street to the new access location off 130 Avenue. The Contractor shall coordinate the construction and timing of the entrance sign relocation with the City. The Contractor shall provide written notice to the City when the existing entrance gate hardware, card readers and lighting are to be removed. The Contractor shall store salvaged components in a secure location and protect them against theft, vandalism or damages. The materials shall be made available to the City for pick up for a period of 30 days. The Contractor shall be responsible for disposal of remaining components after this 30 day period has elapsed.

The Contractor shall facilitate the removal of the existing gate, card readers and lighting by the City such that the integrity of the operation of the existing roadway lighting and CCTV equipment outside the Project Limits is not compromised.

200.2.3.18.3 17 Street NW/115 Avenue Service Roads

Prior to Traffic Availability, the Contractor shall design and construct a Service Road network in the industrial area south of Yellowhead Trail between 17 Street NW and Anthony Henday Drive as shown on Drawings 18-A-3.05 and 18-A-3.08 in Appendix A. These Service Roads shall have a design speed of 60 km/h.

The Local Authority for Service Roads in this vicinity is the County. These Service Roads shall be designed and constructed in accordance with the typical section for a "Paved Service Road, Industrial Collector", as shown on Drawing 18-A-4.04 in Appendix A. The use of curb and gutter is permitted for the Service Road connection between 115 Avenue and 116 Avenue where there is limited right-of-way and potential conflicts with existing utilities.

The Contractor shall design and construct a signalized intersection at 17 Street and 115 Avenue to become the main access from 17 Street into the industrial area. The commencement of signals operation shall be coordinated with the decommissioning of the signals at the intersection at 116 Avenue and 17 Street. The City will be performing intersection alterations and decommissioning of the signals at 116 Avenue.

The existing 116 Avenue shall be closed at the N-S access to/from Highway 16 and obliterated in accordance with Section 200.4.12 (Roadway Obliteration). The N-S portion of the Service Road extension from 115 Avenue to north of the CPR lands must be in operation prior to severing the access along 116 Avenue.

200.2.3.18.4 CNR Clover Bar Yard / Hayter Road Service Road

Prior to Traffic Availability, the Contractor shall design and construct a Service Road to provide access from Hayter Road to the CNR Clover Bar Yard as shown on Drawings 18-A-3.05 and 18-A-3.11 in Appendix A. This Service Road shall be designed and constructed in accordance with the typical section for a "Paved Service Road, Local Industrial", as shown on Drawing 18-A-4.04 in Appendix A. The use of curb and gutter is permitted where there is limited right-of-way and potential conflicts with existing utilities.

The lane width of 4.5 m shall be widened starting under the Anthony Henday Drive NB bridge at the CNR Clover Bar Yard and continue around the horizontal curve east of the bridge to accommodate tracking of a WB-21 vehicle. The offset from the edge of pavement to the bridge headslope/retaining wall shall be no less than 2.0 m.

200.2.3.18.5 Intentionally Deleted

200.2.3.18.6 Petroleum Way Service Road

The Contractor shall design and construct Stage 1 of Petroleum Way as a Service Road and centered on the Ultimate Stage centerline of Petroleum Way as shown on Drawing 18-A-5.07 in Appendix A. The design speed for Petroleum Way is 70 km/h. The Local Authority is the County for Petroleum Way. This Service Road shall be designed and constructed in accordance with the County's *Engineering Servicing Standards Roads, Section B* for urban design, including curb and gutter, as shown on Drawing 18-A-4.03 in Appendix A.

The Contractor will be responsible for demolition and removal of the existing arch bridge culvert structure (Alberta Transportation Bridge File #BF77416) at this location. The Contractor shall complete the demolition of the bridge culvert structure in accordance with Section 200.2.3.24 (Demolition).

Any portion of the existing roadway within the Project Limits not incorporated into the newly constructed Service Road shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration). An unused utility culvert is present under Anthony Henday Drive north of Petroleum Way. The Contractor will be responsible for the demolition and removal of the existing utility culvert.

A storm sewer pipe is owned by the County and installed west of Anthony Henday Drive along Petroleum Way. The use of this storm sewer is strictly governed by the County and any application to use this storm sewer line shall be made to the County.

Stage 1 construction shall include the design and construction of a 3.0 m multi-use trail on the north side of Petroleum Way within the Project Limits.

Petroleum Way is an emergency evacuation route for the adjacent refinery. Petroleum Way is to remain open at all times with traffic operations unimpeded. If a detour is required for access, the detour must be constructed to an equal or better standard than the existing roadway and in accordance with Section 200.2.3.23 (Detours). The Contractor shall provide the adjacent refinery and the County with a minimum of 30 days written notice prior to implementation of any detour. Direct access to/from Anthony Henday Drive is not permitted.

200.2.3.18.7 Sherwood Park Freeway / 76 Avenue Service Road

As part of the Contractor's removal of the WB-SB grade separated access to 76 Avenue from Sherwood Park Freeway, access to adjacent properties will be provided by the construction of a Service Road. This Service Road shall have a design speed of 60 km/h. The Contractor is required to remove the south leg of the intersection at 76 Avenue and 9 Street and curved road portion joining 9 Street to 76 Avenue. Prior to Traffic Availability, the Contractor shall design and construct a tangent section of Service Road to connect 76 Avenue in an E-W direction as shown on Drawings 18-A-3.03 in Appendix A. The design speed of this Service Road is 60 km/h. This Service Road shall be designed and constructed in accordance with the typical section for a "Paved Service Road, Local Industrial", as shown on Drawing 18-A-4.04 in Appendix A.

The Contractor shall design and construct an access on the newly aligned 76 Avenue for all businesses with access from 8 Street and 76 Avenue. The Local Authority in this area is the City.

76 Avenue runs east-west until west of Anthony Henday Drive, at which point it becomes Meridian Street running north-south. The new interchange footprint will require realignment of the portion of 76 Ave/Meridian Street as shown on Drawing 18-A-3.03 in Appendix A. Access to the remaining adjacent business properties shall be designed and constructed by the Contractor to a similar standard as the existing access. The portion of 76 Avenue/Meridian Street shall be obliterated by the Contractor in accordance with Section 200.4.12 (Roadway Obliteration).

The Contractor is required to close the direct access from southbound Anthony Henday Drive to Hurstwood SW. The existing access to Hurstwood SW shall not be taken out of service until the Service Road connection from 76 Avenue and 9 Street to Meridian Street is open to public traffic. The Contractor shall provide written notice to the Department six months prior to closure of the Hurstwood Road access from Anthony Henday Drive.

200.2.3.18.8 Anthony Henday Drive / Sherwood Park Freeway Service Roads

Prior to Traffic Availability, the Contractor shall design and construct a Service Road within the Road Right of Way on the east side of Anthony Henday Drive, north of Sherwood Park Freeway. The design speed of this Service Road is 60 km/h. This Service Road shall be designed and constructed as a Class IV Rural Grid Road (Dust Abated Gravel Roadway) in accordance with the County's B-3 Rural Drawing.

The Service Road north of Sherwood Park Freeway shall connect from the extension of Fir Street north to the Telus tower as shown on Drawings 18-A-3.02 - 18-A-3.04 in Appendix A. This Service Road construction will include a new intersection with TWP RD 524A to provide access to Lease 928R (see Appendix G).

The Contractor shall construct a Service Road turnaround at the existing Hulbert Crescent as shown on Drawing 18-A-3.02. The Contractor shall also install a gate in accordance with the County's standard drawings STD-25 through STD-30 (T-Bollard Gate) in *Strathcona County's Open Space Development Standards (OSDS) Manual* (2006) at the north turnaround to provide emergency access to Sherwood Park Freeway. The Contractor may purchase the gate directly from the County.

The applicable Local Authority for these Service Roads is the County.

200.2.3.18.9 Yellowhead Trail / Broadmoor Boulevard Service Road

Prior to Traffic Availability, the Contractor shall design and construct a Service Road on the north side of Yellowhead Trail from Broadmoor Boulevard to Sherwood Drive, as shown on Drawing 18-A-3.09 in Appendix A. The design speed for this Service Road is 60 km/h. This Service Road shall be designed and constructed in accordance with the typical section for a "Paved Service Road, Industrial Collector", as shown on Drawing 18-A-4.04 in Appendix A. The Service Road will extend from 28 Street NE to a cul-de-sac east of Broadmoor Boulevard.
Intersection improvements are required at 121 Avenue and 17 Street NE as shown on Drawings 18-A-3.09 and 18-A-3.10 in Appendix A. New signals shall be designed and constructed in accordance with the third paragraph of this Section 200.2.3.18 by the Contractor. The applicable Local Authority is the City.

200.2.3.19 High Load Corridors

High loads or oversized loads are frequently transported from northeast and southeast Edmonton using the following routes:

- Range Road 232 (Sherwood Drive) to Highway 16 eastbound towards Highway 21;
- 17 Street NW southbound using Sherwood Park Freeway to get to Whitemud Drive destined for Highway 216; and
- 34 Street NW southbound towards Whitemud Drive destined for Highway 216.

Throughout the Construction Period, the Contractor shall ensure that the design, construction and operation of the In-Service Roads safely allow the passage of oversize loads. Traffic signal arms and cantilever sign structures along the above noted routes shall be designed to accommodate pivot or hinge movements at the base to allow passage of oversized loads.

Median crossovers located on Whitemud Drive west of Highway 216, on Highway 216 south of Whitemud Drive, and on Yellowhead Trail east of Sherwood Drive shall operate unimpeded throughout the Construction Period and the Operating Period.

200.2.3.20 Road Closures

The Contractor is responsible for the physical closure of existing roads at locations shown on Drawings 18-A-3.01 to 18-A-3.12 in Appendix A.

The Contractor is responsible for obtaining all permits and approvals for the physical road closures and removals, construction of the required turnarounds, installation of appropriate signage, installation of barricades and disposal of all materials and restoration of the closed road to a natural landscaped area, including the restoration of drainage to its original lines. The roadway structure shall be obliterated in accordance with Section 200.4.12 (Roadway Obliteration) then topsoiled and seeded in accordance with Section 200.2.9 (Topsoil and Seeding).

The Contractor is responsible for coordination of all removals and closures with the Local Authority. The Contractor shall apply to the Local Authority for road closure permits a minimum three months prior to the planned date of the road closure. The Department will be responsible for obtaining legal road closure and the Contractor shall cooperate with the Department in the supply of information for legal road closure.

The Contractor is responsible for the removal and obliteration of the right-in-right-out access to Hurstwood Road from Anthony Henday Drive southbound. The closure of this road requires approval by the Department.

The Contractor shall not close any road prior to the date stipulated in this Schedule, if applicable. In addition, the Contractor shall not close any road until such time as permanent alternative access to affected properties is available and in full operation.

The Contractor shall construct turnarounds as shown on Drawing 18-A-4.04 at locations shown on Drawings 18-A-3.01 to 18-A-3.12 in Appendix A. When specified or shown on the drawings, turnarounds shall be designed and constructed to accommodate a WB-36 design vehicle.

200.2.3.21 Traffic Signals

The Contractor is responsible for design and installation of all necessary traffic signals on the specified interchange ramps and intersections. The Contractor shall verify that design and installation of the new signals will not compromise the integrity of the operation of the existing signals outside the Project Limits.

All signal systems shall be reasonably similar to those used by the Local Authority. The signal timing shall be coordinated with the Local Authority. The signal electronics shall meet NEMA standards. All poles and hardware shall be galvanized.

Traffic signal systems shall include an emergency vehicle override system that is compatible with the Local Authority's emergency equipment, vehicle detection, and traffic signal communication interconnection systems.

All existing traffic signals at the proposed interchanges in Stage 1 construction shall be replaced as part of the New Infrastructure.

The Contractor is responsible for the removal of the following existing traffic signals as shown on Drawings 18-A-3.03 and 18-A-3.08 in Appendix A:

- Broadmoor Boulevard at the existing intersection with the exit/entrance ramps of both directions on Yellowhead Trail;
- 17 Street at the existing intersection with the exit/entrance ramps on Sherwood Park Freeway; and
- 116 Avenue NW at the existing intersection with 17 Street NW.

The Contractor is responsible for coordination of all traffic signal removals with the Local Authority. The Contractor shall apply to the Local Authority for permit a minimum three months prior to the planned date of the removal. On the scheduled removal date, the Contractor shall remove existing traffic signals and provide written notice to the appropriate Local Authority that the existing traffic signal hardware has been removed and is available for pick up for a period of 30 days. The Contractor shall store signal hardware in a secure location and protect it against theft, vandalism or damages. The Contractor shall be responsible for the disposal of remaining components after this 30 day period has lapsed.

200.2.3.22 Intentionally Deleted

200.2.3.23 Detours

The Contractor is responsible for maintaining existing traffic and access on all roadways and for all properties affected by the construction. The extent of all detours shall be constructed entirely within the Project Limits. As required by Section 100.2.8 (Construction Management Plan), all detour plans shall be submitted to the Department for review in accordance with section 5.5 of the DBFO Agreement. Traffic accommodation plans shall be in accordance with Alberta Transportation's *Traffic Accommodation in Work Zones* (2008) manual and the Roadside Design Guide. Horizontal geometry and barrier placement for all Mainline detours shall be in accordance with Exhibit 200.2.3.23-1 (Typical Mainline Detour) in Part 2 of Appendix B. The

Highway Geometric Design Guide shall form the basis for the horizontal and vertical geometry of all detours.

The Contractor is responsible for ensuring proper detour signage, barriers, markings, lighting, safety devices, and other appurtenances are installed and maintained for the duration that the detour is in use. Any existing overhead or ground-mount guide signs that display information contrary to the intended operation of the detours shall be covered up or removed for the duration that the detour is in place.

The Contractor shall provide detour plans showing geometry, traffic accommodation, and signing changes to the Local Authority for all crossroads and Service Roads and to the Department for all Mainline and Systems Ramps for their information a minimum of 14 days prior to detour implementation.

Detours for all roadways, if required, shall maintain safe passage of traffic, and shall allow for the minimum number of specified lanes open in each direction at all times. All such detours must be constructed with a surface type equal to or better than the surface on the connecting roadways on either end of the detour, and shall meet specified minimum design and posted speeds. Detours shall be illuminated to equivalent standards of existing roadway. Concrete barriers that are compliant with MASH are required to separate Mainline or directional ramp traffic from construction work zones while traffic detours are in use.

The lane width of detours shall be 3.5 m unless otherwise specified in this Section. Detour standards (minimum lanes and minimum design and posted speeds) are indicated in the following table:

Roadway(s)	**Min. # Lanes (Each Direction)**	**Min. Shoulder Width (m)**	**Minimum Design Speed**	**Minimum Posted Speed**
Yellowhead Trail	2 @ 3.7 m	2.0	90	80
Anthony Henday Drive	2 @ 3.7 m	2.0	90	80
18 Street	1	1.0	60	50
153 Avenue	1	1.0	60	50
Hayter Road	1	1.0	60	50
17 Street NW	1	1.0	60	50
Petroleum Way	1	1.0	60	50
Baseline Road	2	1.0	60	50
Sherwood Park Freeway	2	2.0	70	60
34 Street NW	1	1.0	60	50
Whitemud Drive	2	2.0	70	60
Broadmoor Boulevard	2	1.0	60	50
Sherwood Drive	2	1.0	60	50
EB-SB at Yellowhead Trail/Anthony Henday Drive	1	2.0	80	70

Roadway(s)	Min. # Lanes (Each Direction)	Min. Shoulder Width (m)	Minimum Design Speed	Minimum Posted Speed
WB-SB at Yellowhead Trail/Anthony Henday Drive	1	2.0	80	70
NB-EB at Yellowhead Trail/Anthony Henday Drive	1	2.0	80	70
NB/SB-WB at Yellowhead Trail/Anthony Henday Drive	1	2.0	70	60

Detour Standards (minimum lanes, minimum lane width, minimum design speed and posted speeds) for existing or temporary bridge crossings are indicated in the following table:

Existing or Temporary Bridge Crossing(s)	Min. # Lanes (Each Direction)	Min. Lane Width (m)	Minimum Design Speed	Minimum Posted Speed
Yellowhead Trail over CPR	2	3.7	90	80
Anthony Henday Drive over Yellowhead Trail	2 NB, 1 SB	3.5	90	80
Petroleum Way under Anthony Henday Drive	1	3.5	60	50
Anthony Henday Drive over CPR south of Yellowhead Trail (YHT)	1 SB, 2 NB plus 1-lane EB-SB merge off YHT	3.5	90	80
Baseline Road over Anthony Henday Drive	2	3.5	60	50
Sherwood Park Freeway over Anthony Henday Drive	2	3.5	70	60
17 Street NW over Sherwood Park Freeway	1	3.5	60	50
34 Street NW over Sherwood Park Freeway	1	3.5	60	50
Whitemud Drive over Anthony Henday Drive	2	3.5	70	60
Broadmoor Boulevard over Yellowhead Trail	2 NB, 1 SB	3.5	60	50
Sherwood Park Freeway over CNR	2	3.7	60	50

The Department may consider reduced shoulder widths for existing or temporary bridge crossings. The Contractor shall submit to the Department for review a detailed detour plan showing the proposed lane and shoulder widths.

Notwithstanding the minimum lane requirements in the preceding tables, the Contractor shall maintain existing traffic movements throughout the Construction Period at all loops and ramps, all movements at at-grade intersections, and accesses to properties affected by construction activities until the access is to be removed, where applicable.

The Department may permit short term local detours to reroute traffic at crossroads or interchanges to accommodate short term construction operations such as girder erection. Prior to the implementation of short term local detours the Contractor shall submit to the Department for review a detailed detour plan and other material to comply with the City's OSCAM processes for incorporation into the Contractor's Traffic Management Plan under Section 100.2.5, and an updated Traffic Management Plan identifying the number of lanes, all horizontal and vertical detour geometry, anticipated traffic volumes relative to peak traffic volumes, traffic management and traffic control devices, and hours of operation. A single lane detour may be used for short term, local detours wherever the traffic can be safely accommodated on a single lane. The Contractor shall ensure that multiple site short term local detours are not required for adjacent routes serving the same communities. The Contractor shall notify the appropriate Local Authority and emergency service providers, with a copy of all such notices provided concurrently to the Department, a minimum of one week prior to all proposed short term traffic interruptions. Short term detours shall be limited to the hours of 10:00 p.m. to 6:00 a.m. local time.

If the Contractor's detour requires the alteration of traffic signals or traffic signal timing on signals owned by the Local Authority, the Contractor shall coordinate any changes with the Local Authority, and shall hire the Local Authority to make the necessary signal revisions on signals owned by the Local Authority. In addition, the Contractor shall confirm that the signal alteration will not result in a reduction of capacity during the a.m. and p.m. peak periods.

The following requirements, including without limitation Payment Adjustments (unless expressly stated otherwise), shall apply during the Construction Period (with such modifications as necessary) to all detours (the "**Deemed New Infrastructure**") as if all detours were New Infrastructure:

(a) Section 400.1.5 (Imminent Danger Repairs);

(b) Section 400.1.6 (Lane Closure) applied to any reduction of the minimum lane requirements for the Deemed New Infrastructure as set out in Section 200.2.3.23 (Detours). The provisions applicable to the Schedule of Lane Closures and telephone service shall not apply. Except with the prior written approval of the Department, acting reasonably, and except for an Excepted Lane Closure, the Contractor shall not close all lanes in either direction or close any lanes for an extended period of time (as determined by the Department acting reasonably). For planned maintenance activities on Deemed New Infrastructure with two lanes in each direction the Contractor must have at least one lane in each direction open to traffic at all times, unless otherwise approved in writing and in advance by the Province, acting reasonably. For the purposes of the second bullet of the definition of Lane Closure in the third last paragraph of Section 400.1.6 (Lane Closure), the Minimum Posted Speed in the fifth column of the above tables in this Section 200.2.3.23 are deemed to be 75% of the normal posted speed for the applicable detour;

(c) Section 400.2.1.1 (Routine Observations);

(d) Section 400.2.2 (Emergency Maintenance);

(e) Section 400.2.3 (Routine Maintenance);

(f) Section 400.2.4 (Measuring for Compliance);

(g) Section 400.3.1 (General). For the Winter Maintenance Standards table in Section 400.3.1, Highway 16 is deemed a Class AAA roadway, Highway 216 is deemed a Class AA roadway, and all other crossroads are deemed Class A roadways;

(h) Section 400.3.2 (Equipment and Materials);

(i) Section 400.3.3 (Snow Clearing and Ice Control Operations);

(j) Section 400.4.1 (Roadway Maintenance Requirements), except for the requirements in the third bullet under Section 400.4.1.2 (Completing Repairs);

(k) Sections 400.4.4 (Rutting Performance Requirement (New Infrastructure Only)) and 400.4.6 (General Pavement Maintenance Requirements). Detours shall be designed to accommodate the anticipated traffic and to meet the requirements of “$/Isolated Deficiency” column of Section 400.4.4.2 (Payment Adjustments) of Section 400.4.4 (Rutting Performance Requirement (New Infrastructure Only)) and Section 400.4.6 (General Pavement Maintenance Requirements), except the requirements in Section 400.4.6.3 and 400.4.6.4 and that the definition of localized roughness in Section 400.4.6.2 shall be modified to be any abrupt deviation in excess of 12mm when measured with a 1.2m straight edge;

(l) Section 400.4.7 (Miscellaneous - Operation and Performance Requirements), except for the requirements in Section 400.4.7.9 and for any Payment Adjustments set out in Section 400.4.7; and

(m) Section 400.4.8 (Traffic Control Devices - Operation and Performance Requirements), except for any Payment Adjustments set out in Section 400.4.8.

The Contractor is expected to act reasonably and professionally throughout the Construction Period and shall take all reasonable precautions to prevent damage to existing infrastructure.

The Contractor will be permitted to detour traffic onto bridges included with the New

Infrastructure prior to Traffic Availability.

200.2.3.24 Demolition

The Contractor shall demolish, remove and dispose (the "**Demolition**") of all buildings, associated works (wells, poles, etc.), other structures or installations located on the Affected Areas (as defined below), and all existing fences and above ground constructed features within the crossroads rights-of-way described in the City Agreement (as defined in Section 200.4.1). The Contractor shall obtain all required permits and approvals for the Demolition. The Province shall ensure the Affected Areas have been vacated by the Affected Areas' tenants so as to enable the Contractor to carry-out the Demolition. The Contractor shall remove and dispose of all rubbish from the Affected Areas after tenants have vacated. All building demolitions must be completed by December 31, 2012. The Contractor shall restore the Affected Areas after the Demolition to a landscaped state consistent with the surrounding area, including the restoration of existing drainage. Burial of the demolition materials is not allowed. The "**Affected Areas**" means:

(a) those lease areas set out in Appendix G (Alberta Infrastructure Land Lease Summary and Drawings);

(b) the property with short legal description Plan 6125HW, Block 1, Lot 10 located between Leases 900X and 903A; and

(c) the property with short legal description Plan 3813MC, Lot B on which located was Great West Containers and on which remain some massive structures and pieces of equipment that require Demolition.

The Contractor shall Demolish all retaining walls and existing bridge structures identified in Section 200.2.3 (Design Specifics) in accordance with the referenced restoration and disposal requirements. Burial of the demolition materials within the Lands is not allowed.

The Contractor shall be responsible for Demolition of existing bridge structures indicated in Section 200 and as shown on Drawings 18-A-5.01 to 18-A-5.38 in Appendix A. The Contractor shall obtain all required permits and approvals for demolition from the appropriate Local Authority and railway company. All components of the structure and substructure shall be removed to a minimum depth of 1 m below final grade. The Contractor shall supply both the Department and Department of Infrastructure with plans showing all bridge components left below grade, together with a description of the components, approximate dimensions and depths as extracted off Department "as-built" drawings, and surveyed coordinates. Where these new components are within 20m of any bridge that forms part of the New Infrastructure, this shall be noted on an information sheet in the "C" drawing set for that bridge, together with the number of the drawing that provides detailed descriptions and locations. Burial of the demolished materials within the Lands is not allowed.

The Contractor shall submit the following information in respect of a Demolition to the Department:

- Proposed demolition sequence and schedule;

- Construction limits;
- Demolition methods;
- Depth of removal;
- Traffic Accommodation Plan;
- Safety Plan; and
- Protection measures for existing infrastructure and environment.

All removed asphalt, soil cement and concrete pavement is the property of the Contractor. All operations necessary for the removal of any structures which might endanger the new construction shall be completed prior to the construction of the new work.

Prior to demolition of existing railway bridge structures as indicated in Section 200 and as shown on Drawings 18-A-5.01 to 18-A-5.38 in Appendix A, the Contractor shall invite the applicable railway company to attend an inspection of the existing structure to be removed to identify what portions, if any, of the existing structure are to be salvaged for the railway company. The salvaged components shall be stored outside the limits of construction and in manner satisfactory to the applicable railway company for a period of three months for pick up by the applicable railway company. The Contractor shall dispose of any remaining components after the expiry of the three month period.

The Contractor acknowledges that the description of the buildings, associated works, other structures or installations listed in Appendix G (Alberta Infrastructure Land Lease Summary and Drawings) under the "Demolition Requirements" column is provided for information only and must be confirmed by the Contractor. The Province makes no representation as to the completeness or accuracy of the description therein and no error or omission shall relive the Contractor of its obligations under this Section 200.2.3.24.

200.2.4 INTENTIONALLY DELETED

200.2.5 DRAINAGE

The basis for drainage design shall be generally as outlined in the Functional Plan except where noted below. Drainage works shall be designed in accordance with *Alberta Transportation's Design Bulletin #16 - Drainage Guidelines for Highways Under Provincial Jurisdiction in Urban Areas*, *Alberta Transportation's Best Practice Guidelines for Culvert Selection,* Section 200.2.17 (Miscellaneous Environmental Concerns), specific requirements for stormwater management facilities to meet the *Edmonton Heliport Zoning Regulations SOR/2004-86*, as outlined in the Functional Plan, and the requirements of the Local Authority. The drainage design shall include erosion control installations necessary for the in-situ conditions of the drainage works. The Department's *Design Guidelines for Erosion and Sediment Control for Highways* may be considered for such designs.

The following exceptions to the design criteria as stated in Design Bulletin #16 shall apply:

- notwithstanding what is stated in Page 3 of 7 of the Design Bulletin #16 regarding highway ditches, the highway ditches should maintain a minimum slope of 0.2% to prevent standing water and also be designed to minimize velocities to avoid excessive erosion;

- notwithstanding what is stated in Page 4 of 7 of the Design Bulletin #16 regarding dry ponds, the maximum allowable fluctuation of the 1:100 year event is 2.5 m and the minimum bottom slope is 1.0%; and
- notwithstanding what is stated in Page 4 of 7 of the Design Bulletin #16 regarding wet lands, the allowable fluctuation depth above the permanent pool is 2.5 m.

Stormwater storage facilities shall be sized to accommodate stormwater from within the Road Right of Way, remaining areas of the TUC, and flow volumes from areas outside the TUC within the natural drainage basin. The Contractor shall consider both existing land development conditions and future development planning for those areas, as described in the Functional Plan. Future planning information is to be based on available development planning reports, as listed in section 7.1.4 (Local Drainage Studies) of the Functional Plan and the 2007 Strathcona County Urban Drainage System Assessment ("**SCUDSA**") report.

The Contractor shall determine the design storage requirements to offset the impacts of the elimination of the stormwater storage facility located in the southwest quadrant of the 17 Street/Sherwood Park Freeway interchange, with the approval of Alberta Environment and the City.

The Contractor is to provide erosion control to ensure no scour occurs downstream of the Sherwood Park Freeway bridge culvert outlet or extending across the pipeline right-of-way during extreme rainfall events.

The Contractor may contact Jim Eckert, City of Edmonton for additional information at (780) 496-5647.

Wet ponds are not permitted within loop ramps or between ramps and the Mainline except for Ponds 7, 9, 10, and 14, as shown in the Functional Plan.

The facilities shall be designed and operated to regulate all runoff discharge to receiving water bodies at the general locations and in quantities outlined in the Functional Plan, and as noted herein. All permanent drainage systems and facilities shall be designed and constructed as gravity flow. The use of pumping systems or forcemains is not permitted. Standing water in ditches is not permitted.

The majority of the Anthony Henday Drive/Manning Drive interchange site is to drain to the Northeast Anthony Henday Drive drainage system, as per the Functional Plan. Ponds 9-1, 9-2 and 9-3 are currently being constructed as part of the Northwest Anthony Henday Drive project to temporarily drain the Manning Drive interchange at a controlled rate to Lake Moran, until the Northeast Anthony Henday Drive drainage system is constructed.

Upon construction of the Northeast Anthony Henday Drive drainage system, drainage from temporary Ponds 9-1, 9-2 and 9-3 are to be redirected into the Northeast Anthony Henday Drive drainage system. The future of temporary Ponds 9-1, 9-2 and 9-3 is to be determined by the Contractor.

Portions of the Northwest Anthony Henday Drive up to immediately west of the Manning Drive interchange are to drain to Lake Moran, as per the Functional Plan.

The Contractor shall remove and replace all existing culvert structures within the Project Limits, except as otherwise noted in Section 200.2.3 (Design Specifics). All stormwater storage facilities and minor conveyance systems shall be designed for the Ultimate Stage. All other drainage components shall be designed to be consistent with the grading in the general vicinity of the individual drainage components.

Stormwater management facility locations shall be determined by the Contractor. For the purpose of minimizing encumbrances to future pipeline construction, stormwater management wetlands and wet ponds are not to be located on TUC lands that are designated for pipelines. Any proposed use of lands outside the Road Right of Way and within the TUC for stormwater management facilities shall require the Contractor to obtain prior written agreement from the Department of Infrastructure.

Access roads are required to all pond inlet and outlet works. Access must also be provided to remove sediment accumulation on the pond bottom. Maintenance vehicle access shall conform to the requirements of the Local Authority as defined in the City of Edmonton's *Design and Construction Standards, Volume 3 Drainage, Section 16.0.*

Stormwater storage facilities placed adjacent to power transmission towers shall be shaped to allow overland access to the tower and a surrounding work area for power company maintenance equipment at the time water levels in the ponds are at design high water levels. Specific details of the access and work area requirements will be developed jointly by the Contractor and the affected power company. The stormwater storage facilities shall be enclosed by fences. The stormwater storage facilities and fences shall be maintained by the Contractor.

Anthony Henday Drive, Highway 16, Petroleum Way, Baseline Road, Sherwood Park Freeway, and Whitemud Drive are classified as dangerous goods truck routes and the provision for hazardous spill containment measures shall be included in the Contractor's stormwater management design.

If the Contractor makes an agreement to handle stormwater from outside the TUC or provincial road right-of-way with any party, then the Contractor shall ensure such agreements indemnify the Department from any future liability. Any such agreements shall require prior written approval of the Department.

Agreements for stormwater management facilities, ditch easements or other agreements which the Contractor may enter into, shall not provide for any payments from the Department without the Department's prior written consent. Such agreements must transfer to the Department at the end of the Term, at no cost to the Department, and must be enforceable in perpetuity.

The Contractor shall not sell drainage capacity in the stormwater management facilities to any third party.

The following miscellaneous drainage requirements shall be met:

- use of smooth wall steel pipes shall require prior written agreement with the Department for the intended use;
- manholes shall not be located within the paved area of the roadway, except for catch basin/manholes in the urban section of crossroads;
- all manholes in excess of 1.0 m depth shall have galvanized metal ladder rungs;
- traversable grates are required on all ends of culverts where the top of the inverts are within the required clear zone;
- permanent drainage systems and facilities shall be designed for gravity flow;
- existing wetlands and their current overflow routes, as well as the potential that they are filled in future, must be considered in the design of the stormwater management systems for the Project;
- approximately 210,000 m^3 of additional storage is to be developed within the TUC adjacent to the tributary of Gold Bar Creek downstream of the Village on the Lake subdivision, upstream of Anthony Henday Drive, with a controlled discharge rate based on 4 L/s/ha. and the following details:
  - the storage is to be developed in a dry pond format to minimize encumbrances to the pipeline and power line utility corridors. The storage is expected to be activated during large flood events, with overflow from the tributary channel;
  - the Service Road to be constructed immediately east of Anthony Henday Drive may be designed to act as a berm to hold back flows to the extent that the required storage volume is generated. It is expected that an outlet control structure through the berm will be required to provide the required controlled release rate;
  - flood levels are to be designed to be fully contained within the TUC with no impact on the residential properties to the east or to the surrounding roadways. This additional storage design is not expected to impact the designs of Ponds 3B and 3C, as shown in the Functional Plan;
  - all conveyance elements to be designed within the Project downstream of this storage facility are to be designed to pass the expected controlled discharges from this facility and from other contributing areas;
- all conveyance elements, including culverts not conveying pond discharges, are to be designed to pass the 1:100 year, 4-hour Chicago event;
- for areas identified in the Functional Plan to flow through the Project Limits with no additional controls (e.g. Areas I & J, and the area between Areas H and I), the Contractor is to design the conveyance piping and channels to the design flows that are the greater of the flows between the Functional Plan and available development planning reports;
  - the Contractor is to determine refinements to the service areas and drainage routes for Areas G & H based on a review of site conditions and available drainage reports; controlled discharges from Area G & H are to effectively pass through Pond 7, in a

flow-through condition, with little to no impact on the storage size required for Pond 7;

- ponds are to be designed to prevent backflow from downstream creeks during high flow events; the use of backflow prevention devices may be accepted only if other design options are exhausted.
- any lands currently contributing to the TUC, not recognized in the Functional Plan, must be accommodated within the Anthony Henday Drive drainage systems; in future, when the adjacent lands develop, it is expected that their drainage will be directed elsewhere, or at least be limited to predevelopment rates;
- contributing areas with controlled discharges are expected to flow through proposed TUC ponds without impacting pond volumes to any extent; external areas I, J, L, P, R and Oldman Creek, as defined in the Functional Plan, are not to be routed through proposed TUC ponds, and are to flow through the TUC;
- for purposes of providing for a practical outlet sewer design, a maximum discharge rate based on the 1:5 year design storm was assumed for ponds discharging directly to the North Saskatchewan River, including ponds 14 through 18. The Contractor is free to design these ponds with discharge rates higher than the 1:5 year rate provided:
    - the resulting impacts on pond storage sizes and downstream piping and outfall structure sizes has been accounted for;
    - the ponds are designed to include the required water treatment features for events up to the 1:2 year event; and
    - that information is supplied to support the designs;
- the capacity of the existing channel (a tributary of Gold Bar Creek) through the TUC from the Village on The Lake subdivision to the Road Right of Way to convey the 1:100 year high flows (approximately 16.6 m^3/s) must be confirmed by the Contractor, and channelization work done where required to ensure conveyance capacity;
- wetland outlet structure designs are the responsibility of the Contractor, with consideration given to the design features described in the Functional Plan and the following:
    - submerged outlet design with outlet controls contained within a structure adjacent to the downstream end of the wetland and with manhole access above the high water level;
    - a small diameter orifice to pass low flows, with invert at normal water level, sized to retain 1:2 year runoff volumes for 24 hours;
    - a larger diameter orifice to pass higher flows, with invert at the 1:2 year pond level and sized such that maximum allowable pond discharges are achieved at pond high water level from the combined discharges through both orifices; and
    - an emergency overflow weir at pond high water level for increased discharge capacity in the case where a storm event larger than the design event occurs;
- dry pond outlet structure designs are to be the responsibility of the Contractor, with consideration given to the design features described in the Functional Plan and the following:
    - outlet controls contained within a structure adjacent to the downstream end of the dry pond and with manhole access above the high water level;
    - an orifice sized to pass the maximum allowable pond discharges at pond high

    water level; and
    - an emergency overflow weir at pond high water level for increased discharge capacity in the case where a storm event larger than the design event occurs;
- the Contractor is to design the following ponds as wetlands with a controlled release based on 4 L/s/ha as follows:
    - Pond 3A – Area's A (64 ha), B (46 ha) and 3A (197 ha) – for a total of 307 ha;
    - Pond 3B – Pond 3A (307 ha), Area C2 (391 ha) and 3B (65 ha) – for a total of 763 ha;
    - Pond 3C – Area D (45 ha), Area 3C (86 ha) – for a total of 131 ha;
- the water treatment and spill containment features of the wetlands are to be designed by the Contractor, with consideration given to the design features described in the Functional Plan and the following:
    - a deeper open water area at the inlet end for collection of sediments from the incoming flows;
    - a deeper open water area at the outlet to provide for a submerged outlet that will allow floatable materials to be contained in the facility and not washed downstream; and
    - a large, circuitous, shallow section between the inlet and outlet pools in which normally occurring low flows can be routed through emergent and submergent vegetation that can provide filtering and plant uptake to remove contaminants;
- deep drop structures must be designed for energy dissipation; and
- river outfall structures must be designed for river ice scour forces.

Immediately following construction of the roadway, including seeding of the side slopes and ditches, the Contractor shall inspect all components of the drainage systems for sediment accumulation and remove any sediment found, including the following locations:

- the inlet ends of the dry ponds and inlet sedimentation bays of the wetlands;
- along the erosion control check dams in the ditches of the roadway approaching the North Saskatchewan River from the north;
- along the sedimentation check dams on the bottom of the dry ponds; and
- in any culverts or sewer systems.

200.2.6 ROADWAY LIGHTING

The roadway lighting system shall seamlessly tie into other adjacent Provincial or Local Authority systems. Transitions shall be gradual, in both colour and intensity. Lighting that was installed as part of the Southeast Anthony Henday Drive project and Northwest Anthony Henday Drive project does not require replacement. The lighting system shall meet or exceed the following requirements:

- *Alberta Transportation Highway Lighting Guide* as amended by Design Bulletin #35 ("**HLG**");
- Light standard offsets for protected poles shall be designed according to Figure 5.1 of the HLG at all stages of the design, otherwise Tables H3.1 and H3.2 of the Roadside Design

Guide shall be used to determine clear zone requirements;

- The lighting system shall be low or medium light pole systems. High mast systems may be used in areas located 600 m or more away from existing or future residential areas;
- Light standards shall be located in the centerline median or off the right side of the roadways for the mainline illumination and off the right side of the roadway for illumination of connectors, ramps, C-D roads and crossroads;
- Maintained luminance values shall be:
  - o $0.6cd/m^2$ for Mainline,
  - o $0.6cd/m^2$ throughout systems interchanges with appropriate transitions at the edge of the Road Right of Way,
  - o $0.6cd/m^2$ for all C-D roads,
  - o $1.2cd/m^2$ for crossroads at flyovers and service interchanges,
  - o $0.8cd/m^2$ for ramps,

utilizing high pressure sodium lamps. The maintained luminance values were derived from table 9.2 of the TAC *Guide for the Design of Roadway Lighting (2006)* and the Contractor's design shall use the associated uniformity and veiling luminance ratios contained therein. Other stipulations of the design are:

  - o The maintained luminance values shall not be exceeded by more than 10% on 90% of the length of roadway, assessed in metres;
  - o Intersection illuminance designs shall use the high pedestrian values in table 10-1 of the *TAC Guide for the Design of Roadway Lighting*;
- The Project shall be considered an urban freeway for the purposes of the application of the HLG;
- Electrical Cables - All electrical cables and communications/signals wiring shall be underground;
- Continuous lighting is required on the Project Mainlines, including all ramps, connector roads, crossroads, and C-D roads;
- Light poles located within the clear zone, as determined to be the highest value of the range given in Table H3.1 of Roadside Design Guide, shall be on break-away bases;
- Light poles located outside the clear zone, as determined to be the highest value of the range given in Table H3.1 of Roadside Design Guide, are not required to be on breakaway bases;
- All light poles and bases shall be designed in accordance with the Bridge Design Code and/or *AASHTO-Standard Specifications For Structural Supports For Highway Signs, Luminaries, and Traffic Signals (5th edition),* whichever governs. If AASHTO equation 3-1, Clause 3.8.1 is used to adjust wind pressures then the equation should be modified as follows:

  $$P_z = 2.5\ q\ K_z\ C_d$$

  where q shall be taken from CAN/CSA S6, Table A3.1.7 for a return period of 50 years;

- The design of highmast/highlevel light poles shall include a complete design of the foundation, pole and luminaire raising mechanism and must be signed off by a structural Professional Engineer with input from a geotechnical Professional Engineer;
- All breakaway bases shall meet the requirements of section 12 (Breakaway Supports) of *AASHTO-Standard Specifications For Structural Supports For Highway Signs, Luminaries, and Traffic Signals (5th edition);*

- Luminaires are generally to be "semi-cutoff"; and
- Lighting requirements for Service Roads shall be governed by the Local Authority in which the Service Roads exist.

All other aspects of the lighting design shall be governed by the HLG. According to Design Bulletin #35, the *TAC Guide for the Design of Roadway Lighting* (2006) is to be used as the source for lighting design parameters not specified in Schedule 18 (i.e. lighting levels and warrants) while the HLG (including general design requirements, constructing and maintenance) is still the primary guideline to be used.

200.2.7 GUIDE SIGNING

Guide signing and guide sign structures for the New Infrastructure shall be designed, installed and maintained by the Contractor. The guide signing for the Project, including all mainline, interchanges and crossroad components, is identified on guide sign drawings ("**Guide Signing for New Infrastructure**") in Appendix E of Schedule 18 (Technical Requirements). The New Infrastructure guide sign structures shall be designed to accommodate the loadings imposed by the addition of Ultimate Stage guide sign panels at a future time. The guide sign structures shall be designed to span the Ultimate Stage roadway. At gore locations, the guide sign structures shall be placed to suit both the Stage 1 and Ultimate Stage roadway.

All guide signs for the Project shall comply with the Department's *Highway Guide and Information Sign Manual*, dated October 2006, and any applicable Alberta Transportation *Design Bulletins*, and includes drawings of ring road signs at a level of detail and to the standards that are compatible with the Appendix E drawings. The guide sign panels shown in Appendix E have individually been identified according to the Department's Guide Sign Panel Identification Protocol in the Department's Guide Sign Master Plan (the "**Protocol**"). In general, the principles being followed in the Protocol are as follows:

For example, the designation 52-SW-01-OH-L indicates:

- 52 = Exit 52 and identifies the exit located 52 km originating from Highway 2 (Calgary Trail) and travelling clockwise;
- SW = identifies the location as being in the southwest quadrant of the interchange;
- 01 = Panel number at this location;
- OH = Support Structure Type (OH for Overhead, C for Cantilever, GM for Ground Mounted); and
- L = Panel Position on this structure (L for Left, M for Middle, R for Right).

This Protocol will apply to all guide sign panels for the New Infrastructure.

The details regarding the location and messaging of all overhead, cantilever and ground-mounted guide signs are set out in Appendix E. The Contractor shall install and maintain all overhead and cantilever signs and ground mounted guide signs required for the New Infrastructure, including without limitation, those signs set out in Appendix E. The Contractor acknowledges that certain overhead, cantilever, and ground-mounted signs set out in Appendix E are located outside the

Project Limits ("**Signs Outside the Project Limits**"). For the Signs Outside the Project Limits, the Contractor shall obtain all the necessary permits and approvals from the appropriate authorities in order to install and maintain the Signs Outside the Project Limits. For signs that are within the project limits for the Southeast Anthony Henday Drive and Northwest Anthony Henday Drive projects, the Contractor shall coordinate with Access Roads Edmonton Ltd. and NORTHWESTCONNECT General Partnership respectively to coordinate and perform sign panel replacement.

The Contractor shall remove all guide signs that contain messaging inconsistent with the requirements set out in Appendix E regarding sign messaging for the New Infrastructure; particularly, such guide signs shall be removed from existing sign structures located on Highway 216, Highway 16, and Sherwood Park Freeway. Existing crossroad guide signs containing messaging inconsistent with requirements set out in Appendix E which are located within the Local Authority shall be removed by the Local Authority. In this regard, the Contractor shall be provide advance notification to, and liaise/coordinate with, the Local Authority accordingly. In all cases, the timing of such guide sign removals shall be coordinated with the Contractor's schedule for Traffic Availability.

The Clearview Highway font shall be used on all guide signing in accordance with Design Bulletin #36, which is posted on the Department's web site. Interchange sequence signs shall be designed in accordance with *Design Bulletin #58*.

The following font sizes and letter heights shall be used for the Project:

- Mainline Overhead Signage – 406 mm (16 inch) Clearview font.
- Mainline Shoulder Mounted Signage – 330 mm (13 inch) Clearview font. In cases where the street name is very long, the letter height may be reduced to 305 mm (12 inch).
- Non Mainline Overhead Signage – 330 mm (13 inch) Clearview font.
- Non Mainline Shoulder Mounted Signage – 254 mm (10 inch) Clearview font.

Overhead directional signs shall have reflective sheeting as specified under Section 300.4.2.11.1 (Reflective Sheeting).

The Contractor shall submit shop drawings using the "**Clearviewhwy font software**" package for the message content and layout on the major guide signs prior to manufacturing to the Department. The Contractor shall obtain the Department's final written approval of all guide sign message content prior to manufacturing the guide signs.

200.2.8 LANDSCAPING

The relocation of trees impacted by the Project shall be done within the Road Right of Way and/or drainage facilities if it is safe and technically feasible. These trees shall be relocated where traffic operations, safety, and drainage are not compromised.

The Province shall have the right to allow third parties, such as the Local Authority or community groups, to carry out supplemental planting or enhanced formal landscape plantings (the "**Third Party Landscaping**") on lands in the TUC but outside the Road Right of Way. The Third Party Landscaping shall be on the following conditions:

- The proposed Third Party Landscaping shall not negatively impact the safety of the roadway or of the O&M;
- The Province shall own the Third Party Landscaping and the applicable third party shall maintain the Third Party Landscaping, and the Province and the applicable third party shall enter into an agreement addressing such ownership, such maintenance and any potential relocation of the Third Party Landscaping; and
- The Third Party Landscaping shall not be used for paid advertising.

Stormwater storage facility wet ponds shall have vegetation for water quality enhancement, and erosion control.

200.2.9 TOPSOIL AND SEEDING

Topsoil material shall be uniformly spread to a depth of 200 mm over the prepared areas to facilitate the required seeding and landscaping. Under no circumstances shall any topsoil be buried, wasted or otherwise disposed of. In the case of large amounts of surplus topsoil, the Contractor shall indicate how the material shall be handled and stored in a manner applicable to relevant regulatory requirements. The handling and storage of topsoil is to be included in the Contractor's Environmental Management System (Section 100.2.2) operational procedures.

Conventional seeding and/or hydro-seeding shall be carried out at the Contractor's discretion to meet the requirements of these specifications related to drainage and erosion.

Seeded areas shall show a uniform stand of grass during the calendar year following the year of initial seeding. Areas which do not show a uniform stand of grass shall be reseeded. A uniform stand of grass will show no bare spots greater than 0.5 square metres in size and provide a minimum of 90% ground cover.

All seed supplied by the Contractor shall be certified free of all prohibited noxious weed varieties identified in the *Weed Control Act* (Alberta).

In order to maintain consistency in vegetation within the TUC, the Contractor shall develop a seed mixture for the New Infrastructure that is similar to that in the existing portions of Anthony Henday Drive.

200.2.10 UTILITIES

This Section 200.2.10 is subject to section 4.8 (Utility, Railway and Drainage Agreements) of the DBFO Agreement. The Contractor shall locate all utility rights of way, easements, or similar interests (whether registered against title to the land or not) affected by the New Infrastructure. The Contractor shall deal with existing utilities in a manner that is consistent with the Department's approach throughout the Province. For relocation or installation of underground utilities crossing Petroleum Way and the 115 Avenue Service Roads, the Contractor shall conform to the more stringent of the Department's standards or the County's standards for roadway crossings as shown on drawing *B-15 Rural-Industrial Pipeline Crossings and Parallel Pipelines* and the following requirements:

- If no depth is specified, the top of pipe elevation is to be a minimum of 1.8m below the lowest single most elevation within the 60.0m or 40.0m right-of-way zone;
- The pipe shall not have bends or kinks throughout the 60.0m or 40.0m right-of-way zone;
- Top of pipe elevation is to be labelled on the cross-section and profile;
- Heavy wall pipe is to be utilized throughout the 60.0m or 40.0m right-of-way zone;
- No open cuts are permitted;
- Pipeline crossing signs are to be installed on both sides of the roadway at property (fence) line;
- Roadway centreline profile information for 200m in either direction from the proposed crossing location is required to be submitted for review and acceptance to confirm minimum crossing elevations as compared to future profile improvements; and
- All elevations are to be geodetic.

The Contractor shall apply the information outlined in the *Alberta Transportation Utility Guidance Manual* (2001) when entering into an agreement with a utility company on behalf of the Department. The Contractor shall use one of the sample agreements provided in Appendix H of the *Engineering Consultant Guidelines for Highway and Bridge Projects - Volume 1, Design and Tender, 2011*. Prior to the agreements being signed by the utility company and the Contractor, they are to be sent to the Department for review. In the event that changes to the wording of the standard agreements are required, the changes will require prior written approval by the Department. A period of two weeks will be required to review new agreement formats after which the Department will provide comments on the suitability. There may be cases in which a utility company consents to enter into a Utility Agreement with the Contractor, where such utility company does not require its pipeline facilities to have any casing protection. In such cases, the Department requires that all pipelines constructed of jointed pipe shall require continuous casing (i.e. casing with welded joints) as a protective measure for containment of a ruptured pipeline. Cured in place pipe is not an acceptable alternative. The casing requirement shall apply when jointed pipelines are crossed by the new construction of a highway or by the new construction of its associated interchanges. For the Project, highways and associated interchanges shall include locations in which there are newly constructed or reconstructed infrastructure as part of the New Infrastructure. These locations are:

- Anthony Henday Drive; and
- Highway 16.

The casings shall extend to a minimum of 5 meters beyond the back of the outer roadside ditch as required for the Ultimate Stage grading. Pipelines crossing the above highways and associated interchange locations or other roadways within the influence of the interchange shall be installed in accordance with the *Alberta Transportation Utility Guidance Manual* (2001). A pipeline is considered to be within the interchange if it is located within the footprint of the interchange extents of which are defined by the gore points of all connecting roadways.

No bends or kinks will be permitted for new or relocated pipeline installations within the Road Right of Way, except for pipelines installed within the existing pipeline component of the TUC or as otherwise approved in advance and in writing by the Province, acting reasonably. In considering its approval, the Province shall consider all factors including the following: (a) the commercially feasible options for relocation; (b) the written rationale and support for the request from the pipeline designer; (c) potential risks to highway operations; (d) potential future highway expansion; (e) approval by the utility owner; and (f) approval by applicable regulatory agencies (for example the National Energy Board and the Energy Resources Conservation Board).

The Contractor will not be required to replace existing pipelines within the Road Right of Way that have kinks or bends and that are not affected by the New Infrastructure.

Municipal utilities including water, wastewater and storm water pipelines shall be continuously cased when crossing the above highways and associated interchange locations if the pipelines are jointed and of a size of 1050 mm in diameter or less. Larger diameter jointed pipes do not require casing. Existing casings crossing Anthony Henday Drive or municipal roadways within the influence of an interchange shall be extended or replaced to meet the casing requirements for Ultimate Stage grading.

In lieu of casing jointed pipes, continuous pipe sections may be used for the crossing. Continuous piping may be either HDPE fused pipe with a minimum SDR rating of 11 or a welded continuous steel line all of sufficient strength to withstand expected loadings. Use of cured in place pipe lining is not permitted. Storm pipelines forming part of the roadside drainage collection system are not required to meet continuous pipe requirements. Storm pipelines from one stormwater management facility ("**SWMF**") to another or from a SWMF to a natural water body crossing the above highways and associated interchange locations require casing equal to or less than 1050 mm in diameter and jointed. Continuous steel casings shall include cathodic protection to meet a minimum design life of 50 years.

In situations where buried utilities are in the vicinity of MSE walls, the Contractor shall conform with Section 300.5.2.22.2 (Waterways and Utilities).

The direct out-of-pocket costs that are incurred by the Contractor pursuant to this casing requirement in relation to the Project shall be subject to the cost-sharing arrangement between the Contractor and the Province as set forth in section 15.4(b) (Assistance with Permits and Utility Agreements) of the DBFO Agreement.

There may be cases in which a utility company consents to enter into a Utility Agreement with the Contractor, where such utility company does not require its powerline facilities to be buried. In such cases, the Department requires that all powerline facilities rated at 25kv or less shall be buried when crossed by the new construction of a highway or by the new construction of its associated flyovers and interchanges. The buried powerline facilities shall extend to a minimum of 5 meters beyond the backslope of the outer roadside ditches as required for the Ultimate Stage grading. The location of the first power pole and/or first pole anchors in any direction from the roadway shall be a minimum of 15 meters from the edge of pavement but in no case shall be closer than the back of the normal 4 meter wide outside road ditch unless in an area that is protected by a guardrail or barrier.

The direct out-of-pocket costs that are incurred by the Contractor pursuant to this requirement to bury powerline facilities in relation to the Project shall be subject to the cost-sharing arrangement between the Contractor and the Province as set forth in section 15.4(b) (Assistance with Permits and TP Interface Agreements) of the DBFO Agreement.

The Department has established utility contacts with the following utility companies, which are not all the relevant utility companies:

Access Pipeline Inc.
Contact: April Smith
Senior Land Administrator
HMA Land Services Ltd.
Suite 100, 7710 - 5th Street S.E.
Calgary, Alberta T2H 2L9
accesspipeline@hmaland.com

Air Liquide Canada
Contact: Hector Duran
Maintenance Manager
Air Liquide Canada
Scotford Complex Bag 25
Fort Saskatchewan, Alberta T8L 3T2
hector.duran@airliquide.com

Alberta Envirofuels Ltd.
Contact: Rob Weiss
Inspector
Alberta Envirofuels Ltd.
P.O. Bag 2424
Edmonton, Alberta T5J 4R3
Rob_weiss@envirofuels.com

ATCO Gas
Contact: Jessica Stang
Senior Administrative Coordinator
ATCO Gas
6th Floor, 10035 - 105 Street NW
Edmonton, Alberta T6J 2V6
Jessica.stang@atcogas.com

ATCO Pipelines
Contact: Maira Guzman
Land Administrator
ATCO Pipelines
7210 - 42 Street NW
Edmonton, Alberta T6B 3H1
landadmin@atcopipelines.com

Bell Supernet
Contact: Nicholas Dollery
Detailed Engineering - OSP Western Region
Bell Canada
Operations NP&P Western Region District
Edmonton, Alberta T5J 0H8
Nicholas.dollery@bell.ca

BP Canada Energy
Contact: Sally Gribben
Surface Land Administrator
BP Canada Energy Company
P.O. Box 200
Calgary, Alberta T2P 2H8
surfaceright@bp.com

City of Edmonton Drainage
Contact: Siri Fernando
Director, Design and Construction
City of Edmonton Asset Management and Public Works
Drainage Services Branch
Edmonton, Alberta T5M 3B8
siri.fernando@edmonton.ca

Enbridge Pipelines Inc.
Contact: Theresa Doolittle
Lands and Right-of-Way Agent
Enbridge Pipelines Inc.
Lands and Right-of-Way - Operations

EPCOR Power
Contact: Kevin Sorenson
Scheduler
EPCOR North Service Centre
12116 - 107 Street NW

Edmonton, Alberta T5J 2J9
theresa.doolittle@enbridge.com

Edmonton, Alberta T5G 2S7
ksorenson@epcor.ca

EPCOR Wastewater Utilities
Contact: Herman Stad, P. Eng.
Manager, Capital Projects
EPCOR Wastewater Utilities
10977 - 50 Street NW
Edmonton, Alberta T6A 2E9
hstad@epcor.ca

EPCOR Water
Contact: David Mathew
Construction Coordinator - EPCOR Water
EPCOR Water
10065 Jasper Avenue NW
Edmonton, Alberta T5J 3B1
dmathew@epcor.ca

Gibson Energy Ltd.
Contact: David Kulcsar
General Manager, Operations
Gibson Energy Ltd.
1700, 440 - 2nd Avenue S.W.
Calgary, Alberta T2P 5E9
dkulcsar@gibsons.com

Imperial Oil Ltd; and
Alberta Products Pipeline Ltd.
Contact: Kelly Hollman
Right-of-Way Coordinator
Imperial Oil Ltd.
P.O. Box 5860
Edmonton, Alberta T6E 6P9
kelly.a.hollman@esso.ca

Keyera Energy
Contact: Rod Duncan
Pipeline Maintenance
Keyera Energy
1680 - 102 Avenue NW
Edmonton, Alberta T6P 1V7
rod_duncan@keyera.com

Kinder Morgan Canada
Contact: Sandi Topilko
Right-of-Way and Crossings Coordinator
Kinder Morgan Canada
Unit 68, 80 Chippewa Road
Sherwood Park, Alberta T8A 4W6
sandi_topilko@kindermorgan.com

Nova Chemicals Corp; and
Alberta Ethane Development Company
Contact: Norm Bower
Pipeline Technician - Operations
Nova Chemicals Corp.
104 - 2181 Premier Way
Sherwood Park, Alberta T8H 2V1
bowern@novachem.com

Pembina Pipeline Corp.; and
Alberta Oil Sands
Contact: Tom Greaves
Coordinator, Special Projects
Pembina Pipeline Corp.
2000, 700 - 9th Ave S.W.
Calgary, Alberta T2P 3V4
tgreaves@pembina.com

Pipeline Management Inc.; and
Cold Lake Pipeline; and
Inter Pipeline
Contact: Donna Morningstar
Land Administrator
Pipeline Management Inc.
2600, 237 - 4th Avenue S.W.
Calgary, Alberta T2P 4K3
donna.morningstar@interpripelinefund.com

Plains Midstream Canada; and
PMC (Nova Scotia) Plains Midstream
Contact: Jack McNeill
Land Manager
Plains Midstream Canada, L.P.
Suite 1400, 607 - 8th Avenue S.W.
Calgary, Alberta T2P 0A7
jack.mcneill@plainsmidstream.com

Praxair Canada
Contact: Leigh Anne Sullivan
Lockwork Coordinator

Shell Canada Ltd.
Contact: Colt Henderson
Land Administrator

Praxair Canada Inc.
1, City Centre Drive
Mississauga, Ontario L5B 1M2
leigh_anne_sullivan@praxair.com

Shell Canada Ltd.
P.O. Box 100 Station M
Calgary, Alberta T2P 2H5
colt.henderson@shell.com

Strathcona County
Contact: James Patterson
Utilities Analyst
Strathcona County
Engineering and Environmental Planning
Sherwood, Park Alberta T8A 3W7
patterson@strathcona.ab.ca

Suncor Energy Canada (formerly Petro-Canada); and
Petro-Canada
Contact: Carlynn Ratcliffe
Surface Land Coordinator
Suncor Energy Canada
241 Kaska Road
Sherwood Park, Alberta T8A 4E8
cratcliffe@suncor.com

TELUS
Contact: Marilyn Lukion
TELUS Access Planning
Alberta NE/Edmonton SW/NE
17th Floor, 10020 - 100 Street
Edmonton, Alberta T5J 0N5
marilyn.lukion@telus.com

Air Products Canada
Contact: Jody Arner
Operations Group
Allentown, PA
Postal: 18195-1501
arnerj@airproducts.com

Alberta Capital Region Wastewater Commission (ACRWC)
Contact: Mark Pennie
Project Manager
23262 Township Road 540
Fort Saskatchewan, AB T8L 4A2
mpennie@acrwc.ab.ca

Altalink Management
Contact: Kyle Klages
Right-of-Way Planner
2611 - 3rd Avenue SE
Calgary, AB T2A 7W7
kyle.klages@altalink.ca

Capital Region Northeast Water Services Commission
Contact: Tammy Lockhart
Sturgeon County Centre
9613 - 100 Street
Sturgeon County (Morinville), AB T8R 1L9
tlockhart@sturgeoncounty.ab.ca

Fortis Alberta
Contact(s): Paul Drew-Brook, Claudio Raho
Automated Mapping and Facilities Management Data Coordinators
320 17Ave SW
Calgary, AB T2S 2V1
amfmdataintegrity@fortisalberta.ca

Keyera Corp.
Contact: Rod Duncan
Inspection Team Leader
1680 102 Ave,
Edmonton, AB T6P 1V7
rod_duncan@keyera.com

Rogers Communications
Contact: Richard Austria
Outside Plant Engineer
8200 Dixie Road
Brampton, ON L6T 0C1
richard.austria@rci.rogers.com

Shaw Communications
Contact: Val Bernardi
Senior Planner
10450 178st NW

Alberta Diluent Terminal
(See Keyera Corp.)

Edmonton, AB T5S 1S2
Val.Bernardi@sjrb.ca

Sanitary Trunk (SERT)
(See ACRWC)

The Contractor shall pay all costs associated with design, utility protection, relocation, damage to or other costs with respect to all utility rights of way, easements, or similar interests (whether registered against title to the land or not) affected by the New Infrastructure.

The Contractor shall locate any abandoned utilities which impact construction of the New Infrastructure. The Contractor shall remove and decommission any such abandoned utilities in accordance with industry practice and in accordance with any applicable laws.

The Contractor shall accommodate future utility rights of way, easements, or similar interests (the "**Future Utility**") on, under or above the Lands when requested by the Department. All costs associated with the installation, maintenance and operation of the Future Utility shall be the responsibility of the applicable Future Utility owner.

The Contractor shall recognize the authority of the Department of Infrastructure to manage the TUC at all times (including both during the Construction Period and the Operating Period). The Contractor shall follow the *Transportation/Utility Corridor (TUC) Program Policy*, as may be amended from time to time, at all times when processing requests for Future Utility. For the purposes of the *Transportation/Utility Corridor (TUC) Program Policy*, the Contractor shall be considered a "stakeholder" in the TUC.

Applications for Ministerial Consent will be referred to the Contractor for comments who shall return such comments to Department of Infrastructure for further review. The Contractor recognizes that its comments will not be binding. In its response, the Contractor shall identify commercially reasonable steps to accommodate any proposal forwarded to it by the Department of Infrastructure. The Contractor must be prepared (at minimum) to identify standard crossing requirements to proposed Future Utility providers at all times. The Contractor will take an open and cooperative approach in its dealings with existing and future TUC-housed utility suppliers at all times.

At the end of the Term, the Contractor shall return any and all utility as-built drawings and utility agreements to the Department and the Department of Infrastructure.

During the Operating Period, a Future Utility may need to be removed or relocated to facilitate major maintenance or rehabilitation by the Contractor. Relocation or removal of any Future Utility, including all associated costs, shall be borne by the owner of the applicable Future Utility.

In the event that a Future Utility line is no longer required, the applicable Future Utility owner shall advise the Department of Infrastructure and the Contractor and such owner shall arrange for the applicable Future Utility to be removed and, when applicable, for the Lands to be restored to the condition commensurate with that prior to the installation of the applicable Future Utility.

200.2.11 RAILWAYS

This Section 200.2.11 is subject to section 4.8 (Utility, Railway and Drainage Agreements) of the DBFO Agreement. Reference is made to the Existing Railway Agreements (as defined in section 4.8 of the DBFO Agreement). The Existing Railway Agreements are based on road over rail grade separations, except for the existing grade separation subway structures at Highway 16. The Existing Railway Agreements include “structure outline drawings”. Structure outline drawings define clearance envelope requirements and illustrate the bridge configurations on which the agreements were based. However, confirmation of the feasibility of the illustrated bridge configurations is a Contractor responsibility. Changes to the bridge configurations that are illustrated on the structure outline drawings will require amendments to the Existing Railway Agreements. The Contractor shall include the Department in all meetings, correspondence, and discussions with the railroad companies during the negotiation of any railway agreements or amendments of Existing Railway Agreement, as required. A period of two weeks will be required to review proposed agreements or amendments of Existing Railway Agreements, after which the Department will provide comments on their suitability. The Contractor shall obtain the Department’s prior written approval to all railway agreements or amendments of Existing Railway Agreements. Once approved all railway agreements or amendments of Existing Railway Agreements are to be signed by the railway company and then sent to the Department for final execution. It should be noted that the cost apportionment section of the agreements between the Department and the railway companies is final and no further negotiations between the two parties is necessary.

The Contractor shall design and construct bridge structures at the railway crossings as described in Section 200.2.3.7 (Other Crossings). Of these railway crossings, two may result in the construction of rail-carrying structures depending on the option selected (refer to Section 200.2.3.7.2 and 200.2.3.7.3), namely:

- Railway bridge structure to carry Coronado Subdivision over Anthony Henday Drive; and
- Railway bridge structure to carry Vegreville Subdivision over Anthony Henday Drive.

Each of the above two rail-carrying structures are at CNR railway crossings. CNR requires that all rail-carrying structures are designed by its pre-qualified designers identified as follows:

Pre-Qualified Designer Name	Contact	Phone/Fax	Email Address	Street Address
AECOM	Eric Smith	P. (905) 206-8111 F. (905) 238-0038	Eric.A.Smith@aecom.com	5080 Commerce Blvd. Mississauga, ON L4W 4P2

Pre-Qualified Designer Name	Contact	Phone/Fax	Email Address	Street Address
Hatch Mott MacDonald	Julian Mikus	P. (514) 864-5500(ext. 6136) F. (514) 397-1651	julian.mikus@hatchmott.com	5 Place Ville-Marie Suite 200, Montreal, Quebec H3B 2G2
Stantec	Richard Lanyi	P. (780) 917-7119 F. (780) 917-7086	richard.lanyi@stantec.com	10160 - 112 Street Edmonton, AB T5K 2L6
HNTB	John Hronek	P. (816) 472-1201 F. (816) 472-4060	jhronek@hntb.com	P.O. Box 419299 Kansas City, MO 64141
Hanson Professional Services Inc.	Mat Fletcher	P. (309) 691-0902 F. (309) 691-1327	mfletcher@hanson-inc.com	7625 N. University St.Peoria, IL, 61614
Modjeski & Masters	Prucz Zolan	P. (504) 524-4344 F. (504) 561-1229	zprucz@modjeski.com	1055 Saint Charles Ave Suite 400, New Orleans,LA 70130-3994
STV Incorporated	Lawrence L. Kirchner	P. (312) 553-8425 F. (312) 553-0661	lawrence.kirchner@stvinc.com	200 West Monroe St., Suite 1650 Chicago, IL 60606-5015
TranSystems	Todd A. Herman	P. (816) 329-8700 F. (816) 329-8701	marketing@transystems.com	2400 Pershing Road, Suite 400, Kansas City, MO 64108

Alternatively, the Contractor may request of CNR that firms not listed above be permitted to undertake the design duties related to the rail-carrying structures. It is the Contractor's responsibility to satisfy CNR's qualification process. Approval of additional designers is at the sole discretion of CNR.

It shall be the Contractor's responsibility to pay all costs associated with design, railway protection and relocation associated with railway requirements, except as noted in the Existing Railway Agreements (as defined in section 4.8 of the DBFO Agreement). The Contractor should expect that the railway companies may choose to design and construct any detours, shooflies, or temporary crossings proposed by the Contractor; however the cost for such activities shall remain the responsibility of the Contractor.

Design and construction of all railway crossings will require extensive coordination between the Contractor and CNR or CPR. The Contractor shall submit all design and construction plans, including construction staging, to the appropriate railway company for their review and approval. The Contractor shall contact CPR directly in order to locate CPR-owned utilities in the vicinity of CPR crossing locations.

The Contractor shall obtain all necessary approvals in accordance with and in addition to that established in the railway agreements. Such approvals include but are not limited to those required for construction activities on or adjacent to railway lines, construction of temporary at-grade crossings, temporary railway closures, and temporary clearance boxes used during construction.

As part of the design, there shall be no net increase in the drainage along the rail right-of-way. The Contractor shall ensure that no increase of snow drifting, communications impedance, or splashing shall occur on railway rights of way. The Contractor may be required to construct pier protection walls or crash walls at railway grade separations. Pier protection is normally required if a bridge element or other obstruction is within 7.620m from the centreline of the railway track. The Contractor shall confirm all requirements for pier protection or crash walls with the applicable railway company.

The Contractor shall be responsible for the notice of proposed railway work for all railway grade separations, as may be required by the *Railway Safety Act* (Canada), except for the grade separations at CNR Mile 0.16 Camrose Subdivision and CNR Camrose/Wainwright Subdivision Connection.

The Contractor must comply with the *Railway Safety Act* (Canada) and sign a railway right-of-entry form for all sites. The Contractor shall meet Transport Canada's Draft RTD 10 *Road/Railway Grade Crossing Technical Standards* for all at-grade crossings.

For the locations where demolition of railway infrastructure is required, the Contractor shall obtain approval for removal of the existing railway structures from the appropriate railway company and the Department prior to any demolition work commencing.

The Department has established contacts with CNR and CPR:

Canadian National Railway Company
Contact: Doug Allen, Senior Manager, Technical Services
Telephone: 780-472-4093
Fax: 780-472-3725
E-mail: doug.allen@cn.ca
Address: Canadian National, Operations Building, 5th Floor, Box 13, 10229 – 127 Avenue, Edmonton, AB, T5E 0B9

Canadian Pacific Railway Company
Contact: Larry Pereira, Project Engineer
Suite 700, Gulf Canada Square
401 – 9 Avenue SW
Calgary, AB, T2P 4Z4
Telephone: 403-319-6344
E-mail: larry_pereira@cpr.ca

It is the responsibility of the Contractor to conduct the work and adhere to the railway company's specifications and requirements. The Contractor is encouraged to make arrangements to retain the services of railway personnel, such as a flag person or an operations coordinator, to assist with construction activities.

200.2.12 MUNICIPAL AUTHORITIES

The Department has established the following contacts with the Local Authority:

- The City of Edmonton
  Contact: Rob Gibbard, Acting Director of Facility & Capital Planning
  Transportation
  13th Floor, Century Place, 9803 102A Avenue NW, Edmonton, AB, T5J 3A3
  Telephone: (780) 423-5280
  Fax: (780) 496-4287
  Email: rob.gibbard@edmonton.ca

- Strathcona County
  Contact: Saeed Ahmad, Coordinator, Engineering & Environmental Planning
  2001 Sherwood Drive, Sherwood Park, AB, T8A 3W7
  Telephone: 780-464-8091
  Fax: 780-464-8180
  Email: ahmad@strathcona.ab.ca

200.2.13 ENVIRONMENTAL

The *Northeast Leg – Anthony Henday Drive Environmental Assessment - Final Report* (June 2010) is the environmental assessment (the "**EA**") that the Contractor shall refer to for the purposes of carrying out its obligations under the DBFO Agreement. The EA is provided for information purposes only. The Contractor shall also refer to the Fisheries and Oceans *Canadian Environmental Assessment Act* ("**CEAA**") Screening Report ("**SR**") for the purpose of carrying out its obligations under the DBFO Agreement with respect to the North Saskatchewan River crossing. The SR is provided for information only.

The Contractor shall carry out and fulfill all of the requirements (the "**Mitigation Measures**") identified in the Table below entitled "Mitigation Measures for All Valued Ecosystem Components ("**VEC's**") to be Performed by the Contractor" and identified in the Table below entitled "SR Mitigation Measures Table". The Contractor shall provide the Department with reports on the Mitigation Measures every six months starting from the date of Execution of the DBFO Agreement until 12 months after Traffic Availability. All reports shall detail, to a level of detail and in a form satisfactory to the Department, acting reasonably, the Contractor's progress as it relates to the Mitigation Measures with specific regards to implementation and performance of the Mitigation Measures.

Notwithstanding the foregoing two paragraphs, the Contractor shall be responsible for obtaining and complying with all environmental approvals, authorizations, and permits, required by applicable law.

In the two Tables below in this Section 200.2.13 "**Certain Phase IIs**" means:

(a) Limited Phase II Environmental Site Assessment – Transportation Utility Corridor – Project Area C – Edmonton, Alberta, prepared by Green Plan Ltd., Project Number 37249, dated August 30, 2010;

(b) Phase II Final Report: Reconnaissance Testing Program – Edmonton Restricted Development Area – Alberta Public Works – EC-90721B, prepared by Hardy BBT Limited, dated June 1990;

(c) Phase II Environmental Site Assessment Plan 7520525, Lot D, prepared by EcoVision Consulting Group Inc.;

(d) Phase II Environmental Site Assessment Plan 0940748, Area B, prepared by EcoVision Consulting Group Inc.;

(e) Phase II Environmental Site Assessment SE1/4 20-53-23-W4, prepared by EcoVision Consulting Group Inc.;

(f) Phase II Environmental Site Assessment Plan 4084CH, Block RLY, Lot 53, prepared by EcoVision Consulting Group Inc.;

(g) Phase II Environmental Site Assessment Plan 4297HW, Block OT, prepared by EcoVision Consulting Group Inc.;

(h) Phase II Environmental Site Assessment NE-17-53-23-W4M and SE-20-53-23-W4M, prepared by EcoVision Consulting Group Inc.; and

(i) Limited Phase II Environmental Site Assessment – Transportation Utility Corridor – Project Area A – Sherwood Park, Alberta, prepared by Crimson Environmental Limited, Project Number CEL-37249, dated September 15, 2010.

(j) Limited Phase II Environmental Site Assessment - 12009 Meridian Street NE - Plan 8022607, Lot 1 - Edmonton, Alberta, prepared by CRIMSON Environmental Limited, Project Number CEL-37322, dated December 30, 2011;

(k) Limited Phase II Environmental Site Assessment - 12225 Meridian Street NE - Portion of NW1/4 16-053-23 W4M, Edmonton, Alberta, prepared by Green Plan Ltd., Project Number 37323, dated January 2, 2012; and

(l) Phase 2 Environmental Site Assessment O’Hanlon Paving Yard - 11831 Meridian Street - SW1/4 16-53-23 W4M - Edmonton, Alberta, prepared by Parkland Geo-Environmental Ltd. - Project No. ED1312, dated January 20, 2012.

Mitigation Measures for All Valued Ecosystem Components ("VEC's") to be Performed by the Contractor

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
Soils	Slope stability (NSR bridge)	• Conduct a stability analysis for approach fills and retaining structures at the NSR bridge sites.
	Soil erosion	• Develop appropriate site-specific erosion and sediment control (ESC) measures as part of the Contractor's ECO Plan
		• Implement, maintain and monitor ESC measures to stabilize disturbed soils until sufficient vegetation is established. Monitor for revegetation success within the TUC and the Road Right of Way.
		• Re-vegetate promptly following topsoil replacement.
		• Stabilize stockpiles in place for an extended time period against erosion using appropriate methods.
		• Avoid soil handling during very windy and/or rainy conditions.
	Admixing	• Ensure topsoil is salvaged, stored and replaced appropriately during construction. The Contractor's ECO Plan Representative, or designate, will monitor soil handling activities during construction.
		• Strip to colour change or as directed by the Contractor's ECO Plan Representative or designate.
		• If excess stones are brought to the surface, stones that are larger or in greater abundance than the pre-disturbance condition must be picked, as directed by the Contractor's ECO Plan Representative or designate.
	Rutting and compaction	• Monitor soil conditions, suspend soil handling under wet conditions as appropriate and/or as directed by the Contractor's ECO Plan Representative or designate.
		• Use appropriate equipment, subsoiling and/or ripping as needed to alleviate compaction prior to reclamation. (Note: Subsoiling is only effective when the soil is dry enough to shatter, as subsoiling wet soils can lead to deformation and alteration of the soil structure).
	Disturbance of contaminated soils	• The Contractor shall develop mitigation strategies to ensure the proper management of contaminated soils/groundwater indentified in the Certain Phase IIs.
	Soil contamination caused by construction activities	• Implement mitigation measures as described below under 'Hydrology Construction– Contaminant release'. • Excess paving and concrete material will be disposed of appropriately
	Increased surface stones	• Separate handling/storage of gravelly soils. • Pick stones following topsoil replacement, as advised by the Contractor's ECO Plan Representative or designate.
	Wetland topsoil salvage	• Salvage and stockpile topsoil from wetlands that will be disturbed, for replacement in depressional areas and for use in compensation wetlands as appropriate.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
Vegetation Native, Riparian and Rare Plant Communities	Vegetation clearing	• Explore potential to avoid native plant communities and refine clearing limits • Clearly mark clearing limits. • Revegetate disturbed areas as soon after construction as practicable. Implement reclamation best practices for soil handling and replacement, erosion control and re-vegetation. • Trees shall not be allowed to fall into a water body • No equipment is allowed to cross any waterbody during clearing operation • Retain an undisturbed vegetation buffer between the construction site and watercourse to reduce the potential for sedimentation • Apply suitable seed mixes to revegetate disturbed areas. • Consider inclusion of an upland component as part of the Wetland Compensation Plan for the Project. • Monitor revegetation success within the TUC and the Road Right of Way and undertake remedial measures as appropriate.
	Loss of rare plant communities	• Explore potential for further avoidance of rare plant locations during detailed design, particularly sites N12 and N19 referred to in the EA. • Flag all rare plant areas referred to in the EA prior to construction. • Impacted S1 and S2 (Alberta) plant species shall not be destroyed. S1 and S2 plant species are to be transplanted to a suitable location. Transplants will be monitored regularly. • Salvage and stockpile topsoil from wetlands that will be disturbed, for replacement in depressional areas or for use in compensation wetlands as appropriate. • Separate soil salvages, storage and replacement in areas with identified rare plants. • Compensate for wetland loss as required based on detailed designs and as negotiated with Alberta Environment (AENV) to achieve no net loss of wetland function regionally.
	Dust	• Implement road watering or other appropriate dust control measures during construction. • Reclaim and revegetate disturbed areas as soon as practicable following construction. • During construction, the Contractor will conduct regular inspections of the TUC and the Road Right of Way, particularly during windy conditions, to ensure that best practices for dust control are being effectively implemented.
	Road salt	• Minimize salt use on roadways to the extent practicable. • Include salt-tolerant species in seed mix for ditch areas (e.g., alkali grass). • Develop and implement Road Salt Management Plan for the Project.
	Weed establishment	• Programs to address long-term weed issues within the TUC and the Road Right of Way during the Operating Period shall be developed for prohibited noxious or noxious weeds in accordance with the *Weed Control Act* (Alberta) and Weed Control Regulations. Establish priorities regarding the most problematic weed species.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
		• The Contractor shall clean equipment after it has been used in weedy areas or known Club Root Fungus areas and shall pay particular attention to parts of equipment where grease and oil can collect.
		• Separate soil salvage, storage and replacement in areas of weed infestations, as indicated on environmental alignment sheets and during environmental site inspections of the TUC and the Road Right of Way prior to soil salvage.
		• Reclaim to appropriate species immediately following construction .
		• Monitoring for and controlling prohibited noxious weeds using appropriate methods on an ongoing basis, during the Construction Period and the Operating Period.
		• Control measures may include but are not limited to one or a combination of mowing at appropriate intervals prior to seed dispersal, targeted herbicide application, handpicking, tillage and remedial seeding as appropriate.
	Accidental spills	• Implement mitigation measures as described below under 'Hydrology Construction – Contaminant release'.
Wetlands	Decrease in wetland habitat	• Explore potential for further avoidance of wetlands during detailed design. • Clearly mark clearing limits.
		• Develop a Wetland Compensation Plan to address compensation for wetland loss as required based on detailed designs and as negotiated with Alberta Environment to achieve no net loss of wetland function regionally in accordance with the requirements and objectives of the *Water Act* (Alberta) .
		• Liaise with the Local Authority regarding potential wetland compensation sites within the Local Authority
		• Salvage and stockpile topsoil from wetlands that will be disturbed, for replacement in depressional areas or for use in compensation wetlands as appropriate.
		• Re-vegetate disturbed areas as soon as practicable following construction.
	Alteration of hydrological regime	• The Contractor's grading design and installation of overland drainage measures (e.g., ditches, culverts, stormwater management facilities) should maintain surface water flow volumes for retained wetlands. If hydrologic regime of any retained wetlands cannot be maintained, account for impacts within the Wetland Compensation Plan.
Wildlife	Habitat loss	• Clearly mark clearing limits. • If Canadian Toad presence is confirmed at Site A8b of the EA, Alberta Sustainable Resource Development shall be contacted immediately.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
		• Vegetation clearing will not occur between 15 April and 31 July of any given year to avoid the breeding season for migratory birds and prevent disturbance to breeding amphibians unless permission has been given to the Contractor to do so by a Professional Biologist (a member in good standing with the Alberta Society of Professional Biologists) upon the results of relevant surveys.
		• Construction of Stormwater Management Facilities (SWMFs) and provision of compensation for impacts to wetlands affected by the Project will result in no net loss of wetland habitat function regionally.
		• The dens of specified animal species are protected under the *Wildlife Act* (Alberta). The nests of migratory birds are protected under the Federal *Migratory Birds Convention Act.* If a den site or bird nest is found at any time during land clearing or construction, Alberta Sustainable Resources Development will be contacted to determine the appropriate course of action before any work can proceed. Avoidance or mitigation measures may be required to ensure compliance with applicable legislation.
		• Implement mitigation measures as described above under 'Vegetation – clearing' and 'Wetlands – Decrease in wetland habitat'.
	Decreased habitat effectiveness	• Implement mitigation measures as described above under 'Vegetation – Dust' and 'Soils – Soil erosion' to prevent impacts to adjacent breeding and foraging habitat. • The Contractor shall comply with the mitigation measures for noise as identified in the VEC category "Noise Construction" below.
	Disruption of movement corridors	• The Contractor shall comply with the mitigation measures for noise as identified in the VEC category "Noise Construction" below. • The Contractor's design shall not inhibit wildlife passage of large to medium sized wildlife along this corridor. • Wildlife wing fencing shall be installed on each side of the North Saskatchewan River crossing (north and south sides) in order to direct animals under the bridge structures. Wildlife fencing is to be installed parallel to the travelling lanes, in both directions of travel, for a minimum distance of 500 m on the north side and 800 m on the south side. Wildlife jump outs are required on each side of Anthony Henday Drive on the south side of the North Saskatchewan River crossing. The location and design details of the jump outs are to be determined by the Contractor and shall be designed to accommodate ungulates. The fencing shall tie into the bridge structure to create a continuous barrier such that there are no points where wildlife can access Anthony Henday Drive. The fencing shall not create a road safety hazard. The fencing shall be a minimum of 2.4 m in height.
	Mortality risk	• Vegetation clearing will not occur between 15 April and 31 July of any given year unless permission has been given to the Contractor to do so by a Professional Biologist (a member in good standing with the Alberta Society of Professional Biologists) upon the results of relevant surveys
	Decreased habitat effectiveness	• Construction of stormwater management facilities and provision of compensation for impacts to wetlands affected by the Project will result in no net loss of wetland habitat function regionally. • Consider the inclusion of an upland component as part of the Wetland Compensation Plan for the Project.

Valued Ecosystem Component	**Potential Project Effect**	**Mitigation Measures**
	Mortality risk	• Keep ditches clear of debris and tall vegetation to improve visibility and avoid providing cover for wildlife along the roadways. • The Project will include illumination, which can help reduce the number of wildlife-vehicle collisions • Remove invasive bushy vegetation in the immediate vicinity of all roadways and consider planting shrubs away from the road to reduce losses among birds. • An Animal-Vehicle Collision (AVC) monitoring program shall be developed and implemented at the North Saskatchewan River crossing (set up specification equal to Salt Management Plan and ECO Plan requirements) • Wildlife passages shall be provided at both the north and south bridge abutments. The passages shall be level and have a smooth walking surface (e.g. no rip-rap or large boulders). The minimum wildlife passage clearance boxes shall be 4.0 m high and 4.0 m wide on the north and south side abutments. Pedestrian and service access may also utilize this clearance box.
	Disruption of wildlife movements	• Culverts shall be designed, sized and constructed to facilitate drainage within the Project. These culverts may provide opportunities for movements of small wildlife, particularly in the vicinity of wetlands. • Facilitate wildlife movement by creating naturalized corridors using native shrubs and plantings. • Minimize direct and indirect disturbance to remaining wetlands and uplands in undisturbed sections of the Project.
Hydrology Construction	Contaminant release	• A Spill Management Plan ("**SMP**") will be developed to describe measures for spill prevention and emergency spill response including but not limited to spill control and response measures. The SMP shall form part of the Contractor's ECO Plan. • Provide appropriate measures for spill containment in fuel storage and servicing areas and include these measures in the SMP. • Train all personnel working on the Project regarding spill response and ensure appropriate spill kits are available near work areas. • Vegetated ditches provide detention for settling out of sediments and opportunity for spill removal and soil rehabilitation. • Refuelling, maintenance and hazardous materials storage will not be permitted near any water body or in areas supporting native plant communities. • Biodegradable oils and lubricants will be used in equipment whenever working in or near water bodies.
		• The Project's stormwater management infrastructure shall be designed and constructed to capture and direct all runoff, including possible spilled substances via road ditches and culverts, to stormwater management facilities. It is possible that the stormwater management facilities may serve in part to contain spilled substances and minimize the extent of their impact. Stormwater management ponds shall be designed and constructed to contain all runoff from a 24 hr, 1:100 year precipitation event. Pond forebays shall also be constructed so as to provide an opportunity for collection and disposal of spilled substances.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
	Sedimentation	• Surface stability shall be promoted by leaving vegetation undisturbed in areas not exposed to construction. • Soil stockpiles will be located away from watercourses and slopes. • Implement mitigations as described above under 'Soils – Soil erosion'. • Implement appropriate erosion and sediment control measures for works adjacent to or which might potentially affect water bodies. • Vegetate ditches to provide detention for settling out of sediments upstream of stormwater management facilities and ultimately prior to discharge into natural drainages.
	Alteration of drainage patterns	• Maintain surface flows to wetlands retained within the TUC; develop compensation as part of the Wetland Compensation Plan as required, if hydrology of any wetlands will be altered.
	Interaction of stormwater management with existing City of Edmonton stormwater system	• Communicate with The City of Edmonton, Drainage Services to confirm design compatibility.
	Proximity to CFB/ASU Edmonton heliport – bird hazard zone	• The use of wet/dry ponds within the bird hazard zone must have the Department of National Defence approval-in-principle
Hydrology Operation	Increased stormwater release	• Design of stormwater management facilities in accordance with the Technical Requirements to maintain runoff volumes and control release rates based on 1:100 yr storm runoff.
	Contamination of waterbodies caused by bridge deck runoff	• Meet with relevant federal and provincial regulators to discuss bridge runoff strategies in order to acquire the pertinent authorizations/approvals.
Groundwater Construction	Impacts to groundwater levels due to dewatering activities	• Visibly mark and/or fence off any known spring and well locations. • Avoid any known springs and water supply wells during construction; if other springs, water supply wells or other such features are encountered during construction, limit heavy equipment use and disturbance in proximity to the springs, water supply wells, or other such features to the extent practicable and install appropriate engineering controls to maintain groundwater flow.
	Seepage from cuts	• During detailed design, develop measures to manage potential seepage, such as blanket drains and trench drains.
	Contaminated groundwater at former Celanese site (NW quadrant of Yellowhead Trail Interchange)	• The Contractor shall develop mitigation strategies to ensure the proper management of contaminated soils/groundwater indentified in the Certain Phase IIs.
Groundwater Operations	Changes to local shallow groundwater flow regime	• Implement appropriate engineering controls such as drains to maintain groundwater flow. • Design, locate and construct stormwater management facilities so as to maintain surface drainage patterns and release at controlled rates. Stormwater shall be released within the same catchment area as the area in which such stormwater originates and within the range of natural flows.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
	Changes to groundwater quality	• Implement mitigation measures as described above under 'Vegetation – Road salt'. • Implement mitigation measures as described under 'Hydrology Construction – Contaminant release'. • Implement mitigation measures as described under 'Soils – Soil erosion' to prevent sedimentation.
Water Quality Construction	Runoff and sediment transport	• Implement mitigations as described above under 'Hydrology Construction – Sedimentation' and 'Soils – Soil erosion'. • Monitor surface water quality as appropriate for construction activities near water.
	Release of contaminants	• Implement mitigation measures as described above under 'Hydrology Construction – Contaminant release'.
Water Quality Operations	Stormwater runoff	• Utilize existing and proposed stormwater management facilities. • The design and construction of stormwater management facilities shall be in accordance with the Technical Requirements to maintain runoff volumes and control release rates.
	Release of contaminants	• Implement mitigation measures as described above under 'Hydrology Construction – Contaminant release'.
Fisheries and Aquatic Resources Construction	Sediment release due to erosion	• Implement mitigations as described above under 'Hydrology Construction – Sedimentation' and 'Soils – Soil erosion'. • Monitor surface water quality as appropriate for construction activities near water. • Ensure sediment laden water in coffer dams sufficiently settles prior to pumping water back into the watercourse. Implement 'Special Provision SPE 020 Turbidity' at all times when works occur within a watercourse.
		• Make every reasonable effort to minimize the duration of instream work and ensure construction is halted during heavy rains.
		• Prior to construction activities, fish in any areas where stranding may occur or in areas directly impacted by construction activities shall be rescued and released to an area containing sufficient flow and cover. The fish rescue may require a provincial permit and shall include:
		▫ Capture and handling procedures are designed to minimize mortality; and ▫ Rescue operations employing effective methods (e.g. electrofishing, seine netting, minnow trapping) are carried out as stipulated in the Provincial Fish Research License.
		• Fish-bearing watercourse crossings will be designed to allow for fish passage and a monitoring plan during construction shall be developed and implemented.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
		• Isolated crossings are conducted as follows: ◦ Maintain 100% of downstream flow at all times. ◦ Water from flumes, pump-around, diversions or other methods used to maintain downstream flow does not cause erosion or introduce sediment into the channel. Examples of options for preventing erosion include flow dissipaters, protection of the substrate with geotextile, and releasing water onto vegetation if it can be done without erosion. ◦ If a pump-around method is used to maintain downstream flow, back-up pumps with adequate capacity to maintain 100% of downstream flow at all times are on-site and ready to take over pumping if the operating pumps fail. The pumps are continually monitored to ensure downstream flow is maintained at all times until the isolation materials are removed and normal flows restored to the channel. ◦ Pump intakes do not disturb the streambed. Pumps are screened with a maximum mesh size of 2.54 mm and a maximum screen approach velocity of 0.038 m/s (as per DFO’s Freshwater Intake End-of-pipe Fish Screen Guideline). ◦ Where earthen berms are used for isolation, there is containment and separation of berm materials from water at all points of contact. ◦ Berms (including all berm material) and/or other methods of isolation are completely removed from the channel and the streambed and streambank profiles returned to preconstruction conditions by the completion of the works or undertakings. ◦ Should the need for dewatering arise, water is released into a well vegetated area or settling basin and not directly into any watercourse. Water returning to the watercourses is equal to or exceeds the background water quality of the watercourse. ◦ Fish rescue is conducted using a seine net and/or electrofishing and the fish released unharmed downstream. The fish rescue is undertaken within any isolated areas prior to and during dewatering activities. In addition, fish rescue is undertaken on any bypass structures such as diversion channels and flumes prior to them being dewatered after use. Fish rescue may require a permit from the Province. ◦ No isolation is required if the channel is dry or frozen to the bottom at the site of the crossing construction.
		• Disturbance of riparian vegetation shall be kept to a minimum.
		• During construction and until revegetation is sufficient to prevent sediment erosion, effective sediment and erosion control measures are in place, functioning properly, and are maintained and/or upgraded as required to prevent sediment from entering fish habitat.
		• Excavated materials and debris is disposed of above the high water mark and located such that they do not enter any watercourse.
		• All fill material is obtained from off-site and not from below the average high water level of any watercourse.
		• If riprap is used, the riprap is clean, free of fine materials, and of sufficient size to resist displacement during design flood events. Riprap is placed at the original streambank grade to ensure that there is no infilling or narrowing of the watercourse at the crossing site.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
		• All spoil materials are disposed of above the high water mark and located such that they will not re-enter any watercourse.
		• Equipment is refueled and serviced in a manner which ensures that deleterious substances do not enter any watercourse. Equipment operating near any watercourse is free of external grease, oil, mud, or fluid leaks and an emergency spill response kit is kept on-site during construction.
		• A spill response plan will be prepared and is place to prevent deleterious substances from entering fish habitat.
	Accidental contaminant release to waterbodies	• Implement mitigation measures as described under 'Hydrology Construction – Contaminant release'.
Fisheries and Aquatic Resources Operation	Deleterious substance release from bridges over fish bearing water bodies	• Implement mitigations as described above under 'Hydrology Construction – Sedimentation' and 'Soils – Soil erosion'. • The Contractor shall develop and implement a monitoring plan for any HADD compensation works created for all watercourse crossings.
Air Quality Construction	Dust and smoke created by construction activities	• Implement mitigation measures as described above under 'Vegetation – Dust' and 'Soils – Soil erosion'. • Burning of cleared vegetation is not be permitted.
Socio-Economics and Land Use Construction	Communities (noise and dust)	• Implement mitigation measures as described above under 'Vegetation – Dust' and 'Soils – Soil erosion'. • Hours of construction work on the Project will be restricted to the period between 7:00 AM and 10:00 PM Monday through Saturday. On Sundays and Statutory holidays, hours of work will be limited to the period between 9:00 AM and 10:00 PM. Activities exempt from this restriction are: – overhead sign structure installation; – girder erection; – concrete pours for bridge construction; and – line painting. • The Contractor must adhere to the hours of work unless an exemption is granted by the Department. • Consider use of vibratory or enclosed-hammer pile drivers during pile driving.
	Transportation	• Implement traffic accommodation measures (e.g., detours, local access relocations and signage, along with public information and notices) to minimize effects on traffic congestion and maintain traffic flow.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
	Recreation and pathways	• Implement mitigation measures as described above under 'Vegetation – Dust' and 'Soils – Soil erosion'. • Hours of construction work on the Project will be restricted to the period between 7:00 AM and 10:00 PM Monday through Saturday. On Sundays and Statutory holidays, hours of work will be limited to the period between 9:00 AM and 10:00 PM. Activities exempt from this restriction are: – overhead sign structure installation; – girder erection; – concrete pours for bridge construction; and – line painting. • The Contractor must adhere to the hours of work unless an exemption is granted by the Department. • Manage public access to the TUC and the Road Right of Way to ensure safety.
	Public safety	• Implement traffic accommodation measures (e.g., detours, local access relocations and signage, along with public information and notices) to minimize effects on traffic congestion and maintain traffic flow. • Provide notice to commuters and residents adjacent to the TUC and the Road Right of Way of construction-related traffic and safety issues. • Manage public access to the TUC and the Road Right of Way to ensure safety.
Socio-Economics and Land Use Operation	Communities (noise)	• Installation of noise attenuation barriers between the roadway and adjacent residential areas as required in accordance with the Technical Requirements.
	Parks and wetlands	• Promptly revegetate disturbed areas. • Operate storm water management ponds in accordance with the Technical Requirements.
	Recreation and pathways	• Operate new pathway connections in accordance with the Technical Requirements.
Historical Resources Construction	Inadvertent Impacts to unrecorded historical resources during construction	• Suspend construction in area of any discovered artefact and contact Alberta Culture and Community Spirit ("**ACCS**") for required course of action before proceeding further.
Noise Construction	Increased noise from construction equipment	• Hours of construction work on the Project will be restricted to the period between 7:00 AM and10:00 PM Monday through Saturday. On Sundays and Statutory holidays, hours of work will be limited to the period between 9:00 AM and 10:00 PM. Activities exempt from this restriction are: – overhead sign structure installation; – girder erection; – concrete pours for bridge construction; and – line painting. • The Contractor must adhere to the hours of work unless an exemption is granted by the Department. • Consider use of vibratory or enclosed-hammer pile drivers during pile driving.
Noise Operation	Noise levels in excess of 65 dBA Leq(24 hr)	• Install noise attenuation barriers between the roadway and adjacent residential areas as required in accordance with the Technical Requirements.

Valued Ecosystem Component	Potential Project Effect	Mitigation Measures
Lighting Operation	Increased illumination of non-TUC areas	• Lighting will be located adjacent to all roadways to ensure driver safety. • Where feasible, lighting will be used that minimizes lighting spill outside the Road Right of Way.

SR Mitigation Measures Table

Geology/ Geomorphology		***To mitigate for effects on slope stability from the Project, the Contractor will carry out the following:*** 1. The Contractor will incorporate geotechnical data and recommendations into the detailed design phase and implement measures to address identified slope stability issues pre-, during and post-construction.
Soils		***To mitigate for soil erosion, the Contractor will carry out the following:*** 1. Employ erosion control methods, as described in AT's "Design Guidelines for Erosion and Sediment Control for Highways" (2003), such as tackifier, erosion netting, hydroseeding, silt fences and gabions, on any bare slopes or stockpiled soils. 2. Stockpiled soils will be stabilized as soon as possible and no later than two months after stockpiling. 3. Temporary erosion control measures will remain in place until vegetation is established. 4. Monitor erosion control and revegetation. 5. Monitor disturbed areas adjacent to the NSR, Oldman Creek, unnamed tributaries and wetlands. 6. Following construction, stabilize exposed soils by planting approved seed mixtures.
		To mitigate for impacts to topsoil and for sub-soil mixing, the Contractor will carry out the following: 7. Topsoil and subsoil will be stockpiled separately. 8. Environmental inspector or experienced contractor to ensure appropriate salvage depths are determined. 9. Soils used for reclamation purposes shall be replaced back in same area from which it was originally removed/salvaged.
		To mitigate for soil compaction, the Contractor will carry out the following: 10. Sub-soils will be ripped and fine topsoils will be disked to reduce compaction.
		To mitigate for the disturbance of contaminated soils, the Contractor will carry out the following: 12. The Contractor shall develop mitigation strategies to ensure the proper management of contaminated soils/groundwater indentified in the Certain Phase IIs.
Hydrology/ Surface Water Quality		***To mitigate for sedimentation, the Contractor will carry out the following:*** 1. Clearing will be postponed until immediately before construction is scheduled to start. 2. Use of standard erosion control techniques on open slopes. 3. Vegetation will be established on disturbed areas immediately after construction. 4. Standard erosion control techniques will be kept in place until vegetation is established. 5. Monitor and maintain erosion and sedimentation controls until vegetation established.

		To mitigate for contaminated groundwater at the former Celanese site (now Worthington B.P.), the Contractor will carry out the following: 6. The Contractor shall develop mitigation strategies to ensure the proper management of contaminated soils/groundwater indentified in the Certain Phase IIs.
		To mitigate for altered river hydraulics from the new NSR bridge crossing, the Contractor will carry out the following: 7. Ensure bank erosion protection is utilized as required.
		To mitigate for altered drainage patterns, the Contractor will carry out the following: 8. Confirm requirements for permanent slope drainage during detailed design. 9. Identify and confirm groundwater discharge and recharge areas. 10. Maintain existing hydrologic connections.
		To mitigate for increase loading on existing stormwater facilities from the Project, the Contractor will carry out the following: 11. Storage facilities will contain flows in excess of storm system capacity until capacity becomes available. 12. Construct small wet/dry ponds within the DND's bird restriction zone. 13. Assess permanent slope drainage requirements during final design stages.
Air Quality		***To mitigate for dust and smoke generation from road construction activities, the Contractor will carry out the following:*** 1. Burning of cleared vegetation will not be permitted. 2. Minimize dust generation by wetting down dusty areas during construction activities.
		To mitigate for asphalt and concrete batch plan emissions, the Contractor will carry out the following: 3. Alberta Environment's Codes of Practice for Asphalt Paving Plants and Code of Practice for Concrete Producing Plants will be followed with respect to asphalt and concrete batch plant emissions.
Vegetation		***To mitigate for the loss or alteration of upland native plant communities, the Contractor will carry out the following:*** 1. To the greatest extent possible, avoid aligning the Project through native plant communities and refine clearing limits. 2. Clearly mark clearing limits with snow-fence or highly visible flagging. 3. Adhere to vegetation clearing restrictions including: a. Trees and large shrubs within 30 m of a waterbody will be hand cleared only b. No equipment is allowed to cross any waterbody during clearing operations c. Trees shall not be allowed to fall into a waterbody d. Retain an undisturbed vegetation buffer between the construction site and watercourse to reduce the potential for sedimentation 4. Prohibit equipment storage, maintenance and refuelling in areas that support native plant communities.

		To mitigate for the loss of wetland habitat, the Contractor will carry out the following: 5. Where possible, wetlands should be avoided. 6. Where avoidance of wetlands is not possible, enhance existing sites or create similar wetlands in nearby areas to achieve no net loss of wetland habitat and function. 7. Confirm required compensation ratio with Alberta Environment. 8. Complete wetland compensation plan in support of Alberta Water Act approval for draining and filling wetlands. 9. Liaise with City of Edmonton regarding potential wetland compensation sites with the City. 10. Incorporate native shrubs and trees in mitigation for those areas within the Project Limits where it is safe to do so.
		To mitigate for the effects of road salt on adjacent vegetation during roadway operation, the Contractor will carry out the following: 11. Develop and implement a salt management plan for the operation and maintenance of the roadways during the Construction Period and the Operating Period.
		To mitigate for the introduction of weedy or invasive species, the Contractor will carry out the following: 12. Develop an action plan to control the spread of weedy species in reclaimed areas. 13. Clean equipment used in weedy areas before moving into new areas. 14. Use weed control on soil stockpiles left for long periods. 15. Use weed control in disturbed/areas until desired vegetation is established. 16. Revegetation cleared areas as soon as possible with native vegetation.
		To mitigate for the loss of rare plant species, the Contractor will carry out the following: 17. Avoid areas with rare plant where possible and mark clearly in the field. 18. For areas impacted, transplant the plans with large root ball to an area away from future disturbance. 19. Monitor transplants to ensure viability. 20. Collect seeds and donate to the Devonian Botanic Garden.
Wildlife		***To mitigate for the loss of natural upland treed and wetland habitats, the Contractor will carry out the following:*** 1. Mark clearing limits prior to clearing. 2. Revegetate any disturbed areas as soon as possible using native species. 3. Comply with Alberta Environment's Wetland Management in the Settled Area of Alberta – An Interim Policy (1993).
		To mitigate for habitat alienation from construction activities, the Contractor will carry out the following: 4. Minimize night shifts and maintain wildlife passage. 5. Prohibit the harassment of wildlife during construction.
		To mitigate for direct wildlife morality during construction, the Contractor will carry out the following: 6. Do not clear vegetation in the period 15 April to 31 July. 7. Clearing to include all trees, ground cover and brush piles. 8. Clearly mark clearing limits prior to clearing.

		To mitigate for the loss of Canadian Toad (a special status species), the Contractor will carry out the following: 9. Confirm areas to be cleared. 10. Consult with Alberta Environment and Alberta Sustainable Resource Development to confirm status of Canadian Toad and compensation requirements. 11. Adhere to Alberta Sustainable Resource Development's setback distance guidelines for Canadian Toad.
		To mitigate for the loss of American white pelican, least flycatcher, northern harrier, sora, common yellowthroat, horned grebe, lesser scaup, pied-billed grebe and green-winged teal, the Contractor will carry out the following: 12. Do not clear vegetation in the period of 15 April to 31 July. 13. Clearing to include all trees, ground cover and brush piles. 14. Clearly mark clearing limits prior to clearing. 15. Revegetate upland areas associated with wetlands/riparian areas.
		To mitigate for the disruption of wildlife movement corridors during the Project and the O&M, the Contractor will carry out the following: 16. Minimize night shifts during construction and maintain wildlife passage. 17. Incorporate detailed design elements in wildlife passage under the NSR bridge. 18. Consider wildlife fencing to funnel wildlife under NSR bridge.
		To mitigate for wildlife-vehicle collisions, the Contractor will carry out the following: 19. Install lighting along alignment. 20. Keep roadway right-of-way clear of tree and shrub vegetation for better motorist visibility of moving animals. 21. Place ungulate fencing in select locations at bridge crossing site. 22. Facilitate wildlife movement by creating naturalized corridor using native shrubs and plantings. 23. Take additional measures as required.
Fish and Aquatic Resources		***To mitigate for direct habitat alteration, disruption and/or loss, the Contractor will carry out the following:*** 1. Contractor to work in consultation with DFO, Alberta Environment, and Alberta Sustainable Resource Development during detailed design to minimize impacts to fish and minimise HADD. 2. Apply for DFO Fisheries Act Authorizations including conditions for mitigations, compensation, monitoring and reporting. 3. Confirm outfall location on Oldman Creek, tributary to Oldman Creek and tributary to NSR (Gold Bar Creek). 4. Consider the Department's Fish Habitat Manual: Guidelines and Procedures for Watercourse Crossings in Alberta (2009).
		To mitigate for fish entrapment within coffer dams, the Contractor will carry out the following: 5. Rescue any fish within coffer dams and release back to the NSR; document results of the rescue program.

		To mitigate for increased sediment levels, the Contractor will carry out the following: 6. Use appropriate temporary and permanent erosion control measures. 7. Follow the Department's "Design Guidelines for Erosion and Sediment Control for Highways". 8. Follow Alberta Environment's "Code of Practice for Outfall Structures on Waterbodies" (2003). 9. Consider Alberta Transportation's Fish Habitat Manual: Guidelines and Procedures for Watercourse Crossings in Alberta (2009). 10. Isolate instream work areas (e.g., coffer dams). 11. Allow sediment-laden water in coffer dams to settle prior to pumping out. 12. Revegetate immediately following construction. 13. Monitor erosion control until vegetation re-establishes.
		To mitigate for changes to channel morphology from bridge construction and operation, the Contractor will carry out the following: 14. Align bridge piers to flow of river. 15. Design bridges to allow for fish passage. 16. Ensure bank erosion protection is utilized as indicated on the Detailed Designs.
Noise		***To mitigate for increase in noise levels in neighbourhoods abutting the New Infrastructure during the O&M in 2041, the Contractor will carry out the following:*** 1. Monitor noise levels periodically and if warranted, include noise attenuation (e.g., noise walls and/or berms) in planning for Ultimate Stage.
Heritage Resources		***To mitigate for the distribution to or destruction of historical resources, the Contractor will carry out the following:*** 1. If potential heritage resources are discovered, suspend work and contact Heritage Resources Management Branch and Royal Tyrell Museum.
Accidents and Malfunctions		***To mitigate for the deposit of deleterious substances and contamination of groundwater, surface water, soils, and vegetation, the Contractor will carry out the following:*** 1. Follow standard operating procedures and provincial hazardous material spill regulations. 2. Maintain and refuel equipment away from waterbodies. 3. Curbside catch basins, if any are present, will be hoarded. 4. Biodegradable oils and lubricants will be used in equipment. 5. Store on-site fuels in secure tanks with appropriate spill containment. 6. Ensure spill kits are readily available at refuelling/maintenance areas. 7. Train personnel in use of spill kits and immediate response. 8. Develop a site-specific response plan for the NSR crossing. 9. An ECO plan, including an emergency spill response, will be in place. 10. Excess paving and concrete material will be disposed appropriately.

200.2.14 NOISE ATTENUATION

The Contractor is responsible for all road traffic noise attenuation for the New Infrastructure.

The Contractor shall ensure that the maximum noise level of 65 dBA Leq_{24} (A-weighted 24 hour equivalent sound level) measured 2 metres inside the affected residential property line is adhered to. If the threshold is exceeded, the Contractor shall implement noise mitigation measures. Monitoring and measurement to determine where and when noise mitigation measures are required shall be generally completed in accordance with Section 400.4.9 (Road Traffic Noise

Mitigation (New Infrastructure Only)). The mitigation of noise issues could include constructing noise walls or berms. The mitigation must be broadly supported by the affected residents.

Where a new residential subdivision is constructed (after October 1, 2011) adjacent to the New Infrastructure, the new residential subdivision development proponent will be responsible for noise attenuation in respect to that new residential subdivision.

The Contractor's responsibility for noise mitigation applies up to and including mainline AADT volumes of 125,000 vehicles per day, to be determined in accordance with Section 200.3.1 (Traffic Volume Payment Adjustments).

200.2.15 FENCING

Fencing shall be consistent with the Department's approach on other areas of Anthony Henday Drive already constructed. The fencing shall be installed to separate the Lands from the rest of the TUC or to delineate the Road Right of Way. For areas adjacent to existing residential developments, the fence shall be the Department's Class E Standard as shown on Standard Drawing CB6-2.12M5 in Alberta Transportation's CB-6 Manual (Highway Standard Plate), modified by replacing the two strand barbed wires (four point galvanized 2.5 mm thick strands) at the top of the fence with two strand 3.35 mm thick galvanized wire. In all other locations, the fence shall be the Department's Class B fence as shown on Standard Drawing CB6-2.12M2 in Alberta Transportation's CB-6 Manual (Highway Standard Plates).

The Contractor must obtain approval from the Department for the proposed fence lines. The fenced areas must be of a practical size and dimension with free and clear access so that lease potential or other future uses of the rest of the TUC have not been compromised.

The Road Right of Way shall be fenced and the fencing shall extend to the TUC boundaries at the crossroads. Any stormwater storage facilities shall also be fenced.

Wildlife fencing or other types of specialty fencing removed from the TUC during construction shall be replaced with fencing of similar type to separate the Lands from the rest of the TUC.

Access to the utility components shall be controlled by gates. The Contractor shall install gates at various locations throughout the fence line so as to permit ease of access to the utility components, ensuring that no area is inaccessible. Gates shall be large enough to accommodate passage of vehicles, equipment, utility vehicles and farm equipment. The Contractor shall obtain prior written approval from the Department for gate types, sizes and locations. TUC access will be permitted from the crossroads only. No access points will be permitted from the Mainline or its associated entrance and exit ramps.

200.2.16 PREFERENTIAL BRIDGE DECK ICING

The Contractor shall address the prevention of preferential bridge deck icing on the following bridges (the "**PBD Bridges**") in the Preferential Bridge Deck Icing Plan (as defined in Section 100.2.9):

- The Elevated Directional Ramp bridge(s) carrying eastbound Sherwood Park Freeway onto northbound Anthony Henday Drive;
- The Elevated Directional Ramp bridge(s) carrying northbound Anthony Henday Drive onto westbound Yellowhead Trail;
- The Elevated Directional Ramp bridge(s) carrying southbound Anthony Henday Drive onto eastbound Yellowhead Trail, and northbound Broadmoor Boulevard;
- The Elevated Directional Ramp bridge(s) carrying southbound Manning Drive onto eastbound Anthony Henday Drive;
- The twin river bridges on the mainline Anthony Henday Drive over the North Saskatchewan River;
- All bridges, other than crossroads, that have resultant bridge deck slopes greater than 4% at any point along their length. For this purpose the bridge length shall be considered to be the distance between abutment centrelines (the resultant bridge deck slope is the vector sum of the longitudinal grade and the crossfall); and
- All bridges that are located in areas where changes in traffic speed are required.

The PBD Bridges that are part of the New Infrastructure (the "**PBD Bridges (NI)**") will be fitted with the Road Weather Information Systems ("**RWIS**") by the Department's then current RWIS contractor (the "**RWIS Contractor**"). The Contractor acknowledges having been provided with and having reviewed a copy of RWIS contracts without the bid prices in effect as of Execution of the DBFO Agreement.

The Contractor shall permit the RWIS Contractor to complete, prior to Traffic Availability, the installation and commissioning of RWIS on the PBD Bridges (NI).

For each of the PBD Bridges (NI), the RWIS Contractor shall be permitted by the Contractor to install sensors in the pavement approaching the applicable bridge and on the bridge itself and install RWIS tower structures in the Road Right of Way, in locations determined by the RWIS Contractor, acting reasonably.

Once the RWIS on the PBD Bridges (NI) is commissioned and operational, the Contractor shall be entitled to receive weather forecasts from the RWIS Contractor on the same terms and conditions as the Department's other highway maintenance contractors do under the then current RWIS contract. The Department assumes no responsibility for the Contractor's use of such weather forecasts. The Department contact for information about the weather forecasts is:

Allan Lo, P.Eng.
Intelligent Transportation Systems and Traffic Safety Specialist
Alberta Transportation
Telephone: (780) 415-1021.

The Contractor shall:

(a) provide all reasonable cooperation with the RWIS Contractor in respect of the installation, operation, maintenance, or rehabilitation of the RWIS for the New Infrastructure (the "**RWIS**

Work");

(b) coordinate and schedule the Project or the O&M, as applicable, in such manner as will facilitate the RWIS Work;

(c) if and as often as it becomes aware of deficiencies in the RWIS Work as will materially adversely affect or interfere with the Project or the O&M, as applicable, or the obligations of the Contractor under the DBFO Agreement, immediately provide the Department with notice, including reasonable details, of those deficiencies;

(d) without limiting (a) and (b) above, design, build and rehabilitate the New Infrastructure to accommodate the RWIS as set out in Drawing 18-I-01 in Appendix I.

(e) without limiting (a) and (b) above, complete grading and landscaping to enable the installation of the RWIS tower structures for the PBD Bridges (NI) prior to Traffic Availability;

(f) without limiting (a) and (b) above, for the purposes of powering the RWIS systems, provide 120 VAC, 60 Hz power source to each of the four quadrants of each interchange having PBD Bridges (NI) for use by the RWIS Contractor. Each power source shall be available continuously, terminated with a breaker, and located within a weather proof and lock-secured panel box at a streetlight pole located in each of the respective interchange quadrants. The Contractor is required to supply power to the RWIS systems throughout the Operating Period;

(g) without limiting (a) and (b) above, consult with the RWIS Contractor to determine the specific streetlight poles at which the RWIS power sources described in (f) above will be housed;

(h) without limiting (a) and (b) above, permit the RWIS Contractor to obtain power from the power sources described in (f); and

(i) without limiting (a) and (b) above, provide traffic accommodation services to the RWIS Contractor, as reasonably requested by the RWIS Contractor, but at the cost of the RWIS Contractor, such cost as determined by the Contractor acting reasonably.

The Department shall arrange the reciprocal reasonable cooperation of the RWIS Contractor.

200.2.16.1 FIXED AUTOMATED SPRAY TECHNOLOGY

The North Saskatchewan River bridge structures have been identified as having potential icing issues during cold weather events. The Contractor shall supply and install permanent plumbing in these two structures for the future implementation of a Fixed Automated Spray Technology ("**FAST**") system by the Department's FAST contractor (the "**FAST Contractor**"). The Contractor is responsible for the design of the FAST system fit ups for both Stage 1 and the Ultimate Stage, and for the installation of plumbing in the Stage 1 bridge elements. Notwithstanding the foregoing, any plumbing for the Ultimate Stage bridges shall also be completed to the extent that it does not interfere with the operation of Stage 1 infrastructure.

The Contractor's design shall accommodate FAST systems provided by two major FAST system suppliers, as mutually agreed to by the Department and the Contractor, prior to the Contractor undertaking design. The Contractor's design shall include the following elements:

- Embedded rigid longitudinal PVC conduit in the concrete bridge barrier, including PVC expansion joints at bridge expansion joints, where applicable;

- The FAST system design shall be incorporated into one of the Department's existing standard barriers. The FAST system components shall be incorporated into the standard barriers in such a manner as to not compromise the integrity, durability or structural capacity of the barriers. All modifications to the existing standard barriers shall be submitted to the Department for review;
- Junction boxes for all accessories, including but not limited to valves, sensors and accumulators, embedded in the exterior faces of concrete bridge barriers;
- Vertical drain tubes from these junction boxes, with tube ends projecting proud of the exiting surface;
- Embedded FAST associated works shall be installed continuously through the full length of each bridge, and the approach roadway in the direction of approaching traffic for approximately 70 metres from the bridge abutment;
- Minimum bend radii and duct diameters of all conduits shall be in accordance with the more conservative requirements of the two major FAST systems being designed for. The ducting requirements of these proprietary systems shall be included with the ducting submission to the Department;
- Conduits shall be installed in accordance with Section 300.5.2.12 (Ducts and Conduit Systems); and.
- The Contractor shall supply metered unswitched A/C power to the FAST pump house location in the form of 347 volt three-phase, with 100 amp power distribution centre for the system. The Contractor is required to supply power to the FAST system throughout the Operating Period.

The Contractor's design shall include provisions for the following future elements:
- Lateral conduit will be sawcut into asphalt wearing surface, and the conduit installed within the barrier shall allow for the connection of these new lateral conduits;
- Lateral conduit within barrier to be locatable with a magnetic finder after placement of the wearing surface. Location also to be marked and surveyed, and coordinate noted on record drawings;
- Spray nozzles and pavement sensors will be installed in the deck wearing surface, and the deck wearing surface shall accommodate these future components;
- An RWIS/FAST pump house compound will be constructed at the bridge site and use the provided power supply; and
- When the Ultimate Stage bridges are constructed, any additional ducting associated with the Ultimate Stage FAST system that was designed to be accommodated into new Ultimate Stage barriers will be installed.

200.2.17 MISCELLANEOUS ENVIRONMENTAL CONCERNS

200.2.17.1 Wetland Compensation

The Contractor is responsible for wetland replacement, compensation and management activities during the Construction Period and the Operating Period. All regulatory requirements including design, construction, maintenance, monitoring and/or reporting shall be the responsibility of the Contractor. The Department must be kept apprised of all discussions and shall receive copies of all agreements respecting wetland replacement and compensation.

200.2.17.2 Campsites

There shall be no campsites or sleeping trailers permitted within the TUC. Notwithstanding the foregoing sentence, a work camp will be permitted in the southeast portion of the TUC during the Construction Period only, provided:

(a) the Contractor obtains all approvals, permits, and consents required by applicable law in respect of the work camp;
(b) the Contractor demonstrates that public consultation has been undertaken and public support has been achieved in respect of the work camp being a specific component of the Project and in accordance with Section 100.2.7 (Public Communication Strategies);
(c) the Contractor obtains a written confirmation (the "**Local Authority Work Camp Confirmation**") from the Local Authority within whose boundaries the proposed work camp is to be located, confirming the Local Authority has no concerns with the proposed work camp, or no concerns provided certain conditions are met, including without limitation agreeing to any required water, sewer, or other Local Authority utility connections;
(d) the Contractor acknowledges and agrees in writing with the Province (the "**Acknowledgement**") that the Contractor: (i) accepts all risks arising in any way from the work camp; and (ii) waives any right to claim a Relief Event arising in any way from the work camp, including the failure to obtain a Ministerial Consent. The Acknowledgement shall be in a form satisfactory to the Department, acting reasonably; and
(e) after the Contractor has complied with (a) to (d) immediately above, the Contractor obtains a Ministerial Consent for the proposed work camp. The Ministerial Consent, if granted, will incorporate the conditions, if any, set out in the Local Authority Work Camp Confirmation.

200.2.17.3 Burning

No burning will be allowed within the TUC or the Road Right of Way.

200.2.17.4 Historical Resources

Copies of the February 3, 1997 *Historical Resources Act* (Alberta) clearance letter for Highway 16 from east of the North Saskatchewan River to the west boundary of Elk Island National Park, the January 1, 2005 *Historical Resources Act* (Alberta) clearance letter for Southeast Anthony Henday Drive, and the May 11, 2007 *Historical Resources Act* (Alberta) clearance letters for North Edmonton Ring Road are attached as Appendix D.

Pursuant to section 31 of the *Historical Resources Act* (Alberta), should any paleontological or historical resources be discovered during the conduct of construction activities, the Contractor shall immediately inform the Department in writing.

200.2.17.5 Pollutants

The Contractor shall ensure that no pollutant occasioned by the carrying out of the Project or the O&M, including debris from clearing operations, petroleum products from equipment operations and construction refuse, is allowed to enter any water body whether flowing or static.

200.2.17.6 Topsoil

Topsoil, salvaged during the Project or the O&M, shall be maintained free of deleterious material and subsoil and shall be distributed evenly over designated areas once embankment construction and excavation have been completed. No burial, removal and/or sale of topsoil materials salvaged during the Project or the O&M is allowed without the prior written approval of the Department.

200.2.17.7 Organic Materials

Organic materials from wetland excavation shall be salvaged and stockpiled in separate stockpiles prior to reuse in accordance with environmental requirements. No burial, removal and/or sale of organic materials salvaged during the Project or the O&M is allowed without the prior written approval of the Department.

200.2.18 AESTHETICS

The Contractor shall develop and incorporate in its design an aesthetic theme throughout the New Infrastructure that complements the surrounding environment. As much as is practical, architectural treatments shall be similar to the northwest leg of Anthony Henday Drive. The Contractor acknowledges having reviewed the plans and specifications for the northwest leg of Anthony Henday Drive and acknowledges having inspected the condition of the northwest leg of Anthony Henday Drive just prior to the signing of the DBFO Agreement.

The following specific aesthetic features shall be incorporated into the New Infrastructure:

- The “wild rose” emblem 1.6 m in diameter on abutment wingwalls facing traffic. On twin bridge structures, the emblem is not required on the downstream structure;
- The aesthetic treatment of pier shapes for roadway grade separation bridges;
- The use of pigmented sealers (three colours) on exposed concrete surfaces;
- Artistic renderings that cover a minimum of 25% of the exposed surface area on all retaining walls except for retaining walls at railway overpasses;
- Unless otherwise specified elsewhere in the Technical Requirements, the height of any retaining wall, or the combined height of multiple retaining walls, shall not exceed 8.0 m at any location adjacent to roadways, or 12 m adjacent to railway grade separations. The height of retaining wall for this purpose shall be taken as the vertical height from top of coping to top of finished grade in front of the wall;
- Circular or square column cross sections in bridge piers shall not be used on grade separation structures. Ends of pier caps and pier shafts facing oncoming traffic shall be either circular or chamfered (minimum 300 mm x 300 mm). Similar type architectural treatment shall be used as far as practicable for all structures having similar characteristics such as spans, superstructure type, etc.; and
- Down spouts at high abutments shall be recessed into the exposed face of the abutment wall in a chase formed into the front of cast in place walls, or by using special wall panels in the case of MSE walls.

200.3 OPERATION AND MAINTENANCE OF THE INFRASTRUCTURE

200.3.1 TRAFFIC VOLUME PAYMENT ADJUSTMENTS

The New O&M Payments and the Existing O&M Payments shall be adjusted, in accordance with this Section, effective each April 1st of the Operating Period based upon changes in traffic volume calculated during the previous calendar year.

The Department shall provide automatic traffic recorder ("**ATR**") devices and all connections, to the Contractor for installation by the Contractor at the Contractor's expense on the Infrastructure. Thereafter, the Department shall, at its own expense, operate and maintain the ATRs throughout the Operating Period on the Infrastructure.

The detailed ATR specifications are contained in Appendix H – Automatic Traffic Recorder (ATR) Specifications.

The Department has existing ATR's at the following locations:

- Highway 216 North of Whitemud Drive;
- Highway 216 North of Sherwood Park Freeway;
- Highway 216 North of Baseline Road; and
- Sherwood Park Freeway east of 17 Street NW.

The Contractor is responsible for installing new ATR hardware provided by the Department at the aforementioned locations of the existing ATRs. In addition, the Contractor shall install new ATR hardware provided by the Department to monitor Yellowhead Trail EB and WB lanes between the North Saskatchewan River bridges and 17 Street NW.

The Contractor shall install a new ATR on the mainline lanes of Highway 216 between 153 Avenue and Manning Drive. The data collected from the ATR located between 153 Avenue and Manning Drive shall be the only ATR used for the purpose of determining Traffic Volume Payment Adjustments and the upper threshold for noise mitigation requirements.

No Traffic Volume Payment Adjustments shall be made based on partial years or for changes in traffic volume within the current year.

There shall be no Traffic Volume Payment Adjustment for the first April 1st of the Operating Period.

The Department shall count the total number of vehicles to cross a point in both directions during a calendar year and shall divide this total by the number of days in that calendar year to determine the average annual daily traffic (the "**AADT**"). For the partial year between Traffic Availability and the subsequent April 1st, the AADT shall be considered equivalent to the average daily traffic measured in that partial year. The AADT shall be calculated by the Department's traffic statistics consultant. In the event that the ATR is not recording for a given period of time, the Department's traffic statistics consultant shall make an estimate of AADT.

Weather conditions permitting, the Department shall repair the ATR to bring it into operation within four weeks of the time that the Department first becomes aware that the ATR is not functioning.

If the AADT for any calendar year exceeds 125,000 vehicles per day for the location identified on the New Infrastructure (Anthony Henday Drive mainline between 153 Avenue and Manning Drive), a onetime supplement of 5% of the New O&M Payment for such calendar year (before any Traffic Volume Payment Adjustment) shall be added to each of the New O&M Payments for the 12-month period starting April 1st after such calendar year.

In the event that unusual conditions, such as construction activity by a Local Authority on roadways other than the New Infrastructure, result in a temporary change in traffic volume on the mainline of Anthony Henday Drive, the Department, in the interest of both parties avoiding unnecessary costs, will advise the Contractor that the Department wishes to negotiate with the Contractor with respect to a temporary full or partial waiver of the Traffic Volume Payment Adjustment and a corresponding temporary full or partial waiver of certain requirements under Section 400.3 (Winter Maintenance Operation Requirements).

200.3.2 INTENTIONALLY DELETED

200.3.3 INTENTIONALLY DELETED

200.3.4 WEED CONTROL AND LANDSCAPE MAINTENANCE

200.3.4.1 General

All areas within the TUC or the Road Right of Way, except for Privately-Owned TUC Land (as defined in section 2 of Schedule 12 of the DBFO Agreement) and the Third Party Leased Lands, shall be mowed/cut as seeded areas in accordance with Section 200.3.4.5 (Seed Establishment and Maintenance of Seed Areas) and maintained in a weed free condition by the Contractor until Construction Completion. The "**Third Party Leased Lands**" are those lands as set out in Appendix G (Alberta Infrastructure Land Lease Summary and Drawings) where it is indicated at the relevant time that such land is still subject to a lease. Thereafter, all areas within the Road Right of Way and/or stormwater management facilities of the Infrastructure shall be maintained in a weed free condition by the Contractor until the end of the Term.

Weeds to be eradicated include all species identified under the *Weed Control Act* (Alberta) and the applicable Local Authority's bylaws, or species which interfere or compete with the seeded varieties. Volunteer crops from previous land use will be considered as weeds.

The Contractor shall be responsible for any fines or weed control notices issued for the TUC or the Road Right of Way until Construction Completion and then for the Road Right of Way and/or any stormwater management facilities outside the Road Right of Way but inside the TUC until the end of the Term. All notices shall be dealt with in a timely fashion. Copies of all fines and notices shall be provided to the Department.

200.3.4.2 Method

Weed control shall be carried out by cultivation, seeding, and spraying. The areas (as set out in the first sentence of Section 200.3.4.1 (General)) not affected by the construction of the New Infrastructure as determined by the Contractor shall be tilled to ensure that all nuisance weeds are controlled. In addition, the tilled areas shall be seeded in the Spring of 2015 using the seed mixes in Section 200.2.9 (Topsoil and Seeding).

Any method of weed control adopted by the Contractor shall take into account wind directions and velocities. The Contractor shall ensure that residents located near the Infrastructure are not subjected to dust and/or spray drift resulting from its weed control operations. Natural areas shall not be subjected to spray drift. The Contractor shall be responsible for all costs associated with any damage to residential property, natural areas or retained plant materials resulting from spray drift or poor agricultural or weed control practices carried out by or for the Contractor.

In the event the Contractor chooses seeding with commercial crops as a method of weed control, any crops harvested shall become the property of the Contractor. The use of commercial crops as a method of weed control shall only be allowed during the Construction Period, not the Operating Period.

Pesticide applicators must meet all requirements in the *Code of Practice for Pesticides* (applicable by regulation under section 36 of the *Environmental Protection and Enhancement Act* (Alberta)). Pesticide applicators must also comply with all requirements of the *Environmental Protection and Enhancement Act* (Alberta), its associated regulations and all other applicable laws. The Contractor or any subcontractor that the Contractor hires for herbicide application must hold a valid Pesticide Service Registration with Alberta Environment (or its successor).

200.3.4.3 Weed Control Signage and Notification

The Contractor shall provide signs and notices to residents affected by the work prior to commencement of chemical applications. Signage and notification shall follow policies and procedures set by the Local Authority. The Contractor shall become familiar with the policies and procedures by contacting the Local Authority for the affected area.

The Contractor shall notify the Local Authority a minimum of 48 hours prior to spraying with information including the following: location, target weeds, chemicals to be used and date and time of application.

Prior to spraying, the Contractor shall purchase all necessary signage from the Local Authority to assist in identifying spray areas. Signage shall be installed at a minimum 100 m interval and at all entry points, corridors and walkways adjacent to the TUC or the Road Right of Way or as directed by the Local Authority. The Contractor shall be responsible for displaying and removing signs in accordance with the time frame required for public notification and re-entry intervals. The Contractor is to ensure that signs refer project inquires to the Contractor’s contact number.

The Contractor shall be responsible for obtaining information from the Local Authority regarding citizens in the vicinity of the TUC or the Road Right of Way with medical sensitivities or other concerns related to spraying. The Contractor shall be responsible for determining if any such area residents are affected and then take appropriate measures to meet their specific needs.

200.3.4.4 Mowing and Trimming at Fences

The Contractor shall carry out mowing and trimming around fences, as part of weed control in the following instances:

- as an emergency procedure in response to weed notices;
- to control weeds that are not effectively responding to the weed management program;
- as a clean-up procedure at the end of the growing season; and
- in areas adjacent to residences where spraying is not feasible.

The trimming of weeds around fences shall be conducted as reasonably required and in any event at least once every 60 days during the period April 1 to October 31 each year.

200.3.4.5 Seed Establishment and Maintenance of Seeded Areas

Any area of unsatisfactory seed establishment shall be top dressed and reseeded by the Contractor. The acceptable minimum number of plants of all seeded species per square metre shall be 150.

The seeded areas shall be mowed/cut to 100 millimetre height a minimum of twice during the growing season. Baling and/or raking of the mowed/cut plant material shall be performed upon completion of the mowing/cutting operation in order to prevent accumulation of mulch. Bales and raked material shall be removed from site immediately upon completion of the baling/raking operation. All bales and raked material shall become the property of the Contractor.

Weeds that emerge during the one year establishment period are to be controlled as per the requirements and methods described in the Section 200.3.4.2 (Method).

200.3.5 MAINTENANCE OF DRAINAGE SYSTEMS

In addition to maintenance of the New Infrastructure drainage system, the Contractor is responsible for the maintenance of previously installed drainage systems on other portions of the Road Right of Way and the TUC as set out in Drawings 18-A-3.01 to 18-A-3.12 in Appendix A. This includes the entire drainage network from the source points to the various outfalls and all features in between. The Contractor shall ensure that the design hydraulic capacity, water treatment capabilities and spill containment features of the network as a whole and each of its elements is maintained at all times. The Contractor shall have regular inspection/performance monitoring program, and carry out a regular cleanup of rubbish or other deleterious materials. The Contractor shall note that some elements of the drainage network are shared between the Department and the Local Authority. The Contractor acknowledges as having reviewed the agreements describing the shared systems. The Contractor shall not be permitted to interfere with the function of any shared system without the permission of both the Department and the affected communities.

In the event of a roadway spill that may impact the drainage system, the Contractor shall be responsible for managing the clean-up. This shall include but not be limited to implementing any safeguards to prevent contaminants from entering adjacent water bodies or the groundwater system.

200.3.6 BRIDGE INSPECTIONS

200.3.6.1 Level 1 BIM Inspections

Level 1 BIM inspections shall be completed for all bridges in the Existing Infrastructure within 30 days after Construction Completion. Level 1 inspections shall be repeated every 21 months thereafter, until the end of the Operating Period.

200.3.6.2 Level 2 Bridge Deck Inspections

Initial specialized Level 2 Bridge Deck Inspections (as defined by *Alberta Transportation's Bridge Inspection and Maintenance System* ("**BIM**")) for bridges in the Existing Infrastructure shall be carried out by the Contractor as follows:

Starting in 2016: Specialized Level 2 deck inspections consisting of concrete deck inspection, Copper Sulphate Electrode testing and chloride ion content testing.

- Bridge carrying the eastbound lanes of Whitemud Drive over Anthony Henday Drive (BF81157E-1);
- Bridge carrying the westbound lanes of Whitemud Drive over Anthony Henday Drive (BF81157W-2);
- Bridge carrying 34 Street over Sherwood Park Freeway (BF76094-1);
- Bridge carrying the eastbound lanes of Sherwood Park Freeway over CNR at the east boundary of the City (BF76093E-1); and
- Bridge carrying the westbound lanes of Sherwood Park Freeway over CNR at the east boundary of the City (BF76093W-2).

Only qualified and experienced bridge inspectors that have a current Class A certification under the Department's BIM shall complete inspections.

Following the initial Level 2 Bridge Deck Inspection, subsequent Level 2 Bridge Deck Inspections for the bridges in the Existing Infrastructure shall be repeated by the Contractor at an interval of every four years, until the end of the Operating Period.

200.3.7 PREVENTATIVE BRIDGE MAINTENANCE

Sealing of the bridges in the New Infrastructure and Existing Infrastructure shall initially be carried out by the Contractor in 2016 and subsequently repeated at an interval of every four years thereafter until the end of the Operating Period.

200.3.8 INTENTIONALLY DELETED

200.3.9 SPECIAL EVENTS

There will be occasions where the Department requires the cooperation and coordination of the Contractor for special operations. Any work required by the Contractor under this Section 200.3.9 (Special Events) shall require a Change Order.

200.3.9.1 Full Lane Availability Events

Sometimes special events will be approved by the Department in the area which will generate extra traffic in the Infrastructure. Some events that generate extra traffic in the Infrastructure will occur independently of approval by the Department.

Such events may require:

- Installation of special banners or special signs;
- Adjustment of traffic signals; and
- Additional traffic management or traffic accommodation measures.

200.3.9.2 Partial or Full Closure Events

There will be times when the Infrastructure is utilized for special events ("**Approved Special Events**"), approved by the Department that may require closure or partial closure of the Infrastructure. The following measures may be required:

- Installation of special signs; and
- Additional traffic management or traffic accommodation measures.

The Contractor is required to develop a communications and operations plan to accommodate Approved Special Events when so notified by the Department. The Department shall approve such plan and the Contractor shall implement the approved plan.

Lane Closure Payment Adjustments shall not apply to lane closures required for Approved Special Events.

200.3.10 OPERATION AND MAINTENANCE OF IN-SERVICE ROADS DURING CONSTRUCTION PERIOD

Commencing at 12:00 a.m. on the date that is two months after Execution of the DBFO Agreement, the Contractor shall be responsible to perform operations and maintenance on existing infrastructure within the Project Limits during the Construction Period, including snow and ice control. The following sections of roadway and crossroads (including bridges in both cases) within the Project Limits are currently open to public traffic (the "**In-Service Roads**") and are to be operated and maintained by the Contractor during the Construction Period as if the roadway and crossroads (including bridges in both cases) were New Infrastructure:

- Anthony Henday Drive (Highway 216) and the associated crossroads as follows:
  - Baseline Road interchange;
  - Sherwood Park Freeway; and
  - Whitemud Drive interchange.
- Highway 16 (Yellowhead Trail) and the associated crossroads as follows:
  - Broadmoor Boulevard; and
  - Sherwood Drive.

The Contractor shall be responsible for snow and ice control of the In-Service Roads during the Construction Period. It is a Project Requirement that operations and maintenance of the In-Service Roads during the Construction Period, including but not limited to surface repair, line painting, pathways and sidewalks, signage, signal and lighting maintenance, shall be the Contractor's responsibility and shall be conducted to meet the standards set out in the sub-paragraphs (a) to (n) below.

The following requirements, including without limitation Payment Adjustments (unless expressly stated otherwise), shall apply during the Construction Period starting the date that is two months after Execution of the DBFO Agreement (with such modifications as necessary) to the In-Service Roads:

(a) Section 400.1.5 (Imminent Danger Repairs);

(b) Section 400.1.6 (Lane Closure) applied to any reduction of the minimum lane requirements for the In-Service Roads as set out in Section 200.2.3.23 (Detours). The provisions applicable to the Schedule of Lane Closures and telephone service shall not apply. Except with the prior written approval of the Department, acting reasonably, and except for an Excepted Lane Closure, the Contractor shall not close all lanes in either direction or close any lanes for an extended period of time (as determined by the Department acting reasonably). For planned maintenance activities on the In-Service Roads with two lanes in each direction the Contractor must have at least one lane in each direction open to traffic at all times, unless otherwise approved in writing and in advance by the Province, acting reasonably;

(c) Section 400.2.1.1 (Routine Observations);

(d) Section 400.2.2 (Emergency Maintenance);

(e) Section 400.2.3 (Routine Maintenance);

(f) Section 400.2.4 (Measuring for Compliance);

(g) Section 400.3.1 (General). For the Winter Maintenance Standards table in Section 400.3.1, Highway 16 is deemed a Class AAA roadway, Highway 216 is deemed a

Class AA roadway, and all other crossroads are deemed Class A roadways;

(h) Section 400.3.2 (Equipment and Materials);

(i) Section 400.3.3 (Snow Clearing and Ice Control Operations);

(j) Section 400.4.1 (Roadway Maintenance Requirements), except for the requirements in the third bullet under Section 400.4.1.2 (Completing Repairs);

(k) Section 400.4.6 (General Pavement Maintenance Requirements), except the requirements in Sections 400.4.6.3 and 400.4.6.4 and that the definition of localized roughness in Section 400.4.6.2 shall be modified to be any abrupt deviation in excess of 12 mm when measured with a 1.2 m straight edge;

(l) Section 400.4.7 (Miscellaneous - Operation and Performance Requirements), except for the requirements in Section 400.4.7.9 and for any Payment Adjustments set out in Section 400.4.7;

(m) Section 400.4.8 (Traffic Control Devices - Operation and Performance Requirements), except for any Payment Adjustments set out in Section 400.4.8; and

(n) Section 400.5.2.4 (Preventative Bridge Maintenance) but only the requirements of annual washings of bridge decks, sealing of all bridge decks exposed to de-icing salts and sealing of all curbs.

200.4 MISCELLANEOUS

200.4.1 LOCAL AUTHORITY

The Contractor acknowledges having reviewed a copy of the Highway Transfer Agreement between the Province and the City dated March 15, 2012 (the "**City Agreement**"). The Contractor shall take all such actions, or refrain from such actions, as are necessary so as to enable the Province to comply with the Province's obligations under the City Agreement in respect of the Project, the O&M and the Infrastructure.

The Contractor acknowledges having reviewed a copy of the Road Transfer Agreement between the Province and the County dated March 1, 2012 (the "**County Agreement**"). The Contractor shall take all such actions, or refrain from such actions, as are necessary so as to enable the Province to comply with the Province's obligations under the County Agreement in respect of the Project, the O&M and the Infrastructure. The Contractor shall obtain prior approval from the County for the Contractor's use of roads within the County but outside the Project Limits for the purpose of detours or haul routes.

200.4.2 HOURS OF WORK / WORK RESTRICTIONS

On the days Monday through Saturday, construction work on the Project shall be restricted to the period between 7:00 a.m. and 10:00 p.m. local time. On Sundays and statutory holidays, construction work on the Project shall be restricted to the period between 9:00 a.m. and 10:00 p.m. local time.

Activities exempted from these time restrictions are:

- Overhead sign structure installation;
- Girder erection;
- Concrete pours for bridge construction; and
- Line painting.

Other activities may be exempted with the prior written approval of the Department subject to the review and evaluation of the predicted levels of impact to surrounding residents.

When the Contractor's construction work on the Project is being carried out within the jurisdictional boundaries of a particular Local Authority, then the Contractor's construction work shall be restricted to the hours permitted by that Local Authority's bylaws or the hours of work restrictions in the first paragraph above, whichever hours of work restrictions or parts of the restrictions are more restrictive. The Contractor may obtain a noise by-law waiver from the Local Authority (if required) and a waiver of the hours of work restrictions in the first paragraph above from the Department.

200.4.3 COORDINATION WITH LOCAL AUTHORITIES

The Contractor is responsible for coordinating all operations on crossroads with the Local Authority during construction. Should a Local Authority initiate a lane rental policy for operations on that Local Authority's streets and roads, the policy will not apply on New Infrastructure crossroads.

The Contractor shall contact Adam Laughlin, The City of Edmonton at least 48 hours prior to commencing work on or adjacent to the applicable Local Authority's roads.

The Contractor is responsible for obtaining an On-Street Construction and Maintenance ("**OSCAM**") Permit required by the City for work on the New Infrastructure within the City of Edmonton.

The Contractor shall provide the County with a copy of the OSCAM Permits for the following roadways:

- Yellowhead Trail;
- Sherwood Park Freeway;
- Baseline Road;
- Whitemud Drive; and
- 17 Street NW at Sherwood Park Freeway.

The Contractor is responsible for obtaining a Temporary Traffic Control Permit ("**TTCP**") from the County for work on the New Infrastructure within the County.

The Contractor shall contact Saeed Ahmad (Phone: (780) 464-8091) or his designate at least 48 hours prior to commencing work on or adjacent to County roads.

The Contractor shall be responsible for the coordination of the design requirements and construction phasing with the Local Authority. The Contractor shall also be responsible for removal of and for coordination with the Local Authority regarding any required road removals and closures in the TUC.

200.4.4 POLICE AND FIRE SERVICES

Police and fire services for any area of the Infrastructure within the boundaries of a Local Authority will be provided by and under the jurisdiction of the Local Authority and obtained by 911 call.

The Contractor shall take all such actions, or refrain from all such actions, as are necessary to enable the police, Local Authority, and others with statutory duties or functions in relation to the Infrastructure or adjoining roads to fulfil those duties and functions. Without limiting the generality of the foregoing, the Contractor shall permit the police, Local Authority, and others with statutory duties or functions in relation to the Infrastructure, to carry out "Check Stops" and speed enforcement activities.

In the case of an emergency, the Contractor is responsible for installing traffic control devices, which includes without limitation the erection of barricades, establishing detours, and providing and installing emergency signage. The Contractor shall also remove debris and apply absorbent material to minor spills resulting from the emergency. All costs associated with such traffic control and such spill clean-up resulting from the emergency shall be the responsibility of the Contractor.

200.4.5 LAND ISSUES

Administration of the TUC is undertaken by Department of Infrastructure on behalf of the Province. Any individual or organization proposing to enter the TUC outside the Road Right of Way to undertake an activity or use requires at least one authorization from Department of Infrastructure. The document entitled "*Transportation/Utility Corridor* ("**TUC**") *Program Policy*" published by Department of Infrastructure, as may be amended from time to time, explains in detail the objectives of the TUC program. Steps for obtaining Ministerial Consents and other related authorizations from Department of Infrastructure are included in this policy.

200.4.6 LAND REQUIREMENTS IN THE EXISTING TUC

By Construction Completion, the Contractor shall have installed a fence separating the Road Right of Way from the remaining utility components of the TUC (the "**TUC Outside the**

ROW"). At that time, the Department of Infrastructure will desire to reassign the TUC Outside the ROW as lease areas. The Contractor will be relieved of its maintenance responsibility for those portions of the TUC Outside the ROW that the Contractor had responsibility, if the state of this land is acceptable to the Department of Infrastructure. Conditions for the handover back to the Department of Infrastructure shall require that these areas are fully vegetated and in a healthy and vigorous weed-free growing condition in accordance with the Contractor's Environmental Management System.

Any features or appurtenances related to the roadway, such as stormwater management facilities, that may fall within the TUC Outside the ROW shall remain the responsibility of the Contractor. The Contractor shall make specific arrangements with the Department of Infrastructure to ensure that the Contractor's maintenance of these features does not interfere with any future tenants or other land uses.

200.4.7 INTENTIONALLY DELETED

200.4.8 WORK BY OTHER FORCES

The Contractor shall coordinate all construction activities with any work that may be undertaken by utility stakeholders on their plants or facilities within the TUC or by Local Authorities at or beyond the Project Limits.

The Department has engaged NORTHWESTCONNECT General Partnership for the design, construction, operation and maintenance of elements of the Manning Drive interchange as part of the Northwest Anthony Henday Drive project. The Contractor shall cooperate and coordinate construction activities with NORTHWESTCONNECT General Partnership and its subcontractor, Carmacks Enterprises Ltd., which is the operations and maintenance contractor responsible for the Northwest Anthony Henday Drive mainline and ramps at the Manning Drive interchange and west.

The Contractor shall cooperate and coordinate construction activities with Access Roads Edmonton Ltd. and its subcontractor, Traffic Systems Management Inc. ("**TSMI**"), which is the operations and maintenance contractor responsible for the Southeast Anthony Henday Drive from north of 34 Avenue south along Highway 14 and west along Anthony Henday Drive.

The Contractor shall provide Carmacks Enterprises Ltd., TSMI, Carillion Canada Inc. and the City, as required, with details of all temporary construction installations to be operated and maintained throughout seasonal shut-down periods. The Contractor shall provide a schedule of planned seasonal shut-down periods to the appropriate maintenance forces and update it as required. The Contractor is expected to act responsibly and professionally throughout the Construction Period and take all reasonable precautions to prevent damage to existing infrastructure.

The PBD Bridges (NI) will be fitted with the RWIS by the RWIS Contractor, as set out in Section 200.2.16 (Preferential Bridge Deck Icing).

200.4.9 VEHICLE INSPECTION SERVICES

Commercial vehicles travelling on the Alberta provincial highway system are randomly inspected and weighed by officials from the Department (currently the Vehicle Inspection Services Branch of the Department). Commercial vehicles travelling on the Infrastructure will be inspected and weighed in a similar manner and frequency as on the rest of the provincial highway system.

The Contractor may purchase at agreed upon rates additional inspection services from the Department should the Contractor wish to increase the inspection frequency to reduce the potential for overload commercial vehicles travelling on the Infrastructure.

The Contractor is not permitted to construct pull-out areas along the Mainline.

200.4.10 SURVEY

The Contractor shall, as soon as reasonably practical after Construction Completion, obtain at its cost but on the Department's behalf, a survey (the "**Survey**") of the Lands. The Contractor shall provide the Department with copies of the Survey. The Contractor and the Department shall in good faith negotiate an amendment to the DBFO Agreement to describe the Lands by referencing the Survey.

200.4.11 CLEANING OF ROADWAYS

The Contractor shall not track material from the construction site onto roadways used by the public. If tracking should occur, the Contractor shall immediately remove all tracked material from the affected roadway.

200.4.12 ROADWAY OBLITERATION

All roadways, ramps, and access roads designated for removal, shall have the road structure removed, filled with clean material native to the surrounding land, landscaped neatly with slopes flatter than 5 horizontal to 1 vertical within the Road Right of Way and flatter than 6 horizontal to 1 vertical outside the Road Right of Way, culverts removed and existing drainage patterns maintained, then topsoiled and seeded in accordance with Section 200.2.9 (Topsoil and Seeding).

The Contractor shall assume ownership of all debris and salvaged materials, such as culverts, roadway lighting and traffic signals except as otherwise identified. All materials having salvage value shall be carefully removed to avoid damage to existing infrastructure that is to remain. The old pavement structures shall be removed to an existing joint or cut to a true vertical face at the tie-in locations to existing infrastructure. After removal, the Contractor shall store on site any existing lighting or traffic signal systems owned by the Local Authority and shall provide the Local Authority with written notice, and the Department with a copy of such notice concurrently, that any materials to be salvaged are to be removed by the Local Authority within 30 days. If the Local Authority has not removed the materials within 30 days from notice, the lighting systems and/or traffic signal systems become the property of the Contractor.

200.4.13 INTENTIONALLY DELETED

200.4.14 PROJECT SIGNAGE

The Contractor shall supply and install project signage applicable to projects delivered through federal and provincial partnership. The provincial signage shall be designed and fabricated in accordance with *Alberta Transportation's Design Bulletin #53 – Project Identification Signs for Capital Construction Projects*. The federal signage shall be in accordance with *Canada's Economic Action Plan – Road Improvement* signage. Each of the provincial and federal project signs shall be ground mounted and measure no less than 1.2 metres by 2.4 metres. The signage shall be located within the Project Limits at the following locations with the exact locations to be determined in consultation with Department:

- Yellowhead Trail & Highway 216 interchange (4 signs);
- Anthony Henday Drive & Manning Drive interchange (3 signs); and
- Highway 216 & Whitemud Drive interchange (3 signs).

All provincial and federal signage shall be maintained in good condition during the Construction Period and for a period of twelve months after Traffic Availability. The Contractor shall remove and dispose of the project signage but prior to doing so shall obtain the Department's approval.

Any additional signage within the Project Limits and not related to traffic operations shall be subject to approval by the Department.

The Contractor shall supply and install two WC-13 wildlife crossing signs 750 mm x 750 mm in size. The signs shall be located adjacent to the eastbound and westbound lanes on Anthony Henday Drive approximately 500 metres before the North Saskatchewan River structures.

300.0 DESIGN AND CONSTRUCTION - NEW INFRASTRUCTURE

300.1 INTRODUCTION

This Section covers the design and construction requirements applicable to roadways and bridge structures in the New Infrastructure.

300.2 DESIGN – GENERAL

300.2.1 GENERAL DESIGN REQUIREMENTS

The performance requirements to be met in the design of all roadways, bridge structures and other appurtenances include requirements in the areas of safety, functionality/serviceability, durability/maintainability and aesthetics. The standards to which these performance requirements are to be met are generally specified in this Schedule 18 (Technical Requirements). If a performance requirement is not specified in this Schedule 18 (Technical Requirements), the performance requirement shall be set to a standard generally being met on new roadways and bridge structures of similar type on the Provincial highway system.

Bridge structures must be designed to be structurally and operationally safe in terms of accommodation of traffic, operations and maintenance activities for the duration of the design life.

All designs shall incorporate the appropriate selection of design concepts, design details, specifications, materials and construction methods and techniques.

Unless otherwise specified, bridge substructures shall not be designed to be wider than necessary to accommodate the Stage 1 superstructure.

For bridges that are to be widened in the Ultimate Stage, piers shall be proportioned so that the spacing and proportioning of shafts in the Ultimate Stage are a reasonably close match to the spacing and proportioning of shafts in Stage 1, so that the architectural integrity of the Stage 1 design is maintained in the Ultimate Stage design. Some asymmetry of piercap cantilevers is acceptable in Stage 1, but piercap cantilevers shall be reasonably symmetrical in the Ultimate Stage. Where Stage 1 piercap cantilevers are designed to be extended in the Ultimate Stage, the Stage 1 pier and foundation shall be designed for Ultimate Stage loading, and construction details shall be included in the Stage 1 design to facilitate reinforcement of the Ultimate Stage cantilevers, either through embedded couplers or provision for future post-tensioning.

300.2.2 RESPONSIBILITY FOR DESIGN

The Contractor is responsible for the design of all elements of the New Infrastructure including, but not limited to, all geotechnical investigations, environmental considerations and permits, topographic surveys, in-stream watercourse surveys, approvals and permits, other field investigations and technical analysis required to complete the designs in a professional and competent manner.

300.2.3 DESIGN DOCUMENTATION

Detailed design documents shall cover the full range of infrastructure required in the Project. Design documentation shall include, but not be limited to:

- Design reports for all aspects of the work including but not limited to the design decision process, criteria and assumptions used for each aspect of the design, agreements, permits, authorizations and special construction requirements.
- Detailed design drawings prepared in accordance with the Department's *Engineering Drafting Guidelines for Highway and Bridge Projects*, including availability in electronic format.
- Detailed traffic signal design drawings prepared in accordance with the Traffic Signal Design and Drafting Guidelines in Package F of Appendix J.
- Comprehensive construction specifications sufficiently detailed to describe the process or end result requirements.

As a basis for this documentation, the Contractor shall further develop and finalize, as required, the design reports, plans and specifications in the Contractor's Designs, including, but not limited to:

- Design plans and profiles;
- Design cross-sections;
- Design appurtenances;
- Signing;
- Lighting;
- Roadside hazards;
- Pavement Design Report (Section 300.4.1.8.1);
- Bridge Structures Design Report (Sections 300.5.3 and 300.5.4);
- Drainage Design Report (found in the Contractor's Designs or in the Contractor's Management Systems and Plans); and
- Electronic survey data with details of the format in which it was collected.

Details of design documentation requirements for these and other design issues are further expanded in this Schedule 18 (Technical Requirements).

Complete design document packages must be available prior to starting construction of the elements designed in any specific package. Any non-conformance with the Technical Requirements shall be rectified by the Contractor, whether the work has been constructed or not.

300.2.4 AESTHETICS

The Contractor is advised that the Department supports and encourages the inclusion of cost effective features to improve the overall roadway and bridge structure aesthetics.

Aesthetics shall be considered in the layout and design of all roadway elements, and the aesthetic principles outlined in the Department's Bridge Aesthetics Study (Version 1.0, April 2005) shall be considered in the layout, shapes, details, finishes and architectural features of all bridge structures. Any proposed aesthetic features shall take into consideration routine and long-term maintenance costs and not lead to potential maintenance and rehabilitation problems in the future.

Proposed twin bridge structures shall be aesthetically similar and constructed of the same material type. Twin bridge structures are structures spanning a common opening and close enough to be located on the same bridge approach fills. Twin bridge structures shall have similar head slopes and openings.

For all retaining walls running nominally parallel to the roadway and on railway overpass and grade separation bridge structures, the bridge headslope and any strip of ground between base of retaining wall and edge of ditch shall be covered with concrete slope protection that prevents erosion and enhances the appearance of the headslopes. For river bridges, any portion of the headslope above pathways shall be covered with concrete slope protection, while any other portions (not including any portions requiring rock riprap) shall receive appropriate aesthetic treatment to prevent erosion and enhance the appearance of the headslopes.

All electrical and communications wiring for the New Infrastructure shall be underground.

300.2.5 PROVISIONS FOR FUTURE STAGES

During design of the roadway elements, the Contractor shall be cognizant of the requirement for future expansion through the addition of lanes or other elements as detailed in Section 200 (Project Specifics). Design and construction must feasibly allow for future economical expansion through addition of lanes and other elements.

During design of the bridge structures, the Contractor shall be cognizant of the potential requirement for future widening and/or lengthening of the bridge structures. When required, the initial design and construction of the bridge structures shall consider provisions that feasibly allow for future economical bridge structure widening and/or lengthening.

Vertical grade lines shall be set so that all vertical clearance requirements are met after any anticipated bridge structure widening and/or lengthening or roadway rehabilitation has occurred.

300.2.6 ROADWAY SAFETY AUDITS

Roadway safety audits shall be performed pursuant to the DBFO Agreement and the Contractor's Management Systems and Plans. Roadway safety audits shall follow the Transportation Association of Canada ("**TAC**") work scope detailed in the *Canadian Road Safety Audit Guide*, for both design and pre-opening stages. The pre-opening safety audit must be conducted after the roadway is paved and all signage and pavement markings are complete. Roadway safety audits shall be an integral part of the QMS.

The Contractor shall provide the Department as soon as practicable with a copy of the Contractor's Response Report to each of the design and pre-opening safety audits. The

Contractor shall implement, at its cost, those recommendations or suggestions in the design and pre-opening safety audits as determined by the Contractor, acting reasonably. The Contractor shall provide the Department with a written explanation as to those recommendations or suggestions in the design and pre-opening safety audits that the Contractor has decided not to implement. The Contractor shall implement or shall refrain from implementing, at its costs, those recommendations or suggestions in the design and pre-opening safety audits as directed in writing by the Department.

300.3 CONSTRUCTION - GENERAL

300.3.1 RESPONSIBILITY FOR CONSTRUCTION

The Contractor is responsible for the supply of all management, professional and technical services, supervision services, construction quality control and quality assurance services, labour, materials, and equipment for performing all of the duties and obligations necessary for delivering all of the requirements of the Project. The Contractor is responsible for obtaining and complying with requirements of all permits and other authorizations required for the construction of the New Infrastructure.

The Contractor shall ensure that construction conforms to the requirements of the design. All construction is to reflect a high degree of workmanship and all materials incorporated into the New Infrastructure shall meet long-term safety, durability and functionality requirements.

Changes to the design documents during construction shall be submitted to the Department for review purposes. Any changes to the design requirements will be subject to the Change Order requirements detailed in the DBFO Agreement.

The Contractor is responsible for reclaiming all areas of the Road Right of Way and/or drainage system that have been disturbed during construction of the Project and shall obtain any required Reclamation Certificates related to these activities within 12 months of completing the reclamation activity and shall provide a copy of same to the Department forthwith.

300.3.2 TRAFFIC MANAGEMENT

The Contractor shall maintain the safe and efficient passage of traffic on existing roadways within the Road Right of Way. All detours required to meet this requirement shall be paved.

Requirements for the accommodation of traffic during construction and operation until the end of the Term are set out in Section 200 (Project Specifics) and Sections 400.1 (Operations – General).

If the Contractor elects to truck haul materials over roads that are not designated as truck haul routes by the Local Authority, the Contractor shall be responsible for obtaining written approval from the Local Authority and the Department for use of proposed haul routes within their respective jurisdictions.

300.3.3 AS-BUILT INFORMATION

The Contractor shall compile and record information on the dimensions and physical characteristics of the New Infrastructure. The Contractor shall compile and retain the As-Built Roadway Construction Report, As-Built Surfacing Information, As-Built Pavement Structural Information, and As-Built Construction Report – Bridge Structures, As-Built Traffic Signal Information, As-Built Drawings, all as described below (the "**As-Built Construction Reports**") that include full descriptions of each phase of the work, including, but not limited to, as-built drawings, and inspection and test reports. The maximum time for completion and the providing of the As-Built Construction Reports to the Department shall be six months after Traffic Availability.

If the As-Built Construction Reports are not available to the Department within the specified time, a Payment Adjustment of $12,000/month or any partial month, for every month in excess of the specified time shall apply until available.

300.3.3.1 As-Built Roadway Construction Report

The As-Built Roadway Construction Report means an as-built report that contains sufficient detail so that an independent reviewer can gain a clear understanding of the Project. The report must be in an electronic PDF format and in hard copy. The As-Built Roadway Construction Report shall contain, but not be limited to the following:

- Project title;
- Scope of the Project, Project description and site plan;
- Project staff, subcontractors, equipment and suppliers;
- Actual Project schedule and key dates;
- Work progress, problems and solutions;
- Innovative and unique aspects of the Project;
- Safety, traffic accommodation and utility relocation;
- DBFO Agreement extensions, Change Orders, or supplemental work;
- Environmental issues;
- Photographs of key activities;
- Commentary on the materials testing results; and
- Copies of all correspondence to the Department and to the Contractor from the Department including minutes of meetings.

300.3.3.2 As-Built Surfacing Information

The Contractor shall prepare an as-built report known as the "As-Built Surfacing Information" which shall include but not be limited to the following:

Project Description - A complete description of the Project, including, but not limited to, the following:

- Highway control section number (e.g. 2:02);
- Project title;
- Project description and site plan;
- Project staff, subcontractors, equipment and suppliers;
- Surfacing schedule and key dates;
- Work progress, problems and solutions;
- Innovative and unique aspects of the surfacing;
- Safety, traffic accommodation and utility relocation;
- All concrete and asphalt mix designs;
- Change Orders;
- Environmental issues;
- Width and thickness charts;
- Photographs of key activities;
- Commentary on the materials testing results for grading and granular base course;
- Commentary and summary of asphalt pavement and hydraulic cement concrete testing results;
- Commentary and summary of test results for all asphalt cements and asphalt materials; hydraulic cement and supplemental cementing agents; aggregate (crushed and uncrushed products) and any other mixture additives; and
- Any other information recorded as part of the QMS and required to document material properties or construction details.

300.3.3.3 As-Built Pavement Structural Information

The Contractor shall prepare an as-built report known as the "As-Built Pavement Structural Information" which shall include, but not be limited to:

Width and thickness diagrams - for each homogeneous section greater than 200 m in length, containing:

- Soil classifications;
- Subgrade additives used, if any (e.g. lime);
- The applicable plans, annotated to show any deviation from the original design;
- The results of any coring or drilling undertaken on the Project;
- The finished surface width (rounded to the nearest 100 mm);
- The constructed sideslope ratios of pavement structure and subgrade as applicable; and
- The constructed pavement structure thickness (rounded to the nearest 5 mm) including:
- The thickness of each layer; and
- The type and grade of asphalt cement and/or type and classification of hydraulic Cement concrete used.

300.3.3.4 As-Built Construction Report - Bridge Structures

The Contractor shall prepare an as-built report known as the "As-Built Construction Report –

Bridge Structures" which shall contain, but not be limited to the following:

- Shop drawings for bridge material fabrication (see Section 300.3.3.6 (Bridge Shop Drawing Submission Requirements));
- Weld procedures;
- Mill reports for stressing strand;
- Stress-strain curves for stressing strand;
- Stressing calculations;
- Camber records;
- Construction Data Sheets for precast concrete girders;
- Mill certificates;
- Test reports for Charpy impact, hardness, radiography, ultrasonic, magnetic particle, and dye penetrant;
- Heat treatment records;
- Concrete and asphalt mix designs;
- Pile driving, pile drilling, foundation records;
- Location and details of remaining substructure elements from demolished structures;
- Concrete test results;
- Post-tensioning and stressing records;
- Material testing results including gradation analysis for backfill materials, clay seal, etc.;
- Any other information recorded as part of the QMS and required to document material properties or construction details; and
- All documents listed in Section 300.5.4 (Final Design Report Requirements).

300.3.3.5 As-Built Traffic Signal Information

The Contractor shall prepare an as-built report known as the "As-Built Traffic Signal Information" for all traffic signals installed. The report shall include, but not be limited to:

- Traffic signal as-built drawings;
- Traffic signal controller database (in both hardcopy format and digital format in native controller database format);
- Shop drawings of all traffic signal poles used;
- Traffic cabinet wiring drawings;
- Traffic camera programming files, if applicable; and
- Traffic camera detection field of view plots, if applicable.

300.3.3.6 Record Drawings

The Contractor shall supply record drawings (C-Drawings), known as "**Record Drawings**" to the Department for record purposes. The Record Drawings shall provide an accurate representation of the completed Project and shall be authenticated by a Professional Engineer to indicate that the construction was completed in accordance with the Design Drawings and the Technical Requirements.

The Contractor shall supply the following Record Drawings to the Department:

Roads:

- One full-size stamped and signed set of C-Drawings on 3 mil Mylar film as per *Engineering Consultant Guidelines for Highway and Bridge Projects - Volume 2 - Construction Contract Administration* and formatted in accordance with the linear referencing requirements of Alberta Transportation's Transportation Information Management System ("**TIMS**") available from the Department;
- Two sets of 11x17 stamped and signed C-Drawings (organized per roadway segment and placed in binders);
- One set of the electronic version of the stamped and signed C-Drawings in Microstation .dgn format; and
- One set of the electronic version of the stamped and signed C-Drawings in .pdf format.

Bridges:

- One full-size stamped and signed set of C-Drawings drawings on 3 mil Mylar film as per *Engineering Consultant Guidelines for Highway and Bridge Projects - Volume 2 - Construction Contract Administration*;
- Two sets of 11x17 stamped and signed drawings for each of Design Data, P-Drawings, C-Drawings, and record shop drawings, organized by bridge structure and placed in binders;
- Two sets of sign structure drawings for the Project, each submitted together with shop drawings in a single 11 x 17 binder, and sequenced from one end of the Project to the other. A single drawing showing all signs shall also be included at the front of each of these binders;
- Two cerlox bound sets of stamped and signed record shop drawings in 11 x 17 format;
- One set of the electronic version of the stamped and signed C-Drawings series drawings in Microstation .dgn format;
- One set of the electronic version of the stamped and signed P-Drawings series drawings in Microstation .dgn format;
- One set of the electronic version of the stamped and signed C-Drawings series drawings in .pdf format;
- One set of the electronic version of the stamped and signed P-Drawings series drawings in .pdf format; and
- All record shop drawings in electronic form on CD or DVD.

300.3.3.7 Bridge Shop Drawing Submission Requirements

- Submit a complete set of shop drawings for each bridge for review, including any shop drawings that are common to more than one bridge.
- Submit shop drawings for review in electronic file format, for printing in 8 ½" x 11" or 11" x 17" format. Minimum text height to be 2.5mm. Quality of shop drawings to be such that all details remain clearly legible in the submitted format size after black and white scanning at 200 dpi.
- Place the review stamp on the front of each shop drawing, legibly signed and dated, and

positioned so that it does not obscure any drawing information.

- Place a standard Shop Drawing Identification Block close to the bottom right of every shop drawing that contains all information identified in the Sample Shop Drawing Identification Block below. Position the shop drawing identification block so that it does not obscure any drawing information. For steel girder bridges that do not have a Concrete Identification Number mark the box as n/a.
- All supplier design shop drawings shall be authenticated according to Section 100.2.1 (Quality Management System).
- Resubmit all revised shop drawings.

Shop Drawing Identification

Sample Identification Block		Comments on Fields
Northeast Anthony Henday Drive		*Project Identifier must go on all shop drawings*
Contractor Structure No.	XXXX	*Supplied by the Contractor based on the Contractor bridge numbering system*
Design Dwg X-Ref	X	*Supplied by the Contractor (this is the design drawing number(s) that the shop drawing relates to)*
Drawing No.	X	*Supplied by the Contractor (must be unique for each sheet, and contain revision numbers where applicable)*
AT Bridge File No.	X	*Supplied by the Department upon request – see below*
AT Structure No.	X	*Supplied by the Department upon request – see below*
Steel Ident No.	X	*Supplied by the Department upon request (where applicable) – see below*
Concrete Ident No.	X	*Supplied by the Department upon request (where applicable) – see below*
Sheet No.		*Leave blank for the Department to fill in afterwards*

300.4 ROADWAYS

300.4.1 DESIGN REQUIREMENTS

300.4.1.1 Geometric Design

The design shall be undertaken in accordance with the latest edition of *Alberta Transportation's Highway Geometric Design Guide* and applicable *Design Bulletins,* Section 200 (Project Specifics) and where noted, associated reference manuals or guidelines. Where specific design elements are not included in the *Alberta Transportation's Highway Geometric Design Guide* and applicable *Design Bulletins*, the design shall be undertaken to conform to the *TAC Geometric*

Design Guide for Canadian Roads. All design performed for this Project shall fully comply with the Roadside Design Guide.

The design shall utilize, as a minimum, the design criteria stipulated in Section 200 (Project Specifics). Where design criteria are not specified, desirable design criteria shall be utilized, except where minimum design criteria are acceptable to the safety auditor. In no circumstance will the use of combinations of inter-related minimum design criteria be accepted.

The Contractor shall consider the ultimate design identified in the Functional Plan, or as detailed in Section 200 (Project Specifics), in all design decisions in order to facilitate any additions to the New Infrastructure during the Term or later. The design shall consider future costs, throwaway costs, user costs, safety, and identify an optimal design within such constraints. Life cycle cost considerations shall be documented in the design report to support the design decisions. The Project mainline, ramps and crossroads shall be designed for the design speeds identified in Section 200 (Project Specifics).

300.4.1.2 Intersections and Interchanges

The design of at-grade intersections shall be in accordance with *Alberta Transportation's Highway Geometric Design Guide* and any applicable *Alberta Transportation Design Bulletins* and the design requirements and design traffic volumes outlined in Packages A through E of Appendix J.

Interchanges shall be designed to the configurations established in the Functional Plan, to Section 200 (Project Specifics), or to equivalent alternative configurations accepted by the Department. The Contractor's design shall achieve the equivalent or better level of service as achieved in the Functional Plan's concept. The traffic volumes stated in the Functional Plan shall be used for the purpose of analysis using an appropriate simulation method.

300.4.1.2.1 Traffic Simulation

The Contractor will not be required to perform traffic simulations on systems interchanges. Traffic simulation using Synchro/Sim Traffic software is required for all service interchanges and the following at-grade intersections:

1. 153 Avenue & Meridian Street;
2. 121 Avenue & Broadmoor Boulevard; and
3. 115 Avenue & 17 Street NW.

The simulation shall be performed using the Packages A through E in Appendix J for the Contractor's use for developing and evaluating alternatives and for confirmation/validation of designs, as outlined in Section 200.2.3 (Design Specifics). Packages A through E of Appendix J include both Stage 1 and Ultimate Stage a.m. and p.m. peak hour Synchro/Sim Traffic model files for each service interchange and at-grade intersection.

Specific instructions are provided in Packages A through E in Appendix J for the following:

Package A (Synchro Modeling Guidelines for Interchange Ramp Intersections):

- Criteria for Failed Operations (list of Measures of Effectiveness as well as interchange performance criteria);
- Synchro Factors
    - Signal phasing requirements and application notes;
    - Minimum traffic signal timing requirements and application notes;
    - Default Synchro/SimTraffic model parameters (parameters that are fixed and not to be modified in any way by the Contractor); and
    - Allowable Synchro/SimTraffic model adjustments (parameters that can be modified by the Contractor in searching for design alternatives);
- Synchro/SimTraffic modeling approach; and
- Simulation results evaluation.

Package B (Synchro & SimTraffic Models for Interchange Ramp Intersections):

- Requirements for turn bay lengths;
- Criteria for determination of turn bay lengths at crossroad ramp intersections; and
- Examples.

Package C (Criteria for Alternative Interchange Configurations):

- Minimum requirements for Synchro/SimTraffic modeling;
- Evaluating Synchro/SimTraffic models;
- Eliminating queue failures; and
- Synchro/SimTraffic models.

If the Stage 1 or Ultimate Stage design for a service interchange proposed by the Contractor is different from the interchange configuration shown in Packages A through C in Appendix J, the Contractor shall:

- Submit Synchro/SimTraffic files which demonstrate that operation of the Contractor's Stage 1 design will meet the requirements specified in the Package under the Stage 1 a.m. and p.m. peak hour period traffic conditions;
- Submit Synchro/SimTraffic files which demonstrate that operation of the Contractor's Ultimate Stage design will meet the requirements specified in the Package under the Ultimate Stage a.m. and p.m. peak hour period traffic conditions; and
- Demonstrate that the Contractor's Stage 1 design is compatible with the Ultimate Stage design.

Specific instructions associated with at-grade intersection assessments and design changes are provided in Packages D and E in Appendix J for the following:

Package D (Synchro Modeling Guidelines for At-Grade Signalized Intersections)

- Applicable for the following at-grade intersections:
    - 153 Avenue & Meridian Street;
    - 121 Avenue & Broadmoor Boulevard; and
    - 115 Avenue & 17 Street.

- Criteria for failed operations (list of measures of effectiveness as well as intersection performance criteria)
- Synchro factors:
  - Signal phasing requirements and application notes;
  - Minimum traffic signal timing requirements and application notes;
  - Default Synchro/SimTraffic model parameters (parameters that are fixed and not to be modified in any way by the Contractor); and
  - Allowable Synchro/SimTraffic model adjustments (parameters that can be modified by the Contractor in searching for design alternatives);
- Synchro/SimTraffic modeling approach; and
- Simulation results evaluation.

Package E (Synchro & SimTraffic Models for At-Grade Signalized Intersections):

- Design Volumes for at-grade intersections;
- Minimum requirements for Synchro/SimTraffic modeling;
- Evaluating Synchro/SimTraffic models; and
- Criteria for determination of turn bay lengths at at-grade intersections.

300.4.1.3 Soils

The Contractor shall undertake the grading design with due consideration for the soil types encountered. A geotechnical investigation shall be carried out by the Contractor in sufficient detail to allow for the identification of all soils issues.

The Contractor shall prepare and provide to the Department detailed geotechnical reports for the entire Project for the purpose of documenting soil conditions and the engineering recommendations for all soils issues. The reports shall be completed in accordance with the *Canadian Foundation Manual* and the Department's *Engineering Consultant Guidelines for Highway and Bridge Projects*.

300.4.1.4 Drainage

The drainage design shall prevent damage to the Road Right of Way, the TUC and the lands adjacent the TUC, caused by flooding or drainage problems.

The Contractor shall be responsible for obtaining all necessary permits and authorizations from, but not limited to, Alberta Environment, the Department, Department of Fisheries and Oceans, and the Local Authority, as applicable.

The drainage design shall include erosion control installations necessary for the in-situ conditions of the drainage works. The Department's *Design Guidelines for Erosion and Sediment Control for Highways* may be considered for such designs.

300.4.1.5 Hazard Protection

The use of barriers shall be limited to those areas where it is necessary to protect the travelling public from roadside hazards. All grade line design shall be such as to minimize the need for barriers.

The Contractor shall utilize the appropriate barrier configuration for providing protection for roadside hazards based on safety considerations. For drainage obstructions, the Contractor shall undertake the design to minimize the need for protection. In any special circumstance where protection is required, the Contractor shall protect the public from the hazard using a barrier that has passed all required tests for *MASH*, Test Level 3, unless otherwise specified in Section 200 (Project Specifics).

The Contractor shall use barrier end treatments that have passed all required tests for *MASH*, Test Level 3.

Where barriers are required and cannot be avoided by altering design characteristics of the roadway, thrie beam rail shall be used. The rail, support posts, and ancillary hardware shall be specified to meet the performance requirements described in *MASH*, Test Level 3 and Section 200 (Project Specifics).

300.4.1.6 Roadway Lighting

The Contractor shall design the roadway lighting in accordance with the requirements of the *Alberta Transportation Highway Lighting Guide*. The design shall result in lighting to levels identified in Section 200 (Project Specifics) for the full length of all roadways. The poles and bases shall meet the requirements of the *Alberta Transportation Highway Lighting Guide.* All lighting structures shall be designed in accordance with CSA S6 or *AASHTO- Standard Specifications For Structural Supports For Highway Signs, Luminaires and, Traffic signals*, whichever governs. If AASHTO equation 3-1, Clause 3.8.1 is used to adjust wind pressures then the equation should be modified as shown in the Alberta Transportation Standard Specifications for Bridge construction section 24.2 for Sign structure –design standards.

All designed systems shall be in accordance with the *Canadian Electrical Code* and the regulations of the electrical inspection department having jurisdiction. The Contractor shall prepare shop drawings of all electrical components as part of the design. The drawings shall include poles, luminaires, distribution enclosures and bases. Shop drawings shall be stamped and signed by a Professional Engineer. Screw-in bases are not acceptable.

All poles and associated hardware shall be hot-dip galvanized in accordance with ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM A153/A153M Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware. Where two or more galvanized sections will be placed in close proximity, the finished appearance of each section shall be similar to the adjacent galvanized section(s).

300.4.1.7 Landscaping

All non-hard surfaced areas within the Road Right of Way and other disturbed areas within the TUC shall be topsoiled and seeded to grass as noted in Section 200 (Project Specifics).

300.4.1.8 Pavement Structure

The Contractor shall design the pavement structures in accordance with recognized design procedures on the basis of actual soil parameters for the roadway subgrade. Standard design procedures and terminology used by the Department are described in the Department's *Pavement Design Manual* and associated Design Bulletins. The Department does not consider the AASHTO *Mechanistic-Empirical Pavement Design Guide* ("**M-EPDG**") as a recognized design procedure, however its use for design confirmation purposes is acceptable.

The pavement structures for all roadways within the New Infrastructure shall be designed with no reduction of or restrictions to allowable legal load(s), during spring time thawing conditions or at any other time. For pavement designs such as final-stage paving and rehabilitation, the Contractor's design methodology shall utilize back-calculated layer moduli values that the Contractor shall determine based on non-destructive testing. The non-destructive data shall be no more than four years old at the time of the planned activity.

Materials for the roadway surface may be asphalt concrete pavement or hydraulic cement concrete pavement. All travelled lanes and full shoulder widths shall be paved. Shoulder and lane materials do not have to be the same, however the potential for future widening must be addressed in the design such that increased cost does not result at the time of any future widening. The subgrade widening at tie-ins to existing roadways shall be constructed to avoid disruption of drainage along the subgrade surface and protect the integrity of the existing pavement structure. Pavement structure variation for New Infrastructure shall be introduced beyond the tie-in point to preserve subgrade drainage and structural integrity of existing roads.

Pavements to be placed adjacent to curb and gutter or raised medians present problems in providing future overlays and maintaining proper curb heights and clearances. The Contractor shall design and construct pavements using materials and increased thicknesses to meet a long-life standard such that future rehabilitation will involve mill and replace activities only with no requirement for structural strengthening or overlays. The Department considers the traffic loading of a minimum 50-year design period combined with materials selected for the applicable environmental conditions as meeting a long-life standard.

The pavement structure design shall account for future widening as stipulated in the Functional Plan and Section 200 (Project Specifics). The design shall identify how the future expansion will be accomplished in a cost effective manner. The pavement design shall provide for the shoulder thickness on the side(s) proposed for future widening to provide structural capacity equivalent to the adjoining travel lane.

300.4.1.8.1 Pavement Design Report

The Contractor shall prepare and provide to the Department a pavement design report, for both new construction and subsequent preservation and rehabilitation strategies that shall include, as a minimum:

- All pertinent design inputs such as traffic, soils characteristics, characteristics of the proposed construction materials, environmental inputs to the design and for rehabilitation designs, the existing pavement structure;
- Site plan showing the limits of the roadway covered by the design report;
- Discussion of the inputs used to arrive at design recommendations and the rationale used in selecting the recommended design strategy;
- Typical cross section drawings for the recommended pavement design strategy; and
- For final-stage and rehabilitation designs, graphical presentation of calculated layer moduli, overlay needs, and existing cross sections.

300.4.1.9 Traffic Control Devices

300.4.1.9.1 Signs

Sign patterns for standard signs shall conform to the *Alberta Transportation Sign Catalogue, Design Bulletin #44 and #50*. For signing not addressed by the *Alberta Transportation Sign Catalogue*, sign patterns shall conform to the *TAC Uniform Traffic Control Devices of Canada Sign Pattern Manual*. All lettering on signs shall conform to the series Type Highway Font from the *Standard Alphabet for Highway Signs*, available from the Federal Highway Administration (CHTO-20), Washington, D.C., 20590, unless otherwise specified by the *Alberta Transportation Sign Pattern Manual* or the *TAC Uniform Traffic Control Devices of Canada Sign Pattern Manual* for the applicable signs.

300.4.1.9.2 Traffic Signals

All traffic signal installations, including pedestrian controls, shall be designed in accordance with *Alberta Transportation Standard Specifications for Highway Construction,* as amended by *Specification Amendments and Supplemental Specifications for Highway and Bridge Constructions,* and any applicable *Design Bulletins,* including *Design Bulletin #32*. Signal phasing and timing designs shall be based on the practices outlined in the current edition of the *TAC Manual of Uniform Traffic Control Devices for Canada*, and the *Institute of Transportation Engineers Canadian Capacity Guide for Signalized Intersections*. The traffic signal design shall be as per the design traffic volumes indentified in Packages A through E of Appendix J. The traffic signals shall be installed prior to the Traffic Availability, unless otherwise specified in Packages A through E of Appendix J. The Contractor shall identify as part of the Contractor's Designs any planned staging of signal installations (the "**Planned Future Signal Installations**") based on traffic volumes at other locations on the New Infrastructure. The Contractor shall verify annually the signal warrants for any unsignalized intersection within the Road Right of Way using the procedures outlined by the new TAC method in the document "*Traffic Signal Warrant Handbook*" which applies the *Canadian Traffic Signal Warrant Matrix Procedure*. The

Contractor shall submit the warrant calculations to the Department as soon as practicable after verification. If the Total Priority Points (as defined in the *TAC Traffic Signal Warrant Handbook)* has been met (minimum 100 cumulative warrant points) and if instructed to do so in writing (the "**Notice**") by the Department, the Contractor shall install traffic signals at such applicable intersection(s) within 12 weeks after the Notice (the "**Installation Deadline**").

If the Contractor fails to complete the Planned Future Signal Installations on or before the Installation Deadline, the "first occurrence of a non-functioning signal location" of the Payment Adjustments set out in Section 400.4.8.2.3 (Traffic Signals – Payment Adjustments) at an amended rate of $600/day or any partial day, until rectified shall apply as if the Planned Future Signal Installations had been completed but for 24 hours per day the deemed installed signals were not at all operational. For the purpose of applying such Payment Adjustment, the time stipulated for completing repairs as set out in Section 400.4.8.2.2 (Traffic Signal – Completing Repairs) shall be deemed to have expired on the Installation Deadline. The foregoing Payment Adjustment shall continue to accrue and be payable until such time as the Contractor completes the Planned Future Signal Installations.

The Contractor shall design the traffic signals to allow for time-based signal coordination, if needed, to provide for traffic progression and interaction of traffic signal coordination timings with the adjacent traffic signals belonging to the Local Authority. The Contractor shall cooperate with the Local Authority to meet all of the requirements of the Local Authority's signal timing design along the corridor, while still meeting the signal timing and phasing requirements of the Department. The guidance provided in Package F in Appendix J shall be followed for traffic signal design and drafting.

The Contractor is required to come up with at least eight time-of-day signal timing programs at each signal location. The timing plans shall be developed using realistic traffic volumes. The Detailed Signal Timing Preparation Requirements are provided in Package G of Appendix J. The Contractor shall prepare initial signal timings using the approach recommended in Package G, followed by post-commissioning 24-hour turning movement count data collection and subsequent signal timing adjustments. The methods and timeline when the post-commissioning traffic count data collection shall be as per the requirements outlined in Package G in Appendix J.

All signal timing plans shall be submitted to the Department as per section 5.5 of Schedule 5 (Design and Plan Certification Process and Review Procedure) to the DBFO Agreement.

All signal systems shall be similar in appearance to those used by the Local Authority on roadways of the same standard in adjacent areas.

The following project acceptance requirements are applicable for traffic signal installations. Detailed Traffic Signal Project Acceptance Requirements are provided in Package H of Appendix J of Schedule 18:

1. Tests
    1) The Contractor shall carry out various tests required by Alberta

Transportation's *Standard Specification for Highway Construction*, Specification 2.26 (Traffic Signals).

2) Traffic Signal Specifications
3) Test results shall be documented and submitted to the Department as part of the documentation requirements for traffic signal installations

2. Inspection
    1) The Contractor shall carry out inspections to traffic signal installations using the inspection forms provided in Package H of Appendix J.
    2) The completed inspection forms shall be submitted to the Department as part of the documentation requirements for traffic signal installations. Inspections needed include:
        i. Traffic signal below ground installations inspection
        ii. Traffic signal above ground installations inspection
        iii. TC cabinet bench test
        iv. Traffic signal pre-commissioning inspection
        v. Traffic signal construction completion inspection

3. Documentation
    1) The following documentation shall be submitted by the Contractor to the Department:
        i. Drawings
            a) Complete set of as-built red line markup plans (quality of markup shall be legible and to scale)
            b) Record drawings for traffic signal installations in both hardcopy and digital pdf format (stamped and signed)
            c) Clearance measurements (mark on pole elevation drawing the distance from the bottom of fixtures on the mast arm to the pavement surface)
            d) Cabinet schematic (in cabinet and in digital format)
        ii. Serial Numbers
            a) TC Cabinet
            b) PD Cabinet
            c) Controller
            d) MMU
            e) Detector
        iii. Tests and Permits
            a) Cable megger test report
            b) Electrical safety codes inspection permit
            c) Concrete test results (for pole bases) – both field slump and air test, and cylinder compressive strength tests
        iv. Equipment and Settings
            a) Controller database printout and digital file (in both raw controller database format and in pdf format)
            b) MMU programming chart
            c) MMU manufacturer's certification

d) Cabinet bench test report and record
e) Cabinet field test record and report

v. Operations and Maintenance Manuals
a) Log book (in cabinet)
b) Controller operations manual (in digital format)
c) Controller maintenance manual (in digital format)
d) Malfunction management manual (in hardcopy, place in cabinet, also in digital format)

4. Commissioning
1) Commissioning of the traffic signal shall be carried out in the presence of the representatives of the Department
2) When the signal pole and the signal heads are installed, all signal displays shall be bagged for a minimum of seven days
3) The traffic signals shall not be placed into a flash mode before commissioning. Instead, when the traffic signal is ready for full operation, the Department shall give permission to the Contractor to start up the signal. The signal display shall be unbagged at such time.
4) Commissioning or start-up of the traffic signal shall be scheduled between 9 a.m. and 3 p.m.
5) The following requirements shall be met before the start-up of the traffic signal
i. Backfilling completed along all trenched areas and around pole bases, cabinets and junction boxes
ii. All signal related traffic control signs are installed
iii. All detection devices are installed and in operation
iv. All signal timings are programmed
v. Documentation provided

5. Traffic Signal Project Acceptance
1) The traffic signal installation is considered accepted by the Department if all the above requirements are met, and
2) The traffic signal has been in operation for 28 days without any operational or equipment problems. The 28 day period is called the “burn in” period for the traffic signal.
3) The Contractor shall rectify any traffic signal equipment or operations problems reported within 28 days after the traffic signal is commissioned, and then notify the Department so the correction can be verified through a field visit.
4) The same 28 day burn in period will then apply. If no traffic signal equipment or operation problems are reported in the following 28 days, the traffic signal installation is then considered accepted by the Department.

300.4.1.9.3 Pavement Markings

The Contractor shall design, install and maintain painted or durable pavement markings with or without "cat eye reflectors" in conformance with the *Alberta Transportation Pavement Marking Guide,* as amended by *Design Bulletins #56* and *#62*, and the *Alberta Transportation Highway Geometric Design Guide.* The placement and details of chevron paint markings in gore areas shall be in accordance with the Department's Recommended Practice for Chevron Gore Pavement Markings, which can be found on the Department's website.

On roadways with design speed less than or equal to 70 km/h, urban pavement marking arrows shall be used in accordance with Figures TCS-C-401.1, TCS-C-405 and TCS-C-405.1 of the Department's *Highway Pavement Marking Guide* (March 2003). On roadways with a design speed greater than 70 km/h, rural pavement marking arrows shall be used in accordance with Figure TCS-C-401 of the Department's *Highway Pavement Marking Guide* (March 2003).

300.4.1.10 Miscellaneous

300.4.1.10.1 Fencing

Fencing shall be designed and installed along the entire length of the Lands and around any stormwater management facilities related to the New Infrastructure outside the Lands but inside the TUC, as specified in Section 200 (Project Specifics).

300.4.2 MATERIALS

The Contractor shall select the materials to be used for construction and ongoing maintenance to meet the Technical Requirements. Where materials, such as culverts and ducting, have an expected life of greater than 30 years, the selection of the appropriate materials shall be based on a minimum of a 50 year life for the material.

Except for reclaimed asphalt pavement ("**RAP**") materials, all construction materials shall be new materials specifically manufactured for their intended purposes.

300.4.2.1 Topsoil

Topsoil shall consist of a natural, friable surface soil of organic character, suitable for agricultural purposes.

300.4.2.2 Aggregates

Aggregates for hydraulic cement concrete shall be suitable for use in concrete, shall exhibit suitable long term performance characteristics and shall conform to the requirements of CSA Standard 3-A23.1. Specifically, aggregates for use in concrete pavements or appurtenances shall exhibit suitable resistance to alkali-aggregate reactivity.

Aggregates for use in asphalt concrete shall be selected to provide suitable long term performance. Asphalt-aggregate compatibility shall be evaluated as part of the asphalt mix design process and during construction using AASHTO T-283 "Resistance of Compacted Hot Mix Asphalt to Moisture-Induced Damage". Mixes with a tensile strength ratio less than 0.75

shall be considered as moisture susceptible and are to be treated with lime or an appropriate liquid anti-strip agent.

300.4.2.3 Hydraulic Cement Concrete

Hydraulic cement concrete for use in roadway elements including pavements, curbs, gutters, sidewalks, barriers or other appurtenances shall consist of a mixture of hydraulic cement, supplementary cementing materials, fine aggregate, coarse aggregate, water and admixtures where required, in proportions to meet the requirements of the design.

Hydraulic cement concrete designed for any application that will be in contact with winter maintenance materials shall consist of materials shown to provide adequate resistance to scaling and other freeze thaw damage.

The hydraulic cement used shall meet the requirements of CSA Standard 3-A5, Hydraulic Cement, for the type of cement specified. The hydraulic cement concrete shall meet all the requirements of CSA Standard A23.1. For CSA A23.1 section 17.4.2, Air Content of Hardened Concrete, the confirmation of the air-void system shall be on drilled cores obtained from the in-place concrete.

300.4.2.4 Asphalt

Asphalt binders shall meet the requirements of Alberta Infrastructure and Transportation's Specification 5.7 (Supply of Asphalt) as stated in its *Standard Specifications for Highway Construction*, Edition 13, (2007), and any relevant Specification Amendments issued by the Department as of the deadline for the submission of SR Package 2.

All grades of paving asphalts shall also be tested and graded according to the requirements of AASHTO M320 "Performance-Graded Asphalt Binder".

300.4.2.5 Fencing Materials

Fencing materials are defined in Section 200.2.15 (Fencing).

300.4.2.6 Reinforced Concrete Pipe

Reinforced concrete pipe for storm sewers or culvert applications shall conform to the material and fabrication requirements of CSA Standard A257.2. Concrete manhole risers and tops shall conform to all the material and fabrication requirements of CSA Standard A257.4.

Joints for circular concrete and culvert pipe using flexible rubber-type gaskets shall conform to all the material and fabrication requirements of CSA Standard A257.3.

300.4.2.7 Polyvinyl Chloride Pipe

Polyvinyl chloride ("**PVC**") pipe shall be made of virgin PVC plastic as defined in CSA

Standard C22.2 No. 211.1. Gaskets for PVC pipe shall conform to the requirements of CSA Standard B182.2.

300.4.2.8 Smooth Walled Steel Pipes

Smooth walled steel pipe materials are described in Section 200 (Project Specifics).

300.4.2.9 Corrugated Metal Pipe And Pipe Arches

Corrugated metal pipe and pipe arches (less than 1.5 m diameter) shall be selected to ensure a minimum design life of 50 years for the soil conditions in which they are to be installed. Any pipe 1.5 m or larger is considered a bridge structure.

Corrugated steel pipe ("**CSP**") and pipe arches including couplers and appurtenances shall be galvanized, polymer coated or aluminum coated in accordance with the latest edition of CSA Standard G401.

Corrugated aluminum pipe ("**CAP**") and pipe arches including couplers and appurtenances shall be manufactured to meet the requirements of AASHTO M196 and M197 and shall be marked with the manufacturer's name or trade mark and the date of manufacture.

During installation, any damaged coating shall be reinstated with the appropriate material in accordance with CSA Standard G401.

300.4.2.10 Curbs, Gutters, Medians, Traffic Islands, Sidewalks and Other Appurtenances

All curbs, gutters, raised medians, traffic islands, sidewalks and other appurtenances shall be constructed with hydraulic cement concrete.

300.4.2.11 Permanent Highway Signs, Posts and Bases

Sign panels shall be shipped, stored and installed in a manner to prevent damage to any sign panels. All damaged signs shall be repaired or replaced by the Contractor. The installed sign panels shall be new, clean, and not bent or twisted. The reflectorized surface shall be free of scratches, marks, blemishes, blisters, tears or other defects.

300.4.2.11.1 Reflective Sheeting

Reflective sheeting for standard regulatory, warning and side mounted guide signs shall meet or exceed the minimum requirements as specified in ASTM D4956 for Type III and Type IV High Intensity Retro-Reflective Sheeting Material and Section 200 (Project Specifics).

For installations of the following signs:

- RA-1 "Stop";

- RA-2 "Yield";
- RB-22 "Wrong Way"; and
- RB-23 "Do Not Enter",

the reflective sheeting shall meet or exceed the minimum requirements as specified in the ASTM-D4956, Performance Requirements Type IX or Type XI Unmetalized Cube Corner Microprismatic Retroreflective Element Material.

For overhead guide signs with sign illumination, the reflective sheeting shall meet or exceed the minimum requirements as specified in ASTM-D4956, Performance Requirements Type III or IV, High Intensity Retroreflective Sheeting.

Design Bulletin #50 shall apply for specific warning signs (roadway alignment, traffic control ahead, hazard, and pedestrian signs), such that reflective sheeting shall meet or exceed the minimum requirements as specified in ASTM-D4956, Performance Requirements Type IX or Type XI Unmetalized Cube Corner Microprismatic Retroreflective Element Material.

For overhead guide signs without sign illumination, the reflective sheeting shall meet or exceed the minimum requirements as specified in ASTM-D4956, Performance Requirements Type IX or Type XI Unmetalized Cube Corner Microprismatic Retroreflective Element Material.

300.4.2.11.2 Sign Posts

Sign posts on rural cross-sections, including but not limited to the mainline facility, shall meet the material and breakaway requirements set forth in Section H8.2 (Sign Post Selection) of the Roadside Design Guide. The material and breakaway requirements for sign posts on urban cross-sections may be selected to match adjacent existing urban sign post materials, provided that the material selected for all single posts is the same.

300.4.2.12 Pavement Marking Materials

The Contractor shall supply pavement marking materials that will meet the requirements of the design and the performance requirements in Section 400.4.8.3 (Pavement Markings). Re-application shall meet the same performance requirements.

Transverse lane markings at all signalized intersections shall be permanent or durable pavement markings. These shall include stop lines, crosswalk lines, pavement arrows (in the vicinity of the intersection or within 100 m of the intersection) and left turn guide lines.

300.4.2.13 Guardrail and Posts

Guardrail and post materials are described in Section 200 (Project Specifics).

300.4.2.14 Intentionally Deleted

300.4.2.15 Flexible Guide Post Traffic Delineators

Material for flexible guide post traffic delineators shall meet the requirements of *Alberta Transportation Standard Specifications for Highway Construction*, Specification 5.28, Supply Flexible Guide Post Traffic Delineators.

Traffic delineators are required on all interchange ramps and shall be spaced appropriately for the design speed and horizontal curvature of the ramps.

300.4.2.16 Intentionally Deleted

300.4.2.17 Underground Electrical Conduit and Cable Ducts

Underground electrical conduit utilities shall meet the requirements of the *Alberta Electrical and Communication Utility Code* and *CSA Standard C223 No. 7-94* "*Underground Systems*", with amendments as listed in the *Alberta Electrical and Communications Utility Code* and *CSA Standard B196.3* "*PVC Underground Telecommunication Cable Ducting and Fittings*". All underground utility work shall be coordinated with the appropriate utility and shall follow the requirements of the *Canadian Electrical Code, Part 1, C22.1.*

300.5 BRIDGE STRUCTURES

300.5.1 GENERAL

300.5.1.1 Existing Reference Documents

The standards set out in the following documents shall be followed in the design, build, and rehabilitation of the New Infrastructure, except as noted elsewhere in this Schedule 18:

- *Bridge Welding Code* (AWS D1.5) (the "**Bridge Welding Code**");
- *Canadian Highway Bridge Design Code* (CAN/CSA Standard S6) (the "**Bridge Design Code**");
- *Alberta Transportation's Engineering Drafting Guidelines for Highway and Bridge Projects* (the "**Drafting Guidelines**")*;*
- *Alberta Transportation's Design Guidelines for Bridge Size Culverts* (the "**Design Guidelines for Bridge Culverts**"); and
- *Alberta Infrastructure and Transportation's Roadside Design Guide.*

300.5.2 DESIGN CRITERIA

300.5.2.1 Design Codes

The Contractor shall complete all bridge structure design in accordance with the Bridge Design Code, which may be supplemented with other relevant codes and recognized current engineering practices and specifications with the prior written approval of the Department. Exceptions to the Bridge Design Code requirements are noted in this Section 300.5.2 (Design Criteria).

Live load bending moments and shear forces used for girder design shall not be less than those obtained by using the simplified methods of analysis specified in clauses 5.7.1 through 5.7.5 in the Bridge Design Code, unless otherwise specifically agreed to in writing and in advance by the Department. If a bridge does not satisfy the criteria that allow the simplified methods of analysis to be used, the live load bending moments and shear forces used for girder design shall not be less than those that would have been determined if the bridge had met these criteria. The equivalent number of wheel lines/girder necessary to achieve these forces shall be shown in the Detailed Design.

Notwithstanding section 1.4.2.5 of the Bridge Design Code, approval will not be given for the use of single load path structures. Exceptions to this are piers with three columns or less and straddle bents, providing the requirements of Section 300.5.2.10 (Substructure/Foundations) are met. Slab and girder bridge structures shall have a minimum of four girder lines.

300.5.2.2 Design Load

(a) Highway Bridges

The minimum highway bridge live load shall be the Bridge Design Code CL-800 plus Dynamic Load Allowance. Truck axle and wheel loads shall be proportioned from the CL-625 truck. No adjustments are required for the 9 kN/m uniformly distributed load for lane load.

In section 5.7.1.3 of the Bridge Design Code the width (B) of the bridge may be assumed to be reduced to a width that provides a value of B. < 10. The number of design lanes (n) shall be reduced as required shall be consistent with the assumed bridge width (B).

As it relates to section 3.4.4 (Serviceability limit states) of the Bridge Design Code, the anticipated degree of pedestrian use for all bridges with sidewalks shall be “occasional pedestrian use”, except for the pedestrian bridge under the North Saskatchewan River bridge for which the anticipated degree of pedestrian use shall be “frequent pedestrian use”.

(b) Pedestrian Bridges

The minimum pedestrian bridge live load shall be in accordance with sections 3.8.9 and 3.8.11 of the Bridge Design Code. For flexible structures, dynamic response and side sway that could cause discomfort to pedestrians shall be considered.

(c) Intentionally left blank

(d) Fatigue

All new bridges shall be designed to comply with the Bridge Design Code Class A Highway requirements (section 1.4.2.2). This requirement shall apply to all bridge components for considerations of structural fatigue.

(e) Vehicle Collision Force on Bridge Piers

Bridge structural supports located ≤ 10 m from the edge of the ultimate stage pavement shall be designed for a vehicle collision force. For roadways with a design speed < 80 km/hr, a 1400 kN collision load shall be applied in accordance with the Bridge Design Code clause 3.15. For roadways with a design speed ≥ 80 km/hr, the collision force shall be increased to 1800 kN, and applied in any direction in a horizontal plane located 1.2 m above ground.

(f) Straddle Bents

1. Straddle bents shall include both conventional and integral straddle bent girders, and all associated bearings, columns, footings and piles.
2. Straddle bent girders shall be designed to have zero tension in top and bottom flanges over their design life under SLS Combination 1 loading.
3. All elements of straddle bents shall be designed for ULS Combination 8 loading for a collision load applied as a point load at any location along the straddle bent girder above the underpassing roadway and right and left clear zones. The collision load shall not be less than:
   a. A static force of 1250 kN applied anywhere in a plane parallel to the underpassing roadway; or
   b. A static force of 625 kN applied anywhere in a plane normal to the underpassing roadway.
4. All elements of the straddle bent from point of contact down to and including the foundation shall be designed for the collision load. The possible effects of the collision load being applied to the web of the straddle bent shall also be considered.
5. SLS Combination 1 loading for bearing design shall include an additional static force of not less than 625 kN applied at any location along the straddle bent girder above the underpassing roadway and right and left clear zones.
6. All elements of straddle bents shall be designed with adequate post-collision capacity to carry CL-625 loading at ULS Combinations 1 and 2. Post-collision capacity shall be based on the designer's engineering assessment of potential damage modes. Local experience suggests that the following could be expected due to over-height collisions:
   a. Straddle bents pushed off their bearings;
   b. Punching failure through girder webs at point of impact;
   c. Bending failure in webs just below top flange due to transverse load applied to bottom flange;
   d. Loss of prestressing strands in area of impact; and
   e. Local loss of web or flange section near the point of impact.

300.5.2.3 Hydrotechnical

Unless otherwise noted, the provisions of the Bridge Design Code with reference to section 1.3.4 Hydraulic Definitions and 1.9 Hydraulic Design shall NOT apply to the Project.

The technical requirements set out in the following Department publications form part of the Technical Requirements:

- *Culvert Sizing Considerations;*
- *Design Bulletin #45; and*
- *Bridge Best Practice Guidelines #7 and #9.*

For proposed bridge structures over watercourses, including bridge size culverts (1.5 m diameter or larger), the Department will evaluate the proponent's hydrotechnical design using the Department's current "*Hydrotechnical Design Guidelines for Stream Crossings*" document.

Bridge structure openings on watercourses shall be sized and protected so that over the design life of the structure they do not:

- Cause an unacceptable level of flooding on neighbouring flood sensitive lands and developments;
- Cause any flooding of the highway road surface;
- Have a negative impact on local channel stability; and
- Cause erosion affecting the stability of the bridge structure or roadway fills.

300.5.2.3.1 Minimum Freeboard for Stream Crossings

Bridges shall be designed to have a minimum 1.0 m freeboard unless otherwise specifically noted.

Bridge size culverts shall be designed to have a minimum freeboard of one-sixth the culvert rise (to a maximum of 1.0 m) and a minimum invert burial depth of one-quarter the culvert rise (to a maximum of 1.0 m).

300.5.2.4 Geotechnical

Bridge structure foundations shall be designed in accordance with the Bridge Design Code. Geotechnical boreholes shall extend a minimum of 3 m below the estimated pile tip elevation.

The selection of representative or "characteristic" geotechnical parameters used to determine foundation capacity shall be based on the results of appropriate field and laboratory investigations (to be available to the Department on request) and shall represent the Contractor's Engineer's "best estimate" of the likely values of the parameters, taking into account all the factors that may have influence on the soil properties, in accordance with the Canadian Foundation Engineering Manual, 4th Edition, Chapter 8.5.

Silt material specified as "**ML**" or "**MH**" material (in accordance with the "**Modified Unified Soil Classification System**") shall neither be used in the design and construction of the bridge headslopes and approach fills, nor in the roadway embankments. The global stability of bridge headslopes and approach fills, including the effects of retaining walls, shall be designed for a minimum factor of safety of 1.5.

The design of the bridge approach fills and retaining walls, shall account for stability, long-term settlements and wall deformations. Stability analyses (to be available to the Department on request) shall be carried out to determine that head slopes and retaining walls shall have acceptable short term and long term stability in order to prevent failure or excessive deformation. Deformations of the embankment and wall (including settlement and lateral movements) shall be determined using appropriate deformation analyses, with representative soil parameters derived from site specific geotechnical investigations and local experience. The expected range of embankment and wall displacements including settlement and lateral movements shall be taken into account in the design of the bridge and shall provide for acceptable structural and aesthetics performance of the embankments and walls. Any differential settlement between the bridge structure and approach fills shall not cause a deviation of more than 0.5% from the roadway design grade. Tire derived aggregate is not permitted for use as bridge approach fills or retaining walls.

300.5.2.5 Geometrics

Unless otherwise noted, the provisions of the Bridge Design Code with reference to section 1.5 Geometry shall not apply to the Project.

Where practical, bridges shall be located on tangent horizontal alignments.

For deck drainage purposes, the Department considers a minimum grade of 1% to be desirable. However, the Department recognizes that grade line constraints for grade separation structures may require crest curves that result in portions of the bridge deck having a grade of less than 1%. Wherever possible, the tops of crest curves shall be located beyond the length of the superstructure and approach slabs. For sag curves the slope at the low end shall not be less than 0.4%.

Bridge deck widths shall as a minimum have the same width as the clear roadway on the bridge approaches, except where the roadway shoulders on Anthony Henday Drive are 3.7 m to accommodate future traffic lanes, in which case the minimum shoulder widths on bridge structures shall not be less than 2.5 m on inside shoulders and 3.0 m on outside shoulders. Shoulders on bridge decks shall be designed wider where required to meet shy distances, minimum sight lines or drainage requirements, and the inside shoulder in Stage 1 on Manning Drive C-D road shall be 2.5 m to match the Ultimate Stage requirements as shown on Drawing 18-A-5.34 in Appendix A. The bridge deck shall also have a 2% crown unless the grade line over the bridge structure is superelevated. The tops of sidewalks and medians shall slope 2% towards the roadway. The tops of abutment seats, pier caps, curbs and barriers shall have a wash slope of 3%.

Bridge decks shall not have longitudinal joints. The clear distance between nominally parallel bridges shall not be less than 3 m.

Top of bridge headslope fill widths shall be out-to-out bridge structure end width plus at least 2 m. Beyond the bridge end the width of fill shall be sufficient to meet guardrail standard requirements. Where no guardrails are required, the headslope fill width shall be transitioned at 30:1 or flatter to the approach roadway width.

Corner transitions between headslope and sideslope shall use an elliptical curve at the toe of the slope.

Bridge structure supports, including abutments, piers, retaining walls and sign structure columns, shall not be located within the clear recovery zone of the underpassing roadway and shall allow all required Stage 1 and Ultimate Stage sight distances to be met.

The vertical clearance posting for all grade separation bridge structures shall be a minimum of 5.4 m as determined below, for both Stage 1 and Ultimate Stage geometry.

The Department's process for determining the vertical clearance posting is as follows:

- Measure minimum vertical clearance between the roadway surface and lower bottom edge of the girder within roadway width including shoulders to the nearest centimetre (i.e. 5.51 m);
- Round down to the nearest decimetre (i.e. 5.5 m); then
- Subtract one decimetre for tolerance (i.e. Post vertical clearance as 5.4 m)

Vertical clearance measurements shall be made in accordance with chapter 7 – Vertical Clearance Measurements (VLC2) of the Alberta Transportation *Bridge Inspection and Maintenance System – Level 2 Inspection Manual (Version 1.1)*.

The minimum vertical clearance below structures shall be maintained through future overlays either by initially providing additional vertical clearance or by milling and filling under structures with appropriate transition paving to the overlaid portion away from the bridge.

Advance vertical clearance signs are required for all bridge structures.

300.5.2.6 Preferential Bridge Deck Icing

Bridge decks that anywhere have a resultant slope of 4% or greater due to roadway grade and cross-slope, or that are located in areas where changes in traffic speed are required, shall be designed with systems that can either prevent preferential bridge deck icing or predict its occurrence in advance so that preventative measures can be taken.

300.5.2.7 Durability

Design Life
Minimum design life of bridge structures shall be:
Bridges including bridge size culverts** ....75 years
MSE walls ....100 years
Overhead sign structures ....50 years

**Metal culvert liners may be designed with a service life of 50 years providing that they are oversized to allow for future lining. Cathodic protection is not permitted.

The level of maintenance, rehabilitation and/or repair required during the design life of the bridge structures shall be consistent with or better than that generally anticipated to be required for other bridge structures of similar age and type on the Provincial highway system.

Bridge Deck Protection
Unless specified otherwise in Section 200 (Project Specifics), the deck protection system shall consist of:

- Class HPC concrete;
- Stainless steel reinforcing bar; and
- A deck waterproofing system.

The Department's standard deck waterproofing system as shown on Standard Drawing S-1443-11 (Deck Water Proofing System With 80mm Two Course Hot Mix ACP) shall be used on all bridge decks, roof slabs and approach slabs. Bridge decks with waterproofing membranes shall have provision made along the gutter lines to allow for the controlled drainage and discharge of water that penetrates the asphaltic wearing surface at the bridge ends. No intermediate discharge locations are permitted. The asphalt mix type and grade shall conform to an Alberta Transportation Type H2 Asphalt Mix using a 150-200A asphalt cement grade.

Bridge decks shall be constructed to the full width of Stage 1 with no longitudinal construction joints in the deck. Similarly, waterproofing and ACP shall both be placed full width of Stage 1 without any longitudinal cold joints.

Protection from Bridge Deck Drainage
Bridge deck drainage shall not be allowed to discharge onto any exposed sub-structure concrete surfaces, nor to discharge within 4 m of piers and abutments or pedestrian pathways, pedestrian bridges or multi-use trails, or to be directed onto the road pavement beneath. Joints around abutments and approach slabs shall be sealed at the surface and kept sealed with proper maintenance. Any steel buried elements that may potentially be exposed to leakage of salt contaminated moisture shall be protected by an approved impervious waterproofing membrane.

Deck Joints
The number of deck joints shall be kept to a minimum and bridge superstructures shall be continuous for live load over the piers. All deck joints shall include provision to capture and manage deck drainage such that it does not come into contact with other concrete and steel surfaces of other bridge elements other than concrete slope protection and drain troughs.

Splash Zone Surfaces
Splash Zone Surfaces are surfaces subject to salt spray beyond the bridge deck/bridge abutment footprint, and are defined as follows:

- Top surfaces of all pier and abutment concrete that projects beyond the bridge deck/bridge abutment footprint, to a horizontal distance of 6 m from inside edge of barrier/curb. This includes the horizontal members of trellis structures and straddle bents.

- Vertical or near vertical faces of substructure elements, monolithic concrete protection barriers, or MSE wall panels that fall within a horizontal distance of 6 m of edge of lane of under-passing roadway. Slope protection not included.

Concrete Slope Protection
All concrete slope protection shall be done in accordance with Standard Drawing S-1409-00 (Concrete Slope Protection).

Sealer
An approved Type 1c sealer shall be applied to all concrete surfaces that are susceptible to deterioration by water and de-icing salts, as detailed in section 300.5.7.17 (Type 1c Sealer).

Pedestrian Bridge
The pedestrian bridge shall have an HPC concrete deck and curbs, stainless steel reinforcing bar, and galvanized steel railing. All exposed structural steel and steel hardware shall be galvanized. Any connection between the pedestrian bridge galvanized steel and the main bridge girders shall be electrically isolated. The deck shall have an approved Type 1c sealer applied to the walking surface and curbs.

Concrete Classes
Classes of concrete shall be as detailed in Section 300.5.7.5 (Class and Composition of Concrete). The following gives minimum concrete classes that shall be used in the specified locations on bridges.

- Class HPC concrete:
  - cast-in-place decks, curbs, barriers, sidewalks, and medians;
  - abutment and pier diaphragms;
  - deck joint blockouts;
  - tops of abutment backwalls (300mm minimum);
  - the entire trellis beam, straddle bent or piercap where any portion of the component is a Splash Zone Surface;
  - abutment roof slabs, approach slabs, and sleeper slabs;
  - precast partial depth deck panels;
  - MSE precast wall panels;
  - MSE wall coping; and
  - All concrete within a depth of 300 mm of Splash Zone Surfaces.
- Class C concrete:
  - pilecaps;
  - substructure elements and monolithic concrete protection barriers other than concrete within a depth of 300 mm of splash zone surfaces;
  - sign structure foundations (with the exception that cement shall be type HS or HSb);
  - drilled caissons above the frost line; and
  - MSE wall levelling pads.

- Class B concrete:
  - concrete slope protection; and
  - concrete drain troughs.
- Class Pile concrete:
  - pipe pile infill concrete; and
  - drilled caissons below the frost line.
- Bridge girder concrete shall conform to Section 300.5.9 (Precast Concrete Units).

Concrete for underground components that are exposed to chemicals shall also meet the requirements of CSA A23.1.

Clear Concrete Cover

The following minimum clear covers for reinforcing steel shall be specified on the Detailed Designs, unless noted otherwise in Department Standard Drawings. These are minimum requirements to be met during construction, and shall not be reduced by placement tolerances. Where not specified below, clear concrete cover shall be as specified in the Bridge Design Code:

Minimum Clear Cover to Reinforcing Steel

- concrete subject to normal exposure	50 mm
- concrete cast in contact with soil (no form)	75 mm
- bottom layer of approach slab on clean granular fill and polyethylene sheeting	40 mm
- precast prestressed concrete girders	30 mm
- cast-in-place elements not protected by a waterproofing membrane and ACP wearing surface, that will come into contact with de-icing salts, including splash zone surfaces, but excluding the near vertical traffic faces of curbs, medians and barriers	70 mm
- near vertical traffic faces of curbs, medians and barriers	100 mm
- top layer of cast-in-place decks and slabs protected with waterproofing membrane and ACP wearing surface	50 mm
- bottom layer of suspended decks and slabs	40 mm
- precast concrete straddle bent - soffit	50 mm
- precast concrete straddle bent - vertical surface	55 mm
- cast-in-place concrete straddle bent - soffit	60 mm
- cast-in-place concrete straddle bent - vertical surface	70 mm

Minimum Clear Cover to Prestressing Steel

- concrete with 28 day compressive strength greater than or equal to 65 MPa	45 mm
- concrete with 28 day compressive strength less than 65 MPa	50 mm
- precast concrete straddle bent - soffit	65 mm
- precast concrete straddle bent - vertical surface	70 mm

Minimum Clear Cover to Post Tensioning Ducts

- concrete with 28 day compressive strength greater than or equal to 65 MPa	45 mm
- concrete with 28 day compressive strength less than 65 MPa	50 mm
- precast concrete straddle bent - soffit	70 mm
- precast concrete straddle bent - vertical surface	75 mm
- cast-in-place concrete straddle bent - soffit	80 mm

- cast-in-place concrete straddle bent - vertical surface 90 mm

Reinforcing Steel Type by Location

The following gives reinforcing steel types that shall be used in the specified locations on bridges unless otherwise specified in Section 200 (Project Specifics). Unless otherwise specified, the requirement is for all reinforcement in the member:

- Stainless Steel Reinforcing Bar
  - full depth cast-in-place decks and partial depth cast-in-place decks over precast panels;
  - reinforcing bars projecting from precast concrete partial depth deck panels;
  - curbs and barriers above the deck/wingwall construction joint, including dowels projecting through the construction joint;
  - sidewalks and medians;
  - deck joint blockouts;
  - abutment roof slabs, approach slabs, sleeper slabs;
  - corbels and dowels connecting approach slabs to corbels;
  - all reinforcing bars in a trellis beam, straddle bent or piercap where any portion of the component is a Splash Zone Surface;
  - concrete within 300 mm of the tops of abutment backwalls, diaphragms and wingwalls; and
  - concrete within 300 mm of Splash Zone Surfaces, unless otherwise specified.

- Stainless Steel Reinforcing Bar, or Low Carbon/Chromium Steel Reinforcing Bar
  - stirrups projecting from precast girders into deck slabs.

- Epoxy Coated Reinforcing Bar
  - MSE wall panels.

- Carbon Steel Reinforcing Bar
  - all locations not otherwise specified; and
  - precast girders, excluding stirrups projecting from precast girders into deck slabs – grade 400W or deformed welded wire mesh.

300.5.2.8 Materials

a) Concrete:

   Materials for concrete shall be as detailed in Section 300.5.7.4 (Materials for Concrete).

b) Reinforcing Steel:

   Carbon steel reinforcing bar shall conform to CSA G30.18M “Carbon steel Bars for Concrete Reinforcement” minimum yield 400 MPa.

Epoxy coated reinforcing bar shall be carbon steel reinforcing bar coated by a manufacturer certified under the Concrete Reinforcing Steel Institute ("**CRSI**") Voluntary Certification Program for Fusion Bonded Epoxy Coating Application Plants.

Epoxy-coated reinforcing bar shall be prepared and coated according to the requirements of ASTM A775 and the Ontario Provincial Standard Specification ("**OPSS**") 1442, Material Specification for Epoxy-coated Steel Reinforcement for Concrete unless specified otherwise.

Film thickness of the coating, after curing, shall be 175 µm to 300 µm (7 to 12 mils). The epoxy coating material shall conform to the requirements of OPSS 1443, "Material Specification for Organic Coatings for Steel Reinforcement".

Deformed welded wire mesh shall conform to ASTM A615, minimum yield 480 MPa.

Stainless steel reinforcing bar shall conform to the requirements of ASTM A276 and ASTM A955/A955M including Annex 1.2 or 1.3. The minimum yield strength shall be 420 MPa. The design of the stainless reinforcing steel, including hooks, development lengths and bar splices, shall be based on a yield strength of 420 MPa.

Stainless steel reinforcing bar shall be of the following designations as defined by the Unified Number System ("**UNS**"):

- S31653
- S31603
- S31803
- S30400
- S32304

Reinforcing steel shall be produced and tested in accordance with the applicable standard(s). Material manufacturer mill test certificates showing proof of compliance shall be submitted to the Department a minimum two weeks prior to the placement of any reinforcing steel.

Mill test certificates shall be provided for each lot delivered to the site.

The following additional information, as applicable, shall be supplied for each lot of stainless steel reinforcing delivered to the site:

- Austenitic grades: Test results verifying compliance with ASTM A262, Practice E; and
- Duplex grades: Test results verifying compliance with ASTM A923, Method A, by demonstrating an unaffected etched structure.

Stainless reinforcing steel shall be descaled and then pickled to remove all mill scale

and surface oxidation. Details of the manufacturer's descaling and pickling processes shall be included with mill test certificate submissions.
Low carbon/chromium steel reinforcing bar shall conform to ASTM A1035 with a minimum yield strength of 690 MPa based on 0.2% offset. The design of the low carbon/chromium steel reinforcing bar, including hooks, development lengths and bar splices, shall be based on a yield strength of 500 MPa

c) Prestressing Steel:

Prestressing strand shall conform to the requirements of ASTM Standard A-416 for low relaxation strand (fpu = 1860 MPa).
Prestressing rods shall conform to the requirements of ASTM G297 fpu = 1030 MPa

d) Structural Steel:

1)	Girders and all materials welded to steel girders.	CSA G40.21M-Grade 350AT CAT 3 or *ASTM A709 Grade 345WT* Type B with Charpy value of 27 J @ -30˚ C
2)	Ungalvanized bearing and bracing materials bolted to girders.	CSA G40.21M-Grade 350A or ASTM A709 Grade 345 Type B
3)	Galvanized bearing materials not welded to girders and galvanized bracing materials.	CSA G40.21M-Grade 300W
4)	Miscellaneous steel including deck joints (except for finger plates)	CSA G40.21M-Grade 300W
5)	Structural bolts	22 mm diameter A325M - Type 3 weathering steel
6)	Finger plates for finger plate deck joints	CSA G40.21M-Grade 350A

e) Anchor rods:

1)	Anchor rods for bearings in contact with black steel.	Stainless steel AISI Standard Type 316 minimum yield (0.2%) = 290 MPa
2)	Anchor rods for bearings in contact with galvanized steel only.	Galvanized anchor rods CSA G40.21M Grade 300W or ASTM A307
3)	Galvanized high strength anchor rods, e.g. bridgerail post anchors	ASTM A193 GRADE B7 (Fy = 725 MPa, Fu = 860 MPa). Note galvanizing of high strength material requires special procedure, see Standard Drawing S1642.

300.5.2.9 Overhead Sign Structures and High-Level Lighting Support Structures

Overhead sign structures and high-level lighting support structures with a height greater than 16m, shall be designed in accordance with the requirements of AASHTO "*Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*" (the "**AASHTO Standard Specs**"), latest edition plus interims and the following additional criteria:

- Equation 3-1 of AASHTO Clause 3.8.1 shall be modified as follows:

  $$P_z = 2.5\ q\ K_z\ C_d$$

  where q shall be taken from *CAN/CSA S6*, Table A3.1.7 for a return period of 50 years;

- The design ice thickness for ice accretion shall be the value given in *CAN/CSA S6*, Figure A3.1.4;
- The Fatigue Importance Factors in Table 11-1 of the AASHTO Standard Specs shall be based on Fatigue Category I;
- Further to AASHTO Standard Specs section 11.7 "Fatigue Design Loads", a dynamic analysis of the structure will not be accepted in lieu of using the equivalent static pressures provided in the specification;
- Further to AASHTO Standard Specs section 11.7.1 "Galloping", the Department will not approve the use of vibration mitigation devices in lieu of designing to resist periodic galloping forces. Furthermore, the Department requires that galloping loads be considered for the fatigue design of all overhead cantilevered sign support structures regardless of their configuration;
- Further to AASHTO Standard Specs section 11.8 "Deflection", the vertical deflection for sign structures shall not exceed 200 mm regardless of their configuration;
- Anchor bolts shall be hot-dip galvanized and shall conform to the requirements of ASTM F1554 Grade 55 (Fy=380 MPa). Anchor bolts shall be the single nut type pretensioned by the turn-of-the-nut method on top of grouted base plates. Base plates shall be grouted with Sika 212 flowable grout or equivalent;
- Design sign panel area shall be taken as the largest of:
  - Initial stage sign panels;
  - Ultimate Stage sign panels (Ultimate Stage shall consider any potential changes due to safety audits, which changes and audits are the Contractor's responsibility); and
  - Area of 3.5 m x 60% of horizontal span length, placed in any position along the span to create the most critical load effects;
- Sign structures shall have a minimum permanent vertical camber of L/ 200 where L is the span of the horizontal arm of the sign structure;
- Sign structure structural framing shall be at least 600 mm above the bottom edge of sign panels;
- The tops of the concrete foundations shall project from 700 mm to 850 mm above the adjacent ground surface on the traffic side. The exposed portion of the foundation shall be of finished concrete with circular cross-section; and
- The Contractor shall prepare a general layout drawing for each individual sign structure in

accordance with Standard Drawing S-1721-07 (Sign Structure Sample General Layout).

300.5.2.10 Substructure/Foundations

Piling

All welded pile splices whose tensile or flexural capacity is critical to the structural integrity of the bridge (for example with integral bridges), shall be identified as tension splice welds on the Detailed Designs. These welds will require testing using non-destructive testing techniques.

Dynamically cast-in place piles (Compacto piles) are not permitted.

For substructure elements founded on driven steel H-Piles, HP 310 or larger piles shall be used.

Bridge Piers

Piers in stream crossings shall not be founded on spread footings, but shall be founded on driven piles or drilled caissons with a minimum penetration of 5 m into competent material.

Land piers may be founded on piles or spread footings, but spread footings shall not be used unless founded directly on competent bedrock.

The ends of pier cap cantilevers shall have cast-in stainless steel drip sheets across the full underside width of the pier cap to prevent staining of sub-structure concrete.

Piers with one column shall have a minimum cross-section of 2.8 m^2. Piers with two columns shall have a minimum cross-section area of 2.8 m^2 for each column. Piers with three columns shall have a minimum cross-section area of 2.8 m^2 for each column, or alternatively smaller columns shall be linked together with a strut extending from the top of the foundation to 1.4 m above the ground adjacent to the pier. Adjacent bridges shall not be supported on a single continuous pier cap.

Straddle bents supporting over-passing superstructures shall be of heavy post-tensioned concrete construction to reduce damage when subject to over-height vehicle collisions.

For monolithic pier diaphragms which are cast around girder ends, the girders shall be erected on a minimum 150 mm high plinth to provide sufficient clear space between the girder bottom and previously cast concrete, to ensure proper flow of concrete under the ends of the girders.

The upstream face of river piers shall be protected by a galvanized nose plate.

Bridge Abutments

Drawings SK-9 to SK-19 in Appendix B help further clarify a number of the requirements set out in the text of this Bridge Abutments part of Section 300.5.2.10.

(a) General

Bridge ends shall be supported on piles.

Bridge ends shall have cast-in-place wingwalls oriented parallel to the overpassing roadway.

- For abutments without roofslabs, these wingwalls shall be cantilevered from the abutment seat or the superstructure end diaphragm (as illustrated in the elevation views on drawings SK-9 to SK-11 in Appendix B);
- For abutments with roofslabs, these wingwalls shall be cantilevered from the gradebeam (as illustrated in the elevation view of drawing SK-12 (Standard Details for Conventional Abutment with Roof Slab in Appendix B));
- For conventional abutments, when these wingwalls are over 10m in length they shall be designed with roof slabs and gradebeams;
- For integral abutments, those wingwalls shall meet the additional requirement of Section 300.5.2.10(d) (Integral Abutments) below; and
- For abutments with roofslabs, access to the cavity below the roofslab shall be provided through the abutment backwall, with access positioned between girders and accessible through the abutment diaphragm, in compliance with the details provided on detail S "Access Door" on Drawing SK-12 in Appendix B.

EPS foam and MSE walls shall not be used behind abutments to reduce lateral pressures on abutments or abutment wingwalls, and soil reinforcement shall not be attached to abutments, backwalls, wingwalls or piles to resist lateral pressures.

Inspection access shall be provided at all abutments. The inspection walkway shall be accessible from the side without need of any equipment.

- For conventional headslopes, provide minimum 0.6 m wide bench at grade in front of abutment seats for inspection access;
    - Proportion conventional abutments with maximum abutment seat height of 1.8m above grade (as illustrated in Section S (Headslope Option) on drawings SK-11 and SK-12 in Appendix B);
    - Proportion integral and semi-integral abutments such that the maximum height from top of grade to underside of girders is 1.5 m (as illustrated in Section A (Headslope Option) on drawings SK-9 and SK-10 in Appendix B);
- For abutments behind retaining walls, provide a concrete walkway not less than 0.5 m wide in front of abutment seat suitable for inspection access. This walkway shall be a

concrete slab, monolithic with any abutment retaining wall coping, with a 3 percent wash slope towards the vertical face. Protect walkway with continuous safety railing, designed as a "guard" in accordance with Part 9 of the Alberta Building Code, having a minimum height of 1070mm and consisting of vertical posts and not less than two horizontal rails. Chain link fence is not permitted;

  - Proportion conventional abutments with maximum abutment seat height of 1.8m above the walkway (as illustrated in Section A MSE Wall Option on drawings SK-11 and SK-12 in Appendix B); and
  - Proportion integral and semi-integral abutments such that the maximum height from walkway to underside of girders is 1.5 m (as illustrated in Section A MSE Wall Option on drawings SK-9 and SK-10 in Appendix B).

Further to the above, for box girder or solid slab superstructures used in combination with integral or semi-integral abutments, abutments shall be proportioned such that the height from top of grade or top of walkway to underside of girders/slab shall be nominally 1.5 m.

Minimum abutment seat and wingwall embedments are illustrated on drawings SK-9 to SK-12 in Appendix B.

- For cast-in-place wingwalls parallel to the over-passing roadway, extend wingwalls not less than 0.6 m beyond top of fill line, and provide an embedment of not less than 0.6 m below top of grade at all locations;
- For conventional headslopes provide a minimum abutment seat embedment of 0.5 m below top of bench; and
- For abutment seats behind independent retaining walls, provide a minimum abutment seat embedment of 0.5 m below top of walkway.

Bridge plaques and bench mark tablets shall be provided at bridge abutments in accordance with Department Standard Drawings S-1477-04 (Standard Large Bridge Plaque Installation Details) and S-1617-04 (Standard Large Bridge Plaque Casting Details (Drafting Standards)).

Drainage details shall be incorporated into the design of abutments and shall include the following:

- The joints around the approach slab shall be well sealed to prevent water infiltration (Reference Department Standard Drawings S-1411-87 (Standard Concrete Joints) and S-1443-11 (Deck Water Proofing System with 80 mm Two Course Hot Mix ACP));
- A secondary system consisting of granular backfill, sheet wall drains and of sub-soil weeping drains shall be provided to collect, channel and remove the seepage;
- Except for MSE wall abutments with steel soil reinforcement, sheet wall drains shall be provided and spot-glued to the earth face of the abutment seat and wingwalls to intercept and channel seepage into a perforated weeping drain with a minimum positive drain slope of 2% that will be day-lighted on the headslope or through the sideslope;

- Clean, well graded, crushed granular backfill with a maximum aggregate size of 25 mm (Des 2, Class 25) shall be provided behind abutment seats and wingwalls complete with perforated weeping drains under the abutment seat and wingwalls;
- Concrete drain troughs and drains shall be placed in accordance with Section 300.5.2.20 (Bridge Drainage); and
- For MSE wall abutments see Section 300.5.2.22 (Mechanically Stabilized Earth (MSE) Walls) for additional details.

Headslopes and retaining walls at bridge abutments shall be designed such that approach slabs, deck joints, bearings, barriers, and integral abutment piles in casings will operate as intended by the design without imposing excessive stresses on the structure, or requiring premature replacement of any bridge superstructure or substructure components during longterm movements of abutment seats. The structural design shall include soil structure interaction analysis where appropriate. Mitigating measures such as early fill placement, temporary surcharges, wick drains, stone columns, lightweight fill, or soil reinforcement shall be carried out where necessary to limit long-term movements.

Conservative estimates of the long term vertical, longitudinal and lateral movements of headslopes and retaining walls that will follow after completion of construction shall be made. These movements shall be estimated at the elevations of deck joints, bearings and tops of piles as applicable. Joints, bearings and piles shall be designed to accommodate these long term movements over and above cyclical movements and girder shortening, in addition to an allowance for construction tolerances. The long term movements incorporated into the design shall be identified on the Detailed Design drawings.

(b) Layout of Retaining Walls at Abutments

This Section applies to the layout of independent high retaining walls at abutments adjacent to roadways and railways, and shall be read together with drawings SK-16 and SK-17 in Appendix B. In this Section bridge skew at any abutment shall be considered to be the skew angle between centreline of overpassing roadway and the edge of shoulder of the underpassing roadway, or the centreline of track of the underpassing railway adjacent to the abutment. Walls shall have one of the following layouts:

- Layout 1 (illustrated on drawing SK-16 (Wall Layout for Site Drainage for Bridge Skew Angles $\leq 45^{o}$) in Appendix B). For all bridge skews up to and including 45 degrees, retaining wall wingwalls shall be placed parallel to the underpassing roadway at all locations, other than the southeast corner of Anthony Henday Drive northbound over Hayter Road, except that the retaining wall wingwall on the approaching traffic side for the underpassing roadway shall be flared away from traffic at a flare rate of 20:1 and the end of the retaining wall wingwall shall be buried into the ground. For walls parallel to underpassing railways, the retaining wall wingwalls shall be flared away from the track at both sides of the abutments at a flare rate of 20:1; or
- Layout 2 (illustrated on drawing SK-17 (Wall Layout and Site Drainage for Bridge Skew Angles $> 45^{o}$) in Appendix B). This layout shall only be used for skews greater than 45 degrees. For this layout:

- At the acute angled corner only, the retaining wall shall be turned back parallel to the overpassing roadway, and the exterior face of the retaining wall wingwall shall be set-back behind the exterior face of the traffic barrier along the top of the wall. Notwithstanding Section 300.5.2.11 (Retaining Walls), the height of the turned-back portion may exceed 8 m, but shall not exceed 12 m as illustrated on drawing SK-18 (Turned Back Wingwall Details for Bridge Skews > 45^o) in Appendix B, and notwithstanding Section 300.5.2.10 (c) "Approach Slabs", the barrier may be integral with the approach slab over the turned back retaining wall wingwall;
- If a roof slab is required, both wingwalls shall be cast-in place concrete and cantilevered off the gradebeam;
- Conventional abutments with deck joints shall be used. Integral abutments are not permitted;
- Other than for walls adjacent to underpassing railways, at all locations other than at the acute angled corner, retaining wall wingwalls shall be placed parallel to the underpassing roadway except that the retaining wall wingwall on the approaching traffic side for the underpassing roadway shall be flared away from traffic at a flare rate of 20:1 and the end of the retaining wall wingwall shall be buried into the ground; and
- For walls adjacent to underpassing railways, at all locations other than at the acute angled corner, retaining wall wingwalls shall be placed parallel to the underpassing railway except that the retaining wall wingwall shall be flared away from the track at a flare rate of 20:1 beyond the abutment.

For both layouts, where the length of retaining wall wingwall on the approaching traffic side for the underpassing roadway extends over 20 m beyond the abutment, only the end 20 m shall be flared.

(c) Approach Slabs

Approach slabs shall be in accordance with the provisions of section 1.7.2 of the Bridge Design Code except as noted:

- Approach slabs shall have sufficient length to limit their rotation due to settlement to 0.5%, and shall have a minimum length of 6000 mm (measured parallel to centreline of roadway);
- Approach slabs shall not be constructed with integral barriers or curbs, except for the barrier over the turned-back portion of an independent high retaining wall wingwall at the abutment;
- Approach slab thickness shall be as required by the designer but shall have a minimum thickness of 300 mm;
- Approach slab reinforcement shall be as required by the designer but bottom steel shall not be less than 20M @ 150 mm placed parallel to centreline of roadway and 15M @ 150 mm placed parallel to abutment backwall, and top steel shall not be less than 15M @ 300 mm each way; and
- Approach slabs shall be connected to the bridge in a manner that provides for free hinging rotation without causing restraining moments and forces.

(d) Integral Abutments

This Section applies to integral abutments, and shall be read together with drawings SK-9, SK-10, SK-13 and SK-15 in Appendix B. Integral abutments shall include both fully integral and semi-integral abutments. Integral abutments shall not be used for bridge spans greater than specified in "Table - Maximum Thermal Spans" below. In addition to the general requirements for abutments, integral abutments shall also be designed to meet the following requirements:

(a) The effects of skew and potential for twisting of superstructure on plan shall be analyzed and accounted for, especially for skew greater than 20°;

(b) The amount of structure and earth that have to move with the abutment during thermal movement of the superstructure shall be minimized. Abutment seat heights above grade shall not be greater than 1.5 m. Turned back wingwalls shall be parallel to the roadway and shall not exceed 8 m in length measured from back of abutment seat/abutment diaphragm to end of wingwall, cantilevered off the back of the abutment;

(c) Additional deck reinforcement shall be provided for negative bending moments due to torsional restraints provided by the stiff abutments diaphragms and adjacent girders;

(d) For fully integral abutments the abutment foundation shall be a single row of H-piles oriented for weak axis bending wherever possible. For large movements exceeding the movement range of Type C1 control joints or when surrounding soils will restrict pile movement, piles shall be installed in permanent steel casings. The casings shall be filled with Styrofoam beads. Styrofoam beads shall be "Storopack" virgin polystyrene 14.4 kg/m^3 (0.9 pounds per cubic foot) filler bead nominal diameter of 5 mm, or approved equivalent. Steel casings shall be designed to last the same life as the bridge, and an appropriate sacrificial corrosion thickness or galvanizing shall be provided. The H-piles shall be embedded a minimum of two pile widths into the abutment seat;

(e) Cycle control joint types C1 and C2 shall be located at least 1.125 m beyond the ends of the wing walls by extending the length of the approach slab. Wick drains from the deck wearing surface and cycle control joints shall be daylighted or connected to positive drainage;

(f) The installation of expansion foam material behind integral abutments for the purpose of relieving earth pressures shall not be permitted;

(g) Integral approach slabs shall not be designed to move longitudinally in and out between stationary and parallel non-integral wingwalls;

(h) Two layers of polyethylene sheet shall be provided under the approach slab to minimize frictional forces due to horizontal movement. The connection between the approach slab and the superstructure shall be designed to resist these forces;

(i) The thriebeam transition shall be rigidly attached to the ends of barriers, regardless of whether they are stationary or moving;

(j) Where barriers are permitted to be constructed integral with approach slabs, the design shall be such that loss of barrier height due to settlement and overlay does not exceed 50 mm. The joint between the barrier on the approach slab and the barrier beyond the approach slab shall be kept sealed; and

(k) Provision shall be made for thermal movement between integral abutments and slope protection or inspection walkways. Gaps shall be protected against moisture ingress.

"Table - Maximum Thermal Spans" below provides maximum thermal spans for joint types C1 and C2. The difference in concrete and steel bridge lengths reflects the greater thermal mass of concrete and the greater sensitivity of steel in reacting to temperature changes.

The thermal span shall be taken as the span measured from the fixed point to centreline abutment bearings/centreline piles.

Table - Maximum Thermal Spans

Joint type	Maximum Thermal Span for Steel Girder Bridges	Maximum Thermal Span for Concrete Girder Bridges
C1	22.5 m	30 m
C2	45 m	60 m

Joint Types C1and C2 shall be designed as shown on drawing SK-13 (Cycle Control Joint Details for Integral Abutments) in Appendix B.

Joint type C1 - The pavement shall be saw-cut at the end of the approach slab for crack control.

Joint type C2 - A sleeper slab shall be provided under the end of the approach slab. The trench excavated for the installation of the sleeper slab and the granular base shall be extended across the full width of the road embankment and daylighted at the sideslope for drainage. The ends of the trench shall be integrated with the abutment drain troughs if they are present.

(l) For monolithic abutment diaphragms which are cast around girder ends, the girders shall be erected on a minimum 150 mm high plinth to provide sufficient clear space between the girder bottom and previously cast concrete, to ensure proper flow of concrete under the ends of the girders. This is illustrated in Detail Q on Drawing SK-9.

300.5.2.11 Retaining Walls

Limits on retaining wall height are given in Section 200.2.18 (Aesthetics).

Any bridge components located immediately behind retaining walls, such as abutment seats, integral cantilevering wing walls, abutment deck joints, abutment bearings and traffic barriers, shall be designed to accommodate any movements resulting from lateral wall displacements.

In locations where traffic runs adjacent to the top of, and nominally parallel to a retaining wall, a rigid bridge barrier shall be provided that meets the appropriate Performance Level requirements of the Bridge Design Code section 12. The retaining wall shall be designed to fully resist the collision loads applied to the barrier, and loads from any attachments such as signs and lamp posts.

Unless a traffic barrier, pedestrian rail or bicycle barrier is mounted directly on top of a retaining wall, a safety railing shall be mounted on the top concrete surface of all retaining walls and shall be designed as a "guard" in accordance with Part 9 of the Alberta Building Code. Safety railing shall have a minimum height of 1070 mm and shall consist of vertical posts with not less than two horizontal rails. Chain link fence is not permitted. Retaining walls shall be designed to resist the loads from all barriers;

Toe slopes in front of retaining walls that are nominally parallel to the adjacent roadway shall be covered with concrete slope protection and shall have a maximum slope as specified in Section 200.2.2 (Geometric Design) to allow for safe vehicle recovery.

Non-mechanically stabilized earth retaining walls shall be designed in accordance with the provisions of the Bridge Design Code.

Mechanically Stabilized Earth retaining walls shall also be designed in accordance with Section 300.5.2.22 (Mechanically Stabilized Earth (MSE) Walls).

Dry cast concrete block walls are not permitted.

300.5.2.12 Ducts and Conduit Systems

(1) Utility Ducts in Curbs and Barriers

The Contractor shall provide one 75 mm diameter utility duct on each side of the bridge deck for the future accommodation of utilities. For bridges that are to be widened at Ultimate Stage, a duct will not be required on the side on which widening occurs. However, if widening takes place on both sides, a duct will be required on one side, and the side will be identified by the Department upon request. The utility ducts shall be placed within the bridge curbs and/or barriers and shall be extended beyond the ends of the abutment wingwalls and terminated behind the roadway approach rails in a location where they can be accessed without damage to any road or bridge construction. The utility duct termination location shall be dimensioned on the abutment drawings. If additional utility ducts are required for the utility needs of the Project and the O&M, they may be placed within bridge curbs/barriers that will not be removed at the Ultimate Stage, provided they do not impact the strength of the barriers. Utility ducts shall not be placed within the bridge deck or attached to the bridge girders.

All utility ducts shall be continuous and free and clear of obstructions, and shown to be so by passing a spherical object of the appropriate size through the entire length.

O-ring expansion fittings shall be provided at all bridge expansion joints. At any locations where the curb/barrier may undergo rotation and/or vertical displacement, other appropriate fittings shall be used to accommodate the movements.

All utility ducts cast into curbs/barriers shall be rigid PVC DB2, meeting the requirements of CSA C22.2 No. 211.1 and in accordance with the rules of the Canadian Electrical Code, Part 1. Coupling shall be solvent bell ends (SBE). Rigid conduit shall be bent only with a standard conduit bender.

(2) Conduit Systems for Under-bridge Lighting

Any conduits required for wiring to under-bridge lighting systems shall be cast within the bridge piers and pier caps and shall not be routed through abutment ends. If, at a specific bridge structure, no piers exist or other conditions exist so that routing of conduits for electrical supply through the abutment ends is desired, a proposed alternative routing may be proposed for review by the Department.

The concealed conduit system shall comprise rigid PVC conduit having a minimum trade size of 38 mm, together with industry-standard junction boxes and fittings. The system shall provide a continuous concrete-proof and weatherproof conduit arrangement from below ground to the top surface of each pier cap.

Conduits shall be placed as follows:

(a) Conduits shall enter the bridge structure a minimum 1000 mm below finished ground elevation at the exterior of the pier as necessary and shall bend up to connect with a PVC junction box to be recessed on the exterior surface of the pier shaft 1000 mm above finished ground elevation. Minimum dimensions for this PVC junction box shall be 150 mm x 150 mm x 150 mm. The junction box may be larger if necessary for the proper connection and bonding of bridge wiring to incoming supply cables according to Canadian Electrical Code (“**CEC”**) requirements. The PVC junction box is to be set flush with the surface of the pier shaft and shall be fitted with a gasketted weatherproof cover.

(b) A riser conduit shall then extend up to a weather proof PVC access junction box secreted in the top surface of the pier cap. This box shall be sized for the number of luminaire conduits and wires to be accommodated at that point. For bridge structures where a concrete pier diaphragm precludes placement of an access junction box in the top of the pier cap, it may, subject to Department approval of detailed design, be placed unobtrusively in the face of the pier cap near its top edge. For bridge structures with integral pier cap/diaphragm, the riser conduit shall extend into the pier cap/diaphragm and up to the weather proof PVC access junction box secreted in the side surface of the pier cap/diaphragm.

(c) Additional weather proof access junction boxes may be installed in the pier cap as required by the width of the bridge and the number of luminaires to be serviced. These additional access junction boxes shall be supplied by a rigid PVC conduit not less than 25.4 mm trade size cast horizontally within the pier cap/diaphragm.

(d) Rigid conduits exiting the access junction boxes to service under-bridge luminaires shall be the minimum diameter consistent with CEC requirements for the number and sizes of wires employed and the availability of attachment support points, but not less than 12.7 mm inch trade size.

(e) Luminaire conduits shall be run in neat vertical and horizontal alignments, supported as necessary to comply with CEC requirements and to mitigate the effect of vibrations induced in the bridge by passing traffic.

(f) Luminaires shall be mounted on bridge pier caps or steel diaphragms as required. Where it is necessary to install a horizontal conduit run to access a luminaire, the conduit or any necessary conduit support tray or truss shall be fixed to the vertical face of the bridge girder haunch. No attachments shall be fixed to the girders or to the underside of the bridge deck.

(g) Luminaires conduits and/or conduit support equipment that are supported on the superstructure shall be located within interior girder bays.

(h) Luminaire conduits and/or conduit support equipment shall be attached to the bridge structure with anchors cast into the haunch concrete at appropriate locations.

(i) In the event that precast deck panels are utilized, anchors for the purpose of supporting lighting conduits shall be cast into the underside of the precast deck panels. These anchors shall be positioned at the edges of the precast deck panel so that the conduits are located within 100 mm of the edge of the girder top flange. Spacing between anchors in the precast deck panels and between anchors on adjacent precast deck panels shall not exceed the maximum conduit support distance allowed in the CEC.

(j) All wiring to under-bridge luminaires shall be RW90 of appropriate number and gauge to comply with voltage drop limitations. A continuous ground wire is required in all under-bridge lighting conduits to ensure the whole system is properly bonded. Conduits shall be sized to accommodate the noted wiring requirements.

(k) Prior to the wiring being installed, all conduits shall be proven to be free and clear of obstructions.

300.5.2.13 Intentionally Deleted

300.5.2.14 Intentionally Deleted

300.5.2.15 Deck, Curbs, Medians, Concrete Barriers, Sidewalks

(a) Cast-in-place deck slabs for beam and slab bridges shall be designed with the empirical method in accordance with clause 8.18.4 of the Bridge Design Code, and shall have a minimum slab thickness equal to the greater of the girder spacing divided by 15.0 or 225 mm. Use of this method requires composite action between the slab and girder over the entire girder length.

(b) Clause 5.7.1.6 of the Bridge Design Code covers deck slab moments due to loads on the cantilever overhang in concrete decks supported on longitudinal girders. For the Project this clause of the Bridge Design Code shall be amended as follows:

- the third paragraph of clause 5.7.1.6.1.1 shall be amended to read:

  "For the design moment intensity due to the vertical axle loads of the CL-800 Truck, the effects of individual loads shall be obtained and superimposed or, alternatively, the design moment intensity due to the CL-800 Truck may be obtained directly by multiplying the maximum cantilever moments in Table 5.10 by a factory of 1.28, for stiffened and unstiffened overhangs, as applicable (Table 5.10 includes the factor [1+DLA]).

- in clause 5.7.1.6.2, wheel load P shall be changed from 87.5 kN to 112 kN.

(c) Deck and curb reinforcement required to develop the capacity of bridgerail post anchors are site specific designs. Guidance for design of decks supporting bridgerail posts is available from AASHTO LRFD Bridge Design Specifications Appendix A13.

(d) Cast-in-place deck slabs designed to be composite with supporting precast box beams shall be a minimum of 225 mm thick and have two mats of deck reinforcement.

(e) Deck systems using precast concrete partial depth panels shall meet the requirements of Section 300.5.2.23 (Deck Systems Using Precast Concrete Partial Depth Deck Panels)

(f) Full depth precast deck construction shall not be allowed.

(g) Stay in place corrugated steel, timber or other deck soffit formwork types are not allowed.

(h) Concrete curbs and barriers shall have crack control joints at a maximum spacing of 3 m (centred between bridgerail posts where bridgerail posts are used), with the exception of the standard PL-3 barriers which have a maximum crack control joint spacing of 2.3 m. Longitudinal reinforcing in the curbs shall be discontinuous at the joints. Control joints shall extend down to the top of the concrete deck and shall be caulked prior to application of deck waterproofing membrane in accordance with Standard Drawing S-1443-11 (Deck Water Proofing System with 80 mm Two Course Hot Mix ACP). Standard curb details shall be detailed in accordance with Standard Drawing S-1680-07 (Standard Curb Details).

(i) Concrete paving lips along the edge of ACP are not permitted.

(j) The portion of the structural deck slab under sidewalks and raised concrete medians shall be protected by a waterproofing membrane and protection board. The sidewalk slab or raised concrete median shall be poured after the membrane and protection board have been applied to the structural deck slab. The top slab surface of sidewalks and medians shall have transverse tooled joints at a spacing matching adjacent curb/barrier control joints.

The sidewalk shall have a curb projecting 100 mm above the finished top of the sidewalk along the outside edge. If the roadway has a normal crown and the sidewalk is higher than the adjacent road surface, the sidewalk shall drain through slots in the traffic separation barrier onto the roadway gutter (see Standard Drawing S-1443-11 (Deck Water Proofing System with 80 mm Two Course Hot Mix ACP)). If a sidewalk is located on the high side of a superelevated roadway, the sidewalk shall drain to the outside edge and the drainage shall be carried longitudinally down the edge of the sidewalk.

(k) For sidewalks and raised concrete medians, barrier curbs may conflict with road barrier or barrier cushion end performance, and the use of mountable or semi-mountable curbs may be required. For more detailed guidance, refer to Section H4.3 and H11.3 of the Roadside Design Guide. Required median width (lip of gutter to lip of gutter) transition from roadway to bridge shall be maintained with lane markings.

(l) The following set-back requirements or protective measures shall be followed when attachments, such as signs, lamp posts, sign structure support columns, etc. are on top of or close behind bridge barriers:

Applicable roadside barrier standard	**Minimum set-back requirements**
TL 2	- Provide minimum 305 mm set-back from traffic face at top of barrier.
TL 3	- Provide minimum 610 mm set-back from traffic face at top of barrier.
TL 4	When PL-2 bridge barriers are required: - Provide PL-2 combination barrier (Standard Drawings S-1700-06 (PL-2 Combination Barrier Bridgerail Details) & S-1701-06 (PL-2 Combination Barrier End Details) with a height of 1400 mm) - Provide minimum 610 mmset-back from traffic face of top steel rail. When PL-3 barriers are required: - Provide PL-3 barrier (Standard Drawings S-1702-

Applicable roadside barrier standard	**Minimum set-back requirements**
	06 (PL-3 (TL-5) Double Tube Type Bridgerail – Bridgerail Details) to S-1705-06 (PL-3 (TL-5) Double Tube Type Bridgerail – Approach Rail Transition Details) with the overall height increased to 1370 by increasing the height of the concrete base; -Provide minimum 610 mm set-back from traffic face of top steel rail.

For piers of adjacent bridges, a 3,000 mm minimum set-back is required.

Base plates and anchors for attachments shall be grouted and sealed with a penetrating sealer. A minimum 40 mm nominal thickness grout pad shall be provided under base plates. The grout shall sit in a grout pocket recessed 20 mm into the surface of the structure. The grout pocket shall be 40 mm larger than the base plate around the perimeter.

(m) A minimum of two electrical connections are required on bridge decks to accommodate the copper sulphate electrode ("**CSE**") or half-cell testing as identified in Section 400.5.1.3.3 (Specialized Level 2 Inspections) of Schedule 18 (Technical Requirements) without damaging the deck waterproofing membrane.

The first electrical ground connection and associated hardware shall be located on the soffit of the deck overhang at the corner of the bridge identified as the CSE test origin in the Department's *Level 2 Bridge Inspection Manual* section 3.3.1. The second electrical ground connection shall be located at the opposite end and opposite soffit of the bridge. Ground connections shall be accessible by foot and without the use of specialized equipment.

300.5.2.16 Bearings

(1) Bearing types for beam and slab bridges shall be: (a) steel reinforced elastomeric bearing pads with or without stainless steel and Teflon sliding surfaces; (b) fixed steel plate rocker bearings; or (c) proprietary pot bearings.

(a) Steel reinforced elastomeric bearings with or without stainless steel and Teflon sliding surfaces shall incorporate the following standard features:

- Steel sole plates and base plates shall be provided;
- Self-rocking pintel welded under base plate shall be used to ensure uniform contact between the elastomeric bearing pad and the girder bottom flange at erection. No tolerance for construction and fabrication is required when using the self-rocking pintel;
- All bearings shall be grouted in prior to casting deck concrete;

- Bearings pads shall be designed for all rotations that take place after the bearings are grouted, plus an allowance for uncertainties of 0.005 radians at SLS;
- Notwithstanding section 11.6.6.2.2 of the Bridge Design Code elastomer shall conform to section 18 "Bearings" Division II of *AASHTO Standard Specifications for Highway Bridges 2002 Edition* and shall meet the requirements of AASHTO Grade 5 for cold temperature performance;
- Typical expansion bearing details shall be in accordance with the Standard Drawing S-1761-08 (Typical Expansion Bearing Details). For expansion bearings, an unfilled 3 mm thick Teflon sheet shall be bonded to an exposed stainless steel shim which shall be bonded to the top of the elastomeric pad. The stainless steel sliding surface shall conform to AISI Type 304, No. 8 finish and shall be welded to the bottom of the sole plate as shown on Standard Drawing S-1761-08 (Typical Expansion Bearing Details);
- Un-lubricated PTFE shall be specified; and
- Elastomeric pads shall be restrained from walking out by means of 6 mm high corner keeper bars bolted to the top of the base plate, as shown on Standard Drawing S-1761-08 (Typical Expansion Bearing).

(b) Fixed steel plate rocker bearings shall incorporate the following standard features:

- Fixed steel plate rocker bearings consist of a curved steel rocker plate and a base plate, connected with anchor bolts or pintles;
- The curved surface of the rocker plate and the top central 250 mm width of the base plate shall be machined to a surface finish of 6.4 µm and a flatness tolerance of 0.001 x bearing length;
- Base plates are installed level on galvanized steel shim stacks, and shall be grouted prior to casting deck concrete; and
- Notwithstanding clause 11.6.1.1 of the Bridge Design Code, fixed steel plate rocker bearings shall be designed for all rotations that take place after grouting, plus a fabrication and construction tolerance of 0.005 radians plus an allowance for uncertainties of 0.005 radians at ULS.

(c) Proprietary pot bearings shall incorporate the following features:

- Pot bearings shall be installed on a level base plate on galvanized steel shim stacks, and grouted in prior to casting deck concrete;
- Notwithstanding clause 11.6.1.1 of the Bridge Design Code, Pot bearings shall be designed for all rotations that take place after grouting, plus a fabrication and construction tolerance of 0.005 radians plus an allowance for uncertainties of 0.005 radians at SLS and ULS; and
- Notwithstanding clause 11.6.5.4 of the Bridge Design Code, the average stress in the Elastomer at serviceability limit states loads shall not exceed 30 MPa. The Elastomer shall conform to section 18 "Bearing", Division II of AASHTO Standard Specifications for Highway Bridges 2002 Edition and shall meet the requirements of AASHTO Grade 5 for cold temperature performance;
- Notwithstanding clause 11.6.3.6 of the Bridge Design Code, the average contact

pressure for unfilled PTFE elements, based on the recessed area of the PTFE, shall not exceed the following; and:

Limit State	Permanent Load (MPa)	All Loads (MPa)
SLS	25	35
ULS	40	55

- Notwithstanding clause 11.6.3.6 of the Bridge Design Code, the average contact pressure for all loads at the ultimate limit state for PTFE elements filled with up to 15% by mass of glass fibres and used to face mating surfaces of guides for lateral restraint shall not exceed 55 MPa.

(2) Expansion bearings shall provide an excess travel capacity in each direction of at least 25% of the theoretical thermal movement, but not less than 25 mm, beyond theoretical travel. An allowance shall be made for additional movement if required for concrete creep and shrinkage and foundation movements. The stainless steel plate shall be wider than the elastomeric pad by at least 10 mm on each side.

(3) Bearings shall be set level by using tapered sole plates, with the following two exceptions:

- When finger plate expansion joints or cover plated joints are used, the sole plate shall be tapered such that the sliding plane of the abutment expansion bearings shall be set parallel to the roadway grade for proper functioning of the joint. Effects of longitudinal forces generated by the inclined sliding bearings on the structure shall be investigated.
- Tapered sole plates are not typically required for fixed steel plate rocker bearings due to their large rotational capacity.

(4) Bearing finishing and attachments:

- Base plates shall be hot-dip galvanized or metalized;
- For steel girders, sole plates or rocker plates shall be either welded or bolted to the bottom flange. Sole plates or rocker plates shall be Grade 350AT Category 3 black steel when welded to the girder bottom flange. Sole plates or rocker plates shall be galvanized when bolted to the girder bottom flange and shall be as listed in Section 300.5.2.8(d) (Materials-Structural Steel). Bolts attaching sole plates or rocker plates to the girder bottom flange shall be galvanized;
- For precast girders, shoe plates cast into the girders and sole plates shall be hot-dip-galvanized. Sole plates shall be attached to shoe plates by field welding. All galvanizing damaged by field welding shall be metallized after welding;
- Attachment of the sole plate to the girder flange or shoe plate by welding shall be in the longitudinal direction along the edge of the girder. Transverse overhead welding shall not be permitted. Transverse ends not welded shall be sealed with Sikaflex 1a or an approved caulking material;
- Other than surfaces of bolts or bolt holes, galvanized surfaces shall be isolated from black steel surfaces by painting two coats of epoxy mastic paint;

- Galvanized surfaces in contact with concrete or cementitious grout shall have the contact surfaces protected by a barrier coating; and
- Pot bearing components, other than those in contact with the elastomer, shall be metallized or galvanized and shall be attached to galvanized plates by bolting.

(5) Preparation of load bearing plates in contact:

- Steel load bearing plates in contact shall be machined to a surface finish of 6.4 µm and a flatness tolerance of 0.001 x bearing dimension;
- Contact surfaces with elastomeric pad and grout or cast-in-place concrete do not require machining; and
- Where required, machining shall be performed prior to hot-dip galvanizing. Where the galvanizing process may cause distortion, metalizing shall be used instead.

(6) An 80 mm nominal thickness grout pad shall be provided under bearing base plates. The grout should sit in a grout pocket recessed 40 mm into the top of the substructure. The grout pocket shall be 75 mm larger than the base plate around the perimeter.

(7) Uplift bearings shall not be used.

(8) Shim plates used for shim stacks shall be hot-dip galvanized.

(9) Bridges and bearings shall be designed and detailed to allow for bearing replacement. Typical bearing replacement includes simultaneously jacking all girder lines, and supporting them in the raised position while bearings are replaced one at a time with overhead traffic being directed away from the bearing being replaced. Locations for future jacking shall be shown on the Detailed Designs and shall be based on estimated jack and distribution plate sizes. Details of the designed bearing replacement procedure shall be noted on the drawings, together with the unfactored dead load and live load jacking force that will be required for bearing replacement.

(10) Wherever practical, reinforced concrete shear keys independent of bearings shall be used to transfer lateral loads between the superstructure and substructure, in accordance with Standard Drawing S-1761-08 (Typical Expansion Bearing Details).

300.5.2.17 Girders

300.5.2.17.1 General

Attachment of utilities to bridge girders or other primary load carrying members shall not be permitted.

Vertical clearance signs shall be provided on all bridge structures at the locations of underpassing roadways and shall be mounted on the lower half of the upstream fascia girder. Shop drilled holes for steel girders or cast-in inserts for concrete girders shall be incorporated during girder fabrication.

Except for integral abutment designs, abutment diaphragms shall be steel to provide open access for inspection and maintenance of bearings and abutment deck joints.

Continuous bridges shall have the same number of girders on adjacent spans or adjacent segments to be spliced in the field, such that each individual girder line is fully continuous from end to end of the structure.

Precast concrete and steel girders that are designed as composite girders shall be designed such that the non-composite girders carry the slab dead load in an unshored condition.

300.5.2.17.2 Precast-Prestressed Concrete Girder Bridges

Precast-prestressed concrete girder bridges shall be designed to meet the following requirements:

(a) For NU girders, typical girder details shall be in accordance with the Department's Standard Drawings S-1757-08 and S1758-08 (NU Girder Bridges-Typical Details Sheet 1 and 2).

(b) Pier diaphragms shall be continuous cast-in-place concrete diaphragms and shall be either pinned, fully monolithic with the pier top or permit free expansion. Positive moment connections at piers shall be developed by either one or a combination of grouted unstressed tendons, bent-up strands or cast in hooked rebar. Minimum separation between girders ends shall be 150 mm with grouted tendons only, and 300 mm with bent strands or hooked rebar. For pier diaphragms with a pinned or expansion connection to the pier, end ends of both girders shall be supported on separate reinforced elastomeric pads. For pier diaphragms connected monolithically to the pier top, girder ends may be supported on plain elastomeric pads for construction loads only.

(c) The minimum age for girders before field cast continuity connection shall be 60 days. Girder design and detailing shall consider the effects of differential camber between girders. Girder design strength for girders with haunches shall be based on the nominal girder depth assuming a haunch height for not more than 13 mm at mid-span.

(d) Appropriate allowance for girder shortening due to prestress losses (pre-tension and post-tension) shall be included in the fabricated length of the girders.

(e) Stirrup projections from the top of the precast girder into the deck shall meet all code requirements for lap splicing with vertical stirrups, and anchorage requirements for developing full composite action. All stirrups shall have 135º hooks around longitudinal bars. When projection of stirrups is less than 40 mm above the underside of the bottom mat of deck bars, additional hat shape extension bars shall be provided to tie the slab and the deck haunch together. When precast concrete partial depth deck panels are supported on the precast girder flanges, stirrup projection above the top surface of the precast girder flanges shall be sufficient to project at least 25 mm above the top surface of the precast deck panels, in all locations. Longitudinal deck bars shall be detailed with a bar centred directly over the girder webs and the remaining bars spaced evenly between girder lines.

(f) Horizontal interface shear design for composite action shall satisfy the requirements from the Bridge Design Code or AASHTO LRFD Bridge Design Specifications, whichever is more stringent. The longitudinal distribution of shear forces shall be taken conservatively to be the same as the ULS shear envelope.

(g) For NU girders and other "I" shaped girder, the area of additional stirrups for end crack control shall be calculated in accordance with the Bridge Design Code clause 8.16.3.2. The end stirrup shall be located as close to the end of the girder as cover permits. For pretensioned girder ends without thickened end blocks, the concrete cover to the end stirrup may be reduced to 30 mm for girder end crack control. For girder ends to be encased in field cast concrete diaphragms, the end cover can be reduced to 25 mm for girder end crack control.

(h) For NU girders and other "I" shaped girders, 10M closed ties shall be provided in the bottom flange to confine the pre-tensioning strands. Within the distance h from the end of the girder, closed ties shall be provided as required for confinement, however spacing of closed ties shall not exceed 150 mm. Beyond the distance h from the end of the girder, closed ties shall be provided at a minimum spacing of 300 mm. Closed ties are normally fabricated in two pieces with full tension lap splices. The top of the ties can be left open in the midspan region whereever there is conflict with post-tensioning cables.

(i) For post-tensioning ducts in pre-cast concrete girders with 28 day concrete strength greater than or equal to 65 MPa, the inside duct diameter shall not exceed 50% of the web thickness and the inside duct area shall be $\geq$ 250% of the strand area.

(j) For conventional abutments with deck joints, abutment girder ends shall be designed as part of the abutment steel diaphragm for transfer of lateral forces.

(k) For NU Girders and other "I" shaped girders all girder ends shall have cast-in shoe plates anchored into the girders. Shoe plate design shall account for the different support conditions at the abutments and piers.

(l) For NU Girders a minimum of four bonded pretensioning strands shall be incorporated in the top flange to assist in controlling stresses during transportation and deck construction.

(m) For connecting diaphragms in exterior girders, no connection components shall be visible on the exterior surface of the girders.

(n) For girders containing pretensioning strands, Clause 8.15.4 of the Bridge Design Code states "the number of stands where the bonding does not extend to the ends of the member shall not exceed 25% of the total number of strands." This requirement shall apply to pretensioned only as well as combined pretensioned and post-tensioned girders. For combined pretensioned and post-tensioned girders, the 25% limit shall be applied to the total number of pretensioning strands only. In addition, the number of debonded strands in any horizontal row shall not exceed 40% of the strands in that row, and not more than 40% of the debonded strands, or four strands, whichever is greater, shall have the debonding terminated at any section. Debonded strands shall be symmetrically distributed about the centerline of the girder. Debonded lengths of pairs of strands that are symmetrically positioned about the centerline of the girder shall be equal. Exterior strands in each horizontal row shall be fully bonded.

The effect of debonding shall be such that all limit states are satisfied with consideration of the total developed resistance at any section being investigated.

(o) All miscellaneous steel that is attached to or embedded into girders, and has exposed faces, shall be galvanized. All intermediate steel diaphragms, including all associated plates, washers and bolts, shall be galvanized.

300.5.2.17.3 Steel Girder Bridges

Welded steel plate girder bridges shall be designed to meet the following requirements:

(a) Typical welded steel plate girder details shall be in accordance with the Department's Standard Drawings S-1759-08 and S-1760-08 (Steel Plate Girder-Typical Details Sheet 1 and 2).

(b) Vertical stiffeners and girder ends shall normally be square to the girder flanges. Abutment detailing dimensions shall account for the effects of girder end tilt.

(c) Stiffened plate girder webs shall in no case have intermediate transverse stiffeners spaced at greater than 1.5 times the girder depth.

(d) All welded steel girders, regardless of span, shall be cambered for 100% of dead load deflection and roadway gradeline profile.

(e) All bearing stiffeners shall be "fit to bear bottom" and "fit only top", and then fillet welded to both top and bottom flanges and to the web.

(f) For long bridges with large expansion movements, the use of multiple bearing stiffeners shall be considered.

(g) Location of jacking stiffeners shall be based on estimated jack sizes required for bearing replacement, plus sufficient clearance to the edge of the abutment seat or pier cap.

(h) Diaphragm connector plates and intermediate stiffeners at stress reversal locations shall be welded to both top and bottom flanges. Corner cope of plates shall normally be 80 mm vertical x 35 mm horizontal for web thicknesses of 14 to 20 mm. Intermediate stiffeners, other than at stress reversal locations, shall be welded to the compression flange only, and cut short of the tension flange with web gap meeting the requirement of clause 10.10.6.4 of the Bridge Design Code.

(i) Corners of stiffener plates projecting past the outside edge of flange plates shall be coped

45º.

(j) No intersecting welds are allowed. Where horizontal stiffeners and vertical stiffeners intersect on the same side of the web, the vertical stiffener shall be continuous. The ends of the horizontal stiffener shall be corner coped adjacent to the vertical web, 80 mm along web and 35 mm perpendicular to web, and attached to the vertical stiffener..

(k) All weld ends for stiffeners, gussets, and other attachments to girders shall terminate 10 mm from the edge or end of plates.

(l) Gusset plates for attachment of horizontal bracing shall be bolted and not welded to girders.

(m) Material properties for steel girders and attachments, bracing and bolts shall be as per Section 300.5.2.8 (d) (Materials - Structural Steel). All weathering steel shall be uncoated.

(n) The following features shall be used to prevent staining of sub-structure concrete:

- At pier locations, the exterior edge of the bottom flange of exterior steel girders shall have a 19 x 19 x 8000 mm long rubber strip centred over the pier, in accordance with Standard Drawing S-1760-08 (Steel Plate Girder Bridge Typical Details – Sheet 2).
- At abutments, exterior steel girders shall have the same rubber strip attached around the bottom flange at 2000 mm from the face of the abutment walls. Where steel girders are cast into fully integral abutments, a second rubber strip shall be applied all around the bottom flange of all girders immediately in front of the concrete abutment face.

(o) Changes in girder flange widths shall be tapered at a taper of 2.5 (longitudinal):1 (transverse).

(p) Shear stud projections from the top of girder flanges into the deck shall meet all Bridge Design Code requirements for stud development and anchorage requirements and ensure full composite action in accordance with design requirements. When the shear stud projection, measured from the underside of the head of the stud to the top of the bottom transverse deck reinforcement, is less than 25mm, additional hat shaped reinforcement shall be provided and designed as shear friction reinforcement for a horizontal shear plane at the deck/girder haunch interface. When precast concrete partial depth deck panels are supported on the girder flanges, stud projection above the top surface of the steel girder shall be sufficient to project at least 25 mm above the top surface of the precast deck panels, in all locations.

(q) Stainless steel rub plates shall be welded to the sides of steel girder flanges or bearing plates that will come into contact with the sides of concrete shear blocks.

300.5.2.17.4 Intermediate Diaphragms

(a) Typical intermediate diaphragm locations and details shall be in accordance with Standard Drawings S-1757-08 (NU Girder Bridges Typical Details – Sheet 1) to S-1760-08 (Steel Plate Girder Bridge Typical Details – Sheet 2) inclusive.

(b) Intermediate diaphragms are required in all bridge structures with girder and slab superstructures. Intermediate diaphragms in bridge structures with steel girder and slab superstructures shall have a maximum spacing of 8.0 m. Intermediate diaphragms in bridge structures with precast concrete girder and slab superstructures shall have a maximum spacing of 13.0 m.

(c) Intermediate diaphragms for steel or precast girders 1200 mm deep or shallower, shall be channel or W shape of at least 1/3 and preferably 1/2 the girder depth. For girders deeper than 1200 mm, full depth X or K bracing with top and bottom horizontals shall be provided.

(d) Intermediate diaphragms and girders shall be designed for construction loads during deck concrete placement in accordance with section 3.16 of the Bridge Design Code and other code requirements. Specifically, diaphragms, exterior steel and precast girders carrying deck overhangs shall be checked to ensure sufficient strength and stability to handle concentrated loads from deck finishing machines, work bridges, fog misting equipment, and loads from formwork, wet concrete and temporary walkways. Loads assumed for such design shall be based on realistic estimates for each bridge and shall be shown on Detailed Designs. Diaphragms provided shall become part of the permanent structure and be left in place for possible future maintenance, i.e. widening, rehabilitation, etc.

300.5.2.18 Deck Joints

(a) New structures shall be fully continuous from end to end. Deck joints shall only be permitted at abutments.

(b) The following standard deck joints shall be used unless prior written acceptance is obtained from the Department to use other deck joints: (note that joint movement perpendicular to the deck joint has been designated “normal movement”, and joint movement parallel to the joint has been designated “shear movement”.

Department Standard Drawing	**Joint Type**	**Maximum Permissible Normal Movement**	**Maximum Permissible Shear Movement[1]**
S--1810-12 to S-1812-12 (Type I Strip Seal Deck Joint - Sheets 1 to 3)	Multi-cell strip seal	115 – 60 = 55 mm	13 mm
S-1638, S-1639, S-1640 (Standard Finger Plate Deck Joint Assembly)	Finger plate joint	n/a	n/a
S-1800 to S-1802 (Cover Plated V-	Cover-plated V-seal (102 mm V-seal)	100 – 60 = 40 mm	20 mm (2)

Seal Deck Joint)(3)			
S-1800 to S-1802 (Cover Plated V-Seal Deck Joint)(3)	Cover-plated V-seal (125 mm V-seal)	125 - 60 = 65	25 mm(2)
S-1800 to S-1802 (Cover Plated V-Seal Deck Joint)3	Cover-plated V-seal (178 mm V-seal)	150 - 60 = 90 mm	30 mm(2)

1. *The design shear movement from joint installation to the maximum design gap shall not exceed:*
    a. *13 mm for multi-cell strip seals*
    b. *20 percent of the maximum allowable joint gap for V-seals.*
2. *The maximum permissible shear movement for the V-seal might not apply concurrently with the maximum normal movement. The maximum permissible shear movement for any specific joint shall be the lesser of:*
    a. *the movement given in the above table; and*
    b. *the maximum movement, authorized by the V-seal supplier, that can be used concurrently with the design maximum normal gap.*
3. *Not to be used for roadway design speed > 80 km/h. Cover plate details to be used for curbs, barriers, sidewalks and median slabs regardless of design speed.*

Only approved strip seals listed on the Department's deck joint Standard Drawings shall be used. Multi-cell strip seal deck joints are the Department's preferred deck joint system where their use is not limited by the movement capacity of the seal perpendicular and parallel to the joint.

(c) Deck joints shall incorporate stop movement bars to maintain a minimum joint gap of 60 mm to facilitate seal replacement. Designers should note that this is often larger than the minimum gap indicated on manufacturer's brochures, which provide gap widths suitable for first installation only.

(d) For multi-cell strip seal type deck joints with skew angles within the range of 20º to 45º, snow plow guard plates shall be installed in accordance with Standard Drawing S-1810-12 to S-1812-12 (Type I Strip Seal Deck Joint - Sheets 1 to 3) to prevent snow plow blades from catching the edge of the joint extrusion. Welded snow plow guard plates shall not be located directly under wheel paths.

(e) Finger plates shall be fixed to the deck side to allow jacking and raising of the superstructure.

(f) Modular seal deck joint systems are not permitted.

(g) The free ends of any cover plates at deck joints shall be pointed towards the bridge abutments to allow jacking and raising of the superstructure.

(h) Deck joints on steel girder superstructures shall be erected by bolting to the girders. The bolted connections shall utilize slotted holes to provide for adjustment in the vertical, lateral and longitudinal directions. Deck joints on concrete girder superstructures or abutments shall be erected on adjustable supports by projecting dowels with threaded couplers for elevation adjustment.

(i) Deck joints shall run continuously across the full width of the deck. Exterior bridge barriers and curbs shall have full cover plates on the inside face and across the top. Interior traffic separation barriers shall have full cover plates on both sides and across the top. Raised concrete medians shall have deck joints follow the top surface or run across the median at the deck level complete with cover plates across the median. Deck joints across the width of sidewalks or pathways shall have non-slip cover plates.

(j) Only neoprene V-seal and multi-cell strip seals shall be permitted.

300.5.2.19 Bridgerails

(a) The Contractor shall use Department standard bridgerails, barriers, and approach end transitions, as listed in the following table.

Standard Drawing	Title	Application/ Transition Type
S-1642-00	PL-2 (TL-4) Double Tube Type Bridgerail – Bridgerail Details (Sheet 1 of 2)	Preferred bridgerail for most applications.
S-1643-00	PL-2 (TL-4) Double Tube Type Bridgerail – Approach Rail Transition Details (Sheet 2 of 2)	14 m long Thrie Beam Approach Rail Transition PL-2 (TL-4) and Strong Post Approach Rail (TL-3).
S-1650-00	PL-2 (TL-4) Single Slope Concrete Bridge Barrier – Barrier Details (Sheet 1 of 2)	Bridgerail for use in urban areas where aesthetics is important.
S-1651-00	PL-2 (TL-4) Single Slope Concrete Bridge Barrier – Approach Rail Transition Details (Sheet 2 of 2)	14 m long Thrie Beam Approach Rail Transition PL-2 (TL-4) and Strong Post Approach Rail (TL-3).
S-1681-07	PL-3 (TL-4) Bridgerail to Modified Thrie Beam Transition Details	8.2 m long Modified Thrie Beam Approach Rail Transition PL-2 (TL-4).
S-1700-06	PL-2 (TL-4) Combination Barrier – Bridgerail Details (Sheet 1 of 6)	Bridgerail for use on urban bridges with 4.2 m widened outside lane for cyclists.
S-1701-06	PL-2 (TL-4) Combination Barrier – Barrier End Details (Sheet 2 of 6)	Connects to single slope concrete road barrier.
S-1702-06	PL-3 (TL-5) Double Tube Type Bridgerail – Bridgerail Details (Sheet 3 of 6)	Bridgerail for use when high AADT with heavy truck volumes and/or high structure requires a PL-3 (TL-5) bridgerail.
S-1703-06	PL-3 (TL-5) Double Tube Type Bridgerail – Barrier End Details (Sheet 4 of 6)	N/A
S-1704-06	PL-3 (TL-5) Double Tube Type Bridgerail – Concrete Barrier Details (Sheet 5 of 6)	N/A
S-1705-06	PL-3 (TL-5) Double Tube Type Bridgerail – Approach Rail Transition Details (Sheet 6 of 6)	14 m long Thrie-Beam Approach Rail Transition PL-2 (TL-4) and Strong Post Approach Rail (TL-3).
S-1798-08	PL-2 (TL-4) Single Slope Concrete and Double Tube Type Barriers along Top of MSE Wall	Traffic barrier for traffic running adjacent to top of MSE retaining walls and end treatment beyond MSE wall.

When a vehicular bridge includes a sidewalk, a traffic separation barrier shall be provided between the sidewalk and the roadway, designed in accordance with the Bridge Design Code clause 12.4.3.3. The traffic separation barrier is typically a standard single slope concrete barrier without a top ledge on the sidewalk side, as shown on the sidewalk detail of Standard Drawing S-1650-00 (PL-2 Single Slope Concrete Bridge Barrier – Barrier Details).

(b) Pedestrian/Cyclist railing:

The pedestrian/cyclist handrail shall be 1300 mm high, mounted on a concrete curb projecting 100 mm above the sidewalk for a total handrail height of 1400 mm. Details of the handrail shall be based on Standard Drawing S-1401 (1150 mm Vertical Bar Type Handrail) or S-1426 (1150 mm Staggered Vertical Bar Type Handrail) as appropriate.

(c) Bridgerail Layout:

- Bridgerail expansion joints shall be provided at all deck joint locations. For long bridges, additional expansion joints shall be provided at a maximum spacing of 45 m.
- Department Bridgerail Standard Drawings show a standard bridgerail expansion joint with a gap of 100 mm, and a large expansion joint with a gap of 200 mm. The selection of the bridgerail expansion joint gap shall ensure that the bridge deck expansion gap closes before the bridgerail expansion gap.
- Steel bridge railing for bridges with curve radii of 600 m or less shall be fabricated curved.

(d) Exterior bridge barriers adjacent to 4.2 m wide traffic lanes shall be combination traffic/ cyclist railings with a minimum height of 1400 mm.

300.5.2.20 Bridge Drainage

(a) Concrete drain trough collectors shall be located at low corners of bridges to channel water off of the bridge and into drain troughs lined with granular filled "Geoweb" ditch or equivalent accepted by the Department. Drain troughs may be eliminated if the roadway drainage at the bridge barrier transitions is being controlled by curbs/concrete barriers and catch basins. Typical drain trough details are shown on drawings SK-14 and SK-15 in Appendix B. The drain troughs shall drain directly down the slope (not across the slope), and shall extend to the bottom of the roadway approach fills. The drain troughs shall be designed to function as intended while accommodating differential settlements and other movements between the bridge and the roadway approach fills.

(b) Additional drains required to accommodate deck drainage or drainage through deck joints shall be hidden from view where practical. Drains, including mounting brackets that cannot be hidden from view shall receive a finish that is acceptable to the Department and that causes them to blend into the surrounding structure.

(c) Deck drainage adjacent to barriers, curbs or medians shall not encroach into the adjacent traffic lane. Bridge runoff shall be evaluated using the Rational Method with runoff coefficient = 0.9, and rainfall intensity = 150 mm/hr. Flow width shall be calculated using the Manning equation with a roughness coefficient = 0.016. Discharge through deck drains shall be assessed based on the FHWA document "Design of Bridge Deck Drainage. Hydraulic Engineering Circular 21." (1993).

300.5.2.21 Engineering Drafting Requirements

(a) General

Drafting standards and standard details shall be in accordance with section 2 – Guidelines for Bridge Projects of the "Engineering Drafting guidelines for Highway and Bridge Projects", *Design Bulletin #34 Grid-to-Ground Survey Application,* and the following supplementary guidelines. Note that whenever reference is made to the *Engineering Drafting Guidelines for Highway and Bridge Projects* throughout the Technical Requirements, it shall be deemed to include these supplementary requirements.

1. Do not use screened-back lines or screened-back patterns. Greyscales are not acceptable.
2. Do not use the utility symbols provided in section 2 of the *Engineering Drafting Guidelines for Highway and Bridge Projects.* Instead use the utility symbols provided in section 3 for both road and bridge drawings.
3. Provide bench mark locations on drawings in coordinates and not as stations and offsets.
4. All lettering is to be done in capitals except metric SI unit symbols which are to follow SI practice (e.g. mm, m, km, kN, MPa). Minimum text size shall be 3 mm on a 22 x 34 plot.
5. When associated with a number, symbols shall always be used (e.g. 16 m, not 16 metre). However, in text the unit shall be spelled out in full.
6. When a decimal fraction is used, place a leading zero in front of the decimal point.
7. Do not abbreviate unless required to save space. Do not abbreviate in notes.
8. When abbreviating, use only the standard abbreviations provided, and use without periods.
9. Place annotations as close as possible to the relevant item to eliminate or reduce the length of leaders.
10. Where possible annotations shall be in full and positioned to be readable from the bottom of the plan.
11. Use standard Department symbols when available.
12. River and stream names shall follow the shape of the feature.
13. Use a space between numbers and units (e.g. 100 mm).
14. Cross references to other drawings in notes shall refer to the other drawing number (e.g. for details see dwg 12756).
15. Electronic CAD files shall be submitted in Microstation V8 format, and shall be submitted as "flat" files without entire models attached to each sheet or referenced details.
16. All Microstation files shall be configured so that when plotted on the Department's plotters the plots replicate the signed Mylar originals. The Department will supply the pen tables and font libraries for their HP6100 series plotters on request.

17. Drawings submitted on Mylar shall be wet plotted on 3 mil double matte finish Mylar film. Electrostatic plots are not acceptable.
18. Professional stamps shall be signed in permanent black ink. Smeared signatures will not be accepted.
19. All dimensions shall be ground dimensions. Stations may be given in either grid or ground coordinates. Chosen system to be specified in the general notes and used uniformly across all drawings sets.
20. Skew angles to be given to the nearest minute.
21. All drawing sets shall have consistent presentation, and shall be modelled on Department practice. Design teams shall be coordinated so that all like drawings are presented in a uniform manner.
22. Design drawings shall illustrate what is to be constructed, and shall not show multiple options.
23. The general principle to be used is that General Arrangement drawings show everything that will exist at the end of construction. Because of this, future girder and substructure layouts are not to be shown on the General Layout drawing. Instead this information must be included on one of the information sheets.

(b) Design Data Drawings (DD Drawings)

DD drawings are planning drawings, and shall show both Stage 1 and Ultimate Stage functional requirements. They do not contain any information on any specific bridge structure apart from the assumed dimensions used to demonstrate that vertical and horizontal clearance requirements can be met. They form their own set of drawings, and will be used after construction by the Department when future planning issues are under consideration. Sample DD drawings can be obtained from the Department on request.

Site specific DD drawings shall be submitted for review prior to submission of the site specific Design Drawings. Where applicable, the hydrotechnical report shall be submitted at the same time. DD drawings are not required for bridge size culverts less than 4.5 m in diameter or for sign structures.

DD drawings shall, at a minimum, include the following items. Note that in the following requirements for DD drawings the term “stream” is used also to designate a road or railway track in the case of a grade separation or railway crossing.

DETAILED SITE PLAN

Detailed Site Plan

- Location and alignment of the proposed bridge crossing relative to the “stream”, together with direction of flow and “stream” name, with stationing on both the road alignment and the “stream”. For a divided road, the direction of flow would correspond to the direction of travel, e.g. EB or NB. A north arrow.

- Centrelines and edges of existing roads as well as lane and shoulder markings where applicable.
- Any benchmarks within the immediate area.
- Existing bridge data (where applicable) giving type of structure/substructure, clear roadway, year of construction and foundation details where these might be in conflict with new construction.
- All utilities and appurtenances, existing and required right-of-way and any existing development, including fences, buildings, access roads, drainage culverts, etc.
- Location of all test holes.
- A detour alignment that meets minimum standards.
- All existing and proposed river training and/or bank protection works where applicable.

Elevation

- Existing bridge, including abutments, piers and foundations.
- Bridge headslopes (existing and proposed).
- Gradeline with stations, elevations and grades at intersection of tops of fills with gradeline.
- Assumed depth of structure and minimum deck elevation.
- Geotechnical information including test holes.
- For grade separations - lane arrangements, vertical clearances and clear zone distances.
- For railway crossings - track locations and clearance box requirements.
- For water crossings:
  - Design bed width and elevation;
  - Existing and proposed bank protection works;
  - Design hydraulic conditions including, design high water elevation, high water elevation at time of survey with date of measurement, minimum freeboard, design ice conditions, and anticipated scour.

Bridge Cross-Sections

- Cross-sections showing the minimum proposed clear deck width, lane configurations and crown or superelevation, and approach fills at bridge ends.

Site Map

- Generally 1:250,000 scale, showing bridge location with bridge site circled and identified with file number, with north arrow in the top half of the map.

Drawing Index

- On bottom right of front sheet with the names and numbers of all the sheets in the set, including any standard drawings being used for the Project, and including reference drawings where applicable.

General Notes

- Survey Information:
  - Name of surveyor, date of survey.
  - List of geodetic bench marks (ASCM), with location and elevation.

  - Bench marks set up for specific site. e.g. "BENCH MARK 1, 25 mm x 52 mm WOODEN STAKE, STA 3+650, 15.3 m RT CENTRELINE, EL 931.5, N - 5570551.486, E -30000.0".

- Hydrotechnical Summary (for water crossing):
  - Drainage area;
  - Design discharge and return frequency;
  - Historical high flood;
  - Mean low velocity for design discharge through the proposed bridge opening;
  - Flowing ice condition with situation & elevation;
  - Streambed slope;
  - Anticipated backwater due to proposed bridge.

- General Notes:
  - Dimensions in metres unless noted otherwise.
  - Highway geometric design standard that is being used for the bridge and underlying roadway where applicable.
  - Reference to any applicable approach fill drawing.
  - Type, specification and quantities of any bridge and/or bank protection material including concrete slope protection or Filter Fabric and Heavy Rock Riprap.

MOSAIC PROFILE SHEET

Site Mosaic (Typically 1:5000)
- Proposed bridge and extent of fills.
- Location of stream and direction of flow, with river training works and/or bank protection works.
- Existing roadway system including horizontal alignment curve data, showing tie-in to proposed bridge.
- Legal land lines, right of way lines and land ownership.
- Aerial photo number and date of photography.

Highway Profiles (Typically 1:5000H, 1:100V or 1:200V)
- Proposed headslopes
- Sodlines for approximately 250 m either side of the bridge (usually 20.0 m left and right of proposed centreline).
- Existing and proposed gradelines, with stations and elevations for tops of fills, BVC, EVC and PIs and associated K values.
- For roadway crossings, roadway elevations or roadway profile of underlying roadway for approx 750 m each side of the crossing.
- For railway crossings, top of track elevations or track profile of underlying track for approx 750 m each side of the crossing.
- For water crossings, minimum bottom flange elevation, design high water & design high ice elevations, high water elevation with date, if available, water level elevation at time of survey with date.

Streambed and Water/Ice Profiles (for water crossing)

- Streambed profile along the thalweg for a distance of 700 m upstream and 700 m downstream of the proposed crossing, with any beaver dams and irregularities in the streambed identified.
- Top of water/ice elevations at 50 m intervals over the length of the surveyed streambed.

(c) P Drawings

Site specific design drawings are designated as P drawings or as P series drawings. The P drawings reflect the drawing status at the end of the review period. The designation "P" is used, together with Department supplied drawing numbers, in the Department's bridge drawing record system for all bridge design drawings relating to site specific projects (e.g. 16523-P).

(d) C Drawings

Record Drawings are designated as C drawings or as C series. The "P" designation of the site specific design drawings is changed to a "C" designation for the as -built drawing set (e.g. 16523-C), and therefore have the same format as the design drawings. The Record Drawings shall show all relevant as-built details of the New Infrastructure including, but not limited to, bridge structures, horizontal alignment, vertical alignment, cross-section elements, intersection layouts, interchanges, etc. Details of signing and pavement markings shall be described through reference to standard plans where possible. A detailed description and location of all underground utilities and conduits, showing horizontal locations, elevations, size and type of utility, etc., shall be shown on Record Drawings. All revisions shall be flagged with a single revision symbol.

For bridges, the Record Drawings shall be an accurate representation of the as-built condition, both dimensionally and visually. All elevations shall be updated to represent the as-built condition. Pile tip elevations shall be updated with average installed pile depths, and drawings shall be revised to show the average installed pile depths to scale. Surveyed benchmark tablet elevations shall be recorded on the drawings. Locations of electrical ground connections for CSE testing, installed in accordance with Section 300.5.2.15(l), shall be recorded on the drawings.

For sign structures, the General Layout drawings shall be updated to match the actual sign structures as fabricated.

(e) The preferred drawing order for bridge type structures is as follows:

- General Layout.
- Information Sheet/Sheets.
- Abutments.
- Pier/Piers.
- Bearings.

- Girders.
- Deck.
- Deck Joints.
- Other (If required).
- Standard Drawings.

Concrete strength, concrete cover and grade of reinforcing steel shall be noted on the leading drawing sheet for each bridge component.

(f) Other types of structures (culverts, etc.) should follow the same basic order with drawings added and/or deleted as necessary.

(g) Clear zone requirements, calculated critical vertical clearances with their critical locations for current construction as well as the Ultimate Stage construction shall be shown on the General Layout for all grade separation structures. Design high water elevation, high ice elevation, low water elevation (with date of survey), design general and local scour elevations shall be shown on the General Layout of all river structures.

(h) Design drawings shall show above grade geometry of all MSE walls, earth slopes in front of and behind the wall, wall loading, site drainage including drainage details for roadway run-off, location and type of fences and traffic barriers where applicable, interface details between the bridge structure and the MSE wall where applicable, (e.g. piles, abutment seat, wingwalls, backwalls, diaphragms, and approach slabs), the location and size of any obstructions within the mechanically stabilized earth mass, and the location of all utilities that may affect the design of the MSE wall. The MSE wall drawing in the bridge drawing package shall contain all information needed by the MSE wall designer including dimensions, details of any soil improvement to be undertaken below the wall, and a diagram showing all forces imposed by the bridge on the wall. Design drawings shall also include design requirements for the concrete facing panels including concrete compressive strength, reinforcing steel type and grade, concrete cover and panel finish requirements, and guidelines for aesthetic treatment. On the "C" drawing set, shop drawings shall be cross referenced by shop drawing number.

(i) An index listing of all drawings included in the drawing set shall be shown on the first sheet of the set. The index shall be orientated from the bottom up; i.e., sheet No. 1 shown at the bottom and successive sheets listed upward from there.

(j) Control line designations shall be selected from the following list of examples, and shall be used consistently throughout the same set of drawings: Centreline NBL Hwy XX, Centreline N-W RAMP, Centreline RDWY, Centreline CROWN, Centreline BRG ABUT #X, Centreline ABUT #X (for integral abutments), Centreline PIER #X, Centreline median Hwy XX. Where the centreline is also the control line, the words control line shall be added after the first designation.

"Top of Centreline Finished Crown" stations and elevations are to be shown for each end of the structure. Top of Centreline Finished Crown is defined as the point where the headslope line intersects the finished centreline roadway profile. Station is given to the nearest decimetre and elevation to the nearest centimetre. These points are to be shown on all DD drawings and on most design drawings. However, in cases where abutments are located behind retaining walls, these theoretical points have no relevance and should be left off the design drawings. Where there is a portion of headslope above the wall, the station and elevation of the intersection of this headslope and the top of finished crown on the control line should be included and denoted as top of headslope..

(k) Substructure elements are to be numbered in the direction of increasing stationing, i.e. Abutment 1 or Pier 1 occurs at the lower station location and numbering increases from there.

(l) Reinforcing Steel Details

- Further to the Department's *Engineering Drafting Guidelines for Highway and Bridge Projects*.
- Bar marks shall not be duplicated on any bridge unless the bars are identical.
- Incremented bars should each have their own bar mark.
- Bar mark suffixes on bar lists for bars other than carbon steel reinforcing bars shall be as follows:
    - C Epoxy coated bars
    - MX Low carbon/chromium steel bars (ASTM 1035)
    - SS Solid stainless steel bars (UNS S31653, S31603, S31803, S30400, S32304 or S32101)

- The type of stainless steel bars shall be updated to actual bar type used for construction on the C-drawings;
- In the quantity summary on the Information Sheet drawing, totals for each bar type shall be shown separately for substructure and superstructure; and
- The minimum size of reinforcing bars shall be 15M with the following exceptions:
    - Welded wire mesh in headslope protection;
    - Reinforcing bars in precast concrete girders;
    - Reinforcing bars in precast deck panels;
    - Reinforcing bars in drain troughs.

(m) Substructure / Foundations

The following design pile load information for abutment and/or pier piles shall be shown in the General Notes on the Information Sheet:

- SLS permanent loads only
- SLS extreme loads (combination #)
- ULS permanent loads only
- ULS extreme loads (combination #)

Outlines of the foundations and estimated pile tip elevations shall be shown relative to test holes on the geotechnical information sheet.

All welded pile splices whose tensile or flexural capacity is critical to the structural integrity of the bridge (for example with integral bridges), shall be identified on the Detailed Designs. The following note is an example:

"ALL OF THE PILE SPLICE WELDS THAT ARE REQUIRED WITHIN THE TOP "X" METRES OF THE PILE ARE TENSION SPLICE WELDS"

The long-term longitudinal and lateral movements for which deck joints, bearings and tops of piles at integral abutments have been designed shall be recorded in the general notes on the information sheet.

(n) Girders

Span lengths established from preliminary engineering requirements shall be rounded up to the nearest whole metre.

Girder camber variations shall be accommodated by adjusting the deck formwork elevation and thickness of the deck haunch on the girders. The following standard note shall be shown on the deck drawing and shall apply to the nominal girder haunch and the outside of curb/ fascia dimensions:

"THESE DIMENSIONS WILL VARY DUE TO VARIATIONS IN GIRDER CAMBER. THE CONTRACTOR SHALL DETERMINE THE ADJUSTMENTS AND MAKE THE APPROPRIATE CORRECTIONS."

i. Steel Girder Superstructures:

The span lengths shown on the general layout drawings shall be measured at a fabrication temperature of 20 degrees Celsius, from centreline bearing to centreline bearing along the bottom flange for uniform depth girders, and along the top flange for tapered or haunched girders. Expansion bearings are to be centred on centreline bearing at -5 degrees Celsius.

Ground stationing for locating the centreline bearing of sub-structure elements shall be adjusted to account for the following:

- length difference between gradeline profile and horizontal surveyed distances,
- length difference due to thermal change between 20 degrees Celsius and -5 degrees Celsius,
- longitudinal shift due to off-plumb tilting of bearing stiffeners or control sections set perpendicular to the top flange, when span lengths are measured along the top flange,
- differences between ground distances and other surveying systems.

For expansion bearings, a bearing temperature setting chart shall be provided for positioning bearing components according to the girder temperature at the time of bearing setting.

For fixed bearings for continuous steel girder bridges, bearings shall be centred on girder bearing stiffeners. The size of voids for grouting anchor rods shall have sufficient room to accommodate girder length changes at erection temperatures other than -5 degrees Celsius, in addition to normal construction tolerances. Supporting piers shall be designed for any eccentricities that may arise.

The following standard note shall be incorporated on the general layout drawing:

"GIRDER LENGTHS SHOWN ARE MEASURED ALONG BOTTOM (TOP) FLANGE AND ARE CORRECT AT +20 DEGREES CELSIUS. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT -5 DEGREES CELSIUS".

Welded steel girders shall be cambered for 100% of the dead load deflection and roadway gradeline profile. Camber data shall be shown on a camber diagram, at 10th span points, centreline of supports, and centreline of field splices, along with net camber values for individual girder segments between splices. For spans longer than 50 m, data shall be presented at 20th span points. Data shall include girder DL, deck DL, Super-imposed DL (including curb/barrier/median/sidewalk + wearing surface), and vertical grade. Notwithstanding the Bridge Design Code clause 10.7.4.1, welded steel girders spanning less than 25 m shall be cambered to compensate for dead load deflection and highway grade profile.

Structural steel mass for steel girder superstructures shall be calculated and the mass, in tonnes, shall be shown in the 'General Notes' area on the steel girder drawings. Mass shall include girders, diaphragms, stiffeners, and splice plates but does not include deck joints, bearings, and bolts.

ii. Precast Concrete Girder Superstructures:

Lengths of precast concrete girders are to be shown on the general layout drawings together with pier diaphragm thicknesses between girder ends, and distance from abutment girder end to centreline abutment bearing. Precast girder lengths shall be set to meet geometric and clearance requirements and shall be measured along the bottom flange at a fabrication temperature of 20 degrees Celsius. Allowance shall be made for prestress shortening, shrinkage and creep up to the time of girder erection. Expansion bridge bearings shall be centred on centreline bearing at -5 degrees Celsius.

Ground stationing for locating the centreline bearing of sub-structure elements shall be adjusted to account for the following:

- length difference between gradeline profile and horizontal surveyed distances,
- length difference due to thermal change between 20 degrees Celsius and -5 degrees Celsius,

- differences between ground distances and other surveying systems.

For expansion bearings, a bearing temperature setting chart shall be provided for positioning bearing components according to the girder temperature at the time of setting the bearing. The bearing design and setting chart shall make allowances for girder shortening due to post-tensioning and long term shrinkage and creep.

The following standard note shall be incorporated on the general layout drawing:

"GIRDER LENGTHS SHOWN ARE MEASURED ALONG BOTTOM FLANGE AND ARE CORRECT AT +20 DEGREES CELSIUS. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT -5 DEGREES CELSIUS. PRECAST SUPPLIERS SHALL MAKE APPROPRIATE ALLOWANCE FOR PRESTRESS SHORTENING, SHRINKAGE AND CREEP UP TO THE TIME OF GIRDER ERECTION".

Theoretical calculated cambers based on best estimates shall be shown on the Detailed Designs. Camber data shall be provided at various construction stages, such as at transfer, erection, deck pour, post-tensioning, Super-imposed DL, gradeline profile, etc.

iii. Cast In Place or Segmental Concrete Superstructures:

Data shall be presented on the drawings to allow setting of form elevations. The deflection data used in the determination of the form elevations shall be presented.

The span length shown on the general layout drawing shall be the ground distance on the control line between centreline bearings. The following standard note shall be incorporated on the general layout drawing:

"SPAN LENGTH SHOWN IS THE GROUND DISTANCE ON CONTROL LINE BETWEEN CENTRELINE OF BEARINGS"

iv. Curved and flared Superstructures:

For curved structures with equal girder lengths (parallel chords) within each span, measure span length along girder lines as defined above for steel and precast concrete girders.

For curved or flared bridges with variable girder lengths (either curved or chords) within a span, measure span length along a selected girder line on the general layout drawing, with a cross reference to a detailed girder layout drawing showing complete geometry of all girders.

Actual girder lengths for all girders, measured along centreline of each girder as defined above for steel and precast concrete girders, shall be detailed elsewhere in the drawing set, with the following note:

"GIRDER LENGTHS SHOWN ARE MEASURED ALONG BOTTOM (TOP) FLANGE AND ARE CORRECT AT +20 DEGREES CELSIUS. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT -5 DEGREES CELSIUS".

For precast girders, the following note shall be added:

"PRECAST SUPPLIERS SHALL MAKE APPROPRIATE ALLOWANCE FOR PRESTRESS SHORTENING, SHRINKAGE AND CREEP UP TO THE TIME OF GIRDER ERECTION"

(o) Bridgerail

All dimensions for bridgerail layouts are to be given on centreline of bridgerail anchor bolts.

(p) Benchmark Tablets

Benchmark tablet numbers can be obtained from the Department through the Survey and Imagery Coordinator at (780) 644-1706. Once the benchmarks have been installed and surveyed, report the elevations of the benchmarks back to the Survey and Imagery Coordinator.

300.5.2.22 Mechanically Stabilized Earth (MSE) Walls

300.5.2.22.1 Design Standards

Drawings SK-16 to SK-19 in Appendix B help further clarify a number of the requirements set out in the text of this Section 300.5.2.22.

MSE walls shall also meet all requirements of Section 300.5.2.11 (Retaining Walls).

The Detailed Designs shall include location, layout, geometry control, global stability and allowable foundation bearing capacity, stability and all elements for a complete MSE wall system. Bridge abutments shall be independently supported on piled foundations.

The most stringent requirements of the following standards shall be met:

- Canadian Highway Bridge Design Code (CSA Standard CAN/CSA-S6);
- AASHTO LRFD Bridge Design Specifications;
- Roadside Design Guide Section – Section H7.6.

The following publication is a recommended reference:

- Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume 1 FHWA-NHI-10_024

Maximum reinforcement loads shall be calculated using the "Simplified Method" as presented in the AASHTO LRFD Bridge Design Specification.

MSE wall embedment depths shall not be less than provided in Table C11.10.2.2.1 "Guide for Minimum Front Face Embedment Depth" in the AASHTO LRFD Bridge Design Specifications Commentary, and in addition shall not be less than 1 m.

The design life for all MSE wall components shall be as defined in section 300.5.2.7 (Durability).

300.5.2.22.2 Waterways and Utilities

MSE walls shall not be used adjacent to waterways.

Mechanically stabilized earth mass shall not be placed over or in the vicinity of any utilities, unless such utilities can be removed and repaired without disturbing the mechanically stabilized earth mass, excavation of such utilities can be executed without impact on wall stability, and agreement is obtained from the utility owners. This shall include water carrying appurtenances, such as catch basins, drainage inlets/outlets, and culverts. Utilities carrying potentially eroding materials shall not be permitted within 10 m of any wall backfill unless the utilities are appropriately sheathed to protect the MSE wall system from any leakage, and the extent of the sheathing is sufficient to protect the MSE wall system against discharges from the ends of this sheathing. No change of direction of utility lines, and no valves, valve chambers or any other discontinuity shall be permitted within the mechanically stabilized earth mass.

300.5.2.22.3 Facing

All MSE walls shall be faced with precast concrete wall panels. The non-exposed side of MSE wall panels shall be in full contact with compacted backfill unless otherwise approved in writing by the Department. Installed MSE wall panels shall be repairable/replaceable in the event of damage and a repair/replacement procedure shall be included with the shop drawings.

300.5.2.22.4 Coping Cap

A cast-in-place concrete coping cap shall be placed on the top of all walls not covered by a concrete barrier, and shall have full depth joints lining up with panel joints. The top of the cast-in-place concrete wall coping shall be smooth and have no steps or abrupt changes in height.

300.5.2.22.5 Vertical Slip Joints

Where staged construction is required and large differential settlement is expected between stages, appropriately located full height vertical slip joints shall be provided.

The cast-in-place coping cap shall be designed with vertical joints in line with panel joints, and with horizontal reinforcement in the cap made discontinuous at these joints.

300.5.2.22.6 Geometric Requirements

MSE wall backfill shall extend a minimum of 0.5 m beyond the end of the soil reinforcement.

For stepped levelling pads, the maximum elevation difference between adjacent steps shall not exceed 1250 mm. The minimum length of each stepped section shall be 1500 mm.

For MSE walls utilizing geosynthetic reinforcing materials, soil reinforcing details shall be designed to accommodate the requirements in Section 300.5.11.4.5 (Backfill) for overlapping reinforcing.

Acute corners less than 70° inside panels shall not be allowed.

300.5.2.22.7 Surface Drainage

Drawings SK-16 to SK-19 in Appendix B help further clarify a number of the requirements set out in the text of this Surface Drainage part of Section 300.5.2.22.7.

Highway and bridge surface drainage shall be controlled and channelled away from the back of the MSE walls and the mechanically stabilized earth mass.

All steel soil reinforcement under roadways shall be protected from exposure to roadway de-icing salt by an impervious geomembrane placed below the road base but above the top layer of soil reinforcement to collect and discharge the runoff. The geomembrane shall be sloped at a minimum of 5% to drain away from the MSE wall into intercepting weeping drains leading away from and outletted beyond the mechanically stabilized earth mass. Immediately adjacent to the roadway, the steel soil reinforcement shall be similarly protected by a geomembrane for a minimum width of 5 m parallel to the roadway. The geomembrane shall be sloped at a minimum of 5% to drain beyond the ends of the steel soil reinforcement. For MSE walls that run parallel to the roadway, the impermeable geomembrane barrier shall also intercept drainage from the roadway base layer and direct it away from all MSE walls. No trough drain or wick drain carrying roadway drainage shall be located over the steel soil reinforcement, and no drain pipe carrying roadway runoff shall be located within the MSE wall soil reinforcement. For MSE wall abutments, the concrete walkway provided in front of the abutment for inspection purposes shall be underlain by an impermeable geomembrane. In all cases the geomembrane material shall be made continuous and water-tight, and shall extend a minimum of 500 mm beyond the extent of the steel soil reinforcement. Any necessary joints shall be shingled in the direction of drainage and welded or bonded to prevent leakage.

Grassed swales with a non-degradable erosion control mat shall be provided behind the tops of the MSE walls to collect and discharge surface water. Swales shall be designed for the 1:100 year storm event without over-topping, but shall have a minimum width of 600 mm and a minimum depth of 150 mm. The swales shall have a bottom liner of impervious geomembrane that has positive drainage to the ends of the walls. Swales and top of walls shall slope away from bridge abutments. Mitigating measures shall be designed to direct flow away from toes and ends of walls, and to prevent erosion at these locations and at drainage swale discharge points.

Down spouts shall be provided for drainage from deck joints and deck wearing surface wick drains. These down spouts shall not be directed through the mechanically stabilized earth mass, and shall subject to additional conditions in Section 200.2.18 (Aesthetics).

300.5.2.22.8 Sub-Surface Drainage

Weeping drains consisting of perforated 150 mm diameter pipe complete with filter sock shall be provided near the front and the back bottom corners of the mechanically stabilized earth mass. The weeping drains shall be day lighted or connected for positive drainage. The water level within the mechanically stabilized earth mass shall be assumed to be at the invert level of the weeping drains or higher should the design warrant it.

300.5.2.22.9 Traffic Barriers

MSE walls with traffic running parallel to the top of the wall shall have rigid barriers meeting the requirements of the Bridge Design Code section 12 PL-2 barriers shall be detailed to Standard Drawing S-1798-09 (PL-2 Single Slope Concrete and Double Tube Type Barriers along Top of MSE Wall). Such bridge barriers shall be supported on moment slabs to resist sliding and overturning, and located on top of the MSE walls. Flexible guardrail systems shall not be used.

300.5.2.22.10 Obstructions within the Backfill

Obstructions within the mechanically stabilized earth mass, such as foundation piles and associated casings, or casings for future pile installations, shall be accommodated with appropriate arrangement of soil reinforcing around such obstructions. For those MSE wall systems that lend themselves to splaying of the soil reinforcement, the splay angle shall not exceed 20° from the perpendicular of the facing panel. For other MSE wall systems, coverage ratios of soil reinforcement shall be specifically developed for each wall location within the Project.

300.5.2.22.11 Panels

Minimum precast concrete panel thickness shall be 140 mm, excluding any additional thickness required for aesthetic surface treatment. Minimum cover to reinforcing bars shall be 50 mm on both front and back faces of the panels, and steel reinforcing bars shall be electrically isolated from soil reinforcement attachment hardware.

The precast concrete panel system shall be designed to accommodate a differential settlement of 100 mm in 10 metres of length along the wall. The gap between adjacent panels shall be 20 mm nominal.

Joints between panels shall have a lip and recess (ship-lap) configuration to protect the joint material. Butt joints may also be used if the Contractor can provide a backing board with sufficient strength and durability to meet the design life requirement, and which can protect the joint material from intentional damage from the front.

Special corner units shall be used, designed so as to prevent joint gaps from opening up due to deflection of adjacent panels in different directions during construction.

300.5.2.22.12 Intentionally Deleted

300.5.2.23 Deck Systems Using Precast Concrete Partial Depth Deck Panels

300.5.2.23.1 General

This Section 300.5.2.23 is for the design of deck systems using precast concrete partial depth deck panels.

Unless otherwise noted in this Section 300.5.2.23, all other requirements of Section 300.5.2 (Design Criteria) shall apply to the design of deck systems using precast concrete partial depth deck panels.

300.5.2.23.2 Design

Deck slabs using precast concrete partial depth deck panels shall be permitted with the following design requirements:

(a) Deck slabs using precast concrete partial depth deck panels shall consist of a cast-in-place concrete deck slab on partial depth precast panels (precast panels);

(b) The cast-in-place concrete deck slab shall be designed to be fully composite with the precast panels;

(c) The minimum composite deck slab system thickness shall be the greater of the girder spacing divided by 15.0 or 225 mm. In addition, the following shall be satisfied:

   i) The precast deck panel shall have a minimum thickness of 90 mm;

   ii) The cast-in-place concrete portion of the composite deck slab system shall have a minimum thickness of 115 mm;

(d) The precast panels shall be fully prestressed and the stresses in the precast panel shall not exceed the following:

   i) From transfer until the 28 day strength is attained:
   - Compression: 0.6 f’ci;
   - Tension: 0.5 fcri;

   ii) After the 28 day strength is attained and at serviceability limit states:
   - Tension: fcr;

   iii) The average compressive stress in the precast panel at prestress strand release shall be ≤ 7.0 MPa;

(e) The empirical method in accordance with clause 8.18.4 of the Bridge Design Code shall not be permitted for design of the composite deck slab system using partial depth precast deck panels;

(f) The composite deck slab system shall be designed using flexural design methods based on elastic moments:

i) For square deck slabs continuous over three or more girder lines, the maximum positive and negative transverse moments shall be determined using the simplified elastic method in accordance with clause 5.7.1.7.1 of the Bridge Design Code, with P adjusted to 112 kN to correspond with the CL-800 Design Truck. These moments shall be used to design the maximum transverse positive moment reinforcing requirements in the panels and the composite slab as well as the transverse maximum negative moment reinforcing requirements in the cast-in-place portion of the deck slab. In addition, reinforcement development and cut-off locations shall be determined using moment envelopes based on elastic analysis;

ii) For curved or skewed bridges, all moments shall be determined by elastic analysis;

iii) For all bridges the following minimum transverse positive moment reinforcing shall be provided over supporting girder lines:

- In addition to the required prestressing strands, transverse stainless steel reinforcing bars, with a minimum reinforcement ratio, ρ, of 0.003, shall be provided throughout the precast panel and shall project over the girder lines and into the cast-in-place concrete portion of the composite deck slab system. The reinforcement ratio, ρ, shall be calculated for d equal to the effective depth of the composite deck slab system. The spacing of the transverse stainless steel reinforcing bars shall not exceed 300 mm;

- At interior girder lines, the transverse stainless steel reinforcing bars shall project out of the precast panel edges and over the girder flanges as required to provide a lap splice with the bars projecting from opposing precast panels supported on the same girder. At exterior girder lines, the transverse stainless steel reinforcing bars shall be extended at least one full development length beyond the exterior girder centreline;

(g) The minimum design compressive strength for the precast panels shall be as specified in Section 300.5.2.7 (Durability);

(h) The composite deck slab system shall conform to the following:

i) The precast panels shall have a minimum age of 45 days and a maximum age of 120 days when the cast-in-place portion of the deck is cast;

ii) The cast-in-place concrete portion shall have 15M continuous bottom longitudinal reinforcing bars (parallel to girders lines) spaced at 300 mm on centre placed directly on top of the precast panels. Where conflict with the transverse positive moment reinforcing bars exists, these longitudinal reinforcing bars shall be placed directly on top of the transverse reinforcing bars;

(i) Prestressing strands shall be 9.5 mm diameter;

(j) Prestressing strands shall not project beyond the edges of the precast panel;

(k) Prestressing strand cast into the panels shall not be coated steel;

(l) With a steel girder superstructure, the following additional provisions shall apply:

i) The precast panel length shall be set to provide a minimum 75 mm bearing (as measured perpendicular to the girder line) on the haunch concrete. A minimum 50 mm thick haunch shall be provided beneath the underside of the panels;

ii) The girder top flange shall have a minimum width of 450 mm;

iii) Shear studs attached to the girder top flange shall project above the top surface of the flange to provide at least 25 mm clearance between the underside of the stud head and the transverse reinforcing bars projecting out of the precast panels;

(m) With precast concrete girder superstructures, the following additional provisions shall apply:

i) For NU girders or any other girder shape where the top flange is less than 150 mm thick at the flange edges, the precast panel length shall be set to provide a minimum 200 mm bearing (as measured perpendicular to the girder line) on the haunch concrete. For all other girders, the precast panel length shall be set to provide a minimum 75 mm bearing (as measured perpendicular to the girder line) on the haunch concrete. A minimum 50 mm thick haunch shall be provided beneath the underside of the panels;

ii) Stirrups projecting from the top girder flange shall project above the top surface of the flange to provide at least 25 mm clearance between the underside of the stirrup tops and the transverse reinforcing bars projecting out of the precast panels;

(n) Vertical bleed holes shall be provided through the panels along the two supported panel edges at a maximum spacing of 200 mm on centre. The holes shall be not less than 25 mm diameter, and shall be located adjacent to the formed edge of haunch to facilitate the escape of entrapped air;

(o) When a bridge includes a traffic separation barrier between a sidewalk and the traffic, any reinforcement required to anchor the separation barrier to the deck shall be cast into the precast panels and project into the barrier; and

(p) No portion of any hardware associated with deck formwork, including deck overhang formwork, shall be visible after removal of all formwork.

300.5.3 DESIGN REPORT REQUIREMENTS

300.5.3.1 Site Specific Design Package

Prior to initiating construction of a bridge structure, the Contractor shall submit a comprehensive design package for the bridge structure, including as applicable *Canada Transportation Act* ("**CTA**") applications, approvals and agreements, *Navigable Waters Protection Act* ("**NWPA**") drawings, permit applications, approvals, and proof of advertising, Department of Fisheries and Oceans ("**DFO**") applications, approvals and orders, geotechnical reports, design drawings, and construction and material specifications not included in the Technical Requirements, to the Department. The geotechnical report shall be in accordance with the Bridge Design Code clause 6.5.6, and shall address the global stability of bridge headslopes and retaining walls;

The comprehensive design packages may be submitted in a manner suiting the Contractor's proposed design and construction schedule, and may be submitted in logical components. However, no construction shall commence on any portion of the bridge for which the design drawings have not been submitted for review.

No construction shall commence on any foundation element until the geotechnical report has been submitted for review, nor on any element requiring construction and material specifications not included in the Technical Requirements until such construction and material specifications have been reviewed and accepted by the Department.

300.5.4 FINAL DESIGN REPORT REQUIREMENTS

Following final completion of the detailed design of a bridge structure, the Contractor shall submit copies of the following documents for the bridge structure, if applicable, to the Department for its bridge structure records system.

- Hydrotechnical report;
- Design notes;
- Design check notes;
- Geotechnical report;
- Corrosion survey report;
- *Canada Transportation Act* ("**CTA**") applications, approvals and agreements;
- *Navigable Waters Protection Act* ("**NWPA**") drawings, permit applications, approvals, and proof of advertising;
- Department of Fisheries and Oceans ("**DFO**") applications, approvals and orders;
- Design Data ("**DD**") Drawings, hardcopy and electronic Microstation.dgn format;

- Site-specific (P) drawings, hardcopy and electronic Microstation.dgn format; and
- Construction and material specifications not contained in Section 300 (Design and Construction - New Infrastructure).

300.5.4.1 Design Drawing Submission Specifics

The Contractor shall supply the following for the Department’s record purposes:

- One full-size stamped and signed set of P series drawings on Mylar film;
- One full-size stamped and signed set of DD series drawings on Mylar film;
- Sets of 11x17 stamped and signed drawings for each of the Design Data, and P series drawings, organized by bridge structure and submitted in binders, and for all sign structures submitted in a single binder, sequenced from one end of the Project to the other A single drawing showing all sign structures shall also be included at the front of each of the sign structure binder;
- One set of the electronic version of the stamped and signed P series drawings in Microstation.dgn format; and
- One set of the electronic version of the stamped and signed P series drawings in .pdf format.

DD drawings shall be submitted as a standalone set for each bridge, and shall be submitted with Department DD drawing numbers (e.g. DD1759, DD1759A etc.). These will be issued by the Department on request.

The “P” drawing submission of design drawings shall include Department drawing numbers, which will be provided by the Department on request. Each structure shall have its own complete stand alone set of “P” drawings, and any drawings that are common to a number of structures shall be included in each set and allocated a different Department number in each set. Electrical drawings pertaining to each structure shall be included in the drawing set.

Keep Department drawing numbers as one sequential set through each bridge “P” drawing package. Include the electrical drawings in the sequential drawing number allocation. Drawing numbers in the drawing index shall be in sequential order with no gaps in the numbering, and shall also list all Standard Drawings used with the Standard Drawing numbers.

Any Contractor assigned drawing numbers shall remain on the drawings, and be located immediately above the “P” drawing numbers.

All sign structures shall have their own General Layout drawing, as illustrated on Standard Drawing S-1721-07 (Sign Structure Sample General Layout).

Sign structure drawings are considered to be bridge drawings, so the same guidelines shall be followed.

300.5.5 CONSTRUCTION REQUIREMENTS

300.5.5.1 General

300.5.5.1.1 Materials

All materials incorporated into the bridge structures for the Project shall be new. Timber materials shall only be used for approach guardrail posts and blocking.

300.5.5.1.2 Existing Reference Documents

The Contractor is advised that the Department has an existing "Specifications for Bridge Construction" document that outlines the requirements for the construction of bridge structures. While the provisions of the document are not directly binding for the Project, unless noted otherwise, it is based on the Department's past experience and best practices and will provide guidance and assistance for the construction of the bridge structures.

300.5.5.1.3 Site Office for Bridge Construction

The Contractor shall provide and maintain in a clean and safe condition an office trailer at the site for the sole use of the Department. The site office trailer shall be located within the Contractor's working area, separate from the Contractor's office or any other structure, and shall meet the following requirements:

- Minimum floor area 60 m^2, with two lockable offices and a common room, with minimum headroom of 2.4 m
- Windproof, weatherproof and insulated
- Lockable exterior door
- Air conditioned and thermostatically controlled heating capable of maintaining a temperature of approximately 20 degrees Celcius in both summer and winter conditions
- Openable windows on all sides, with screens and shades
- Minimum two electrical receptacles in each office and a minimum of two receptacles in the common room
- Resilient flooring material
- Interior electric lighting to the standard of an office environment plus an exterior light at each entrance
- Desks and office chairs for each office
- Table and chairs suitable for 10 people for common room
- A lockable four-drawer filing cabinet for each office
- Laser printer/scanner capable of 11 x 17's
- Telephone, fax and hard-wired high speed internet services.

Details of the site office trailer, its contents and its proposed location shall be submitted in advance to the Department for approval.

The Contractor shall provide the site office trailer prior to the commencement of any field work and ensure that it is continuously available until Traffic Availability has been achieved.

The location of the site office trailer will be determined by the Department based on the work sequence undertaken by the Contractor. The Contractor may be required to move the site office trailer occasionally, as may be reasonably requested by the Department from time to time, to locate it suitably with respect to the work.

If the site office trailer has not been provided to the Department prior to the commencement of any field work or becomes unavailable for the Department's use, Payment Adjustments of $2,000/week or portion thereof for the first four (4) weeks and $5,000/week or portion thereof thereafter shall apply.

300.5.6 CONSTRUCTION CRITERIA

300.5.6.1 Specifications For Bridge Construction

The specifications for bridge structures shall incorporate the following supplemental specifications for bridge structures that incorporate cast-in-place concrete, structural steel, precast concrete units, CSP and SPCSP culverts, post-tensioning, mechanically stabilized earth walls, sign structures, piling, reinforcing steel, waterproofing membrane, deck systems using precast concrete partial depth deck panels and heavy rock riprap:

300.5.6.1.1 Cast-In-Place Concrete

All cast-in-place concrete proposed for the bridge structures in the Project shall be in accordance with Section 300.5.7 (Cast-In-Place Concrete).

300.5.6.1.2 Structural Steel

All structural steel proposed for the bridge structures in the Project shall be in accordance with Section 300.5.8 (Structural Steel).

300.5.6.1.3 Precast Concrete Units and Post-Tensioning

All precast concrete units proposed for the bridge structures in the Project shall be in accordance with Section 300.5.9 (Precast Concrete Units and Post-Tensioning).

300.5.6.1.4 CSP and SPCSP Structures

All proposed CSP and SPCSP bridge sized culverts in the Project shall be in accordance with Section 300.5.10 (Construction of CSP and SPCSP Structures).

300.5.6.1.5 Mechanically Stabilized Earth Walls

All proposed MSE Walls in the Project shall be in accordance with Section 300.5.11

(Mechanically Stabilized Earth Walls).

300.5.6.1.6 Sign Structures

All proposed overhead and cantilevered sign structures in the Project shall be in accordance with Section 300.5.12 (Sign Structures).

300.5.6.1.7 Piling

All piling proposed for the bridge structures in the Project shall be in accordance with Section 300.5.13 (Piling).

300.5.6.1.8 Reinforcing Steel

All reinforcing steel proposed for the bridge structures in the Project shall be in accordance with Section 300.5.14 (Reinforcing Steel).

300.5.6.1.9 Waterproofing Membrane

All waterproofing membrane proposed for the bridge structures in the Project shall be in accordance with Section 300.5.15 (Waterproofing Membrane).

300.5.6.1.10 Deck System Using Precast Concrete Partial Depth Deck Panels

All deck systems using precast concrete partial depth deck panels in the Project shall be in accordance with Section 300.5.16 (Deck Systems Using Precast Concrete Partial Depth Deck Panels).

300.5.6.1.11 Heavy Rock Riprap

All heavy rock riprap for the bridge structures in the Project shall be in accordance with Section 300.5.17 (Heavy Rock Riprap)

300.5.6.1.12 Alternatives to Supplemental Specifications

The Department will consider proposed alternatives to the supplemental specifications, in whole or in part, subject to the proposed alternatives being equal to or better than the supplemental specifications in the judgement of the Department.

300.5.7 CAST-IN-PLACE CONCRETE

300.5.7.1 General

This specification includes the quality requirements, the sampling and testing of the materials and concrete, the methods of producing and handling the constituent materials, and the batching, mixing, handling, transporting, placing and curing as outlined, and which constitute good and acceptable construction practice in structural and similar work.

Metric versions of references are inferred, when available and relevant.

300.5.7.2 Submissions

The Contractor shall submit concrete aggregate tests and concrete mix designs to the Department for each type of concrete proposed. Submittals to be according to Section 300.5.7.5.4 (Aggregate Tests and Concrete Mix Design), and to be made not less than seven days prior to proposed use. All concrete trial mix results shall be included.

The Contractor shall provide notice prior to concrete placing as detailed in Section 100.2.1.2 (Construction).

In the event that the Department requests any of the following information, it shall be submitted within the times noted below:

Five days prior to placing concrete:

- Data showing conformance of the fly ash to the requirements of CSA A3001 for Type “F” fly ash;
- Aluminum content of steel fibres used in Class HPC with steel fibres;

Two days prior to sandblasting/shotblasting:

- Concrete crack measurements for Class HPC and Class HPC with steel fibres concrete;

Within seven days of request by the Department:

- Concrete core strength results;
- Concrete cylinder strength test results;
- Type of machine proposed for grinding of deck, if required.

300.5.7.3 Reference Drawings

- Standard Concrete Joints S-1411-87
- Standard Construction Joints S-1412-99
- Deck Water Proofing System With 80mm Two Course Hot-Mix ACP S-1443-11

300.5.7.4 Materials For Concrete

Concrete shall consist of hydraulic cement, aggregates, water and admixtures or additives which shall conform to the requirements as specified.

<u>Cement</u> - Hydraulic cement shall conform to the requirements of CSA Standard A3001. General use (Normal), Type GU, or High Sulphate Resistant, Type HS or HSb, shall be supplied unless

otherwise specified.

Water - Water to be used for mixing concrete or mortar shall conform to the requirements of CSA Standard A23.1 and shall be free from injurious amounts of alkali, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

Aggregates - Fine and coarse aggregates shall conform to the requirements of CSA Standard A23.1 and shall be stockpiled separately.

Admixtures - All admixtures, such as water-reducing agents, air-entraining agents and superplasticizers, shall conform to ASTM C494 and be compatible with all other constituents including cement, silica fume and fly ash. The addition of calcium chloride, accelerators or air-reducing agents is not permitted.

Hydration Stabilizing Admixtures (HSA's) shall meet ASTM C494 requirements for Type D water reducing and retarding admixtures. The maximum allowable time of set retarding shall be three hours, as measured from the time of mixing. The appropriate dosage rates shall be verified with trial batch tests. The use of HSA's requires the approval of the Department and their usage is limited to those situations where haul times are expected to exceed the specified times and/or projects which require hydration stabilization due to structural considerations .

Silica Fume - Condensed silica fume shall conform to the requirements of CSA Standard A3001 for a Type SF supplementary cementing material, with a SiO_2 content of at least 85%, a maximum loss on ignition of 10%, and a SO_3 content not more than 1%.

Air Entraining Agent - Air entraining agent shall be added to all concrete and shall conform to the requirements of ASTM C260.

Steel Fibres - When specified, steel fibres shall be Novocon XR, Wiremix W50 or an equivalent acceptable to the Department . The fibres shall conform to ASTM A820/A820M-04, Type 1 or 5 and be 50 mm in length with the aluminum content no more than 0.020% by mass when tested in accordance with test method Environmental Protection Agency (EPA) 3050B.

Fly Ash - All fly ash shall conform to the requirements of CSA Standard A3001for Type "F" fly ash not exceeding a calcium content of 12%.

300.5.7.4.1 Storage of Materials

The Contractor shall store all cement, silica fume, fly ash and steel fibres in suitable weather tight buildings to protect such materials from dampness. Cement, silica fume and fly ash shall be free from lumps at all times during their use in the work. Steel fibres shall be free from balls and clumps at all times during their use in the work.

The Contractor shall handle all aggregates so as to prevent segregation and to obtain uniformity of materials. The separated aggregates, and aggregates secured from different sources, shall be piled in separate stockpiles. The site of the stockpiles shall be cleared of all foreign materials and shall be reasonably level and firm. If aggregates are placed directly on the ground, material shall not be removed from the stockpile within 150 mm of the ground level. This material shall remain undisturbed to avoid contaminating the aggregate being used with the ground material.

300.5.7.5 Class and Composition of Concrete

300.5.7.5.1 Class of Concrete

Class of Concrete	Minimum Specified Compressive Strength at 28 Days MPa	Nominal Maximum Aggregate Size mm	Range of Slump[8] mm	Total Air Content[5] %	Max. Water/ Cementing Materials Ratio
B	25	28 to 5	100±30	4 - 7	0.45
C	35	20 to 5 [1]	100±30	5 - 8	0.40
HPC [2]	45 [7]	20 to 5 [3]	120±30 [6]	5 - 8	0.38
D	30	14 to 5	100±30	5 - 8	0.42
S	20	28 to 5	100±30	4 - 7	0.50
Pile	30	28 to 5	130±30	4 - 7	0.42

Note:

1. The size of coarse aggregate shall be 28 to 5 mm for Class C concrete when used in mass pours such as piers and abutments.
2. Additional requirements are listed in Section 300.5.7.5.2 (Class HPC and Class HPC with Steel Fibres). The requirements for Class HPC concrete with steel fibres are the same as for Class HPC concrete.
3. For MSE wall panels, smaller aggregate may be required to suit panel design.
4. Fly ash shall not exceed 30% by mass of cementing materials, however for High Performance Concrete (HPC) it shall be in accordance with Section 300.5.7.5.2 (Class HPC and Class HPC with Steel Fibres) (e) & (g). Fly ash may be used in concrete mixes where the aggregate is assessed to be potentially alkali-silica reactive.
5. Range in air contents to be in compliance with maximum aggregate size as per CSA A23.1 Table 4.
6. For MSE wall panels, the range of slump may be determined by the Contractor.
7. For partial depth deck panels f’ci at release shall not be less than 30 MPa
8. Slumps higher than 100 mm shall be obtained using superplasticizers. Slump ranges proposed by the Contractor that are outside those specified require approval from the Department.

300.5.7.5.2 Class HPC and Class HPC with Steel Fibres

(a) Mix shall include silica fume and fly ash as supplementary cementing materials in combination with compatible air entraining, water reducing and/or superplasticizing admixtures, as required.

(b) The gradation limits for the fine aggregate shall conform to CSA Standard A23.1, except that the amount of material finer than 160 µm shall not exceed 5%.

(c) Coarse aggregate shall conform to CSA Standard A23.1 and the maximum combination of flat and elongated particles (4:1 ratio), as determined by CSA Standard A23.2-13A, shall not exceed 10% of the mass of coarse aggregate.

(d) Minimum cement content (excluding supplementary cementing materials) shall be 335 kg/m^3.

(e) Sum of silica fume and fly ash by mass of cementing materials shall be 17% to 20%.

(f) Silica fume by mass of cementing materials shall be from 6% to 8%.

(g) Fly ash by mass of cementing materials shall be 11% to 15%.

(h) Rapid chloride ion penetration shall be determined in accordance with ASTM C1202 on duplicate laboratory moist cured samples at 28 days. The average of all tests shall not exceed 1000 coulombs, with no single test greater than 1250 coulombs. For HPC with steel fibres, rapid chloride ion penetration testing shall be done without the presence of the steel fibres.

(i) An air-void spacing factor shall be determined in accordance with ASTM C457 modified point-count method at 100 times magnification. The average of all tests shall not exceed 230 μm with no single test greater than 260 μm.

(j) When Class HPC with steel fibres is specified, it shall contain 60 kg of 50 mm long steel fibres, per cubic metre. The Contractor shall review test results of the aluminum content in the steel fibres prior to placing concrete at the site. When alternative steel fibres are proposed, their equivalency and dosage rate shall be determined in accordance with ASTM C1609. The toughness (T^D_{600}) shall be greater than or equal to that specified.

(k) The temperature of the centre of the in-situ concrete shall not fall below 10 degrees Celsius or exceed 60 degrees Celsius and the temperature difference between the centre and the surface shall not exceed 20 degrees Celsius. In addition, the requirements of Table 21 of CSA A23.1 shall apply.

(l) The Contractor shall take steps to ensure that the proportions selected will produce concrete of the quality specified. Trial batch(es) shall be performed at least 35 days prior to placement of concrete at site. Each trial batch shall be a minimum of 3 m^3 or 50% of the rated mixer capacity (whichever is greater) and simulate the anticipated placing procedures at site. The trial batch shall assess the workability and slump retention characteristics of the concrete. The initial slump of the trial batch shall be measured after an elapsed time from batching of not more than 15 minutes. Slump retention shall be assessed at 30, 50, 70 minutes after batching, and slump retention 60 minutes after batching shall be at least 50% of initial slump. At an elapsed time of 70 minutes from the time of batching, the concrete shall be sampled and samples shall be cast to verify that requirements pertaining to compressive strengths at seven and 28 days, rapid chloride ion penetration and air void system parameters of hardened concrete will be met. The shrinkage of the trial batch concrete shall be measured in accordance with CSA A23.2-21C. Shrinkage test results shall be submitted to the Department within seven days of test completion. For multi year projects, all trial batch testing shall be repeated annually in conjunction with required aggregate testing.

300.5.7.5.3 Intentionally Deleted

300.5.7.5.4 Aggregate Tests and Concrete Mix Design

The Contractor shall prepare a concrete mix design for each proposed class of concrete.

For each mix design the following aggregate analysis shall be provided:

- Source(s) of proposed aggregates;
- Fine and coarse aggregate sieve (CSA A23.2-2A);
- Amount of material finer than 80 µm in aggregate (CSA A23.2-5A);
- Organic impurities in sands for concrete (CSA A23.2-7A);
- Results of deleterious substances and physical properties of aggregates included in Table 12, CSA Standard A23.1-04 (Test methods A23.2-23A, A23.2-24A, A23.2-29A);
- Assessment of potential for deleterious alkali-aggregate reactivity ("**AAR**") (CSA A23.2-27A); and
- Petrographic examination of coarse aggregate for concrete (for Class HPC and Class HPC with steel fibres only) (CSA A23.2-15A).

The analysis of the aggregates shall be current and fully represent the material to be used in production. In accordance with CSA A23.1 Clause 4.2.3, yearly testing is required for concrete aggregates. All sampling and testing for sieve analysis, material finer than 80 µm and organic impurities in sand shall have been done no more than 90 days prior to concrete production. Petrographic examination of coarse aggregate for concrete shall have been done no more than 180 days prior to concrete production. Additional analyses of more recent sampling shall be provided as required to confirm that the aggregates continue to meet requirements. A break in production of a particular class of concrete shall not constitute the need for additional testing provided the Contractor has conclusive evidence that the material initially tested is still representative.

If the fine aggregate consists of a blend from more than one source, the "Fine Aggregate Sieve" analysis shall show the gradation of the blended fine aggregates. Similarly in the case of blended coarse aggregates, the "Coarse Aggregate Sieve" analysis shall indicate the gradation of the blended coarse aggregates.

Fine aggregate, tested in accordance with CSA Standard A23.2-7A, *"Organic Impurities in Sands for Concrete"*, shall produce a colour not darker than the Standard colour (Organic Plate Number 3). Aggregate producing a colour darker than the Standard colour will be rejected in the absence of a satisfactory record of performance of a similar class of concrete (minimum 30 tests over the last 12 months); provisions 4.2.3.3.3.2 (a) and (b) of CSA Standard CAN3-A23.1 shall not apply.

The potential for deleterious alkali-aggregate reactivity shall be assessed in accordance with CSA Standard A23.2-27A. This assessment shall include the risk level associated with structure size and environment, the level of prevention related to design life requirements and the determination of the appropriate preventative measures, including testing in accordance with CSA A23.2-28A. Current (less than 18 months old) test data evaluating the potential alkali-silica reactivity of aggregates tested in accordance with CSA Standard A23.2-14A or CSA Standard A23.2-25A is required. In the absence of current test data and outside of areas of known highly reactive aggregate, the aggregate shall be presumed to be moderately reactive.

Petrographic analysis on the proposed coarse aggregates shall be performed in accordance with CSA A23.2-15A by experienced personnel employed by a CSA certified laboratory. The (weighted) petrographic number shall not exceed 130, and the ironstone content shall not exceed 0.8%. The Petrographic Analysis report shall be stamped by either a Professional Engineer, a professional geologist, or a geological engineer registered in the Province of Alberta.

The sampling and testing of aggregates, and the concrete mix design shall be completed by an independent CSA certified and qualified concrete testing laboratory which shall have a permit to practice in the Province of Alberta. Concrete mix designs including sampling and testing of aggregates may be completed by the concrete supplier, with the condition that documentation is stamped by a Professional Engineer. For either situation, the mix design including sampling and testing shall be reviewed and stamped for compliance with the respective specifications, by an independent CSA certified and qualified concrete testing laboratory having a permit to practice in the Province of Alberta. For either case, the testing laboratory shall provide an engineering opinion that the concrete aggregate and mix designs are suitable for the intended use and are expected to perform to specified standards.

Concrete mixes that will be placed by concrete pump shall be designed for pumping.

Notwithstanding the Department's review of, or failure to review, the concrete mix designs, it remains the Contractor's responsibility to meet the Technical Requirements.

300.5.7.5.5 Mix Adjustments

If during the progress of the work the mix design is found to be unsatisfactory for any reason including poor workability, the Contractor shall make the necessary adjustments, and shall provide details of all adjustments to the Department for review. Notwithstanding the Department's review of, or failure to review, the concrete mix design adjustments, it remains the Contractor's responsibility to meet the Technical Requirements.

300.5.7.5.6 Measurement of Materials

Coarse and fine aggregate materials shall be separated and measured separately by weighing. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of aggregate and the cement shall be weighed separately. The accuracy of weighing devices shall be such that successive quantities can be measured to within 1% of the desired amount. The mix water shall be measured by volume or by weight. The water measuring devices shall be capable of control accurate to +/- 0.5% of the design quantity. Air entraining agent or other admixtures shall be added to the mix in a water-diluted solution. For mix adjustments at the site, the Contractor shall provide facilities to control the amount of superplasticizer and air entrainment so that the required tolerances can be met.

300.5.7.6 Mixing Concrete

Mobile continuous mixers or other such concrete supply equipment shall not be used.

All concrete shall be mixed thoroughly until it is uniform in appearance, with all ingredients uniformly distributed. If required by the Department, the Contractor shall demonstrate compliance with CSA 23.1 Clause 5.2.3.5. In no case shall the mixing time per batch be less than one minute for mixers of one cubic metre capacity or less. The "batch" is considered as the quantity of concrete inside the mixer. This figure shall be increased by 15 seconds for each additional half cubic metre capacity or part thereof. The mixing period shall be measured from the time all materials are in the mixer drum.

The Contractor shall in no case load the mixer above its rated capacity. The Contractor shall maintain the mixer in good condition. Inner surfaces of the mixer shall be kept free of hardened concrete and mortar. Mixer blades which are bent or worn down so as to affect the mixing efficiency shall be renewed. Any mixer leaking mortar or causing waste of materials through faulty charging shall be taken out of service until repaired. The Contractor shall, at all times, operate the mixer at the speed recommended by the manufacturer and shall, if requested, supply the manufacturer's certification of the mixing capacity of the machine in use.

The mixer shall be fitted with an accurate and dependable means for measuring the water added, which is not affected by variation in pressure in the water supply line. All joints, valves and other parts shall be maintained so that there is no leakage of water into the mixer drum. Mixers that do not have an accurately working and dependable water gauge shall not be used.

Water shall be released first and continue to flow while the solid materials are entering the mixer. The water discharge pipe shall be so arranged and be of such size that the flow into the mixer is completed within the first quarter of the mixing time, and the water is delivered well within the mixer where it will be quickly mixed with the entire batch.

Air entraining agents and admixtures shall be placed in the mixer after the initial water is in the mixer drum but before the remaining materials are added. Superplasticizer shall be added after initial mixing and as per the manufacturer's recommendation.

300.5.7.6.1 Truck Mixing

Truck mixers shall be of the revolving drum type, watertight, and so constructed that the concrete can be mixed to ensure uniform distribution of materials throughout the mass. All materials for the concrete shall be accurately measured and charged concurrently at the proportions which satisfy the approved mix design into the drum at the production plant.

Increases in water-cement ratio will not be permitted.

The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing shall commence immediately upon introduction of ingredients into the drum and be continued for not less than 70 revolutions, with the mixing rate being in accordance with the manufacturer's recommended rate, and shall be such as to thoroughly mix the concrete.

When adjustment to the mix by adding air entraining agent or superplasticizer at the site is made, the mixer shall rotate for a minimum of 70 additional revolutions to ensure homogeneity of the concrete before discharge. Discharge chutes shall be kept clean and free from hardened concrete and shall be wetted down prior to use.

300.5.7.6.2 Time of Hauling

The maximum time allowed for all classes of concrete other than Class HPC and Class HPC with steel fibres including delivery to the site of the work and discharge shall not exceed 90 minutes after batching. For Class HPC and Class HPC with steel fibres this requirement is reduced to 70 minutes. In hot weather, or under conditions contributing to quick setting of the concrete, a further reduction in these times may be required. Batching of all classes of concrete is considered to occur when any of the mix ingredients are introduced into the truck mixer drum, regardless of whether or not the drum is revolving.

300.5.7.6.3 Delivery

The concrete supplier shall have sufficient plant capacity and satisfactory transporting equipment to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such that cold joints will not develop. The methods of delivering and handling the concrete shall facilitate placing with a minimum of re-handling, and without damage to the structure or the concrete.

300.5.7.6.4 Discharge Temperature

The temperature of all classes of concrete not containing silica fume shall be between 10 degrees Celsius and 25 degrees Celsius at discharge. Temperature requirements for Class HPC and Class HPC with steel fibres shall be between 10 degrees Celsius and 18 degrees Celsius at discharge.

300.5.7.7 Inspection and Testing

The Department shall be afforded full access for any inspections that it may carry out relative to the concrete itself and/or the constituent materials. This includes at the worksite and any plant used for the manufacture of concrete wherever this may be situated. The access shall be adequate to permit proper sampling of concrete, making of test cylinders and testing slump and air content. The proper storage of all site cast concrete cylinders in accordance with the relevant specifications, including cylinders cast by the Department, is the responsibility of the Contractor and adequate cylinder storage space shall be provided prior to any concrete pour.

The Contractor shall utilize ACI or CSA certified testers with extensive related experience to test at site, the air content, density slump and temperature of each batch. Additional tests shall be done if the results are borderline or widely variable. In case of an unacceptable result, one check test will be accepted. The certified testers shall cast the test cylinders as specified in Section 300.5.7.7.3 (Test Cylinders). The certification of the testers shall be current and available for ad hoc auditing by the Department. The certified testers shall utilize the "Concrete Testing Summary at Site" forms contained in Appendix B. The completed forms shall accompany the concrete test cylinders to the testing laboratory.

Current summaries of concrete testing results including bridge identification, pour location, cylinder identification, slump, air, and individual and average compressive strengths at seven days and 28 days shall be kept by concrete type for each bridge, and these summaries shall be forwarded to the Department at the end of every month.

300.5.7.7.1 Strength Tests

A "Strength Test" shall consist of the compression tests of four standard test specimens, sampled, made, cured, and tested in accordance with CSA Standard Specifications as modified herein. One cylinder shall be tested at seven days. The 28 day test result shall be the average of the strengths of the remaining three specimens, except that if any specimens in a test showing distinct evidence of improper sampling, molding or testing, shall be discarded and the remaining strengths averaged. Additional cylinders may be cast, at the discretion of the Contractor.

For Class HPC and Class HPC with steel fibres the Contractor shall take a strength test to represent each approximate 20 m^3 portion of the concrete pour, to a minimum of one strength test for every two loads of concrete. For all other concrete, the Contractor shall take a strength test to represent each bridge element or portion of the element (e.g. abutment seat, abutment backwall, pier footing, and pier cap. On larger pours a strength test shall be taken to represent each approximate 30 m^3 portion of the concrete pour, to a minimum of one strength test for every three loads of concrete. Such tests shall be taken from representative batches.

300.5.7.7.2 Sampling

Sampling of concrete shall be carried out in accordance with CSA Standard A23.2-1C.

When a concrete pump is used to place concrete, sampling shall be at the end of the discharge hose.

300.5.7.7.3 Test Cylinders

Making and curing concrete test cylinders shall be carried out in accordance with CSA Standard A23.2-3C, except that the time for cylinders to reach the testing laboratory shall be between 20 and 48 hours. The test cylinders shall be cast by the Contractor in standard CSA approved heavy duty steel or plastic moulds. Plastic moulds shall have a wall thickness of at least 6 mm. The Contractor shall provide properly designed temperature-controlled storage boxes for test cylinders, as specified in section 8.3.2.1 of CSA Standard A23.2-3C for a period of at least 24 hours and for protection, from adverse weather and mishandling until removed from the site. The Contractor shall provide a max-min thermometer for each storage box and record site curing temperatures for all test cylinders. Storage in a portable building which will be used by Contractor's personnel or the Department during the first 24-hour storage period is not permitted. Storage facilities shall be provided, installed, and accepted by the Department before any concrete is placed.

Handling and transporting of the cylinders shall be in accordance with CSA Standard 23.2-3C. No extra laboratory curing time shall be allowed for cylinders that are delivered late to the laboratory. For Class HPC and HPC with steel fibres, the ends of cylinders shall be ground flat prior to testing.

If the test cylinders exhibit frost etchings or were stored at temperatures below 10 degrees Celsius or above 25 degrees Celsius, or are otherwise mishandled resulting in unreliable strength test results, the Contractor shall reject those portions of the work represented by the cylinders unless the strength of the concrete is confirmed by core testing in accordance with section 300.5.7.18.6 (Coring for Compressive Strength Testing).

300.5.7.7.4 Slump

Slump tests shall be conducted in accordance with CSA Standard A23.2-5C.

300.5.7.7.5 Air Content and Density

Air content and density tests shall be made in accordance with CSA Standard A23.2- 4C and A23.2 – 6C respectively.

300.5.7.7.6 Testing Cylinders

Test cylinders shall be tested in compression in accordance with CSA Standard A23.2 by an independent CSA certified testing laboratory engaged by the Contractor.

300.5.7.7.7 Failure to Meet Slump or Air Content Specifications

If any batch of concrete fails to meet slump or air content specifications, attempts at mitigation shall be limited to adjusting the quantities of superplasticizer and air entraining agent at site. The Contractor shall reject any batch in the event of confirmed unacceptability as determined by quality control tests, and shall immediately remove any concrete from this batch which may have already been placed in the structure.

300.5.7.8 Falsework and Formwork

300.5.7.8.1 General

All falsework and formwork drawings shall be prepared and sealed by a Professional Engineer, and inspected prior to placing concrete to confirm that it is in conformance with the design and drawings. All forms shall be of wood, metal or other acceptable materials, and shall be designed and built mortar-tight and of sufficient rigidity to prevent distortion due to the pressure of vibrated concrete and other loads incidental to the construction operation. The forms shall be substantial and unyielding, and shall be designed so that finished concrete will conform to the design dimensions and contours. The shape, strength, rigidity, water tightness and surface smoothness of re-used forms shall be maintained at all times. Any warped or bulged formwork shall be repaired or replaced before being used. For narrow walls and columns, where the bottom of the form is inaccessible, removable panels shall be provided in the bottom form panel to enable cleaning out of extraneous material immediately before placing the concrete. Forms which are unsatisfactory in any respect shall not be used. The Contractor shall make every effort to accurately position formwork against hardened concrete so as to avoid form lines and discontinuities at the construction joint.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Falsework which cannot be founded on a satisfactory footing shall be supported on piling.

All formwork shall be removed from the completed structure.

300.5.7.8.2 Standard Details

Refer to Standard Drawing S-1411-87 (Standard Concrete Joints) S-1412-99 (Standard Construction Joints) and S-1443-11 (Deck Water Proofing System With 80mm Two Course Hot-Mix ACP) for joints and deck waterproofing details.

300.5.7.8.3 Deck Formwork

Prior to commencing deck formwork, the Contractor shall profile all the girders and determine the deck concrete thickness and girder haunch dimensions required to achieve the specified grade line, and shall perform an independent check to confirm the girder survey and haunch calculations. In the event that actual girder camber values vary significantly from the estimated values indicated on the drawings, the Contractor may raise or lower the grade line accordingly.

The Contractor shall design and install support brackets to avoid damage to girder flanges and webs. Where brackets bear against girder webs, the Contractor shall protect the contact surface with timber or neoprene softeners. No drilling of additional holes, or any other modifications including field welding, shall be made to the superstructure elements. Effects of concentrated loads on thin webs shall be checked, and where necessary, sufficient means shall be provided to distribute or carry such concentrated loads to the supporting flanges or stiffeners. Formwork for decks, curbs, sidewalks and parapets shall be fabricated so that the lines and grades shown on the drawing are achieved, with adjustments made where necessary to compensate for variances in girder dimensions, positioning, alignment and sweep.

300.5.7.8.4 Forms for Exposed Surfaces

Forms for exposed surfaces which require a Class 1 "Ordinary Surface Finish" shall be made of good quality plywood, or an equivalent acceptable to the Department, of uniform thickness, with or without a form liner. Forms for exposed surfaces requiring a Class 2 "Rubbed Finish" or Class 3 "Bonded Concrete Surface Finish" are designated “coated formply”, which shall be all new material consisting of Douglas Fir substrate with resin-impregnated paper overlay and factory treated chemically active release agent. All form material for exposed surfaces shall be full-sized sheets, as practical.

All forms for exposed surfaces shall be mortar-tight, filleted at all sharp corners, and given a bevel or draft in the case of all projections. At the top edges of exposed surfaces, the chamfers are to be formed by chamfer strips.

The minimum acceptable forming for all exposed concrete where the pour height is 1.5 m or less shall have 18 mm approved plywood, supported at 300 mm maximum on centres. Where the pour height is greater than 1.5 m the minimum acceptable forming for all exposed concrete shall have 18 mm approved plywood supported at 200 mm maximum on centres. The support spacings specified here assume the use of new material. Closer spacings may be required in case of re-used material. Strong-backs or walers placed perpendicularly to the supports shall be employed to ensure straightness of the form.

Metal bolts or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least 20 mm from the concrete surface. Break-back type form ties shall have all spacing washers removed and the tie shall be broken back a distance of at least 20 mm from the concrete surface. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size. Torch cutting of steel hangers and ties will not be permitted. Formwork hangers for exterior surfaces of decks, including underside surfaces, shall be an acceptable break-back type with surface cone, or removable threaded type. All cavities created from ties or associated hardware removal shall be filled with an approved concrete patching material and the surface left sound, smooth, even and uniform in colour. When plastic sleeves with removable inner rods are used, the plastic sleeves shall be removed for a distance of 100 mm back from the face of the concrete, except for curbs, barriers and medians where the entire plastic sleeve shall be removed. The entire cavity shall be filled with an approved non-shrink grout to 75 mm from the concrete surface and cured a minimum 24 hours. The remaining 75 mm of the cavity shall then be filled with an approved concrete patching material. When fibre reinforced polymer rods are used they shall be removed a distance of 75 mm back from the face of the concrete and filled with an approved concrete patching material.

300.5.7.8.5 Protection of "Weathering" Steel Girders

Where steel girders are fabricated of "weathering" steel, it is essential that the uniformity of rust formation is not adversely affected by the Contractor's operation.

The Contractor shall exercise utmost care and provide the necessary protection to prevent marking or staining of the girders. All joints between deck formwork and steel members (including interior girders, and diaphragms) shall be sealed to prevent leakage of cement paste or concrete. Caulking, duct tape, "Ethafoam", or any other suitable means or material, shall be used to achieve the seal.

Should foreign material spill onto the girders despite the protection provided, the Contractor shall clean off, wash, and sandblast the contaminated areas. Additionally, should the exterior face of an exterior girder become stained or marked, the entire exterior face of the girder line shall be lightly sandblasted and "weathered" so that uniformity of girder color is achieved.

"Weathering" shall be achieved by repeatedly fogging the exterior girder faces with clean water and allowing them to dry. Fogging should leave the girders wet but not "running wet", and should be repeated when the girders are completely dry.

300.5.7.8.5.1 Protection of Sub-Structure from Staining

The Contractor shall take precautions to protect all concrete work from staining prior to the deck, curb or barriers being cast and deck joints installed. All staining shall be removed and the specified finish completed.

300.5.7.9 Handling and Placing Concrete

300.5.7.9.1 General

The method of concrete placement shall have a consistent minimal impact on the concrete properties. All the necessary equipment for any particular pour shall be on site and proven to be in working condition before the pour commences, with backup equipment on site. The equipment shall be well maintained, suitable in kind and adequate in capacity for the work.

In preparation for the placing of concrete, all sawdust, chips and other construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays, and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. When placing operations would involve free drop of concrete by more than 1 m, it shall be deposited through metal or other acceptable pipes.

Concrete for the structure shall be deposited in the forms in the order indicated on the Detailed Designs, and each portion placed between construction joints shall be placed in one continuous operation. Concrete placing operations shall not work off, or transport concrete directly over concrete already placed, when this concrete is less than 48 hours old, no matter what system of runways, supports or protection is used on the surface of the concrete already placed if it is subjected thereby to live or dead loads.

300.5.7.9.2 Consolidation

Concrete, during and immediately after depositing, shall be thoroughly consolidated. The consolidation shall be done by mechanical vibration, and subject to the following conditions:

- The vibration shall be internal;
- Vibrators shall be capable of transmitting vibrations to the concrete at frequencies of not less than 4500 impulses per minute;
- The intensity of vibration shall be such as to visibly affect a mass of concrete of 25 mm slump over a radius of at least 0.5 m;
- The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms;
- Vibrator operators shall be suitably instructed in the use of vibrators, and the importance of adequate and thorough vibration of the concrete;
- Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures, and into the corners and angles of the forms. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted vertically and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any point to the extent that localized areas of grout are formed. Application of vibrators shall be at points uniformly spaced and not farther apart than the radius over which the vibration is visibly effective;
- Vibration shall not be applied directly or through the reinforcement of sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms; and
- Vibration shall be supplemented by spading as is necessary to ensure smooth and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

Once vibrated, the Contractor shall avoid disturbing concrete, and shall not step into it or add additional concrete after vibration.

300.5.7.9.3 Additional Requirements

When concrete placing is discontinued, for whatever reason, all accumulations of mortar splashed on the reinforcing steel and the form surfaces shall be removed. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete, while cleaning the reinforcing steel.

Concrete shall be placed while fresh and before it has taken its initial set. Partially hardened concrete shall not be re-tempered with additional water. No concrete shall be used which does not reach its final position in the forms within the time stipulated under Section 300.5.7.6.2 (Time of Hauling) above.

After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcing bars which project.

Concrete which would be adversely affected by the presence of freestanding water shall be protected to prevent its occurrence, and the Contractor shall take whatever steps may be necessary to prevent free water build-up in the event of unexpected rainfall or similar occurrences for the first 24 hours.

Water used to keep equipment clean during the pour, or to clean equipment at the end of the pour, shall be discharged clear of the structure and any water channel.

Any damaged concrete such as honeycomb, cavities, cracking and other casting defects shall be repaired. Repair procedures shall be developed by the Contractor and submitted for review and acceptance by the Department prior to the commencement of the repair.

(a) Honeycomb, Cavities, Casting Defects

Honeycomb, cavities and other deficiencies are defined as those areas that are greater than 30 mm in depth or 0.1 m^2 in area.

As a minimum the repair procedure shall include removing and replacing the damaged concrete with the originally specified class of concrete. Repair extents shall be saw cut 25 mm deep in neat perpendicular lines and concrete removed to a depth of 25 mm below reinforcing steel. Repair areas shall be roughened to remove all loose material and laitance. Exposed reinforcing steel shall be clean and repaired to its original condition. Repair areas shall be saturated with water for a period of 24 hours prior to concrete placement. Curing shall be in accordance with the requirements for the class of concrete.

Formwork misalignment for highly visible components, including barriers, pier shafts, and exterior faces of wingwalls shall in no case exceed 3 mm in any direction. Formwork misalignment for all other components shall in no case exceed 5 mm in any direction. Concrete sections with formwork misalignments exceeding the allowable tolerances shall be removed and recast.

(b) Cracks

In addition to the requirements stated in Section 300.5.7.15.4 (Class HPC and Class HPC with Steel Fibres – Crack Identification/Repair), all cracks 0.2 mm or greater in width, for all c lasses of concrete, shall be repaired by epoxy injection in accordance with the manufacturer's recommendations.

300.5.7.9.4 Pumping

The operation of the pump shall produce a continuous flow of concrete without air pockets. The equipment shall be so arranged that the freshly placed concrete is not damaged by any form of vibration caused by the pump. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

300.5.7.10 Placing Pile Concrete

300.5.7.10.1 General

The Contractor shall make every attempt to obtain a "Dry" pile hole prior to placing pile concrete. The placement of pile concrete under water will only be permitted in the event that all attempts at obtaining a dry hole fail.

300.5.7.10.2 Concrete Placed in the Dry

Pile concrete shall be placed by means of a hopper equipped with a centre pipe drop tube. The pipe drop tube shall be a minimum of 200 mm in diameter and 2 m long. Concrete may be placed free fall, providing the fall is vertically down the centre of the casing or drilled hole and there are no transverse ties or spacers. Pile concrete shall have a slump range of 100 - 160 mm at time of discharge. Concrete in the upper 3 m of the piles shall be consolidated by the use of an approved concrete vibrator.

300.5.7.10.3 Concrete Placed Under Water

Placement of pile concrete under water shall be in accordance with Section 300.5.7.14 (Depositing Concrete Under Water). In addition, all drilled pile shafts cast under water shall be inspected by Crosshole Sonic Logging ("**CSL**") to check structural integrity.

In order to test for voids or other abnormalities in the concrete, all drilled pile shafts cast under water shall be equipped with PVC or steel access tubes to permit inspection by CSL. The Contractor shall submit the proposed method for review two weeks before beginning drilled pile work. The Contractor shall supply and install four 50 mm inside diameter tubes in each drilled pile with a diameter of 1.5 m or less and six tubes in each pile with a diameter greater than 1.5 m.

Tubes supplied shall be round and have a regular internal diameter that is free from defects, obstructions and joints, and shall be watertight, free from corrosion and have clean internal and external faces to ensure a good bond between the concrete and the tubes. Tubes may be extended with watertight mechanical couplings but all coupling locations shall be recorded. Tubes shall be installed in a manner that the CSL probes pass through the entire length of the tube without binding.

The Contractor shall fit all tubes with watertight shoes on the bottom and removable caps on the top. Tubes shall be secured to the interior of the reinforcement cage at least every 1.2 m along the length of the pile. Tubes shall be installed uniformly and equidistantly around the circumference of the pile such that all tubes are parallel for their full length. Tubes shall extend to within 150 mm of the drilled shaft bottoms, and shall extend a minimum of 600 mm above the drilled shaft tops or where they are accessible. Tubes shall be capped to prevent debris from entering the access tubes.

The Contractor shall ensure that CSL tubes are not damaged during the installation of the reinforcement cage. If testing equipment does not pass through the entire length of the CSL tube, a 50 mm diameter core hole shall be drilled. Special care must be taken to avoid tube debonding between the concrete and the tubes. If tube debonding occurs, the Contractor shall core drill a 50 mm diameter hole to the depth of debonding for each debonded tube.

The Contractor shall make CSL measurements at depth intervals of 65 mm from the bottom of the tubes to the top of each pile. Upon completion of testing and acceptance of the pile concrete, the tubes shall be filled with an approved grout mix.

a) Qualification

The testing agency hired by the Contractor shall have a minimum of three years experience in CSL testing and have a Professional Engineer supervising the testing and interpretation of results. The Contractor shall provide written evidence of successful completion of CSL tests by the testing agency on drilled piles in the Province of Alberta. The Contractor's submission of such written evidence shall also include personnel qualifications and equipment description.

b) CSL Results

The condition of the concrete piles shall be evaluated based on the results of the CSL testing according to the criteria listed in the table below. The Contractor shall not grout the CSL tubes or perform any further work on the CSL tested drilled piles until it has been demonstrated to the Department's satisfaction that the drilled pile is acceptable.

Concrete Condition Rating Criteria

Rating	Velocity Reduction *	CSL Results
Good ("**G**")	≤ 10%	Good quality concrete
Questionable ("**Q**")	>10% & <20%	Minor contamination or intrusion: questionable quality concrete
Poor/Defect ("**P/D**")	≥ 20%	Defects exists, possible water/slurry contamination, soil intrusion and/or poor quality concrete
No Signal ("**NS**")	No Signal Received	Soil intrusion or other severe defect absorbed the signal

** From highest measured signal velocity in the comparable zone*

CSL test results with ratings other than "G" shall be considered unacceptable and shall result in rejection of the pile. However, in the event that the Contractor elects to carry out further investigation to prove the acceptability of the pile, boundaries of any defective/unconsolidated zones shall be delineated by means of cross-hole tomography, supplemented by additional testing as required by the designer. This additional testing may include 3D tomographic imaging, single-hole sonic testing, sonic echo or impact response tests, or concrete coring. The Contractor shall then submit to the Department a full report signed and stamped by the Design Engineer that demonstrates the functionality of the pile, including test summaries, results and analyses. The pile shall not be considered acceptable until the Department has accepted the report.

Pile edge defects are considered critical and any defects that expose the rebar are not acceptable under any circumstance and shall result in rejection of the pile.

The depth, location, diameter and number of core holes when concrete coring is required shall be proposed by the Contractor in a written submission to the Department. If the Department is concerned about concrete strength or requires the use of a borehole camera for inspection, large diameter cores may be required. A minimum of two cores would be required to intercept the suspected defect zones.

c) Correction of Unacceptable Drilled Pile

When a drilled pile is unacceptable and rejected by the Department, the Contractor shall submit a remedial action plan with supporting calculations for review by the Department. The remedial action shall be designed by the Contractor and stamped by a Professional Engineer.

300.5.7.11 Placing HPC Concrete and HPC Concrete with Steel Fibres

300.5.7.11.1 General

Concrete shall not be placed when the air temperature is below 5 degrees Celsius, or is expected to fall below 5 degrees Celsius during the curing period, or when the air temperature is above 25 degrees Celsius, or in the event of rain or excessive wind or dust, or when there are other conditions detrimental to the concrete.

Deck, roof slab, approach slab and deck overlay concrete shall be placed between the hours of 6:00 pm and 10:00 am of the following day, except in occasional exceptional circumstances when the sky will be overcast for the duration of the pour, the ambient temperature is below 15 degrees Celsius, and it can be demonstrated that no detrimental conditions will occur despite placing concrete outside the specified hours. Deck, roof slab, approach slab and deck overlay concrete shall not be placed when the evaporation rate exceeds 0.5 $kg/m^2/hr$. The evaporation rate shall be determined using Figure D.1, of CSA A23.1 – Annex D. The rate of evaporation shall be recorded as concrete placing operations progress and the Contractor shall make all necessary adjustments to ensure the evaporation rate does not exceed the specified limit. Proper lighting shall be provided for night pours. The temperature of the concrete during discharge shall be in accordance with Section 300.5.7.6.4 (Discharge Temperature). The temperature of the mix shall be controlled by the inclusion of ice to the mix which shall not alter the design water cementing materials ratio. Immediately prior to placing concrete, the substrates shall be thoroughly wet with clean water.

All deck concrete and deck overlay concrete shall be consolidated in accordance with Section 300.5.7.9.2 (Consolidation) even when vibratory drum type finishing machines are used.

300.5.7.11.2 Placing/Finishing Machines

For all deck concrete and deck overlay concrete, screeding shall be by concrete placing/finishing machines as follows or equivalents:

- Bidwell Model RF200, 364, 2450, 3600 and 4800;
- Gomaco Model C450 and C750.

The Contractor shall provide two work bridges, separate from the placing/finishing machine, of adequate length to completely span the width of the pour, and shall provide details of these to the Department for review. The work bridges will facilitate the operations of concrete finishing and placing of filter fabric. The work bridges shall be supported essentially parallel to the concrete surface, between 250 mm and 600 mm above the concrete surface, and shall be at least 800 mm wide to permit diverse uses concurrently, and be rigid enough that dynamic deflections are insignificant.

300.5.7.11.3 Screed Guide Rails

Steel screed guide rails shall be installed to suit the profile of the required surface and to ensure a smooth and continuous surface from end to end of the bridge, as well as run off length at both ends of a pour to allow finishing of the full length of any pour by the screed machine. Guide rails shall be located outside of the finished surface of the pour, and shall extend beyond the ends of the bridge to accommodate finishing of the entire surface with the deck finishing machine.

300.5.7.11.4 Dry-Run

The finishing machine shall be set-up to match the skew angle of the bridge, when the skew angle exceeds 15°. For skewed bridge structures on vertical curves, this requirement may be altered to suit actual site conditions.

The finishing machine and guide rails shall be adjusted so that the height of the screed will finish the concrete to the design grade line and crown. To confirm the adjustment of the machine and guiderails, the screed shall be dry-run prior to the pour and clearance measurements taken at each of the girder tenth points. The Contractor shall perform an independent check to confirm the resulting design surface profile, deck thickness and rebar cover. Re-setting of the machine and/or screed rails shall be done as necessary, to obtain an acceptable dry-run. Adjustments to the machine or screed rails shall not be done after an acceptable dry-run has been completed. The dry run shall be done again if the finishing machine is lifted off the screed rails for repositioning.

Where screed rails are supported on cantilevered formwork that could deflect under the weight of the fresh concrete and the deck finishing machine, the Contractor shall pre-load a section of the cantilevered formwork on each side of the bridge to determine deflections that will occur during concrete placement. The formwork, machine and/or screed rails shall be adjusted to compensate for the expected formwork deflection.

300.5.7.11.5 Intentionally Deleted

300.5.7.11.6 Screeding Concrete

Concrete shall be placed as close as practical ahead of the finishing machine, and at no time more than 6 m in front of the trailing end of the finishing machine's roller. The screed shall be moved slowly and at a uniform rate. In general the direction of the pouring shall be from the low end of the bridge to the high end. A roll of concrete shall be maintained along the entire front of the screed at all times to ensure the filling and consolidation of the surface concrete. The Contractor shall also ensure that the required concrete thickness is being placed by randomly probing the concrete behind the finishing machine.

Screeding shall be completed in no more than two passes. The screed shall not be allowed to run except when screeding is actually in progress. The screeded surface shall not be walked on or otherwise damaged.

300.5.7.11.7 Bull Floating/Surface Texturing

The concrete surface produced behind the finishing machine shall be manually bull floated with a magnesium bull float to ensure that the surface is free from open texturing, plucked aggregate and local projections or depressions. Bull floating and surface texturing shall follow as close as practically possible behind the screed. It is imperative that competent workers be employed to carryout bull floating and surface texturing.

Evaporation reducer or water shall not be finished into the concrete at any time during finishing operations.

The surface shall be checked for tolerance by the Contractor with a 3 m long expanded polystyrene straight edge immediately after final bull floating and before texturing or application of evaporation reducer.

300.5.7.11.8 Surface Defects and Tolerances

The finished surface of the concrete shall conform to the design grade line profiles as indicated on the Detailed Designs.

The surface shall be free from open texturing, plucked aggregate and local projections.

Except across the crown, the surface shall be such that when checked with a 3 m long straight edge placed anywhere in any direction on the surface, there shall not be any gap greater than

3 mm between the bottom of the straight edge and the surface of the deck.

Areas that do not meet the required surface accuracy shall be clearly marked out and the Contractor shall:

(a) Grind down any areas higher than 3 mm but not higher than 10 mm above the correct surface.

(b) Correct any areas lower than 3 mm but not lower than 10 mm below the correct surface, by grinding down the adjacent high areas.

(c) When the deviation exceeds 10 mm from the correct surface, the deck slab shall be replaced for a length, width and depth which will allow the formation of a new slab, of the required quality, in no way inferior to the adjacent undisturbed slab. The perimeter of the joint created by the repair area shall be waterproofed in accordance with the details on S-1443-11 (Deck Water Proofing System With 80mm Two Course Hot-Mix ACP).

Grinding shall be carried out by a machine, of a type and capacity suitable for the total area of grinding involved, until the surface meets the specified requirements.

300.5.7.11.9 Deck Joint Assembly Installation

The finished surface of the concrete shall conform to the design grade line profiles as indicated on the Detailed Designs.

The Contractor shall check the deck joint assembly grade, elevation, gap, and crown prior to concrete placement, and shall not place concrete if the deck joint assembly position is incorrect. The Contractor shall confirm the deck joint assembly grade, elevation, gap, and crown immediately after the concrete curing period. Measurements shall be done by instrument. If the deck joint assembly position is incorrect, the Contractor shall promptly remove and replace the deck joint and concrete.

300.5.7.12 Construction Joints

300.5.7.12.1 General

Construction joints shall be made only where indicated on the Detailed Designs or shown in the pouring schedule.

If not detailed on the Detailed Designs, or in the case of emergency, construction joints shall be installed according to the Standard Drawings. Shear keys or inclined reinforcement shall be used where necessary to transmit shear, or to bond the two sections together. Construction joints should be located to allow a minimum of 50 mm minimum concrete cover on reinforcing steel running parallel to the joint.

Construction joints in deck slabs shall not be situated in locations where they will not be waterproofed in accordance with the details on Standard Drawing S-1443-11 (Deck Water Proofing System with 80 mm Two Course Hot-Mix ACP).

300.5.7.12.2 Bonding

Before depositing new concrete on or against concrete that has hardened, the forms shall be re-tightened and the surface of the hardened concrete shall be thoroughly cleaned and in a saturated surface dry condition. The placing of concrete shall be carried out continuously from joint to joint. The face edges of all joints that are exposed to view shall be carefully finished true to line and elevation.

300.5.7.13 Concreting In Cold Weather

The Contractor shall accept full responsibility for the protection of concrete during adverse weather conditions. In addition to the requirements stated below, all concrete shall be cured in accordance with Section 300.5.7.15 (Curing Concrete).

When the ambient air temperature is below 5 degrees Celsius at time of concrete placement, or may be expected to fall below 5 degrees Celsius during the curing period, the following requirements for cold weather concreting shall be put in place:

(1) All aggregate and mixing water shall be heated to a temperature of at least 20degrees Celsius but not more than 65 degrees Celsius. The aggregates may be heated by either dry heat or steam; in the latter case the quantity of mixing water shall be reduced as necessary to maintain the mix design water cement ratio. The temperature of the concrete at the time of placing shall be in accordance with Section 300.5.7.6.4 (Discharge Temperature).

(2) The Contractor shall enclose the structure in such a way that the concrete and air temperature within the enclosure can be kept above 15 degrees Celsius for a period of seven days after placing the concrete. Where elements being cast consist of HPC concrete, this seven day period shall be increased to 14 days.

    Enclosures shall be constructed with a minimum 300 mm clearance between the enclosure and the concrete. However, for casting of HPC concrete an enclosure shall be constructed large enough to comfortably accommodate the men and equipment necessary to place finish and cure the HPC concrete. In addition, the underside of the deck shall be suitably protected. For casting of HPC concrete an enclosure is mandatory and no alternatives are acceptable.

    The relative humidity within the enclosure shall be maintained at not less than 85%.

    Heaters shall be kept well clear of the formwork housing. The system of heating, and positioning of steam outlets, heaters, and fans, shall be designed to give a uniform distribution of heat, and the use of salamanders, coke stoves, oil or gas burners and similar spot heaters that have an open flame and intense heat is prohibited. Heaters shall have air intakes outside the enclosures to prevent the accumulation of carbon dioxide within the enclosure.

(3) Before placing concrete, the Contractor shall provide adequate preheat to raise the temperature of formwork, reinforcing steel, previously placed concrete, and/or soil to at least 10 degrees Celsius. The preheat shall be adequate to ensure that no portion of the fresh concrete freezes when placed against existing surfaces, or has curing retarded by cold temperatures.

(4) Fully insulated formwork may be used as an alternative to provision of further heat during the curing period. The Contractor shall design and insulate such formwork to enable the initial heat of the mix, and the heat generated during the hydration of the cement, to maintain the specified curing conditions, throughout the curing period. In the event that the insulated formwork fails to maintain the specified curing conditions, the Contractor is responsible for immediately implementing supplementary measures to restore the specified curing conditions.

(5) The adequacy of protection shall be monitored and recorded a minimum of every 4 hours for the first 72 hours, and every 8 hours for the remainder of the curing period, including measurement of internal and surface concrete temperature and relative humidity. The protective measures shall be modified as necessary to maintain the specified curing conditions.

(6) Protection and heating, where used, shall be withdrawn in such a manner so as not to induce thermal shock stresses in the concrete. The temperature of the concrete shall be gradually reduced at a rate not exceeding 10 degrees Celsius per day to that of the surrounding air. To achieve this, in an enclosure, the heat shall be slowly reduced. The temperature differential between the core of the element and the surface of the element shall not exceed 20 degrees Celsius. In addition the temperature differential between the surface of the element and the ambient air shall not exceed 15 degrees Celsius. Ambient air temperature is defined as the temperature at mid-height and 300 mm from the surface of the element. The Contractor shall measure the temperature of internal concrete, surface of the concrete and ambient air temperatures a minimum of every 4 hours, and shall make adjustments as necessary to keep the rate of cooling within the specified parameters.

300.5.7.14 Depositing Concrete Under Water

Concrete shall not be deposited in water unless this is unavoidable, in which case anti-washout admixtures incorporating viscosity modifiers (whelan gum, etc.) may be used.

Concrete to be deposited in water shall be of the specified class, with mix design modified to yield 170 mm +/- 30 mm slump, and with an excess of 15% of the cement quantity added beyond its normal designed amount. The mix should contain an approved “anti-washout” admixture to enhance the performance of the mix. The concrete temperature shall be between 10 degrees Celsius and 25 degrees Celsius. The modified concrete mix design shall be reviewed and stamped by a Professional Engineer.

To prevent segregation, concrete shall be carefully placed in a compact mass, in its final position, by means of a concrete pump. When specifically reviewed and accepted by the Department, a properly designed and operated tremie may be used. The concrete shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms underwater shall be watertight.

The discharge end of the concrete pump line shall be lowered to the bottom of the form or hole. Pumping shall then proceed with the end of the discharge line being continually buried no less than 500 mm below the surface of fresh concrete at all times, to maintain a seal until the form or hole is completely filled with fresh uncontaminated concrete.

Concrete shall not be placed in water which is below 4 degrees Celsius.

The surface of the concrete shall be kept as nearly horizontal as is practicable at all times. The discharge end of the tremie shall be kept buried at least 500 mm in previously placed concrete.

Dewatering will not be permitted while concrete is being placed. Dewatering may proceed when the concrete seal is sufficiently hard and strong. All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, chipping or other means which will not injure the surface of the concrete.

300.5.7.15 Curing Concrete

300.5.7.15.1 General

Freshly deposited concrete shall be protected from freezing, abnormally high temperatures or temperature differentials, and premature drying, excessive moisture, and moisture loss through the curing period. This includes protection from freezing during the full duration of moist cure and for 12 hours after the removal of moist cure. In addition the temperature of the centre of in-situ concrete shall not fall below 10 degrees Celsius or exceed 60 degrees Celsius, and the temperature difference between the centre and the surface, as well as the temperature differential between top and bottom surfaces, shall be controlled to be within 20 degrees Celsius. In addition, the requirements of Table 21 of CSA A23.1 shall apply.

All Class B, C and D concrete surfaces other than concrete slope protection shall be moist cured. The Contractor shall cover the concrete surface(s) with a single layer of clean, light coloured filter fabric (Nilex 4504 or approved equivalent) as soon as the surface will not be marred by so doing. The light coloured filter fabric shall be kept continuously wet for 72 hours. Where the formwork is left in place for 72 hours or more, no additional curing will be required. Curing compound shall not be used on any concrete surfaces other than for concrete slope protection.

300.5.7.15.2 Curing Requirements for Concrete Slope Protection

In addition to the general curing requirements, the following shall apply:

Concrete slope protection shall receive two coats of a "Type 2" curing compound meeting the requirements of ASTM C309 (or ASTM C1315). The first coat is to be applied immediately after the concrete has been satisfactorily finished, and the second coat is to be applied within three hours after the application of the first coat. Each application shall be at the rate specified by the manufacturer. In cases where premature drying is severe or is anticipated to be severe, then moist curing, as specified in Section 300.5.7.15.1 (Curing Concrete – General), shall be done prior to application of curing compound.

300.5.7.15.3 Curing Requirements for Class HPC Concrete and Class HPC Concrete with Steel Fibres

In addition to the general curing requirements, the following shall apply:

The Contractor shall prepare a procedure for the wet cure of class HPC concrete and class HPC concrete with steel fibres. Details shall include information with regards to the type and description of equipment and materials being used, and the work methods/techniques employed to satisfactorily carry out the work. The wet cure procedure shall be demonstrated to the Department for adequacy and suitability prior to scheduling placement of these classes of concrete.

During the cure period for Class HPC concrete and Class HPC concrete with steel fibres, the Contractor shall provide whatever means and take whatever actions are necessary to ensure that the concrete temperature and the temperature differences within the concrete remain within the limits specified in Section 300.5.7.15.1.

During the cure period the Contractor shall provide protection to ensure that the difference between the concrete temperature and the ambient air temperature at the site remains within the limits specified in Section 300.5.7.15.1 (Curing Concrete - General). The Contractor shall supply and install two thermocouples, one in the centre and one at the surface of the concrete, for every 100 m^2 of deck, at locations determined by the Department. The Contractor shall monitor and record the temperatures every four hours for the first 72 hours after concrete placement and every 8 hours thereafter for the remainder of the specified cure period and shall provide whatever means, and take whatever actions are necessary to ensure that the concrete temperature and the temperature differences within the concrete remain within the limits specified in Section 300.5.7.15.1 (Curing Concrete - General). The Contractor shall make these temperature readings available to the Department on a daily basis if requested.

For concrete decks, an evaporation reducer, such as "Confilm" manufactured by BASF or an approved equivalent, having a monomolecular film-forming compound intended for application to fresh concrete for temporary protection against moisture loss, shall be applied by a hand sprayer with a misting nozzle at the manufacturer's recommended concentration and application rate immediately after final bull floating and/or surface texturing, prior to installation of the wet cure system. Evaporation reducer or water shall not be finished into the concrete at any time during finishing operations.

Two layers of light coloured filter fabric (Nilex 4504 or an approved equivalent) shall be placed on the fresh concrete surface as soon as the surface will not be marred as a result of this placement. A fine spray of clean water shall be immediately applied to the filter fabric until the filter fabric is saturated. Edges of the filter fabric shall overlap a minimum of 150 mm and shall be held in place without marring the surface of the concrete. The filter fabric shall be maintained in a continuously wet condition throughout the curing period, by means of soaker hoses or other means. Wet curing with filter fabric and water shall be maintained for a minimum period of 14 days at an average ambient temperature of 10 degrees Celsius.

For those locations where formwork is removed prior to the completion of this specified curing period, the resulting exposed concrete surfaces shall be wet cured for the remaining days. Formwork for barrier concrete shall be removed no later than 24 hours after concrete placement. Wet curing shall commence immediately after formwork removal.

In the event that any portion of the HPC or HPC with steel fibres becomes surface dry during the curing period, the concrete may be considered unacceptable.

300.5.7.15.4 Class HPC Concrete and Class HPC Concrete with Steel Fibres – Crack Identification and Repair

After the curing period the Contractor shall inspect the dry concrete surface(s) and identify and plot all cracks, recording the crack widths in millimetres and the crack lengths in metres.

The Contractor shall repair cracks with widths equal or greater than 0.2 mm using the following procedure:

(a) Clean and dry cracks with oil-free compressed air;

(b) Seal partial depth cracks with a gravity flow concrete crack filler in accordance with the manufacturer's recommendations. The crack filler shall maximize the penetration by taking into consideration the ambient temperature, substrate temperature, viscosity and pot life of the material. The crack filler shall be chosen from the Alberta Transportation Product List/Crack Treatment/Concrete Crack filler/Proven or Potential Products and have a viscosity less than 105 centipoises (cP); and

(c) When cracks extend the full depth of the deck slab, barriers or curbs or extend partial depth of decks that are cast to grade, epoxy injection will be required. The epoxy resin shall meet the requirements of ASTM C881 Type IV, Grade 1, Class B or C and have a viscosity less than 500 cP. The injection procedure shall be submitted by the Contractor for acceptance by the Department.

The Contractor shall repair all cracks, regardless of their width if the total crack frequency is greater than 0.150 m/m^2, using the following procedure:

(d) Shotblast the deck surface to ICRI CSP No 3. Clean and dry cracks with oil-free compressed air. Apply a gravity applied reactive methacrylate resin or approved equivalent at the manufacture's recommended application rate to the entire deck surface. The resin shall have a maximum viscosity of 15 cP, a tensile strength greater than 25 MPa and elongation greater than or equal to 5.5%;

(e) For decks that are to be waterproofed, once the resin is applied and fully cured the deck shall be shotblasted again to remove surface resin and blown clean with oil-free compressed air prior to receiving its waterproofing system; and

(f) For cast to grade decks or concrete overlays the resin shall be seeded with clean Sil 7 sand broadcast to refusal prior to setting.

300.5.7.16 Concrete Surface Finish

300.5.7.16.1 General

On exposed concrete surfaces to 600 mm below grade or, in the case of river piers, 600 mm below lowest water level, surface finishes shall be applied as follows:

Class 1 Ordinary Surface Finish
- All exposed concrete surfaces unless other finishes are specified.
- Top surfaces of abutment seats and pier caps.

Class 2 Rubbed Surface Finish
- Solid shaft river piers;
- Inside vertical surfaces of curb, barrier, median and sidewalk; and
- Cast-in-place concrete girders except exterior vertical fascia.

Class 3 Bonded Concrete Surface Finish
- Abutment seats except top surface;
- Pier caps except top surface;
- Exterior faces of curtain walls/wingwalls, cast-in-place walls and MSE wall copings;
- Grade separation piers except top surfaces;
- exterior concrete girder faces (when specified) (see Drawing SK-1 (Finishes and Sealing for Exterior Concrete Girders) in Appendix B);
- Exposed end surfaces of cast-in-place concrete diaphragms;
- Underside of the deck overhang to top flange of girder; and
- Exterior surfaces of deck slab, curb, barrier and sidewalk.

Class 4 Floated Surface Finish
- Top surfaces of concrete deck and roof slabs which are to receive waterproofing membranes and wearing surfaces;

Class 5 Floated Surface Finish, Broomed Texture
- Top surfaces of curbs, sidewalks, medians and pedestrian bridge deck;
- Approach slab concrete which will be covered by a wearing surface only (without waterproofing membrane);
- Concrete slope protection; and
- Deck joint blockout concrete top surfaces.

Class 6 Floated Surface Finish, Surface Textured
- Top surfaces of deck, deck overlay, roof and approach slabs which will not be covered with either waterproofing membrane or wearing surface.

Only approved wood or magnesium floats shall be used for finishing concrete. Finishing agents are not permitted during concrete finishing.

Class 2 and 3 finished concrete surfaces shall be such that when checked with a 3 m long straight edge placed anywhere in any direction on the surface, there shall not be any gap greater than 2 mm between the bottom of the straight edge and the concrete surface unless otherwise specified.

Class 1, 4, 5 and 6 finished concrete surfaces shall meet the requirements of Section 300.5.7.11.8 (Surface Defects and Tolerances) and be such that when checked with a 3 m long straight edge placed anywhere in any direction on the surface, there shall not be any gap greater than 3 mm between the bottom of the straight edge and the concrete surface unless otherwise specified.

300.5.7.16.2 Class 1. Ordinary Surface Finish

Unformed Surfaces - Immediately following placing and compacting, the concrete shall be screeded to conform to the required surface elevations, and then trowelled to ensure that the surface is free from open texturing, plucked aggregate, and local projections or depressions.

Formed Surfaces - Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces. On all surfaces the cavities produced by form ties, and all other holes, honeycomb areas, broken corners or edges and other defects, shall be thoroughly chipped out, cleaned, and shall be filled with a Department approved patching product. The repair material shall be appropriate for the intended application, and shall be placed in accordance with the manufacturer’s recommendations. All repairs shall be wet cured for a minimum of 72 hours. Curing compounds are not permitted.

300.5.7.16.3 Class 2. Rubbed Surface Finish

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces. All lines that are not true shall be corrected by chipping, grinding or repairing as necessary. Parging shall not be used to correct irregularities. On all surfaces, the cavities produced by form ties, air bubbles and all other holes, honeycomb areas, broken corners or edges and other defects, shall be thoroughly exposed by diamond grinding wheels. Surface voids less than 19 mm in diameter and 30 mm deep formed by air bubbles shall be filled with a pre-bagged sack rub material, placed in accordance with the manufacturer's recommendations. Surface voids greater than 19 mm in diameter but less than 0.1 m2 in area or 30 mm deep formed by air bubbles shall be filled with a Department approved patching material. The repair material shall be appropriate for the intended application and placed in accordance with the manufacturer's recommendations. All repairs and sack rubbed surfaces shall be wet cured for a minimum of 72 hours. Curing compounds are not permitted. When the patching and filling have adequately hardened, a carborundum stone shall be used to finish the surface to a smooth, uniform and closed texture. Any voids opened during the stone rubbing process shall be refilled.

It is essential that the prepared concrete surface, including all patching and filling be uniform in colour and texture. All portions of bridge elements, including those cast in more than one pour, shall be of the same colour and texture. Any staining caused by cement, water, weather, or other conditions shall be prevented, removed, or covered. After the surface preparation has been completed the Contractor shall apply sealer as specified in Section 300.5.7.17 (Type 1c Sealer).

300.5.7.16.4 Class 3. Bonded Concrete Surface Finish

Surface preparation shall be done as is specified for Section 300.5.7.16.3 (Class 2. Rubbed Surface Finish) above, except that uniformity in colour is not required. After the surface preparation has been completed, the concrete surfaces shall be pressure washed to remove all dust, dirt, laitance and all other bond breaking materials. The concrete surface shall be dried for a minimum of 24 hours. The Contractor shall then apply a pigmented concrete sealer, which meets the requirements for a Type 3 sealer in Alberta Transportation's *"Material Testing Specifications for Concrete Sealers"* (B388).

The pigmented concrete sealer shall be applied in accordance with the manufacturer's specifications and as a minimum two applications totalling the Department approved application rate of the pigmented sealer are required. When spray application is used the surface shall be back rolled. The Contractor shall ensure that no colour variation is visible, and shall match the colour of any previously painted adjoining surfaces. Acceptance of the pigmented sealer used will not relieve the Contractor of full responsibility for its acceptable appearance.

300.5.7.16.5 Class 4. Floated Surface Finish

Unless otherwise noted on the Detailed Designs, concrete which is to receive a waterproofing membrane and a final wearing surface, shall be manually floated with a magnesium bull float and trowelled as necessary to provide a smooth surface.

300.5.7.16.6 Class 5. Floated Surface Finish, Broomed Texture

The concrete surface shall be floated and trowelled as necessary to produce a smooth surface. The surface shall not vary more than 3 mm under a 3 m long straightedge.

After the concrete has set sufficiently, the surface shall be given a transversely broomed finish using a coarse broom to produce regular corrugations to a maximum depth of 2 mm. An edging tool shall be used at all edges and expansion joints. Where indicated on the Detailed Designs, sidewalk surfaces shall be laid out in blocks using an approved grooving tool.

300.5.7.16.7 Class 6. Floated Finish, Surface Textured

After the concrete has been bull floated, it shall be given a suitable texture with a "flat wire" texture broom having a single row of tines. The desired texture is transverse grooving which may vary from 1.5 mm width at 10 mm centres to 5 mm width at 20 mm centres, and the groove depth shall be 3 mm to 5 mm. This operation shall be done at such time and in such manner that the desired texture will be achieved while minimizing the displacement of the larger aggregate particles or steel fibres. The textured surface shall be uniform and consistent.

Following the surface texturing, a strip of the concrete along the inside curb line, shall be trowelled smooth and the surface left closed.

300.5.7.16.8 Concrete Finishing Under Bearings

All concrete areas on which bearing plates or pads are to be placed are to be at the required elevation, and are to be finished or ground to a smooth and even surface in preparation for bearing plates or pads. The finished surface shall not vary more than 1 mm over an area whose dimensions exceed the dimensions of the bearing plates by 60 mm. Air voids created by forming grout-pad depressions shall be filled with an approved patching material, well in advance of girder erection. In cold weather conditions this work shall be completed while the concrete is still warm and adequate protection shall be provided.

300.5.7.17 Type 1c Sealer

An approved Type 1c sealer shall be applied to all concrete surfaces which are susceptible to deterioration by water and de-icing salts. This shall include all concrete surfaces to 600 mm below grade, or in the case of river piers 600 mm below lowest water level, or as specified and shall include all surfaces which are to receive a Class 2, Class 4, Class 5 and Class 6 Finish. This does not apply to surfaces covered with waterproofing membrane and ACP wearing surface, drain troughs and concrete slope protection. Sealer will not be required on the underside of bridge decks and on concrete diaphragms in the interior bay areas; however, the faces of the end diaphragms nearest the abutment backwalls, inside faces of backwalls, top surface of abutment seats, excluding bearing recess pockets, and the deck and curb overhangs shall be sealed.

Type 1c sealers shall meet the Department's current "*Material Testing Specifications for Concrete Sealers*" (B388).

The sealer shall be applied in accordance with the manufacturer's recommendations; however, the application rate shall be increased by 30% from that indicated on the approval list. Before applying the sealer the concrete shall be cured for at least 28 days. The concrete surface shall be dry, and air blasted to remove all dust prior to applying sealer. In order to ensure uniform and sufficient coverage rates the Contractor shall apply measured volumes of sealing compound to appropriately dimensioned areas of concrete surface, using a minimum of two coats. All asphalt surfaces shall be adequately protected from overspray and runoff during sealer application.

300.5.7.18 Concrete Strength Requirements

Concrete with Strength Test Results shown below shall be removed:

- Class B concrete less than 20 MPa
- Class D and Pile concrete less than 24 MPa
- Class C concrete less than 27 MPa
- Class HPC concrete less than 40 MPa
- Class S concrete less than 16 MPa

The Department reserves the right to reject any concrete whatsoever which does not meet all the requirements for that class of concrete as stated in Section 300.5.7.5 (Class and Composition of Concrete). However, provided that the Contractor’s Engineer is of the opinion that the low strength concrete will meet all performance requirements throughout the life of the New Infrastructure, the Department may, in its sole discretion, accept concrete the strength of which falls below the specified strength requirements.

Payment Adjustments will be made in accordance with the following (however, if the minimum specified design strength for a class of concrete is increased above the design strength shown in Section 300.5.7.5 (Class and Composition of Concrete), then the Payment Adjustment strength ranges shown in this Section 300.5.7.18 (Concrete Strength Requirements) shall be increased by the same amount):

300.5.7.18.1 Class B Concrete, 25 MPa

Strength Test Results

24 MPa to 25 MPa	$30 per cubic metre
23 MPa to 24 MPa	$60 per cubic metre
22 MPa to 23 MPa	$90 per cubic metre
21 MPa to 22 MPa	$120 per cubic metre
20 MPa to 21 MPa	$160 per cubic metre

300.5.7.18.2 Class D Concrete, Pile Concrete, 30 MPa

Strength Test Results

29 MPa to 30 MPa	$30 per cubic metre
28 MPa to 29 MPa	$60 per cubic metre
27 MPa to 28 MPa	$90 per cubic metre
26 MPa to 27 MPa	$120 per cubic metre

25 MPa to 26 MPa	$160 per cubic metre
24 MPa to 25 MPa	$220 per cubic metre

300.5.7.18.3 Class C Concrete, 35 MPa

Strength Test Results

34 MPa to 35 MPa	$30 per cubic metre
33 MPa to 34 MPa	$60 per cubic metre
32 MPa to 33 MPa	$90 per cubic metre
31 MPa to 32 MPa	$120 per cubic metre
30 MPa to 31 MPa	$160 per cubic metre
29 MPa to 30 MPa	$220 per cubic metre
28 MPa to 29 MPa	$300 per cubic metre
27 MPa to 28 MPa	$400 per cubic metre

300.5.7.18.4 Class HPC Concrete, 45 MPa

Strength Test Results

44 MPa to 45 MPa	$40 per cubic metre
43 MPa to 44 MPa	$100 per cubic metre
42 MPa to 43 MPa	$180 per cubic metre
41 MPa to 42 MPa	$280 per cubic metre
40 MPa to 41 MPa	$400 per cubic metre

300.5.7.18.5 Class S Concrete, 20 MPa

Strength Test Results

18 MPa to 20 MPa	$30 per cubic metre
16 MPa to 18 MPa	$70 per cubic metre

The Payment Adjustments for all classes of concrete shall apply to the volume of concrete represented by the Strength Test as defined in Section 300.5.7.7.1 (Strength Tests).

300.5.7.18.6 Coring for Compressive Strength Testing

Coring to confirm or contest low concrete Strength Test results shall be subject to approval by the Department. When coring is approved, arrangements shall be made by the Contractor, to employ a CSA Category 1 or higher level certified testing laboratory, all at the expense of the Contractor. The cores shall be taken and tested within seven days of the testing of the 28-day cylinders representing the concrete in question. Where practical, three 100 mm diameter cores shall be taken for each non-compliant Strength Test previously taken, and there shall be no doubt that the cores taken and the cylinders under consideration, represent the same batch of concrete. Cores may not be taken unless the Department is present. Cores shall be tested by an independent CSA certified Category 1 or higher level testing laboratory and in accordance with the requirements of CSA Standard A23.2-14C. CSA Standard A23.1-09, Clause 4.4.6.6.2 (Cores drilled from a structure) shall not apply. The average strength of each set of three cores shall be equal to or greater than the 28-day specified strength. The average strength of the cores as reported by the independent testing service shall constitute a test.

In cases where the concrete strength, as indicated by the cores, is higher than the strength based on the concrete cylinder results, the core results shall be used as the basis for acceptance of the concrete. If the core strengths are lower than the strength from the concrete cylinder tests, the cylinder tests shall govern.

The average strength of each set of three cores shall be equal to or greater than the 28 day specified strength. CSA A23.1-09 Clause 4.4.6.6.2 "Cores Drilled from a Structure" does not apply.

300.5.8 STRUCTURAL STEEL

300.5.8.1 General

This specification in Section 300.5.8 is for the supply, fabrication, delivery and erection of structural steel. Structural steel shall include steel girders, trusses, diaphragms, bracing, splice plates, deck drains, structural bearings, anchor bolts, dowels, deck joint assemblies, buffer angles, connector angles, anchor bolt sleeves, curb and median cover and trough plates, pier nose plates, pier bracing, bridge rails and miscellaneous components.

300.5.8.2 Submissions

The following information shall be submitted to the Department by a date that is reasonable having regard to the design and construction process and in any event within the times noted below. In the event that the Department requests any of the following information, the requested information shall be provided within seven days, notwithstanding the times noted below.

- Proposed fabrication sequences (at least five days prior to fabrication). The Department shall be advised a minimum of two days prior to a component being ready for inspection at an inspection station;
- Web and flange plate arrangements for welded plate girders (at least five days prior to fabrication);
- Welding procedures for all welds (at least five days prior to fabrication);
- Shop drawings (two copies) (at least five days prior to fabrication);
- Mill certificates for all material;
- Repair procedures for excessive girder camber, if required;
- Repair procedures for unsatisfactory weldments and accidental arc strikes, if required;
- Repair procedures for flame straightening of members, if required;
- Product data sheets for coatings required between galvanized steel and concrete;
- Repair procedures for galvanizing, if required;

- All results from Testing and Inspection (Section 300.5.8.4.4);
- Erection procedures, including drawings for falsework, berms and traffic accommodation (two copies) (at least 14 days prior to erection);
- Procedures for straightening bent material during erection, if required; and
- Methods of forming and pouring grout (at least 14 days prior to placing grout).

300.5.8.3 Supply and Fabrication

300.5.8.3.1 Standards

Fabrication of structural steel shall conform to *AASHTO LFRD Bridge Construction Specifications* and the *American Welding Society* (“**AWS**”) - *Bridge Welding Code, D1.5*.

All welding, cutting and preparation shall be in accordance with the AWS - *Bridge Welding Code, D1.5*.

300.5.8.3.2 Qualification

The Contractor shall be responsible for the work of all subcontractors.

The fabricator shall operate a recognized steel fabricating shop and be fully approved by the CWB as per Canadian Standards Association (“**CSA**”) Standard W47.1 in the following Divisions:

- Fabrication of steel girders, girder components and welded steel trusses – Division 1;
- All other bridge components – Division 2.

In addition, fabricators of steel girders, girder components and welded steel trusses shall be certified by the Canadian Institute of Steel Construction (CISC) in an appropriate class.

Only welders, welding operators and tackers approved by the CWB in the particular category shall be permitted to perform weldments. Their qualifications shall be current and available for auditing by the Department.

300.5.8.3.3 Engineering Data

(1) Approval of Plate Arrangement for Welded Plate Girders

Prior to the placing of material orders, the Contractor shall prepare and provide sketch drawings showing the general description of the proposed fabrication scheme. This shall include the general arrangement of plates or shapes, including the location of all shop and field splices.

(2) Welding Procedures

Welding procedures, including Welding Procedure Datasheets shall be prepared for each type of weld used in the structure. The procedures shall bear the approval of the CWB and shall also be submitted to be reviewed by the Department prior to use on the structure.

(3) Shop Drawings

Shop drawings showing all details shall be prepared by the Contractor. The shop drawings shall be legible and of adequate quality to be reproduced and microfilmed.
In addition to specific details, the shop drawings shall include the following:

(a) Drawings showing details of connections not shown on the Detailed Designs shall bear the signature and stamp of a Professional Engineer ;
(b) All dimensions shall be correct at 20 degrees Celsius unless otherwise noted;
(c) Weld procedure identification shall be shown on the shop drawings in the tail of the weld symbols;
(d) All material splice locations shall be shown on the drawings;
(e) Bearings shall be centered at -5 degrees Celsius;
(f) Shop assembly drawings shall indicate camber and splice joint offsets measured to the top of top flange at a maximum spacing of 4 m; and
(g) The Department's bridge file number and project name shall be shown on all the shop drawings.

(4) Proposed Fabrication Sequence

Prior to commencement of fabrication, the Contractor shall prepare an outline of the fabrication sequence and details of equipment which will be used for the fabrication. The fabrication scheme shall include the order of make-up and assembly of all the component parts, as well as shop assembly, inspection stations, and surface preparation. If any equipment causes repeated defective work it shall be substituted with a suitable alternative.

(5) Mill Certificates

Mill certificates shall be obtained for all material before fabrication commences.

300.5.8.4 Materials

(1) Structural Steel

Structural steel shall conform to the standard noted on the Detailed Designs. Interpretation of equivalent steels will be as per Appendix "A" of the CSA Standard G40.21 (1976 only). Mill certificate data and results of impact tests shall be obtained prior to shipment of material from the mill to provide sufficient time for replacement or for heat treating of material that does not meet the Technical Requirements.

All steel for bridgerail shall conform to the standard noted on the Detailed Design. The silicon content for various bridgerail and handrail components shall be as follows:

- structural tubing less than 0.04%

- structural sections, handrail bars, base plate less than 0.04% or between 0.15% to 0.25%.

(2) Bolts

All bolts, nuts and washers shall conform to ASTM Standard A325 or shall meet property Class 8.8 of the Industrial Fasteners Institute for metric high strength structural bolts, nuts and washers. Metric bolts shall be marked with the symbol A325M and those of a "weathering" steel shall have the A325M symbol underlined. Metric nuts shall be marked with three circumferential lines with an "M" between two of them or shall be marked with a "3" if made of a weathering grade. Washers shall be identified as metric preferably by having an "M" indented in the surface or a "3" for weathering grades. Certified mill test reports for the fastener material shall be obtained.

(3) Stud Shear Connectors

All stud shear connectors shall conform to the chemical requirements of ASTM Standard A108, Grades 1015, 1018 or 1020. In addition they shall meet the mechanical properties specified in AWS D1.5, Table 7.1 for Type B studs. Certified mill test reports for the stud material shall be obtained.

(4) Bearings

Elastomeric bearings and pot bearing shall be in accordance with Section 300.5.18 (Elastomeric and Pot Bearings).

300.5.8.4.1 Welding

(1) Filler Metals and Welding Processes

Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal. The low hydrogen covering and flux shall be protected and stored as specified by AWS Standard D1.5. Flux cored welding or use of cored filler wires in the submerged arc process or shielding gas processes, are not considered as conforming to low hydrogen practice, and will not be permitted.

(a) Submerged Arc Welding ("**SAW**")
Submerged arc welding process is allowed for all flat and horizontal position welds. All flange and web butt joints shall be made by an approved semi or fully automatic submerged arc process. All web to flange fillet welds and all longitudinal stiffener to web fillet welds shall be made by an approved fully automatic submerged arc process.

(b) Shielded Metal Arc Welding ("**SMAW**")
Shielded metal arc welding is allowed for girder vertical stiffener to flange fillet welds and for miscellaneous components such as deck drains, bridge bearings, deck joint assemblies, pier nose plates and buffer angles.

(c) Metal Core Arc Welding ("**MCAW**")
Metal core welding process utilizing low hydrogen consumables with AWS designation of H4 is allowed for vertical stiffeners and horizontal gussets of the girders, bridgerails, and miscellaneous components such as deck drains, bridge bearings, deck joint assemblies, pier nose plates and buffer angles.

Field application of metal core arc welding is not allowed.

(2) Cleaning Prior to Welding

Weld areas must be clean, free of mill scale, dirt, grease and other contaminants prior to welding.

(3) Intentionally Deleted

(4) Tack and Temporary Welds

Tack and temporary welds shall not be allowed unless they are to be incorporated in the final weld. Tack welds, where allowed, shall be of a minimum length of four times the nominal size of the weld and length shall not exceed 15 times the weld size, and shall be subject to the same quality requirements as the final welds. Tack welds shall be sufficiently ground out prior to final weld in order to obtain a uniform weld bead. Cracked tack welds shall be completely removed prior to welding over.

(5) Run-off Tabs

Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. The tabs shall be a minimum of 100mm long unless greater length is required for satisfactory work. They shall be tack welded only to that portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs are to be removed by flame cutting, not by breaking off.

(6) Preheat

Preheat requirements shall be performed and maintained as per AWS D1.5, except that all welds on girder flanges shall be preheated to a minimum temperature of 100 degrees Celsius unless a higher temperature is required by AWS D1.5 for the flange thickness. The preheat temperature of the web to flange joint shall be measured 75 mm from the point of welding on the side of the flange opposite to the side where the weld is being applied.

(7) Welding at Stiffener Ends

To prevent notching effects, stiffeners and attachments fillet welded to structural members shall have the fillet welds terminate 10 mm short of edges.

(8) Methods of Weldment Repair

Repair procedures for unsatisfactory weldments shall be prepared by an experienced welding engineer registered as a Professional Engineer prior to repair work commencing.

(9) Arc Strikes

Arc strikes will not be permitted. In the event of accidental arc strikes a repair procedure shall be prepared by an experienced welding engineer registered as a Professional Engineer. The repair procedure shall include the complete grinding out of the crater produced by the arc strike.

(10) Grinding of Welds

Flange butt welds shall be ground flush or to a specified slope on both sides. Web butt welds which are sufficiently smooth with a neat appearance and uniform profile, as determined by the Contractor's independent welding inspector but subject to the Department's review, will not require grinding. Fillet welds not conforming to acceptable profile shall be ground to the proper profile without substantial removal of the base metal. Grinding shall be smooth and parallel to the line of stress. Caution shall be exercised to prevent over grinding.

(11) Plug and Slot Welds

Plug welds or slot welds shall not be permitted.

(12) Field Welding

Where field welding of structural members is carried out, the following requirements shall be met:

(a) All welding, cutting and preparation shall be in accordance with the American Welding Society ("**AWS**") - Bridge Welding Code, D1.5.

(b) Only welders approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments.

(c) Welding procedures approved by the Canadian Welding Bureau shall be prepared and submitted for review by the Department prior to use on the structure.

(d) Low hydrogen filler, fluxes and welding practices shall be used in accordance with Section 300.5.8.4.1(1) (Filler Metals & Welding Processes).

(e) When the air temperature is below 10 degrees Celsius, all material to be welded shall be preheated to 100 degrees Celsius for a distance of 80 mm beyond the weld and shall be sheltered from the wind.

(f) When the air temperature is below 0 degrees Celsius, welding shall not be permitted unless suitable hoarding and heating is provided. The air temperature inside the enclosure shall be a minimum of 10 degrees Celsius. If the steel temperature is less than 10 degrees Celsius, preheat as in (e) above.

(g) All field welds of structural members shall be visually inspected by an independent welding inspector certified to Level 3 of CSA W178.2.

Where field welding of non-structural members is carried out, the following requirements shall be met:

(h) Journeyman welders with Class B tickets shall be permitted to perform weldments.

(i) Welding procedures prepared and stamped by a Professional Engineer shall be prepared.

(j) Low hydrogen filler, fluxes and welding practice shall be used in accordance with Section 300.5.8.4.1 (1) (Filler Metals & Welding Processes).

(k) When the air temperature is below 5 degrees Celsius, all material to be welded shall be preheated to 100 degrees Celsius for a distance of 80 mm beyond the weld and shall be sheltered from the wind.

(l) When the air temperature is below 0 degrees Celsius, welding shall not be permitted unless suitable hoarding and heating, is provided.

Structural field welds are welds that are required to maintain the integrity of the structure. An example of non-structural field welding is Type 1 deck joint splices.

(13) Welding to Girder Flanges and Webs

With the exception of longitudinal web to flange welds, all stiffener, gusset plate, or any other detail material welds to girder flanges shall be a minimum of 300 mm from the flange butt welds.

With the exception of longitudinal web to flange welds and longitudinal stiffener to web welds, all stiffener, gusset plate, or any other detail material welds to girder webs shall be a minimum of 300 mm from the web butt welds.

300.5.8.4.2 Fabrication

Fabrication shall be performed in a fully enclosed area which is adequately heated. The shop temperature shall be at least 10 degrees Celsius.

(1) Heat Number Transfer

As the plate is subdivided for webs and flanges, all heat numbers shall be transferred to each individual section. The numbers shall remain legible until such time as the material location in the final assembly has been recorded. Mill identification numbers stamped into the material shall be removed by grinding at an appropriate time.

(2) Marking Systems

Steel stamps shall not be used. The only exception is the match marking of splice plates which may be steel stamped using low stress stamps. The stamps and specific locations of such stamps must be shown on the shop drawings.

(3) Cutting of Plate

All plate material for main members, splice plates and any plate material welded to the main member shall be flame cut using an automatic cutting machine. Shearing is not allowed.

(4) Flange Stripping

All flange material shall be cut so that the direction of the applied stress will be parallel to the direction of the plate rolling.

(5) Flame Cut Edges

The flame cut edges of girder flanges shall have a maximum Brinell hardness as stated by Section 300.5.8.4.4(10) (Hardness Test). The surface roughness of the flame cut edge shall not be greater than ANSI B46.1 500 μin. (12.5 μm) and be such that to allow Brinell hardness testing without spot grinding. The Contractor shall report all blow backs or signs of lamination observed during the cutting of the material. The Contractor will perform Brinell hardness tests on the as is flame cut edge. If the hardness exceeds the requirements, the edges shall be repaired so that they meet the requirements.

The surface of flame cut apertures shall be finished by grinding and shall be free of nicks and gouges.

(6) Vertical Alignment

The structure shall be fabricated to conform to the requirements of the deflection and vertical curve, as noted on the Detailed Designs. For rolled shapes, advantage shall be taken of mill camber that may be inherent in the material.

(7) Shop Assembly

(a) <u>Plate Girders</u>
Shop assembly of girders shall be by the progressive assembly method according to AASHTO, except that only two, instead of three, sections need to be assembled. The detailed method of assembly, including points of support, dimensional checks, method of trimming to length, drilling and marking of splices, shall be to the procedure prepared as per Section 300.5.8.3.3(4) (Proposed Fabrication Sequence). Each individual girder section shall meet the camber requirements for that particular length, with the splices between these

sections falling on the theoretical camber line for the entire span. Correction for variation in flange thickness must be considered. When the camber of the girder fails to meet the required tolerance, the Contractor shall develop a method of repair prior to commencement of repair. The camber of each individual girder section must be known for the next two girder sections in the girder line prior to shop assembly of any particular girder section. This is to allow the use of a best fit line to reduce the effect of any camber differences should it be deemed necessary. Camber for plate girders will be measured on the top of the top flange. The camber of plate girders shall be measured in the "no load" condition.

(b) Box Girders

The progressive shop assembly for box girders shall be as per Section 300.5.8.4.2(7)(a) (Plate Girders); items described in this section are specific to box girders.

The camber of box girders shall be measured on the top of the top flange, and each top flange of a box shall individually meet the required camber. Girder sections assembled for splicing shall be supported within 2 m of the end of each section. Girder sections shall be supported in such a manner as to provide the correct angular relationship at the splice between girder sections while the splices are being reamed or drilled. Shop drawings shall clearly indicate the expected dead load deflection of each section and the elevations of the sections while supported for the drilling or reaming of each splice.

(c) Drilling

All splices shall be drilled from solid material while assembled or shall be sub-punched or sub-drilled and then reamed to full size while in the shop assembly position.

(8) Splice Plates

After shop assembly, splice plates and girders shall be clearly match marked to assure proper orientation and location of splice material for erection. All holes shall align with holes in the attached member. Splice plates shall then be removed, de-burred, solvent cleaned to remove all oil and sandblasted to remove all mill scale in order to provide a suitable faying surface. These plates shall then be securely ship-bolted to the girders. The match marking system shall be shown on the shop drawings.

(9) Bolt Holes

Clause 11.4.8 in AASHTO *LFRD Bridge Construction Specifications* shall apply except that all bolt holes in load carrying segments of main members and any material welded to main members shall be drilled full size or sub-punched 5 mm smaller and reamed to full size. Punching of full size holes for secondary members such as bracings which are not welded to main member is allowed for material less than 16 mm thick. All holes in girder splices shall be circular and perpendicular to the member and shall be deburred to ensure a proper faying surface.

(10) Dimensional Tolerances

Normal tolerance for structural steel fabrication and fitting between hole groups will be ± 3 mm unless specified otherwise. The dimensional tolerances for structural members shall be within the AWS Standard D1.5, section 3.5, except as otherwise noted below:

(a) Girder Camber
Camber of beams and girders shall be uniform, true and accurate to the centreline of the top flange. Permissible variation in camber shall be within ± (0.2Lt + 3) mm; where Lt is the test length in metres. This applies to fabricated pieces only, prior to shop assembly. During shop assembly, splice points shall be located on the theoretical camber line or at a specified amount from the line.

Where field splices are eliminated by combining girder segments into longer girder lengths, the cambers of the girders at the eliminated splice points shall be within ± 3 mm.

(b) Box Girders
Tolerances for box girder camber, sweep and depth shall be measured relative to two imaginary surfaces: a vertical plane passing through the centre line of the girder; and a surface located at the theoretical underside of the top flanges following the theoretical camber of the girder.

(c) Splices
Fill plates shall not be permitted at main girder field splices unless specified. The tolerance for girder depth or box girder geometry shall be as specified by AWS D1.5, except that the difference between similar dimensions of the adjoining sections being spliced shall not exceed ± 3 mm.

(d) Fitted Stiffeners
The bearing ends of bearing stiffeners shall be flush and square with the web and shall have at least 75% of this area in contact with the flanges, whereas fitted stiffeners may have a gap of up to 1 mm between stiffener and flange.

(e) Bearing to Bearing Dimension
Bearing to bearing distance is a set dimension and therefore has no tolerance.

(f) Deck Joint Assemblies
Deck joint assemblies shall be assembled for inspection in a relaxed condition with erection angles removed. Approval of the assembly is required prior to application of the erection angles. Tolerances for straightness shall be considered over the length of the assembly between the crown and gutter line both before and after galvanizing. Deviation from straightness in a vertical plane shall not exceed ± 6 mm. Horizontal sweep or variations in gap setting shall not be greater than 3 mm.

(g) Combined Warpage and Tilt
Combined warpage and tilt of flange at any cross section of welded I-shape beams or girders shall be determined by measuring the offset at the toe of the flange from a line normal to the plane of web through the intersection of the centerline of the web with the outside surface of the flange plate. This offset shall not exceed 1/200 of the total width of

the flange or 3 mm whichever is greater at bolted splice location. Bolted splices of main stress carrying members shall have parallel planes and the surfaces shall be in full contact without any gap.

(11) Corner Chamfer

Corners of all flanges shall be ground to a 2 mm chamfer. Corners of stiffeners, structural sections and plates shall be ground to a 1mm chamfer.

(12) Milling Tolerances

Tolerance for milled to bear stiffeners shall be 0.05 mm with at least 75% of the area in bearing.

(13) Web Panning

The maximum variation from flatness for webs shall be 0.01d where d is the least dimension of the panel formed by the girder flanges and/or stiffeners. Should the panning in one panel be convex and the panning in the adjacent panel be concave then the sum of the panning in the two adjacent sections shall not exceed that allowed for one panel. Localized deformation in the web shall not exceed 3 mm in 1 m.

(14) Flame Straightening

Flame straightening shall not be performed on any material or member without the development of a repair procedure by a Professional Engineer. The repair procedure shall address locations, temperatures and cooling rates.

(15) Stress Relieving

When stress relieving is specified, it shall be performed in accordance with AWS D1.5. Copies of the furnace charts shall be supplied to the Department.

(16) Handling and Storage

All lifting and handling shall be done using devices that do not mark, damage, or distort the assemblies or members in any way. Girders shall be stored upright, supported on sufficient skids and safely shored to maintain the proper section without buckling, twisting or in any way damaging or misaligning the material.

300.5.8.4.3 Surface Preparation and Coating

(1) Blast Cleaning

Unless otherwise noted, all steel components shall be blast cleaned after fabrication in accordance with the *Society for Protective Coating Standard (SSPC) No. SP6*. Essentially this is a surface from which all oil, grease, dirt, rust, foreign matter, mill scale and old paint have been completely removed except for slight shadows, streaks or discolourations caused by rust stain or mill scale oxide binder. The exterior face of exterior girders shall be uniform in appearance.

(2) Galvanizing

Galvanizing shall be by the hot dip method, after fabrication, in accordance ASTM *A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products* and ASTM *A153/A153M Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware* with additions and exceptions as described in this specification. The fabricator shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing.

Repair of galvanizing shall only be done if bare areas are infrequent, small, and suitable for repair. A detailed repair procedure shall be prepared by a Professional Engineer prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A780, Method A3 Metallizing. The thickness of the metallizing shall be 180 μm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing.

(3) Additional Galvanizing Requirements for Bridgerail, Handrail and Light Standards

The bottom surface of each base plate shall be protected by a medium grey colour barrier coating to prevent contact between the zinc and the concrete. The galvanized surface must be roughened prior to application of barrier coating. The surface preparation of the galvanized surface and the dry film thickness ("**DFT**") of the coating shall be in accordance with the coating manufacturer's recommendations. The Contractor shall test the adhesion of fully cured coating as per ASTM D3359. The method selected for testing (Method A or B) shall depend on the dry film thickness of the coating. The coating manufacturer's product data sheets shall be obtained prior to the application of the coating. The adhesion test result shall meet a minimum of "4B" classification, i.e. a maximum allowable flaking of 5%.

The fabricator shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing. The galvanized finish shall meet the aesthetic requirements of the application and shall have a continuous outer free zinc layer without any significant zinc-iron alloy showing through the outside surface. Lumps, globules or heavy deposits of zinc will not be permitted. Handrails shall be free of any sharp protrusions or edges.

Double dip galvanizing is not advised but will be accepted if a surface finish similar in appearance, colour and quality to that of single dip galvanizing is produced. The lapped area of the double dip shall be straight, the coating smooth, adherent and free of uncoated areas, blisters, flux deposits, dross inclusions, acid and black spots.

300.5.8.4.4 Testing and Inspection

(1) Access

The Contractor shall provide full access for the inspection of material and workmanship by the Department. Free access shall be allowed to the Department to all parts of the works. When required by the Department, the Contractor shall provide needed manpower for assistance in inspection duties.

(2) Testing by the Department

The Department may perform visual, radiographic, ultrasonic, magnetic particle and any other inspection that may be required at its own expense.

(3) Testing by the Contractor

Any test records made by the fabricating shop in the course of normal quality control shall be open to the Department for inspection.

All welds shall be visually inspected by an independent welding inspector certified to Level 3 of CSA W178.2.

(4) Inspection Station

To ensure that each stage of inspection is performed in an orderly manner, during the fabrication of major structures, inspection stations shall be set up at specific points. Sub-assemblies of the work will then be checked by the Contractor, and all deficiencies shall be corrected, prior to the work being sent to the next stage of fabrication.

Typical check points for a plate girder are:

- Flange plates prepared.
- Web plates prepared.
- Web to flange welds completed prior to fitting any stiffeners.
- Completion of all welding prior to splicing.
- Splice set-up prior to drilling.
- Surface preparation and coating.
- Clearance to ship.

(5) Non-destructive Methods of Examination

The methods of non-destructive examination shall be in accordance with the following standards:

- Radiography - AWS Standard D1.5
- Ultrasonic - AWS Standard D1.5

- Magnetic Particle - ASTM Standard E-709
- Dye-Penetrant - ASTM Standard E-165
- Hardness tests - ASTM Standard E-103

The non-destructive examination shall be done by a company certified to CAN CSA W178.1. Radiographic testing and magnetic particle testing technicians shall be certified to Level II of CGSB.

(6) Radiographic Inspection Schedule

Unless otherwise noted, radiographic inspection of welded plate girders shall be performed by the Contractor in accordance with the following schedule:

(a) 100% of all tension flange and stress reversal butt welds, all stiffener butt welds and all diaphragm butt welds, and any groove welded attachments to flange plates.
(b) A minimum of 25% of all other flange butt welds randomly selected for each structure. Additional testing may be required to ensure the quality of welds.
(c) All web butt welds in tension and stress reversal zones plus additional 300 mm of web butt weld in compression zone at the end of the web.

(7) Radiographic Inspection of Miscellaneous Material

Unless otherwise noted, radiographic inspection of miscellaneous material shall be performed by the Contractor in accordance with the following schedule:

(a) 100% of all tension members.
(b) 50% of all other members.

(8) Magnetic Particle Inspection Schedule

Unless otherwise noted, magnetic particle inspection of welded plate girders shall be performed by the Contractor for each girder section in accordance with the following schedule:

(a) 50% of the web to flange welds or any fillet welds placed on flange plates.
(b) 10% of the web to stiffener welds.
(c) 100% of the stiffeners to flange welds.
(d) 100% of the bearing sole plate to flange welds.
(e) 20% of the diaphragm connector plate welds.

(9) Dye Penetrant Inspection

Dye penetrant inspection shall be performed by the Contractor at the ends of the weld metal of all flange butt welds after the removal of run-off tabs. Defects discovered by this inspection shall be repaired by the Contractor, and the suspect area re-inspected.

(10) Hardness Tests

Hardness tests shall be performed by the Contractor on the flame cut edges of the girder flange prior to assembly. Unless otherwise noted, the hardness of the flame cut edges shall not exceed a maximum Brinell as noted below:

(a) For carbon steels with a yield strength less than and including 300 MPa, the maximum Brinell shall be 200 BHN.

(b) For carbon steels with a yield strength greater than 300 MPa, the maximum Brinell shall be 220 BHN.

Remedial work to the edges which exceed the specified hardness shall be performed and re-inspected prior to assembly.

(11) Testing Stud Shear Connectors

Stud shear connectors shall meet all requirements as outlined by AWS D1.5. The Contractor shall perform bend testing in accordance with AWS D1.5. When bend testing, the studs shall be bent towards the centre of the girder.

(12) Testing of Deck Joint Strip Seal

The installation of strip seals in deck joints shall be tested by the Contractor for leakage. The failed areas shall be corrected and retested. The defective or torn seal shall be replaced at the Contractor's expense.

300.5.8.5 Structural Steel Erection

The Contractor shall erect the structural steel, remove any temporary construction, and do all work required to complete the erection in accordance with the Detailed Designs and the Technical Requirements. No drilling of additional holes or any other modifications including field welding shall be made to steel elements other than deck joints. Lifting devices shall not be welded to girders. The Contractor shall not erect the structural steel until the substructure concrete has been cured a minimum of three days and achieved 80% of the 28 day specified concrete strength requirement. Without restricting generality, erection includes:

- placing of anchor bolts and bearings;
- erection of temporary supporting structures;
- erection of structural steel;
- placing of expansion assemblies;
- grouting of anchor bolts;
- placing and sealing of grout pads; and
- touch-up painting as required.

300.5.8.5.1 Transporting, Handling and Storing Materials

Material to be stored shall be placed on timber blocking. It shall be kept clean and stored in a properly drained area. Girders and beams shall be placed upright and shored. Long members, such as deck joint assemblies, buffer angles, columns and chords, shall be supported on timber blocking to prevent damage from deflection.

Girders and beams shall be transported in the vertical position. However these elements may be transported in other positions provided:

- A Professional Engineer (structural discipline) performs the analysis and provides a written statement that the proposed method will not damage the elements and a copy of the same shall be provided to the Department forthwith.
- Upon arrival at the site and prior to erection, the elements shall be checked by the Contractor to ensure all tolerances are met. The Contractor shall provide an adequate flat storage area for the inspection.
- Any structural steel member damaged during transportation, handling, storage or erection shall be immediately reported to the Department, and an engineering assessment prepared by a Professional Engineer experienced in evaluation and inspection of damaged steel members. The Contractor shall also provide three day's notice for access, and facilitate any activities required for an independent assessment by the Department if requested; and
- All uncoated steel shall be protected against contamination by road salt during transportation. In the event of contamination, the steel shall be power washed upon arrival at site, or power washed and completely blast cleaned again if the contamination is not initially removed after being power washed.

300.5.8.5.2 Bridge Girders

(1) Temporary Supporting Structures and Berms

The temporary supporting structures and berms shall be designed, constructed and maintained to safely support all loads. Berms shall be constructed in a manner and of such materials that they will not be eroded by stream flow nor introduce silt into the water. The Contractor shall prepare drawings for temporary supporting structures, berms, and for traffic control and accommodation where applicable. All drawings shall bear the seal of a Professional Engineer.

Temporary supporting structures and/or berms will not be permitted to remain in any stream channel during spring break-up or run-off periods, unless all necessary approvals have been obtained from pertinent agencies.

Repair to any damage to other property, such as earth fills and stream banks, resulting from the existence of berms, shall be the responsibility of the Contractor.

(2) Erection Procedure

The Contractor shall prepare, and provide to the Department forthwith, a detailed erection procedure in advance of the scheduled start of erection. The erection procedure shall include all drawings and documents necessary to describe the following:

(a) Traffic accommodation strategy, as applicable.

(b) Access to work, earth berms and work bridges.

(c) Type and capacity of equipment. Cranes shall be used for handling and erecting structural steel girders.

(d) Sequence of operation including position of cranes and trucks with members.

(e) Position of cranes relative to substructure elements such as abutment backwalls, with details of load distribution of wheels and outriggers.

(f) Lifting devices and lifting points. No drilling of additional holes or any other modifications, including field welding, shall be made to steel elements other than deck joints. Lifting devices shall not be welded to the girders.

(g) Details of temporary works, supporting structures drawings, including proposed methods to be used to ensure the required splice elevations and structure shape prior to bolt torquing method of providing temporary supports for stability, top of girder elevations at each bearing and each slice location where appropriate.

(h) Bolt tightening sequence.

(i) Grout Pad Construction (refer to Section 300.5.8.5.2(10) (Grout Pockets and Grout Pads)).

(j) Details of release of temporary supporting structures.

(k) Provide an “As-Constructed” detailed survey of the substructure showing the following:
- location and elevation of all bearing grout pad recesses,
- shim height at each bearing location,
- top of girder elevations at each bearing (and each splice location where appropriate), and
- longitudinal measurements between centrelines of bearings of all substructure units.

The erection procedure shall be stamped by a Professional Engineer who shall assume full responsibility to ensure that its erection procedure is being followed. Safety and compliance with the *Occupational Health and Safety Act* (Alberta) and regulations thereunder shall be an integral part of the design.

Before erection begins the Contractor shall do a complete superstructure layout by means of chalk lines and markings applied to all substructure units, showing bearing and girder positions in accordance with the layout plan.

(3) Fall Protection for Girder Erection and Deck Forming

In order to provide a safe working area for girder erection and deck formwork, the Contractor shall provide 100% fall protection and a safe work procedure.

(4) Bearings and Anchorage

Masonry bearing plates shall not be placed upon bridge seat bearing areas which are improperly finished, deformed or irregular. Bearing plates shall be set level in their exact position.

The Contractor shall remove anchor bolt void forming materials, and accurately set the anchor bolts, except where the bolts were cast into the concrete. Any residues on the concrete surfaces, such as oils, grease or other contaminants, shall be removed by sandblasting. All methods and materials for setting anchor bolts and constructing bearing pads shall be subject to the Department's prior review and acceptance. The location of the anchor bolts, in relation to the slotted holes in the expansion shoes, shall correspond with the temperature at the time of erection. The nuts on the anchor bolts, at the expansion ends of spans, shall be adjusted to permit free movement of the spans.

When steel bearings are employed in conjunction with grout pockets in the substructure, the bearings shall be set accurately on galvanized steel shims, and grouted as detailed on the Detailed Designs, after the erection has been completed. The shims must be located so that a minimum of 75 mm grout coverage is provided. When grout pockets are not detailed, the bearing plates shall be set on the properly finished bearing areas in exact position and shall have a full and even bearing on the concrete.

When required, field welding adjacent to elastomeric pads shall be performed with care to avoid damage to the elastomer. The temperature of the steel adjacent to the elastomer shall be kept below 120 degrees Celsius. The distance between the weld and the elastomer shall be at least 40 mm.

(5) Straightening Bent Material

Straightening of plates, angles or other shapes will not be permitted without a detailed procedure prepared by a Professional Engineer, and provided to the Department for its prior review, prior to any straightening being undertaken.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fractures, which may include non-destructive testing.

(6) Assembly

The parts shall be accurately assembled as shown on the shop drawings and all match-marks shall be followed. The material shall be carefully handled to avoid damage. Hammering, which will injure or distort the members, shall not be permitted. Bearing surfaces and surfaces to be in permanent contact shall be clean before the members are assembled.

Splices and field connections shall have one half of the holes filled with bolts and cylindrical erection pins (half bolts and half pins evenly distributed throughout the splice or connection) before bolting. Splices and connections carrying traffic during erection shall have three-fourths of the holes filled.

Fitting-up bolts shall be of the same nominal diameter as the bolts, and cylindrical erection pins shall be sized to accurately fit the holes.

Should adjustments in elevation of the girder splices become necessary to allow free rotation of the joint, only enough pins or bolts shall be removed.

(7) High-Tensile-Strength Bolted Connections

(a) General

Bolted parts shall fit solidly together when assembled. Contact surfaces, including those adjacent to the washers, shall be descaled or carry the normal tight mill scale. Contact surfaces shall be free of dirt, paint, oil, loose scale, burrs, pits and other defects that would prevent solid seating of the parts. Unless otherwise noted, bolts in exterior girders shall be installed with the heads on the outside face of the girder web and bolts in all girders shall be installed with the heads on the bottom faces of lower flanges. Nuts for bolts that will be partially embedded in concrete shall be located on the side of the member that will be encased in concrete.

Connections shall be assembled with a hardened washer under the bolt head or nut, whichever is the element turned in tightening. Surfaces of bolted parts in contact with the bolt head and nut shall be parallel.

For sloped surfaces, bevelled washers shall be used. The bevelled washers shall be designed to produce a bearing surface normal to the bolt axis.

Bolts shall be of new quality and stored in weatherproof containers to prevent loss of lubrication or accumulation of dirt.

All girders shall be erected with elevations and alignments checked prior to any bolt tightening.

(b) Bolt Tension

Tightening of all high strength bolts shall be by the turn-of-nut method. Before final tightening there shall be a sufficient number of bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into full contact with each other. "**Snug tight**" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. After all bolts have been taken to the snug tight condition, the Contractor shall match mark the outer face of each nut and protruding end of bolt to have a common reference line to determine the relative rotation. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified below, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

Amount of rotation of nut relative to bolt, regardless of which is turned:
- 1/3 turn where bolt length is 4 bolt diameters or less
- 1/2 turn where bolt length is over 4 bolt diameters and not exceeding 8 bolt diameters
- 2/3 turn where bolt length exceeds 8 bolt diameters

Notes:
- tolerance 1/6 turn (60^o) over, nothing under
- length of bolt measured from underside of head

(c) Reuse of Fasteners
High strength bolts shall be tensioned only once and shall not be reused. Retightening previously tightened bolts, which may have been loosened by tightening adjacent bolts shall not be considered as reuse.

(d) Department Inspection
The Contractor shall provide safe and adequate access meeting O*ccupational Health and Safety Act* (Alberta) requirements to all working areas, including all necessary scaffolding to enable the Department to carry out its inspection. The Contractor shall provide a competent workman to assist the Department in the inspection of bolt tightening work.

(8) Misfits

The correction of minor misfits involving reaming, cold cutting and chipping for secondary members may be allowed by the Department. If such field corrections are proposed by the Contractor they shall immediately be reported, and a repair procedure submitted, to the Contractor's Engineer and to the Department. If the repair procedure is accepted, it shall be done in the presence of both the Contractor's Engineer and the Department.

(9) Girder Adjustment

It is essential that the girders are erected with utmost attention being given to girder positioning, alignment, and elevation. Adjustment to girder position, bearing location and bearing elevation shall be done in order to achieve as closely as possible the lines and grades shown on the Detailed Designs.

The Contractor shall ensure that the structural steel is maintained in correct alignment until the adjoining or encasing concrete components have been completed.

(10) Grout Pockets and Grout Pads

The Contractor shall fill the grout pockets and construct the grout pads using Sika 212 flowable grout or equivalent. Filling of grout pockets and construction of grout pads shall be done by workers competent in this work.

Grout shall be packaged in waterproof containers with the production date and shelf life of the material shown. It shall be mixed, placed, and cured in strict accordance with the manufacturer's recommendations.

The method of forming and pouring the grout shall be submitted for review and acceptance. Dry-pack methods of constructing grout pads will not be accepted.

Sealer shall be supplied and applied to the exposed grout pad surfaces in accordance with Section 300.5.7.17 (Sealer).

(11) Grouting in Cold Weather

When the daily minimum air temperature, or the temperature of the girders, bearings or substructure concrete, in the immediate area of the grouting, falls below 5 degrees Celsius, the following provisions for cold weather grouting shall be affected:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the adjacent areas of the girders, bearings and substructure concrete to at least 10 degrees Celsius.
(b) Temperature of the grout during placing shall be between 10 degrees Celsius and 25 degrees Celsius.
(c) The grout pads (or girders where appropriate) shall be enclosed and kept at 10 degrees Celsius to 25 degrees Celsius for at least five days. The system of heating shall be designed to prevent excessive drying-out of the grout.

(12) Removal of Falsework, Berms, and Clean-Up

Upon completion of the erection the Contractor shall remove all earth material or falsework placed in the stream channel or elsewhere during construction. The Contractor shall remove all piling, excavated or surplus materials, rubbish and temporary buildings, replace or renew any damaged fences, and restore in an acceptable manner all property damaged during the execution of its work.

The Contractor shall leave the bridge site, roadway and adjacent property in a neat restored and presentable condition. When required, the Contractor shall provide written evidence to the Department that affected property owners or regulatory agencies have been satisfied.

All steel shall be left clean and free of oil, grease, mud, dust, road spray or other foreign matter.

300.5.9 PRECAST CONCRETE UNITS AND POST-TENSIONING

300.5.9.1 General

This specification in Section 300.5.9 (Precast Concrete Units) is for the supply, manufacture, delivery and erection of prestressed and precast concrete bridge units and miscellaneous precast components.

300.5.9.2 Submissions

The following information shall be submitted to the Department by a date that is reasonable having regard to the design and construction process and in any event within the times noted below. Units fabricated without meeting the time limits noted below will be rejected. In the event that the Department requests any of the following information related to ongoing production, the requested information shall be provided within seven days.

- Fabrication schedules and location of manufacture (at least 14 days prior to fabrication)
- Shop drawings (two copies) (at least five days prior to fabrication);
- Stressing calculations including jack calibration data (two copies) (at least five days prior to fabrication);
- Load/elongation curve for prestressing strand (at least five days prior to fabrication);
- Concrete and grout mix designs, including test data showing conformance of cement, silica fume, aggregate and admixtures to required standards (at least five days prior to fabrication);
- Details of concrete curing systems (at least 14 days prior to fabrication);
- Details of standard concrete repair procedures (at least five days prior to fabrication);
- Time-temperature graphs showing concrete curing rates;
- Mill certificates for miscellaneous steel;
- Certified mill test reports for all bearing material;
- Repair procedures for galvanizing, if required;
- Repair procedures, if required, for repair of casting defects or other damage to precast concrete units;
- Concrete cylinder strength results;
- Concrete core strength results, if required;
- Erection procedures, including drawings for falsework, berms and traffic accommodation (two copies) (at least 14 days prior to erection and grading); and
- Methods of forming and pouring grout.

300.5.9.3 Reference Drawing

Drawing SK-1 (Finishes and Sealing for Exterior Concrete Girders) is attached in Appendix B.

300.5.9.4 Supply and Manufacture

300.5.9.4.1 Standards

The manufacture of prestressed and precast concrete bridge units shall be in accordance with CSA A23.4.

Where imperial/metric conversions are necessary, The National Standard of Canada, CAN3-Z234.1-79 shall be used as the basis of conversion.

300.5.9.4.2 Qualification

The fabricator shall operate a recognized precast concrete fabricating plant and shall be fully certified by the Canadian Precast/Prestressed Concrete Institute (CPCI) Certification Program.

300.5.9.5 Engineering Data

(1) Shop Drawings

Shop drawings showing all necessary fabrication details of the precast units, such as reinforcing steel, blockouts, stressing system, anchorage devices, void support system and screed rail shall be prepared. The shop drawings shall be legible and of adequate quality to be reproduced and microfilmed.

The Department's bridge file number and project name shall be shown on shop drawings.

(2) Stressing Calculations

Stressing calculations showing elongations and gauge pressures as well as the strand release sequence data shall be prepared. Jack calibrations, performed within the previous six months, shall be obtained.

(3) Stressing Steel Certificate

A copy of the load/elongation curve for each lot of stressing steel shall be obtained.

(4) Concrete and Grout Mix Design

A concrete mix design and grouting mortar mix design shall be prepared by the Contractor and submitted for review by the Department. The mix design shall indicate the design strength, proportions of the constituent materials, type and brand of cement, type and brand of silica fume, origin of aggregates and brand names of all admixtures. The sampling and testing of aggregates, and the concrete mix design, shall be completed by an independent CSA certified and qualified concrete testing laboratory, which shall have the appropriate permit to practice in the Province of Alberta. Concrete mix designs, including sampling and testing of aggregates, may be completed by the concrete supplier, provided that the documentation is stamped for compliance by a Professional Engineer. The mix design, including sampling and testing, shall be reviewed and stamped for compliance with the respective specifications by an independent CSA certified and qualified concrete testing laboratory, which has the appropriate permit to practice in the Province of Alberta. The testing laboratory shall provide an engineering opinion that the concrete aggregate and mix designs are suitable for their intended use and are expected to perform to specified standards.

The concrete mix design information shall include one microscopic air-void analysis performed by an independent testing laboratory in order to determine the spacing factor of the hardened concrete. The test sample shall be made from a trial concrete batch, vibrated into a cylinder mould so as to represent the level of vibration of the production concrete in the forms. If adjustments to the mix design are necessary, the air-void analysis shall be repeated.

Only the reviewed mix design shall be used to cast units. Changes in cement type, and/or decreasing cement content shall be construed as a change in mix design and will not be allowed.

(5) Other Data

Test data to prove conformance to the standards for other materials including cement, silica fume, aggregate and admixtures shall be obtained.

(6) Construction Data Sheets

During manufacture, the construction data sheets shall be kept up to date and available for the Department's review.

300.5.9.6 Materials

(1) Cement

Hydraulic cement conforming to the requirements of CSA Standard A 3001 shall be used.

(2) Water

Water to be used for mixing concrete or mortar shall conform to the requirements of CSA Standard A23.1 and shall be free from injurious amount of alkali, organic materials or deleterious substances. The Contractor shall not use water from shallow, stagnant or marshy sources.

(3) Silica Fume

Ten percent condensed silica fume by weight of cement (plus or minus 0.5%) shall be used in all precast concrete. Condensed silica fume shall conform to CSA Standard A3001, for a Type SF supplementary cementing material, with a SiO_2 content of at least 85%, a maximum loss on ignition of 10%, and SO_3 content shall not exceed 1%. An acceptable compatible superplasticizing admixture shall be used together with the silica fume.

(4) Aggregates

(a) Normal Weight Aggregates
Fine and coarse normal weight aggregates shall conform to the requirements of CSA A23.1, with maximum aggregate size of 14 mm.

(b) Lightweight Aggregates
Fine and coarse lightweight aggregates shall conform to the requirements of the ASTM C330, with maximum aggregate size of 14 mm.

(5) Air Entraining Agent

Air entraining agent shall conform to the requirements of the ASTM C260.

(6) Chemical Admixtures

Chemical admixtures shall conform to the requirements of ASTM C494. All chemical admixtures must be suitable for use in precast concrete, be supplied by the same manufacturer as the air entrainment agent, and be compatible with each other. The addition of calcium chloride, accelerators, retarders or set controlling admixtures and air reducing agents will not be permitted.

Acceptable admixtures are air-entraining agents, superplasticizers and water-reducing agents.

(7) Concrete

Concrete shall consist of hydraulic cement, condensed silica fume, aggregates, water and acceptable admixtures. The type of concrete to be used will be specified on the Detailed Designs.

The density, entrained air and air void spacing requirements for the various types of concrete are specified in Table 300.5.9.6 below.

Table 300.5.9.6

Type of Concrete	Aggregates	Concrete Unit Weight, Plastic State kg/m^3	Minimum Total Air Content %	Maximum Air Void Spacing Factor (hardened concrete) mm
Standard Weight	Fine and Coarse Standard Weight	--	5	0.23
Lightweight	Fine and Coarse Lightweight	1680 ± 5%	6	0.23
Semi-Lightweight	Fine Standard Weight & Coarse Lightweight	1920 ± 5%	6	0.23

(8) Reinforcing Steel

Reinforcing steel shall conform to Sections 300.5.2.7 (Durability) and 300.5.2.8 (Materials).

(9) Stressing Strand

Stressing strand and wire shall be uncoated Grade 1860, low relaxation 7-wire strand conforming to the requirements of the ASTM A416. Shop drawings and stressing calculations shall clearly show the type of strand to be used, and changes will not be allowed during production.

(10) Lifting Hooks

Lifting hooks made of prestressing strand shall conform to the requirements of ASTM A416, and shall be fabricated in a manner that distributes the load evenly to all strands.

(11) Miscellaneous Steel

Miscellaneous steel shall conform to the requirements of the CSA *CAN/CSA G40.21M-300W* or *ASTM A36* or as specified on the Detailed Designs. The Contractor shall obtain mill certificates to prove conformance to the standard. Fabrication shall conform to Section 300.5.8 (Structural Steel).

(12) Bridgerail and Anchor Bolts

The assemblies shall be hot dip galvanized after fabrication. All nuts and washers shall be shop assembled on the anchor bolts.

(13) Voids and Ducts

All void and duct material must remain dimensionally stable during the casting and curing of the units. Voids shorter than 400 mm shall be eliminated except when noted otherwise on the Detailed Designs.

(14) Bearings

Elastomeric bearings and pot bearing shall be in accordance with Section 300.5.18 (Elastomeric and Pot Bearings).

(15) Galvanizing

Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM *A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products* and ASTM *A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*, with additions and exceptions as described in this specification. The Contractor shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing.

Repair of galvanizing shall only be done if bare areas are infrequent, small and suitable for repair. A detailed repair procedure shall be prepared by a Professional Engineer, and provided to the Department, prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A780, Method A3 Metallizing. The thickness of the metallizing shall be 180 μm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing.

300.5.9.7 Manufacture

(1) Forms

Precast concrete units are to be manufactured in steel forms.

For all beam members, the forms shall be designed such that they can be removed without damaging the beam. For all “I” or “T” beam members, the side forms shall be removed horizontally away from the beam by a method that prevents any contact of the form with the top flange after release of the form. The top flange shall not be subjected to a vertical force at anytime.

Holes or voids shall not be cast girders to accommodate formwork.

MSE wall panels shall be manufactured in smooth steel forms, mortar tight, and set on a rigid foundation.

(2) Reinforcing Steel

Fabrication, handling, storage, placement and fastening of all steel reinforcement shall conform to Section 300.5.14 (Reinforcing Steel).

(3) Stressing Strand

Stressing strand shall be free from corrosion, dirt, grease, rust, oil or other foreign material that may impede the bond between the steel and the concrete. Stressing strand shall be protected at all times from manufacture through to encasing concrete or grouting. Stressing strand that has sustained physical damage at any time shall be rejected. Stressing strand splices shall not be placed within a precast concrete unit.

Stressing strands shall not be stressed for more than 36 hours prior to being encased in concrete. The stress in the stressing strands shall be measured both by the jacking gauges and by the elongation of the strands. The maximum allowable discrepancy between jack pressure and elongation shall be within 5%. Alternatively, the factors contributing to the difference must be identified and corrected before proceeding. Changes in strand temperature and slippage at strand anchorages shall be measured between stressing and concrete encasement. Any changes in strand stress due to these effects shall be accounted for in the design.

Seven wire stressing strand with any broken wire shall be removed and replaced. All stressing strands shall be checked for wire breaks before placement of concrete.

The prestressed unit ends shall have 15 mm deep strand termination recesses formed around the strands. All strands shall be cut flush with the bottom of the recesses, and the recesses shall then be filled flush with the ends of the girders with a moisture insensitive epoxy paste adhesive meeting the requirements of ASTM C881, Type IV, Grade 3, Class B or C. The paste shall be grey in colour. An approved Type 1C sealer shall be applied over the patched recessed areas prior to steam curing. Sealer shall not be applied to the patched recessed areas when girder ends are designed to be encased in field cast concrete.

The Contractor shall be responsible for recording and reporting the elongation to the Department, or tension of each strand during the stressing operation, if requested by the Department.

(4) Void and Duct Placement

Voids and ducts shall be placed as shown on the Detailed Designs and must be tied and securely held in the required positions to prevent movement. Continuous ducts shall align precisely. The ends of the voids shall be sealed. Voids found to be distorted, damaged or of insufficient strength will be rejected. Blow holes caused by air expanding within the voids and rising to the surface, shall be repaired when the concrete is in the plastic state. Holes or voids to accommodate formwork are not permitted.

(5) Concrete Measuring, Mixing and Placing

The procedures outlined in ACI Standard 304 *Guide for Measuring, Mixing, Transporting and Placing Concrete* shall be followed. The time from initial mixing of the concrete until placing the concrete in the forms shall not exceed one hour. The elapsed time between the successive placement of concrete onto previously placed concrete shall not exceed 45 minutes.

(6) Concrete Temperature

The concrete temperature shall be between 10 degrees Celsius and 30 degrees Celsius at the time of placing it in the forms.

(7) Finished Riding Surface

Where the top surface of the girder is designed to be the riding surface, the use of a continuous screed rail, independent of the top of the grout keys, shall be employed. The top surface shall follow a smooth profile, which incorporates the required camber adjustments.

(8) Camber Hubs

Three camber hubs shall be placed in each girder, located along the centreline of the girder at the midpoint and 150 mm from each end. The camber hubs shall consist of 10 mm galvanized bars, of sufficient length to project vertically 10 mm above the riding surface.

The Contractor shall store the members in such a manner as to provide access for measuring camber. The Contractor shall record the girder camber at the midpoint of each girder within 24 hours of girder destressing.

(9) Concrete Finish

The exterior concrete girder faces shall have a Class 3 Rubbed Surface Finish. Except the top, all the remaining surfaces shall have a Class 1 Form Surface Finish.

(a) Class 1 Form Surface Finish

This finish is essentially that obtained when concrete has been cast and adequately compacted in a properly oiled steel form. All fins, honeycomb, irregularities, cavities over 10 mm diameter or other similar defects shall be thoroughly chipped out. These areas shall be saturated with water for a period of not less than 30 minutes, carefully pointed and trued with mortar of a colour which will match the existing concrete. Mortar used for pointing shall be less than one hour old.

The patches shall be properly cured by placing the repaired unit in the curing enclosure for a period of four days immediately after patching.

The finished surfaces shall be true and uniform. All surfaces which cannot be repaired satisfactorily shall be finished as specified for Class 2.

(b) Class 2 Rubbed Surface Finish

Class 2 finish shall be essentially the same as Class 1 except that all holes, cavities and defects shall be repaired so that the finished surface presents a smooth, true, dense, uniformly coloured, and non-stained appearance. The concrete surfaces shall be thoroughly wire brushed to expose any hole or cavity prior to repairs. All residue of form oil shall be removed from the surface.

(c) Class 3 Bonded Concrete Surface Finish

Surface preparation shall be done as is specified for (b) Class 2 (Rubbed Surface Finish) above, except that uniformity in colour is not required. After the surface preparation has been completed, the concrete surfaces shall be pressure washed to remove all dust, dirt, laitance and all other bond breaking materials. The concrete surface shall be dried for a minimum of 24 hours. The Contractor shall then apply a pigmented concrete sealer, which meets the requirements for a Type 3 sealer in Alberta Transportation’s *"Specifications for Concrete Sealers”* (B388).

The pigmented concrete sealer shall be applied in accordance with the manufacturer's specifications. A minimum of two applications, totalling the approved application rate of the pigmented sealer, are required. The colour(s) of the proposed coating scheme shall be as specified in the design. When spray application is used the surface shall be back rolled. The Contractor shall ensure that no colour variation is visible, and shall match the colour of any previously painted adjoining surfaces

(d) Class 4 Floated Surface Finish

After the concrete has been consolidated and the surface carefully screeded to the cross section and profile shown on the Detailed Design, it shall be floated and trowelled as necessary to provide a closed, uniformly textured surface without brooming.

(e) Class 5 Floated Surface Finish, Broomed Texture

After the concrete has been consolidated, the surface shall be carefully screeded to the cross section and profile shown on the Detailed Design. When the concrete has hardened sufficiently, the surface shall be finished with a broom of an accepted type. The broom strokes shall be perpendicular to the edge of the unit, and extended from edge to edge, with adjacent strokes slightly overlapped producing corrugations of 2 to 3 mm in depth. Brooming shall be done when the concrete has set sufficiently to produce clear, crisp brooming marks which do not sag or slump, without tearing the surface or disturbing coarse aggregate particles. After final brooming the surface finish shall be free of porous spots, irregularities, depressions, pockets and rough spots and must not vary more than 5 mm when measured using a 3 m straight edge.

Accepted finishing and edging tools shall be used on all edges and expansion joints after brooming.

(10) Curing

All prestressed concrete units shall be cured at an elevated temperature. The curing of prestressed concrete units shall essentially be in accordance with CSA A23.4 unless otherwise specified. The ambient curing temperature shall be increased at a rate not exceeding 20 degrees Celsius per hour until a maximum temperature of not more than 60 degrees Celsius is attained. After curing, the temperature of the units shall be reduced at a rate not exceeding 10 degrees Celsius per hour until the temperature of the concrete has fallen to within 10 degrees Celsius of ambient temperature outside the enclosure.

Care must be exercised to protect prestressed and non prestressed concrete units from thermal shock at all times until fully cured.

(a) Prestressed Concrete

(i) Curing in the Form

The initial application of heat shall commence only after the last of the freshly placed concrete has attained its initial set, which is normally two to four hours after casting. Heat shall not be applied directly to the concrete, but by a method that will produce a consistent ambient temperature throughout the entire form and enclosure. The increase in temperature and the holding temperature shall be monitored and permanently recorded on a chart at a minimum of 3 quarter points along the form.

(ii) Curing After Removal From the Form

Upon removal from the forms the units shall be cleaned, patched and finished within a period not exceeding 12 hours. The units shall be placed in a manner that will facilitate any clean up or repair work, and that will allow full inspection of all surfaces. Within 24 hours of removal from the form, the units shall be placed within a suitable enclosure, for curing.

The curing enclosure shall provide a minimum of 150 mm of free air space between the concrete surfaces and the coverings. Flexible coverings shall be secured to prevent any moisture loss.

The difference in ambient air temperature adjacent to the concrete at different locations within the enclosure shall not exceed 10 degrees Celsius at any time.

The curing process shall be continued for a period of 4 days with one of the following methods:

1) Steam Curing
Steam jets shall not directly impinge on the concrete surfaces. The steam must be in a saturated condition maintaining an atmosphere of 95% to 100% relative humidity and a uniform ambient temperature between 40 degrees Celsius and 60 degrees Celsius.

For days with periods of four or more hours within a 24-hour period, where measured temperature or humidity levels do not meet the required limits, these days will not count as a full day of steam cure. An additional day of steam cure beyond the specified four days will be required for each non compliant day.

2) Curing with Continuous Misting & Heat
Sufficient number of atomizing misting nozzles shall be strategically located to produce a fine mist with 100% relative humidity in the enclosure. The water shall be preheated to a temperature which will produce a misting temperature compatible with the ambient temperature. The enclosure shall be heated with radiant heaters to a temperature of between 40 degrees Celsius and 60 degrees Celsius. Dry heat shall never touch the concrete surface at any time. A control system shall be installed to shut off the heat when the humidity level drops below 90% in the enclosure. Should the temperature in the concrete rise above 40 degrees Celsius without the misting, the unit will be rejected.

Two continuously recording thermometers and two continuously recording hygrometers shall be provided for each curing enclosure to monitor the concrete and curing rates. All time-temperature and time-humidity recordings shall be clearly shown on the graph.

(b) Non Prestressed Concrete

Curing of all non prestressed concrete shall be in accordance with one of the following methods.

(i) <u>Elevated Temperature Curing</u>
Upon removal from the forms the units shall be cleaned, patched, finished and elevated temperature cured for four days as per Section 300.5.9.7 (10) (a) (Prestressed Concrete).

(ii) <u>Moist Curing</u>
The units may be moist cured in lieu of elevated temperature curing as noted below:

Upon removal from the forms the units shall be cleaned, patched, finished, and ready for inspection within a period not exceeding 12 hours. Patching shall be performed with an approved product and at an ambient temperature of between 15 degrees Celsius to 30 degrees Celsius. After completion of patching and finishing, within 24 hours of removal from the form, the units shall be placed under two layers of light coloured filter fabric (Nilex C-14 or equivalent) at an ambient temperature of not less than 15 degrees Celsius. The filter fabric shall be kept in a continuously wet condition throughout the curing period by means of a soaker hose or other means as reviewed and accepted by the Department. Curing with filter fabric and water shall be maintained for a minimum period of seven days.

For curing of MSE panels, covering with filter fabric is not required provided that the moist curing system maintains a continuously wet condition at all panel surfaces.

(11) Release of Stressing Strand

The stressing strand shall not be released until the specified concrete release strength is attained, and the release shall be in accordance with the accepted sequence.

Evidence of casting defects shall be repaired prior to release of the strands.

(12) Repairing Damaged Concrete

Serious damage, honeycombing and other casting defects shall be immediately reported to the Design Engineer and to the Department.

Repairs to defects such as cracks, honeycombs or spalls shall be carried out in accordance with this section. Units with unacceptable cracks, honeycombs or spalls shall be rejected.

All repair procedures shall be developed by a Professional Engineer, agreed to by the Design Engineer and reviewed by the Department prior to the commencement of the repair. All repairs shall be completed prior to curing of the unit at an ambient temperature of 15 degrees Celsius to 30 degrees Celsius, and units shall be protected from dehydrating prior to curing.

In this section, the "bearing area" of a girder is defined as the portion of the girder bottom flange up to the underside, but not including the radiused transition between the bottom flange and the web, directly above the bearing. The bearing area extends from the end of the unit to 75 mm beyond the edge of the shoe plate. The "anchorage area" of a girder is defined as the full-height portion of the girder that is within two times the girder depth from the end of the girder but is not in the bearing area.

(i) Cracks

The following cracks are unacceptable and shall result in rejection of the unit unless accepted and signed off by the Design Engineer and accepted by the Department:

- Cracks in the bearing area of a girder.
- Cracks in the anchorage area of a girder exceeding 0.5 mm in width.
- Cracks outside of the girder bearing and anchorage areas exceeding 0.2 mm in width or longer than 300 mm.

All repairable cracks 0.2 mm or greater in width shall be repaired by epoxy injection in accordance with the manufacturer's instructions. Coring shall be carried out to confirm the penetration of the epoxy into the crack, if so requested by the Department.

The Contractor shall immediately notify the Design Engineer and the Department if a crack that has the potential to be a shear crack exceeds 0.15 mm in width and is longer than 0.25 times the girder depth. The crack length shall be measured along the horizontal axis, and a crack shall be considered to be a shear crack if it is inclined at an angle between 30° and 60° from the horizontal.

(ii) Honeycombs and Spalls

The following conditions of honeycomb or spall are unacceptable and shall result in rejection of the unit unless accepted and signed off by the design engineer and accepted by the Department.

- Any honeycomb or spall in the bearing or anchorage areas of a girder.
- Major honeycombs and spalls in areas outside the bearing or anchorage areas of a girder.
- Honeycombs and spalls in precast units shall be considered major if more than 30 mm deep or more than 0.1 m^2 in area.

When approved by the design engineer and reviewed by the Department, repairs for honeycombs and spalls may be made using a cementitious material. Repairs of minor honeycombs and spalls may be made after destressing of the girder. However major honeycombs and spalls shall be repaired before destressing the girder.

(13) Sealers

The Contractor shall supply and install an approved Type 1c sealer to the girder surfaces as shown on Drawing SK-1 (Finishes and Sealing for Exterior Concrete Girders) in Appendix B. Type 1c sealers shall be in accordance with Section 300.5.7.17 (Sealer) and pigmented sealer shall be in accordance with Section 300.5.7.16.4 (Class 3. Bonded Concrete Surface Finish). The sealer shall be applied on clean dry surfaces free of form oil, and in accordance with the manufacturer's recommendations.

The Contractor shall ensure that the sealer is not applied in the grout pockets, lifting hook pockets or areas of the girders that will have field concrete cast against them.

The Department reserves the right to sample and test the sealer supplied by the Contractor.

(14) Sandblasting

The concrete surfaces in shear key, block out, diaphragm and girder end void locations shall be sandblast roughened. The blasting shall be sufficient to remove all laitance and uniformly expose the aggregate particles.

(15) Dimensional Tolerances of Cast Units

The maximum dimensional deviation in mm, of cast units from that as detailed on the Detailed Designs shall not exceed the following:

Length	-	± 20 mm x length (m) ÷ 50
Width	-	± 3 mm
Depth	-	± 5 mm
Camber	-	± 20 mm x length (m) ÷ 50
Sweep (NU Girders)*	-	1 mm/m

Sweep (Other Girders)*	-	deviation from true, 20 mm x length (m) ÷ 50
Projection of Stirrups		
Top of Girder	-	± 12 mm
Bearing Areas	-	out of flatness of bearing areas, 3 mm
Bulkheads	-	warpage or tilt of ends, 5 mm
Rail Anchor Bolts	-	out of line, 5 mm
	-	in spacing, 5 mm
	-	in projection, 5 mm
Dowel Holes	-	out of plumb, 5 mm
Void Location	-	surface to void dimension, ± 15 mm after casting

* Measured in the plant immediately prior to shipping to site.

(16) Handling and Storage

Precast units shall be handled by means of accepted lifting devices at designated locations. Units shall be maintained in an upright position, supported near the ends and on stable foundations.

(17) Identification of Units

Fabricator's name, year of manufacture, unit serial number and design loading shall be cast into the bottom of the units in 50 mm letters about 1.0 m from the unit end.

(18) Fabrication of Prestressed/Precast Units in Cold Weather

The Contractor shall accept full responsibility for the protection of prestressed/precast concrete units when fabricating in adverse weather conditions.

When the ambient temperature is, or is expected to be, below 5 degrees Celsius during fabrication the following provisions for cold weather casting shall be put in place:

(1) The Contractor shall construct an enclosure and shall maintain the ambient temperature within the enclosure between 15 degrees Celsius and 30 degrees Celsius. The enclosure shall be sufficiently sized that it will accommodate steel forms, workers and the casting equipment. The enclosure temperature shall be constantly monitored.

(2) The heating system shall be designed to provide uniform distribution of heat and the combustion by-products shall be kept out of the enclosure.

(3) Before casting concrete, adequate preheat shall be provided to raise the temperature of the formwork, reinforcing steel, stressing strand, miscellaneous iron, etc. to at least 10 degrees Celsius.

(4) The fabricated units shall be kept in the enclosure until they are patched, repaired and transferred to the curing enclosure.

300.5.9.8 Testing and Inspection

(1) Access

The Contractor shall provide the Department with suitable and safe access to the works for the purposes of testing and inspection of the precast concrete units. The Contractor shall provide the following:

(a) Cylinder storage box with temperature control and a max./min. thermometer, as per CSA A23.2-3C.
(b) A calibrated weigh scale.

(2) Inspection

The Contractor shall be responsible for all quality control and relevant testing. Inspection of the units by the Department will not relieve the Contractor of its responsibility for quality control.

(3) Test Methods

Sampling, making, curing and testing concrete specimens shall be in accordance with the requirements of the following CSA standards:

- Sampling - A23.2-1C
- Concrete Test Cylinders - A23.2-3C
- Testing Concrete Cylinders - A23.2 - 9C
- Air Content - A23.2-4C
- Density of Concrete - A23.2-6C
- Air Void Determination – A23.2-17C

(4) Testing by the Contractor

The Contractor shall engage an independent CSA certified testing laboratory to conduct all the required concrete testing and ensure that the concrete supply meets all requirements of the Technical Requirements. The CSA certified testing laboratory shall be independent of both the Contractor and the Contractor's subcontractors. The Contractor shall maintain the required air entrainment by testing and making adjustments to the mix prior to and during the placing of concrete in the forms.

The Contractor's testing agency shall make and test concrete cylinders to determine the 28-day compressive strength. Samples for testing shall be taken from the fresh concrete being placed in the forms at the rate of one set of cylinders for every three bridge units cast continuously. A set shall consist of a minimum of three cylinders. A strength test will be the average of the 28-day strengths of the three cylinders (one set). Continuous casting shall mean no break in the casting longer than one hour.

(5) Release Strength Test Cylinders

The Contractor shall arrange to make and test concrete cylinders to prove that the required release strength as stated on the Detailed Designs has been attained prior to release of the stressing strand. When one or more units are cast continuously, at least two cylinders shall be taken from the concrete of the last unit poured to represent the release strength for all units. These cylinders shall be cured with the bridge unit. Only testing of the first cylinder will be necessary if the required release strength is obtained. In the event all cylinders are tested without the required strength being obtained, the Contractor's Engineer and the Department shall be contacted.

300.5.9.9 Failure To Meet Strength Requirements

(1) Right of Rejection

The Department reserves the right to reject any concrete whatsoever which does not meet the specified strength determined in accordance with this Section 300.5.9 (Precast Concrete Units).

In the event that the concrete tested is more than 4 MPa below the specified 28-day compressive strength, the bridge units fabricated from the concrete represented by the test specimens shall be rejected. In the event that the unit has been delivered and/or erected in the field, it shall be removed and returned to the Contractor's plant for replacement.

(2) Coring

If any concrete tested fails to meet the specified strength, the Contractor may request permission to core. If the coring is accepted by the Department, the Contractor shall make arrangements, to employ a CSA certified, Category 1 or higher level qualified testing laboratory, at the Contractor's expense.

The Contractor's Engineer shall specify the location of the coring to ensure that the cores represent the same concrete as the cylinders. The average of three adjacent cores taken from one bridge unit shall constitute a test. The cores shall be taken and tested in accordance with CSA Standard A23.2- 14C within seven days of the date of testing the 28-day cylinders, but contrary to CSA A23.1, the compressive strength of the concrete will only be considered adequate if the average of each set of three cores is greater or equal to the 28 day compressive strength. The core test will represent all bridge units represented by the strength test. Alternatively, the Contractor may choose to take a core test from each of the other units in question, in which case each of these core tests will then represent a bridge unit.

The acceptability of the as-delivered concrete shall be determined using the concrete cylinders, with the modification set out in the next two sentences. In cases where the concrete strength, as indicated by the cores, is higher than the strength based on the concrete cylinder results, the core results shall be used as the basis for acceptance of the concrete. If the core strengths are lower than the strength from the concrete cylinder tests, the cylinder tests shall govern.

300.5.9.10 Erection of Precast Concrete Units

300.5.9.10.1 General

The Contractor shall erect the units, remove any temporary construction, and do all work required to complete the erection in accordance with the Detailed Designs and the Technical Requirements. No drilling, coring, nailing, retrofitting of any fastening or anchoring systems, or any other modifications shall be made to the concrete elements. The Contractor shall not erect precast concrete girders until the substructure concrete has been cured a minimum of three days and achieved 80% of the 28-day specified concrete strength requirements.

Without restricting generality, erection includes:

- Removing anchor bolt grout can lids;
- Placing and grouting anchor bolts and bearings;
- Erecting the girders;
- Placing and grouting of connector bolts and diaphragms;
- Post-tensioning;
- Placing and sealing grout bearing pads; and
- Cutting-off lifting hooks and grouting lifting holes on exterior girders and all lifting hook pockets.

300.5.9.10.2 Handling And Storing Materials

Precast concrete units to be stored shall be placed upright and shored on timber blocking and kept clean and properly drained.

300.5.9.10.3 Temporary Supporting Structures And Berms

The temporary supporting structures and berms shall be properly designed and substantially constructed and maintained for the forces which may come upon them. Berms shall be constructed in a manner and of such materials that they will not be eroded by stream flow nor introduce silt into the water. The Contractor shall prepare drawings for temporary supporting structures and berms, and for traffic control and accommodation where applicable. All drawings shall bear the seal of a Professional Engineer.

Temporary supporting structures and/or berms will not be permitted to remain in any stream channel during spring break-up or run-off periods, unless all necessary approvals have been obtained by the Contractor from pertinent agencies.

Incidental damage to other property, such as fills and stream banks, resulting from the existence of berms, shall be the responsibility of the Contractor.

300.5.9.10.4 Erection Procedure

The Contractor shall prepare a detailed erection procedure for review in advance of the scheduled start of erection. The erection procedure shall include all drawings and documents necessary to describe the following:

(a) Access to work, earth berms and work bridges.

(b) Type and capacity of equipment. Cranes shall be used for handling and erecting precast concrete units.

(c) Sequence of operation, including position of cranes, trucks with girders, and traffic accommodation.

(d) Detailed crane position on the ground, particularly adjacent to substructure elements, such as abutment backwalls, with details of load distribution on wheels and outriggers.

(e) Details of crane position on the structure, showing wheel loads and axle spacing of equipment moving on structure.

(f) Loads and their position from crane wheels and outriggers during all positions of lifting when crane is on structure.

(g) Details of temporary works, supporting structure drawings, including proposed methods to be used to ensure the required splice elevations and structure shape prior to placing concrete, and/or post-tensioning and method of providing temporary supports for stability.

(h) Details of lifting of units, showing vertical forces at lifting hooks.

(i) Provisions for control and adjustment of errors for width and positioning of curbs or exterior units.

(j) Complete details of blocking for bearings where necessary to constrain movements due to horizontal forces and/or gravity effects.

(k) Details of post-tensioning procedures, including strand specifications, jack dimensions, pressures, forces and elongations, and grouting.

(l) Grout pad construction (refer to Section 300.5.9.10.6 (Grout Pockets and Grout Pads)).

(m) Details of release of temporary supporting structures.

(n) Provide an “as-built” detailed survey of the substructure showing the following:
- location and elevation of all bearing grout pad recesses;
- shim height at each bearing location; and
- top of girder elevations at each bearing (and each splice location where appropriate).

The erection procedure shall bear the seal of a Professional Engineer, who shall assume full responsibility to ensure that its design is being followed. Safety and compliance with the

Occupational Health and Safety Act (Alberta) and regulations thereunder, shall be integral parts of the design.

Before erection begins the Contractor shall do a complete superstructure layout by means of chalk lines and markings applied to all substructure units, showing bearing and girder positions in accordance with the approved layout plan.

300.5.9.10.5 Girder Adjustments

It is essential that the girders be erected with utmost attention being given to girder positioning, alignment, and elevation. The Contractor shall adjust girder position, bearing location and bearing elevation in order to achieve as closely as possible the lines and grades shown on the Detailed Designs. The Contractor shall minimize any differential camber (girder to girder), and the sweep of the girders, by jacking, loading of girders, winching, or whatever means are necessary, and shall provide the necessary temporary attachments to hold the girders in position. The Contractor shall inspect for and map crack locations if force is required to bring girders into alignment.

The maximum dimensional deviation in mm, of erected precast concrete units from that as detailed on the Detailed Designs shall not exceed the following:

- Sweep (NU Girders) - 1 mm/m
- Sweep (Other Units) - deviation from true, 20 mm x length (m) ÷ 50

300.5.9.10.6 Grout Pockets And Grout Pads

The Contractor shall construct grout pads using Sika 212 flowable grout or equivalent. Filling of grout pockets and construction of grout pads shall be done by workers competent in this work.

Grout shall be packaged in waterproof containers with the production date and shelf life of the material shown. It shall be mixed, placed, and cured in strict accordance with the manufacturer's recommendations.

Dry pack methods of constructing grout pads will not be accepted.

Sealer shall be applied to the exposed grout pad surfaces in accordance with Section 300.5.7.17 (Sealer).

300.5.9.10.7 Grouting In Cold Weather

When the daily minimum air temperature, or the temperature of the girders, bearings or substructure concrete, in the immediate area of the grouting, falls below 5 degrees Celsius, the following provisions for cold weather grouting shall be affected:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the adjacent areas of the girders, bearings, and substructure concrete to at least 10 degrees Celsius.

(b) Temperature of the grout during placing shall be between 10 degrees Celsius and 25 degrees Celsius.

(c) The grout pads (or girders where appropriate) shall be enclosed and kept at 10 degrees Celsius to 25 degrees Celsius for at least five days. The system of heating shall be designed to prevent excessive drying-out of the grout.

300.5.9.10.8 Bearings and Anchorage

The Contractor shall remove anchor bolt void forming materials prior to grouting. Any residues on the concrete surface, such as oils, grease or other contaminants that can reduce bonding characteristics, shall be removed by sandblasting.

Anchor bolts shall be set accurately and grouted with a non-shrink cement grout. The location of the anchor bolts, in relation to the slotted holes in the expansion shoes, shall correspond with the temperature at the time of erection. The nuts on the anchor bolts, at the expansion ends of spans, shall be adjusted to permit free movement of the spans.

When steel bearings are employed in conjunction with grout pockets in the substructure, the bearings shall be set accurately on galvanized steel shims, and grouted as detailed on the Detailed Designs, after the erection has been completed. The shims must be located so that minimum 75 mm grout coverage is provided. When grout pockets are not detailed, the bearing plates shall be set on the properly finished bearing areas in exact position and shall have a full and even bearing on the concrete.

Where the design requires that the girders bear on neoprene pads placed directly on pier or abutment seat concrete, the Contractor shall ensure a properly finished bearing area so that the girders have full and even bearing. In the event full bearing is not achieved the neoprene pads shall be fabricated to the required dimensions so that each girder has full and even bearing.

Where required, field welding adjacent to the elastomeric pads shall be performed with care to avoid damage to the elastomer. The temperature of the steel adjacent to the elastomer shall be kept below 120 degrees Celsius. The distance between the weld and the elastomer shall be at least 40 mm.

300.5.9.10.9 Assembly

The parts shall be accurately assembled as shown on the Detailed Designs. The material shall be carefully handled so that no parts will be distorted, broken or otherwise damaged. Bearing surfaces, and surfaces to be in permanent contact, shall be cleaned before the members are assembled. Diaphragms shall be erected as indicated on the Detailed Designs.

300.5.9.10.10 Lifting Hooks and Lifting Holes

After the girders are properly erected and positioned, all lifting holes on exterior girders shall be filled with an accepted grout; all lifting hooks shall be cut off 50 mm below surface, and all lifting hook pockets shall be filled with grout.

300.5.9.10.11 Removal of Falsework and Site Clean-Up

Upon completion of the erection the Contractor shall remove all earth material or temporary supporting structures placed in the stream channel or elsewhere during construction. The Contractor shall remove all piling, excavated or surplus materials, rubbish and temporary buildings, replace or renew any damaged fences, and restore in an acceptable manner all property damaged during the execution of its work.

The Contractor shall leave the bridge site, roadway and adjacent property in a neat restored, and presentable condition, and when required, the Contractor shall provide the Department with written evidence that affected property owners or regulatory agencies have been satisfied.

300.5.9.10.12 Post-Tensioning

300.5.9.10.12.1 General

This work consists of post-tensioning and grouting of cable ducts, both for cast-in-place and precast concrete.

300.5.9.10.12.2 Submissions

The following information shall be submitted to the Department:

- Post-tensioning drawings illustrating the stressing system and, where appropriate, design details and sequence of stressing (two copies);
- Stressing calculations taking into account all applicable losses (two copies);
- Load/elongation curves for the prestressing strand;
- Mill certificates for the prestressing strand; and
- Details of permanent anchoring devices.

300.5.9.10.12.3 Standards

Applicable requirements of the current edition of the following standards shall be followed:

- *CSA A23.1/23.2 – Concrete Materials and Method of Concrete Construction.*
- *CSA A23.4 – Precast Concrete Materials and Construction.*
- *Section 300.5.7 (Cast-in-Place Concrete).*
- *Guide Specification Acceptance Standards for Post Tensioning Systems – PTI.*
- *Specifications for Grouting of Post Tensioned Structures - PTI.*
- *AASHTO LRFD Bridge Construction Specifications.*

300.5.9.10.12.4 Qualification

The Contractor, or its subcontractor, shall have extensive experience in this work and shall utilize only fully trained, competent and experienced operators. The Contractor shall ensure that the site supervisor responsible for the tensioning and grouting operations is at the site whenever these operations are being carried out.

300.5.9.10.12.5 Materials

(1) Prestressing Strand

Stressing strand shall conform to the requirements of Sections 300.5.9.6(9) (Prestressing Strand) and 300.5.9.7(3) (Stressing Strand).

Corrosion inhibitor is required when the stressing and grouting operations are not completed within 20 days of the installation of the stressing steel. The corrosion inhibitor, when required, shall be water-soluble and shall have no deleterious effect on the steel, grout or concrete; or bond strength of steel to concrete.

(2) Anchorages and Distribution

All stressing steel shall be secured at the ends by means of permanent anchoring devices. These devices shall comply with *CAN/CSA S6* Clause 8.4.4.1.

Steel distribution plates or assemblies may be omitted when the anchoring devices are sufficiently large and used in conjunction with an embedded steel grillage that effectively distributes the compressive stresses to the concrete.

(3) Ducts

Ducts shall be corrugated, semi-rigid galvanized metal tubes and be capable of withstanding concrete pressures without excessive deformation or permitting the entrance of cement paste during the placement of concrete. The ducts shall have sufficient rigidity to maintain the required profile between points of supports. The interval between supports shall not exceed 1.0 m.

The Contractor shall provide mortar tight inlets and outlets in all ducts with a nominal diameter of 20 mm in the following locations:

- The anchorage area;
- All high points of the duct, when the vertical distance between the highest and lowest point is more than 500 mm;
- Place an inlet at or near the lowest point; and
- Place a free draining outlet at all low points of duct.

The Contractor shall provide inlets and outlets with valves, caps or other devices capable of withstanding the grouting pressure. The ducts and vents shall be securely fastened in place to prevent movement. The Contractor shall provide details of inlets and outlets on the shop drawings.

(4) Concrete

Concrete shall be supplied in accordance with Section 300.5.7 (Cast-in-Place Concrete), however the maximum size of coarse aggregate shall be 10 mm and the 28 day compressive strength shall be a minimum of 50 MPa.

(5) Grout

Grout shall be Class C as described in Table 10.9.3-1 of, and the properties as described in Table 10.9.3-2 of, the AASHTO LRFD Bridge Construction Specification. In addition to the requirements noted in these tables, a test for wet density shall also be performed in accordance with the "Standard Test Method for Density" ASTM C138. Prebagged grouts shall be packaged in plastic lined bags or coated containers, stamped with the date of manufacture, lot number and mixing instructions. Copies of the quality control data for each lot number and shipment sent to the job site shall be provided to the Department for review prior to grouting. Materials with a total time from manufacture to usage in excess of six months shall be retested and certified by the supplier before use, or shall be removed from the job site and replaced.

The average minimum compressive strength of 3 cubes at 28 days shall be a minimum of 50 MPa as per CSA A23.2-1B. The results for bleed test and fluidity test shall meet the requirements noted in Table 10.9.3-2 of the AASHTO *LRFD Bridge Construction Specifications*.

The Contractor is responsible to perform all grout testing in the field and shall notify the Department a minimum of 24 hours prior to grouting and grout testing in the field. The frequency of grout testing shall be as follows:

Strength Test
Precast Concrete Girders: One strength test per girder line
Cast-In-Place Girders: One strength test for every four longitudinal ducts

Bleed Test
At the beginning of each day's grouting operation, perform a wick induced bleed test in accordance with ASTM C940 and with modifications noted in Table 10.9.3-2 of the AASHTO LRFD Bridge Construction Specifications.

Fluidity Test
At the inlet and outlet, perform fluidity test in accordance with the standard ASTM C939 flow cone test or the modified ASTM C939 flow cone test.

Wet Density Test

Perform wet density test in accordance with American Petroleum Institute Mud Balance Test API Practice 13B-1 "Standard Procedures for Field Testing Water-

Based Drilling Fluids".

300.5.9.10.12.6 Equipment

(1) Stressing

- Hydraulic jacks and pumps of sufficient capacity shall be used for tensioning of strands;
- The force induced in the prestressing strand shall be measured using calibrated jacking gauges, load cells or a calibrated dynamometer;
- The pressure gauge shall have an accurate reading dial at least 150 mm in diameter;
- The forces to be measured shall be within 25 and 75% of the total graduated capacity of the gauge, unless calibration data clearly establishes consistent accuracy over a wider range; and
- The measuring devices shall be calibrated at least once every six months. The jack and the gauge shall be calibrated as a unit. A certified calibration chart shall be kept with each gauge.

(2) Grouting

- A high speed shear mixer shall be used that is capable of continuous mechanical mixing and producing grout that is free of lumps and undispersed cement. The water supply to the mixer shall be measured by an accurate gauge;
- The holding tank shall be capable of keeping the mixed grout in continuous motion until it is used. The outlet to the pump shall have a screen with 3 mm maximum clear opening;
- A positive displacement type pump shall be used which is capable of producing an outlet pressure of at least 1.0 MPa. A pressure gauge having a full-scale reading of no greater than 2 MPa shall be placed at some point in the grout line between the pump outlet and the duct inlet. A spare fully functional pump shall also be on site;
- Standby flushing equipment with water supply shall be available at the site prior to commencing grouting;
- The grouting equipment shall be of sufficient capacity to ensure that grouting of the longest duct can be completed within 30 minutes after mixing; and
- Grout hoses and their rated pressure capacity shall be compatible with the pump output and the maximum grout pressure. All connections from the grout pump to the duct shall be airtight so that air cannot be drawn into the duct.

300.5.9.10.12.7 Construction

(1) Checking Post Tensioning Ducts

Prior to placing post-tensioning steel, the Contractor shall verify that all ducts are unobstructed.

(2) Welding

Welding of stressing tendons shall not be permitted. Stressing tendons shall not be used as an electrical "ground". Where the ends of strands are welded together to form a tendon so that the tendon may be pulled through the ducts, the length of the strands used as an electrical "ground" or 1.0 m, whichever is greater, shall be cut off from the welded end prior to stressing.

(3) Tensioning

Post-tensioning shall be carried out as per the Detailed Designs and stressing calculations. The stressing and release of tendons shall be done in the sequence specified on the Detailed Designs. All strands in each tendon shall be stressed simultaneously with a multi-strand jack. The force in the tendons shall be measured by means of pressure gauge and shall be verified by means of tendon elongation. All tendons shall be tensioned to a preliminary force as necessary to eliminate any slack in the tensioning system before elongation readings are started. This preliminary force shall be between 15 and 25 percent of the final jacking force.

Stressing tails of post-tensioned tendons shall not be cut off until the record of gauge pressures and tendon elongations has been reviewed by a Professional Engineer. A record of the following post-tensioning operations shall be kept for each tendon installed:

- Project Name and File Number;
- Subcontractor;
- Tendon location and size;
- Date tendon installed;
- Tendon pack/heat number;
- Modulus of elasticity (E);
- Date stressed;
- Jack and gauge identifier;
- Required jacking force and gauge pressures;
- Elongation (anticipated and actual);
- Anchor set (anticipated and actual);
- Stressing sequence;
- Witnesses to stressing operation;
- Grout information (Brand Name);
- Time for grouting each tendon; and
- Date grouted.

(4) Concreting

The anchorage recesses shall be concreted after tensioning but before grouting the tendons.

The concrete surface of the anchorage recesses shall be abrasive blasted. The recesses shall be thoroughly wetted and covered with a thin cement scrub coat immediately before placing fresh concrete.

(5) Grouting

All ducts or openings shall be clean and free of all deleterious matter that would impair bonding of the grout to the ducts and stressing steel. All ducts shall be thoroughly flushed out with water and blown out with compressed oil free air. All inlets and outlets shall be checked for their capacity to accept injection of grout by blowing compressed oil free air through the system.

Before stressing and grouting internal or external tendons, install all grout caps, inlets and outlets and test each tendon with compressed air to determine whether duct connections need repair. Pressurise the tendon to 345 kPa (50 psi) and lock-off the outside air source. Record pressure for 1 minute. A pressure loss of 170 kPa (25 psi) is acceptable for tendons up to 45 m long, and a pressure loss of 100 kPa (15 psi) is acceptable for tendons longer than this. If the pressure loss exceeds the acceptable, repair leaking connections using methods approved by the Department, and retest.

A thoroughly mixed grout, meeting all the requirements described in Section 300.5.9.11.5 (5) (Grout) shall be passed through a screen with 3 mm maximum clear openings before entering the pump. All grout vents shall be opened prior to commencement of grouting. The duct shall be completely filled by injecting grout from the lowest end of the tendon in an uphill direction. Grout shall be pumped continuously through the duct until no visible signs of water or air are ejected at the outlet. A fully operational grout pump shall be on site for all pumping procedures. A continuous, one way flow of grout shall be maintained at a rate of 5 to 15 lineal metres of duct per minute. The grouting of a tendon shall be completed within 30 minutes of mixing of the grout.

Normal pumping pressure shall be between 0.1 MPa and 0.4 MPa measured at the inlet. The pumping pressure at the injection vent shall not exceed 1 MPa. If the actual pressure exceeds the maximum allowed, the injection vent shall be closed and the grout shall be injected at the next vent that has been or is ready to be closed as long as one-way flow is maintained. Grout shall not be injected into a succeeding vent from which grout has not yet flowed. For each tendon, immediately after uncontaminated uniform grout discharge begins, a fluidity test shall be performed on each tendon from the discharge outlet. The measured grout efflux time shall not be faster than the efflux time measured at the inlet or the minimum efflux time established. If the grout efflux time is not acceptable, additional grout shall be discharged from the discharge outlet. Grout efflux time shall be tested. This cycle shall be continued until acceptable grout fluidity is achieved. In addition to fluidity test, check the grout density using the wet density method. The density at the final outlet shall not be less than the grout density at the inlet. To ensure the tendon remains filled with grout, the ejection and injection vents shall be closed in sequence, respectively under pressure when the tendon duct is completely filled with grout. Valves and caps are not to be removed until the grout has set.

Grouting shall not be done when the air temperature is below 5degrees Celsius or above 25 degrees Celsius, nor when there are other conditions that would be detrimental to the grouting operations.

The Contractor shall provide 50 mm deep grout tube termination recesses formed around the tubes projecting from top of the deck. After grouting, all tubes shall be cut flush with the bottom of the recesses, and the recesses shall then be grouted flush with the top of the deck.

300.5.10 CONSTRUCTION OF CSP AND SPCSP STRUCTURES

300.5.10.1 General

This section describes the requirements for the supply, fabrication, delivery and installation of Corrugated Steel Pipe and Structural Plate Corrugated Steel Pipe with an equivalent diameter of 1.5 m or greater.

Abbreviations for the various types of metal pipe are as follows:

- CSP	Corrugated Steel Pipe
- CSP Arch	Corrugated Steel Pipe Arch
- SPCSP	Structural Plate Corrugated Steel Pipe
- SPCSP Arch	Structural Plate Corrugated Steel Pipe Arch

300.5.10.2 Submissions

The following information shall be submitted to the Department by the Contractor by a date that is reasonable having regard to the design and construction process and in any event no later than 21 days after request by the Department, acting reasonably:

- Shop drawings (two copies); and
- Dates fabricated materials are to be shipped from the fabricating plant. This information shall be provided to the Department a minimum of two days prior to shipping.

300.5.10.3 Reference Drawings

Installation of Large Steel Pipes, Standard Drawing S-1418-03 (Installation of Large Steel Pipes).

300.5.10.4 Reference Tables (attached in Appendix B)

Details of Standard 2:1 Sloped End Sections for CSP Round Culverts	A
Details of Standard 2:1 Sloped End Sections for CSP Arch Culverts	B
Details of Standard 2:1 Sloped End Sections for SPCSP Round Culverts	C

300.5.10.5 Supply and Fabrication

300.5.10.5.1 Standards

The supply and fabrication of all galvanized, polymer coated and aluminum coated Corrugated Steel Pipe including couplers and appurtenances and Structural Plate Corrugated Steel Pipe shall be in accordance with the current edition of CSA Standard G401 with additions and exceptions as described in this Section 300.5.10 (Construction of CSP and SPCSP Structures).

300.5.10.5.2 Engineering Data

(1) Shop Drawings

Shop drawings for SPCSP structures and any non-standard materials (e.g. elbows, bottomless arch details, horizontal ellipses, etc.) as well as bevel end details shall be prepared.

(2) Plate Arrangement

The arrangement of the plates for SPCSP structures shall be shown on the shop drawings. The shop drawings shall also indicate that the bolts in the valley of each longitudinal seam are nearer to the visible edge of the plate than the bolts in the crest. With the exception of “change of radii” locations, all longitudinal seams shall be staggered a minimum of 2N.

300.5.10.5.3 Materials

Previously installed pipe shall not be used. All pipe supplied shall be clearly marked with the following information at intervals of not less than 3 m.

- Manufacturer’s Name or Trade Mark;
- Nominal Thickness and Type of Metal;
- Plate/Metal Coating (for non-standard coating);
- Specification Designation;
- Plant Designation Code; and
- Date of Manufacture.

300.5.10.5.4 Fabrication

(1) Fabrication of CSP

(a) Sloped Ends
Sloped end sections are required for each culvert unless otherwise shown in the Detailed Designs. When 2:1 sloped end sections are specified, the Reference Tables A and B (see Section 300.5.10.4 (Reference Tables (attached in Appendix B))) will apply unless stated otherwise.

(b) Termination of Lockseams
On pipes 1.0m diameter or larger all lockseams terminating at the cut edges of a sloped or square end section shall have a 75mm length of fillet weld run along both sides of the lockseam (staggered 300mm apart) at each cut edge. The weld and surrounding area shall be zinc coated in accordance with CSA G401.

(c) Cut Ends
All cut edges of a sloped or square end section shall be made smooth by grinding so that all the burrs are removed. Any damaged protective coating shall be recoated with appropriate material in accordance with CSA G401.

(d) Re-corrugated Ends

All corrugated steel pipes shall have ends re-corrugated to provide annular corrugations for couplers.

(e) Couplers

Only annular corrugated couplers will be accepted unless specified otherwise. The couplers for pipes 1.6 m and over in diameter shall be a minimum of 600 mm width. There shall be a minimum of five bolts per coupler.

(2) Fabrication of SPCSP

(a) Sloped Ends

Sloped end sections are required for each culvert unless otherwise noted on the Detailed Designs. When 2:1 sloped end sections are specified, the Reference Table C (see Section 300.5.10.4 (Reference Tables (attached in Appendix B))) will apply unless stated otherwise.

300.5.10.5.5 Shop Inspection

(1) Inspection, Sampling, and Testing

All materials shall be subject to inspection by the Department. The Contractor shall provide safe, convenient access acceptable to the Department for inspection and sampling of the materials, and shall cooperate in the inspection and sampling process when requested to do so.

(2) Notification

The Contractor shall contact the Department prior to contemplated shipment. This is to facilitate inspection of the materials at the plant.

300.5.10.5.6 Storage of Material

(1) Storage Stains

In addition to CSA G401, SPCSP material is to be stored concave down. This requirement is to reduce the occurrence of storage stain damage on plates that are not going to be assembled immediately.

300.5.10.5.7 Handling of Material

All culvert material shall be handled carefully and in such manner as to prevent bruising, scaling or breaking of the galvanized coating. Culvert material shall also be handled and unloaded without undue stress and in such a manner that the radii or dimensions of the pipes remain true. Coupling bands shall be shipped with all necessary hardware and fittings attached thereto, or in suitable shipping containers. All SPCSP bolts are to be shipped with plates. Where the material supplied is damaged, the Contractor shall immediately separate nested sections of plate or pipe to facilitate more detailed inspection.

300.5.10.6 Installation

Metal pipes are flexible, and their resistance to deformation depends on careful bedding and backfilling. As they deflect under vertical load they must build up wide support and therefore, to obtain maximum load bearing capacity, it is essential that the material under and beside the pipe be of good quality, carefully placed and properly shaped and compacted as specified on the Detailed Designs. It is essential that the structure be kept dewatered to the bottom of the excavation until all backfilling is complete.

300.5.10.6.1 Bedding

Where the bottom of the excavation lies at 600 mm or less below the pipe invert the fill material shall be compacted by the Contractor to a minimum of 95% of Standard Proctor Density at optimum moisture content. Where the bottom of the excavation extends more than 600 mm below the pipe invert, the fill material shall be compacted at the 600 mm level to a minimum of 95% of Standard Proctor Density at optimum moisture content. The structural fill shall be placed in lifts not exceeding 150 mm when compacted. The Contractor shall use whatever materials, labour, equipment and incidentals are necessary to achieve a stable bed.

When foundation conditions are considered soft and unstable, the Contractor shall supply and place woven geotextile filter fabric at the base of the excavation between the clay seals as shown on Standard Drawing S-1418-03 (Installation of Large Steel Pipes) (see Section 300.5.10.3). The woven geotextile filter fabric shall be in accordance with the following table:

Woven Geotextile Filter Fabric	
Specifications and Physical Properties	
Grab Strength	1275N
Elongation (Failure)	15%
Puncture Strength	275 N
Burst Strength	3.6 MPa
Trapezoidal Tear	475 N
Minimum Fabric Lap to be 1.0 m	

The granular material within 150 mm of the bottom of pipe shall be placed in a loose uncompacted state. All other structural fill, including the clay seepage cutoffs, shall be compacted to a minimum of 95% of Standard Proctor Density at optimum moisture content.

The top of the bedding is that portion of the structural fill in contact with the bottom of the pipe and shall be constructed to the exact grade. Where camber is specified, the top of the bedding shall be constructed on a gradual crest curve with no sudden breaks in the grade. Where preshaping is specified, the top of the bedding shall be constructed to the exact curvature of the bottom plates. The top of the preshaping shall be 200 mm to 300 mm below the horizontal seam which joins the sidewall to the bottom plates, or as shown on the Detailed Designs.

300.5.10.6.2 Assembly

<u>Assembly of CSP</u>
CSP sections shall be laid so that the ends are in close contact. Couplers shall be well fitted and evenly tightened all around the pipe.

<u>Assembly of SPCSP</u>
SPCSP shall be assembled as shown on the drawings which will be provided by the pipe supplier and as outlined below:

(a) All bolted seams shall be properly lapped and plates shall be in contact for the full width and length of the lap. The bolts in the valley of each longitudinal seam shall be nearer to the visible edge of the plate than the bolts in the crest.

(b) After two complete rings have been loosely assembled, the vertical dimensions shall be checked and where necessary adjusted with horizontal cables and/or supports to obtain design rise dimensions.

(c) Each adjacent ring shall then be assembled and adjusted in a similar manner until the entire structure is loosely assembled and conforms to design geometry with nested plates.

(d) The vertical axis shall be upright and the longitudinal seams shall be straight. Rotation of the pipe and/or spiralling of the longitudinal seams shall not be permitted.

(e) Adjustments shall be made to produce design dimensions with fully nested laps. When horizontal tie cables are used for shape adjustment, adequate means shall be taken to ensure distribution of concentrated forces at the pipe walls. Distortion of the pipe side walls at the cable points will not be tolerated.

(f) Unless otherwise indicated by the manufacturer's specifications, bolts shall be torqued to not less than 200 Nm and not more than 340 Nm. This includes bolts which connect special features to the pipe.

(g) Distortion of bolt holes caused by over-torquing, or poor assembly methods will not be permitted. Where additional holes are required they shall be drilled. Torch cutting of holes or welding on the pipe will not be permitted.

(h) The shape of the pipe shall be maintained within two percent of design dimensions. This includes the rise, the span, and any chords or chord offsets.

300.5.10.6.3 Backfilling

When the assembly of the structure has been completed, backfilling with granular and or non-granular materials as specified on the Detailed Designs may proceed. In addition, the requirements set out in the four paragraphs below shall be met.

When the air temperature is below 0 degrees Celsius, no backfilling is allowed. All backfill materials shall be in a thawed state when placed and compacted. No backfill material will be permitted to be placed on frozen substrate.

The backfilling under the haunches shall be compacted in thin layers filling all corrugations and ensuring firm contact with the entire bottom surface of the pipe.

The backfilling shall fill each corrugation, be free of voids and provide uniform support to the pipe. The backfill shall be placed such that the level of fill on one side of the pipe does not exceed the level of fill on the other side of the pipe by more than 300 mm.

The Contractor shall supply suitable material for the compacted non-granular backfill. Generally the material shall consist of clay or till materials. Highly plastic clay material or material with a high silt content will not be permitted.

300.5.10.6.4 Strutting for Composite Concrete/SPCSP Structure

For composite concrete/SPCSP structures strutting and scaffolding shall be supplied and installed as shown on the Detailed Designs.

300.5.10.7 Concrete Work

Where detailed and specified, concrete work shall be constructed as shown on the Detailed Designs and in accordance with the relevant sections of Section 300.5 (Bridge Structures):

- Section 300.5.7 - Cast-In-Place Concrete
- Section 300.5.14 - Reinforcing Steel

300.5.10.8 Fish Baffles

Fish baffles shall be constructed as shown in the Detailed Designs.

300.5.10.9 Rock Riprap

Rock riprap shall be placed as shown in the Detailed Designs.

300.5.11 MECHANICALLY STABILIZED EARTH WALLS

300.5.11.1 General

This specification in this Section 300.5.11 is for the supply, fabrication and construction of mechanically stabilized earth ("**MSE**") retaining walls with precast concrete facing panels. MSE retaining walls shall include, but not be limited to, excavation for the wall, concrete levelling pads, precast concrete panels, compacted granular backfill, soil reinforcement, perforated drain pipe complete with filter fabric sock, geotextiles and geomembranes, surface drains, cast-in-place concrete wall coping, traffic barrier, pedestrian railing, permanent safety railing, hardware and all associated materials.

MSE retaining walls shall be constructed in accordance with the drawings and the provisions contained herein.

300.5.11.2 Submission

Shop drawings shall be authenticated in accordance with Section 100.2.1.1 (Design), and submitted in accordance with Section 300.3.3.7 (Bridge Shop Drawing Submission Requirements).

As a minimum shop drawings shall contain design criteria and materials lists, wall layout plan and elevation with dimensions and elevations and typical wall cross-sections, all components and connection details, site drainage and drainage details, reference to relevant design drawings by drawing number, and construction procedures and construction sequence.

300.5.11.3 Materials

300.5.11.3.1 Concrete

Concrete for MSE wall precast concrete panels, MSE wall levelling pad concrete and MSE wall coping concrete shall be as specified in Section 300.5.2.7 (Durability).

300.5.11.3.2 Concrete Reinforcing

Reinforcing steel shall be as specified in Section 300.5.2.7 (Durability).

300.5.11.3.3 Soil Reinforcing Materials

Steel soil reinforcing shall be galvanized in accordance with ASTM Standards A123/A123. All damage to galvanizing shall be repaired in accordance with ASTM A780.

Geosynthetic reinforcements shall meet AASHTO LRFD Bridge Design Specifications Clause 11.10.6.4.3b. The requirements “for applications involving severe consequences of poor performance or failure” shall apply. Product specific durability studies shall be carried out to determine the product-specific long term strength reduction factor (RF). These studies shall be used to estimate the short term and long term effects of the environment factors on the strength and deformational characteristics of the geosynthetic reinforcement throughout the specified design life.

Geosynthetic reinforcing materials shall satisfy the requirements of the following tests with the understanding that the test methods are current at the time of construction:

- GG 1-87 “Standard Test Method for Geogrid Rib Tensile Strength”

- GG 2-87 "Standard Test Method for Geogrid Rib Junction Strength"
- GG 3-90 "Standard Test Method for Tensile Creep Testing of Geogrids"
- GG4-05 "Standard Practice for Determination of the Long Term Creep Design Strengths of Geogrids"

Geosynthetic reinforcing materials shall contain stabilizers or inhibitors to prevent degradation of properties due to ultraviolet light exposure.

The nominal long-term reinforcement design strength (Tal) values for specific products shall be determined by third party agencies such as the Highway Innovative Technology Evaluation Centre ("**HITEC**") or AASHTO National Transportation Product Evaluation Program ("**NTPEP**"), and product lines shall be re-tested at least every 3 years.

300.5.11.3.4 Safety Rail Materials

Safety Rail shall be fabricated in accordance with Section 300.5.8 (Structural Steel).

300.5.11.3.5 MSE Wall Backfill Materials

MSE wall backfill shall be "Crushed Aggregate Material" meeting the requirements of the following table, and shall be free of organic matter and other deleterious substances:

Designation/Class

Metric Sieve Size (CGSB 8-GP-2M)	**Crushed Aggregate Material Des 2 Class 20**	**Crushed Aggregate Material Des 2 Class 25**	**Crushed Aggregate Material Des 2 Class 40**
Sieve Size µm	**Percent Passing**	**Percent Passing**	**Percent Passing**
40 000			100
25 000		100	70 - 94
20 000	100	82 - 97	
16 000	84 - 94	70 - 94	55 - 85
10 000	63 - 86	52 - 79	44 - 74
5 000	40 - 67	35 - 64	32 - 62
1 250	22 - 43	18 - 43	17 - 43
630	14 - 34	12 - 34	12 - 34
315	9 - 26	8 - 26	8 - 26
160	5 - 18	5 - 18	5 -18

Metric Sieve Size (CGSB 8-GP-2M)	Crushed Aggregate Material Des 2 Class 20	Crushed Aggregate Material Des 2 Class 25	Crushed Aggregate Material Des 2 Class 40
Sieve Size µm	**Percent Passing**	**Percent Passing**	**Percent Passing**
80	2 - 10	2 - 10	2 - 10
% fractures by weight (2 faces)	60+	60+	50+
Plasticity Index		NP - 6	NP - 6
L.A. Abrasion Loss Percent Maximum		50	50

*Note: Wall systems with geosynthetic reinforcement shall have the class of backfill assumed in the design clearly noted on the drawings.

In no case shall any backfill material placed within 2.0 m of the face panels have more than 5% passing the 0.080 mm (80 µm) sieve size.

The physical properties of the MSE wall backfill material selected by the Contractor shall be used by the MSE wall supplier in the design of the MSE walls.

Soil filters between soil zones shall be designed based on the properties of the adjacent materials.

The MSE wall backfill material for steel soil reinforcing shall also meet the following electrochemical parameters with the understanding that the test methods are current at the time of construction:

REQUIREMENTS FOR STEEL REINFORCING

Select Backfill Requirements		Test Method (ASTM)	Test Method (AASHTO)
Resistivity	≥ 3000 ohm-cm	G57	T 288
pH	5 - 10	G51	T 289
Chlorides	≤ 100 ppm	D512	T 291
Sulphates	≤ 200 ppm	D516	T 290
Organic Content	≤ 1.0%	D2974	N/A

REQUIREMENTS FOR GEOSYNTHETIC REINFORCING

Select Backfill Requirements		Test Method (ASTM)	Test Method (AASHTO)
pH	4.5 - 9	G51	T 289

Organic Content	≤ 1.0%	D2974	N/A
Design Temperature at the Wall Site	≤ 30^{o}C	N/A	N/A

Sampling of backfill material stockpiles shall be as follows:

Range of Resistivity (ohm-cm)	Preconstruction			Construction	
	No. of Samples for Resistivity Tests	No. of Samples for Other Tests	Standard Deviation of Resistivity (ohm-cm)	Sample Interval for Resistivity (m^3)	Sample Interval for Other Tests (m^3)
> 5000	3	6	< 2000	3000	1500
< 5000	5	10	< 1000	1500	750

Notes
1. Sample stockpiles from the top, middle and bottom portions, approximately 0.6 m in from the face of the stockpile.
2. If the resistivity is less than 3000 ohm-cm, obtain additional samples in the area to identify if there are specific areas where the material is unsuitable.
3. Reject entire backfill source if any sample has a resistivity less than 700 ohm-cm, or chlorides greater than 500 ppm, or sulphates greater than 1000 ppm.
4. The standard deviation of resistivity testing is an additional constraint to the Requirements for Steel Reinforcing. If this standard deviation is exceeded, retest on new samples. If the standard deviation is exceeded on second batch of samples, reject the entire backfill source.

300.5.11.3.6 Intentionally Deleted

300.5.11.3.7 Geotextiles

Non-woven geotextile filter fabric shall be in accordance with the following table of minimum average roll value properties:

Non-Woven Geotextile Filter Fabric	
Specifications and Physical Properties	
Grab Strength	650 N
Elongation (Failure)	50%
Puncture Strength	275 N
Burst Strength	2.1 MPa
Trapezoidal Tear	250 N
Minimum Fabric Lap to be 300 mm	

Impervious geomembrane shall be PVC, HDPE or LLDPE geomembrane with a minimum thickness of 0.75 mm, and in accordance with the following minimum properties:

Impervious geomembrane	
Specifications and Physical Properties	
Tear Strength - ASTM D1004	45 N
Puncture Strength – ASTM D48330	140N

Specific designs may warrant the use of roughened surface geomembranes. The membrane shall be installed in accordance with the manufacturer's recommendations. All seams in the membrane shall be welded or bonded to prevent leakage.

300.5.11.4 Construction

300.5.11.4.1 Panel Production

The fabrication of precast concrete panels shall conform to the requirements of Section 300.5.9 (Precast Concrete Units). Chamfered edges shall be created around the periphery of all precast facing panels. In addition to the tolerances specified in CSA A23.4, the variation in panel face trueness for any line across a panel face from a straight edge shall be no more than 2mm over 1m. Geogrid reinforcement embedded into concrete panels shall exit perpendicular to the face of the panel.

Concrete for panels shall conform to the requirements of Section 300.5.7 (Cast-In-Place Concrete). Curing for panels shall conform to the requirements of Section 300.5.9 (Precast Concrete Units), with the following additional requirements:

- Saturation of the face of the panels in preparation for the repair of surface cavities shall begin immediately after stripping. During repair of surface cavities, and up to the start of elevated temperature curing or moist curing, panels faces shall be kept in a continuously wet condition; and
- As an alternative to moist curing with filter fabric panels may be moist cured in an enclosure with a controlled temperature and humidity environment such that all exposed concrete surfaces remain saturated for the duration of the curing period. If stacked during curing, sufficient space shall be maintained between panels to permit airflow and inspection of surfaces.

Panels with the following defects shall be rejected:

- Units with honeycombing, cracks, spalls or broken corners;
- Units with more than 10 surface cavities per square metre with cavity diameters from 2mm up to 5mm;
- Units with more than three surface cavities per square metre with cavity diameter from 5mm up to 10mm; and
- Units with any surface cavities greater than 10mm in diameter.

Repair of surface cavities shall be done in a sheltered environment with a minimum ambient temperature of 10 degrees Celsius. Panels with 10 or less surface cavities per square metre with cavity diameters from 2 mm up to 5 mm do not require repair. All exposed panel faces shall receive a Class 3 Bonded Concrete Finish in accordance with Section 300.5.9.7 (Manufacture) with the exceptions that all surface cavities shall be filled with an 'approved pre-bagged concrete patching material for bridges' as identified on the most current Department approved products list, such that the entire panel finish texture shall be equivalent to a form finish and not a washed or rubbed finish.

300.5.11.4.2 MSE Wall Construction

The Contractor shall employ qualified personnel experienced in constructing MSE walls to supervise and perform this work. The construction of the MSE wall system shall conform to the details on the shop drawings, and shall be in accordance with the supplier's recommendations. The Contractor shall require the supplier of the MSE wall system to provide a full-time qualified representative on site during construction to advise the Contractor's personnel regarding construction procedures and to monitor that the MSE wall construction is being done in accordance with the shop drawings and supplier's recommendations.

300.5.11.4.3 Conformance Criteria

Prior to starting wall construction the Contractor's geotechnical engineer shall:

- Document details of the foundation base preparation details, and have these signed off by the Contractor's geotechnical engineer;
- Document details of on-site delivery of all MSE wall components for each wall, including mill certificates; and
- Provide documentation that the backfill material meets the Technical Requirements.

The Contractor shall maintain soil reinforcing placement records, soil compaction records, and panel placement records throughout wall construction.

300.5.11.4.4 Excavation and Levelling Pads

Excavation shall be done to establish grades to within reasonably close conformity to the design grades and limits shown on the drawings and shop drawings. The foundation subgrade shall be proof rolled to identify any soft spots. Soft material shall be removed and replaced with compacted granular material to the satisfaction of the design engineer.

Concrete levelling pads that project at least 75 mm either side of the precast panels shall be used. Elevations shall be set by instrument. Tolerance on local irregularities shall be 3 mm over a 3 m length. After erection of first row of panels, any openings between levelling pad steps shall be filled.

300.5.11.4.5 Backfill

Backfill shall be placed in conformance with the wall supplier's specifications, and backfill compaction control testing of the reinforced backfill shall be done at a minimum frequency of one test per lift for every 45 m of wall or part thereof, with not less than one test per day.

Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed in such a manner as to avoid any damage or disturbances of the wall materials or misalignment of the face panels. All wall materials that are damaged during backfill placement shall be removed and replaced, and any misalignment or distortion of the face panels due to placement of backfill shall be corrected before continuing with the work.

A minimum 300 mm wide strip of filter fabric shall be installed behind all face panel joints. An adhesive shall be used to hold the fabric securely against the panels.

Where geosynthetic reinforcing materials are used, overlap of geogrids can occur in walls with curves or acute angle corners as illustrated on drawing SK-19 in the "Layout of Geogrid Reinforcement For Curved Walls" detail. For any wall layout where overlap of geogrids occurs, a minimum 75 mm of compacted backfill shall be placed between geogrids to ensure proper anchorage.

No equipment shall be allowed to run directly on the soil reinforcement. Backfill compaction shall be performed in such a manner that the compactor shall move in a direction parallel to the wall panels and work toward the end of the soil reinforcement away from the wall facing. Only hand operated power tampers and vibrators shall be used for compaction within 1000 mm of the wall panels. At the completion of each day’s work the Contractor shall slope the last level of backfill material away from the wall panels, so as to direct potential run-off away from the wall face. In addition, the Contractor shall not permit any surface runoff from adjacent areas to enter the wall construction site.

300.5.11.4.6 Precast Panel Placement Tolerance

Precast panel placement tolerances after installation shall be:

1. The out-of-flatness of wall surfaces measured in any direction shall not exceed 25 mm under a 3 m straight edge.
2. The step in face of adjacent panel edges at joints shall not exceed 10 mm.
3. The overall out-of-vertical or near vertical alignment of the completed wall shall not exceed 4 mm/m of wall height from top to bottom of wall.
4. The joint gap between any two constructed panels, measured at any point between panels and perpendicular to the line of the joint shall be within plus or minus 10 mm of the design gap for the wall system used.

Should any sections of the wall system or any individual panels be out of tolerance, the backfill shall be removed and the panels reset to the proper tolerance before continuing construction.

Should any panel crack or spall, or have a corner break during construction operations, the panel shall be removed and replaced.

To facilitate construction of the cast-in-place concrete coping, nominal-sized, pre-formed holes in the top row of precast panels are permitted providing the holes are located a minimum 100 mm above the underside of the coping.

300.5.11.4.7 Precast Panel Storage

Precast concrete panels shall be stacked on timber planks or pallets on a level graded lay-down area, and separated by timber bearing blocks as required by the MSE wall supplier. Soil reinforcing material and connectors shall be stored clear of the ground. All materials shall be covered and protected from rain, snow, dirt and ultraviolet light. The precast panels shall be stored such that the uniform color of the panels is maintained and protected from staining or discoloration. Panels with stained or discoloured front faces shall not be incorporated into the wall.

300.5.11.4.8 Concrete Coping

The exposed faces of the cast-in-place wall coping shall have a Class 3 finish.

300.5.12 SIGN STRUCTURES

300.5.12.1 General

This Section 300.5.12 (Sign Structures) is for the design, supply, fabrication, erection and all associated work pertaining to overhead and cantilevered sign structures and panels.

300.5.12.2 Submissions

The following information shall be submitted to the Department by a date that is reasonable having regard to the design and construction process and in any event no later than 21 days after request by the Department, acting reasonably:

- Shop drawings (two copies);
- Welding procedures for all welds;
- Proposed fabrication sequence and schedules. The Department shall be notified a minimum of two days prior to a component being ready for inspection at an inspection station;
- Mill certificates for all material;
- Repair procedures for unsatisfactory weldments and accidental arc strikes, if required;
- Product data sheets for coatings required between galvanized steel and concrete;
- Repair procedures for galvanizing, if required;
- The results of seam weld testing; and
- Method for forming and placing of grout.

300.5.12.3 Reference Drawings

Sign Structure Steel Identification Plaque, Standard Drawing S-1682-04 (Sign Structure Steel Identification Plaque).

300.5.12.4 Engineering Data

(1) Shop Drawings

Shop drawings shall be authenticated in accordance with 100.2.1.1 (Design), and submitted in accordance with 300.3.3.6 (Bridge Shop Drawing Submission Requirements).
In addition to specific details, the shop drawings shall include the following:

(a) The Department's Bridge File numbers, A-Ident numbers and project title, as provided by the Department, shall be shown on all the shop drawings;
(b) Design criteria for each individual overhead sign structure, including:
  - AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, including interims;
  - Initial sign panel area and/or minimum design sign panel areas;
  - Design wind pressure;
  - Fatigue category and fatigue loadings;
  - Design ice thickness;
  - Other dead loads;
  - Design temperature range;
  - Foundation soils parameters; and
  - Critical anchor bolt forces;
(c) Each individual shop fabricated section or assembly, shown separately with complete and clearly identified welded or bolted details;
(d) Weld procedure identification shown in the tails of the weld symbols;
(e) All material splice locations ;
(f) Complete material list; and
(g) Erection procedure including tensioning procedure for anchor bolts.

300.5.12.5 Supply and Fabrication

300.5.12.5.1 Standards

Fabrication of sign structures shall conform to the *AASHTO LFRD Bridge Construction Specifications* and the *American Welding Society* ("**AWS**") - *Bridge Welding Code, D1.5*.

Where imperial/metric conversions are necessary, The National Standard of Canada, CAN 3-Z234.1-79 shall be used as the basis of conversion.

All welding, cutting and preparation shall be in accordance with the American Welding Society ("**AWS**") - *Bridge Welding Code, D1.5*, and D1.1.

300.5.12.5.2 Qualification

The Contractor, or its subcontractor, shall operate a recognized steel fabricating shop and be fully approved by the CWB as per CSA W47.1 in Divisions 1 or 2.

Only welders, welding operators and tackers approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments. Their qualifications shall be current and available for review by the Department.

300.5.12.5.3 Engineering Data

(1) Welding Procedures

Welding procedures, including Welding Procedure Datasheets, shall be prepared for each type of weld used in the structure. The procedures shall bear the approval of the Canadian Welding Bureau and shall also be submitted to be reviewed by the Department prior to use on the structure.

(2) Proposed Fabrication Sequence

Prior to commencement of fabrication, the Contractor shall prepare an outline of the fabrication sequence that clearly describes the order of make-up and assembly of all the component parts, as well as shop assembly and inspection stations.

(3) Mill Certificates

Mill certificates shall be obtained for all material before fabrication commences.

(4) Schedules

The Contractor shall prepare and keep current a complete fabrication schedule.

300.5.12.5.4 Materials

(a) All materials shall be new.
(b) The use of aluminium is not acceptable.
(c) Structural steel plate material shall conform to CSA -G40.21M 300W (*Silicon content less than 0.04% for the shafts, whereas for flanges and base plates the silicon content shall be either less than 0.04% or between 0.15% to 0.25%.)***.**
(d) All bolts, nuts and washers shall conform to ASTM A325 or shall meet property class 8.8 of the Industrial Fasteners Institute for metric high strength structural bolts, nuts and washers. Certified mill test reports for the fastener material shall be obtained.

Anchor bolts shall be hot-dip galvanized and shall conform to the requirements of ASTM F1554 Grade 380 MPa. Anchor bolts shall be the single nut type pretensioned by the turn-of-the-nut method on top of grouted base plates. Base plates shall be grouted with Sika 212 flowable grout or equivalent.

All steel materials including all hardware and anchor bolts shall be hot–dip galvanized.

300.5.12.5.5 Welding

(1) Filler Metals

Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. The low hydrogen covering and flux shall be protected and stored as specified by AWS D1.5. Flux cored welding or use of cored filler wires in the submerged arc process or shielding gas processes are not considered as conforming to low hydrogen practice. These methods will not be permitted. However, metal core welding process utilizing low hydrogen electrodes with AWS designation of H4 will be allowed. Metal core arc welding shall not be permitted in the field. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal.

(2) Cleaning Prior to Welding

Weld areas must be clean, free of mill scale, dirt, grease, and other contaminants prior to welding.

(3) Longitudinal Seams

All longitudinal seams shall be made by a semi or fully automatic submerged arc or metal core welding process.

(4) Weld Penetration

The full penetration welds shall be completed using properly fitted backing bars or back-gouged to sound metal. The longitudinal seams shall have a minimum 60% penetration; however if a backing bar is used for the longitudinal seam, the weld penetration shall be 90%. The following welds shall have 100% penetration:

(a) Column to base plate.
(b) Member to flange plate.
(c) Flange plate to gusset plate.
(d) Longitudinal seam welds within 150 mm of circumferential welds and 150 mm beyond hand holes (when provided) shall be full penetration groove welds. The transitions between full and partial penetration welds shall be ground smooth.
(e) Backing bar splices.

The backing bars for full penetration welds shall be properly fitted and the member prepared to a sharp edged 45° chamfer. The groove weld shall be placed in a minimum of two passes by using 100 degrees Celsius of preheat (unless higher preheat is required as per AWS-D1.5) and maintain a root opening of 5 mm. A rod size no greater than 4.0 mm shall be used for the first pass. A reinforcing fillet weld shall be placed all around the joint.

(5) Tack and Temporary Welds

Tack and temporary welds shall not be allowed unless they are to be incorporated in the final weld. Tack welds, where allowed, shall be of a minimum length of four times the nominal size of the weld, and shall be subject to the same quality requirements as the final welds. Cracked tack welds shall be completely removed prior to welding over.

(6) Run-off Tabs

Run-off tabs shall be used at the ends of all welds that terminate at the edge of a member. The tabs shall be a minimum of 100mm long unless greater length is required for satisfactory work. They shall be tack welded only to that portion of the material that will not remain a part of the structure, or where the tack will be welded over and fused into the final joint. After welding, the tabs are to be removed by flame cutting, not by breaking off.

(7) Methods of Weldment Repair

Repair procedures for unsatisfactory weldments shall be prepared by a Professional Engineer experienced in welding prior to repair work commencing.

(8) Arc Strikes

Arc strikes will not be permitted. In the event of accidental arc strikes, the Contractor shall have a repair procedure prepared by a Professional Engineer. The repair procedure shall include the complete grinding out of the crater produced by the arc strike.

(9) Plug and Slot Welds

Plug welds or slot welds shall not be permitted.

300.5.12.5.6 Fabrication

Fabrication shall be performed in a fully enclosed area which is adequately heated. The shop temperature shall be at least 10 degrees Celsius. Field welding is not permitted.

(1) Cutting of Plate

All plate material for main members and any plate material welded to the main member shall be flame cut using an automatic cutting machine. Shearing is not allowed.

Corners of plates and structural sections shall be ground to a 1mm chamfer.

(2) Additional Requirements

(a) Each column, arm, extension, clamp and bracket shall be fabricated from one piece of sheet steel.

(b) Intermediate circumferential butt welds will not be allowed, however horizontal members greater than 12 m span may have a bolted splice.
(c) Columns, arms, extensions and clamps shall be brake press formed or roll formed. The brake press knife shall have a radius suitable for the thickness of the material and nature of the bend.
(d) All plate edges shall be free of notches and gouges.
(e) The depth or projection of any imperfections on the inner or outer surfaces shall not exceed 15% of wall thickness. Any depth or projection up to 33% of wall thickness may be repaired by welding. Any excessive projecting weld metal shall be removed.
(f) The diameter of bolt holes in base plates shall be 10 mm larger than the bolt diameter.
(g) Punching of full size holes will not be permitted. The holes shall be circular and perpendicular to the member and shall be deburred to ensure a proper faying surface.
(h) Hand holes with cover plates are required on the top and bottom of columns of illuminated sign structures.
(i) Hand hole (when required) shall be stiffened by providing a reinforcing rim with semi-circular ends. The rim shall be welded to the member with a full penetration groove weld supplemented with an all around fillet weld.
(j) Only low stress stamps shall be used for identification marks. The stamps and specific location shall be shown on the shop drawings.
(k) Stiffeners are not allowed on column to base plate and member to flange plate connections.

(3) Dimensional Tolerances

All fabrication shall meet the tolerances described below:

(a) Straightness
The straightness of any item shall not exceed the overall length divided by 300 from the surface at any point. This shall be measured with a straight line joining the surface at both ends. The difference between the straight line and the surface shall then be measured to determine the straightness.

(b) Twisting
The twist in the overall length of any column, arm, or extension shall not exceed 7°.

(c) Length
The specified length of any item shall be within 0 to 60 mm or -0 to +5% (whichever is less) with the exception of sign bridge spans which shall be within 5 mm of the specified dimensions in the unloaded condition. The tolerance for height shall be –0 to +60 mm.

(d) Across the Flat Dimensions
The average of all across the flats dimensions from a given cross section shall be within 1% of the specified dimension. In addition, the ratio of the maximum to minimum across the flats dimensions shall be less than or equal to 1.05.

(e) Tolerance for Flatness of Base Plates and Flange Plates
Surfaces of column base plates shall be flat to within 3 mm tolerance in 305 mm, and to

within 5 mm tolerance overall. Faying surfaces of flange plates shall be flat to within 2 mm tolerance overall.

(f) Arm Rise
Arm rises apply to unloaded structure in the standing position.

(4) Pre-Assembly

After welding and fabrication but prior to galvanizing, the Contractor shall pre-assemble all structures complete with sign clamps to check the fit and geometry. Pre-assembled structures may be inspected by the Department.

The structures shall then be disassembled for galvanizing.

(5) Galvanizing

Galvanizing shall be by the hot dip method, after fabrication, in accordance with the current edition of ASTM *A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products* and ASTM *A153/A153M Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware* with additions and exceptions as described in this Section 300.5.12 (Sign Structures). The Contractor shall provide a smooth finish on all edges and surfaces, and remove all weld spatter and all welding flux residue from the steel components prior to galvanizing. Lumps, globules or heavy deposits of zinc will not be permitted. All threaded holes or threaded couplings shall be retapped after galvanizing.

Repair of galvanizing shall only be done if bare areas are infrequent, small, and suitable for repair. A detailed repair procedure shall be prepared by a Professional Engineer. It should be noted that repairs may require complete removal of the galvanized coating and regalvanizing. Repair shall be in compliance with ASTM A 780, Method A3 Metallizing. The thickness of the metallizing shall be 180 μm, and the repair tested for adhesion. The finished appearance shall be similar to the adjacent galvanizing.

(6) Base Plate Corrosion Protection

The bottom face of each base plate shall be protected by a medium grey colour barrier, to prevent contact between the zinc and the grout. The galvanized surface must be roughened prior to application of barrier coating. The surface preparation of the galvanized surface and the dry film thickness ("**DFT**") of the coating shall be in accordance with the coating manufacturer's recommendations. The Contractor shall test the adhesion of fully cured coating as per ASTM D3359. The method selected for testing (Method A or B) shall depend on the dry film thickness of the coating. The coating manufacturer's product data sheets shall be obtained prior to the application of the coating. The adhesion test result shall meet a minimum of "4B" classification, i.e. a maximum allowable flaking of 5%.

300.5.12.5.7 Testing and Inspection

(1) Access

The Contractor shall provide full facilities for the auditing of material and workmanship. Free access shall be allowed to the Department to all parts of the works. When required by the Department, the Contractor shall provide needed manpower for assistance in inspection duties.

(2) Testing by the Contractor

The Contractor shall provide quality control throughout the course of fabrication. All test records made by the fabricating shop in the course of normal quality control shall be open to the Department for inspection.

All welds shall be visually inspected by an independent welding inspector certified to Level 3 of CSA W178.2.

The Contractor shall arrange to have all full penetration welds inspected either by ultrasonic testing or radiographic inspection methods. Partial penetration seam welds shall be inspected by ultrasonic testing. The frequency of partial penetration weld inspections shall be three random locations per weld and the length of weld for ultrasonic inspection at each location shall be 200 mm. Calibration blocks for each thickness shall be prepared for ultrasonic testing to establish sensitivity levels and acceptance criteria. The Non-Destructive Testing shall be done by a company certified to CAN/CSA W178.1. Ultrasonic and radiographic testing technicians shall be certified to Level II of CGSB.

(3) Testing by the Department

The Department may perform visual, radiographic, ultrasonic, magnetic particle and any other testing that may be required at its own expense.

(4) Inspection Station

To ensure that each stage of inspection is performed in an orderly manner, during the fabrication, inspection stations will be set up at specific points. Certain items of the work will then be checked, and deficiencies shall be corrected, prior to the work being sent to the next stage of fabrication. These check points shall be determined by the Contractor prior to commencement of fabrication.

(5) Non-destructive Methods of Examination

The methods of non-destructive examination shall be in accordance with the following standards:

- Radiography - AWS D1.5;
- Ultrasonic - AWS D1.5; and
- Magnetic Particle - ASTM E-709.

(6) Inspection Schedule

All welds will be visually inspected.

Ultrasonic inspection will be performed on full penetration welds.

300.5.12.5.8 Identification Tag

The Contractor shall supply and install an identification tag on one column of each structure at 2.4 m above base plate. The column shall be drilled and tapped for 2-10 mm diameter attachment bolts. The identification tag shall be fabricated as per Standard Drawing S-1682-04 (Sign Structure Steel Identification Plaque).

300.5.12.6 Erection

All product damaged in shipping shall be replaced.

The Contractor shall not erect the structural steel until the substructure concrete has been cured a minimum of three days and achieved 80% of the 28 day specified concrete strength requirement.

All components shall be handled with care to prevent stress to the components through bending or twisting. The use of steel chains as slings shall not be permitted. Any damage to the components through overstress, scratching or denting shall be repaired or replaced.

The structure shall be set accurately on galvanized shim plates. The shim plates must be located so that a minimum of 75 mm grout coverage is provided from shims to grout edge. The method of forming or pouring the grout shall be documented. Dry-pack methods of constructing grout pads will not be allowed.

Hand hole bolts shall be coated with anti-seize lubricant.

(1) High-Tensile-Strength Bolted Connections

Bolted parts shall fit solidly together when assembled. Contact surfaces shall be free of dirt, grease, burrs, pits and other defects that would prevent solid seating of the parts. Connections shall be assembled with a hardened washer under the bolt head or nut, whichever is the element turned in tightening. Surfaces of bolted parts in contact with the bolt head and nut shall be parallel.

(2) Bolt Tension

All structural bolts shall be tightened by using turn-of-nut method to provide bolt tension specified in Table 1 set out at the end of this Section 300.5.12.6 (Erection). There shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into full contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified below, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

Amount of rotation of nut relative to bolt, regardless of which is turned:

- 1/3 turn where bolt length is 4 bolt diameters or less;
- 1/2 turn where bolt length is over 4 bolt diameters and not exceeding 8 bolt diameters; and
- 2/3 turn where bolt length exceeds 8 bolt diameters.

Notes

- o tolerance 1/6 turn (60^{o}) over, nothing under; and
- o length of bolt measured from underside of head.

Table 1 - BOLT TENSION

Specified Bolt Size (A325M Bolts)	**Minimum Bolt Tension**		**Commonly Supplied Equivalent Imperial Size (A325 Bolts)**	**Minimum Bolt Tension**	
	Kilonewtons	**pounds-force**		**Kilonewtons**	**pounds-force**
M16X2	94	21,180	5/8	85	19,200
M20X2.5	147	33,050	3/4	126	28,400
M22X2.5	181	40,700	7/8	175	39,250
M24X3	212	47,660	1	227	51,500
- -	- -	- -	1 1/8	251	56,450
M30X3.5	337	75,760	1 1/4	319	71,700
- -	- -	- -	1 3/8	380	85,450
M36X4	490	110,160	1 1/2	463	104,000

300.5.12.7 Foundation

Where detailed and specified, concrete work shall be constructed as shown on the Detailed Designs and in accordance with the relevant sections of Section 300.5 (Bridge Structures):

Section 300.5.7 - Cast-In-Place Concrete
Section 300.5.13 - Piling
Section 300.5.14 - Reinforcing Steel

(1) Material

Reinforcing steel and concrete shall comply with Sections 300.5.2.7 (Durability) and 300.5.2.8

(Materials).

(2) Anchor Bolt Installation

Anchor bolts shall be supplied and installed in one complete assembly and consist of, but not limited to: anchor bolts complete with plate washers, top temporary templates, bottom anchor plates, bottom anchor nuts, and thin clamping nuts. No welding of any component is allowed. Anchor bolts shall be true and plumb. Anchor bolts shall be by the turn-of-the-nut method from a snug tight condition after the grout pads have attained design strength. All voids including slots and the annular space around anchor bolts in the base plate shall be filled with corrosion inhibiting paste.

(3) Grout Pockets and Grout Pads

The Contractor shall fill the grout pockets and construct the grout pads using Sika 212 flowable grout or equivalent. Filling of grout pockets and construction of grout pads shall be done by workers competent in this work. The grout pocket shall be 25 mm deep and the total grout thickness shall not be less than 75 mm.

Grout shall be packaged in waterproof containers with the production date and shelf life of the material shown. It shall be mixed, placed, and cured in strict accordance with the manufacturer's recommendations.

The method of forming and pouring the grout shall be documented. Dry-pack methods of constructing grout pads will not be allowed.

(4) Grouting in Cold Weather

When the daily minimum air temperature, or the temperature of the girders, bearings or substructure concrete, in the immediate area of the grouting, falls below 5 degrees Celsius, the following provisions for cold weather grouting shall be affected:

(a) Before grouting, adequate preheat shall be provided to raise the temperature of the substructure concrete to at least 10 degrees Celsius.
(b) Temperature of the grout during placing shall be between 10 degrees Celsius and 25 degrees Celsius.
(c) The grout pads shall be enclosed and kept at 10 degrees Celsius to 25 degrees Celsius for at least five days. The system of heating shall be designed to prevent excessive drying-out of the grout.

(5) Clean-Up
All steel shall be left clean and free of oil, grease, mud, dust, road spray or other foreign matter.

300.5.13 PILING

300.5.13.1 General

This Section 300.5.13 (Piling) is for the supply and installation of steel H-piles, plain and galvanized steel pipe piles, precast concrete piles, and cast-in-place concrete piles. It includes driven bearing piles, drilled cast-in-place concrete bearing piles, and drilled cast-in-place concrete/steel pipe composite bearing piles.

300.5.13.2 Submittals

The following information shall be submitted to the Department by a date that is reasonable having regard to the design and construction process and in any event no later than 21 days after request by the Department, acting reasonably:

- Mill certificates for piling
- Pile driving equipment and procedures to be used for the installation of driven piles; and
- Pile drilling equipment and procedures to be used for the installation of drilled piles.
- Non-destructive testing results for steel pile splices.

300.5.13.3 Reference Drawings

- Standard Pipe Pile Splice - S-1414-87
- Standard H-Pile Splice - S-1415-87
- Standard Closed Pipe Pile End Plate – S-1479

300.5.13.4 Materials

300.5.13.4.1 Steel "H" Piling

Steel "H" piling shall meet the requirements of Specification ASTM A36, CSA G40.21M 350W or better. Where piling is designated in metric dimensions, imperial equivalent piling will be acceptable. Mill certificates shall be obtained prior to pile installation.

Splice plates shall be fabricated to the dimensions shown on Standard Drawing S-1415-87 (Standard H-Pile Splice).

300.5.13.4.2 Steel Pipe Piling

Steel pipe piling shall meet the requirements of Specification ASTM 252 Grade 2 or better, except that hydrostatic testing is not required. Although piling is designated in metric dimensions, imperial equivalent piling will be acceptable. Mill certificates shall be obtained prior to pile installation. Some out-of-roundness of the pipe is acceptable provided an acceptable splice can be completed.

Galvanized piling shall be galvanized by the hot dip method, in accordance with the ASTM

A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

Splice backup rings and closed pipe pile end plates shall be fabricated as shown on Standard Drawing S-1414-87 (Standard Pipe Pile Splice) and Standard Drawing 1479 (Standard Closed Pipe Pile End Plate).

300.5.13.4.3 Timber Piling

The use of timber piling will not be permitted.

300.5.13.4.4 Pile Concrete

Concrete shall meet the requirements of Pile Concrete as specified in Section 300.5.7 (Cast-In-Place Concrete).

300.5.13.4.5 Reinforcing Steel

Steel reinforcement incorporated in the pile concrete shall comply with Sections 300.5.2.7 (Durability), 300.5.2.8 (Materials) and Section 300.5.14 (Reinforcing Steel).

300.5.13.5 Handling

Piling shall be handled, hauled and stored in a manner that avoids damage to the piling materials. Loading and unloading shall be by crane, loader or other appropriate hoisting equipment.

Care shall be taken in order to prevent damaging the galvanized surface on galvanized piling. Fabric slings, wood blocking or other approved methods shall be used to support and separate galvanized piling when handling, hauling or storing. Piling on which the galvanized coating has been damaged shall be replaced or repaired. Where repair of damaged galvanizing is required, the repair shall be by metallizing in conformance with ASTM A780, Method A3, to a thickness of 180 µm.

300.5.13.6 Driven Bearing Piles

300.5.13.6.1 Equipment and Driving Methods

Acceptable driving equipment includes diesel hammers, hydraulic hammers, vibratory hammers, and driving frames. Drop hammers shall not be used under any circumstances.

The driving of piles with driving extensions shall be avoided if practicable. When driving extensions are used, one pile from each group of 10 shall be a long pile driven without extensions, and shall be used as a test pile to determine the average bearing power of the group. For the special types of piling, driving heads, mandrels, or other devices in accordance with the manufacturer's recommendations shall be provided so that the pile may be driven without damage and without unnecessary trimming.

Adequate precautions shall be taken to ensure that the piles are in proper alignment, including the use of installation frames, fixed leads or other means as are necessary.

Piles shall be driven with a variation of not more than 20 mm per metre from the vertical or from the batter shown on the Detailed Designs, except that piles in exposed bents shall not be out of position at the ground line by more than 50 mm and shall not be out of position more than 25 mm in the pile cap. Foundation piles shall not be out of the position shown on the Detailed Designs more than 150 mm after driving, except that for fully integral abutments the foundation piles shall not be out of the position shown on the Detailed Designs more than 50 mm after driving. In addition, for fully integral abutments, the variation in position between the pile casing center and the pile centre shall have a maximum allowable tolerance of 25 mm. In the event that these tolerances are not met, immediate changes shall be made to pile driving procedures to correct this.

For pile installation purposes, the Contractor shall paint markings on each pile at 0.25 m intervals, with a label at each 1.0 m interval, starting from the toe of the pile.

300.5.13.6.2 Bearing Values

The piles shall all be driven to the tip elevations shown on the Detailed Designs, or lower, to achieve the required stability and specified minimum bearing capacity. The pile bearing capacities shall be estimated by the Bearing Formula given below, or by the methods given in 300.5.13.8 (Pile Capacity Testing).

In the case of friction piles, the piles shall be driven to the tip elevations shown on the Detailed Designs, or lower, in order to achieve the required stability and design load carrying capacity.

Bearing Formula

When not driven to practical refusal, and when the pile capacity is not determined by the methods given in 300.5.13.8 (Pile Capacity Testing), then the safe bearing values for piles shall be determined by the following formula:

For Diesel and Hydraulic Hammers

$$P = \frac{165 \times E \times F}{S + 5}$$

Where P = pile reaction at Service Limit State (SLS) (kN)
E = energy output of hammer (kJ)
F = efficiency factor
S = the average penetration per blow for the last 10 to 20 blows (mm per blow)

The efficiency factor of the hammer shall be determined at site by comparing the actual recorded blows per minute to data provided by the manufacturer of the hammer.

The above formula is applicable only when:

(1) The head of the pile is not broomed, crushed, or deformed.
(2) The penetration is reasonably quick and uniform.
(3) A driving extension is not used.

300.5.13.6.3 Steel Piles

Steel piles shall consist of structural steel shapes or pipes of the section shown on the Detailed Designs or otherwise specified. Full length piles shall be provided wherever possible to avoid field splicing.

When pipe piles are to be driven closed-ended, one section of pipe for each proposed pile shall be supplied with the end-plate welded-on, in conformity with Standard Drawing S-1479 (Standard Closed Pipe Pile End Plate).

When pipe piles are to be driven open-ended and the interiors cleaned out, a power screw rotary auger shall be used to remove the required material. All loose material and all material adhering to the walls of the piles shall be removed.

After installation, closed ended or open ended pipe piles shall be filled with pipe concrete.

The total energy developed by the hammer shall be sufficient to achieve the required bearing value or tip elevation, but in no case shall the total energy developed be less than 35 kJ per blow.

The head shall be cut squarely and a driving cap or follower shall be provided to hold the axis of the pile in line with the axis of the hammer. The follower shall be of adequate dimensions to allow driving the pile without trimming or reducing the cross-section of the pile. When damage or buckling is evident at the driving end of the pile, in order to obtain the desired bearing capacity or penetration of the pile, the driving end of the piling shall be reinforced, or, other suitable equipment or procedures provided, to prevent such damage.

Piles shall be cut off level at the required elevation. If capping is required, the connection shall be made according to details shown on the Detailed Designs.

300.5.13.6.3.1 Steel Pile Splices

When splicing, whatever means necessary shall be employed to match out-of-round piling. Exposed pile splices shall be avoided. Refer to Standard Drawing S-1415-87 (Standard H-Pile Splice) and Standard Drawing S-1414-87 (Standard Pipe Pile Splice)with the exception that Item 1 for both “Requirements and Procedure for Splicing H-Piles” and “Requirements and Procedure for Splicing Pile Piles” is replaced with “All field welding shall be in accordance with Section 300.5.8.4.1(12)”.

Where the upper portions of piling are specified to be galvanized, excess piling shall be removed from the ungalvanized portion of the piling to ensure that the galvanized portion extends to the elevation shown on the Detailed Designs. Splicing within the galvanized portion of the piling shall be avoided; however if splicing becomes necessary due to unforeseen circumstances, the damage galvanized area shall be metallized in accordance with ASTM A780 method A3 to a minimum thickness of 180 μm.

Site welding personnel shall be advised of the hazardous fumes which are generated during welding or cutting of the galvanized steel.

The Contractor shall perform ultrasonic testing for a minimum of 20% of all full penetration compression splice welds for all piles at each bridge component. Ultrasonic testing shall be done for welds where visual inspection indicates a possible defect. Additional testing may be required for the full penetration compression splice welds to ensure the integrity of the structure. In addition, the Contractor shall inspect 100% of the full penetration tension splice welds, as defined on the Detailed Designs. The ultrasonic testing shall be done by a company certified to CAN/CSA W178.1. Ultrasonic testing technicians shall be certified to Level II by the Canadian General Standards Board. Welds shall be repaired if full penetration has not been achieved.

Temporary caps shall be supplied and secured on all open pipe piles or drilled holes.

300.5.13.6.4 Defective Piles

The procedure incident to the driving of piles shall not subject them to excessive and undue abuse producing deformation of the steel, or crushing and spalling of the concrete. Piles damaged by improper driving, or driven out of proper location, or driven below the cut-off elevation, shall be corrected by one of the following methods:

(a) The piles shall be withdrawn and replaced by new and, if necessary, longer piles, or

(b) replacement piles shall be driven adjacent to defective or low piles, or

(c) the piles shall be spliced or built up, as otherwise provided herein, or a sufficient portion of the footing extended to properly embed the piles. All piles, pushed up by the driving of adjacent piles or by any other cause, shall be driven down again.

In case the required penetration and bearing capacity are not obtained, the Contractor may provide a hammer of greater energy or resort to pre-drilling.

300.5.13.7 Drilled Cast-in-place Concrete Bearing Piles

300.5.13.7.1 General

In addition to drilled cast-in-place concrete bearing piles this Section 300.5.13.7 (Drilled Cast-in-place Concrete Bearing Piles) shall include drilled cast-in-place concrete/steel pipe composite bearing piles. The work shall include drilling and belling the holes, as required, supplying and placing the steel pipe and reinforcing steel, and supplying, placing, protecting and curing the concrete.

Where cast-in-place piles are designed based on the use of semi-empirical methods, supported by geotechnical investigation with soil parameters determined by laboratory, field testing and local experience, and with appropriate levels of construction monitoring and verification, the ultimate bearing capacity may be adjusted for Limit State Design by a geotechnical resistance factor of 0.4.

300.5.13.7.2 Equipment and Drilling Methods

Due to the nature of the work, the drilling subcontractor shall have adequate equipment and a proven record of competence in this work.

Only powered screw rotary type augers will be acceptable for drilling.

The installation of further piling shall not proceed if for any reason, the quality of the adjacent piling is compromised due to the effects of vibration or other reasons.

300.5.13.7.3 Drilling Pile Holes

The drilled pile holes shall be stabilized and sealed by means of temporary casings or other methods to prevent the possible collapse of the pile holes or ingress of water. Every attempt necessary shall be made to obtain "dry" pile holes prior to placing the pile concrete.

Temporary casing, if used in drilling operations, shall be removed from the hole as pile concrete is being poured. The bottom of the casing shall be maintained below the top of the concrete during withdrawal and pouring operations. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing.

The elevations shown on the Detailed Designs of the bottoms of the pile holes shall be considered approximate only, and further drilling may be required as necessary to secure satisfactory bearing of the piles.

Where belling of the piles is specified, belling shall proceed only after the pile hole has been drilled to the specified elevation.

The walls and bottoms of the pile holes shall be cleaned to remove all loose and extraneous material. The presence of any gas shall be determined and appropriate means and equipment shall be employed to ensure a safe work site. Pile reinforcement and pile concrete shall not be placed until the pile hole is deemed acceptable.

300.5.13.7.4 Open Drilled Holes

All open drilled holes on the site shall be covered until the time they are filled with concrete or otherwise properly backfilled. The covers shall be of adequate strength and securely fitted so that machinery and workmen are protected against cave-in and surface water is prevented from running into the pile hole.

300.5.13.7.5 Reinforcement

Steel reinforcement shall be fabricated in the sizes and to the dimensions shown on the Detailed Designs and shall be placed, centered and braced in the pile hole as detailed.

Particular care shall be taken in locating projecting "column dowel bars", to a tolerance not exceeding 10 mm in any direction, and pouring will not be permitted until provisions are made to confirm to this requirement.

Adequate "shoes" or spacers shall be firmly anchored to the reinforcement to ensure the reinforcement is kept centered in the concrete.

300.5.13.7.6 Concrete Placement

When the reinforcement has been acceptably placed, concrete shall be immediately deposited in the pile hole. The concrete shall be "Pile Concrete" and the provisions of Section 300.5.7 (Cast-In-Place Concrete) shall apply.

Suitable forms shall be used to maintain the specified dimensions of concrete piles above ground level.

Pile concrete placed under water will require validation by "Crosshole Sonic Logging ("**CSL**") in accordance with 300.5.7.10.3 (Concrete Placed Under Water).

300.5.13.7.7 Cold Weather Conditions

In cold weather, which shall be considered to exist if night-time low temperatures are expected to be below 0 degrees Celsius, heated concrete shall be used. Such concrete shall have a temperature of between 15 degrees Celsius and 25 degrees Celsius when placed.

When the ground against which pile concrete is placed is below -5 degrees Celsius, the concrete shall be protected from heat loss. The pile boring shall be made oversize down to the depth of 2 m, and the concrete shall be poured in an insulated form. Concrete at the top of the pile is to be insulated. After four days the form and insulation may be removed, and the space is to be backfilled immediately with compacted non-granular fill or lean concrete to the elevation of top of pile.

In a region where the ground temperature is above -10 degrees Celsius but below -5 degrees Celsius, the hole may be bored 100 mm diameter oversize, and filled directly with pile concrete, as an alternative to the procedure described above. Concrete at the top of the pile is to be insulated.

If the top of the pile extends above the existing ground surface, in cold weather, it is to be adequately protected from the cold for a period long enough to ensure proper curing.

300.5.13.7.8 Pile Tolerance

Piles shall be accurately located, and shall be installed plumb or at the batter specified on the Detailed Designs. The maximum tolerance allowed shall be 50 mm for variation off the centre of any pile at the cut-off elevation, and no pile shall be out of plumb or specified batter by more than 20 mm per metre. Any pile out of centre or plumb beyond the tolerances specified shall be corrected.

300.5.13.8 Pile Capacity Testing

300.5.13.8.1 Static Load Testing

When specified, the load carrying capacity of piles shall be determined by static load tests.
In general static load tests can be performed on any pile type. Static load tests shall consist of the application of a test load on a suitable platform supported by the pile, or through the use of adjacent reaction piles, with suitable apparatus for accurately measuring the test load and the settlement of the pile under each increment of load. The tests shall be in general conformance with ASTM D3689. Osterberg or Statnamic tests may be used in place of static load tests.

Where sufficient static load testing has been done to satisfy Limit State Design, Load and Resistance Factor Design ("**LRFD**"), or reliability-based design statistical requirements, the factored geotechnical resistance may be taken as 0.6. Where allowable or working state design methods are used in the design, or where the requirements of Limit State Design are not fulfilled, the allowable load shall be considered as 50% of that load which, after a continuous application of 48 hours, produces a permanent settlement not greater than 6 mm measured at the top of the pile. This maximum settlement shall not increase by a continuing application of the test load for a further period of 60 hours or longer.

At least one pile for each group of 100 piles shall be tested. The frequency of testing shall be increased to account for changing soil conditions, pile sections and types, and construction methods.

300.5.13.8.2 Dynamic Load Testing / Pile Driving Analysis (PDA) Testing

Dynamic Load Testing may be used as part of a quality control method during pile installation. Pile Driving Analyzer ("**PDA**") testing can be used as an alternate or supplemental test method to static load tests for the determination of pile capacity. This method involves installing instruments on the pile head with accelerometers and strain gauges, then impacting the pile head using a pile driving hammer or similar device over a very short period of time (3-4 milliseconds). The impact imparted on the pile shall be sufficient to fully mobilize the pile skin friction and end bearing resistances of the pile, and shall result in a net permanent set per blow between 3 mm and 8 mm upon impact from the pile hammer.

The PDA test may be conducted on either driven or cast-in-place piles. For driven piles, the PDA test shall be conducted at the end of the initial driving stage, such that the end bearing and skin friction resistances can be determined upon initial installation of the pile. Where time dependant changes in the soil conditions are anticipated, such as pile setup or relaxation, additional tests shall be conducted upon re-strike on a sample of previously tested piles to determine the bearing parameters after driving induced pore pressures have dissipated. The re-strike shall be conducted no sooner than one week after initial driving, or longer as directed by the Contractor's geotechnical engineer. It is permissible to initially drive piles to a capacity below the required ultimate capacity and rely on pile setup to produce the required capacity.

Where the capacity of the pile at re-strike is relied upon for design, a minimum of one third of piles tested during initial drive shall be tested again during re-strike. If dynamic testing is only undertaken upon re-strike, then a minimum of 10% to15% of all piles shall be PDA tested on re-strike.

The hammer energy used during PDA tests at the end of initial drive and during re-strike driving shall be such that the required ultimate pile capacity can be mobilized in a single blow without additional data interpretation.

For cast-in-place piles, the PDA test shall not be conducted within one week after the installation of the pile.

The results of the test can be processed in the short term using the Wave Equation Analysis of Piles ("**WEAP**") method to provide real time monitoring of pile stresses, pile integrity, hammer performance, and pile capacity; and in some cases can be used to confirm pile termination depths when borehole information is not available. However, this method shall only be used as an initial determination of bearing capacity, and where the test is being used to determine the capacity of the pile for design methods, a signal matching analysis using a Case Pile Wave Equation Program ("**CAPWAP**") shall be utilized.

ASTM D4945-08 shall be followed. In addition, at least two accelerometers on a driven pile and four accelerometers on a cast-in-place pile shall be installed. All accelerometers and transducers shall be calibrated and inspected to ensure proper attachment to the pile.

Where the PDA methods are used strictly as a Quality Assurance/Quality Control tool, a minimum of 5% of production piles shall be monitored dynamically. When used as a design or confirmatory tool, a minimum of 10% of piles shall be tested, including tests at each substructure element associated with the project and where soil conditions are expected to vary, or as required for statistical validation of a LRFD design, whichever is greater. The piles selected for testing shall be representative of other piles in the same structure. Where driven piles exhibit lower driving resistances and/or shorter penetrations than normal, or where cast-in-place piles experience extraneous soil, ground water, and/or installation conditions, additional tests over and above minimum number of tests specified earlier shall be required. Further, additional tests shall accompany changes in piling equipment, procedure and pile requirements.

In the situation where one pile in a pile group does not meet capacity requirements, additional tests shall be done to confirm that this pile is an isolated case. In such case, it may be permissible to rely on group effects to compensate for the lower pile capacity. The Contractor's geotechnical engineer shall have the final say in this situation. Under no circumstances shall superposition of axial and shaft capacity from different strikes, re-strikes or any combination thereof be permitted.

Where sufficient dynamic load testing has been done to satisfy Limit State Design, LRFD or reliability-based design statistical requirements, the geotechnical resistance factor for design of pile foundations may be taken as 0.5.

Pile driving equipment shall be sized such that piles can be driven with reasonable effort to the specified ultimate bearing capacity without damaging the pile. Approval of the pile driving equipment shall be based on the WEAP analysis and/or PDA testing. The Contractor shall submit details of the proposed pile driving equipment for review by the Field Review Engineer a minimum of 14 days prior to the commencement of pile installation. The information provided shall include the following:

- Hammer Data: hammer type, manufacturer, model number, serial number, maximum rated energy and range in operating energy, stroke at maximum rated energy and range of operating stroke, ram weight, modifications;
- Striker Plate Data: weight, diameter, thickness, composition;
- Hammer Cushion Data: manufacturers, area, thickness per plate, number of plates, total thickness, and composition;
- Helmet Data: weight, composition; and
- Pile Cushion Data: material, area, thickness per sheet, number of sheets, total thickness of cushion.

The PDA testing agency shall prepare a daily field report summarizing the preliminary test results including driving stresses, transferred energy and estimated pile capacity within 24 hours of testing. The final test results shall be presented to the Department within seven days of testing. The testing report shall be prepared in accordance with the requirements of ASTM D4945. As a minimum, the report shall include the following:

- Pile and driving system information;
- Pile installation data;
- PDA testing equipment and procedure;
- Energy imparted;
- Maximum driving stresses;
- Hammer blow rate;
- CAPWAP input parameters including quake and damping factors; and
- Shaft friction, end bearing and total pile capacity.

The test results shall be used to determine the subsequent termination criteria, requirements for modification of driving procedures or equipment, and pile acceptance. No work shall be done on the foundation elements (pile caps, cut-off, welding, etc) prior to this testing report being reviewed by the Field Review Engineer.

300.5.14 REINFORCING STEEL

300.5.14.1 General

For the purposes of this Section 300.5.14, carbon steel reinforcing bar, stainless steel reinforcing bar, low carbon/chromium steel reinforcing bar, and epoxy coated reinforcing steel will be referred to collectively as reinforcing steel. For the purposes of this Section 300.5.14, both stainless steel reinforcing bar and low carbon/chromium steel reinforcing bar will be referred to collectively as corrosion resistant reinforcing steel ("**CRR**").

Reinforcing steel shall be supplied in the lengths and shapes, and installed as indicated on the Detailed Designs.

The Contractor shall provide mill test certificates for each lot or part of lot of reinforcing steel to verify that the reinforcing steel supplied was produced and tested in accordance with the applicable specification requirement as noted in Section 300.5.2.8 (Materials).

Only one type of stainless steel reinforcing bar and one type of low carbon/chromium steel reinforcing bar shall be used in any one bridge structure.

300.5.14.2 Intentionally Deleted

300.5.14.3 Fabrication

All bars requiring bends shall be cold bent at the fabrication facility. Heating of bars to facilitate bending shall not be permitted. Bars shall be cut by shearing or with fluid-cooled saws. Torch cutting shall not be permitted. Bars showing evidence of torch cutting will be rejected.

Unless otherwise specified, all hooks and bends shall be fabricated using the pin diameters and dimensions as recommended in the Reinforcing Steel Institute of Canada ("**RSIC**"), *Manual of Standard Practice*. Bars shall conform accurately to the dimensions shown on the drawings and be within the fabricating tolerances detailed in the RSIC, *Manual of Standard Practice*.

Fabrication of epoxy coated reinforcing steel after application of the coating shall be in accordance with the requirements of Ontario Provincial Standard Specification OPSS 1442.

Fabrication of stainless steel reinforcing bars shall be carried out in such a manner that bar surfaces are not contaminated with deposits of iron and other non-stainless steels, or suffer damage due to straightening or bending.

Reinforcing steel shall be fabricated without laminations or burrs.

Mesh reinforcement shall be supplied in flat sheets only when used in precast concrete.

300.5.14.4 Shipping, Handling and Storage

Reinforcing steel shall be covered and protected at all times during transportation.

Reinforcing steel of differing material types shall be stored separately. Bar tags identifying the material type shall be clearly visible and shall be maintained in-place until installation of the material.

The Contractor shall store all reinforcing steel on platforms, skids, or other suitable means of support able to keep the material above the ground surface while protecting if from mechanical injury or deterioration.

The Contractor shall take all precautions necessary to prevent damage to the material during handling operations. Bundles shall be handled with spreaders and non-metallic slings.

Special care shall be taken when handling epoxy-coated reinforcing steel to prevent damage to the epoxy coating. Epoxy-coated reinforcing bars shall not be dropped or dragged, and shall be lifted with non-metallic slings. Protective measures shall be implemented to prevent bar-to-bar abrasion and excessive sagging of bundles.

On site storage of epoxy-coated reinforcing steel shall not exceed 120 days, and exposure to daylight shall not exceed 30 days. If the exposure time is expected to exceed 30 days, the epoxy-coated reinforcing steel shall be protected by covering with opaque polyethylene sheeting or equivalent protective material. Epoxy-coated reinforcing steel that is exposed to daylight for more than 30 days, or which is stored on site for over 120 days shall be removed and replaced.

CRR bars stored on site shall be protected with polyethylene sheeting or an equivalent protective material.

300.5.14.5 Intentionally Deleted

300.5.14.6 Placing and Fastening

All reinforcing steel shall be accurately placed in the positions shown on the Detailed Designs, and shall be securely tied and chaired before placing the concrete. Bars shall be tied at all intersections, except where spacing is less than 250 mm in each direction alternate intersections may be tied. Specified distances from forms shall be maintained by supports, spacers or other means approved by the Department.

Welding of reinforcing steel shall not be permitted.

Field bending of low carbon/chromium steel reinforcing bar is not permitted. Field bending of all other reinforcing steel types, regardless of circumstance, will not be permitted unless specified on the Detailed Design.

Where CRR is being installed, corrosion resistant supports or spacers shall be equivalent to the reinforcing steel being placed. Supports and spacers fabricated from alternate material types may be used with written prior approval from the Department.

Tie wire shall be manufactured from the same material type and grade as the reinforcing steel being tied. Plastic coated tie-wire may be used where low carbon/chromium reinforcing steel being placed.

300.5.14.7 Splicing

Splicing of bars, unless shown on the Detailed Design is prohibited.

Splices, where permitted, shall be staggered. For lapped splices, bars shall be placed in contact and wired together while maintaining the minimum required clear distance to other bars, and the required minimum distance to the surface of the concrete.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

300.5.14.8 Field Repair of Epoxy Coating

Bars shall be examined prior to installation to identify bars to be rejected or repaired, and again after installation. Bars with coating damage greater than 1% of the surface area in any one metre length of bar shall be rejected.

All damage to epoxy coating on epoxy-coated reinforcing steel shall be repaired prior to being cast into concrete, regardless of the cause of damage, and all repairs shall be completed a minimum of 12 hours prior to placing concrete. Field cutting of epoxy coated reinforcing steel shall not be carried out unless accepted by the Department in writing. Cuts shall be made by shearing or saw cutting only.

Repair of damaged epoxy coating, sheared and sawed ends shall be completed using a two component epoxy-coating patching material in accordance with the manufacturer’s written recommendations regarding. The areas to be repaired shall be cleaned by removing all surface contaminants and damaged coating before applying patching material. Where rust is present, it shall be completely removed immediately prior to applying the patching material. Repairs shall not be done when the temperature of the bar or ambient air is 5 degrees Celsius or less, or when moisture is present on the bar. The patching material shall be overlapped onto the original coating for a minimum distance of 25 mm or as recommended by the patching material manufacturer. The dry film thickness of the patched areas shall be between 175 µm to 300 µm, and all repairs shall be fully cured prior to being covered in concrete. When the field repairs result in a total bar surface area covered by patching material that exceeds 5% of the bar surface area, the bar shall be replaced.

300.5.14.9 Repair of Stainless Steel Reinforcing Bars

Individual stainless steel reinforcing bars exhibiting any of the following defects shall be repaired or replaced:

- Any single area of iron contamination greater than 100 mm in length;
- Two or more areas of iron contamination greater than 50 mm in length;
- Frequent small occurrences of iron contamination along the full length of the bar.

Material exhibiting excessive staining shall have contaminates identified by energy dispersive x-ray analysis (EDXA). The methods proposed for repair of stainless steel reinforcing bars shall be approved by the Department prior to implementation.

Stainless steel reinforcing bars exhibiting mechanical damage shall be replaced.

300.5.15 DECK WATERPROOFING SYSTEM

300.5.15.1 General

This Section 300.5.15 (Deck Waterproofing System) is for the supply and installation of deck waterproofing and asphalt concrete pavement.

Deck waterproofing shall be carried out in accordance with the following specifications, as shown on the Detailed Designs, and Standard Drawing S-1443-11 (Deck Water Proofing System with 80 mm Two Course Hot Mix ACP).

300.5.15.2 Intentionally Deleted

300.5.15.3 Materials

The materials supplied shall be able to withstand the heat generated during the waterproofing processes without affecting the performance of the material.

Tack Coat
The tack coat shall be a primer type meeting the requirements of CAN/CGSB-37-GP-9MA.

Asphalt Membrane
Material for asphalt membrane shall be hot applied rubberized asphalt meeting the requirements of the Ontario Ministry of Transportation’s OPSS 1213 Specification.

Asphalt membrane materials shall be selected from products listed on the Ministry of Transportation, Ontario DSM List 9.90.15 (http://www.roadauthority.com) at the time of installation. Asphalt membrane materials shall be supplied in cakes in the manufacturer’s sealed and labeled containers.

Rubber Membrane
Rubber membrane shall consist of 1.2 mm thick butyl and ethylene propylene diene monomer ("**EPDM**") rubber. The membrane shall meet the requirements of CAN/CGSB 37-52M.

Membrane Reinforcing Fabric
Membrane reinforcing fabric shall be spun bonded sheet structure composed of 100% continuous filament polyester fibres bonded together at their crossover points. The membrane shall be supplied in minimum widths of 300 mm.

Wick Drain
Wick drain shall be composite polypropylene with a total thickness of 3.6 mm and supplied in 100 mm widths. The puncture strength shall be a minimum of 45 N measured in accordance with ASTM D4833.

Waterproofing Protection Board
Waterproofing protection board shall consist of durable panels designed to provide a protective cushion between the hot mix asphaltic concrete pavement and the asphalt membrane. The waterproofing protection board shall meet the requirements of the Ontario Ministry of Transportation's OPSS 1215 for Protection Board.

Waterproofing protection board materials shall be selected from those listed on the Ministry of Transportation, Ontario DSM List 9.90.60 (http://www.roadauthority.com) at the time of installation.

300.5.15.4 Equipment

An approved heating and mixing kettle shall be used to heat the hot applied rubberized asphalt membrane. The kettle shall be a double boiler oil transfer type with a built-in agitator and shall be equipped with permanently installed dial type thermometers with an accuracy of ±2 degrees Celsius to measure the temperature of the melted compound and the oil. A separate calibrated thermometer with an accuracy of ±2 degrees Celsius to verify the material temperature shall be available on site. The unit shall be capable of keeping the contents continuously agitated, free flowing and lump free until the material is drawn for application.

300.5.15.5 Installation

300.5.15.5.1 Traffic Restrictions

Once surface preparation operations have commenced, traffic restrictions apply to all traffic other than the construction equipment directly associated with the waterproofing operations and the paving operations from traveling over the prepared areas.

These restrictions shall remain in place until such time that the ACP has been placed and cooled to ambient temperature.

300.5.15.5.2 Procedure

All of the operations involved in waterproofing shall be carried out in sequential order, such that there are no delays between individual operations except those necessary to meet the requirements of this Section 300.5.15 (Deck Waterproofing System).

Waterproofing operations shall only be carried out when air and concrete surface temperature are 5 degrees Celsius or higher.

300.5.15.5.3 Surface Preparation

Grout tubes shall be cut flush with the deck surface prior to surface preparation, and shall be re-cut flush with the concrete surface if surface preparation operations result in the tube projecting above the concrete. A 450 mm by 450 mm piece of membrane reinforcing fabric, centered on the tube, shall be installed as described in Section 300.5.15.5.4 (Waterproofing of Joints and Cracks).

Concrete surfaces to receive waterproofing shall be cured a minimum of 14 days prior to waterproofing installation.

The concrete, surfaces shall be completely dry prior to commencing any waterproofing installation work. Drying of the concrete surfaces by use of torch or other means will not be permitted.

The concrete surface shall be prepared for waterproofing installation by sandblasting or shotblasting to expose sound, laitance-free concrete for the entire installation area. All dirt and debris shall be removed and disposed of, leaving a prepared surface satisfactory for tack coating.

Immediately prior to the application of the tack coat, the concrete surface shall be blown clean with oil and water free compressed air to remove all dust and other foreign material. The tack coat shall be cut back with an equal volume of gasoline type solvent or an alternative cut back asphalt product compatible with the asphalt membrane. Tack coat shall be applied wherever waterproofing membrane is required.

The tack coat application rate shall be such that the tack material will be absorbed into the concrete, resulting in a surface that is dull and black in appearance. Excess application of tack coat, indicated by a shiny black surface, shall be avoided. Tack coat material shall be applied rate of 0.25 L/m^2.

Waterproofing equipment or material shall not be permitted on the tack coat until it has fully cured and is completely tack-free.

300.5.15.5.4 Waterproofing of Joints and Cracks

Special attention shall be paid to waterproofing over construction joints, lift hook pockets, grout tubes, patches and cracks.

After the tack coat application and Prior to the application of the primary hot asphalt membrane, a coat of hot asphalt membrane 4 mm thick and wide enough to extend 200 mm on either side of the joint or crack, shall be applied in accordance with Section 300.5.15.5.6 (Application of Asphalt Membrane) to the tack-coated concrete surface. A strip of membrane reinforcing fabric material wide enough to extend 150mm on either side of the construction joint, lift hook pocket, grout tubes, patch or crack shall be applied while the asphalt membrane is still hot and tacky. The membrane reinforcing fabric shall then be covered with an additional layer of waterproofing 2 to 3 mm thick. Membrane reinforcing fabric shall be overlapped a minimum of 100 mm when multiple strips are used.

For areas along all curbs, barrier walls, and deck drains the hot asphalt membrane shall be applied to the height of the top of the hot mix ACP surface course and 150 mm onto the deck. Rubber membrane shall be applied into the first coat of asphalt membrane while it is still hot and tacky. The rubber membrane shall extend 50 mm up the vertical face, and 100 mm onto the deck surface. Rubber membrane shall be overlapped for a minimum of 100 mm where multiple strips are used. A second coat of asphalt membrane shall then be applied to fully cover the rubber membrane.

300.5.15.5.5 Installation of Wick Drain

Wick drains shall be installed along the full length of gutters and shall be installed when the asphalt membrane is still hot and tacky. Special attention shall be given to waterproofing and wick drain modifications at deck drain pipe locations. Wick drains shall not receive tack coat prior to paving.

300.5.15.5.6 Application of Asphalt Membrane

Cakes of asphalt membrane shall be melted in the heating and mixing kettle to a temperature not exceeding that recommended by the manufacturer.

The asphalt membrane shall not be applied until the tack coat has cured completely.

The application temperature of asphalt membrane shall be within the range recommended by the manufacturer. The membrane shall be applied in a uniform film having a minimum thickness of 4 mm and a maximum thickness of 6 mm.

The asphalt membrane thickness and its corresponding location along the deck surface shall be checked and recorded at a minimum of every 50 square metres to ensure conformance to the Technical Requirements, prior to placing the protection board.

Application shall commence at the low end of the bridge and shall be carried out in a continuous manner to the extent practicable. Where joints are unavoidable, they shall be overlapped by a minimum of 150 mm. The total membrane thickness at the joint location shall not exceed 6 mm. The membrane shall be applied over all waterproofed joints and cracks, and shall extend up the face of curbs, barrier walls, and deck drains, to the height of the top of the hot mix surface course. Deck drains and drainage tubes shall not be plugged.

300.5.15.5.7 Application of Protection Board

Protection boards shall be laid on the asphalt membrane, while the membrane is still hot, with the length of the board running transversely, on the deck. The protection boards shall be placed with edges overlapping a minimum of 12 mm to a maximum of 25 mm both longitudinally and transversely. The protection board edge shall be within 5 mm of all wick drains, vertical faces of drains and vertical faces of expansion joints.

Protection board shall be lapped to produce a shingling effect in both the transverse and longitudinal directions.

Protection boards shall be placed such that the longitudinal (direction of traffic flow) joints are staggered at least 150 mm. Boards shall be rolled using a linoleum or lawn type roller while the membrane is still warm to ensure good contact with the membrane. Holes shall be cut through the protection board to allow water to drain freely through the drainage tubes. At locations where the edges of the protection board have curled up, the curled up edges shall be cemented down using hot membrane material.

Protection boards that are warped, distorted or damaged in any way, whether by manufacture, storage, handling or exposure to the elements, shall be replaced with new materials.

300.5.15.6 Sampling and Testing

If requested by the Department, sufficient quantities of the asphalt membrane, rubber membrane, membrane reinforcing fabric and protection board being used on the Project shall be sent for immediate testing in accordance with Ontario Provincial Standard Specifications OPSS 1213 and OPSS 1215. All test results shall be provided to the Department forthwith.

300.5.15.7 Intentionally Deleted

300.5.15.8 Paving Equipment and Methods

300.5.15.8.1 General

Equipment and methods used for asphalt concrete pavement on bridge deck waterproofing membranes shall be adequate to produce and place the material as specified.

300.5.15.8.2 Paver

Pavers shall be self-propelled and operated to maintain required levels, cross-falls and joint matching.

300.5.15.8.3 Compaction Equipment

Sufficient self-propelled equipment shall be provided to obtain the required degree of compaction of the asphalt concrete mixture. The compaction capability of the equipment used shall equal or exceed the placing rate of the spreading operations and shall be capable of obtaining the required compaction before the temperature of the mat falls below specified levels. Compaction equipment shall be of a suitable size, weight and type, such that displacement of the mat and/or disruption of underlying materials does not occur. Specialized equipment may be required to achieve adequate compaction and smoothness in tight corners at expansion assemblies and deck joints.

The Contractor shall provide a minimum of one rubber tired roller and one smooth steel drum type roller. The rollers shall have a minimum 10 tonne mass. Vibrators on vibratory rollers shall not be activated.

The compaction equipment shall be in proper mechanical condition and shall be operated such that uniform and complete compaction is obtained throughout the entire width, depth and length of the pavement being constructed. Rollers shall be configured to ensure uniform and complete compaction up to the face of barriers, curbs and medians. Rollers provided shall leave a smooth, properly finished surface, true to grade and cross-section without ruts or other irregularities. All compaction equipment shall be equipped with methods of wetting the tires or drums to prevent adhesion or pickup of the asphalt mixture.

300.5.15.9 Placement of Asphalt Concrete Pavement

300.5.15.9.1 Protection of Adjacent Bridge Components

The Contractor shall protect all bridge components to prevent splatter or staining from asphaltic materials.

300.5.15.9.2 Tack Coat

Asphalt tack coat shall be applied to the existing protection board and between lifts of asphalt concrete pavement, but shall not be applied to wick drains.

The surface to be tacked shall be dry and free of loose or deleterious material when the tack is applied.

The asphalt tack coat shall be applied in a uniform manner at an application rate of 0.5 ℓ/m^2 and suitable asphalt temperature. Air temperature in the shade at the time of application shall be 5 degrees Celsius or higher.

On areas where traffic is to be accommodated, the tack coat shall be applied in two operations. In the first operation one half of the width shall be tacked with the remaining half being tacked after the first half has cured.

The tack coat shall be protected from traffic or other damage. Areas on which the tack has been damaged by traffic shall be re-tacked.

300.5.15.9.3 Spreading and Compaction

300.5.15.9.3.1 General

The mixture shall be placed only upon a dry, frost free substrate on which the tack coat has cured, and under suitable weather and temperature conditions. Prior to the delivery of the mixture on the work, the base shall be cleaned of all loose or foreign material. The mixture shall be spread and compacted during daylight hours only, unless artificial light is provided.

During spreading and compaction operations, care shall be taken at all times to ensure that:

- Asphalt mixture is not wasted over the side or onto the adjacent surface mat.
- Damage is not done to the waterproofing membrane, curbs, barriers, medians, concrete paving lips, manholes, drains or medians.
- Damage is not done to guide posts, guardrails, signs, power conduits or any other roadside installations.

Immediate and adequate repair shall be made of any damage resulting from construction activities.

300.5.15.9.3.2 Spreading

Deck asphalt shall be placed and compacted in two nominal 40 mm lifts.

The first lift of the ACP Wearing Surface shall be spread by the asphalt paver in the direction of the protection board laps (downhill). In the event that paving cannot be carried out in the direction of the protection board laps, the Contractor shall submit a procedure for review, identifying measures that will be taken to ensure that the protection board and waterproofing membrane will not be damaged during paving. To avoid damaging the waterproofing membrane, the paver shall not push the delivery trucks, all equipment shall perform all turning movements off the bridge deck, and the asphalt mixture shall not be dumped onto the protection board ahead of the paver.

The longitudinal and transverse edges of each lane shall be straight in alignment, uniform, and of the same thickness as the adjoining pavement lift. Adequate measures for the protection of the exposed edges shall be maintained throughout the work.

To avoid displacement of the mixture the first lift shall be compacted only after the spread asphalt mixture has cooled to 105 degrees Celsius. The second lift shall be compacted when the spread asphalt mixture is within the following temperature ranges:

ASPHALT GRADE	COMPACTION TEMPERATURE RANGE	
	FIRST LIFT	**SECOND LIFT**
150 - 200 (A)	MAX. 105 Degrees C	128 Degrees C - 138 Degrees C
200 - 300 (A)	MAX. 105 Degrees C	123 Degrees C - 133 Degrees C

The first lift shall be placed, finished and compacted for the full width, and then allowed to cool down to 50 degrees Celsius or colder prior to commencing the second lift.

In the placing of successive lifts, the individual mixture spreads shall be aligned in a manner such that the longitudinal joints in successive lifts do not coincide. Unless otherwise directed, the lateral distance between the longitudinal joints in the successive lifts shall be not less than 0.30 m. The longitudinal joint of the final lift of asphalt concrete pavement shall not be located within the wheel path areas.

All longitudinal and transverse joints shall be of the vertical butt joint type, made in a careful manner, well bonded and sealed, and shall be finished to provide a continuous, smooth profile across the joints.

300.5.15.9.3.3 Compaction

The compaction process shall be monitored using a Control Strip Method. Control Strips are generally established on each mat placed.

The Control Strip lift shall be compacted using at least the following equipment:

(a) One steel roller weighing not less than 10 t; and

(b) One self-propelled pneumatic rollers, ballasted to its maximum capacity, weighing not less than 10 t.

Once the mix has been spread by the paver and the initial pass of the breakdown roller has been done, moisture and density measurements for determining the Control Density will commence at five locations within the Control Strip area, and will continue following repeated passes of the compaction equipment until the apparent maximum density is attained. These measurements will be taken using nuclear testing equipment.

The second lift of pavement shall be compacted to a minimum average density of 97% of Marshall Density, with no individual density less than 95%.

When required by the Department, the Contractor shall take and test cores from the top lift of pavement.

Percent compaction will be expressed in percent of Marshall Standard Density. The Marshall Standard Density used for determining pavement compaction shall be as follows:

(a) Marshall Densities determined on field sampled mix, or if not available then;

(b) Marshall Design Density as reported in the accepted mix design.

Coring shall be done using methods which will not damage the rubberized asphalt membrane or protection board. Core holes shall be completely de-watered and dried. A generous application of liquid asphalt shall be applied to the bottom and sides of the core hole and allowed to cure. Asphalt mix shall then be tamped in lifts into the core hole until flush with the surface of the surrounding pavement.

In order to maintain the crown of the bridge deck and approaches, the Contractor shall avoid operating the compaction equipment on or across the crown. Compaction procedures and equipment shall be such that displacement of the mixture does not occur. Roller wheels shall be kept slightly moistened by water or oil to prevent picking up the mixture, but an excess of either water or oil will not be permitted.

In cases where the asphaltic mixture is placed under weather and temperature conditions which may be considered less than ideal, normal operations shall be modified to provide special attention to these situations such that specified compaction results are achieved.

300.5.15.9.3.4 Segregation of Bridge Asphalt Concrete Pavement

Pavement segregation shall be classified in accordance with section 3.50.4.7.2 “Classifying Pavement Segregation” of the Alberta Transportation Standard Specifications for Highway Construction.

During paving operations, the Contractor shall make every effort to achieve a finished surface that has a uniform closed texture and is free of segregated areas. At the end of paving every day, the Contractor shall perform an inspection of the paving to identify any instances of pavement segregation. If segregation is evident, the Contractor shall take immediate corrective action to the paving process to prevent any further occurrence of segregation. When slight segregation is identified in the bottom lift, the Contractor shall identify and correct the cause of the segregation to prevent similar segregation at the top lift.

The Contractor shall repair all areas of segregation as follows:

(a) When any moderate or severe segregation or centre of paver streak is identified in the bottom lift, the top 20 mm of the entire lift shall be removed and replaced.
(b) When any moderate or severe segregation or centre of paver streak is identified in the top lift, the entire lift shall be removed and replaced.
(c) When slight segregation is identified in the top lift and the total area of slight segregation does not exceed 0.5% of the total paved area, the areas identified shall be repaired with a slurry patch.
(d) When slight segregation is identified in the top lift and the total area of slight segregation exceeds 0.5% of the total paved area, the entire lift shall be removed and replaced.

300.5.16 DECK SYSTEMS USING PRECAST CONCRETE PARTIAL DEPTH DECK PANELS

300.5.16.1 General

This specification in this Section 300.5.16 is for the fabrication and construction of deck systems using precast concrete partial depth deck panels.

Unless otherwise noted in this Section 300.5.16, all the requirements of Section 300.5.2 (Design Criteria) shall apply to the design of deck systems using precast concrete partial depth deck panels.

Unless otherwise noted in this Section 300.5.16, all the requirements of Section 300.5.9 (Precast Concrete Units and Post-Tensioning) shall apply to the supply, manufacture, delivery and erection of precast concrete partial depth deck panels.

Unless otherwise noted in this Section 300.5.16, all the requirements of Section 300.5.7 (Cast-in-place Concrete) shall apply to the construction of deck systems using precast concrete partial depth deck panels.

300.5.16.2 Intentionally Deleted

300.5.16.3 Manufacture

The panels shall be cast flat.

All edges of the panel shall have a minimum 20x20 mm chamfer, except the transverse joint which shall have a 55x55 mm chamfer along the top edges.

300.5.16.3.1 **Stressing Strand**

All strands shall be cut flush with the precast panel edges, and the ends of the strands shall be sealed with Sikadur-31 or an approved equivalent.

300.5.16.3.2 **Surface Finish**

The top surface of panels shall be clean, free of laitance, and roughened to 3 mm amplitude with spacing not greater than 15 mm with grooves parallel to strands. Formed chamfer surfaces that will be in contact with cast-in-place concrete shall be sandblasted to remove all laitance and uniformly expose aggregate particles.

300.5.16.3.3 **Tolerances for Panels**

Precast concrete deck panels shall meet the following tolerances:

a) Panel lengths: ± 5 mm (as measured perpendicular to the girder lines).

b) Panel widths: ± 10 mm (as measured parallel to the girder lines).

c) The maximum difference in plan view diagonal dimensions (squareness) of rectangular panels shall not be greater than 3.5 mm per meter of diagonal length;

d) Thickness of panel: + 5 mm, - 3 mm.

e) Strands shall be located at the centroid of the panel with a vertical tolerance of + 0 mm, - 3 mm, measured from the soffit and a horizontal tolerance of ± 10 mm.

f) Deviation from straightness of panel edges along the transverse joint between adjacent panels shall not exceed 1.5 mm per metre length;

g) Vertical bowing of panels out of plane, after casting and immediately prior to erection, in the direction of measurement, shall not be greater than the panel length/360 or the panel width/360, whichever is less, and in no case shall it exceed 10 mm maximum; and

h) Warping of panels shall not be greater than 5 mm per metre of distance from the nearest adjacent corner.

Tolerance measurement results shall be provided to the Department forthwith, upon request. Panels not meeting any of the tolerances listed above shall be rejected.

300.5.16.3.4 **Defects and Deficiencies Causing Rejection**

A panel having any one of the following defects or deficiencies shall be rejected:

a) Panels with honeycombing or spalls when the depth exceeds 15 mm or when the area of defect exceeds 25 mm x 25 mm;

b) Panels with any voids or spalls in the bottom of the panel;

c) Panels with any crack located parallel to or over the strands or reinforcing steel;

d) Panels with any crack at the edges and / or with cracks at the bottom; and

e) Panels with cracks that are deeper than 25 mm and/or wider than 0.1 mm.

300.5.16.4 Erection and Construction

The precast panels shall be erected on the girders with temporary supports. The precast panels shall be erected so that the transverse joints between adjacent panels are never greater than 5 mm. All transverse joints shall be sealed with Sikaflex 15LM or an approved equivalent to prevent mortar leakage.

The haunches shall be formed to be flush with the edge of the girder flanges. All haunch forming material shall be completely removed after casting the deck to fully expose the haunch concrete.

The deck and haunch concrete shall be cast monolithically in a two stage process to ensure full consolidation of concrete in the haunch area.

The first stage shall include placement of concrete in the haunch area and over the girder top flange in continuous strips. The depth of the first stage pour shall be above the bottom surface of the precast panel, but shall not exceed the top surface of the precast panel, and shall not extend in front of the second stage pour by more than 10 m. Placement and consolidation of concrete in the first stage shall be completed in such a manner that entrapped air on the vertical and horizontal formed surfaces of the haunch is minimized.

The second stage shall include placement of the remaining deck concrete. Concrete placement shall occur in a timely manner as to not result in any cold joint between the first and second stages. If cold joints are produced the entire deck section shall be removed and replaced including but not limited to the cast-in-place HPC concrete, steel reinforcing bars and precast deck panels.

Voids, cavities, or areas of honeycombing found in the haunch concrete meeting the following parameters shall be repaired by the Contractor:

a) Any defects with depth greater than or equal to 20 mm;

b) Defects greater than or equal to 25 mm high or 25 mm wide x 10 mm deep;

c) 10 or more defects between 20 mm wide or 20 mm high x 15 mm deep per lineal metre; or

d) 30 or more defects between 10 mm wide or 10 mm high x 15 mm deep per lineal meter.

Proposed repair procedures shall be submitted for review by the Department.

No portion of any hardware associated with deck formwork, including deck overhang formwork, shall be visible after removal of all formwork. For precast concrete girder superstructures, anchors for the exterior hangers may be cast into the girder top flanges. For steel girder superstructures, anchors for the exterior hangers may be shop attached to the girder top flanges. Field drilling of the girders or precast panels shall not be permitted.

All lifting hooks for the precast panels shall project through the top surface of the precast panel and shall be removed by cutting flush with the top surface of the precast panel after erection.

300.5.17 HEAVY ROCK RIPRAP

300.5.17.1 Rock Material

Heavy Rock Riprap shall be hard, durable and angular in shape, resistant to weathering and water action, free from overburden, spoil, shale or shale seams and organic material, and shall meet the gradation requirements for the class specified. No sandstone is permitted.

The minimum dimension of any single rock shall be not less than one third of its maximum dimension. The minimum acceptable unit weight of the rock is 2.5 t/m^3.

The Contractor shall provide evidence of the acceptability of the riprap material. Reliable performance records of proposed material, other than fieldstone, will be considered evidence of acceptability. Angular fieldstone shall be considered to have a reliable performance record, and will be accepted

Sampling and testing are required for Class 2 and Class 3 rock riprap for which no performance records are available. Sampling and testing are not required for Class 1 rock riprap and field stone. Tests are based on the Durability Index and Durability Absorption Ratio as developed by the State of California, Department of Transportation. The Contractor shall submit representative samples of the proposed material to an independent certified testing laboratory, and test reports shall be stamped by a Professional Engineer. A representative sample of not less than 70 kg is required for each type and source of rock to be tested, and shall contain a number of pieces ranging up to 25 kg mass. Additional testing shall be carried out in the event of material difference between supplied material and the tested sample.

The material provided for each class specified shall have a gradation that conforms to the following:

		CLASS			
		1M	**1**	**2**	**3**
Nominal Mass (kg) **Nominal Diameter (mm)**		**7** **175**	**40** **300**	**200** **500**	**700** **800**
None greater than:	kg or mm	40 300	130 450	700 800	1800 1100
20% to 50% greater than	kg or mm	10 200	70 350	300 600	1100 900
50% to 80% greater than	kg or mm	7 175	40 300	200 500	700 800
100% greater than:	kg or mm	3 125	10 200	40 300	200 500

Percentages quoted are by mass.

Sizes quoted are equivalent spherical diameters, and are for guidance only.

Rock riprap shall meet the following minimum requirements for specific gravity, absorption and durability:

Method of Test	Requirements
California Department of Transportation Method of Test for Specific Gravity and Absorption of Coarse Aggregate (California Test 206)	Minimum Specific Gravity = 2.60 Maximum Absorption = 2.0 percent
California Department of Transportation Method of Test for Durability Index (California Test 229)	Minimum Durability Index = 52 (unless DAR* > 23)

* Durability Absorption Ratio (DAR) = Durability Index / (Absorption % + 1%)

300.5.17.2 Geotextile Filter Fabric

Where geotextile filter fabric is specified, the slope shall be graded to provide a smooth, uniform surface. All stumps, large rock, brush or other debris that could damage the fabric shall be removed. All holes and depressions shall be filled so that the fabric does not bridge them. Loose or unstable soils shall be replaced.

Non-woven geotextile filter fabric shall be used under all riprap in accordance with the following table of minimum average roll value properties (MARV's) for each specific Class of riprap:

Non-Woven Geotextile Filter Fabric		
Specifications and Physical Properties		
Property	Class 1M, 1 and 2	Class 3
Grab Strength	650 N	875 N
Elongation (Failure)	50%	50%
Puncture Strength	275N	550 N
Burst Strength	2.1 MPa	2.7 MPa
Trapezoidal Tear	250 N	350 N
Minimum Fabric Lap to be 300 mm		

The non-woven geotextile filter fabric shall meet the specifications and physical properties as listed above.

The fabric shall be laid parallel to the slope direction. It shall be placed in a loose fashion, however folds and wrinkles shall be avoided. Adjacent strips of fabric shall be overlapped a minimum of 300 mm, except where placed underwater, the minimum lap width shall be 1 m. Overlaps shall be pinned using 6 mm diameter steel pins fitted with washers and spaced at 1 m intervals along the overlaps.

The top edge of the filter fabric shall be anchored by digging a 300 mm deep trench, inserting the top edge of the fabric and backfilling with compacted soil.

Care shall be taken to prevent puncturing or tearing the geotextile. Any damage shall be repaired by use of patches that extend at least 1 m beyond the perimeter of the tear or puncture.
The fabric shall be covered by rock riprap within sufficient time so that ultraviolet damage does not occur; in no case shall this time exceed seven days for ultraviolet material and 14 days for ultraviolet protected and low ultraviolet susceptible polymer geotextiles.

Riprap placement shall commence at the base of the blanket area and proceed up the slope. The height of drop of riprap shall be limited to 1.0 m or less, and the riprap shall not be allowed to roll down the slope. Heavy equipment will not be permitted to operate directly on the geotextile.

300.5.17.3 Placing of Rock

The rock shall be handled, dumped or placed into position to conform to the specified gradation and to the cross section shown on the drawings. The finished surface shall be reasonably uniform, free from bumps or depressions, and with no excessively large cavities below or individual stones projecting above the general surface.

300.5.17.4 Inspection of Rock

Control of gradation will be by visual inspection. The Contractor shall provide a minimum of two samples of rock, of the minimum sample size specified below. These samples shall be proven to acceptably conform to the required gradation by direct weighing of all the individual pieces with suitable scales; the mass of each piece in the sample shall be painted on the piece. These samples, located as required by the Design Engineer at the construction site and at the source or quarry site, may be incorporated in the finished riprap when they are no longer required for reference purposes. The samples shall be used for frequent reference in judging the gradation of the riprap being loaded at the source and placed at the site. The minimum sample size in area shall be as follows:

Class	Minimum Sample Size
1M	1 m x 1 m
1	2 m x 2 m
2	3 m x 3 m
3	4 m x 4 m

The Contractor shall provide whatever facilities are required to assist the Design Engineer or the Department in auditing gradation.

If, during the delivery of the material to the site, a particular load is found to be made up of pieces predominantly one size, or to be lacking in pieces of one size, it shall be dumped in a suitable location outside the area to be protected. Additional material as required to make up the deficient sizes shall be added to this load such that the combination can then be placed to ensure uniformity.

300.5.18 ELASTOMERIC AND POT BEARINGS

300.5.18.1 General

This specification in this Section 300.5.18 is for the supply, fabrication and installation of elastomeric bearings and pot bearings. Installation shall be in accordance with Section 300.5.8 (Structural Steel) and Section 300.5.9 (Precast Concrete)

300.5.18.2 Submissions

The following information shall be submitted to the Department within ten days prior to fabrication.

- Identification of bearing supplier;
- Layout installation drawings;
- Welding procedures for all welds;
- Shop drawings;
- Mill certificates and mill test reports for all material; and
- Quality assurance test reports.

The following shall be submitted for review in the event of repairs being required:

- Repair procedures for unsatisfactory weldments and accidental arc strikes; and
- Repair procedures for damage galvanizing.

The following information shall be submitted to the Department on request:

- Methods and materials for setting anchor bolts and constructing bearing pads; and
- Methods of forming and pouring grout.

300.5.18.3 Supply and Fabrication

300.5.18.3.1 Standards

Fabrication of plain and laminated elastomeric bearings and pot bearings shall conform to:

- The American Association of State Highway and Transport Officials (AASHTO) LRFD Bridge Construction Specifications,
- AASHTO's Standard Specifications for Transportation Materials and Methods of Sampling and Testing M251-06 Standard Specification for Plain and Laminated Elastomeric Bridge Bearings, and
- The American Welding Society (AWS) - Bridge Welding Code, D1.5.

Where imperial/metric conversions are necessary, The National Standard of Canada, CAN3-

Z234.1-79 shall be used as the basis of conversion.

300.5.18.3.2 Qualification

The Fabricator for the steel components shall be fully approved by the Canadian Welding Bureau (CWB) as per CSA Standard W47.1 in Divisions 1 or 2.

Only welders, welding operators and tackers approved by the Canadian Welding Bureau in the particular category shall be permitted to perform weldments. Their qualifications shall be current and available for examination by the Department.

300.5.18.3.3 Engineering Data

300.5.18.3.3.1 Welding Procedures

Welding procedures including welding procedure datasheets approved by the Canadian Welding Bureau shall be submitted for each type of weld to be used.

300.5.18.3.3.2 Shop Drawings

Shop drawing requirements shall be as per Section 300.5.8.3.3. In addition, the following requirements shall be met:

The shop drawings shall clearly indicate all material properties, dimensions, connection attachments, fasteners and accessories, the bearing identification, and the load capacity at the serviceability and ultimate limit states as follows:

(a) Maximum vertical permanent and total load.

(b) Maximum lateral load and corresponding vertical load.

(c) Maximum rotational capacity about any horizontal axis and about the vertical axis at the centre of the bearing

When bearings for more than one bridge are included, individual shop and erection drawings shall be submitted for each bridge.

300.5.18.3.4 Materials

All materials shall be new and unused, with no reclaimed material incorporated in the finished bearing.

300.5.18.3.4.1 Steel

The steel laminates shall be rolled mild steel with a minimum yield strength of 230 MPa. The steel for base plate, keeper bars, pintels and shims shall conform to the requirements of CSA G40.21 Grade 300W. The steel for sole plate and top bearing plate shall be as per Section 300.5.2.16.

300.5.18.3.4.2 Stainless Steel

Stainless steel sheets shall conform to the requirements of the American Iron and Steel Institute (AISI) Type 304, no. 8 mirror (0.2 μm) finish. The chemical and mechanical properties conform to the requirements of ASTM A 240M.

300.5.18.3.4.3 Brass

Brass sealing rings for confined elastomer bearings shall be according to ASTM B36M, halfhard.

300.5.18.3.4.4 Elastomer

Elastomeric compounds shall be low temperature Grade 5 and meet the physical and low temperature brittleness requirements listed in Table 1 and Section 8.8.4 of AASHTO M251-06. Elastomeric compounds shall have 60 Duro hardness for elastomeric bearing pads and 50 ± 5 shore A for pot bearings.

300.5.18.3.4.5 PTFE

PTFE used for horizontal sliding surfaces shall be unfilled, 100% virgin polymer.

PTFE used for guides for lateral restraint may be one of the following:

(a) Unfilled PTFE, or

(b) PTFE filled with up to 15% by mass of glass fibres.

PTFE shall conform to Section 18.8.2 of the AASHTO LRFD Bridge Construction Specifications.

300.5.18.3.4.6 Lubricant

Lubricant shall be silicone grease, effective to -40 °C, and shall comply with U.S. Department of Defense MIL-S-8660C.

300.5.18.3.4.7 Adhesives

Adhesive for bonding PTFE to metal shall be an epoxy resin producing a bond with a minimum peel strength of 4 N/mm, when tested according to ASTM D 429, Method B. Adhesives shall not degrade in the service environment.

300.5.18.3.4.8 Base Plate Corrosion Protection

Bearing base plate corrosion protection shall be as per Section 300.5.12.5.6 (6).

300.5.18.3.4.9 Connecting Bolts

For connecting bolts, the following material properties shall be used:

Bolts through girder bottom flange and into sole plate (galvanized or weathering steel)	ASTM A325 Type 3.
Bolts connecting galvanized or weathering steel sole plate to top bearing plate	ASTM A325 galvanized.

300.5.18.3.5 Welding

300.5.18.3.5.1 Filler Metals

Low hydrogen filler, fluxes and low hydrogen welding practices shall be used throughout. The low hydrogen covering and flux shall be protected and stored as specified by AWS Standard D1.5. Flux cored welding or use of cored filler wires in the submerged arc process or shielding gas processes are not considered as conforming to low hydrogen practice, and shall not be used. However metal core welding process utilizing low hydrogen electrodes with AWS designation of H4 will be allowed. The deposited weld metal shall provide strength, durability, impact toughness and corrosion resistance equivalent to base metal.

Field application of metal core arc welding shall not be used.

300.5.18.3.5.2 Cleaning Prior to Welding

Weld areas shall be clean, free of mill scale, dirt, grease, and other contaminants prior to welding.

300.5.18.3.5.3 Tack and Temporary Welds

Tack and temporary welds shall not be used unless they are to be incorporated in the final weld. Tack welds, where used, shall be of a minimum length of four times the nominal size of the weld and shall be subject to the same quality requirements as the final welds. Cracked tack welds shall be completely removed prior to welding over.

300.5.18.3.5.4 Methods of Weldment Repair

Repair procedures for unsatisfactory weldments shall be submitted for review by the Department prior to repair work commencing.

300.5.18.3.5.5 Arc Strikes

Arc strikes will not be permitted. In the event of accidental arc strikes, the Contractor shall submit to the Department a proposed repair procedure for review. The repair procedure shall include the complete grinding out of the crater produced by the arc strike. These areas may be examined by the Department to ensure complete removal of the metal in the affected area.

300.5.18.3.5.6 Plug and Slot Welds

Plug welds or slot welds will not be permitted.

300.5.18.3.6 Fabrication

Fabrication shall be performed in a fully enclosed area which is adequately heated. The temperature shall be at least 10°C.

(a) Plain Bearings

Plain bearing pads shall be moulded individually, cut from moulded strips or slabs of the required thickness, or extruded and cut to length.

(b) Laminated Bearings

Laminated bearings shall be moulded under pressure as a single unit and heated in moulds that have a smooth surface finish.

Steel laminates shall have a uniform 3.2 mm thickness without any sharp edges. The bond between the elastomer and the metal laminates shall be such that when a sample is tested for separation, failure shall occur within the elastomer and not between the elastomer and metal laminate. The top 10 mm galvanized laminate for sliding bearings shall have a 2.5 mm recess. The recessed surface shall be machined as per Section 300.5.18.3.6.1.

(c) Pot Bearings

Stainless steel sheets in contact with PTFE shall be continuously welded around the perimeter to a backing plate to prevent ingress of moisture. The weld shall be clean, uniform, without overlaps, and located outside the area in contact with PTFE.

The threaded portion of the bolts shall be coated with silicone grease prior to installation.

Virgin or glass filled PTFE elements shall be recessed in a rigid backing material and shall be bonded over the entire area with an adhesive. The rigid backing material shall be grit blasted prior to applying the adhesive.

The PTFE elements used as mating surfaces for guides for lateral restraint shall extend to within 10 mm from the ends of the backing plates.

300.5.18.3.6.1 Machining

Machining shall be done after welding. Any metal to metal contact surfaces shall be machined.

The pots and pistons shall be machined from solid metal plate or castings. There shall be no openings or discontinuities in the metal surfaces in contact with the elastomer or PTFE.

The surface finish of metal plate in contact with any metal plate or elastomer shall be machined to a surface finish of 6.4 μm and a flatness tolerance of 0.001 x bearing dimension.

300.5.18.3.6.2 Identification

Each bearing shall be marked with the fabricator's name, date of manufacture and unique identification number. The characters shall be not less than 10 mm in height.

300.5.18.3.6.3 Coating

Metal components described on the site specific drawings, except weathering steel (CSA G40.21 350 A and 350 AT) and stainless steel, shall be hot dip galvanized after fabrication in accordance with ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and ASTM F2329 Standard Specification for Zinc Coating Hot-Dip Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

Pot, piston and sliding plate, except surfaces in contact with elastomer for pot bearings, shall be metalized as per ASTM A780, Method A3. The thickness of metalizing shall not be less than 180 microns.

Repair of galvanizing shall only be done if bare areas are infrequent, small, and suitable for repair. A detailed repair procedure shall be submitted for review by the Department prior to its use. It should be noted that repairs may require complete removal of the galvanized coating and re-galvanizing. Repair shall be in compliance with ASTM A780, Method A3 Metalizing. The thickness of the metalizing shall be 180 µm, and the repair shall be tested for adhesion.

Top surface of bolted galvanized sole plate or metalized slider plate shall be coated with two coats of epoxy mastic paint when in contact with girder bottom flange (weathering steel).

300.5.18.3.6.4 Tolerances

Plain and laminated bearing tolerances shall be as per AASHTO Standard M251-06.

Pot bearing tolerances shall be as follows:

(a) The deviation from flatness of PTFE surfaces shall not exceed:

  i) 0.2 mm, when the diameter or diagonal is equal to or less than 800.
  ii) 0.00025 of the diameter or diagonal, when the diameter or diagonal is greater than 800 mm.

(b) The deviation from flatness of stainless steel in contact with PTFE for plane surfaces and from the theoretical surface for spherical surfaces shall not exceed:

i) 0.0003 LH mm for a rectangular PTFE element.
ii) 0.0006 RH mm for a circular PTFE element

where:

L = the greater plan dimension for a rectangular bearing,
R = the radius of a circular bearing, and,
H = the free height of PTFE element

(c) For confined elastomer bearings, the tolerance of fit between the piston and the pot shall be + 0.75 to + 1.25 mm. The inside diameter of the pot cylinder shall be the same as the nominal diameter of the elastomer and shall be machined to a tolerance of:

i) 0 to + 0.125 mm for diameters up to and including 500 mm.
ii) 0 to + 0.175 mm for diameters over 500 mm.

(d) The plan dimensions of the recess for PTFE shall be the same as the nominal plan dimensions of the PTFE and shall be machined to a tolerance of 0 to + 0.2% of the diameter or diagonal.

i) Overall bearing plan dimension ± 3 mm
ii) Overall bearing height ± 3 mm
iii) Machined surface dimensions ± 0.4 mm

(e) Elastomeric components shall meet the following tolerances:

Diameter: 0.0 to -1.5 mm for diameters ≤ 500 mm
0.0 to -2.0 mm for diameters > 500 mm

Thickness 0.0 to + 1.0 mm

(f) Brass rings shall meet the following tolerances:

i) Difference between internal diameter of brass ring and diameter of recess in the moulded elastomer shall be 0 to + 0.5 mm.
ii) Difference between sum of thicknesses of brass rings and recess depth in the moulded elastomer 0 to + 0.25 mm

(g) Recessed Guide Bars shall meet the requirements of the American Standard Clearance Locational Fit Class LC3 according to ANSI B4.1.

(h) Guides for lateral restraints shall have a 0.50 mm ± 0.25 mm gap between metal restraints surfaces and mating PTFE elements.

(i) PTFE components shall meet the following requirements:

i) The plan dimension of the PTFE shall be 0 to - 0.2% of diameter or diagonal.

Difference between internal diameter of brass ring and diameter of recess in the moulded elastomer shall be 0 to + 0.5 mm.

ii) The thickness of the PTFE shall be within 0 to + 10.0% of the design thickness. The depth of recess of the PTFE shall be within 0 to + 0.3 mm of the design depth

300.5.18.3.7 Testing and Inspection

The Contractor shall be responsible for quality control and quality assurance testing required to ensure the work meets the Detailed Designs and the Technical Requirements, and shall engage an independent accredited testing company to perform testing of bearing materials and the finished bearings. All quality control/quality assurance testing and inspection records shall be made available to the Department on request.

The testing shall meet the acceptance criteria outlined in the standards. The Contractor shall also submit a written affidavit from the manufacturer certifying that the materials supplied meet all technical requirements.

300.5.18.3.7.1 Elastomeric Bearings

Testing of elastomeric compounds shall be completed in accordance with AASHTO M251-06. Testing of the finished bearings shall be in accordance with AASHTO M251-06. The optional testing described in section 8.9 of AASHTO M251-06 is not required.

The increment in compressive deformation of laminated bearings shall not exceed 0.05 of the effective rubber thickness, when the bearing load is increased from an initial pressure of 1.5 MPa to a pressure of 7 MPa when tested as per the requirements of Section 9.1 of the AASHTO M251-06.

300.5.18.3.7.2 Pot Bearings

Testing of elastomeric compounds shall be completed in accordance with AASHTO M251-06. Testing of the finished bearings shall be completed in accordance with requirements of 18.3.4 of the AASHTO LRFD Bridge Construction Specifications. The long-term deterioration test described in 18.3.4.4.3 is not required. The proof load test described in 18.3.4.4.4 shall be carried out as per the long-term proof load test requirements.

300.5.18.3.8 Approved Pot Bearings Suppliers

The following pot bearing manufacturers have been approved for the use of their products, based on compliance with the design parameters in the Detailed Designs and the Technical Requirements.

- Glacier
- Goodco Z-Tech
- LCL-Bridge

400.0 OPERATIONS - NEW INFRASTRUCTURE AND EXISTING INFRASTRUCTURE

400.1 OPERATIONS - GENERAL

This Section 400.0 (Operations - New Infrastructure and Existing Infrastructure) covers the operations, maintenance and rehabilitation requirements applicable to roadways and bridge structures in the Infrastructure.

400.1.1 RESPONSIBILITY FOR OPERATIONS

The Contractor is responsible for the supply of all management, supervision, professional and technical services, quality control and assurance, labour, materials, utilities and equipment for performing all of the duties and obligations to operate, maintain and rehabilitate the Infrastructure, except as excluded herein.

These responsibilities include the supply and payment for electrical power for roadway lighting and signalization, and any other utilities required for the New Infrastructure. The Contractor is responsible for safe and efficient site traffic accommodation.

The operational and performance requirements described in the Technical Requirements represent the requirements that shall be met. The Contractor shall measure roadway and bridge structure conditions and assure compliance to the operational and performance requirements. Where specific operational and performance requirements are not given, the Contractor is expected to operate and maintain roadway elements and bridge structures to a standard of safety, effectiveness and operation equal to, or better than, what is currently being provided on other roadway systems of similar age and type on the Provincial highway system.

Reduction of or restrictions to allowable legal load(s), during spring time thawing conditions or at any other time, is not permitted for any roadway within the New Infrastructure, during the Operating Period.

The Contractor shall display during the Operating Period the Contractor's name and phone number on eight signs located safely adjacent to Anthony Henday Drive (Highway 216) and Yellowhead Trail within the Project Limits. Each sign panel shall be 4' x 8' and shall be manufactured on 3/4" plywood or extruded aluminum and the sheeting and sign supports shall be in accordance with the Department’s recognized products list for non-standard signs. Lettering and symbols shall be clear and legible with minimum lettering size to be 200 mm. Reflective sheeting shall meet or exceed the minimum requirements as specified in the ASTM-4956, Performance Requirements Type IX or Type XI Unmetalized Cube Corner Microprismatic Retroreflective Element Material. All signs are to be installed by Traffic Availability.

400.1.2 MAINTENANCE AND REHABILITATION REQUIREMENTS

The requirements to be met in the maintenance of the Infrastructure shall conform to the requirements of the Contractor’s Operation and Maintenance Plan of Schedule 4 (Contractor’s Managements Systems & Plans) to the DBFO Agreement. In addition, the requirements to be met in the maintenance and rehabilitation of the New Infrastructure during the Operating Period shall conform to the requirements for design and construction of the New Infrastructure, as well as those of the Contractor's Infrastructure Wholelife Management Plan (such Plan forming part of Schedule 4 (Contractor's Management Systems and Plans) to the DBFO Agreement).

As-Built Construction Reports shall be updated, as required, to reflect maintenance and rehabilitation activities that change the physical dimensions or characteristics of the Infrastructure. The maximum time for completion and the providing of the updated As-Built Construction Reports to the Department shall be two months after completion of the maintenance or rehabilitation activity. If the updated As-Built Construction Reports are not available to the Department within the specified time, a Payment Adjustment of $2,400/month or any partial month, for every month in excess of the specified time shall apply until available.

The Contractor is responsible for reclaiming all areas of the Road Right of Way and/or stormwater management facilities that have been disturbed during the Operating Period and shall obtain any required Reclamation Certificates related to these activities within 12 months of completing the reclamation activity, and provide a copy of the same to the Department forthwith.

400.1.3 COMPLIANCE WITH PERFORMANCE REQUIREMENTS

The Infrastructure shall be maintained in conformance with any allowable tolerances as specified for individual performance requirements, subject to the following:

- If measurements indicate that the Infrastructure no longer complies with the performance requirements but falls within the permitted tolerance(s), the Contractor will have the option of correcting the Infrastructure such that it conforms to the performance requirements or foregoing the repairs and paying Payment Adjustments. The option of foregoing repairs shall not be allowed at the handback of the Infrastructure to the Department at the end of the Term.

- If measurements indicate that the Infrastructure no longer complies with the performance requirements and also exceeds any allowable tolerances, the Contractor shall repair the Infrastructure so that it conforms to the performance requirements.

For performance requirements that do not include an allowable tolerance, the Contractor shall complete such work as required to achieve full compliance to the performance requirements.

In addition to the Contractor's regular inspection and measurements, the Department may undertake reviews and measurements of the Infrastructure at any time and will advise the Contractor of non-compliance.

Where Payment Adjustments are described relative to a kilometre section of the roadway, the kilometre will be a continuous section of a single lane. Neither the requirement nor the Payment Adjustments will be pro-rated based on a partial kilometre length, but will be calculated for the next highest full kilometre length. Crossroads and individual ramps or loops will be considered as discrete sections and treated as one kilometre regardless of the actual length. Where Payment Adjustments are described relative to a period of time or a portion thereof, the Payment Adjustment shall not be prorated but shall be applied in full even if only a portion of the specified period of time has elapsed.

400.1.3.1 Alternative Inspection and Testing Methods

New technological developments may result in alternative inspection and testing methods and techniques that are more accurate, effective or economical. Mutually agreeable alternative inspection and testing methods and techniques may be introduced. These new testing methods and techniques may also require new mutually agreeable performance requirements that are consistent with the intent of existing performance requirements.

400.1.4 APPEAL OF DEPARTMENT MEASUREMENTS

In any case where Department measurements have concluded that a deficiency exists, the Contractor may appeal within 30 days, the results of any measurement. Measurements made by the Contractor, using methods and equipment of equal or better accuracy to the Department's specified methods, which indicate the appealed component is not deficient, will be the only cause accepted for allowing an appeal.

The Department and the Contractor will mutually select an independent third party to undertake the appeal measurement(s).

The appeal measurements will be arranged for and paid by the Department and the new measurements shall be binding on the Contractor and the Department and shall not be subject to the Dispute Resolution Procedure. Notwithstanding the foregoing, the Department may, at its sole discretion, elect to accept the measurements submitted by the Contractor as cause for the appeal and forego further measurements.

If the independent third party's measurements verify the deficiency, the Contractor shall be invoiced by the Department, and shall reimburse the Department, for the third party appeal measurement costs plus an additional $4,200 per appeal.

Any Payment Adjustments supported by the independent third party's measurements shall be upheld. If the independent third party's measurement(s) verify that no deficiency exists, such Payment Adjustments shall be reversed.

400.1.5 IMMINENT DANGER REPAIRS

In instances where the Contractor and/or the Department determines an Imminent Danger (as defined below) exists on the Infrastructure, the Contractor shall have representation within the Road Right of Way, on route to the Imminent Danger, within 30 minutes of becoming aware of, or of the time the Contractor should have been aware of, the Imminent Danger and shall immediately initiate action to protect traffic and the public from the Imminent Danger and shall continue the action until the Imminent Danger is eliminated. This action may take the form of a temporary solution, including the closing of traffic lanes, until permanent repairs are able to be undertaken or the Imminent Danger is removed. If protective action is not undertaken immediately or implemented as soon as reasonably possible given the circumstances, the

Department may elect to undertake such action as it determines necessary and the Contractor shall be responsible for the actual cost of the actions which may include the cost of accommodating traffic over, through or around portions of the Infrastructure, if necessary, plus a 25% administration fee. These costs shall be deducted from Payments to be made to the Contractor. In instances where the Contractor fails to meet the above timelines and/or the Department is forced to undertake action to protect any user from an Imminent Danger, the Contractor shall also be assessed a Payment Adjustment of $12,000/occurrence. The third occurrence in any consecutive 12 month period anywhere on the Infrastructure shall be a potential Termination Event for the purposes of and having the consequences set out in section 16.8(k) of the DBFO Agreement. The Department shall provide the Contractor with timely notice after the Department has considered it necessary to take action to protect a user from an Imminent Danger situation. The responsibility for the repair of the cause of the Imminent Danger shall be governed by the DBFO Agreement and the other applicable provisions of the Technical Requirements.

For the purposes of this section, "**Imminent Danger**" refers to a safety hazard that may be encountered by any user of the Infrastructure due to a collision, condition or any other abnormal occurrence on the Infrastructure.

400.1.6 LANE CLOSURE

Under no circumstance, except for an Excepted Lane Closure (as defined below), shall the Contractor close all lanes in either direction during the Operating Period nor implement measures to require or to seek to encourage the public to use an alternative route away from the Infrastructure.

If as a result of an Excepted Lane Closure the need arises to use signs or other measures to require the public to use an alternative route away from the Infrastructure, the Contractor may effect such measures, provided that the Contractor shall as soon as reasonably practicable advise the Department of such measures and the reasons therefore. The Contractor shall take all reasonable steps to minimize the duration of such measures.

Within 60 days after Traffic Availability, the Contractor shall submit to the Department in accordance with the Review Procedure as set out in Schedule 5 (Design and Plan Certification and Review Procedure) to the DBFO Agreement (the "**Review Procedure**"), a schedule for Lane Closures (as defined below) in respect of the Infrastructure for the first 12 month period after Traffic Availability (the "**Agreement Year**") and the next succeeding Agreement Year. No later than January 1 in each Agreement Year after the first Agreement Year the Contractor shall submit to the Department in accordance with the Review Procedure a schedule for Lane Closures in respect of the Infrastructure for the next succeeding Agreement Year. Each schedule of Lane Closures (the "**Schedule of Lane Closures**") shall give details of the proposed lanes of Lane Closure, start and end dates for each period of Lane Closure, and the work to be carried out.

The Contractor shall inform the Department of any changes to a Schedule of Lane Closures no later than 60 days prior to the commencement of the applicable Lane Closure.

The Department may raise comments in respect of any period of Lane Closure requested in a Schedule of Lane Closures. In such event, the Department shall notify the Contractor thereof with reasons and shall indicate, in the case of an objection, an appropriate duration for such Lane Closure and in any other case a period when the unacceptable period can be re-scheduled, on the basis that each such re-scheduled period shall be as close as reasonably practicable to the requested period of Lane Closure and of equal duration or, if the Contractor has indicated another period and/or duration that would be preferable to it and that is acceptable to the Department, such other period and/or duration. The Contractor shall thereupon amend the applicable Schedule of Lane Closures accordingly and re-submit the same to the Department in accordance with the Review Procedure.

The Department's approval of Lane Closures shall not be unreasonably withheld or delayed, having regard to the factors set out in the Review Procedure.

The Contractor shall not affect any Lane Closures save:

- in accordance with the Schedule of Lane Closures to which no objection has been made under the Review Procedure; or
- in an Excepted Lane Closure.

Notwithstanding that there has been no objection to the Schedule of Lane Closures in accordance with the Review Procedure, the Department may upon 60 days prior written notice require the Contractor to re-schedule a period of Lane Closure if due to a change in circumstances such re-scheduling is necessary.

The Department may not require:

- that such period of Lane Closure be brought forward by more than 60 days from the scheduled date of commencement of such period; or
- that a period of Lane Closure be deferred by more than 60 days from the scheduled date of commencement.

If as a result of an Excepted Lane Closure, the need arises for unscheduled maintenance or repair work requiring Lane Closures, the Contractor shall effect such Lane Closures provided that the Contractor shall as soon as reasonably practicable advise the Department of such closure and the reasons therefore and shall take all reasonable steps to minimize the duration of such Lane Closure.

All Lane Closures shall be subject to the Lane Closure Payment Adjustments except Lane Closures (the "**Excepted Lane Closure**") arising, and without being caused by a breach by the Contractor of any of the obligations of the Contractor under the DBFO Agreement or the negligence of the Contractor or those for whom the Contractor is responsible at law, from:

- an emergency, including without limitation clean-up of a motor vehicle collision;
- an order of the police, fire department, emergency medical services, military, or other similar emergency services providers;

- Approved Special Events as defined in Section 200.3.9.2 (Special Events – Partial or Full Closure Events);
- Severe Storm Events (as defined in Section 400.3.1 (Winter Maintenance Operation Requirements – General));
- Repairs of damage to the Infrastructure caused by the Province, its agents, employees, and contractors (except the Contractor but including, without limitation, those contractors other than the Contractor engaged by the Province under sections 7.3, 7.4 or 11.8 of the DBFO Agreement) and their employees and by third parties (other than the Contractor's agents or subcontractors or others for whom the Contractor is legally responsible) provided, if the Contractor is obligated or retained to do the repairs, all reasonable steps are being taken by the Contractor to complete the repairs in accordance with the Contractor's obligations;
- a direction of the Department or the performing of the Province's obligations under the DBFO Agreement;
- the express authorization for such Lane Closure set out in a permit issued by the Province pursuant to section 7(2) of the *Highways Development and Protection Regulation* (AR 326/2009, as amended);
- movement of high loads or oversized loads pursuant to section 6.4 of the DBFO Agreement and required by a permit authorizing such movement issued by the Province;
- any EI Deficiencies or EI Rehab Deficiencies (as both terms are defined in section 6.6 of the DBFO Agreement); or
- any rehabilitation work being carried out or having been carried out by or on behalf of the Department in relation to the Existing Infrastructure.

The Contractor shall provide to the Department such information (including without limitation details of proposed Lane Closures and information about its traffic safety and management measures on the Infrastructure) as may be required for purposes of any information service operated by or on behalf of the Department from time to time.

The Contractor shall operate a telephone service answered by a knowledgeable person of the Contractor to respond to questions from the public in relation to the Infrastructure.

Subject to the Excepted Lane Closures, for every full or partial hour of Lane Closure (as defined below) occurrence anywhere on the Infrastructure, the Contractor shall be assessed a Payment Adjustment at the applicable lane closure rate. The length of the Lane Closure for determination of Lane Closure Payment Adjustments shall be rounded up to the next higher whole kilometre.

For planned maintenance and rehabilitation activities on roadways or bridge structures that have two lanes in each direction, the Contractor must have at least one lane open to traffic in each direction at all times.

For planned maintenance and rehabilitation activities on roadways or bridge structures that have three lanes or four lanes in each direction, the Contractor must have at least two lanes open to traffic in each direction at all times.

Lane Closure Payment Adjustments are as follows:

Type	Timing/Duration	Rate
Peak Hours* - Weekdays	0600 to 0900 and 1530 to 1800 hrs	$480/hr/lane-km
Day – Weekdays	0900 to 1530 hrs	$180/hr/lane-km
Day - Weekends and Statutory Holidays	0600 to 1800 hrs	$180/hr/lane-km
Evening	1800 to 2200 hrs	$120/hr/lane-km
Night	2200 to 0600 hrs	No Charge

* *A Lane Closure for planned operational purposes may not be started during Peak Hours.*

A Lane Closure is defined as:

- Any partial or complete closure of a traffic lane; or
- Any reduction of posted speed to less than 75% of the normal posted speed prior to construction impacting any through lane, merge lane or ramp, collector-distributor (C-D) road, turn lane, crossroad, bridge structure, detour or other road forming a part of or connected to the Infrastructure.

Conclusion of Lane Closure is defined as:

- Continuous, smooth, paved intact travel surface;
- Traffic control removed and traffic fully restored; and
- Cause of closure has been removed and all safety requirements have been satisfied.

Also reference Section 400.5.1.3.7 (Traffic Accommodation).

400.1.7 IN-SERVICE SAFETY REVIEW (NEW INFRASTRUCTURE ONLY)

On as as-needed basis, the Department will compare the reported collision rates on roadway segments and interchanges on the New Infrastructure to rates recorded on similar segments of divided highways and interchanges in Alberta.

If the collision rate on any roadway segment or interchange on the New Infrastructure exceeds the benchmark by 10% or more, the Department may elect to conduct an In-Service Safety Review. If so elected, the review will be undertaken within three months of notification of the need for such a review. The In-Service Road Safety Review shall be undertaken following the Transportation Association of Canada's guidelines.

The Department will provide a copy of the In-Service Safety Review to the Contractor. The Contractor shall implement any minor operational recommendations at its cost within six months of the completion of the review. Whether the operational recommendations are minor shall be determined by the Department acting reasonably. The minor operational recommendations shall include the following:

- Provision and installation of delineators;
- Revised snow clearing and ice control procedures;
- Bridge deck icing plan procedures;
- Revised pavement markings;
- Revised directional, regulatory and warning signing (does not include sign structures);
- Revised traffic signal timings; and
- Guardrail adjustment or installation of new guardrail.

If the minor operational recommendations from the In-Service Safety Review are not implemented within the specified time by the Contractor, a Payment Adjustment of $1,200/week or any partial week, for the first four weeks and $2,400/week or any partial week, thereafter shall apply until all of the minor operational recommendations are implemented.

400.2 INSPECTION, EMERGENCY AND ROUTINE MAINTENANCE REQUIREMENTS

400.2.1 ROADWAY INSPECTIONS REQUIREMENTS

The Contractor's Operation and Maintenance Plan (Section 100.2.9) shall include details on how roadway inspections will be carried out and shall as a minimum, meet the following requirements:

- Inspect the roadway at a minimum frequency of every two hours between 6:30 a.m. and 6:30 p.m., Monday to Friday with the exception of non-Business Days, and every four hours between 6:30 p.m. and 6:30 a.m., Monday to Friday with the exception of non-Business Days;
- Inspect the roadway a minimum of once every four hours (24 hours per day) on days other than Business Days;
- Observe road conditions, repair requirements, snow or weather issues, icing conditions on bridge decks, and sign conditions for each inspection;
- Inspect traffic signal operation in accordance with Package I in Appendix J; and
- Confirm the retroreflectivity of signs visually during dark (night time conditions) at least once every two months. Signs that are reasonably considered to be deficient shall be tested within 30 days of the visual inspection.

The Contractor shall provide sufficient resources to patrol the roadway, to observe, react to and report all circumstances or conditions affecting the travelling public or the future repair of the roadway or appurtenances. The Contractor shall investigate reports of adverse conditions from members of the public, regulatory agencies, police authorities and the Department, and perform the immediate repair of all hazardous conditions in accordance with Section 400.1.5 (Imminent Danger) and Section 400.2.2 (Emergency Maintenance).

400.2.1.1 Routine Observations

During the performance of roadway inspections, emergency maintenance, routine maintenance or at any other time the Contractor's personnel are travelling on the roadway, such personnel shall observe conditions of the roadway surface, appurtenances, and the Road Right of Way for the purpose of identifying any deficiencies and scheduling such work as required to maintain compliance to the Technical Requirements.

Items of work which would typically be identified during routine observations include but are not limited to the following:

- Damaged signs and delineators;
- Drainage problems including blockages, erosion or lack of capacity of ditches, culverts and drainage grates, particularly during spring thaw and run-off. The Contractor shall make interim repairs in these areas when possible;
- Any required cleaning, litter removal or snow removal;
- Damage to structures or appurtenances;
- Roadside or median barriers which have been damaged or moved from the original position, or any other condition that prevents, or reduces the effectiveness of the barrier from performing its intended function;
- Graffiti;
- Burned out lights on the roadway lighting systems;
- Non-functioning, malfunctioning or burned out lights on traffic control lighting systems; and
- Condition of bridge structure components, e.g. bridge rail, bridge deck and bridge deck joints.

400.2.1.2 Daily Road Reports

As part of normal winter duties or as otherwise required, the Contractor shall provide daily road reports in the Department's standard format to the Alberta Motor Association by 0600 hours. These reports shall detail driving conditions on the Infrastructure and shall be updated as required, so that the travelling public is kept current with changing roadway or weather conditions. The Contractor shall provide the Department with a copy of all reports issued.

400.2.2 EMERGENCY MAINTENANCE

Any work identified which falls under the category of emergency maintenance or otherwise results in an unsafe condition shall be immediately addressed by the Contractor and, subject to the DBFO Agreement and the other applicable provisions of the Technical Requirements, at the Contractor's cost.

Emergency maintenance activities, requiring the Contractor's immediate response by having representation within the Road Right of Way, on route to the emergency, within 30 minutes of becoming aware of, or of the time the Contractor should have become aware of, include but are not limited to, the following:

- Repairing or replacing critical regulatory signs (STOP and YIELD) or performing temporary repairs of signs;

- Removing from the roadway surface, roadkill and debris of a size or type that may create a hazard;
- Report all incidences of roadkill to the appropriate authorities;
- If an animal is injured, the Contractor shall contact the police and/or fish and wildlife officials, who will determine and arrange for the action required;
- In cases involving livestock, the Contractor shall remove the carcass from the roadway surface and contact the owner of the animal to dispose of the carcass. If the owner cannot be contacted, the Contractor shall remove the carcass from the Road Right of Way, dispose of the carcass at an approved site and immediately notify the Department;
- Repairing traffic signals and advanced warning devices, including without limitation:
  - Resetting signals if the lights are in flash mode;
  - Replacing burned-out bulbs;
  - When the lights are completely out of service, setting up portable STOP signs from all directions until permanent repairs occur; or
  - Establish traffic signal trouble call requirements as detailed in Package I in Appendix J;
- Responding to collisions or natural disasters, including without limitation:
  - Traffic control, including erecting detours or barricades in accordance with appropriate traffic control requirements;
  - Supply and erection of emergency signs;
  - Cleaning-up the collision or disaster site;
  - Removing from the roadway surface, any material including damaged guardrail which presents a hazard to the travelling public;
  - Applying absorbent material to minor spills at collision sites;
  - Placing “Police Emergency Ahead” signs at the scene of collisions, spills or obstructions on the roadway;
  - Providing emergency traffic control and arrowboards;
  - Reopening of the roadway within one hour of clearing the collision or natural disaster; and
  - Communication with, coordinating with, and providing access for, emergency response services that may be required on the Infrastructure or be required to pass over the Infrastructure;
- Notification of and cooperation with the relevant emergency and/or regulatory authorities in the containment and clean-up of all spills, including those in ditches and ponds. The Contractor shall also notify the Department of any spills within 24 hours of any occurrence;
- Providing adequate marking of any conditions on the roadway surface or in the Road Right of Way which are a hazard to the travelling public, including:
  - Emergency repair and marking of unsafe or poor pavement conditions; and
  - Emergency repair and/or marking of unsafe or poor bridge structure conditions.

400.2.3 ROUTINE MAINTENANCE

The Contractor’s routine maintenance activities shall include, but not be limited to, the following:

- Removing and disposing of incidental refuse and litter from within the Road Right of Way;
- Straightening or reinstalling sign posts;
- Shimming and tightening connections on breakaway sign posts as required;
- Straightening or reinstalling delineator posts and replacing reflective strips on guardrails and delineator posts;
- "Summerize" signals and control boxes;
- "Winterizing" signals and control boxes;
- Performing regular traffic signal maintenance twice per year at all traffic signal locations in accordance with Package I in Appendix J;
- Washing signs, delineators and reflective strips on guardrail. If soap is used, it must be biodegradable;
- Removing graffiti from all sites;
- Removing non-conforming signs from within the Road Right of Way;
- Performing annual inspections of all drainage system components, scheduling required maintenance and draining, and completing such maintenance and draining prior to freeze-up each year;
- Removing minor blockages in the drainage system on a regular basis;
- Removing, collecting and disposing of winter sand by May 15 of each year; and
- Removing, collecting and disposing of tracked dirt and all other debris from the roadway.

400.2.4 MEASURING FOR COMPLIANCE

For all roadway inspection, emergency maintenance and routine maintenance requirements, the Contractor shall undertake the work within the time periods stipulated in the Technical Requirements and in accordance with the Contractor's Operation and Maintenance Plan (Section 100.2.9).

All traffic signal timings, after they are implemented by the Contractor, shall be subject to review by the Department. The Contractor shall make necessary adjustments to the signal timing to meet traffic signal operation requirements outlined in Packages A through E in Appendix J.

400.2.5 PAYMENT ADJUSTMENTS

If the roadway inspection, emergency maintenance and routine maintenance are not completed within the required time period on the Infrastructure, the Contractor shall be assessed the following Payment Adjustments.

In this section, "**occurrence**" refers to an occurrence anywhere on the Infrastructure.

If the Contractor fails to undertake the roadway inspections, Payment Adjustments shall be made as follows. The number of occurrences of non-conformance shall be determined for a consecutive 12 month period.

- $2,500 for the first occurrence;
- $5,000 for the second occurrence;

- $10,000 for the third occurrence; and
- $20,000 for the fourth occurrence and each occurrence thereafter.

If the Contractor fails to undertake routine maintenance in any consecutive 12 month period, Payment Adjustments shall be made as follows:

- $5,000 for the first occurrence;
- $10,000 for the second occurrence;
- $20,000 for the third occurrence, and each occurrence thereafter.

If the Contractor fails to undertake emergency maintenance in any consecutive 12 month period, Payment Adjustments shall be made as follows:

- $20,000 for the first occurrence;
- $40,000 for the second occurrence; and
- The third occurrence shall be a potential Termination Event for the purposes of and having the consequences set out in section 16.8(k) of the DBFO Agreement.

The Department shall notify the Contractor after the first and second occurrence of non-compliance with an emergency maintenance performance requirement in any consecutive 12 month period.

400.2.6 REPORTING PROCEDURES

All actions taken related to Section 400.2.2 (Emergency Maintenance), shall be reported immediately to the Department.

The Contractor shall record conditions identified during roadway inspections, and any work performed as a result of the observations. Such information shall be reported to the Department. The report shall make a distinction between conditions that required immediate response and those that could be scheduled as future work.

The Contractor shall record and report monthly, all routine maintenance performed, including segments worked and activities performed.

These reports shall include:

- Segment(s) worked; and
- Action(s) taken.

400.3 WINTER MAINTENANCE OPERATION REQUIREMENTS

400.3.1 GENERAL

When undertaking winter maintenance operations, the Contractor shall coordinate its operations to achieve Bare Pavement (as defined below) conditions on all driving lanes and pathways or walkways. "**Bare Pavement**" is defined as the travel lanes, and walkway/pathways being free of snow, packed snow, frost and ice. Gore areas may have accumulations of loose snow up to 100 mm and shoulders may have accumulations of loose snow up to 30 mm. Drainage points shall be kept free of snow and debris.

All roadways within the Infrastructure shall have a class assigned to each segment, as described in the following table, on the basis of AADT for that segment. The AADT for all segments shall be determined in accordance with Section 200.3.1 (Traffic Volume Payment Adjustments).

Winter snow clearing and ice control traffic segments may change in length or class depending on the changes in traffic volume (AADT).

The following table defines the requirements for snow clearing and ice control for the Infrastructure.

Should winter snow and ice conditions dictate, the "Max. Time to Bare Pavement" requirement may be waived by the Department if the temperature after the "Max. Time to Bare Pavement" is below the indicated value in the last column of the following table. During this time of cold temperatures, the Contractor shall apply winter abrasive material and attempt to physically remove ice and packed snow from the roadway surface. At all times, abrasives will be present on all slippery surfaces within the driving lanes, to ensure safety for the travelling public.

Once the temperature rises above the indicated value in the last column of the following table, the "Max. Time to Bare Pavement" requirement shall recommence, and the Contractor will have the full time to achieve Bare Pavement.

A "**Severe Storm Event**" is defined as:

a. A combination of heavy snowfall over a short duration, accumulation of more than 2 cm/hr, or snowfall greater than five days duration, wetter snow, and high winds that results in visibility conditions such that snowplow operations become hazardous and such operations should reasonably cease for several hours;
b. A wind event where the wind is greater than 60 km/h for four consecutive hours; or
c. A freezing rain or hail event where the accumulation on fixed objects is greater than 6 mm.

Winter Maintenance Standards							
					Severe Storm Event		**Max. Time to Bare Pavement Temperature Waiver (°C)**
Class	**AADT Range**	**Max. Time to React (hrs)**	**Max. Time to Bare Pavement (hrs)**	**Clean Up (hrs)**	**Max. Time to Bare Pavement (hrs)**	**Clean Up (hrs)**	
A	0 to 30 000	1.5	5	48	10	120	-10
AA	30 001 to 75 000	1.0	3	48	6	120	-15
AAA	75 001 to 125 000	0.5	2	24	4	96	-20
AAAA	125 001 and above	0.5	2	24	4	72	-30

Pathways and walkways shall be cleaned of snow within 48 hours of the end of the Storm Event (as defined below).

The reaction time shall be measured from the time that the Contractor is made aware or notified, or becomes aware or should have been aware of, the need to mobilize equipment, to the time the Contractor starts to engage in snow/ice removal activities with the appropriate equipment. The Contractor shall have engaged snow/ice control activities prior to an accumulation of 15 mm of loose snow. The Contractor may be made aware by its own forces, by the Department, Local Authorities or by police authorities.

The time to Bare Pavement shall be measured from the end of the Storm Event. "**Storm Event**" shall be defined as a period of time of continuous precipitation and/or condensation and/or wind causing the formation of snow and/or ice on the roadway surface. The end of a storm event shall be considered the last known time of precipitation, heavy snow drifting or condensation affecting the roadway.

Clean-up shall be undertaken after the Storm Event. Banks or drifts of snow greater than 0.5 m shall be removed to at least 2 m from all high speed (posted 100 km/hr or greater) driving surfaces. Intersection sight distance shall be restored on all ramps, intersections and crossroads. Time to complete clean-up is measured from the time precipitation or heavy snow drifting has stopped to the time all clean-up activities are complete.

The Contractor shall prepare an annual specific and updated Snow Clearing and Ice Control Operations Plan that meets the requirements of Section 400.3 (Winter Maintenance Operation Requirements). The plan must be acceptable to the Department and in place by September 15th of each year.

During a Major Snowfall Event (as defined below), the Contractor shall provide a minimum level of snow removal service that includes maintaining one driving lane open in both directions (including on/off ramps). The Contractor shall return to the snow removal effort required to achieve Bare Pavement conditions as soon as the snowfall begins to subside. A "**Major Snowfall Event**" is defined as one where there is heavy snowfall over a short duration, accumulation of snow of more than 2 cm/hour, or snowfall greater than five days in duration.

The Snow Clearing and Ice Control Operations Plan must provide for the deployment of snowplows and spreader equipment capable of meeting and which does meet the following objectives:

- The Infrastructure roadways must be open to the driving public at all times, unless the Department closes the road;
- All lanes remain operational during snow conditions;
- Plowing shall commence prior to snow accumulation reaching 15 mm on any roadway. The maximum allowable accumulation of loose snow on the roadway is to be 30 mm;
- The deployment of snowplows and spreader units shall be calculated based on these requirements and the locations of the Contractor's sand and salt stockpiles;
- If required to meet labour and plowing standards and/or where storm intensities are beyond the capabilities of the normal snow removing equipment complement during storms which

last more than 48 hours, identify a procedure for obtaining and deploying additional resources;
- Snowplows and spreader units shall respond within the applicable response times;
- Include a contingency plan to address storm conditions which may force the closure of the roadway facility or instances where traffic prevents the deployment of the standard snowplow/equipment complement;
- Plowing coverage shall provide for the continuous integrated plowing of both shoulder and surface of the roadway facility including interchange ramps, intersections and cross-roads;
- Snowplowing on bridges shall be done to prevent snow, ice or other substances from being thrown onto underlying roadway, railways or canals;
- A plan for meeting the Section 400.3 (Winter Maintenance Operation Requirements), in case of a winter storm or winter driving conditions, during the non-winter months;
- Address the cover-off of equipment operators who meet their "Hours of Service" limits or tire. Provide cover-off operators and ensure all equipment remains operational and operated, for the duration of the storm and for the clean-up periods;
- Provide for the provision of regular winter condition reporting to the Department and the Alberta Motor Association ("**AMA**") or any other agency identified by the Department; and
- Coordinate winter maintenance with the Local Authority.

The accepted Snow Clearing and Ice Control Operations Plan shall be adhered to throughout the Construction Period and the Operating Period.

400.3.2 EQUIPMENT AND MATERIALS

The Contractor's Snow Clearing and Ice Control Operations Plan (see Sections 100.2.9 and 400.3.1) shall include periods for which the level of equipment shall be available from October 1 to April 30 and identify levels of equipment that will be available from May 1 to September 30 during non-winter months to respond to snow falls during these periods.

Specifications for plowing and sanding trucks shall, as a minimum, be in accordance with applicable law, including without limitation the *Traffic Safety Act* (Alberta) and any regulations thereunder and any replacement or successor legislation, and applicable Department standards, as identified in *Alberta Transportation Maintenance Contracts for Rural Highways*.

Sand and salt materials shall be stored in a manner identified in the EMS (Section 100.2.2). The Environment Canada - Code Of Practice For The Environmental Management Of Road Salts shall be used as a guideline. The Contractor shall adjust the materials storage and handling practices as necessary to address changes or developments in the environmental concerns for any of the materials used.

400.3.3 SNOW CLEARING AND ICE CONTROL OPERATIONS

The Contractor shall conduct all winter maintenance activities with the objective of achieving Bare Pavement (as defined in Section 400.3.1) conditions as quickly as possible and in all cases within the stipulated time periods. Activities shall comply with the accepted Snow Clearing and

Ice Control Operations Plan (see Sections 100.2.9 and 400.3.1) and the following:

- The required complement of snowplows shall be deployed within the time limits identified;
- Emergency vehicles and equipment shall be deployed on the roadway system in the event that the standard equipment complement cannot meet Section 400.3 (Winter Maintenance Operation Requirements);
- Snowplows and sand/salt spreader trucks shall be operated in accordance with applicable laws and regulations;
- Snow/ice equipment shall be operable and operated on a 24 hour basis, throughout the Storm Events (as defined in Section 400.3.1) and subsequent clean up;
- All equipment shall be operated with due diligence to prevent damage to the Infrastructure, and with due regard for the safety of the travelling public; and
- Any damage to the Infrastructure as a result of snow clearing or ice control operations shall be the responsibility of the Contractor.

400.3.3.1 Measuring for Compliance

The Contractor shall monitor its performance relative to Section 400.3 (Winter Maintenance Operation Requirements) and record all response times and snow and ice accumulations in a maintenance management record which shall be provided to the Department on a monthly basis.

400.3.3.2 Non-Compliance

If the Contractor fails to comply with any of Section 400.3 (Winter Maintenance Operation Requirements), despite such a failure, the Contractor shall immediately mobilize in order to minimize snow and ice accumulations.

If non-compliance is observed, Payment Adjustments will be assessed against the Contractor.

Non-compliance is defined as any one of the following:

- The Contractor fails to deploy equipment in accordance with the accepted Snow Clearing and Ice Control Operations Plan (see Sections 100.2.9 and 400.3.1);
- The Contractor has failed to deploy additional resources in accordance with the Snow Clearing and Ice Control Operations Plan;
- The Contractor has failed to plow/remove and/or apply materials as identified in the accepted Snow Clearing and Ice Control Operations Plan;
- The Contractor failed to meet the deployment time frames;
- The Contractor fails to achieve Bare Pavement (as defined in Section 400.3.1) or no ice conditions within the specified time frames following the end of a Storm Event (as defined in Section 400.3.1); and
- The Contractor fails to supply any ice control materials.

400.3.3.3 Payment Adjustments

When the Contractor is non-compliant, Payment Adjustments shall be made as follows:

- $12,000 for each occurrence of non-compliance during a Storm Event (to a maximum of $72,000 total for the Infrastructure);
- $24,000 for each occurrence of non-compliance during a subsequent Storm Event in any consecutive 12 month period (to a maximum of $145,000 total for the Infrastructure); and
- The third occurrence of any non-compliance within a consecutive 12 month period but in a separate third Storm Event shall be a potential Termination Event for the purposes of and having the consequences set out in section 16.8(k) of the DBFO Agreement.

The number of occurrences of non-conformance shall be determined for a consecutive 12 month period.

The Department shall notify the Contractor after the first and second occurrences of non-compliance in any consecutive 12 month period. In this section, "occurrence" refers to an occurrence anywhere on the Infrastructure.

400.3.4 PREFERENTIAL BRIDGE DECK ICING

The Contractor shall implement and carry out the Preferential Bridge Deck Icing Plan (see Section 100.2.9 (Operation and Maintenance Plan)). For the purposes of the Technical Requirements, "**preferential bridge deck icing**" shall mean ice formation within the driving lanes of a bridge deck during a weather circumstance when ice formation within the driving lanes of the roadway leading to and from such bridge deck is not occurring.

400.3.4.1 Measuring for Compliance

The Contractor shall monitor its performance relative to the Preferential Bridge Deck Icing Plan and record all occurrences of preferential bridge deck icing and response times in a maintenance management record which shall be provided to the Department on a monthly basis.

400.3.4.2 Non-Compliance

The Contractor shall be in non-compliance under this Section 400.3.4.2 if preferential bridge deck icing is observed within any of the driving lanes on any of the PBD Bridges (as defined in Section 200.2.16 (Preferential Bridge Deck Icing)) and either:

- such icing has occurred as the result of the Contractor's failure to comply with the current Preferential Bridge Deck Icing Plan; or
- upon becoming aware of such preferential bridge deck icing, the Contractor fails to immediately mobilize in order to reasonably minimize such preferential bridge deck icing; or
- preferential bridge deck icing has previously occurred on any of the PBD Bridges under

the same Preferential Bridge Deck Icing Plan during a prior distinct weather circumstance occurring in the prior 12 month period.

(each a "**Preferential Bridge Deck Icing Non-Compliance Event**").

400.3.4.3 Payment Adjustments

When the Contractor is non-compliant pursuant to Section 400.3.4.2 (Non-Compliance), Payment Adjustments shall be made as follows:

- $12,000 for each occurrence of a Preferential Bridge Deck Icing Non-Compliance Event during a distinct weather circumstance (to a maximum of $72,000 total for the Infrastructure) (the "**First Set of Occurrences**");
- $24,000 for each occurrence of a Preferential Bridge Deck Icing Non-Compliance Event following the First Set of Occurrences during a subsequent but separate and distinct weather circumstance in any consecutive 12 month period (to a maximum of $145,000 total for the Infrastructure) (the "**Second Set of Occurrences**"); and
- The third occurrence of any Preferential Bridge Deck Icing Non-Compliance Event within a consecutive 12 month period but during a separate and distinct weather circumstance shall be a potential Termination Event for the purposes of and having the consequences set out in section 16.8(k) of the DBFO Agreement.

The number of occurrences of non-compliance shall be determined for a consecutive 12 month period.

The Department shall notify the Contractor after the First Set of Occurrences and the Second Set of Occurrences in any consecutive 12 month period. In this section, "**occurrence**" refers to an occurrence anywhere on the Infrastructure.

400.3.4.4 Plan Replacement

The Contractor shall be entitled at any time to replace the Preferential Bridge Deck Icing Plan provided such replacement plan shall be reasonably designed to prevent preferential bridge deck icing from occurring on the PBD Bridges (as defined in Section 200.2.16), including without limitation be reasonably designed to rectify any previous failures in preventing preferential bridge deck icing, and is reviewed in accordance with Schedule 5 (Design and Plan Certification and Review Procedure).

400.4 ROADWAYS

400.4.1 ROADWAY MAINTENANCE REQUIREMENTS

The Contractor shall maintain the entire pavement structure, appurtenances, and all associated works in accordance with the performance requirements. All areas of pavement including shoulders and gores shall be maintained to similar conditions as the driving lanes.

400.4.1.1 Measuring and Testing For Compliance

The Contractor shall be proactive in maintenance of the roadways and appurtenances and shall test conformance with the performance requirements on a minimum of an annual basis or as stipulated by the Technical Requirements. The Contractor shall schedule testing prior to August 1st of each year so that any required repairs can reasonably be completed in the same calendar year. All test results shall be provided to the Department forthwith, upon its request.

For each of the Technical Requirements, the Department may also conduct measurements for compliance and advise the Contractor of any deficiencies.

400.4.1.2 Completing Repairs

When a specific deficiency is identified and times are not defined in the following sections, the Contractor shall correct the work such that it complies with the performance requirements in accordance with the following:

- If the Contractor is aware, or should have been aware, of the deficiency prior to September 1 in any calendar year, the Contractor shall complete the repairs prior to October 31 of the same calendar year;
- If the Contractor is aware, or should have been aware, of the deficiency after September 1 in any calendar year, the Contractor shall complete the repairs prior to June 30 of the following calendar year; or
- When a deficiency with respect to Section 400.4.2.4 (Cross-Slope and Superelevation) or Section 400.4.3 (Smoothness Requirements) is identified during the Operating Period the Contractor shall correct the work such that it complies with the performance requirements by July 31 of the following year.

For all deficiencies, the Contractor shall complete the repairs within these timelines. Failure to do so will result in the applicable Payment Adjustments being assessed. Notwithstanding the allowances for delaying repairs over the winter period the Contractor shall schedule testing to allow time for required repairs within the calendar year. In the event that the Contractor is aware of a deficiency after September 1 due to delays in testing, the specified Payment Adjustment will be assessed for the period until repairs are complete, including the winter period.

400.4.2 PAVEMENT GEOMETRIC REQUIREMENTS (NEW INFRASTRUCTURE ONLY)

This Section 400.4.2 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

The Contractor shall maintain all roadway sections to the designed lines and grades. The following tolerances shall be met. Tolerances refer to the finished pavement surface.

400.4.2.1 Cross-Slope and Superelevation Rates

The roadway superelevation and cross-slope rates shall be maintained to be within ±0.35% of the design rates immediately after construction and within ±1.0% of the design rates during the Operating Period. References to cross-slope requirements shall also apply to superelevation on horizontal curves.

400.4.2.2 Pavement Widths

Design pavement surface width refers to the finished surface as shown on the Contractor's Designs for the standard cross section for the specific segment of roadway. The pavement surface width shall be constructed and maintained to the width defined by the standard cross section for the specific area of roadway. Any mainline pavement with a surface width less than the design width but not greater than 0.35 m less than the design width, either immediately after construction or during the Operating Period, shall be subject to Payment Adjustments.

400.4.2.3 Measuring For Compliance

The Contractor shall measure the roadway superelevation and cross-slope immediately prior to Traffic Availability and after each major surface rehabilitation and whenever the surface appears to not meet the superelevation and cross-slope requirements using a laser based Class I inertial profiling device as defined by ASTM E950, or better. Measurements made using an inertial profiler device shall be averaged for 100 m segments of the roadway. Requirements for cross-slope measuring and conformance shall also apply to superelevation on horizontal curves. Notwithstanding the foregoing, the Department may elect to test or measure the roadway independently if there are concerns regarding the serviceability of the roadway.

The pavement width shall be measured following initial construction and after each rehabilitation which has an impact on roadway width, by means of conventional survey techniques at a minimum of 20 equally spaced measurements per kilometre.

For measurements made using inertial profiling devices, the limiting values will apply to each 100 m segment of the roadway and the average value determined for each consecutive one km section based on the absolute value of the difference between measured and designed cross-slope or superelevation. For width measurements an average value of the difference between measured and design width shall be determined per kilometre, or fraction thereof, shall be determined based on measurements each 50 m.

If the results of the measurements indicate that the work does not comply with the specified criteria, the work will be deemed to be deficient and the Contractor shall schedule remedial work within the specified time period indicated in Section 400.4.1.2 (Completing Repairs).

Cross-slope and superelevation measurements shall be collected for each lane on a continuous basis and reported at 50 m intervals. The measurements shall be made across the entire lane width utilizing an inertial profiling vehicle combining a vehicle frame referenced inertial measurement unit ("**IMU**") with a minimum roll accuracy of 0.01° and a minimum of 10 height sensors. Continuous cross-slope and superelevation measurements shall be calculated based on the linear best fit of the measured transverse profile averaged for each 100 m lane segment of the roadway. The cross-slope and superelevation shall be collected to an accuracy of +/- 0.02 percent and reported to +/- 0.1 percent for each 100 m lane segment.

The Contractor shall conduct an on-site verification prior to the start of the measuring for compliance. The cross-slope and superelevation equipment verification will be based on direct comparison with manually measured transverse profiles at verification sites established by the Contractor. This verification is to validate the cross-slope measurements of the inertial profiling device by using direct comparisons to known roadway geometry. The Contractor is required to run the inertial profiling device over the verification site(s) three times to determine the accuracy and repeatability of the inertial profiling device. The average cross-slope and average superelevation over the 500 m site(s) derived through the automated data collection must be within 0.1 percent of the average cross-slope and superelevation derived through manual survey. The values derived from the automated data collection will be considered repeatable if the values from each run are within +/- 1 standard deviation of the mean for the three runs. All test and measurement results shall be provided to the Department forthwith.

400.4.2.4 Payment Adjustments

Payment Adjustments shall be assessed on a $/lane-km basis for cross-slope and superelevation rate measurement. Pavement width Payment Adjustments shall be assessed on a $/km basis for width variations. Payment Adjustments shall apply to full or partial kilometres and full or partial weeks and shall be assessed until the deficiency is corrected.

Payment Adjustments:

(a) Cross-Slope and Superelevation:

If following construction and prior to the New Infrastructure being opened for use by the public, the roadway superelevation and cross-slope rates are measured and are found not to be maintained within ±0.35% of the design rates then the New Infrastructure shall not be opened for use by the public and no Payment shall be paid until such time as the deficiency is corrected.

If during the Operating Period, the roadway superelevation and cross-slope rates are measured and are found not to be maintained within ±1.0% of the design rates then the following Payment Adjustments will apply:

- $3,600/week or any partial week, for the first four weeks the deficiency is not remedied; then
- $11,000/week or any partial week, thereafter.

Percentages refer to a numeric deviation from the designed percentage and not to a percentage deviation. This means that if the designed percentage is 6%, the deviation referred to in the pre-public use scenario is > 5.65% and < 6.35 %; and the deviation referred to in the operations scenario is > 5.0% and < 7.0%.

(b) Pavement Width Less than Design Width (Mainline):

If following construction and prior to the New Infrastructure being opened for use by the public, the mainline pavement surface width is measured and is found to be up to 0.35 m narrower than the design width then any Payment shall be reduced by an amount equal to the length of the non-conforming roadway, rounded to the next highest kilometre, multiplied by $108,000/km.

If following construction and prior to the New Infrastructure being opened for use by the public, the mainline pavement surface width is measured and is found to be more than 0.35 m narrower than the design width then the New Infrastructure shall not be opened for use by the public and no Payment shall be paid until such time as the deficiency is corrected.

If after final-stage paving or pavement rehabilitation, the mainline pavement surface width is measured and is found to be up to 0.35 m narrower than the design width then there shall be a Payment Adjustment equal to the length of the non-conforming roadway, rounded to the next highest kilometre, multiplied by $108,000/km. Payment Adjustments for the same section of non-conforming roadway will be applied once following construction and again following each paving opportunity (i.e. final-stage paving or pavement rehabilitation, including overlay and/or mill and replace).

If after pavement rehabilitation, the mainline pavement surface is measured and is found to be more than 0.35 m narrower than the design width then the Contractor must repair the deficiency within the timeframes specified in Section 400.4.1.2 (Completing Repairs). A failure to repair such deficiencies shall be a potential Termination Event for the purposes of and having the consequences set out in section 16.8(k) of the DBFO Agreement.

(c) Pavement Width Less than Design Width (C-D Roads, Ramps and Crossroads):

If following construction and prior to the New Infrastructure being opened for use by the public, the pavement surface width on C-D roads, ramps or crossroads is measured and is found to be less than the design width then the New Infrastructure shall not be opened for use by the public and no Payment shall be paid until such time as the deficiency is corrected.

If after pavement rehabilitation, the pavement surface width on C-D roads, ramps or crossroads is measured and is found to be less than the design width then the Contractor must repair the deficiency within the timeframes specified in Section 400.4.1.2 (Completing Repairs). A failure to repair such deficiencies shall be a potential Termination Event for the purposes of and having the consequences set out in section 16.8(k) of the DBFO Agreement.

400.4.3 SMOOTHNESS REQUIREMENTS (NEW INFRASTRUCTURE ONLY)

This Section 400.4.3 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

The roadways shall be maintained with an International Roughness Index ("**IRI**") value equal to or less than those shown in the following table:

Specified Maximum IRI Values

	During Operating Period		**After Initial Construction of New Infrastructure and Immediately Before Traffic Availability**	
Design Speed (km/hr)	**IRI (mm/m) (1 km average)**	**IRI (mm/m) (100 m average)**	**IRI (mm/m) (1 km average)**	**IRI (mm/m) (100 m average)**
> 110	1.9	2.9	0.9	1.9
> 90 ≤ 110	2.0	3.0	1.0	2.0
> 70 ≤ 90	2.2	3.2	1.2	2.2
≤ 70	2.4	3.4	1.4	2.4

at all times based on a one kilometre average value for each lane. Furthermore, individual 100 m long sections shall be maintained with an IRI value less than or equal to the corresponding specified maximum IRI values.

400.4.3.1 Measuring For Compliance

Measurements shall be made by the Contractor immediately prior to Traffic Availability and then at a minimum of once every three years thereafter using a laser based Class 1 inertial profiling device as defined by ASTM E950, or better. The IRI shall be determined in accordance with ASTM E1926 and the recommended "*Best Practice Guidelines*" contained within "*Standardization of IRI Data Collection and Reporting in Canada*" as published by the Transportation Association of Canada. In addition to the "*Best Practice Guidelines*", the IRI for each lane in each direction is to be determined, anomalous roughness events are to be identified with an event "log" during data collection, the start and end limits are to be identified, the data is to be collected during the same week from year to year, and where "should" is used in the *TAC* "*Best Practices Guidelines*" it means that it must be done.

The Contractor shall conduct an on-site verification prior to the start of the measuring for compliance. The profile measurement and IRI post-processing and reporting verification will be based on direct comparison with manually measured longitudinal profiles in each wheel path at verification sites established by the Department for the evaluation of inertial profiling devices on local area roadway(s). The Contractor is required to run the inertial profiling device over the specified site(s) three times to measure the accuracy and repeatability of the inertial profiling device. The average IRI values for each wheel path over the 500 m site(s) derived through the automated data collection must be within 10% of the IRI derived through manual survey. The values derived from the automated data collection will be considered repeatable if the values from each run are within plus or minus 5% of the mean for the three runs.

The limiting IRI values will apply to the average value determined for each consecutive one km section of each lane. All average IRI values will be collected to the nearest 0.01 mm/m and reported to the nearest 0.1 mm/m value.

If the results of the tests or measurements indicate that the work no longer complies with the specified criteria, the work will be deemed to be non-compliant and the Contractor shall undertake the necessary work to address the non-compliance. All test and measurement results shall be provided to the Department forthwith.

400.4.3.2 Payment Adjustments

If the repairs are not completed within the applicable specified time period in Section 400.4.1.2 (Completing Repairs), the Contractor shall be assessed the following Payment Adjustments. The Payment Adjustment shall apply to full or partial lane-kilometres and 100 m sections, as applicable, and will be assessed until the deficiency is corrected.

Payment Adjustments:

Deviation Above Specified Maximum IRI Values as listed in Section 400.4.3 and measured on a 1 lane-km interval:

[1]**Deviation Above Specified Maximum IRI Value (mm/m)**	**Payment Adjustment ($/lane km)**
1. After Initial Construction	
Average IRI is less than (Specified Maximum IRI)	No Payment Adjustment. Roadway may be opened.
Average IRI is equal to or greater than (Specified Maximum IRI) and less than (Specified Maximum IRI + 1.0)	Roadway may open, however repairs and Payment Adjustments to apply. $3,600/week or any partial week, for first 4 weeks, then $11,000/week or any partial week, thereafter
Average IRI is equal to or greater than (Specified Maximum IRI +1.0)	No Payment Adjustment. Cannot open roadway.
2. During Operating Period	
Average IRI is greater than (Specified Maximum IRI + 0.3)	$3,600/week or any partial week, for first 4 weeks, then $11,000/week or any partial week, thereafter

Note [1] Deviation refers to the numeric difference from the specified IRI value, i.e. if the design speed was 110 kph the roadway must be maintained at an IRI of less than 2.0 mm/m. If the measured IRI during the Operating Period was greater than 2.3, then a Payment Adjustment would apply.

Deviation Above Specified Maximum IRI Value as listed in Section 400.4.3 and measured on a 100-metre lane interval.

Deviation Above Specified Maximum **IRI Value (mm/m)**	**Payment Adjustment ($/100 m lane section)**
1. After Initial Construction	
Average IRI is equal to or less than (Specified Maximum IRI)	No Payment Adjustment. Roadway may be opened.
Average IRI is greater than (Specified Maximum IRI) and less than or equal to (Specified Maximum IRI + 1.0).	Roadway may open, however repairs and Payment Adjustments to apply. $3,600/week or any partial week, for first 4 weeks, then $11,000/week or any partial week, thereafter
Average IRI is greater than (Specified Maximum IRI + 1.0)	No Payment Adjustment. Cannot open roadway.
2. During Operating Period	
Average IRI is greater than (Specified Maximum IRI + 0.3)	$3,600/week or any partial week, for first 4 weeks, then $11,000/week or any partial week, thereafter

Payment Adjustments for lane-km averages are based on the average of both wheel path test results and Payment Adjustments shall apply to full or partial lane-kilometres. The Payment Adjustment assessment for individual 100 m sections shall be based on the average of both wheel path test results and Payment Adjustments shall apply to each 100 m section of non-compliance.

400.4.4 RUTTING PERFORMANCE REQUIREMENTS (NEW INFRASTRUCTURE ONLY)

This Section 400.4.4 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

The roadway shall be maintained with rut depths of less than 14 mm at all times based on one km average values. For 100 m sections the rut depths shall be maintained to be less than 19 mm and for any isolated section, less than 25 m in length, the rut depths shall be maintained to less than 29 mm.

400.4.4.1 Measuring For Compliance

Measurements shall be made by the Contractor immediately prior to Traffic Availability and then at a minimum of once every three years thereafter using a laser based Class 1 inertial profiling device as defined by ASTM E950, or better and equipped with a minimum of 10 lasers.

Testing shall be performed during the same week for each test year. Rut depth measurements shall be collected for each lane on a continuous basis and reported at 50 m intervals. Rut depth measurements made with an inertial profiling device shall be averaged for each 100 m lane segment of the roadway for each wheel path of each lane. The rut depths shall be collected to an accuracy of +/- 0.5 mm and reported to +/- 1 mm for each 100 m lane segment.

The Contractor shall conduct an on-site verification prior to the start of the measuring for compliance. The wheel path rut depth measurement equipment verification will be based on direct comparison with manually measured transverse profiles at verification sites established by the Department for the evaluation of inertial profiling devices on local area roadway(s). The Contractor is required to run the inertial profiling device over the specified site(s) three times to measure the accuracy and repeatability of the inertial profiling device. The average rut depth over the 500 m site(s) derived through the automated data collection must be within +/- 3 mm of the average rut depth derived through manual survey. The values derived from the automated data collection will be considered repeatable if the values from each run are within +/- 1 standard deviation of the mean for the three runs.

Measurements of localized areas shall be carried out using a 1.8 m straight edge in accordance with ASTM E1707.

The limiting rut depth values will apply to the average value determined for each consecutive one km section for each lane. Additionally, for each lane, each individual 100 m section rut depth value shall be <19 mm and all localized areas shall be maintained to have rut depth measurements of <29 mm. Localized areas shall be determined for individual wheel path locations, all other rut measurements will be based on the average of both wheel path locations, for each lane. All average rut values shall be rounded down to the nearest mm and reported as an integer value.

If the results of the tests or measurements indicate that the work no longer complies with the specified criteria, the work will be deemed to be non-compliant and the Contractor shall undertake the necessary work to address the non-compliance. All test and measurement results shall be provided to the Department forthwith.

400.4.4.2 Payment Adjustments

If the repairs are not completed within the applicable specified time period, Section 400.4.1.2 (Completing Repairs), the Contractor shall be assessed a Payment Adjustment. The $/lane-km value shall apply to full or partial kilometres and shall be assessed until the deficiency is corrected.

Payment Adjustments:

Average Rut Depth (mm)(1 km average)	**$/lane-km**	**Average Rut Depth (mm) (100 m section)**	**$/Lane 100 m Section**	**Rut Depth (mm) (Isolated Deficiency)**	**$/Isolated Deficiency**
After initial construction >4	No payment, cannot open roadway	After initial construction >4	No payment, cannot open roadway	After initial construction >4	No payment, cannot open roadway
During operations >14 - must fix within specified time period	$3,600/week or any partial week, for first four weeks, then $11,000/week or any partial week, thereafter	During operations >19 - must fix within specified time period	$3,600/week or any partial week, for first four weeks, then $11,000/week or any partial week, thereafter	During operations >29 - must fix within specified time period	$2,400/week or any partial week, for first four weeks, then $7,200/week or any partial week, thereafter

Payment Adjustments for lane-km averages are based on both wheel path test results. The Payment Adjustment for individual 100 m sections applies to the average of both wheel paths except that isolated sections shall be based on individual wheel paths and can result in a Payment Adjustment based on both wheel paths at the same station location. The Payment Adjustment for 100 m sections applies to each 100 m section of non-compliance.

400.4.5 SKID RESISTANCE REQUIREMENTS (NEW INFRASTRUCTURE ONLY)

This Section 400.4.5 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

ASTM E274 or alternate testing methods, as approved by the Department, shall be used to determine the skid resistance of the pavement along the New Infrastructure.

ASTM E 1960 shall be used to determine the calibrated wet friction at 60 km/h (F60) and the speed constant of wet pavement friction (SP). The resulting International Friction Index ("**IFI**") shall be reported along with the actual skid numbers determined.

Areas of pavement which exhibit a physical appearance of polishing, flushing or bleeding and/or which exhibit a higher than average incidence of collisions shall be tested for skid resistance.

400.4.5.1 Measuring For Compliance

After Traffic Availability, areas of pavement on the New Infrastructure which exhibit a visual appearance of polishing, flushing or bleeding and/or which exhibit a higher than average incidence of collisions shall be tested for skid resistance within 30 days of the date which the Contractor first became aware, or the date which the Contractor should have been aware, of such conditions, weather permitting. All test and measurement results shall be provided to the Department forthwith.

400.4.5.2 Completing Repairs

If results of the tests or measurements indicate that the New Infrastructure no longer complies with the specified criteria, the New Infrastructure will be deficient, requiring repair. When a specific deficiency is identified, the Contractor shall correct the work such that it complies with the minimum requirements within 60 days of the deficiency being confirmed. All test and measurement results shall be provided to the Department forthwith.

400.4.5.3 Payment Adjustments

If the repairs are not completed within the applicable specified time period, the Contractor shall be assessed a Payment Adjustment. The $/lane-km value shall apply to full or partial kilometres and will be assessed until the deficiency is corrected.

During operations, Skid Number < 30 - must fix within specified time period	$3,600/lane-km/week or any partial week, for first four weeks, then $11,000/lane-km/week or any partial week.

400.4.6 GENERAL PAVEMENT MAINTENANCE REQUIREMENTS

The Contractor shall maintain all pavement sections including shoulders and gore areas on a regular basis in order to ensure that they remain in a structurally sound and safe condition and continue to provide the service for which they were intended recognizing the Contractor is not responsible for rehabilitating the Existing Infrastructure.

The Contractor shall maintain the pavement surface in a safe condition. If a pavement deficiency is a hazard to motorists, it shall be repaired immediately regardless of size. The following sections provide detailed requirements.

In respect of the Existing Infrastructure only:

(a) the repair methods for localized deficiencies, localized roughness, and localized cracking for both asphalt and hydraulic cement concrete pavements shall be as indicated in Section 100.2.9 (Operation and Maintenance Plan);

(b) the Contractor is not responsible for any work at joints in the hydraulic cement concrete pavement, if any, for the Existing Infrastructure, where work such as mud jacking and grinding, is due to slab movements;

(c) the responsibility for the cost of the repair shall be governed by the DBFO Agreement and other applicable provisions of the Technical Requirements;

(d) the Contractor will be responsible for reporting any pavement related problems with skid resistance, roughness, cross slope, superelevation, structural or other deficiency to the Department; and

(e) the term "**localized**" means access within one metre or less from each other.

400.4.6.1 Localized Deficiencies

Localized deficiencies within any travel lane which are > 0.1 square metre shall be repaired within 24 hours following the time when the Contractor became aware, or should have become aware, of the deficiency. Localized deficiencies which are not located within the travel lanes and/or do not exceed 0.1 square metres shall be repaired within 21 days following the time when the Contractor became aware, or should have become aware, of the deficiency. Spalling or other distress at crack locations and joints shall be treated as a localized deficiency.

400.4.6.2 Localized Roughness

All areas of the pavement shall be maintained true to lines and grades. Localized areas, such as transverse cracks or joints, shall be maintained to prevent localized roughness. Deficiencies which cause localized roughness shall be repaired. The definition of localized roughness shall be any abrupt deviation in excess of 6 mm when measured with a 1.2 m straight edge.

400.4.6.3 Localized Cracking – Asphalt Concrete Pavements (Existing Infrastructure Only)

For all localized cracking in asphalt concrete pavements on the Existing Infrastructure, all transverse cracks between 2mm and 25mm in width and all longitudinal cracks between 2mm and 12mm in width shall be routed and sealed. Routed cracks with missing sealant shall be re-sealed. Transverse cracks greater than 25mm and longitudinal cracks greater than 12mm are to be spray patched. The Contractor shall prepare and carry out a crack sealing program annually, with a completion date for the work of August 31 each year of the Operating Period.

400.4.6.4 Localized Cracking – Hydraulic Cement Concrete Pavements (Existing Infrastructure Only)

For all localized cracking in hydraulic cement concrete, if any, on the Existing Infrastructure, all random cracks between 2mm and 20mm in width shall be sawn/routed and sealed. Sawn/routed cracks with missing sealant shall be re-sealed. The Contractor shall prepare and carry out a crack sealing program annually, with a completion date for the work of August 31 each year of the Operating Period.

400.4.6.5 Measuring For Compliance

The Contractor shall inspect the Infrastructure on a continual basis as part of the schedule of inspection, and shall identify deficiencies related to Section 400.4.6 (General Pavement Maintenance Requirements). All test and measurement results shall be provided to the Department forthwith.

400.4.6.6 Completing Repairs

The Contractor shall undertake any required repairs within the time lines indicated for the specific maintenance need. Where a specific timeline is not indicated, the repairs shall be undertaken within 30 days of the time the Contractor became aware, or should have become aware, of the deficiency. Maintenance repair requirements apply year-round and may be required during poor weather conditions. All test and measurement results shall be provided to the Department forthwith.

400.4.6.7 Payment Adjustments

If repairs, permanent or otherwise, are not completed within the stipulated time period, the Contractor shall be assessed Payment Adjustments at a rate of $600/required repair for each seven day period or any partial week, until the deficiency is corrected.

For the Existing Infrastructure only, if the annual crack sealing programs are not completed by August 31st each year, the Contractor shall be assessed a Payment Adjustment of $2,000/km or any partial km, of single direction unsealed mainline, C-D road, ramp or crossroad/month or portion thereof, until the annual programs are completed.

400.4.7 MISCELLANEOUS - OPERATION AND PERFORMANCE REQUIREMENTS

This Section 400.4.7 covers the performance requirements of specific appurtenances and maintenance activities that must be performed to a specified standard by the Contractor. Notwithstanding the foregoing sentence but subject to the DBFO Agreement, all infrastructure associated with the Infrastructure shall be maintained in an adequate condition and function as designed.

Non-specified items of the Infrastructure such as, but not limited to, backslope, sideslope, or embankment movements, fencing, and pavement shoulders or gore areas shall be maintained to a level consistent with standard practice. Non-specified items shall be monitored and maintained in accordance with standard industry practice. The timing for completing repairs detailed in Section 400.4.1.2 (Completing Repairs), will apply except as specifically noted. Subject to specific reporting requirements specified elsewhere in this Section 400.4.7 (Miscellaneous - Operation and Performance Requirements), all test, measurement, inspection, and other results (including both pre-repair and post-repair) in this Section 400.4.7 (Miscellaneous - Operation and Performance Requirements) shall be recorded and retained by the Contractor, and such records shall be provided to the Department forthwith, upon its request.

400.4.7.1 Delineators

Delineators shall be maintained clean at all times and shall exhibit a minimum retroreflectivity of 80% of design value.

The Contractor shall maintain delineator guideposts plumb within 50 mm throughout their length.

Delineators shall be maintained within 5% of design height and shall not deviate from design locations by more than 50 mm.

Delineators shall be maintained to provide the intended delineation at all times. Delineators that are damaged, or otherwise removed, such that they are not providing the desired delineation shall be replaced.

400.4.7.1.1 Measuring For Compliance

The Contractor shall identify damaged, missing or otherwise ineffective delineators during roadway inspections. At least twice per year (once within one month prior to October 31 and once within one month prior to May 1), the Contractor shall complete a detailed inspection and, when required (i.e. vertical alignment more than 50 mm out of plumb), shall realign delineator guideposts to within 13 mm of plumb throughout their length.

400.4.7.1.2 Completing Repairs

Delineators that become soiled shall be cleaned within seven days providing weather conditions permit.

Delineators that are damaged, missing or otherwise fail to function as designed, shall be replaced within seven days.

400.4.7.1.3 Payment Adjustments

Payment Adjustments shall be assessed against the Contractor for each delineator which does not comply with the requirements of this Section 400.4.7.1 (Delineators) within the stipulated time period at a rate of $24/delineator/day or any partial day, until made to comply.

400.4.7.2 Roadway Lighting

Roadway lighting includes all lights designed and constructed for the Infrastructure or subsequently added to the Infrastructure. The Contractor shall undertake the necessary maintenance to ensure that the desired illumination is provided to motorists at all times. The Contractor shall inspect the operation of the entire roadway lighting system, including the structural integrity of components, power supply, conduit, cables and equipment on a regular basis and this shall be included in the Contractor's QMS (Section 100.2.1). In addition, the following shall apply:

- Individual lights/luminaires shall be maintained to provide light output in accordance with the manufacturer's rated design parameters and lighting shall be maintained and operated to provide the level of illumination as designed;
- Poles shall be maintained plumb within 10 mm in 1 m;
- Poles and other mounting hardware shall be maintained in a clean and neat repair, with no corrosion visible;
- Concrete bases shall be maintained to be structurally adequate for the design loads;
- A regular monitoring program for evaluating the condition of all roadway lights, including the supporting infrastructure shall be conducted and deficiencies in light standards, bases, power supply or other luminaire elements reported to the Department as soon as practicable; and
- All portions of the installation and any repairs or modifications shall with respect to the Existing Infrastructure comply fully with the original designs and any applicable codes and with respect to the New Infrastructure comply fully with the Detailed Designs and construction requirements and any applicable codes.

400.4.7.2.1 Measuring for Compliance

The Contractor shall conduct a regular monitoring program for evaluating the condition of all roadway lights, including all supporting infrastructure, within the Infrastructure. The Department may inspect lights at any time and notify the Contractor of any non-compliance with the Technical Requirements.

400.4.7.2.2 Completing Repairs

The Contractor shall undertake repairs within the following guidelines, from the time that the deficiency is known, or should have been known, to the Contractor:

- Outage of 2 or less consecutive lamps shall be repaired within 96 hours.
- Outage of 3 to and including 5 consecutive lamps shall be repaired within 72 hours.
- Outage of more than 5 consecutive lamps shall be repaired within 48 hours.
- Repair or replacement of lighting infrastructure damaged by an accident shall be done within 21 days, unless consecutive lights are not operating, in which case the repairs shall be done within seven days.

An outage is defined as total failure of the lamp to light, failure of the lamp to produce the manufacturer's rated output (to such an extent that it is visually apparent when compared to other lamps), intermittent lighting caused by cycling on and off, or light is prevented from being properly distributed to the roadway surface.

Poles which are out of alignment more than allowed in the Technical Requirements shall be corrected within 60 days. Any condition of poles or concrete foundations that affect the structural integrity of the installed lighting system shall be repaired within 20 days except for high mast systems, which shall be repaired within five days.

When the work necessitates the replacement of lighting structures, only new materials shall be used, unless otherwise directed in advance and in writing by the Department.

400.4.7.2.3 Payment Adjustments

The Contractor shall be assessed Payment Adjustments for failing to adjust, maintain, repair/replace lamps or components of the roadway lighting system within the stipulated time as follows:

- Lamp repair/replacement, $120/lamp/day or any partial day, that the lamp remains in need of repair/replacement; and
- Repair or adjustment of any pole, base or other lighting system component, $120/component/day or any partial day, that the component needs adjustment.

400.4.7.3 Barriers and Guardrail

Barriers and guardrail shall be maintained to function as designed and to have a neat and tidy appearance at all times. The Contractor shall inspect the condition of guardrail on the Infrastructure on a regular basis and this shall be included in the Contractor's QMS (Section 100.2.1). In addition, the following shall apply:

- Guardrail that is dented, bent, twisted or otherwise misaligned shall be repaired or replaced. Barriers and guardrail shall be maintained in proper alignment, as designed, at all times. Permissible tolerances for plumb and horizontal grades shall be 20 mm from design grades. Permissible tolerances for vertical grades shall be 40 mm from design grade;
- Barriers and guardrail shall be visible at all times and reflective markers shall be clean and function as designed;
- Guardrail damaged by collision shall be replaced. When guardrail is damaged resulting in an Imminent Danger(as defined in Section 400.1.5), it shall be repaired immediately to assure the continued protection of the travelling public. When immediate permanent repair is not possible, temporary repairs shall be implemented immediately incidental to the Imminent Danger. Permanent repairs shall be with new materials and shall be installed to original design specifications, unless otherwise directed in advance and in writing by the Department;
- Posts which are structurally unsound, loose, out of plumb, or otherwise failing to provide the required functionality, shall be replaced;
- All components shall be securely fastened with the designed fasteners at all times;
- Concrete barrier that has concrete pieces missing shall be repaired or replaced as reasonably appropriate;
- Concrete barrier that has structural weakening shall be replaced; and
- The Contractor shall conduct a regular monitoring program for evaluating the condition of all guardrails on the Infrastructure and reporting deficiencies in the guardrail installations on the Infrastructure to the Department as soon as practicable.

400.4.7.3.1 Measuring for Compliance

The Contractor shall undertake daily inspections of all barriers and guardrail sections within the Infrastructure.

400.4.7.3.2 Completing Repairs

In situations when barriers or guardrails are missing or damaged such that they do not function as intended, the Contractor shall undertake repairs or temporarily protect the area immediately. All other non-compliant sections of barrier or guardrail shall be repaired within 60 days. In instances where temporary repairs are required, such temporary repairs may not be in place for more than five days. In winter months when permanent repairs may not be possible due to freezing conditions, temporary measures may stay in-place until the ground is free of frost.

400.4.7.3.3 Payment Adjustments

Following the expiration of the specified time-frame for completing repairs, or in the case where temporary repairs have been in-place until weather permits repairs to be more reasonably undertaken, a Payment Adjustment of $240/metre/day or any partial day, of non-compliant barrier or guardrail shall be assessed until the repairs are completed.

400.4.7.4 Grass Cutting and Landscape Maintenance

400.4.7.4.1 General

The Contractor shall maintain the vegetation in all areas of the Road Right of Way and stormwater management facilities. The Contractor shall remove and dispose of any dead vegetation and re-seed grass, if necessary, to retain the overall landscaping within the Road Right of Way and stormwater management facilities. Areas that are not covered with a uniform stand of grass shall be reseeded. An area is considered to have a nonuniform stand of grass if any bare spots measuring greater than 1 m^2 are present or if there is the ground cover is less than 80% grass.

With the exception of trees and shrubs, all vegetation within the Road Right of Way and stormwater management facilities shall not exceed 300 mm in height, except during the first year following Traffic Availability when the height of vegetation may exceed 300 mm for a maximum duration of one month in certain areas provided that:

- The Contractor has documented and can demonstrate that soil moisture is high in such area of concern and that the use of conventional mowing equipment would likely cause rutting and/or damage to the landscaped area;
- Moisture conditions in such affected areas are assessed biweekly to determine if mowing can be successfully performed without causing damage;
- Control of noxious weeds continues; and
- The Contractor addresses any complaints regarding the vegetation height within seven days to the satisfaction of the Department acting reasonably.

Weed control shall be carried out, by the Contractor, as required to control noxious weeds including all noxious weeds identified under the Weed Control Act (Alberta) and Local Authority bylaws.

The Contractor shall be responsible to repair any damage to grassed areas caused by any vehicles traveling through the Road Right of Way.

400.4.7.4.2 Weed Control

400.4.7.4.2.1 Operating Standards, Approvals and Permits

The Contractor shall comply with the operating standards and practices of the Industrial Vegetation Management Association of Alberta and shall have a service approval agreement from Alberta Environment, or its successor. All personnel applying chemicals shall have a valid applicators license issued by Alberta Environment, or its successor.

Special use approvals issued by Alberta Environment, or its successor, will be required in instances where chemicals are to be sprayed within 30 m of an open body of water. In such instances, the Contractor shall advertise the proposed work in newspapers local to the area, 30 days prior to the scheduled starting date of the work.

The Contractor shall provide the Department with a copy of the newspapers containing the advertisement. All public concerns shall be referred, by the Contractor, to Alberta Environment, or its successor, who will identify any work conditions in the approval. The Contractor shall be responsible for obtaining the special use approval and shall comply with the conditions specified therein.

The Contractor is liable for any damage caused to areas outside the Road Right of Way occasioned by its use of chemicals for weed control and shall promptly handle any damage claims in this regard. The Contractor shall also pay any fines/penalties assessed by the governing authority for failure to promptly comply with applicable requirements.

For the Existing Infrastructure, the Contractor shall not be responsible for watering or re-planting materials but shall be responsible for the weed control within the designated areas, including the planting areas, and shall be responsible for the removal of dead vegetation. The Contractor shall be responsible for replacing plants damaged by the Contractor or by those for whom it is legally responsible.

400.4.7.4.2.2 Materials

The Contractor shall select and supply the appropriate chemical for vegetation control. Only chemicals approved by the appropriate department of the Federal Government for general industrial spraying shall be used. The Contractor shall supply any signs required to identify treated areas in public use areas.

400.4.7.4.2.3 Procedures

The Contractor's use of chemicals, application rates and methods shall comply with the policies, rules and regulations of Alberta Environment, or its successor. The Contractor shall maintain accurate records of all applications including the type and amounts of chemicals used and the locations treated. If requested, the Contractor shall supply this information to the Department along with copies of the bills of lading and the manufacturer's recommended application rates for the chemicals used. The Contractor shall dispose of empty chemical containers only at approved disposal sites.

400.4.7.4.3 Measuring for Compliance

The Contractor shall undertake periodic inspections of all areas of the Road Right of Way and stormwater management facilities to assess the need for any type of landscape maintenance including grass cutting, re-seeding/re-planting, weed control and the removal of dead vegetation. The monitoring program shall comply with the program documented in the Contractor's EMS (Section 100.2.2). The Department may inspect landscaping at any time and notify the Contractor of any non-compliance to these specifications.

Alberta Environment, or its successor, and the Local Authority will also inspect for noxious weeds and any order or direction given to the Contractor regarding deficiencies in compliance shall be dealt with immediately.

400.4.7.4.4 Completing Repairs

When the Contractor fails to observe the need for maintenance, or fails to undertake maintenance within two weeks, then the Contractor will be considered non-compliant and the specified Payment Adjustments will be applied.

400.4.7.4.5 Payment Adjustments

Payment Adjustments shall be assessed against the Contractor on the following basis:

- Grass in excess of the specified maximum height, $120/hectare or any partial hectare/month or any partial month, for any portion of a hectare that fails to meet these requirements.

400.4.7.5 Litter and Graffiti Clean Up

The Contractor shall maintain the Road Right of Way and the drainage system to be reasonably free of litter. The Road Right of Way must be free of any and all litter that may cause damage to vehicles, or otherwise result in a safety hazard for roadway users. The Contractor shall:

- Conduct an annual litter clean up, each spring. Following the annual clean up no litter shall be visible within the Road Right of Way and the drainage system;
- Conduct litter clean up, to the same standard as the spring clean up, on or about July 30, and September 30 each year during the Operating Period. In addition, the Contractor shall clean

up any litter that covers more than 0.025 cubic metres (one cubic foot) in size or greater within the Road Right of Way or the drainage system within one week of observing the litter;

- Remove litter, including dead animals, on the roadway that has the potential to affect traffic immediately and dispose of. Dead animals at any other location on the Road Right of Way or the drainage system shall be removed within six hours of being observed and disposed of;
- Report all incidences (together with reasonable details thereof) of motor vehicles that the Contractor has reason to believe have been abandoned, are parked in contravention of law, regulation or by-law, or are otherwise left unattended in a manner that obstructs the normal movement of traffic or constitutes a present or potential hazard to persons or property, to the appropriate law enforcement authorities as soon as reasonably practical and in any event within 24 hours from the time the Contractor was aware or should have been aware of such incidences. The Contractor shall fully cooperate and properly coordinate with the appropriate law enforcement authorities in the seizure or removal of such motor vehicle;
- Report all incidences (together with reasonable details thereof) of signs or other objects placed within the TUC or the Road Right of Way by third parties;
- Remove graffiti from any location visible from the roadway within 96 hours. Graffiti that cannot be effectively removed shall be covered with appropriate materials; and
- Remove all waste or other litter generated by the Contractor's operation.

Notwithstanding the above requirements for litter clean-up the Contractor shall work with and coordinate with policing authorities and registered motor vehicle owners and their insurers to facilitate clean up of debris resulting from accidents within the Road Right of Way.

400.4.7.5.1 Measuring for Compliance

The Contractor shall undertake periodic inspections of all areas of the Road Right of Way and drainage system to assess the need for litter and graffiti clean up.

The Contractor will be considered to be non-compliant with this Section 400.4.7.5 (Litter and Graffiti Clean Up) if any of the following occur:

- An annual spring clean-up campaign has not been conducted, or has been conducted but has not removed all visible litter from the Road Right of Way and drainage system or graffiti from the Infrastructure, by June 1st of each year;
- The specified summer and fall clean up operations have not been completed by August 15 and October 15 respectively, in each year;
- Litter that poses a hazard has not been removed within the specified time period;
- The Department or the Contractor identifies that the Road Right of Way and drainage system is littered and unsightly and such litter is not removed within the specified time frame;
- The Department or the Contractor identifies that the Infrastructure is covered in graffiti and such graffiti is not removed or appropriately covered within the specified time frame;
- Failure to report abandoned vehicles to the appropriate law enforcement authorities as soon as reasonably practical and in any event within 24 hours from the time the Contractor was aware or should have been aware of such incidences or failure to fully

cooperate and properly coordinate with the appropriate law enforcement authorities in the seizure or removal of such motor vehicles; and

- Waste generated by the Contractor has not been removed within one week of the completion of the work associated with the waste, or if such waste is creating an unsightly or hazardous condition.

400.4.7.5.2 Completing Clean Up

When the Contractor fails to observe the need for litter or graffiti clean-up, or fails to undertake cleanup required within the specified time, then the Contractor will be considered non-compliant and the specified Payment Adjustments shall be applied.

400.4.7.5.3 Payment Adjustments

If the Contractor is determined to be non-compliant, a Payment Adjustment of $300/day, or any partial day, shall be assessed for each and every occurrence of non-compliance. An occurrence is any single or multiple non-compliance. Payment Adjustments for litter or graffiti clean up are cumulative but shall not exceed $600/day. The Payment Adjustment shall be assessed for each day, or portion thereof, until the cleanup is completed.

400.4.7.6 Drainage Systems

Drainage systems shall be maintained to function as designed and to assure that environmental requirements are met at all times.

The Contractor shall undertake drainage system maintenance to ensure that the roadway surfaces and all other elements of the Infrastructure are safe and effectively drained.

The requirements of this section apply to any aspect of the Infrastructure that serves a drainage function, including, but not limited to:

- Drainage structures;
- Culverts;
- Ditches;
- Stormwater management facilities;
- Curb and gutter (drainage function);
- Manholes, inlet and outlet structures, catch basins, flumes; and
- Storm sewers.

The Contractor shall ensure that environmental requirements required by legislation or design are met at all times and shall maintain all aspects of the drainage facilities to prevent the discharge of silt or sediments into water courses.

Drainage system elements shall be maintained to assure full hydraulic and structural capacity.

Ditches, sideslopes, backslopes and any land within the Road Right of Way, the drainage system and/or parts of the TUC drained by the Infrastructure system shall be protected from erosion, including wind erosion. The Contractor shall be responsible for any damage to the Road Right of Way, the TUC, or any lands adjacent the TUC caused by a deficiency in the maintenance of the drainage system for the Infrastructure or by a deficiency in the design and construction of the drainage system for the New Infrastructure.

The Contractor shall manage the drainage system such that deficiencies are repaired immediately if erosion or sedimentation is a potential, or within one year for all other repairs.

400.4.7.6.1 Measuring for Compliance

The Contractor shall complete regular inspections of the Infrastructure to assess the function of the drainage systems and to schedule maintenance and repairs.

400.4.7.6.2 Completing Repairs

The Contractor shall plan for and complete repairs to the drainage system on an annual basis. Drainage deficiencies identified by the Contractor’s inspection shall be corrected within two months of the date of the inspection excepting if such repairs are necessary to prevent the potential for ponding of water on the road surface or if potential for erosion or sedimentation exists, in which case repairs shall be made immediately.

400.4.7.6.3 Payment Adjustments

The ponding of water on the road surface at anytime is not acceptable. For each and every case in which ponded water remains on the road surface for greater than 60 minutes, the Contractor shall be assessed a Payment Adjustment per day, or portion thereof, until the water is removed and the cause of the ponding is rectified.

For paved areas with ponds up to 4 m^2 the Payment Adjustment shall be $1,200/pond/day or any partial day. For paved areas with ponds in excess of 4 m^2 a Payment Adjustment of $6,000/pond/day or any partial day, shall be made.

If erosion of lands occurs, the Contractor shall be assessed a Payment Adjustment if it is not repaired, and the cause rectified within one week of the time of the Contractor becoming aware or should have been aware of the deficiency, of $600/day or any partial day, until repairs are complete.

For all other drainage system deficiencies, the Contractor shall complete the necessary repairs within the stipulated time period or be assessed a Payment Adjustment of $120/day or any partial day, for each deficiency, until the deficiency is repaired.

400.4.7.7 Curb And Gutter

Curb and gutter and any associated works shall be maintained to function as designed recognizing the Contractor is not responsible for the rehabilitation of the Existing Infrastructure. References to curb and gutter shall include curb or gutter sections which may exist separately within the New Infrastructure. The following shall apply:

- Curb and gutter shall be maintained to ensure that their function in overall drainage and driver guidance is maintained at all times;
- Curb and gutter shall be maintained to ensure no ponding of water anywhere along the length of the curb, within the gutter or on any roadway or shoulder;
- Broken or damaged concrete shall be replaced when required to restore functionality;
- Scaling of a concrete surface shall be limited to no more than 10% of surface area in any five lineal metre section of curb and gutter;
- Cracking of concrete shall be limited to a maximum crack width of 3 mm, occurring at a maximum frequency of one crack every 2 m; and
- Curb height shall be maintained to meet the requirements of the design specifications and in no case shall be less than 150 mm.

400.4.7.7.1 Measuring for Compliance

The Contractor shall undertake periodic inspections of all curb and gutter sections within the Infrastructure for the purpose of evaluating the functionality and the condition of the concrete materials.

400.4.7.7.2 Completing Repairs

The Contractor shall complete repairs to restore the functionality of the curb and gutter sections to the level and alignment for which they were originally designed. General repairs shall be completed within 180 days of the time when the Contractor knew of, or should have known of, the deficiency. Replacements of curb and gutter for surface scaling and/or cracking which do not impair functionality shall be completed within 180 days of the time when the Contractor knew or should have known of the deficiency.

400.4.7.7.3 Payment Adjustments

Payment Adjustments for each instance where a curb and gutter section does not conform to the Technical Requirements, and is not repaired within the stipulated time period, shall be $1,200/occurrence/day or any partial day, until rectified.

400.4.7.8 Walks and Multi-use Trails

Walks and multi-use trails shall be maintained to function as designed. The Contractor shall undertake the necessary maintenance to ensure that any walks and multi-use trails within the Infrastructure are maintained in a condition that is safe for pedestrian traffic. The following shall apply:

- Vertical displacement at joints or cracks that exceed 5 mm shall be repaired or replaced to remove the differential elevation and remove any tripping hazard;

- Concrete that is cracked in multiple locations within the same general area of a walks and multi-use trails or otherwise results in a discontinuity that may pose a tripping hazard or be a safety concern shall be removed and replaced;
- Concrete surfaces that exhibit scaling over more than 15% of the surface area in any 1 m² section and results in a rough surface texture shall be removed and replaced; and
- Crack widths in excess of 5 mm require repairs or replacement of the walks and multi-use trails section(s) affected.

400.4.7.8.1 Measuring for Compliance

The Contractor shall undertake periodic inspections of walks and multi-use trails for evaluating the condition of all walks and multi-use trails within the Infrastructure.

400.4.7.8.2 Completing Repairs

The Contractor shall complete repairs to restore the functionality of the walks and multi-use trails to the level for which it was originally designed. Repairs shall be completed within 180 days of the time when the Contractor knew of, or should have known of, the deficiency.

400.4.7.8.3 Payment Adjustments

Payment Adjustments for each instance where a walks and multi-use trails do not conform to the Technical Requirements, shall be $1,200/occurrence/month or any partial month, until rectified.

400.4.7.9 Subgrade Sideslopes and Backslopes (New Infrastructure Only)

This Section 400.4.7.9 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

Subgrade sideslopes shall be maintained as a uniform, smooth surface or straight line from the edge of pavement to edge of sideslope. Over the Operating Period, the straight line sideslope may vary from the design slope angle by no more than 1%.

Backslopes shall be maintained as a uniform, smooth surface or straight line from the ditch bottom to the top of the slope. Over the Operating Period, the straight line backslope may vary from the design slope angle by no more than 2%.

Depressions or abrupt elevation changes greater than 0.05m, for a distance of 2.0 m down the sideslope shall be repaired by the Contractor. Abrupt changes in slope angle that form a depression greater than 0.1 m from the design straight line or slumping in sideslopes or backslopes shall be repaired by the Contractor.

400.4.7.9.1 Measuring for Compliance

The Contractor shall undertake periodic inspections for evaluating the condition of all subgrade sideslopes and backslopes within the New Infrastructure.

400.4.7.9.2 Completing Repairs

The Contractor shall complete repairs to restore the functionality of the sideslopes and backslopes to the level for which it was originally designed. Areas that require repair within the clear zone shall be completed within 30 days of the time when the Contractor knew of, or should have known of, the deficiency. Other areas requiring repair shall be completed shall be completed within 180 days of the time when the Contractor knew of, or should have known of, the deficiency.

400.4.7.9.3 Payment Adjustments

Payment Adjustments for each instance when where the sideslope and backslope does not conform to the requirements herein, shall be $1,200/occurrence/week or any partial week, for deficiencies located within the clear zone and $1,200/occurrence/month or any partial month, for other deficiencies.

400.4.8 TRAFFIC CONTROL DEVICES - OPERATION AND PERFORMANCE REQUIREMENTS

400.4.8.1 Signs

Signs shall be maintained such that they function as designed. The Contractor shall undertake the necessary maintenance to ensure that the desired message is available to motorists at all times. The following shall apply:

- Signing which does not function as designed shall be adjusted, relocated, and/or supplemented to meet the intended function. This includes ensuring signs are not obscured by other signs and do not provide conflicting messages;
- All signs shall be maintained to the physical size, materials, and lettering as designed and constructed for the original installation;
- Signs shall be kept clean and legible at all times;
- Signs shall have an acceptable level of retroreflectivity. Generally, acceptable retroreflectivity can be determined by visual examination of the sign under night-time driving conditions. Signs that exhibit reduced or blotchy retroreflectivity in excess of 25% of the sign area shall be considered to have unacceptable retroreflectivity. Sign reflectivity shall meet the requirements of ASTM D4956;
- Measurement of retroreflectivity will be determined in accordance with ASTM E1709 using a portable retroreflectometer;
- Signs shall be replaced if sign-sheeting material delaminates from the sign blank;
- Sign posts shall be maintained straight and true and shall not lean more than 25 mm in 1 m in any direction;
- Signs shall be kept level, within 25 mm in 1 m, and properly orientated for the travelling public;
- All post replacement of mounted signs shall be the same type as the original installation;

- Galvanized or painted posts shall have the coating maintained such that no corrosion is visible;
- The maintenance of breakaway bases shall be conducted to meet the requirements of the design specifications;
- Signs or billboards containing advertising or for any commercial purpose are not permitted. The Contractor is responsible for the removal of all such signs/billboards; and
- The Contractor shall remove any non-conforming signs or any unauthorized signs from the Road Right of Way.

400.4.8.1.1 Measuring for Compliance

The Contractor shall conduct regular inspections no less than twice per year (once between October 1 and April 30 and once between May 1 to September 30) to evaluate the condition of all signs within the Infrastructure.

400.4.8.1.2 Completing Repairs

The Contractor shall repair/replace any sign that is damaged, stolen, vandalized or which otherwise fails to meet the requirements of this Section 400.4.8 (Traffic Control Devices - Operation and Performance Requirements), within the following timelines:

- Non-critical regulatory signs shall be repaired/replaced within 48 hours;
- Standard information/directional signs shall be repaired/replaced within 14 days; and
- Non-standard information/directional signs shall be repaired/replaced within 60 calendar days.

For straightening, or otherwise maintaining signs, the work shall be conducted within 21 days, unless the deficiency is such as to affect the effectiveness of the sign.

Unauthorized signs shall be removed within one day.

These time lines apply to the time elapsed from when the Contractor knew of, or should have known of, the deficiency with respect to any specification requirement in Section 400.4.8 (Traffic Control Devices - Operation and Performance Requirements).

400.4.8.1.3 Payment Adjustments

Payment Adjustments shall be assessed against the Contractor for failing to maintain, repair/replace signs within the stipulated time as follows:

- General maintenance - \$120/sign/week for any whole or partial week the sign remains in need of maintenance;
- Repair or replacement of regulatory signs - \$1,200/sign/day, or any partial day, until rectified;
- Repair or replacement of information signs < 1 m^2 or failure to remove an unauthorized sign

- \$120/sign/day or any partial day, until rectified; and

- Repair or replacement of information signs $\geq$ 1 m^2 - \$300/sign/day or any partial day, until rectified.

400.4.8.2 Traffic Signals

Traffic signals shall be maintained as designed and shall be fully functional at all times. The following shall apply:

- Signal lights, including any cross-walk lights or advance warning devices shall be maintained such that all lights function at all times;
- Electronics associated with signals shall be maintained such that all signals are functioning at all times;
- Traffic detection devices shall be maintained such that all detection devices are functioning at all times;
- Time clocks in the traffic controllers shall be maintained such that the clock time is accurate matching the Mountain Standard Times;
- Power supplies for signal installations shall be protected, maintained and serviced as required to ensure an uninterrupted power supply is available to keep the signals functioning at all times;
- Signal timing shall be coordinated with the Local Authority to provide consistency throughout the network;
- Signal poles shall be maintained straight and true and shall not lean more than 10 mm in 1 m in any direction;
- Poles, control cabinets and other signal hardware shall be maintained such that no corrosion is visible and that corrosion does not affect the structural and operational integrity of any elements; and
- All repairs shall comply with the original design requirements.

400.4.8.2.1 Measuring for Compliance

The Contractor shall conduct a regular monitoring program as outlined in Package I in Appendix J for evaluating the condition of all traffic signals within the Infrastructure.

400.4.8.2.2 Completing Repairs

The Contractor shall repair/replace any signals damaged, stolen, vandalized or which otherwise fail to meet the requirements of Section 400.4.8.2 (Traffic Signals). Signal problems are classified into the following categories:

(1) Non-functioning traffic signal
(2) Severe Equipment Problem
(3) Minor Equipment Problem
(4) Severe Operation Problem
(5) Minor Operation Problem

The definitions of the traffic signal problems covered under the above categories, the corresponding types of responses required, as well as the required signal repair schedules (response time) are provided in Package I in Appendix J.

The time lines apply to the time elapsed from when the Contractor knew of, or should have known of, the deficiency.

400.4.8.2.3 Payment Adjustments

Any period when the traffic signals are not fully functional, for any reason whatsoever, including power failure under the Contractor's control, shall result in a Payment Adjustment, following the expiration of the specified time period for completing the specific repair, in accordance with the following:

- First occurrence of a non-functioning signal location - $600/hour or any partial hour, until rectified;
- First occurrence of non-functioning bulb or colour display (maximum of one at a signal location) - $120/day or any partial day, until rectified;
- First occurrence of non-functioning bulb or colour display (2 to 4 non-functioning lights or colour displays (provided no non-functioning two bulbs or colour display of the same type affects traffic in any single direction)) - $240/day or any partial day, until rectified;
- First occurrence of mis-aligned signal pole - $120/day or any partial day, until rectified; and
- Each occurrence to remediate corrosion within the specified time - $120/occurrence/month or any partial month, until rectified.

Payment Adjustments for further occurrences of non-compliance following the first occurrence shall be twice the value shown above for each and every such further occurrence. In this section, "occurrence" refers to an occurrence anywhere on the Infrastructure.

The number of occurrences of non-compliance shall be determined for a consecutive 12 month period.

400.4.8.3 Pavement Markings

Pavement markings shall be maintained such that they function as designed. Pavement markings shall be maintained to achieve the following general objectives:

- To provide positive lane delineation for the safe and orderly movement of traffic on the Infrastructure.
- To convey information to a vehicle operator without diverting the driver's attention.
- To complement regulations or warnings by other devices such as traffic signals or signs.

All sections of roadway shall have markings with a minimum retroreflectivity of 100 mcd/lux/m^2. If durable markings are used, the minimum retroreflectivity for white markings shall be 125 mcd/lux/m^2 and the minimum retroreflectivity for yellow markings shall be 100 mcd/lux/m^2. The retroreflectivity shall be evaluated over segments of one kilometre or the length of the line (whichever is less). All retroreflectivity measurements shall be made on a clean dry surface using a 30 m geometry retroreflectometer. Random measurements shall be taken throughout any one kilometre section with results averaged in order to determine any area to be repaired. All markings shall be maintained in a manner such that they are in proper repair, fully visible, complete and intact. Specifically but not exclusively, the Contractor shall ensure that:

- Dirt or debris which obscures the markings is removed;
- Breaks in markings caused by repair work, accident or any other reason, are reinstated;
- Temporary markings for scheduled resurfacing are installed;
- Markings comply with all design requirements and the following tolerances:
  - Nominal 100 mm wide lines shall be applied to a tolerance of 100 mm to 110 mm;
  - Nominal 200 mm line widths shall be applied to a tolerance of 200 to 210 mm;
  - All direction dividing, lane dividing or continuity lines shall not exceed a maximum dimensional length deviation of +/- 100 mm for a specified 6.0 m or 3.0 m length of space; and
  - All markings shall be applied at the proper location in accordance with the designed markings and in no case shall vary from the design location by more than 100 mm;
- All non-conforming markings are obliterated from the roadway; and
- Painted pavement markings shall exhibit:
  - No excessive (more than 10%) overspray;
  - No splattering of paint;
  - Clean definitive edges;
  - No more than five tracks per km;
  - Uniform distribution of glass beads across the line; and
  - Uniform thickness.

400.4.8.3.1 Measuring for Compliance

The Contractor shall inspect the Infrastructure on a continual basis and will identify deficiencies related to general maintenance requirements. Deficient lines or markings will be measured and rounded up to the nearest full kilometre for the Payment Adjustment. Measurement of retroreflectivity of the pavement markings will be determined in accordance with ASTM Standard Test Method E1710 using a portable retroreflectometer.

400.4.8.3.2 Completing Repairs

Temporary markings following repair work, scheduled maintenance or rehabilitation shall be installed the same day as the work is performed.

Permanent markings are required to be installed within seven days of temporary markings being installed.

Incorrect or confusing markings shall be removed immediately. This may involve remedial measures pending scheduling of permanent removal.

400.4.8.3.3 Payment Adjustments

If temporary markings are not installed within the time period specified, Payment Adjustments in the amount of $6,000 per line/marking per km or any partial km, per day or any partial day, shall be assessed until the temporary markings are installed.

If the permanent markings to replace temporary markings are not installed to the required standard within the stipulated time period, Payment Adjustments in the amount of $120 per line/marking per km or any partial km, per day or any partial day, shall be assessed to the Contractor until the repairs are made.

If non-compliant markings are not re-installed to the required standard within the stipulated time period, Payment Adjustments of $120 per marking/day or any partial day, shall be assessed until the markings are re-installed.

If incorrect or confusing markings are not removed within seven days, Payment Adjustments in the amount of $120/marking/day or any partial day, shall be assessed to the Contractor until the repairs are made.

400.4.9 ROAD TRAFFIC NOISE MITIGATION (NEW INFRASTRUCTURE ONLY)

This Section 400.4.9 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

Requirements for road traffic noise mitigation are described in the Section 200 (Project Specifics). If the AADT exceeds 125,000 vehicles per day on the New Infrastructure, the Contractor will be relieved of the responsibility for further road traffic noise mitigation.

400.4.9.1 Measuring For Compliance

The Contractor shall measure noise levels to confirm noise levels are in compliance with Section 200 (Project Specifics). Noise measurements will generally be made in response to public complaints but will not be required more than once in any 12 month period. All test and measurement results shall be provided to the Department forthwith, upon its request.

400.4.9.2 Completing Repairs

When measurements indicate noise exceeds the limiting noise level, the Contractor shall undertake remedial action to either reduce the noise levels generated or to effectively screen the areas as required to reduce noise levels. Any proposed screening devices shall require the prior written approval of the Department. The Contractor shall complete repairs required to result in compliance with the limiting noise level within 180 days of becoming aware of the non-compliance. All test and measurement results shall be provided to the Department forthwith, upon its request.

400.4.9.3 Payment Adjustments

Subject to the second sentence of Section 400.4.9 (Road Traffic Noise Mitigation), if the Contractor fails to implement repairs to attain compliance within the stipulated time period, the Contractor shall be assessed a Payment Adjustment as set out below until repaired.

For the first 180 days, the Payment Adjustment shall be $60,000/30 day period or any partial 30 day period, for each km of roadway or any partial km, which exceeds the noise level.

Following the 180 day period, a Payment Adjustment of $120,000/30 day period or any partial 30 day period, for each km of roadway or any partial km, shall be assessed.

If within 360 days of the time period stipulated for completing repairs, the Contractor has not completed repairs to result in compliance, the Department may undertake the construction of sound attenuating works and deduct the costs, plus a 25% administration fee, from Payments to be made to the Contractor.

The Contractor's responsibility for noise mitigation applies to and includes mainline AADT volumes of 125,000 vehicles per day. AADT volumes shall be determined in accordance with Section 200.3.1 (Traffic Volume Payment Adjustments).

400.4.10 TESTING CONDUCTED WITH AN INERTIAL PROFILER (EXISTING INFRASTRUCTURE ONLY)

Once every three years, the Contractor shall measure the smoothness (IRI), and rutting of the Existing Infrastructure roadways, except all ramps and crossroads.

Measurements with the inertial profiler shall be in accordance with the requirements of the following sections. The measurements must be obtained after June 1st and before August 1st in the years the measurements are obtained:

- Section 400.4.2 (Pavement Geometric Requirements)
- Section 400.4.3 (Smoothness Requirements); and
- Section 400.4.4 (Rutting Performance Requirements).

The data collected for the inertial profiler shall be submitted to the Department on CD ROM in accordance with the ASCII CSV file structure formats and file naming convention used by the Department forthwith.

All data collected by the Contractor is confidential to the Department and shall be turned over to the Department and shall become the property of the Department and may be used in any manner the Department deems appropriate. The Contractor shall not use this data for any purpose nor shall the Contractor disseminate any information to any parties other than the Department.

400.4.10.1 Measuring for Compliance

Measurements with the inertial profiler must be collected during the same week from test year to test year. The profile measurements and IRI post-processing shall be submitted to the Department within three weeks of the collection of the field data.

400.4.10.2 Payment Adjustments

If the field measurements are not collected within the same week of the year in each testing year, the Contractor shall be assessed Payment Adjustments at a rate of $2,000/week or any partial week, for each week in which the field measurements vary from the required week.

If the profile measurements and IRI post-processing is not submitted within the stipulated time period, the Contractor shall be assessed Payment Adjustments at a rate of $500/week or any partial week, for each week that the information is not submitted.

400.5 BRIDGE STRUCTURES

400.5.1 OPERATIONS

400.5.1.1 General

During the Contractor's regularly scheduled inspections of the roadway and appurtenances as specified in Section 400.2 (Inspection, Emergency and Routine Maintenance Requirements), the Contractor shall pay special attention to the condition, functionality and safe operation of the bridge structures. The Contractor shall ensure that qualified personnel carry out the regularly scheduled inspections. Any deficiencies that pose an imminent danger to the travelling public shall be addressed immediately.

In addition, regular scheduled bridge inspections as outlined in Section 400.5.1.3 (Performance Compliance Inspection and Testing) shall be completed by the Contractor to measure and determine compliance of the bridge structures forming part of the Infrastructure with the bridge structure performance requirements identified in Section 400.5.3 (Performance Requirements). Appropriate preventative maintenance, repair and rehabilitation actions are expected to be required. The Contractor is expected to take appropriate action to address identified deficiencies within specified time periods to ensure the long-term durability and serviceability of the bridge structures.

400.5.1.2 Utility Accommodation

The Contractor shall accommodate utilities on the bridge structures when requested by the Department. All costs associated with the installation, maintenance and operation of the utilities shall be the responsibility of the utility owner.

During the Operating Period, the utility line may need to be removed or relocated to facilitate major maintenance, rehabilitation, replacement or closure of a bridge structure. Relocation or removal of the utility line, including all associated costs, shall be borne by the owner of the utility.

In the event that a utility line is no longer required, the utility owner shall advise the Department and the Contractor and arrange for the line to be removed and, when applicable, for the structure to be restored to the condition commensurate with that prior to the installation of the line.

400.5.1.3 Performance Compliance Inspection and Testing

400.5.1.3.1 Inspections and Testing

All bridge structures included in the Infrastructure will be considered a component of the provincial bridge structure inventory and as such shall be subject to at least the same level of inspection as are all other bridge structures on the Provincial highway system.

The Contractor or its designated representative shall complete bridge inspection and testing of the bridge structures to measure and determine compliance to the performance requirements. The compliance inspection and testing shall be based on the Department's existing *Bridge Inspection and Maintenance* ("**BIM**") *System.*

The BIM system consists of two levels of inspection. Level 1 inspections are routine inspections that are carried out on a regular inspection cycle and are primarily a visual inspection carried out without the use of specialized equipment for testing or for access. Level 2 inspections will also be carried out on a specified interval or on a one-time site-specific basis. Using specialized equipment and expertise, the Level 2 inspections gather detailed and quantified information and data on a particular bridge structure or bridge element.

400.5.1.3.2 Routine Level 1 Inspections

The Contractor shall complete routine Level 1 inspections in accordance with the Department's current *Bridge Inspection and Maintenance* ("**BIM**") *System* to confirm that the performance requirements in Section 400.5.3 (Performance Requirements) are being met. Only qualified and experienced bridge inspectors that have a current Class A certification under the Department's BIM system shall complete the inspections.

The routine Level 1 bridge inspections will be completed at the prescribed cycle as follows:

- Initial inspection within 30 days after Construction Completion; and
- Every 21 months after the initial inspection.

The routine inspection cycle may be shortened if deemed necessary by the inspector due to condition, functionality, use of the bridge structures or any other reason.

The Contractor shall complete each routine Level 1 inspection within the time period of one month prior to the originally scheduled date of the routine Level 1 inspection to one month following the originally scheduled date of the routine Level 1 inspection.

400.5.1.3.3 Specialized Level 2 Inspections

The Department currently carries out a number of specialized Level 2 inspections including concrete deck, copper sulphate electrode ("**CSE**") or half-cell testing, chloride ion content testing, ultrasonic inspection of steel elements, scour survey, steel culvert barrel measurement, timber coring, concrete girder, paint system and vertical clearance measurement.

For the bridges forming part of the New Infrastructure using the Department's standard deck protection system as identified in Section 300.5.2.7 (Bridge Structures – Design Criteria – Durability) the Contractor shall complete the following specialized Level 2 inspections to determine the condition of the concrete bridge decks:

- Year 15 Concrete deck inspection, CSE testing, Chloride ion content testing;
- Year 20 Concrete deck inspection, CSE testing, Chloride ion content testing; and
- Year 25 Concrete deck inspection, CSE testing, Chloride ion content testing.

For alternative deck protection systems used on bridges in the New Infrastructure the Contractor shall identify the performance criteria and the testing proposed for determining if the performance of the concrete bridge decks at Years 15, 20 and 25 meets the performance criteria.

For bridges forming part of the Existing Infrastructure, the Contractor shall complete specialized Level 2 inspections in accordance with the schedule outlined in Section 200.3.6.2 (Level 2 Bridge Deck Inspections) to determine the condition of the concrete bridge decks. The specialized Level 2 deck inspections shall consist of concrete deck inspection, CSE testing and chloride ion content testing.

Only qualified and experienced bridge inspectors that have a current Class A certification under the Department's BIM system shall complete the inspections.

The specialized Level 2 inspection and testing, except for the submission of inspection results, shall be completed between May 15 and September 15 of the testing year specified.

400.5.1.3.4 Inspection and Testing Notification

The Contractor shall notify the Department a minimum of two weeks in advance of the scheduled inspection and testing date and time.

The Department reserves the right to direct the Contractor to complete all or a portion of the specified Level 2 inspections in Section 400.5.1.3.3 for the New Infrastructure and the Existing Infrastructure. The Contractor shall request clarification from the Department four weeks in advance of the scheduled Level 2 testing which of the tests specified in Section 400.5.1.3.3 shall be completed for each structure. The Department may elect to have a representative on site during the Contractor's scheduled inspection and testing. The Department also reserves the right to complete inspection or testing concurrently with the Contractor's scheduled inspection and testing or at any other time. In the event the Department elects to complete inspection and testing concurrently with the Contractor's scheduled inspection and testing, the Contractor shall provide the required traffic accommodation and assistance and cooperation.

The Department will use in-house or external engineering consultants to complete the inspection and testing on their behalf. Only qualified and experienced bridge inspectors that have a current Class A certification under the Department's BIM system will perform the Department's inspection and testing work.

400.5.1.3.5 Inspection Reporting

Within 30 days of the completion of a routine Level 1 bridge inspection and within 90 days of the completion of a specialized Level 2 bridge inspection and testing, the Contractor shall provide the results of the inspection and testing to the Department. In addition to the inspection and testing results, the Contractor shall submit a report identifying any components or elements in respect of the Infrastructure found to be non-compliant with the performance requirements in Section 400.5.3 (Performance Requirements). Each identified deficiency will be categorized as structural and operational or standard maintenance in accordance with the requirements of Section 400.5.2 (Bridge Maintenance and Operations) along with the specified time period for commencement or completion of repair and/or remediation actions.

400.5.1.3.6 Payment Adjustments

In the event the Contractor fails to complete the scheduled inspection and testing requirements, including the submission of inspection results to the Department, the Department shall assess the following Payment Adjustments for late submission of inspection results:

- $12,000/bridge/month or any partial month, for routine Level 1 inspections until submitted;
- $24,000/bridge/year or any partial year, specialized Level 2 inspections until submitted.

400.5.1.3.7 Traffic Accommodation

The Contractor is expected to generally perform inspections and testing during non-peak traffic periods and on dates that cause a minimum of inconvenience to the travelling public.

The bridge inspection and testing may require inspectors and workers to be on or in close proximity to the roadway, making traffic accommodation necessary. The Contractor shall provide all necessary temporary signing and traffic accommodation for the duration of the inspection and testing at its own cost.

Lane Closure Payment Adjustments (see Section 400.1.6) shall be charged during inspection and testing carried out by the Contractor but not for testing and inspection carried out by the Department.

400.5.1.3.8 Measurement and Determination

The Department has made every effort to develop and use measurable and quantifiable performance requirements for the bridge structure elements. The BIM system minimizes the subjective nature of these evaluations through formal guidelines and extensive training and certification of inspection personnel.

400.5.2 BRIDGE MAINTENANCE AND OPERATIONS

400.5.2.1 General

For the Existing Infrastructure, the Contractor shall be required to carry out preventative maintenance actions on the bridge structures. The Department will be responsible for the repair of all structural and operational deficiencies (see description in Section 400.5.2.2) and standard maintenance deficiencies (see description in Section 400.5.2.3) in respect of the Existing Infrastructure.

For the New Infrastructure, the Contractor shall be required to maintain the bridge structures in a safe and effective operating condition at all times during the Operating Period. This will require preventative maintenance, standard maintenance and periodic rehabilitation actions during the Operating Period.

The quality and standard of the maintenance, repair, and rehabilitation actions shall be appropriate to ensure the design life of the bridge structures.

400.5.2.2 Structural and Operational (New Infrastructure Only)

This Section 400.5.2.2 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

Structural and operational deficiencies are deficiencies that compromise public safety and must be repaired prior to the 20 months allowed for standard maintenance repairs. An inexhaustive list of some structural and operational deficiencies are as follows:

- Repair of misalignment or cracking to steel girders caused by collision damage, overloads or other causes;
- Repair of excessive cracking, spalling or reinforcement damage to concrete girders caused by collision damage, overloads or other causes;
- Repair of potholes in the bridge deck;
- Repair of deck joint components protruding above the riding surface and causing a hazard to traffic;
- Repair of misalignment, cracking or rupture of bridgerail or guardrail components caused by collision damage or other causes;
- Repair of culverts with deformations exceeding those allowed by the performance requirements;
- Repair of longitudinal cracked seams in culverts; and
- Repair of misalignment and cracking in sign structure support components.
- Repair of bridge approaches when the grade over the length extending over the approach slab

and 3 m beyond it at both ends deviates from the line under a 6 m straight-edge by more than 45 mm, or when the approach slab deviates from the design grade by more than 1.5%.

All structural or operational deficiencies identified shall be notified to the Department forthwith. The Contractor shall commence work to rectify a structural or operational deficiency within 60 days of identification.

For some deficiencies that may not be effectively repaired or rectified during inclement weather, the Department at its sole discretion may extend the required time period for commencement of work to 180 days.

400.5.2.3 Standard Maintenance (New Infrastructure Only)

This Section 400.5.2.3 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

If the Department agrees that deficiencies do not fall within the category of structural and operational they shall be categorized as standard maintenance. These deficiencies are expected to be non-safety and non-hazard related. The Contractor shall complete work to rectify these deficiencies within 20 months of identification.

400.5.2.4 Preventative Bridge Structures Maintenance

The Contractor shall carry out a preventative bridge structures maintenance program for the Infrastructure. The program shall include annual washings of the bridge decks, sealing of all bridge decks exposed to de-icing salts and sealing of all curbs. For the Existing Infrastructure, sealing of all bridge decks shall be with an approved Type 1c sealer and sealing of all curbs with an approved Type 2a sealer; and sealing shall be carried out in accordance with the schedule outlined in Section 200.3.7 (Preventative Bridge Maintenance). For the New Infrastructure, sealing of all bridge decks, curbs and barriers shall be with an approved Type lc sealer.

400.5.2.5 Payment Adjustments

In the event the Contractor fails to meet the specified schedule for preventative maintenance actions or satisfactory repair and remediation of identified deficiencies, the Department shall assess the following Payment Adjustments:

400.5.2.5.1 Structural and Operational (New Infrastructure Only)

This Section 400.5.2.5.1 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

In the event the Contractor fails to commence work within 60 days of identification of a structural or operational deficiency, a Payment Adjustment of $1,200/day or any partial day, per deficiency shall be assessed until the Contractor commences and diligently pursues completion of the work.

For deficiencies where the Department has extended the required time period for commencement of work to 180 days, a Payment Adjustment of $1,200/day or any partial day, per deficiency if the Contractor fails to commence work within 180 days of being notified of the deficiency and shall be assessed until the Contractor commences and diligently pursues completion of the work.

400.5.2.5.2 Standard Maintenance (New Infrastructure Only)

This Section 400.5.2.5.2 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

In the event the Contractor fails to complete work within 20 months of a standard maintenance deficiency being identified, a Payment Adjustment of $6,000/month or any partial month, per deficiency shall be assessed until the Contractor completes the work.

400.5.2.5.3 Preventative Bridge Structures Maintenance

In the event the Contractor fails to complete the scheduled preventative bridge structures maintenance (see Section 400.5.2.4 (Preventative Bridge Structures Maintenance)), with the exception of annual bridge washings within the year scheduled, a Payment Adjustment of $6,000/bridge/month or any partial month, shall be assessed until the Contractor completes the work.

In the event the Contractor fails to complete the annual bridge washings by June 1st of the year scheduled, a Payment Adjustment of $6,000/bridge/month or any partial month, shall be assessed until the Contractor completes the work.

400.5.2.6 Bridge Structure Maintenance and Rehabilitation Requirements (New Infrastructure Only)

This Section 400.5.2.6 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

At least two weeks prior to commencement of any bridge structures maintenance actions, the Contractor shall submit detailed design drawings and construction specifications required for the proposed work to the Department for information and review, if applicable.

At least one month prior to commencement of bridge structures rehabilitation actions, the Contractor shall submit detailed design drawings and construction specifications for the proposed work to the Department for information and review.

400.5.2.7 Notification Of Bridge Structure Maintenance and Rehabilitation (New Infrastructure Only)

This Section 400.5.2.7 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

The Contractor shall notify the Department a minimum of two weeks in advance of any proposed bridge structure maintenance or rehabilitation actions. The written notification shall outline the type of work proposed, schedule for commencement and completion, hours of work and any lane closures or impacts to the travelling public.

400.5.3 PERFORMANCE REQUIREMENTS (NEW INFRASTRUCTURE ONLY)

This Section 400.5.3 applies to the New Infrastructure only and does not apply to the Existing Infrastructure.

400.5.3.1 General

The individual components and elements of bridge structures shall be in adequate condition and functioning as designed during the Operating Period.

No component or element shall show evidence of any loss in structural strength and shall operate safely and in a manner consistent with the Department's Bridge Inspection and Maintenance System.

Notwithstanding the performance requirements stated in Sections 400.5.3.2 (Individual Component Requirements – Bridges), 400.5.3.3 (Individual Component Requirements – Bridge Culverts) and 400.5.3.4 (Individual Component Requirements – Sign Structures) for bridges, bridge culverts and sign structures respectively, all individual components rated three or less under the Department's Bridge Inspection and Maintenance System shall be considered to be in non-conformance.

400.5.3.2 Individual Component Requirements - Bridges

400.5.3.2.1 Approach Slab

The transition on and off the bridge structure from the roadway shall meet the following requirements:

- The grade on the approach slab shall deviate from the design grade by less than 0.5%; and
- The grade over a length extending over the approach slab and 3 m beyond it shall not deviate from the line under a 6 m straight-edge by more than 15 mm. This condition shall apply at both ends of the approach slab.

400.5.3.2.2 Wearing Surface

The wearing surface on bridge structures shall meet the rutting requirements as stated for the roadway in 400.4.4 (Rutting Performance Requirements).

The wearing surface on bridge structures shall meet the skid resistance requirements as stated for the roadway in 400.4.5 (Skid Resistance Requirements).

Asphalt concrete pavement ("**ACP**") wearing surfaces on bridge structures shall meet the general pavement maintenance requirements as stated for the roadway in 400.4.6 (General Pavement Maintenance Requirements).

The pavement markings on bridge structures shall meet the pavement lines and message requirements as stated for the roadway in 400.4.8.3 (Pavement Markings).

400.5.3.2.3 Concrete Bridge Decks

Unless noted otherwise, the bridge deck shall not have any physical defects or chemical deterioration.

The underside of all concrete decks shall be free of stains resulting from deterioration, efflorescence and exudation.

Any cracking on the deck underside shall be limited to a maximum width of 0.3 mm.

The following performance requirements for specialized Level 2 inspections shall be met for the Department's standard deck protection system as identified in Section 300.5.2.7 (Durability):

Year 1 of the Operating Period
Electrical resistance between electrical ground connections shall be measured and recorded to the nearest Ohm (Ω).

Year 15 of the Operating Period
CSE test results showing a minimum of 90% of readings less negative than –0.300 V.

Maximum average total chloride content of 0.010, by percent weight, at the top mat of reinforcing or 100 mm depth, whichever is less.

Year 20 of the Operating Period
CSE test results showing a minimum of 85% of readings less negative than –0.300 V.

Maximum average total chloride content of 0.015, by percent weight, at the top mat of reinforcing or 100 mm depth, whichever is less.

Year 25 of the Operating Period
CSE test results showing a minimum of 80% of readings less negative than –0.300 V.

Maximum average total chloride content of 0.020, by percent weight, at the top mat of reinforcing or 100 mm depth, whichever is less.

Level 2 testing shall be carried out in accordance with the requirements of the Department's *Level 2 Bridge Inspection Manual*.

All test results shall be provided to the Department forthwith.

400.5.3.2.4 Curbs, Barriers, and Medians

There shall be no physical defects or chemical deterioration.

Cracking shall be limited to a maximum width of 0.3 mm occurring at a maximum frequency of one crack every 2 m over the length of the bridge structure.

There shall be no exposure of utility voids or other formed voids.

Differential movement in the horizontal or vertical direction shall be limited to 6 mm.

Joints shall be fully sealed, free of cracks and spalls, and able to accommodate required movements.

The following performance requirements for specialized Level 2 inspections shall be met:

Year 1 of the Operating Period
Electrical resistance between electrical ground connections shall be measured and recorded to the nearest Ohm (Ω).

Year 15 of the Operating Period
CSE test results showing a minimum of 90% of curb readings less negative than -0.300 V.

Year 20 of the Operating Period
CSE test results showing a minimum of 85% of curb readings less negative than -0.300 V.

Year 25 of the Operating Period
CSE test results showing a minimum of 80% of curb readings less negative than -0.300 V.

Level 2 testing shall be carried out in accordance with the requirements of the Department's *Level 2 Bridge Inspection Manual.*

400.5.3.2.5 Bridge and Pedestrian Rails

Elements shall be free of collision damage, horizontal and vertical misalignment, improper guardrail laps, loose connections and missing nuts and bolts.

Steel components shall be free of deformation, cracks, and corrosion.

Anchor bolts shall have proper alignment and firm anchorage.

There shall be no physical defects or chemical deterioration in the grout pads.

400.5.3.2.6 Deck Joints

Deck joints shall be able to accommodate the thermal movements stated on the Detailed Designs without imposing any additional load on substructure or superstructure components. The joints shall be vertically aligned and the variation in the gap along the length of the deck joint shall not exceed 10%. There shall be no missing or loose bolts, nor damage to joint anchorages or blockout concrete.

All deck joints shall capture and manage deck drainage such that it does not come into contact with the concrete and steel surfaces of other bridge elements.

For finger joints, the fingers shall sit level, have no cracks and the trough system under the joint shall function without signs of leakage or debris accumulation. Tolerance for finger gaps shall be within those noted on Standard Drawing S-1638.

For gland type joints, there shall be no signs of leakage or holes or damage to the seal or leakage around the joint.

Steel components shall be free of deformation, cracks and corrosion.

Sidewalk deck joint cover plate slip resistant surfaces shall be effective over not less than 95% of the original slip resistant surface area.

400.5.3.2.7 Bridge Deck Drainage Systems

Build up of gravel or debris shall not cause any ponding on the bridge deck or impede the flow of water away from the bridge deck.

Deck drains and pipes shall not be clogged with debris.

Down spouts shall be low enough to prevent splashing of water on superstructure and substructure elements.

There shall be no ponding of water along the shoulders or in the driving lanes.

For grade separations, the location of drains shall not create ponding water or an icing hazard on the roadway below.

400.5.3.2.8 Concrete Girders

Prestressed concrete girders shall not have any physical defects or chemical deterioration or staining.

Any cracks or defect in the prestressed concrete girders shall meet the requirements of Section 300.5.9.7 (Manufacture).

There shall be no signs of damage or deterioration due to impacts or collisions.

400.5.3.2.9 Steel Girders

Steel girders shall be free of harmful corrosion, notches and cracks.

Bolted connections shall be free of deformation, warping and missing, worn, sheared or deformed fasteners.

Web stiffeners shall not have any evidence of buckling.

Girders shall not show any evidence of sags, buckling, bowing or twisting.

All welds shall be free of cracks.

There shall be no signs of damage or deterioration due to impacts or collisions.

400.5.3.2.10 Intentionally Deleted

400.5.3.2.11 Sidewalks

Sidewalk surfaces shall be smooth but have adequate traction and be free of debris.

There shall be no physical defects or chemical deterioration.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre of sidewalk area.

Steel components shall be free of corrosion, notches, cracks, sheared bolts and cracked welds.

400.5.3.2.12 Bearings

Bearings shall be operational and shall be free of all debris that may impede movement.

Expansion bearings shall be able to accommodate the thermal movements stated on the Detailed Designs without imposing any additional load on substructure or superstructure components.

Coating system on bearings shall be functioning and intact.

Component parts shall have proper alignment, proper contact surfaces and minimum resistance.

Bearing pads and plates shall be in proper position.

There shall be no physical defects or chemical deterioration in the grout pads.

Elastomeric components shall be free of cracks and splits along the edges. Minor bulging of the elastomeric components shall be limited to 10% of the component thickness.

Anchor bolts shall have proper alignment and firm anchorage.

Steel components shall be free of corrosion, notches, cracks, sheared bolts and cracked welds.

400.5.3.2.13 Bearing Seats and Caps

Caps shall not have any rotation or displacement. Integral abutments shall operate within design limits with no signs of distress.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

The bottoms of bearing seats shall not be exposed due to soil settlement or other reasons.

Steel components shall be free of corrosion, notches, cracks, sheared bolts and cracked welds.

400.5.3.2.14 Backwalls and Breastwalls

There shall not be any significant loss of material below the backwall or breastwall.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

Steel components shall be free of corrosion, notches, cracks, sheared bolts and cracked welds.

400.5.3.2.15 Wingwalls and Retaining Walls

Headslopes and retaining walls displacements shall not impact the ability of deck joints, bearings, barriers and piles/casings to operate as designed and without imposing any additional loads to bridge superstructure and substructure components.

The bottoms of wingwalls and retaining walls shall not be exposed due to soil settlement or other reasons.

Defects in precast concrete panels used for the MSE retaining wall shall meet the requirements of Section 300.5.11.4.1 (Panel Production).

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre for cast-in-place components.

Steel components shall be free of corrosion, notches, cracks, sheared bolts and cracked welds.

400.5.3.2.16 Piers

Piers shall not have any evidence of collision damage or damage due to ice or debris.

Visible piles shall not have any evidence of bowing or misalignment due to deterioration, impact, excessive loads or unintended lateral loading.

There shall be no signs of heaving or settlement.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking of concrete components shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

Steel components shall be free of corrosion, notches, cracks, sheared bolts and cracked welds.

400.5.3.2.17 Nose Plates

There shall be no missing plate sections or loose connections.

There shall not be loss of section due to corrosion.

Nose plates with significant impact damage shall be repaired or replaced.

400.5.3.2.18 Concrete Finishes

Concrete finishes in visible areas shall not be stained, chipped or peeling.

400.5.3.2.19 Slope Protection for River Crossing

Any settlement of the headslope fill in the vicinity of the abutment shall be limited to 150 mm.

Slope or scour rock riprap protection shall be of the required gradation and quality as specified in the Detailed Designs.

Average rock size and thickness of the rock layer shall be as specified in the Detailed Designs.

For concrete slope protection, gaps between the abutment and the slab shall be limited to 100 mm.

There shall be no crushing of concrete around the pier or bulging at the toe.

There shall be no physical defects or chemical deterioration.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre of the slope protection area.

400.5.3.2.20 Slope Protection for Grade Separation

Any settlement of the headslope fill in the vicinity of the abutment shall be limited to 150 mm.

For concrete slope protection, gaps between the abutment and the slab shall be limited to 100 mm.

There shall be no crushing of concrete around the pier or bulging at the toe.

There shall be no physical defects or chemical deterioration.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre of the slope protection area.

Drainage shall not penetrate below the slab and there shall be no presence of voids below the slab.

400.5.3.2.21 River Training Works

Average rock size, gradation and thickness of the rock layer shall be as specified in the Detailed Designs.

There shall not be significant scour or erosion around or under the training works.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

400.5.3.2.22 Other Bridge Structure Elements

Other bridge structure elements not listed in these requirements shall be in adequate condition and functioning as designed throughout the Operating Period.

400.5.3.3 Individual Component Requirements – Bridge Culverts

400.5.3.3.1 Embankments

Embankments shall not show any signs of instability such as slumping, excessive settlement, or cracking.

Embankments shall not show any signs of erosion such as gullying or erosion or scour along the toe of the sideslope.

The slope of the embankment shall be as specified in the Detailed Designs.

400.5.3.3.2 Headwalls and Collars

Headwalls and collars shall not have excessive settlement or rotation and must be securely connected to the barrel or bevel section.

Headwalls and collars shall not show any signs of piping, scour or erosion.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

Steel components shall not have excessive corrosion, loss of section or loose connections.

400.5.3.3.3 Wingwalls

Any gap or void between the wingwall and the barrel section shall be limited to a maximum of 75 mm. There shall not be any loss of fill material.

Wingwalls shall have proper vertical alignment and be securely connected to the headwall, if applicable.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

Steel components shall not have excessive corrosion, loss of section or loose connections.

400.5.3.3.4 Cutoff Walls

Cutoff walls shall be securely connected to the culvert invert.

There shall be no signs of undermining, piping or uplift.

400.5.3.3.5 Bevel Ends

For flexible culverts, any deformation (dimensional change) is limited to within 7% of the design or as-constructed dimensions.

There shall be no physical defects or chemical deterioration of concrete culverts.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

400.5.3.3.6 Roofs

For flexible culverts, any deformation (dimensional change) is limited to within 7% of the design or as-constructed dimensions.

There shall be no physical defects or chemical deterioration of concrete culverts.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

400.5.3.3.7 Sidewalls

For flexible culverts, any deformation (dimensional change) is limited to within 7% of the design or as-constructed dimensions.

There shall be no physical defects or chemical deterioration of concrete culverts.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

400.5.3.3.8 Floors

For flexible culverts, any heaving (dimensional change) is limited to within 7% of the design or as-constructed dimensions.

There shall be no physical defects or chemical deterioration of concrete culverts. Any abrasion shall be limited to light scaling over a maximum surface area of 10%.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

400.5.3.3.9 Circumferential Seams

Circumferential seams shall not be misaligned between adjoining sections.

There shall be no evidence of infiltration of backfill material caused by improper connections or separation of adjoining sections.

Circumferential seams shall not have any cracks.

400.5.3.3.10 Longitudinal Seams

Longitudinal seams shall not have any cracks.

Longitudinal seams shall not have any signs of bolt tipping, distortion, cusping, improper nesting or signs of corrosion.

400.5.3.3.11 Coatings

Steel culvert material may have some superficial rust but no pitting or loss of section.

400.5.3.3.12 Fish Passage Enhancement Features

Concrete, steel or rock boulders used for baffles or other fish enhancement features shall be located as specified in the Detailed Designs.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

Steel material may have some superficial rust but no pitting or loss of section.

400.5.3.3.13 Waterway Adequacy

There shall be no reduction in the culvert opening of more than 35% due to debris accumulation, gravel or siltation.

400.5.3.3.14 Slope Protection

Slope or scour protection shall be of the required gradation and quality, as specified in the Detailed Designs.

Average rock size, gradation and thickness of the rock layer shall be as specified in the Detailed Designs.

400.5.3.3.15 River Training Works

Average rock size, gradation and thickness of the rock layer shall be as specified in the Detailed Designs.

There shall not be significant scour or erosion around or under the training works.

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

400.5.3.3.16 Other Bridge Culvert Structure Elements

Other bridge culvert structure elements not listed in these requirements shall be in adequate condition and functioning as designed throughout the Operating Period.

400.5.3.4 Individual Component Requirements - Sign Structures

400.5.3.4.1 Pedestal

There shall be no physical defects or chemical deterioration of concrete components.

Any cracking shall be limited to a maximum width of 0.3 mm and a linear measurement of 1 m of cracking per square metre.

400.5.3.4.2 Column

Columns shall be properly aligned with no bends, bows or kinks.

Steel components shall be free of corrosion, notches, cracks, sheared or loose bolts and cracked welds.

400.5.3.4.3 Connections/Bearings

There shall be no missing anchor nuts and all nuts shall be fully torqued.

Anchor bolts shall have proper alignment and firm anchorage.

There shall be no physical defects or chemical deterioration in the grout pads.

All concrete in the area of the connections shall be sound.

Welds and connections shall be free of cracks and defects.

400.5.3.4.4 Superstructure Elements

The superstructure is defined as that portion of the sign structure that is attached to the support columns and spans between the columns.

Steel elements shall not show any evidence of sags, buckling, bowing or twisting.

Bolted connections shall be free of deformation, warping, and missing, loose, worn, sheared or deformed fasteners.

Steel elements shall be free of corrosion, notches and cracks.

All welds shall be free of cracks.

400.5.3.4.5 Coatings

Coatings shall be intact and effective in preventing corrosion and loss of section.

There shall be no rusting, scaling, peeling, blistering, discolouration or other defects.

400.5.3.4.6 Other Sign Structure Elements

Other sign structure elements not listed in these requirements shall be in adequate condition and functioning as designed throughout the Operating Period.

500.0 HANDBACK REQUIREMENTS

500.1 ROADWAY HANDBACK REQUIREMENTS - NEW INFRASTRUCTURE

At the end of the Term, when the Department assumes responsibility for the New Infrastructure, the roadway shall meet or exceed the following requirements:

500.1.1 CONDITION OF PAVEMENT

The pavements shall meet or exceed the following requirements:

- Cross-slope and superelevation <0.5% deviation from design rate. Percentages refer to a numeric deviation from the designed percentage and not to a percentage deviation. This means that if the designed percentage is 2% the deviation referred to is >1.5% and <2.5%;
- Pavement surface width shall not be less than design width (*Subject to the Payment Adjustment provisions in Section 400.4.2 (Pavement Geometric Requirements.).*

PAVEMENT SMOOTHNESS		
Design Speed (kph)	**IRI (mm/m) 1 km Average**	**IRI (mm/m) (100 m Section)**
>110	1.9	2.9
>90 ≤110	2.0	3.0
>70 ≤90	2.2	3.2
≤70	2.4	3.4

- 1 km average rutting shall be < 10 mm;
- 100 m section average rutting shall be < 15 mm;
- Isolated area rutting shall be < 25 mm;
- Minimum skid number (skid resistance) = 30; and
- Pavement Smoothness IRI Values shall be less than or equal to the numbers in the above table.

All testing and measuring for compliance shall be completed by the Contractor according to the requirements outlined in Section 400.4 within the same calendar year as when the end of the Term occurs. All compliance testing and monitoring results shall be supplied to the Department by September 1 of the year in which the end of the Term falls or two months prior to the end of Term, whichever occurs first.

Notwithstanding the foregoing, the Department may elect to test or measure the roadway independently if there are concerns regarding the serviceability of the roadway.

500.1.2 PAVEMENT SURFACE CONDITION

The pavement surface, including lanes and shoulders, shall be free of any evidence of structural weakness, pitting, potholes, ravelling, segregation, scaling, delamination, localized roughness and all other deficiencies. All cracks and joints shall be sealed with a sealant acceptable to the Department. The pavement surface shall be free and clear of dirt, sand and other debris.

500.1.3 STRUCTURAL REQUIREMENTS

At the time the Department assumes responsibility of the roadway, the structural capacity of each and every lane of the roadway shall be such that a rehabilitation design for 10 years of traffic loading starting as of the date the Department assumes responsibility for the roadway will conform to the following:

- For roadways requiring long-life pavements as described in Section 300.4.1.8, the rehabilitation design will not require any structural strengthening or overlays; and

- For all other roadways, the rehabilitation design will require no more than a 50 mm asphalt concrete overlay or equivalent treatment for the pavement type.

The 10 year traffic loading will be determined based on traffic estimates at the time, but in no case will it exceed 10 million equivalent single axle loads for any lane of any section of roadway.

Pavement strength testing to determine the structural capacity and the rehabilitation needed for the requirement above will be completed by an independent consultant retained and paid for by the Department and acceptable to both the Department and the Contractor. The Contractor shall be responsible for providing all traffic accommodation to allow pavement strength testing or other testing (either destructive or non-destructive), as required.

500.1.4 CONDITION OF ALL SIGNS

All signs on the New Infrastructure must be in-place and functioning as designed and shall meet or exceed the following:

- Have an acceptable level of retroreflectivity. No signs shall exhibit reduced or blotchy retroreflectivity in excess of 25% of the sign area;
- Regulatory signs shall have a minimum retroreflectivity of 250 cd/lux/m^2 at an observation angle of 0.2° and a light entry angle of -4°;
- Information signs shall have a minimum retroreflectivity of 170 cd/lux/m^2 at an observation angle of 0.2° and a light entry angle of -4°;
- Signs shall exhibit no sign-sheeting material delaminations from the sign blank;
- Sign posts shall be maintained straight and true and shall not lean more than 25 mm in 1 m in any direction;
- Signs shall be kept level, within 25 mm in 1 m, and properly orientated for the travelling public;
- Galvanized or painted posts shall have no visible corrosion; and
- All posts of mounted signs are of the same type.

500.1.5 CONDITION OF GUARDRAIL

All guardrail on the New Infrastructure must be installed and functioning as designed and meet or exceed the following:

- All guardrails shall be within 6 mm maximum for plumb and grade;
- All posts are sound and vertical; and
- All components shall be securely fastened with the designed fasteners.

500.1.6 CONDITION OF BARRIERS

All barriers on the New Infrastructure must be installed and functioning as designed and meet or exceed the following:

- All missing pieces and/or areas of structural weakening must be replaced.

500.1.7 CONDITION OF LIGHTING

All lighting systems and related components on the New Infrastructure must be installed and functioning as designed and meet or exceed the following:

- Poles shall be plumb within 10 mm in 1 m;
- Poles and other mounting hardware shall be clean and neat, with no structural corrosion and all visible corrosion areas are to be re-galvanized by methods approved by the Department;
- Concrete bases shall be structurally adequate for the design loads; and
- Each individual light/luminaire shall be operational, provide light output in accordance with the manufacturer's rated design parameters, and overall illumination in accordance with the Detailed Designs.

The Contractor shall cooperate with the Department to coordinate the transfer of supply of electrical power at the end of the Operating Period.

500.1.8 CONDITION OF TRAFFIC SIGNALS

All signal systems on the New Infrastructure must be installed and functioning as designed and meet or exceed the following:

- All signal lights, including any crosswalk lights or advance warning devices, shall be fully functional;
- Traffic detection devices shall be fully functional;
- Time clocks in the traffic controllers shall be accurate matching Mountain Standard Time;
- Electronics associated with signal operation shall be fully functional;
- Signal poles shall be straight and true and shall not lean more than 10 mm in 1 m in any direction;

- Poles, control cabinets and other signal hardware shall have no structural corrosion and all visible corrosion areas are to be re-galvanized by methods approved by the Department; and
- Power supplies are protected and in good condition.

The Contractor shall cooperate with the Department to coordinate the transfer of supply of electrical power at the end of the Operating Period.

500.1.9 CONDITION OF THE DRAINAGE SYSTEM

All components of the drainage system on or related to the New Infrastructure must be installed and functioning as designed. Culverts shall have no perforations. Any perforated culvert shall be replaced or lined as directed by the Department. All ditches, culverts, storm sewers, manholes, inlet and outlet structures, stormwater management ponds and other appurtenances shall be fully operational and clear of any debris or accumulated material.

500.1.10 CONDITION OF CONCRETE CURBS, GUTTERS, SIDEWALKS, BARRIERS (NON-STRUCTURE RELATED)

All concrete infrastructure on the New Infrastructure must be installed and functioning as designed and meet or exceed the following:

- Broken, spalled or damaged concrete shall be replaced where required to restore functionality;
- Curb height shall meet the requirements of the design specifications and in no case shall be less than 150 mm;
- Differential elevation at joints or cracks that exceeds 5 mm shall be repaired or replaced to remove the differential elevation and remove any tripping hazard;
- Concrete that is cracked in multiple locations within the same general area of a sidewalk or otherwise results in a discontinuity that may pose a tripping hazard or be a safety concern shall be removed and replaced; and
- Concrete surfaces that exhibit scaling and results in a rough surface texture shall be removed and replaced.

500.1.11 CONDITION OF LANDSCAPING

All lands disturbed by the Contractor shall have been reclaimed and Reclamation Certificates obtained prior to handback, with a copy of all such Reclamation Certificates provided to the Department as soon as practicable.

All landscaping on the New Infrastructure must be in place and functioning as designed and meet or exceed the following:

- There are no bare spots greater than one square metre in size;
- There is a minimum of 80% ground cover for any 100 square metre area;
- No noxious weeds are present; and

- Grass in the Road Right of Way shall not exceed 300 mm in height.

500.1.12 CONDITION OF FENCING

All fencing on the New Infrastructure must be installed and functioning as designed and meet or exceed the following:

- All posts must be sound and vertical;
- All wires must be in place with no noticeable sag; and
- All gates must be in place and fully operational.

500.1.13 CONDITION OF PAVEMENT MARKINGS

All pavement markings on the New Infrastructure must be installed and functioning as designed and meet or exceed the following:

- All non-illuminated sections of roadway shall have markings with a minimum retroreflectivity of 150 mcd/lux/m² based on a minimum of five discreet measurements in any area of concern;
- Nominal 100 mm wide markings shall be within a tolerance of 100 mm to 110 mm;
- Nominal 200 mm wide markings shall be within a tolerance of 200 to 210 mm;
- All direction dividing, lane dividing or continuity markings shall not exceed a maximum dimensional length deviation of +/- 100 mm for a specified 6.0 m or 3.0 m length of space;
- All markings shall be at the proper location in accordance with the designed markings and in no case shall vary from the design location by more than 100 mm; and
- All painted markings shall display the following:
  - No excessive (more than 10%) overspray;
  - No splattering of paint;
  - Clean definitive edges;
  - No more than five tracks per km; and
  - Uniform distribution of glass beads across the line.

500.1.14 CONDITION OF ROAD TRAFFIC NOISE MITIGATION

All road traffic noise mitigation elements by the Contractor's design on the New Infrastructure shall be installed and functioning as designed and meet or exceed the following:

- Road traffic noise as measured in accordance with Section 200.2.14 (Noise Attenuation) shall not exceed 65 dBA Leq_{24}.

500.1.15 CONDITION OF DELINEATORS

All delineators on the New Infrastructure shall be installed and functioning as designed and meet or exceed the following:

- Delineators shall exhibit a minimum retroreflectivity of 80% of the design value;
- Delineator guideposts shall be plumb within 13 mm throughout their length; and
- Delineators shall be within 5% of design height and not deviate from design locations by more than 50 mm.

500.2 BRIDGE STRUCTURES HANDBACK REQUIREMENTS - NEW INFRASTRUCTURE

500.2.1 GENERAL

At the end of the Operating Period, the bridge structures shall be handed back to the Department. The structures shall be in adequate condition and function as designed with no loss of structural strength and shall meet the handback performance requirements at the end of the Term. The Contractor shall complete any required maintenance or rehabilitation prior to the end of the Term to meet the required functionality state and handback condition prior to returning the bridge structures to the Department's control and management.

Notwithstanding the handback performance requirements stated in this section and Sections 400.5.3.2 (Individual Component Requirements – Bridges), 400.5.3.3 (Individual Component Requirements – Bridge Culverts) and 400.5.3.4 (Individual Component Requirements – Sign Structures), all individual components rated 4 or less under the Department's *Bridge Inspection and Maintenance (BIM) System* shall be considered in non-conformance.

500.2.2 INDIVIDUAL COMPONENT REQUIREMENTS - BRIDGES

With the exception of Section 500.2.2.1 (Concrete Bridge Decks), bridges shall meet the performance requirements specified in Section 400.5.3.2 (Individual Component Requirements – Bridges) at the end of the Term.

Concrete bridge decks shall meet the performance requirements stated in Section 500.2.2.1 (Concrete Bridge Decks) at the end of the Term.

With the exception of Section 500.2.2.2 (Concrete Curbs, Barriers and Medians), bridges shall meet the performance requirements specified in Section 400.5.3.3 (Individual Component Requirements - Bridges) at the end of the Term.

Concrete curbs, barriers and medians shall meet the performance requirements stated in Section 500.2.2.2 (Concrete Curbs, Barriers and Medians) at the end of the term.

500.2.2.1 Concrete Bridge Decks

Unless noted otherwise the bridge deck shall not have any physical defects or chemical deterioration.

Concrete bridge decks cast-to-grade shall not have any cracks greater than 0.1 mm in width and a linear measurement of 0.2 m of cracking per square metre of bridge deck area.

The underside of all concrete decks shall be free of stains resulting from deterioration, efflorescence and exudation.

Any cracking on the deck underside shall be limited to a maximum width of 0.3 mm.

The following handback performance requirements for specialized Level 2 inspections shall be met;

Year 30 of the Operating Period
CSE test results showing a minimum of 75% of readings less negative than –0.300 V.

Maximum total average chloride content of 0.020, by percent weight, at the top mat of reinforcing or 100 mm depth, whichever is less.

The deck area shall not be delaminated or debonded as determined by chain drag testing or hammer sounding in accordance with ASTM D4580.

Level 2 testing shall be carried out in accordance with the requirements of the Department's *Level 2 Bridge Inspection Manual*.

500.2.2.2 Curb, Barriers and Medians

There shall be no physical defects or chemical deterioration.

Cracking shall be limited to a maximum width of 0.3 mm occurring at a maximum frequency of one crack every 2 m over the length of the bridge structure.

There shall be no exposure of utility voids or other formed voids.

Differential movement in the horizontal or vertical direction shall be limited to 6 mm.

The following handback performance requirements for specialized Level 2 inspections hsall be met:

Year 30 of the Operating Period
CSE test results showing a minimum of 75% of readings less negative than -0.300 V.

The curbs, barriers and medians shall not be delaminated as determined by chain drag testing or hammer sounding in accordance with ASTM D4580.

CSE and chloride testing shall be carried out in accordance with the requirements of the Department's *Level 2 Bridge Inspection Manual.*

500.2.3 INDIVIDUAL COMPONENT REQUIREMENTS – BRIDGE CULVERT STRUCTURES

Bridge culvert structures shall meet the handback performance requirements specified in Section 400.5.3.3 (Individual Component Requirements – Bridge Culverts) at the end of the Term.

500.2.4 INDIVIDUAL COMPONENT REQUIREMENTS - SIGN STRUCTURES

Overhead and cantilever sign structures shall meet the handback performance requirements specified in Section 400.5.3.4 (Individual Component Requirements – Sign Structures) at the end of the Term.

500.3 ROADWAY HANDBACK REQUIREMENTS - EXISTING INFRASTRUCTURE

At the end of the Term, when the Department assumes responsibility for the Existing Infrastructure, the roadway shall meet or exceed the following requirements:

500.3.1 PAVEMENT SURFACE CONDITION

The pavement surface, including lanes and shoulders, shall be free of pitting, potholes, ravelling, scaling, delamination, localized roughness, localized deficiencies, and other deficiencies.

- All asphalt concrete pavement transverse and random cracks between 2 mm and 25 mm and all longitudinal cracks between 2 mm and 12 mm shall be routed and sealed. Transverse cracks greater than 25 mm and longitudinal cracks greater than 12 mm shall be spray patched.
- All Hydraulic cement concrete random cracks between 2 mm and 20 mm in width shall be sawn/routed and sealed, and sawn/routed cracks missing sealant shall be re-sealed.
- Areas of localized roughness shall be repaired. Localized roughness shall be any abrupt deviation in excess of 6 mm when measured with a 1.2 m straight edge.
- Roadway surface shall be clean and free of dirt, sand and other debris.
- All cracks shall be sealed with a sealant acceptable to the Department.

500.3.2 CONDITION OF ALL SIGNS

All signs on the Existing Infrastructure must be in-place and functioning as designed and shall meet or exceed the following:

- Have an acceptable level of retroreflectivity. No signs shall exhibit reduced or blotchy retroreflectivity in excess of 25% of the sign area;
- Regulatory signs shall have a minimum retroreflectivity of 250 cd/lux/m^2 at an observation angle of 0.2° and a light entry angle of -4°;
- Information signs shall have a minimum retroreflectivity of 170 cd/lux/m^2 at an observation angle of 0.2° and a light entry angle of -4°;
- Signs shall exhibit no sign-sheeting material delaminations from the sign blank;

- Sign posts shall be maintained straight and true and shall not lean more than 25mm in 1m in any direction; and
- Signs shall be kept level, within 25mm in 1m, and properly orientated for the travelling public.

500.3.3 CONDITION OF GUARDRAIL

- All accident damaged guardrail on the Existing Infrastructure must be repaired or replaced and functioning as designed; and
- All guardrails shall be clean and any reflective markers shall be functioning as designed.

500.3.4 CONDITION OF BARRIERS

- All accident damaged barriers on the Existing Infrastructure must be repaired or replaced and functioning as designed; and
- All barriers shall be clean and any reflective markers shall be functioning as designed.

500.3.5 CONDITION OF LIGHTING

All lights/luminaires on the Existing Infrastructure must be installed and functioning as designed and meet or exceed the following:

- Accident damaged lighting system components must be repaired or replaced and be functioning as designed; and
- Each individual light/luminaire shall be operational, provide light output in accordance with the manufacturer's rated design parameters, and overall illumination in accordance with the Detailed Designs.

500.3.6 CONDITION OF TRAFFIC SIGNALS

All signal systems on the Existing Infrastructure must be functioning as designed and meet or exceed the following:

- All signal lights, including any crosswalk lights or advance warning devices, shall be fully functional;
- Traffic detection devices shall be fully functional;
- Time clocks in the traffic controllers shall be accurate matching Mountain Standard Time;
- Electronics associated with signal operation shall be fully functional;
- Signal poles shall be straight and true and shall not lean more than 10 mm in 1 m in any direction; and
- Power supplies are protected and in good condition.

500.3.7 CONDITION OF THE DRAINAGE SYSTEM

All components of the drainage system on or related to the Existing Infrastructure must be functioning as designed. All ditches, culverts, storm sewers, manholes, inlet and outlet structures, stormwater management ponds and other appurtenances shall be fully operational and clear of any debris and accumulated material.

500.3.8 CONDITION OF CONCRETE CURBS, GUTTERS, SIDEWALKS, BARRIERS (NON-STRUCTURE RELATED)

All concrete infrastructure on the Existing Infrastructure installed by the Contractor must be functioning as designed and meet or exceed the following:

- Broken, spalled or damaged concrete shall be replaced where required to restore functionality;
- Differential elevation at joints or cracks that exceeds 5 mm shall be repaired or replaced to remove the differential elevation and remove any tripping hazard;
- Concrete that is cracked in multiple locations within the same general area of a sidewalk or otherwise results in a discontinuity that may pose a tripping hazard or be a safety concern shall be removed and replaced; and
- Concrete surfaces that exhibit scaling and results in a rough surface texture shall be removed and replaced.

500.3.9 CONDITION OF LANDSCAPING

All landscaping on the Existing Infrastructure must be in place and functioning as designed and meet or exceed the following:

- Grass within the Road Right of Way shall not exceed 300 mm in height;
- No noxious weeds are present; and
- Seeded area shows no bare spots greater than 1 m^2 in size.

500.3.10 CONDITION OF FENCING

All fencing on the Existing Infrastructure must be installed and functioning as designed and meet or exceed the following:

- All posts must be sound and vertical;
- All wires must be in place with no noticeable sag; and
- All gates must be in place and fully operational.

500.3.11 CONDITION OF PAVEMENT MARKINGS

All pavement markings on the Existing Infrastructure must be installed and functioning as designed and meet or exceed the following:

- All pavement markings shall have a minimum retroreflectivity of 150 mcd/lux/m^2 based on a minimum of five discreet measurements in any area of concern;

- Nominal 100 mm wide markings shall be within a tolerance of 100 mm to 110 mm;
- Nominal 200 mm wide markings shall be within a tolerance of 200 to 210 mm;
- All direction dividing, lane dividing or continuity markings shall not exceed a maximum dimensional length deviation of +/- 100 mm for a specified 6.0 m or 3.0 m length of space;
- All markings shall be at the proper location in accordance with the designed markings and in no case shall vary from the design location by more than 100 mm; and
- All painted markings shall display the following:
  - No excessive (more than 10%) overspray;
  - No splattering of paint;
  - Clean definitive edges;
  - No more than five tracks per km; and
  - Uniform distribution of glass beads across the line.

500.3.12 CONDITION OF DELINEATORS

All delineators on the Existing Infrastructure shall be installed and functioning as designed and meet or exceed the following:

- Delineators shall exhibit a minimum retroreflectivity of 80% of the design value;
- Delineator guideposts shall be plumb within 13 mm throughout their length; and
- Delineators shall be within 5% of design height and not deviate from design locations by more than 50 mm.

500.4 BRIDGE STRUCTURES HANDBACK REQUIREMENTS - EXISTING INFRASTRUCTURE

At the end of the Term, maintenance and operations responsibilities for the bridge structures shall be handed back to the Department. There are no handback requirements for bridge structures in the Existing Infrastructure at the end of the Term.

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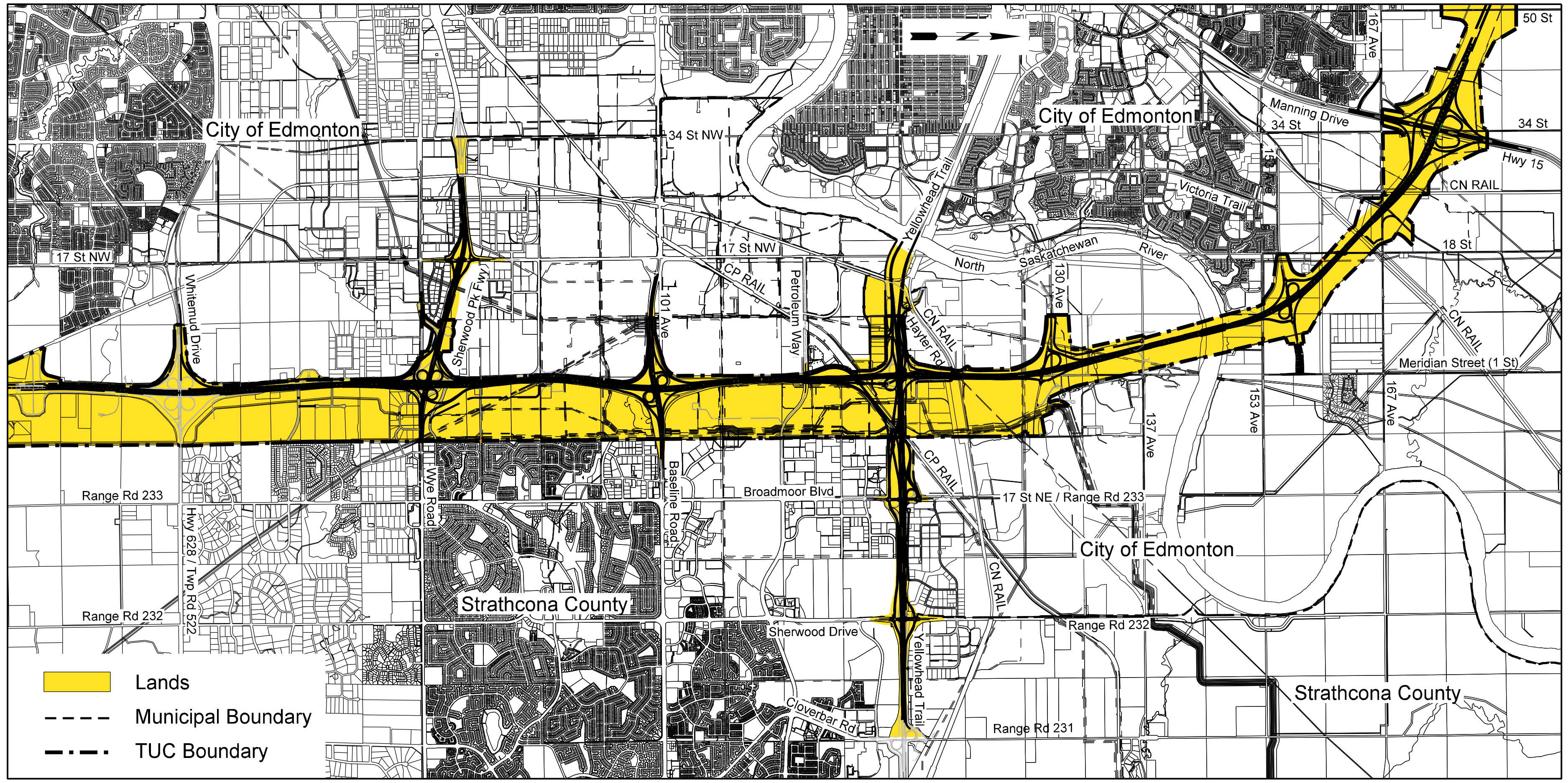

DESIGN, BUILD, FINANCE and OPERATE
NORTHEAST ANTHONY HENDAY DRIVE
EDMONTON, ALBERTA, CANADA

SCHEDULE 18
APPENDIX A - DRAWINGS
EXECUTION VERSION

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
COVER SHEET

BAR CODE

PLAN No. 18-A-1.01
CONTRACT No.
SITE No.

PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

No.	REVISION	BY	DATE
0	EXECUTION VERSION		

SURVEYED
DESIGNED
CHECKED
DRAWN

ISL Engineering and Land Services

Government of Alberta
Transportation

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
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BAR CODE

18-A-1.02

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

DATE	BY	SURVEYED	DESIGNED	CHECKED	DRAWN

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18-A-3.03	3 of 13	SHERWOOD PARK FREEWAY WEST OF 17 STREET TO ORDZE CRESCENT
18-A-3.03A	4 of 13	SHERWOOD PARK FREEWAY - 34 STREET TO 17 STREET
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18-A-3.06	7 of 13	NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE
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18-A-3.09	10 of 13	YELLOWHEAD TRAIL/HIGHWAY 16 - BROADMOOR BOULEVARD TO CLOVER BAR ROAD
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18-A-4.02	2 of 4	TYPICAL SECTIONS AND DETAILS
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18-A-5.05	5 of 38	SHERWOOD PARK FWY OVER ANTHONY HENDAY DRIVE
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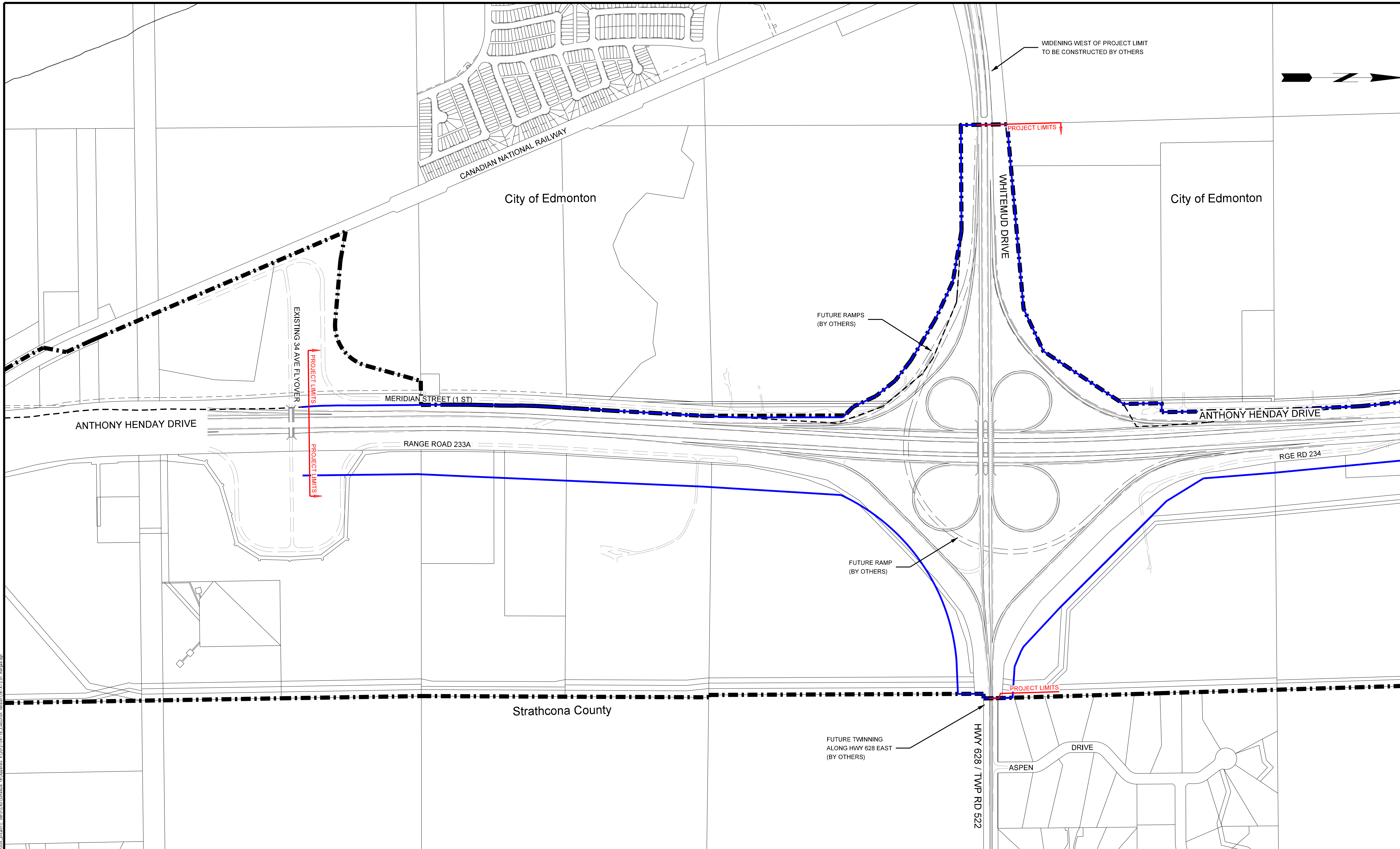

NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS & PRIVATE LANDS WITHIN TUC

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.01	NE ANTHONY HENDAY DRIVE		1 of 10

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS & PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.01

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

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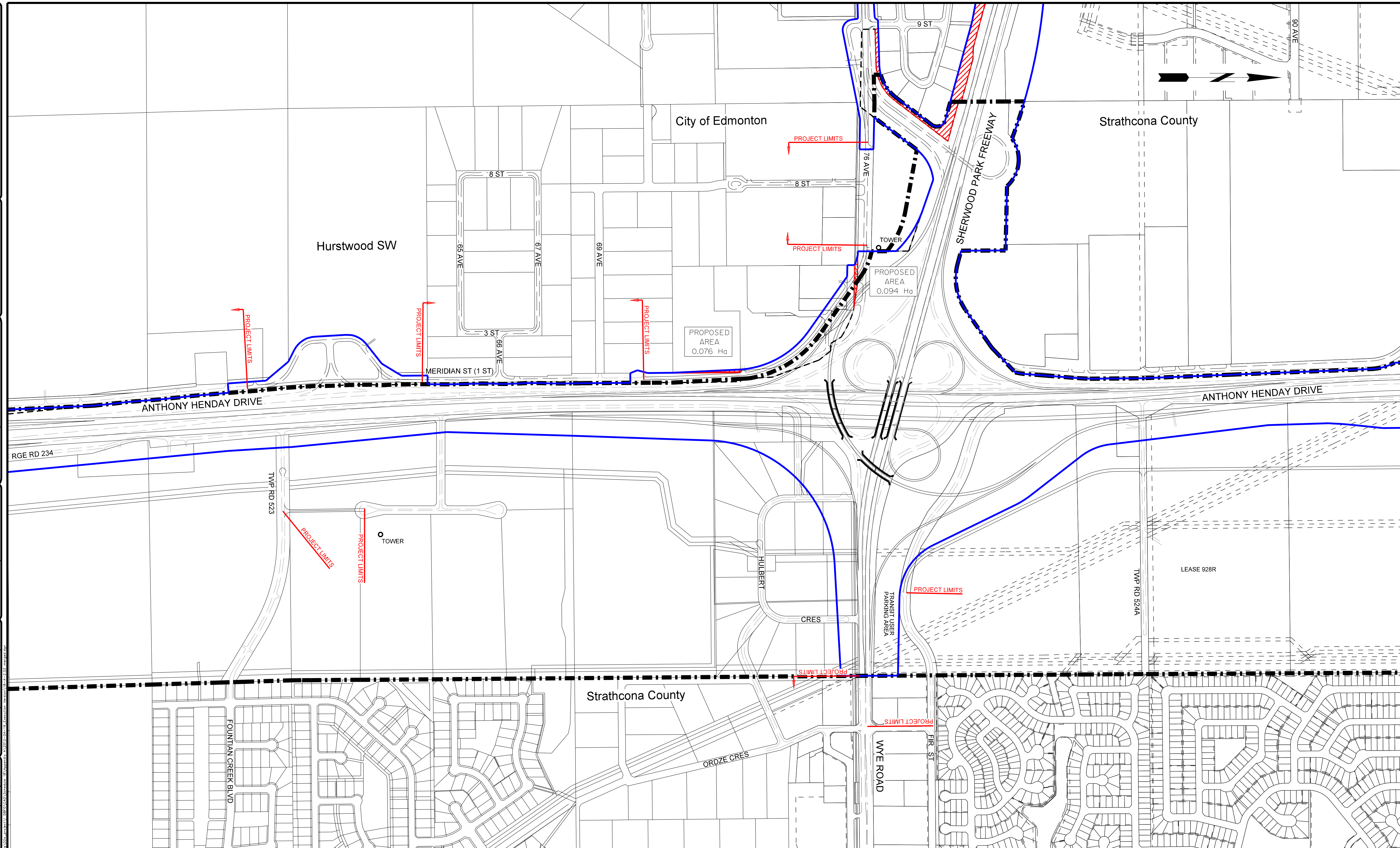

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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
NORTH OF WHITEMUD DRIVE TO
NORTH OF SHERWOOD PARK FREEWAY
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

Government of Alberta ■
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.02	NE ANTHONY HENDAY DRIVE		2 of 10

PLAN DESCRIPTION
NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY SCHEDULE 18 - APPENDIX A PROJECT LIMITS, TO BE ACQUIRED LANDS & PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.02

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

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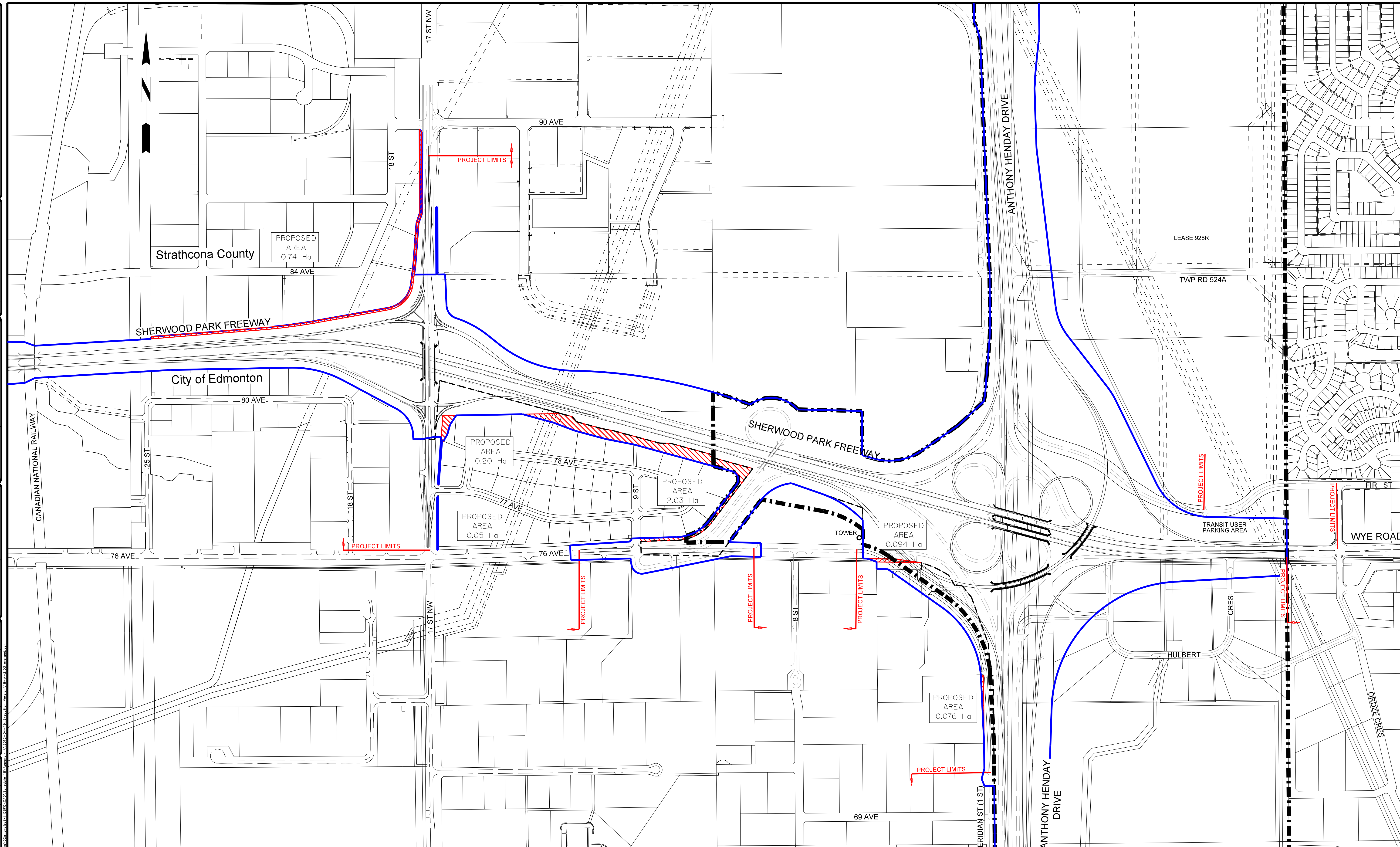

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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SHERWOOD PARK FREEWAY
17 STREET TO ORDZE CRESCENT
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.03	NE ANTHONY HENDAY DRIVE		3 of 10

PLAN DESCRIPTION
SHERWOOD PARK FREEWAY
17 STREET TO ORDZE CRESCENT
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.03

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

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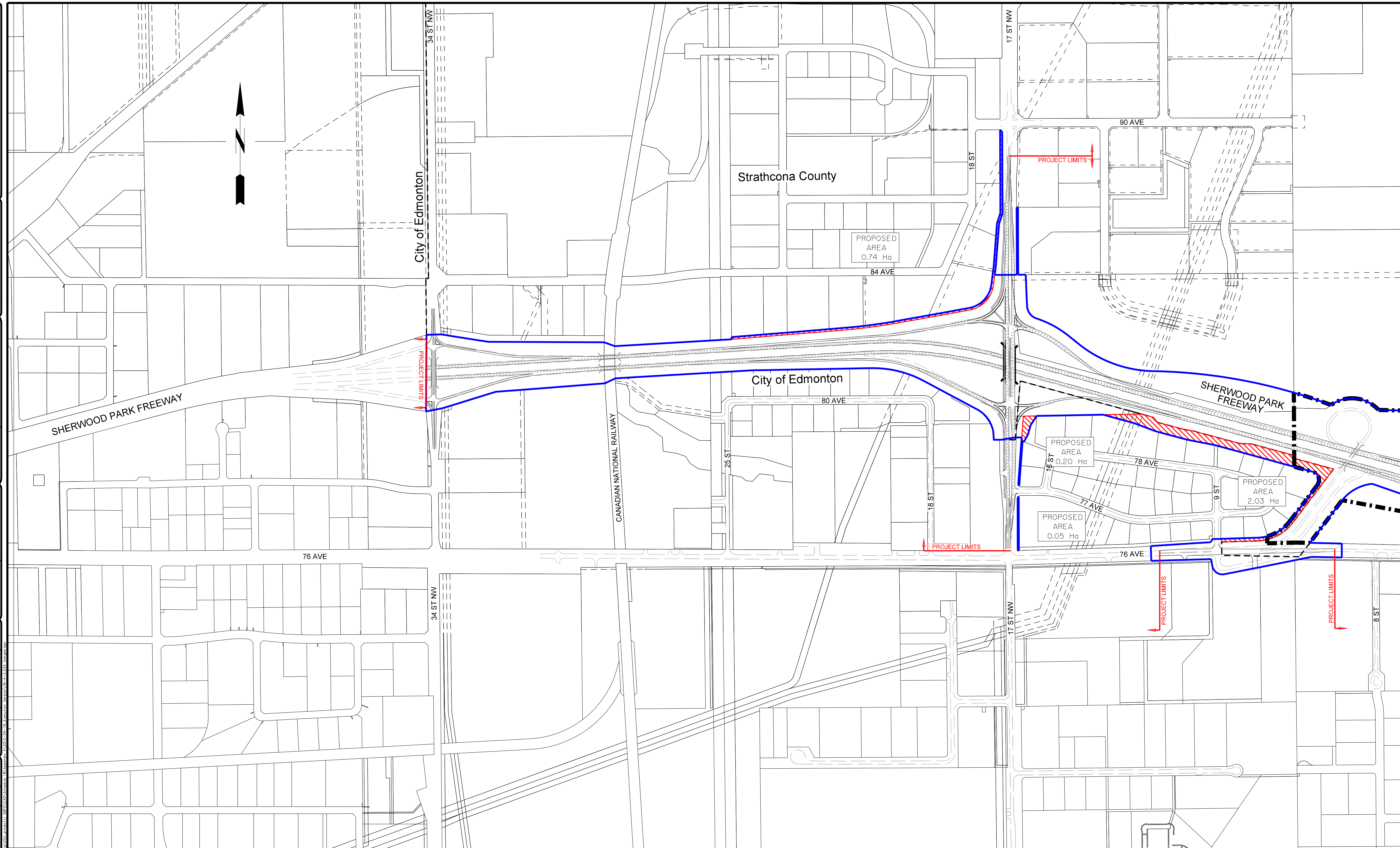

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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SHERWOOD PARK FREEWAY
34 STREET TO 17 STREET
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-A-2.03A	NE ANTHONY HENDAY DRIVE		4 of 10

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
SHERWOOD PARK FREEWAY
34 STREET TO 17 STREET
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.03A

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY

REVISION
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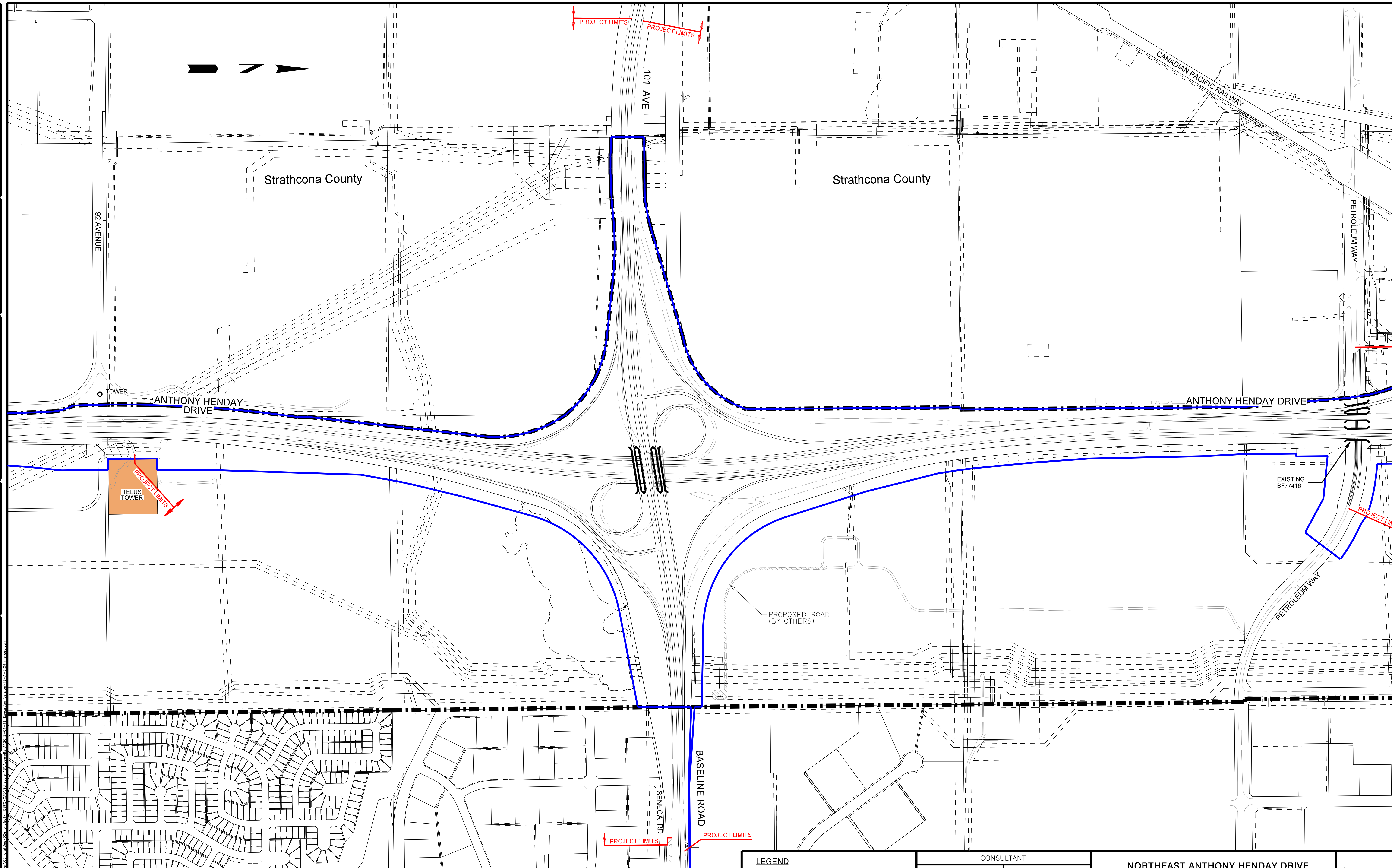

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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
NORTH OF SHERWOOD PARK FREEWAY
TO PETROLEUM WAY
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.04	NE ANTHONY HENDAY DRIVE		5 of 10

Government of Alberta
Transportation

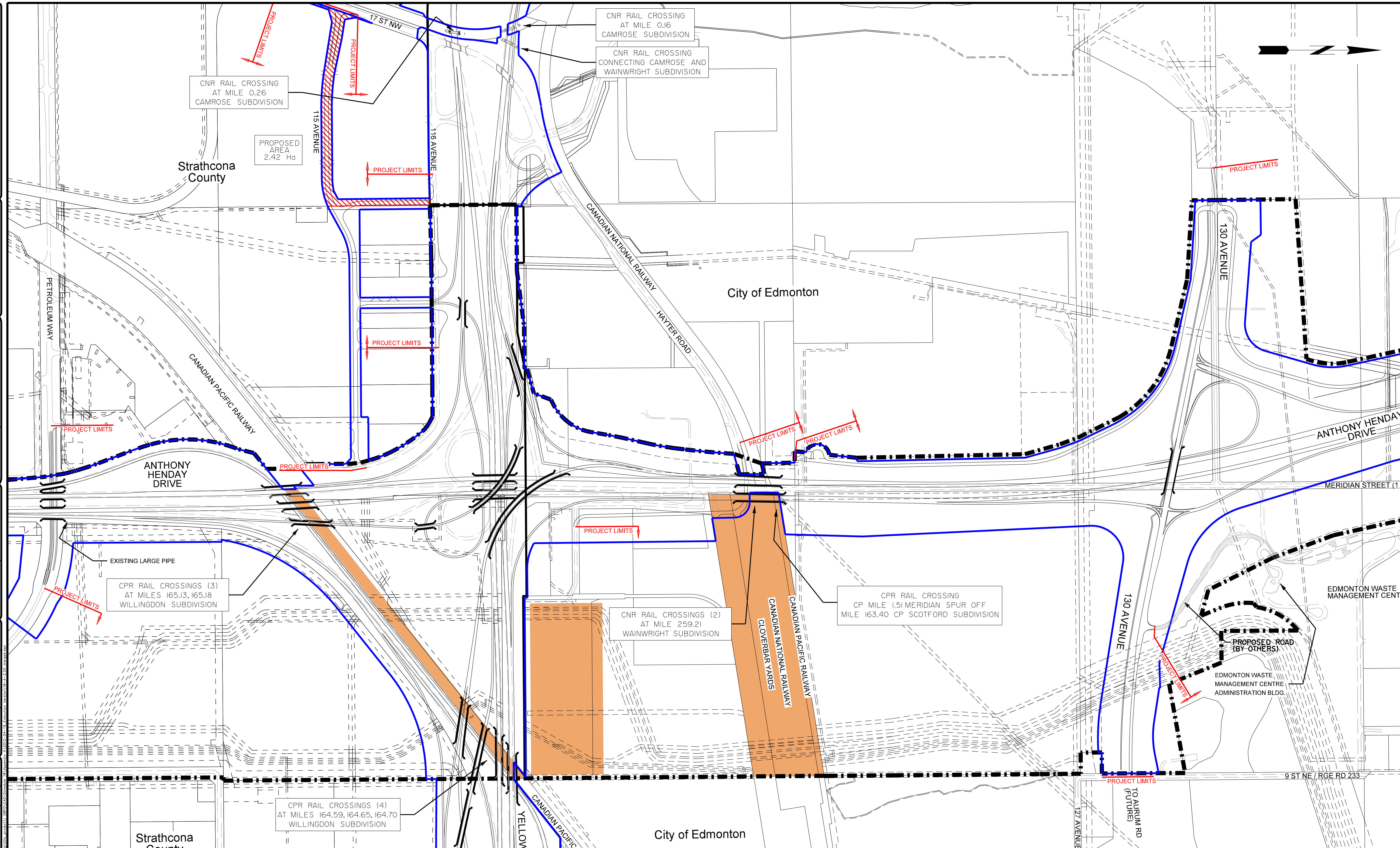
SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY SCHEDULE 18 - APPENDIX A PROJECT LIMITS, TO BE ACQUIRED LANDS & PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.04

PLAN No. CONTRACT No. SITE No.
PHOTO No. TITLE SEARCH DATE GRAPHICS FILE
DATE BY SURVEYED DESIGNED CHECKED DRAWN
DATE BY REVISION
No. 0 EXECUTION VERSION



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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
PETROLEUM WAY TO
NORTH OF 130 AVENUE
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.05	NE ANTHONY HENDAY DRIVE		6 of 10

Government of Alberta ■
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
PETROLEUM WAY TO NORTH OF 130 AVENUE SCHEDULE 18 - APPENDIX A PROJECT LIMITS, TO BE ACQUIRED LANDS & PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.05

PLAN No. CONTRACT No. SITE No.

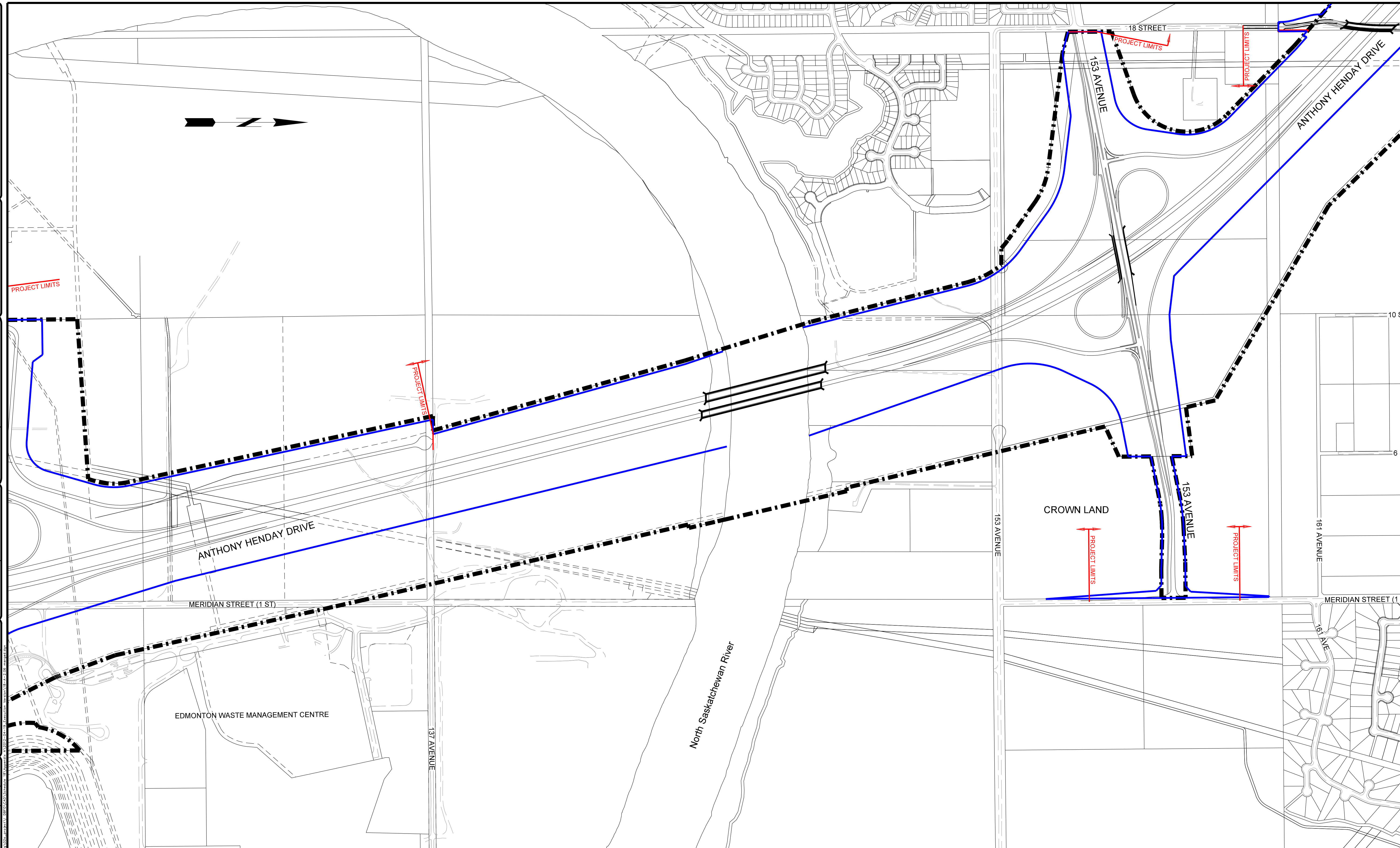
PHOTO No. TITLE SEARCH GRAPHICS FILE

DATE BY

SURVEYED DESIGNED CHECKED DRAWN

DATE BY

No. 0 REVISION EXECUTION VERSION



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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
NORTH OF 130 AVENUE TO
NORTH OF 153 AVENUE
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.06			7 of 10

PLAN DESCRIPTION
NORTH OF 130 AVENUE TO
NORTH OF 153 AVENUE
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.06

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

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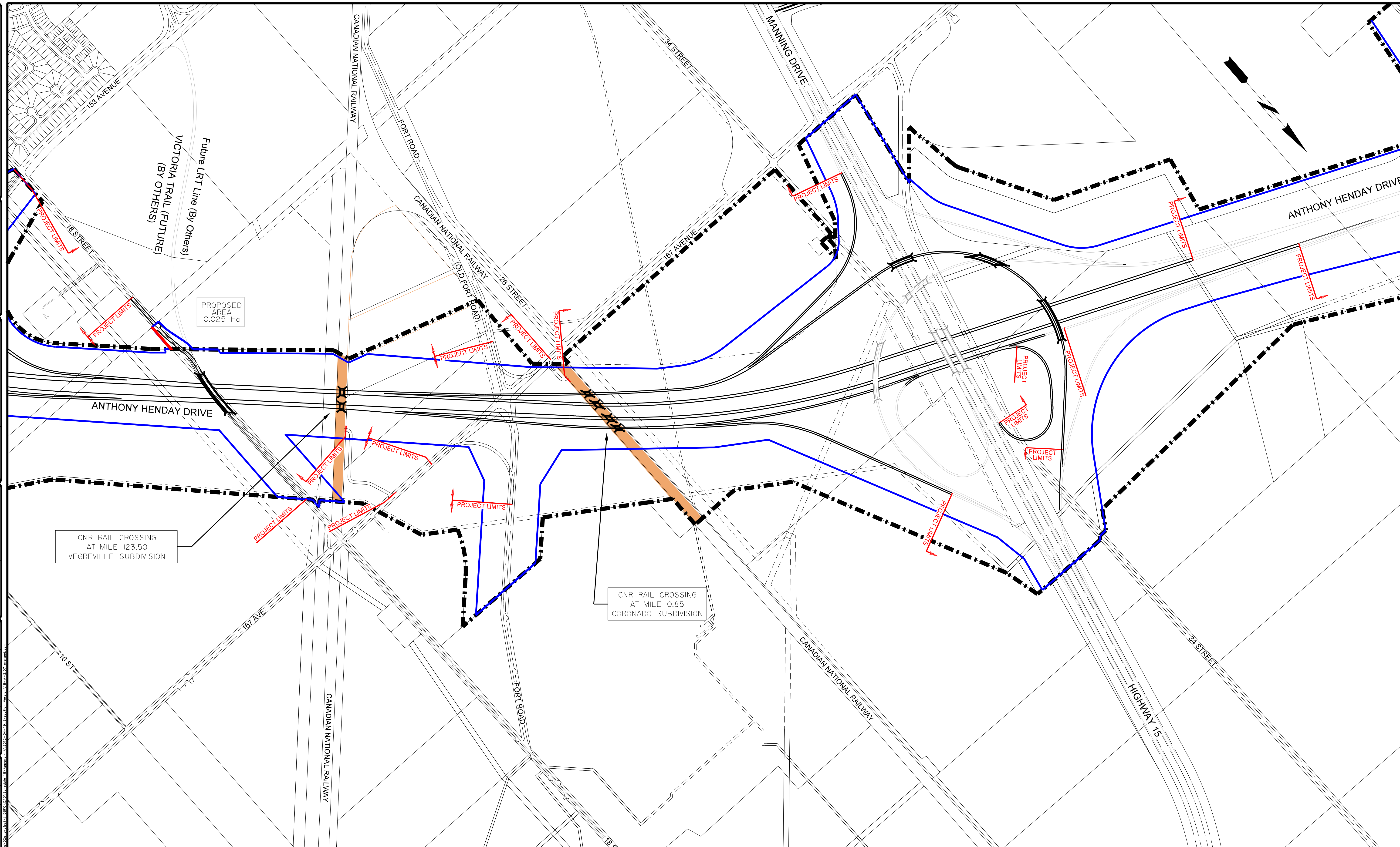

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PROJECT LIMITS

PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
NORTH OF 153 AVENUE TO
WEST OF MANNING DRIVE
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.07	NE ANTHONY HENDAY DRIVE		8 of 10

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
NORTH OF 153 AVENUE TO
WEST OF MANNING DRIVE
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.07

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

DATE | BY

SURVEYED | DESIGNED | CHECKED | DRAWN

DATE | BY

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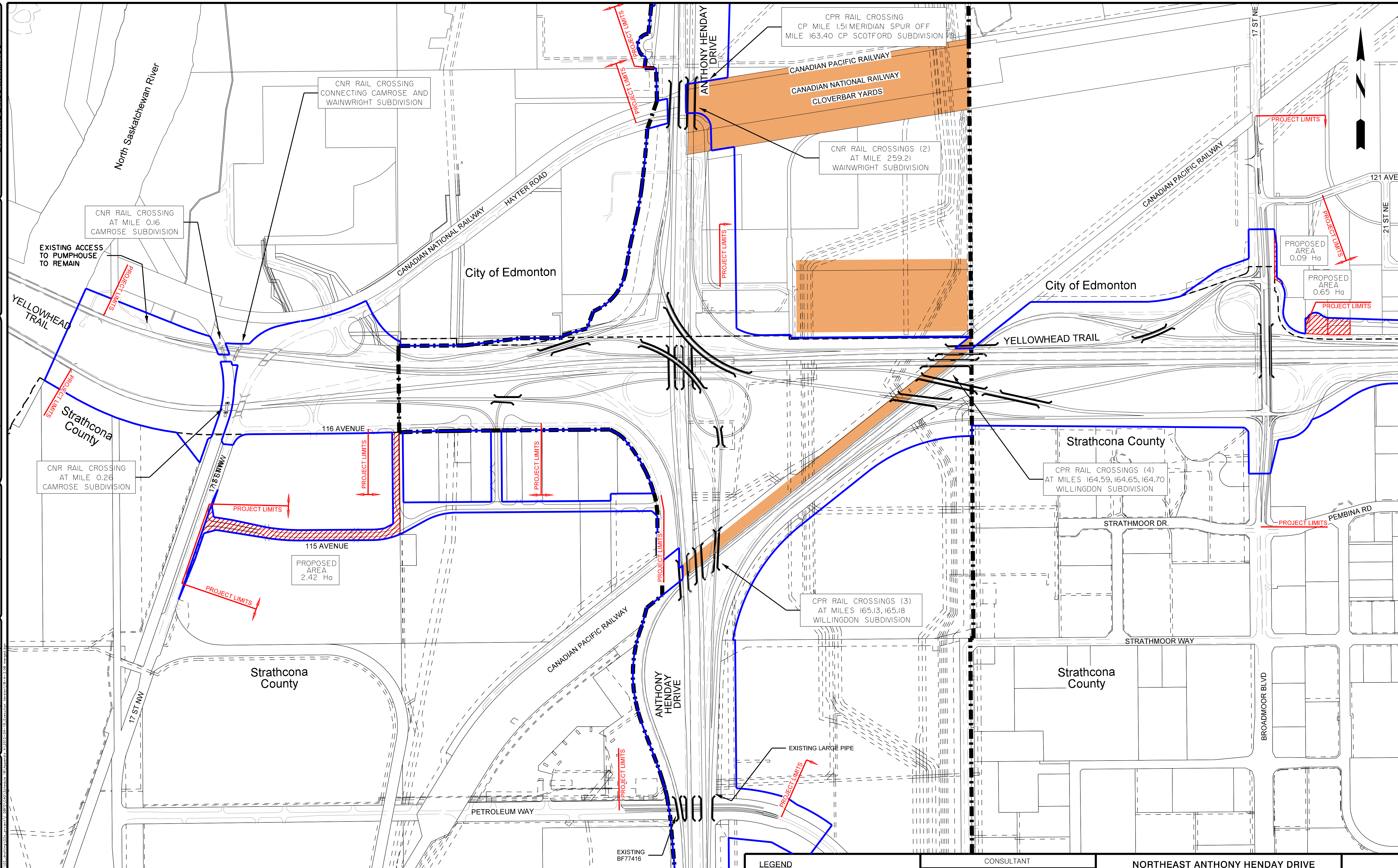
0	EXECUTION VERSION



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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
YELLOWHEAD TRAIL / HIGHWAY 16
NORTH SASKATCHEWAN RIVER TO
BROADMOOR BOULEVARD
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.08	NE ANTHONY HENDAY DRIVE		9 of 10

Government of Alberta ■
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
YELLOWHEAD TRAIL/HIGHWAY 16
NORTH SASKATCHEWAN RIVER TO
BROADMOOR BOULEVARD
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS
& PRIVATE LANDS WITHIN TUC

BAR CODE

18-A-2.08

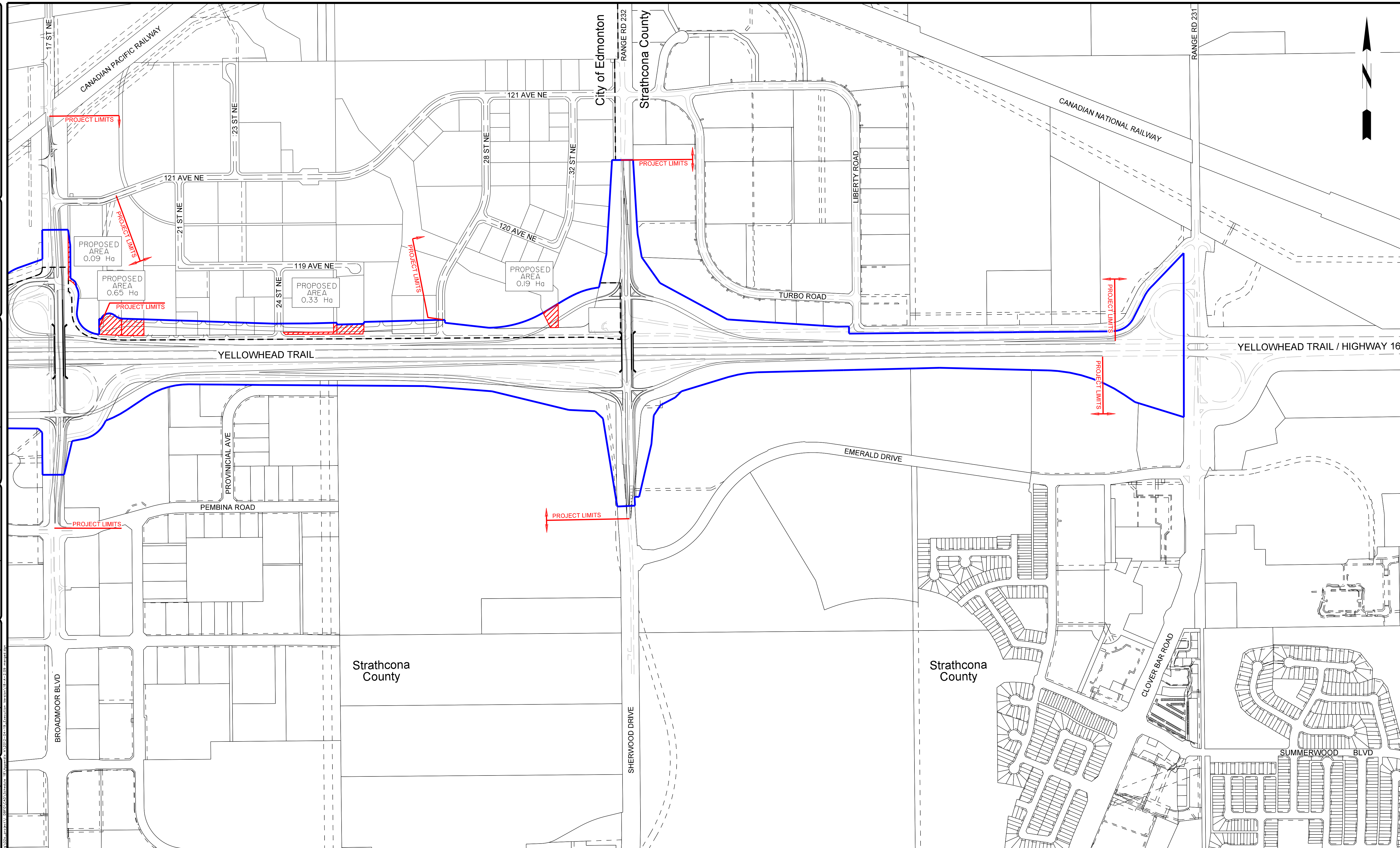
PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY REVISION

No. 0 EXECUTION VERSION



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PROJECT LIMITS PROJECT LIMITS

LEGEND

- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- NEW INFRASTRUCTURE
- TO BE ACQUIRED LANDS
- PRIVATE LANDS WITHIN TUC
- FUTURE ROADS - ULTIMATE STAGE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
YELLOWHEAD TRAIL / HIGHWAY 16
BROADMOOR BOULEVARD TO CLOVER BAR ROAD
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS & PRIVATE LANDS WITHIN TUC

Government of Alberta ■ Transportation

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-2.09	NE ANTHONY HENDAY DRIVE		10 of 10

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
YELLOWHEAD TRAIL / HIGHWAY 16
BROADMOOR BOULEVARD TO CLOVER BAR ROAD
SCHEDULE 18 - APPENDIX A
PROJECT LIMITS, TO BE ACQUIRED LANDS & PRIVATE LANDS WITHIN TUC

BAR CODE

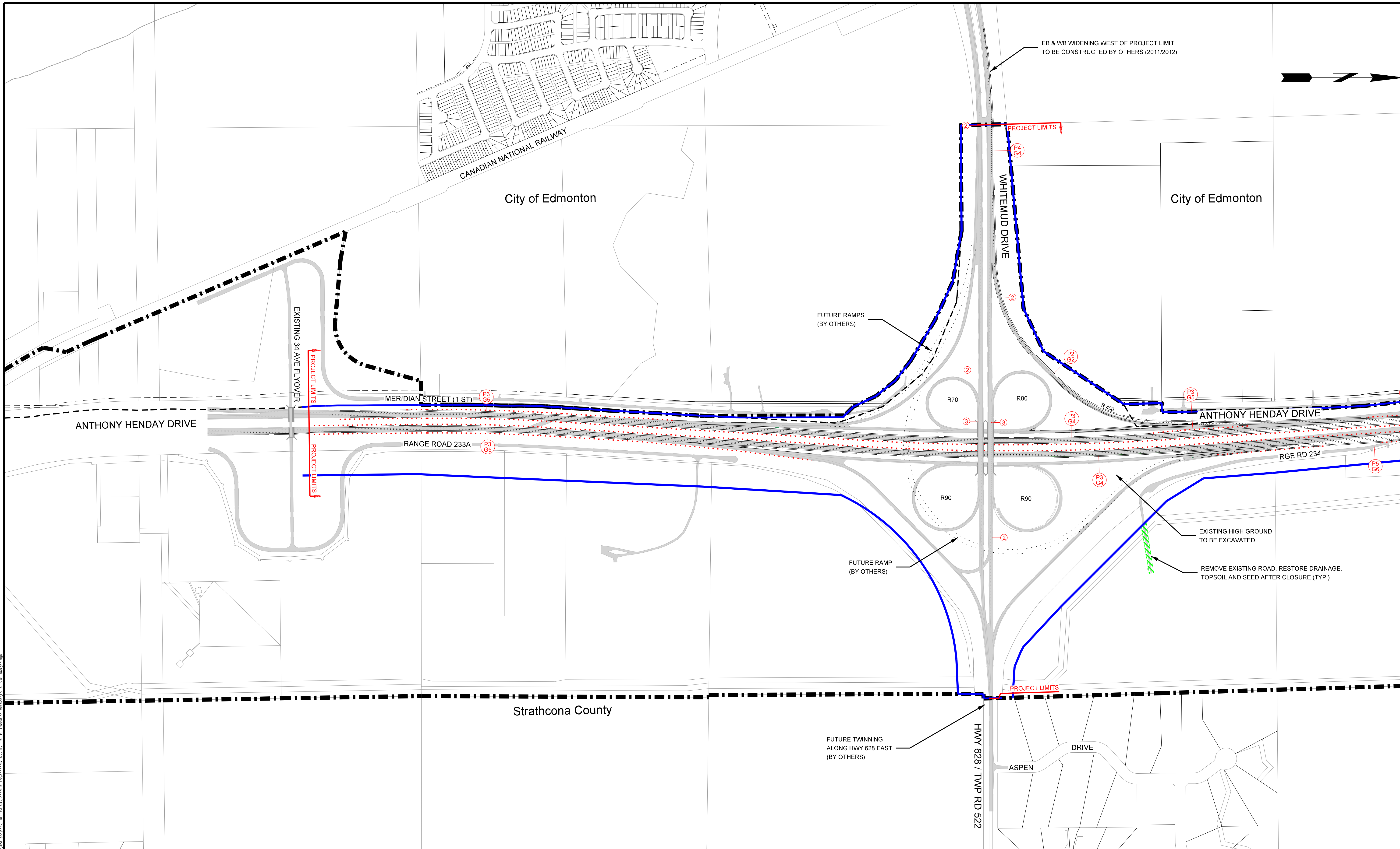
18-A-2.09

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY No. 0 EXECUTION VERSION REVISION



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PROJECT LIMITS
PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
			ROAD RIGHT OF WAY
P3 G4	NUMBER OF PAVED/GRADED LANES		CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE

SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-A-3.01	NE ANTHONY HENDAY DRIVE		1 of 13

PLAN DESCRIPTION
SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.01

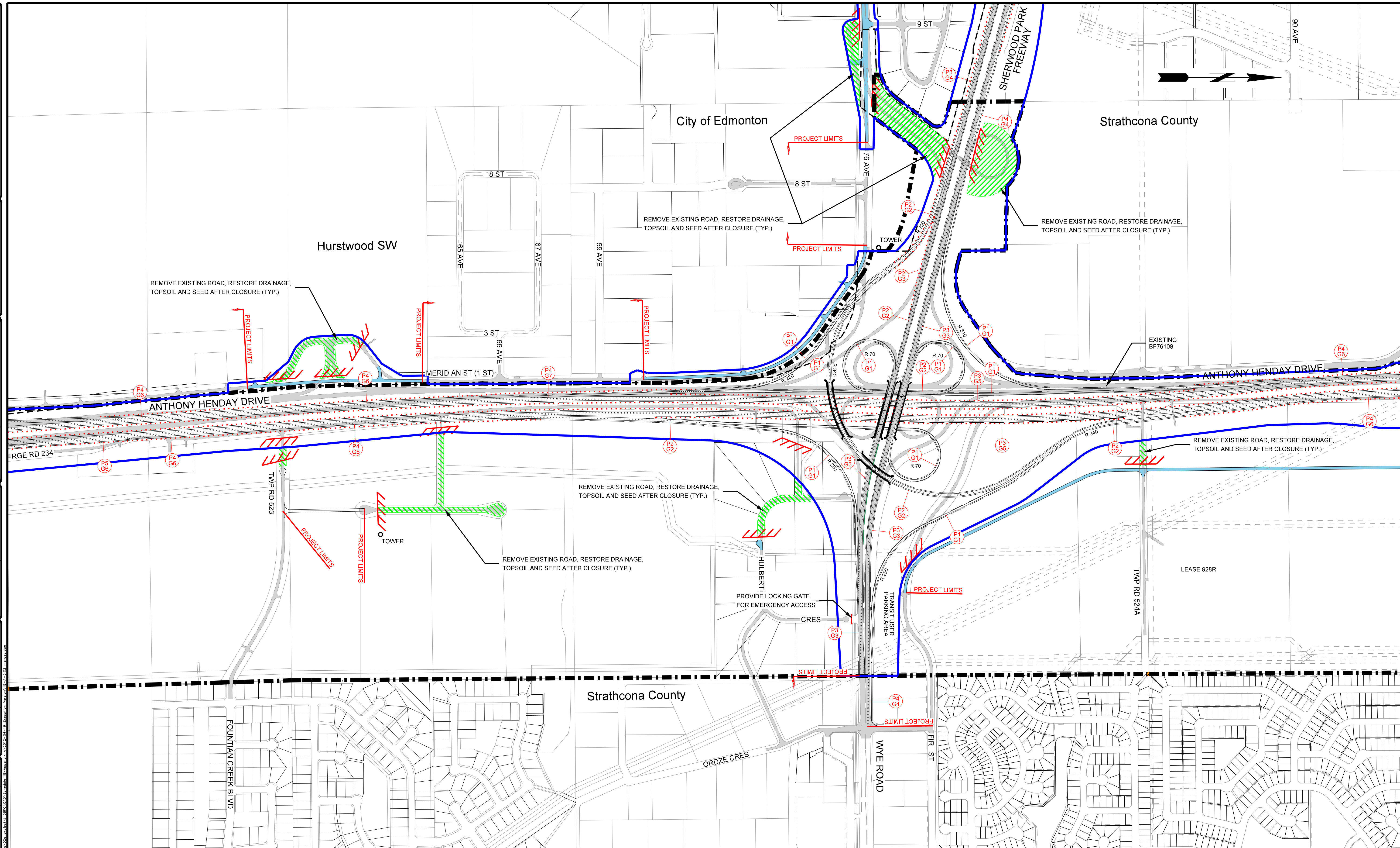
PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY REVISION

No. 0 EXECUTION VERSION



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PROJECT LIMITS PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
			ROAD RIGHT OF WAY
P3 G4	NUMBER OF PAVED/GRADED LANES		CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY

SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.02	NE ANTHONY HENDAY DRIVE		2 of 13

Government of Alberta ■ Transportation

SCALE 1:5000 HORIZONTAL

PLAN DESCRIPTION: NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.02

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

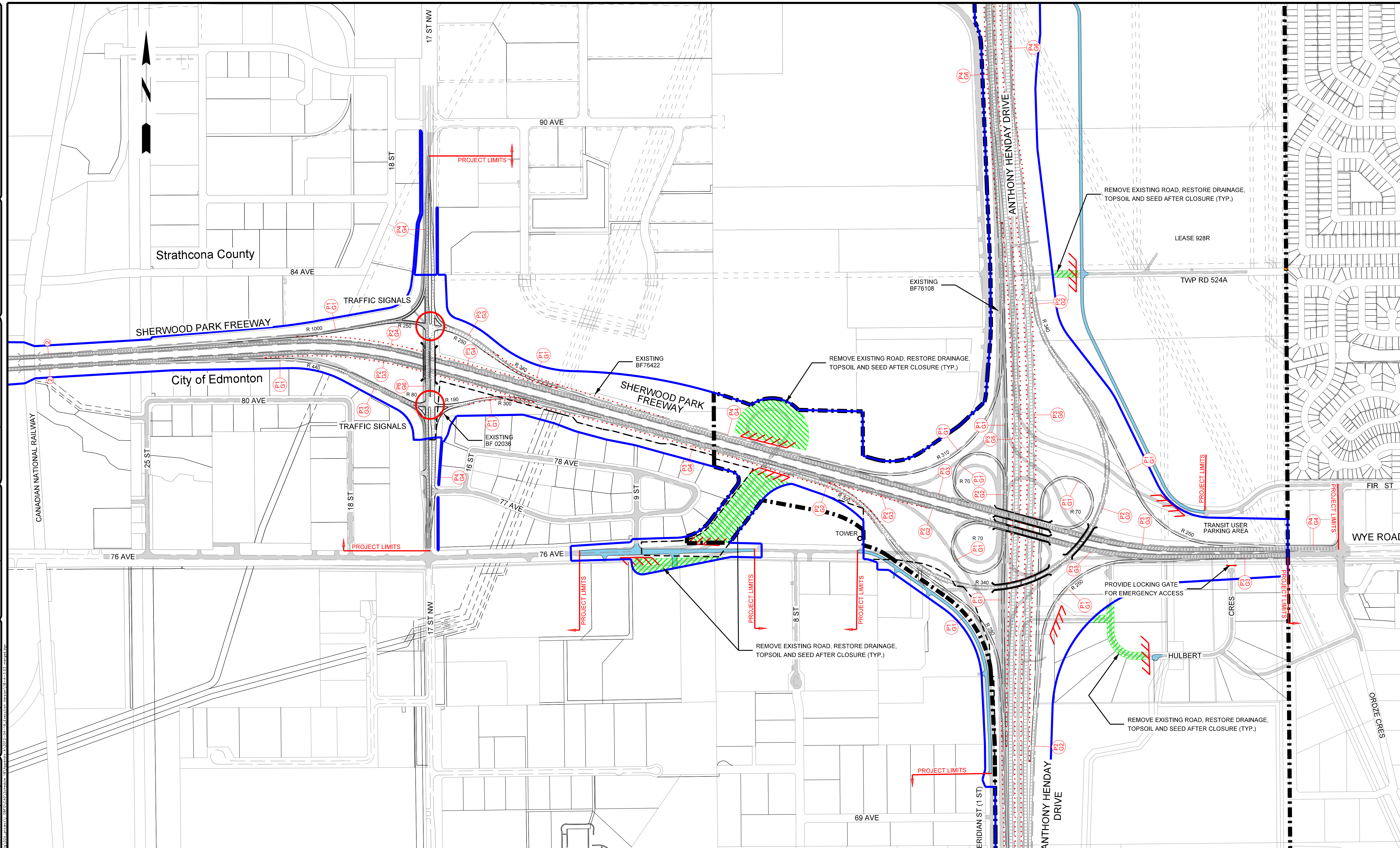
DATE BY

SURVEYED DESIGNED CHECKED DRAWN

DATE BY

No. REVISION

0 EXECUTION VERSION



NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
			ROAD RIGHT OF WAY
P3 G4	NUMBER OF PAVED/GRADED LANES		CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SHERWOOD PARK FREEWAY
WEST OF 17 STREET TO ORDZE CRESCENT
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

Government of Alberta ■ Transportation

SCALE 1:5000 HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-A-3.03	NE ANTHONY HENDAY DRIVE		3 of 13

PLAN DESCRIPTION
SHERWOOD PARK FREEWAY
WEST OF 17 STREET TO ORDZE CRESCENT
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.03

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY

SURVEYED DESIGNED CHECKED DRAWN

DATE BY

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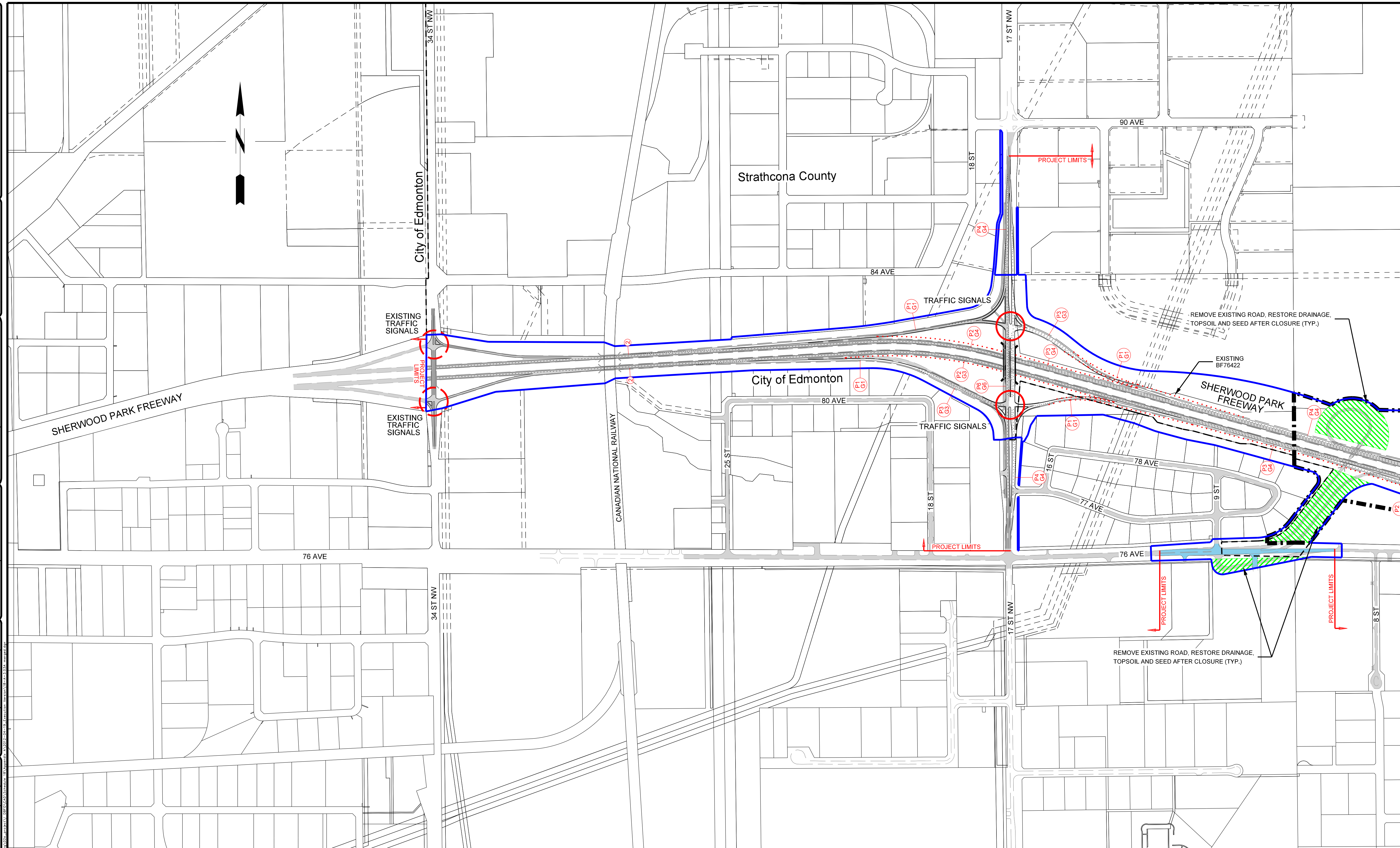

NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
			ROAD RIGHT OF WAY
P3 G4	NUMBER OF PAVED/GRADED LANES		CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SHERWOOD PARK FREEWAY
34 STREET TO 17 STREET
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-A-3.03A	NE ANTHONY HENDAY DRIVE		4 of 13

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
SHERWOOD PARK FREEWAY
34 STREET TO 17 STREET
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.03A

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN DATE BY

No. EXECUTION VERSION REVISION
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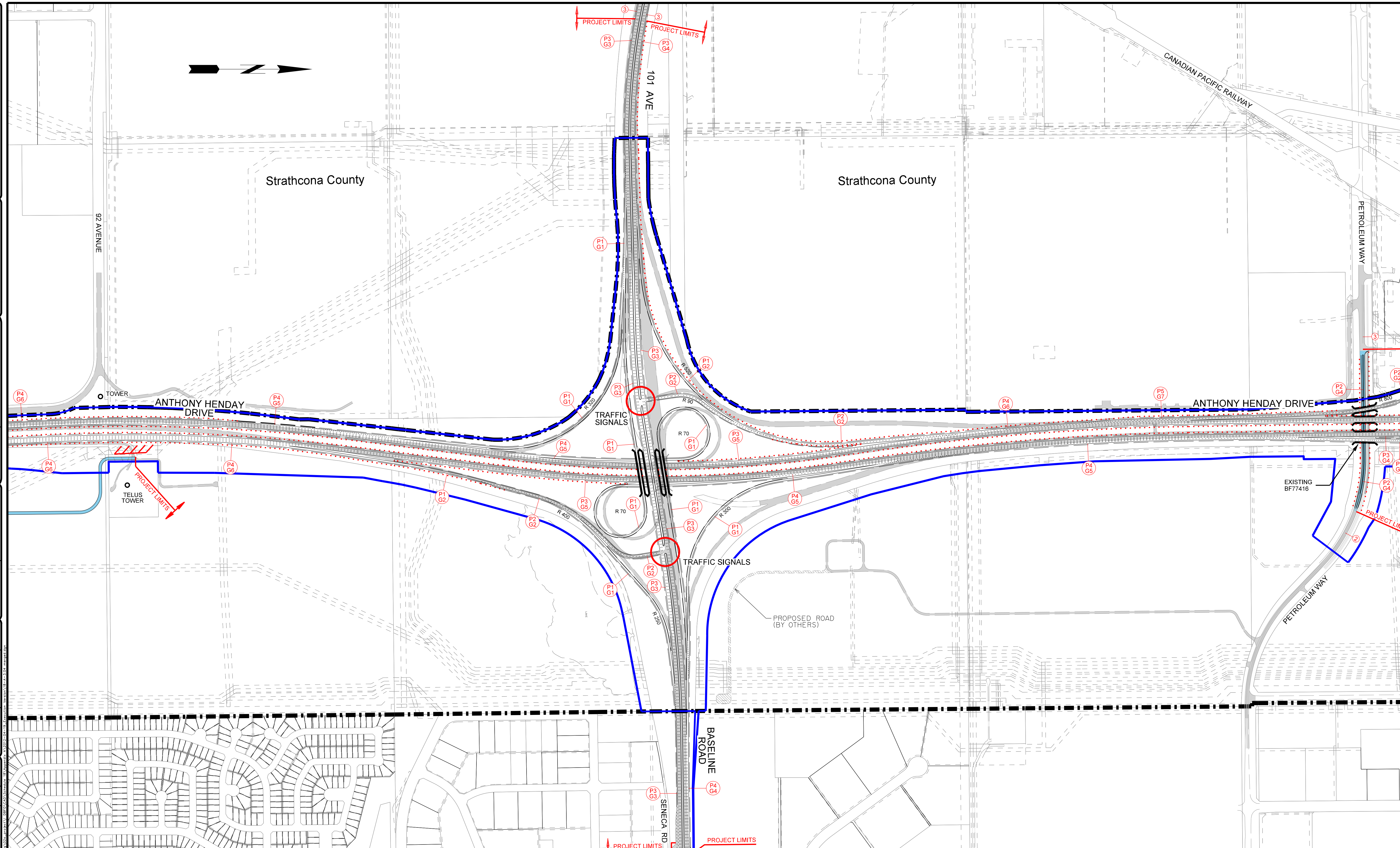


NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
			ROAD RIGHT OF WAY
P3 G4	NUMBER OF PAVED/GRADED LANES		CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY

SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.04	NE ANTHONY HENDAY DRIVE		5 of 13

Government of Alberta ■ Transportation

SCALE 1:5000 HORIZONTAL

PLAN DESCRIPTION: NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.04

PLAN No. CONTRACT No. SITE No.

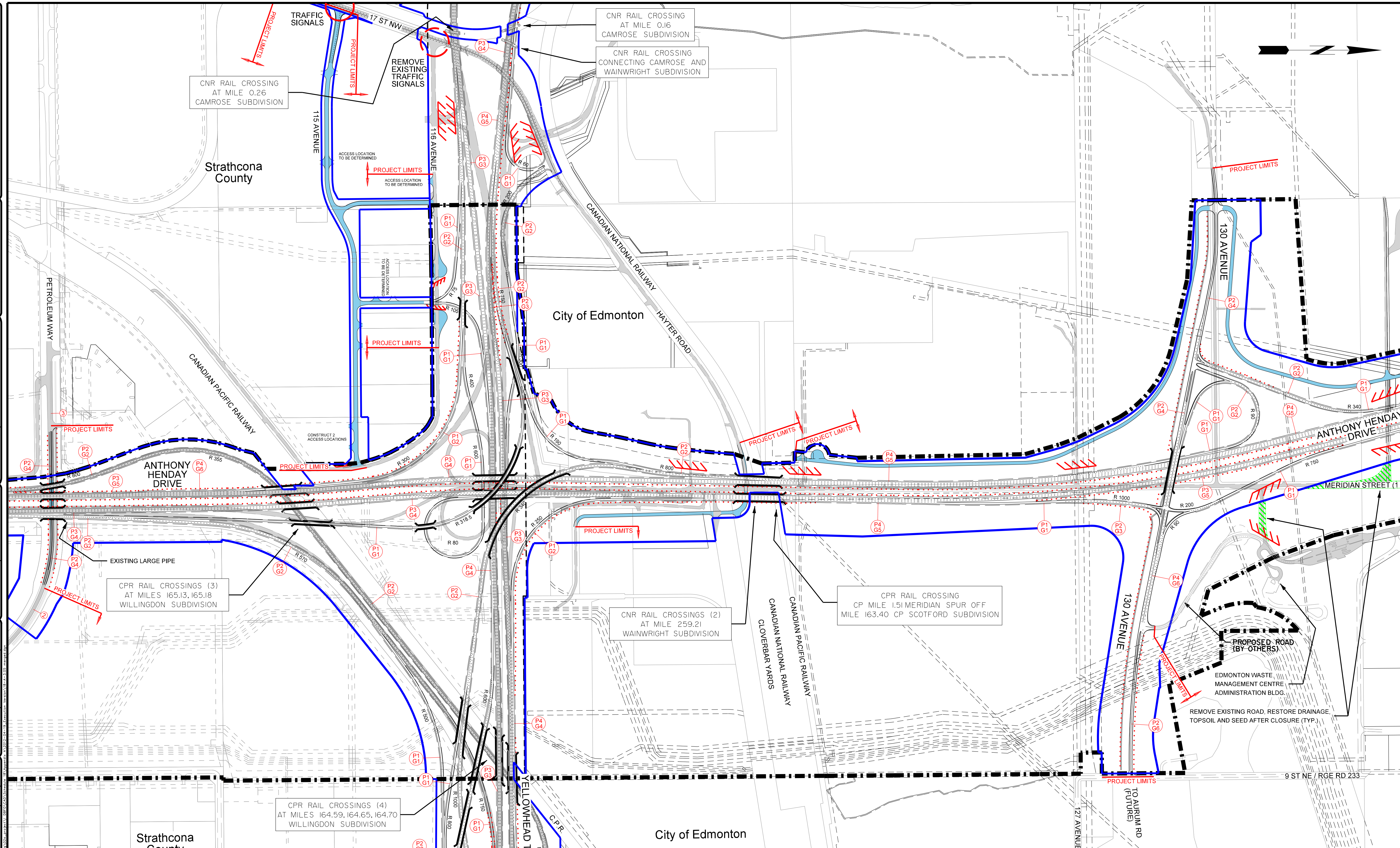
PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY

No. REVISION

0 EXECUTION VERSION



NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

- ROAD CLOSURE
- P3 G4 — NUMBER OF PAVED/GRADED LANES
- FUTURE GRADING (NOT IN CONT.)
- EXISTING ROADWAY
- EXISTING BRIDGES
- TUC BOUNDARY
- ROAD RIGHT OF WAY
- CITY OF EDMONTON BOUNDARY
- PAVING
- GRADING FOR ULTIMATE STAGE
- SERVICE ROAD
- STAGE 1 BRIDGES

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

PETROLEUM WAY TO NORTH OF 130 AVENUE

SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.05	NE ANTHONY HENDAY DRIVE		6 of 13

Government of Alberta Transportation

SCALE 1:5000 HORIZONTAL

PLAN DESCRIPTION: PETROLEUM WAY TO NORTH OF 130 AVENUE SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.05

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN DATE BY

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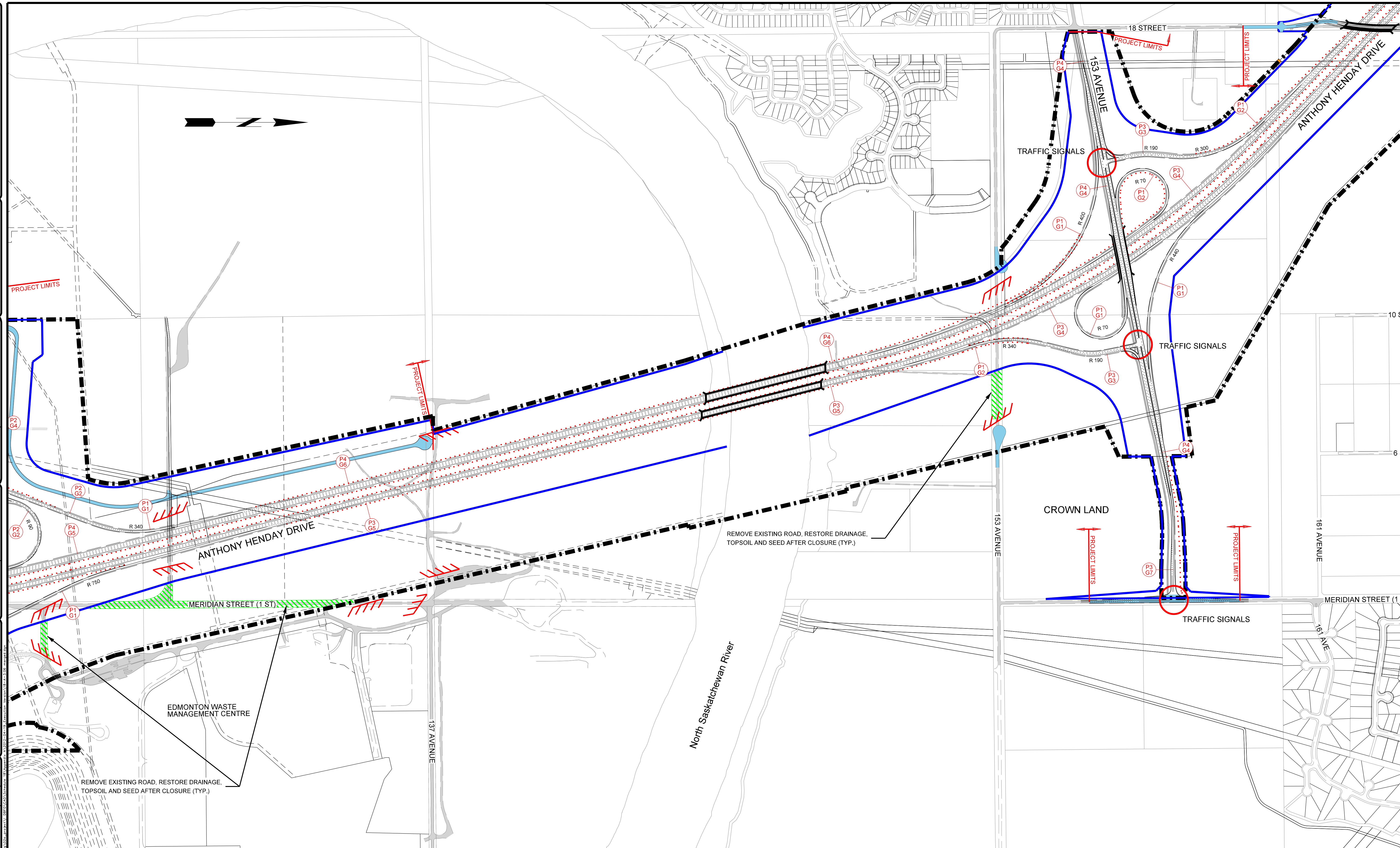


NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
P3 G4	NUMBER OF PAVED/GRADED LANES		ROAD RIGHT OF WAY
			CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

Government of Alberta ■ Transportation

SCALE 1:5000 HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.06	NE ANTHONY HENDAY DRIVE		7 of 13

PLAN DESCRIPTION
NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.06

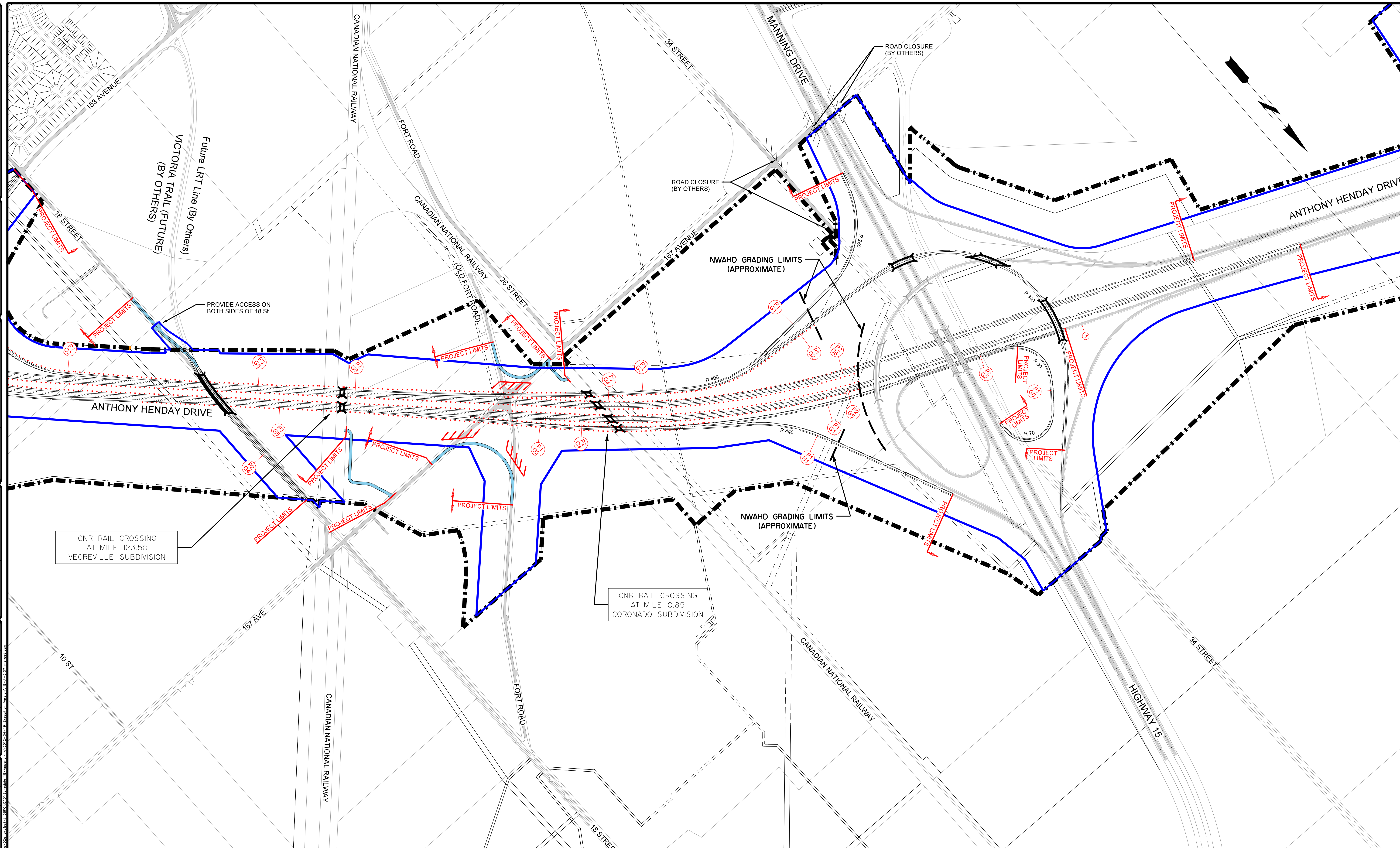
PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY DATE BY

SURVEYED DESIGNED CHECKED DRAWN

REVISION No. 0 EXECUTION VERSION



NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
P3 G4	NUMBER OF PAVED/GRADED LANES		ROAD RIGHT OF WAY
			CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 | PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE

SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.07	NE ANTHONY HENDAY DRIVE		8 of 13

Government of Alberta ■ Transportation

SCALE 1:5000 HORIZONTAL

PLAN DESCRIPTION

NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.07

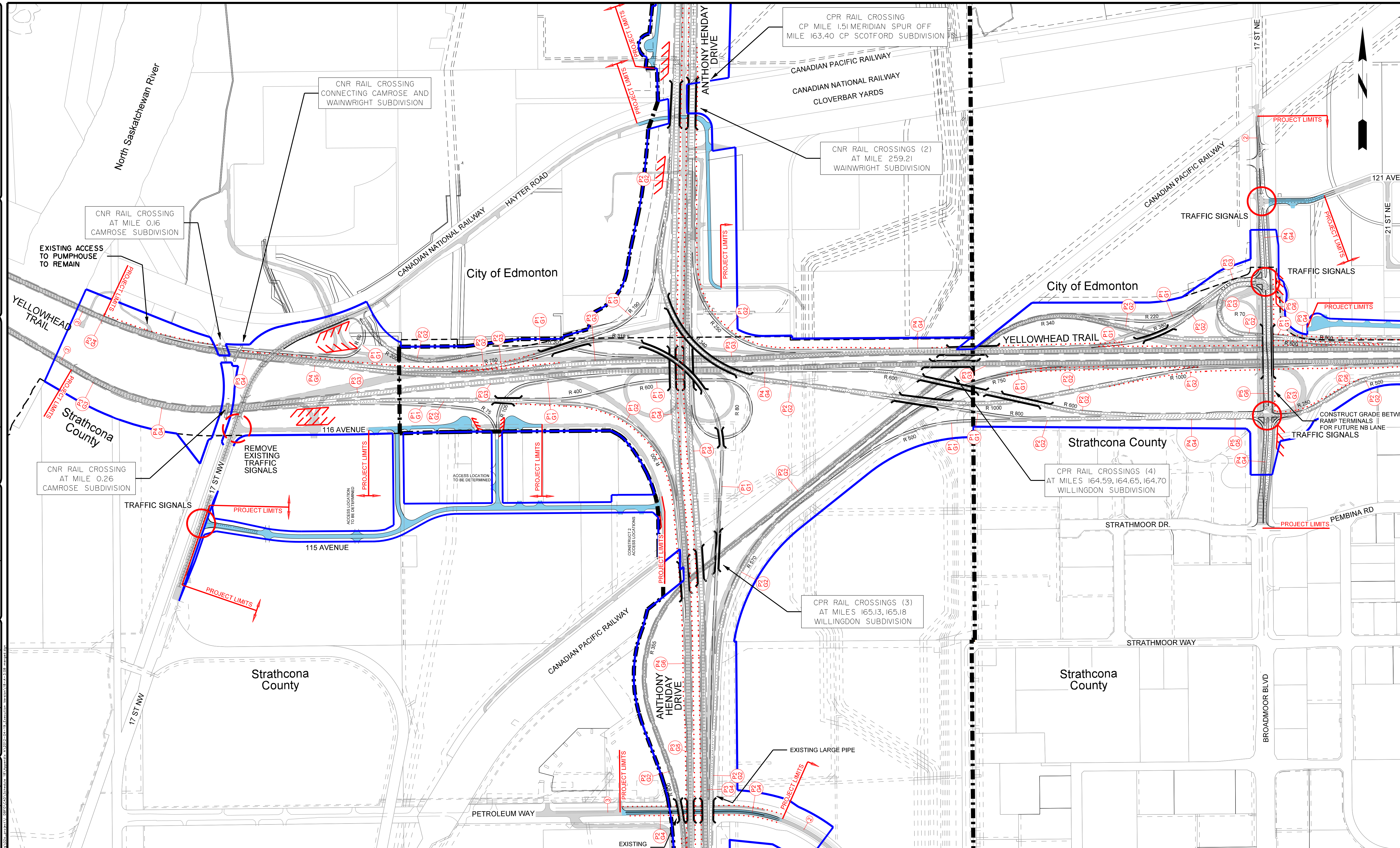
PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY REVISION

No. 0 EXECUTION VERSION



NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS   PROJECT LIMITS

LEGEND

ROAD CLOSURE	TUC BOUNDARY
	ROAD RIGHT OF WAY
NUMBER OF PAVED/GRADED LANES	CITY OF EDMONTON BOUNDARY
	PAVING
FUTURE GRADING (NOT IN CONT.)	GRADING FOR ULTIMATE STAGE
EXISTING ROADWAY	SERVICE ROAD
EXISTING BRIDGES	STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010   PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
YELLOWHEAD TRAIL / HIGHWAY 16
NORTH SASKATCHEWAN RIVER TO
BROADMOOR BOULEVARD
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

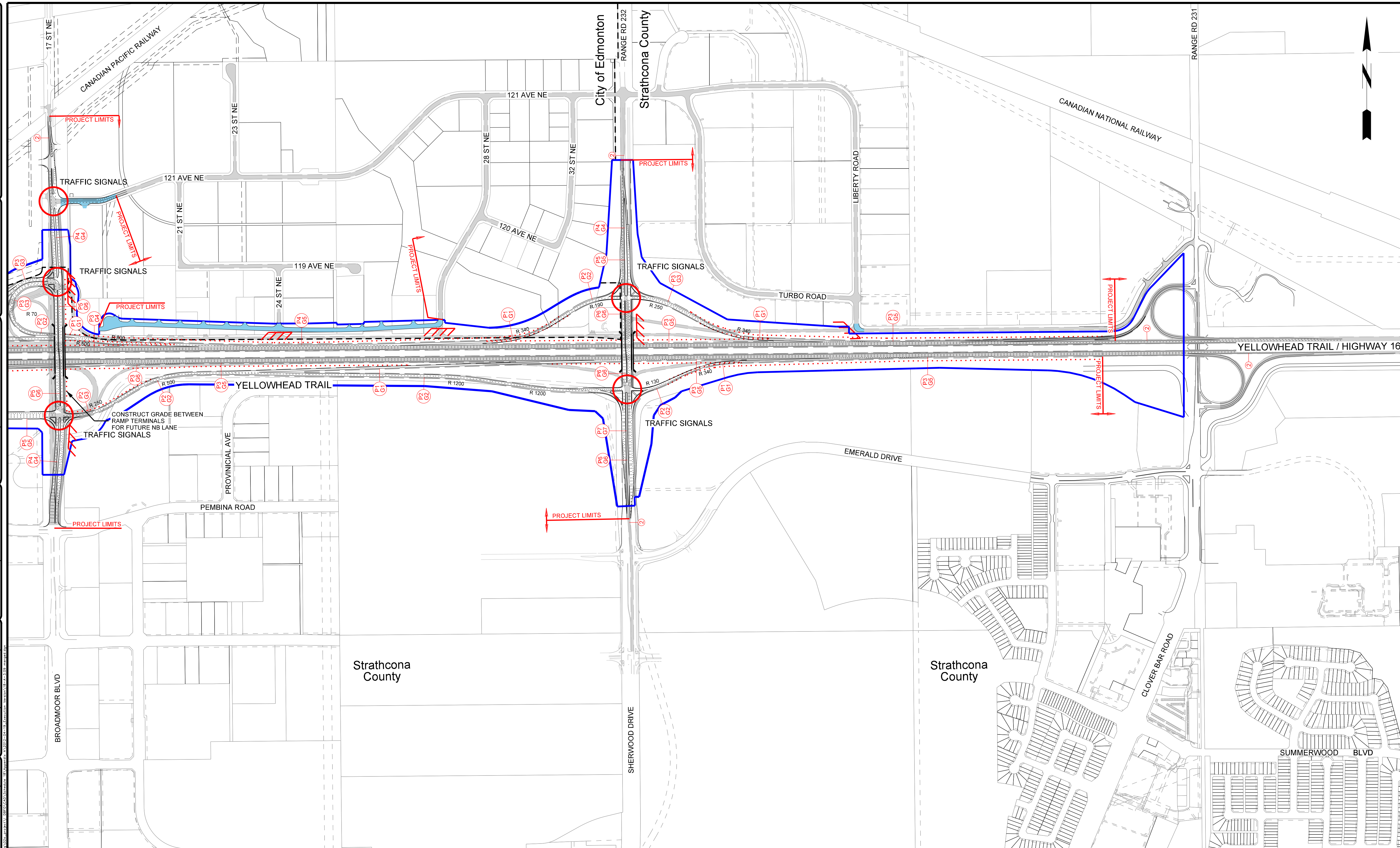
Government of Alberta
Transportation

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.08	NE ANTHONY HENDAY DRIVE		9 of 13

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
YELLOWHEAD TRAIL/HIGHWAY 16
NORTH SASKATCHEWAN RIVER TO
BROADMOOR BOULEVARD
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

18-A-3.08



NOTE: ACTUAL PROJECT LIMITS MAY VARY IN THE DIRECTION INDICATED BY ARROWS SHOWN ON PROJECT LIMIT LABELS.

PROJECT LIMITS PROJECT LIMITS

LEGEND

	ROAD CLOSURE		TUC BOUNDARY
	ROAD RIGHT OF WAY		
P3 G4	NUMBER OF PAVED/GRADED LANES		CITY OF EDMONTON BOUNDARY
			PAVING
	FUTURE GRADING (NOT IN CONT.)		GRADING FOR ULTIMATE STAGE
	EXISTING ROADWAY		SERVICE ROAD
	EXISTING BRIDGES		STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
YELLOWHEAD TRAIL / HIGHWAY 16
BROADMOOR BOULEVARD TO CLOVER BAR ROAD
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.09	NE ANTHONY HENDAY DRIVE		10 of 13

Government of Alberta ■ Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
YELLOWHEAD TRAIL / HIGHWAY 16
BROADMOOR BOULEVARD TO CLOVER BAR ROAD
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.09

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN DATE BY

No. REVISION
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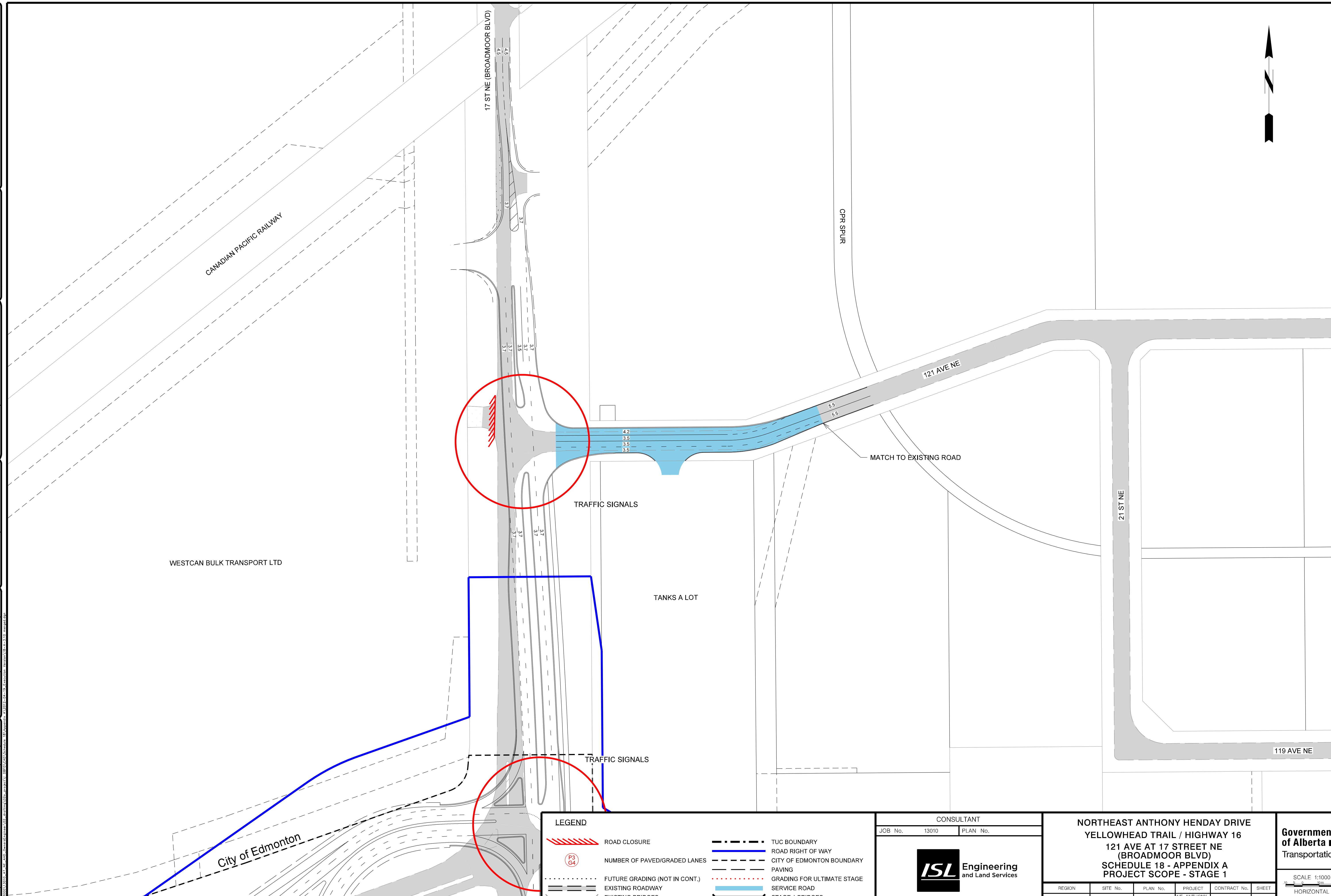


LEGEND

ROAD CLOSURE	TUC BOUNDARY
NUMBER OF PAVED/GRADED LANES	ROAD RIGHT OF WAY
	CITY OF EDMONTON BOUNDARY
	PAVING
FUTURE GRADING (NOT IN CONT.)	GRADING FOR ULTIMATE STAGE
EXISTING ROADWAY	SERVICE ROAD
EXISTING BRIDGES	STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
YELLOWHEAD TRAIL / HIGHWAY 16
121 AVE AT 17 STREET NE
(BROADMOOR BLVD)
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-3.10	NE ANTHONY HENDAY DRIVE		11 of 13

Government of Alberta
Transportation

SCALE 1:1000
HORIZONTAL

PLAN DESCRIPTION
YELLOWHEAD TRAIL/HIGHWAY 16
121 AVE AT 17 STREET NE
(BROADMOOR BLVD0
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.10

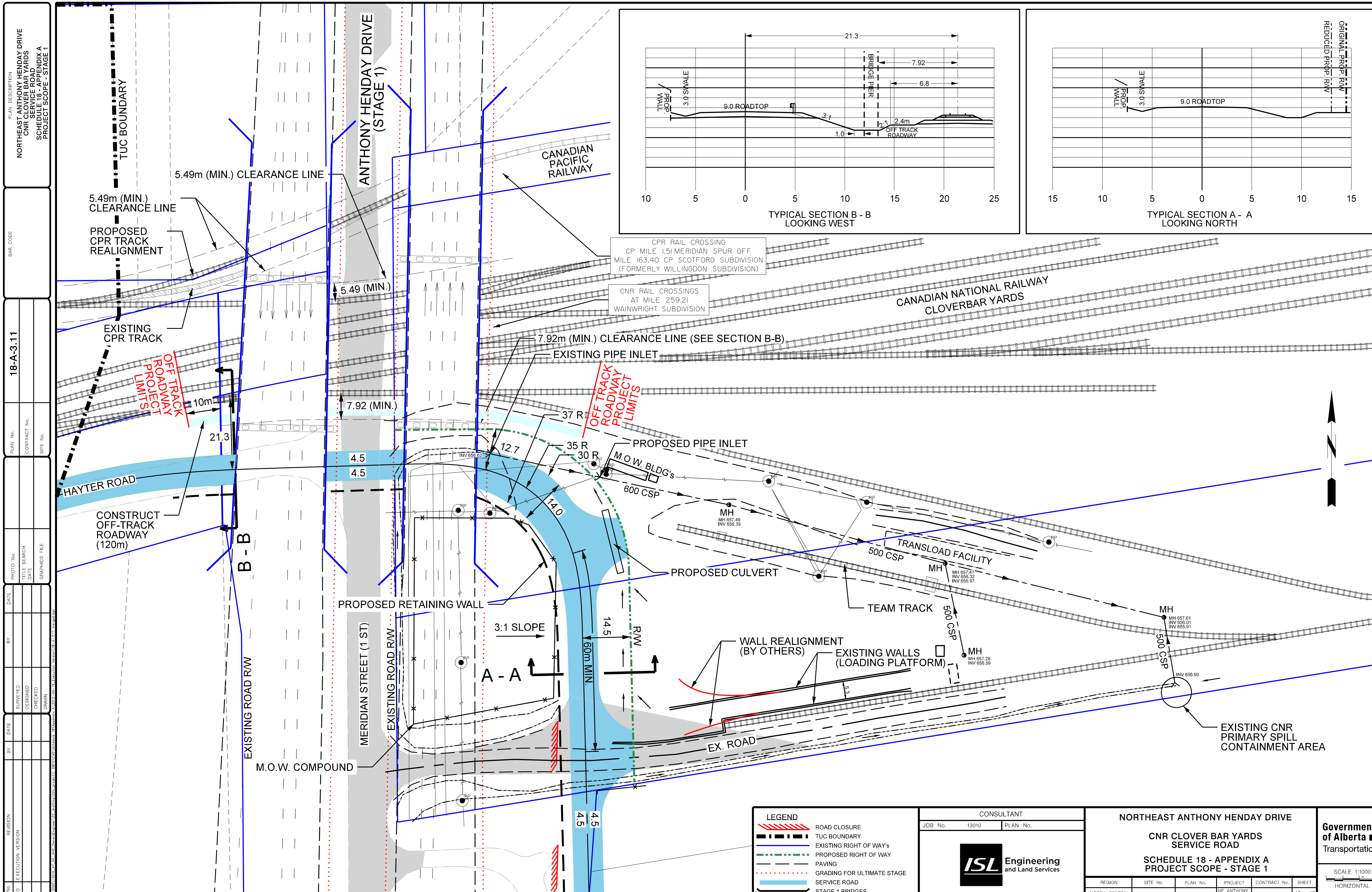
PLAN No. CONTRACT No. SITE No.

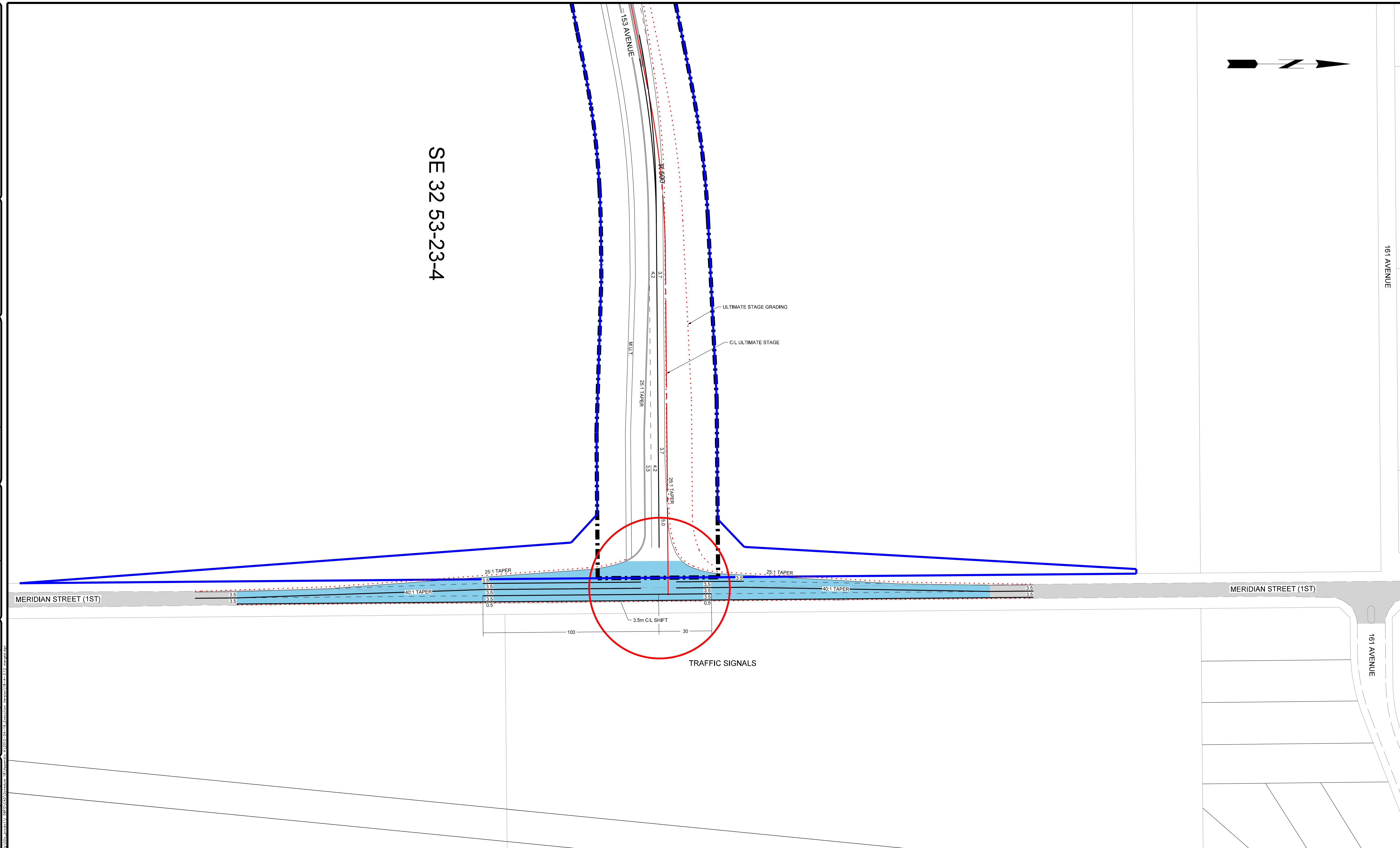
PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY REVISION

No. 0 EXECUTION VERSION


PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE
CNR CLOVER BAR YARDS
SERVICE ROAD
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1
BAR CODE
18-A-3.11
PLAN No.
CONTRACT No.
SITE No.
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE
DATE
BY
SURVEYED
DESIGNED
CHECKED
DRAWN
REVISION
EXECUTION VERSION
No.
0
TUC BOUNDARY
ANTHONY HENDAY DRIVE
(STAGE 1)
5.49m (MIN.) CLEARANCE LINE
5.49m (MIN.)
CLEARANCE LINE
PROPOSED
CPR TRACK
REALIGNMENT
EXISTING
CPR TRACK
CANADIAN
PACIFIC
RAILWAY
CPR RAIL CROSSING
CP MILE 1.51 MERIDIAN SPUR OFF
MILE 163.40 CP SCOTFORD SUBDIVISION
(FORMERLY WILLINGDON SUBDIVISION)
CNR RAIL CROSSINGS
AT MILE 259.21
WAINWRIGHT SUBDIVISION
CANADIAN NATIONAL RAILWAY
CLOVERBAR YARDS
5.49 (MIN.)
7.92m (MIN.) CLEARANCE LINE (SEE SECTION B-B)
EXISTING PIPE INLET
OFF TRACK
ROADWAY
PROJECT
LIMITS
10m
21.3
7.92 (MIN.)
37 R
35 R
30 R
12.7
PROPOSED PIPE INLET
M.O.W. BLDG's
600 CSP
4.5
4.5
HAYTER ROAD
CONSTRUCT
OFF-TRACK
ROADWAY
(120m)
B - B
14.0
MH
MH 657.49
INV 656.39
TRANSLOAD FACILITY
500 CSP
MH
MH 657.47
INV 656.32
INV 655.97
PROPOSED CULVERT
TEAM TRACK
PROPOSED RETAINING WALL
3:1 SLOPE
14.5
R/W
MH
MH 657.61
INV 656.01
INV 655.91
500 CSP
500 CSP
MH
MH 657.28
INV 656.59
INV 656.50
WALL REALIGNMENT
(BY OTHERS)
EXISTING WALLS
(LOADING PLATFORM)
A - A
60m MIN.
EXISTING ROAD R/W
MERIDIAN STREET (1 ST)
EXISTING ROAD R/W
M.O.W. COMPOUND
EX. ROAD
EXISTING CNR
PRIMARY SPILL
CONTAINMENT AREA
4.5
4.5
21.3
7.92
6.8
3.0 SWALE
PROP. WALL
9.0 ROADTOP
BRIDGE PIER
3:1
2:1
2.4m
OFF TRACK ROADWAY
1.0
10 5 0 5 10 15 20 25
TYPICAL SECTION B - B
LOOKING WEST
REDUCED PROP. R/W
ORIGINAL PROP. R/W
PROP. WALL
3.0 SWALE
9.0 ROADTOP
15 10 5 0 5 10 15
TYPICAL SECTION A - A
LOOKING NORTH
N
LEGEND
ROAD CLOSURE
TUC BOUNDARY
EXISTING RIGHT OF WAY's
PROPOSED RIGHT OF WAY
PAVING
GRADING FOR ULTIMATE STAGE
SERVICE ROAD
STAGE 1 BRIDGES
CONSULTANT
JOB No.
13010
PLAN No.
ISL Engineering
and Land Services
NORTHEAST ANTHONY HENDAY DRIVE
CNR CLOVER BAR YARDS
SERVICE ROAD
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1
Government
of Alberta
Transportation
SCALE 1:1000
HORIZONTAL
REGION
NORTH CENTRAL
SITE No.
PLAN No.
18-A-3.11
PROJECT
NE ANTHONY HENDAY DRIVE
CONTRACT No.
SHEET
12 of 13



LEGEND

ROAD CLOSURE	TUC BOUNDARY
NUMBER OF PAVED/GRADED LANES	ROAD RIGHT OF WAY
	CITY OF EDMONTON BOUNDARY
	PAVING
FUTURE GRADING (NOT IN CONT.)	GRADING FOR ULTIMATE STAGE
EXISTING ROADWAY	SERVICE ROAD
EXISTING BRIDGES	STAGE 1 BRIDGES

CONSULTANT

JOB No. 13010 | PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
153 AVENUE
INTERSECTION AT MERIDIAN STREET (1ST)
SCHEDULE 18 - APPENDIX A PROJECT SCOPE - STAGE 1

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18–A–3.12	NE ANTHONY HENDAY DRIVE		13 of 13

Government of Alberta Transportation

SCALE 1:1000
HORIZONTAL

PLAN DESCRIPTION
153 AVENUE
INTERSECTION AT MERIDIAN STREET (1ST)
SCHEDULE 18 - APPENDIX A
PROJECT SCOPE - STAGE 1

BAR CODE

18-A-3.12

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

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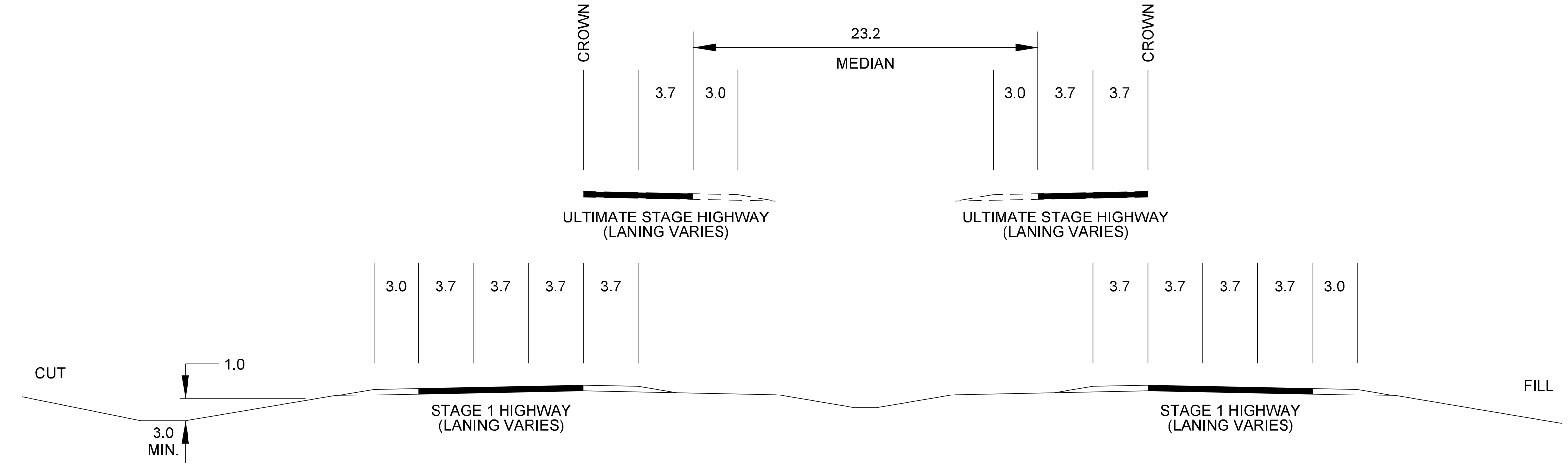
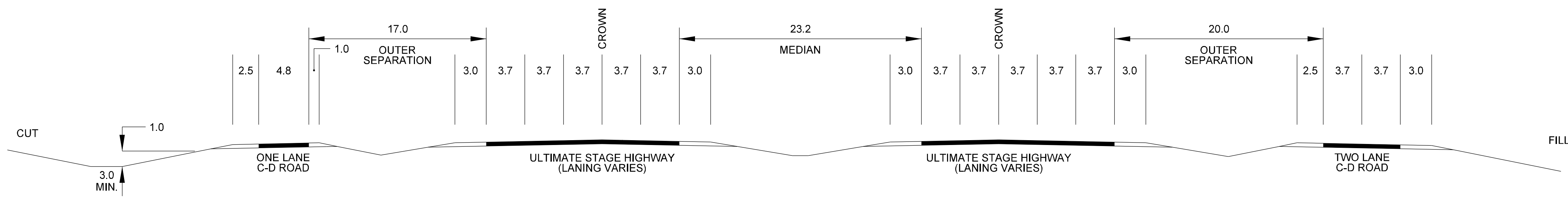
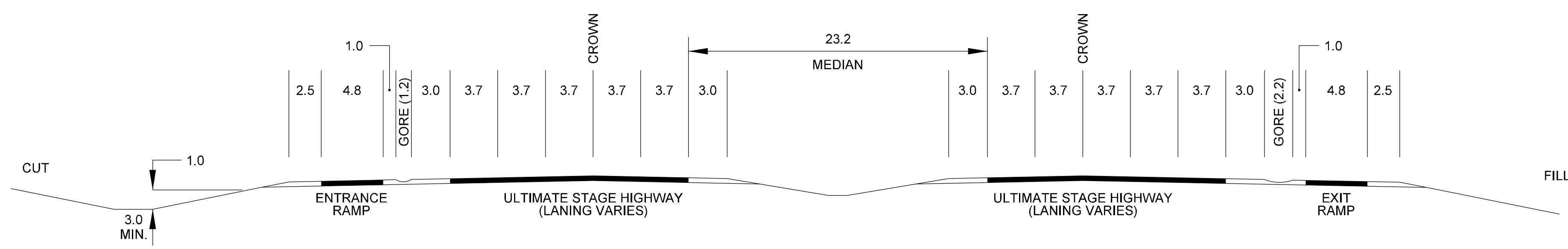
No. 0 | EXECUTION VERSION



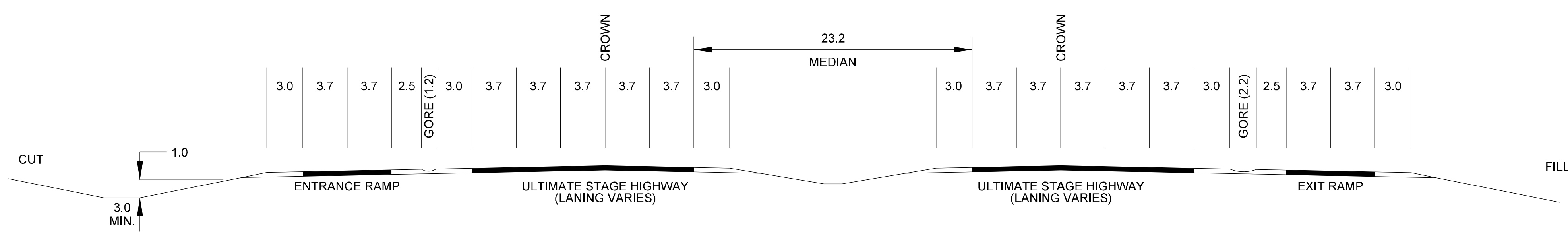
MAINLINE - 10 LANE ULTIMATE STAGE



MAINLINE WITH C-D ROAD



MAINLINE WITH SINGLE LANE RAMPS AT GORE LOCATIONS



MAINLINE WITH TWO LANE RAMPS AT GORE LOCATIONS

NOTE:
REFER TO SECTION 200.2.2 OF SCHEDULE 18
FOR SIDESLOPE AND BACKSLOPE REQUIREMENTS

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-4.01	NE ANTHONY HENDAY DRIVE		1 of 4

Government of Alberta
Transportation

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

BAR CODE

18-A-4.01

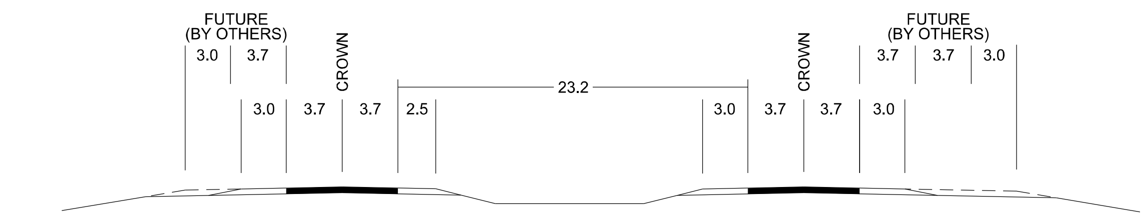
PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY REVISION

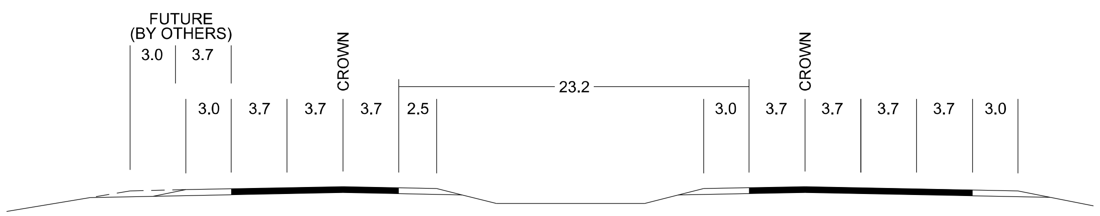
No. 0 EXECUTION VERSION



[DESIGN SPEED = 110 km/h]

SHERWOOD PARK FREEWAY - STAGE 1 & ULTIMATE STAGE

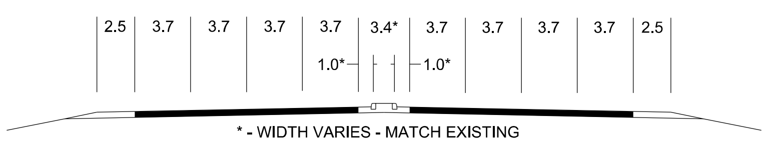
WEST OF EAST SIDE OF 17 STREET NW - LOOKING WEST



[DESIGN SPEED = 90 km/h]

SHERWOOD PARK FREEWAY - STAGE 1 & ULTIMATE STAGE

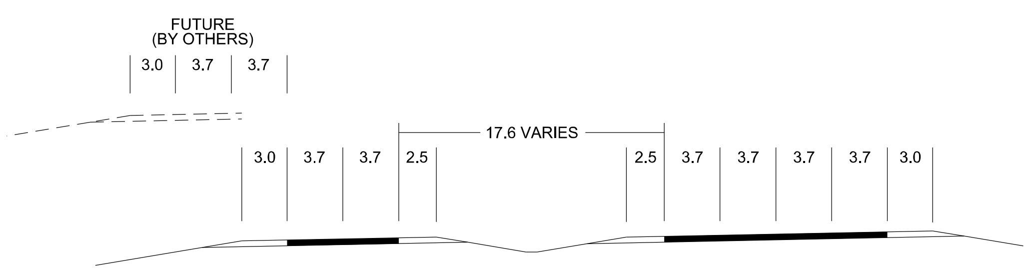
EAST OF EAST SIDE OF 17 STREET NW - LOOKING WEST



[DESIGN SPEED = 80 km/h]

SHERWOOD PARK FREEWAY - STAGE 1 & ULTIMATE STAGE

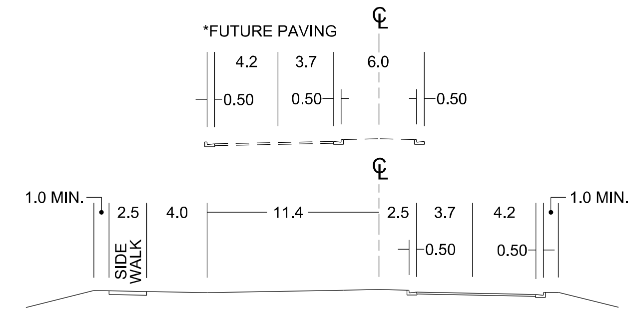
NEAR EAST TUC BOUNDARY - LOOKING WEST



[DESIGN SPEED = 90 km/h]

WHITEMUD DRIVE - STAGE 1 w/ULTIMATE STAGE

NEAR WEST TUC BOUNDARY - LOOKING WEST

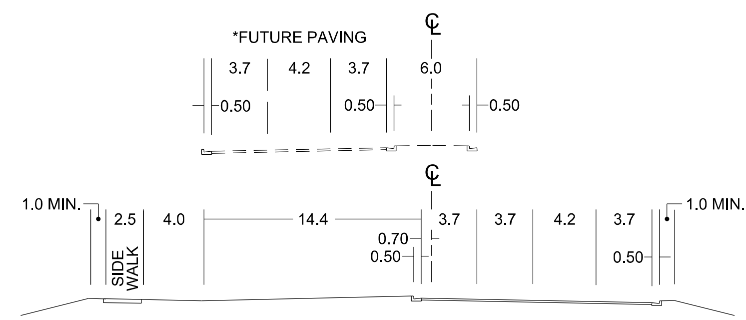


[DESIGN SPEED = 70 km/h]

130 AVENUE - STAGE 1 w/FUTURE STAGE

WEST OF INTERCHANGE - LOOKING WEST

*REFER TO SCHEDULE 18 SECTION 200.2.3.6.5 130 AVENUE INTERCHANGE

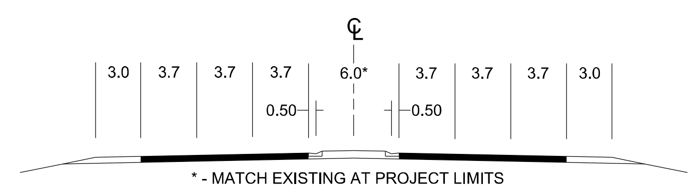


[DESIGN SPEED = 70 km/h]

130 AVENUE - STAGE 1 w/FUTURE STAGE

EAST OF INTERCHANGE - LOOKING WEST

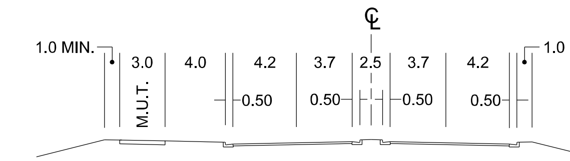
*REFER TO SCHEDULE 18 SECTION 200.2.3.6.5 130 AVENUE INTERCHANGE



[DESIGN SPEED = 80 km/h]

BASELINE ROAD - STAGE 1 & ULTIMATE STAGE

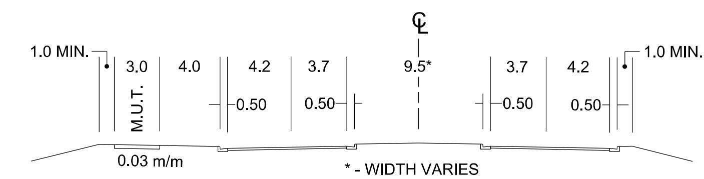
EAST & WEST OF INTERCHANGE - LOOKING WEST



[DESIGN SPEED = 70 km/h]

153 AVENUE - STAGE 1 & ULTIMATE STAGE

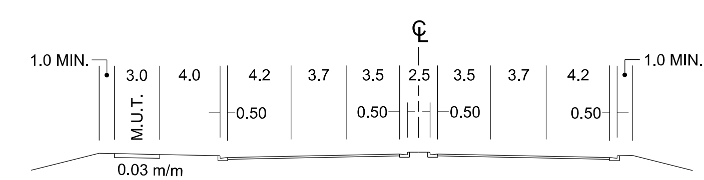
EAST & WEST OF INTERCHANGE - LOOKING WEST



[DESIGN SPEED = 70 km/h]

17 STREET NW - STAGE 1 & ULTIMATE STAGE

NORTH & SOUTH OF INTERCHANGE AT
SHERWOOD PARK FREEWAY - LOOKING NORTH



[DESIGN SPEED = 70 km/h]

17 STREET NW - STAGE 1 & ULTIMATE STAGE

NORTH & SOUTH OF SHERWOOD PARK FREEWAY - LOOKING NORTH

NOTE:
REFER TO SECTION 200.2.2 OF SCHEDULE 18
FOR SIDESLOPE AND BACKSLOPE REQUIREMENTS

PLAN DESCRIPTION: NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

BAR CODE

18-A-4.02

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

DATE | BY | SURVEYED | DESIGNED | CHECKED | DRAWN

BY | DATE | REVISION

No. 0 | EXECUTION VERSION

CONSULTANT	
JOB No. 13010	PLAN No.

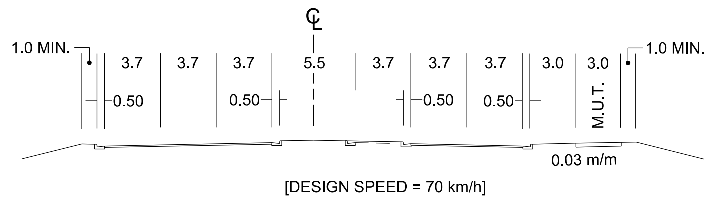
ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

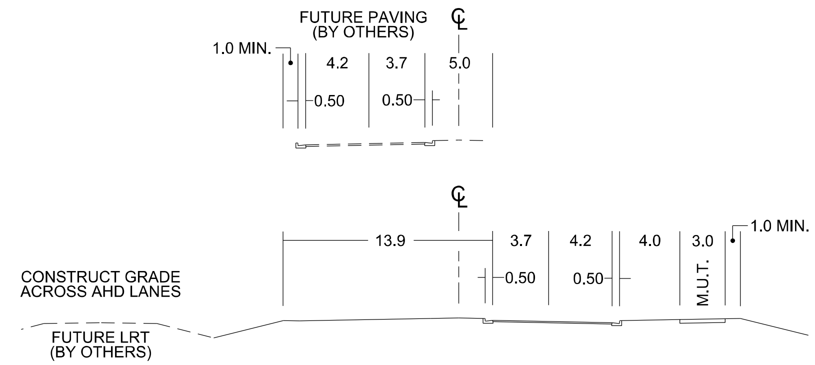
Government of Alberta
Transportation

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-4.02	NE ANTHONY HENDAY DRIVE		2 of 4



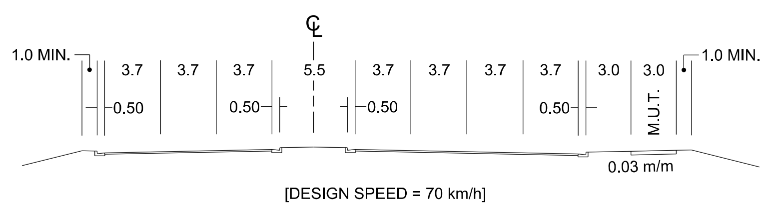
SHERWOOD DRIVE - STAGE 1 & ULTIMATE STAGE

NORTH OF YELLOWHEAD TRAIL WB RAMP INTERSECTION- LOOKING NORTH



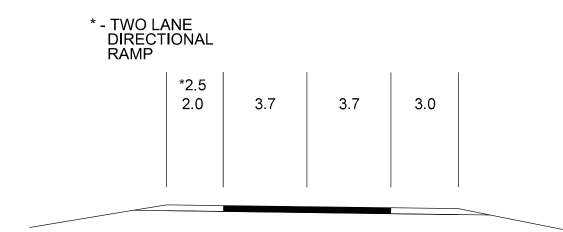
VICTORIA TRAIL - STAGE 1 w/ULTIMATE STAGE

NORTH & SOUTH OF AHD - LOOKING NORTH

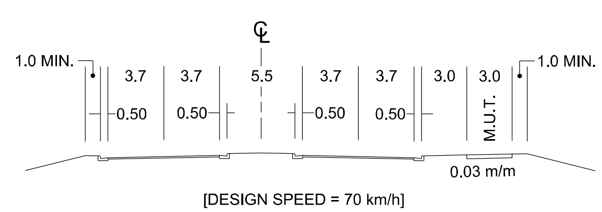


SHERWOOD DRIVE - STAGE 1 & ULTIMATE STAGE

SOUTH OF YELLOWHEAD TRAIL EB RAMP INTERSECTION- LOOKING NORTH

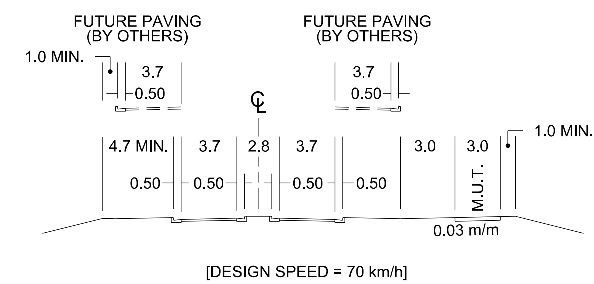


TWO LANE RAMP



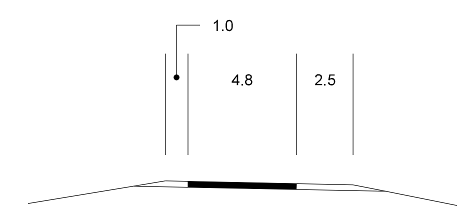
BROADMOOR BLVD - STAGE 1 & ULTIMATE STAGE

NORTH & SOUTH OF YELLOWHEAD TRAIL RAMP INTERSECTIONS - LOOKING NORTH



PETROLEUM WAY - STAGE 1 w/ULTIMATE STAGE

EAST & WEST OF ANTHONY HENDAY DRIVE - LOOKING WEST



ONE LANE RAMP

NOTE:
REFER TO SECTION 200.2.2 OF SCHEDULE 18
FOR SIDESLOPE AND BACKSLOPE REQUIREMENTS

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

Government of Alberta ■
Transportation

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-4.03	NE ANTHONY HENDAY DRIVE		3 of 4

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

BAR CODE

18-A-4.03

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY REVISION

No. 0 EXECUTION VERSION

PLAN DESCRIPTION

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

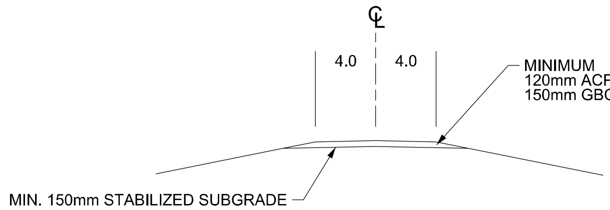
BAR CODE

PLAN No. 18-A-4.04 | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

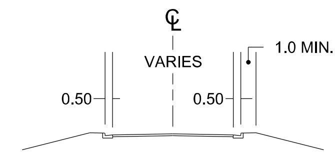
DATE | BY | SURVEYED | DESIGNED | CHECKED | DRAWN

No. 0 | REVISION: EXECUTION VERSION | BY | DATE



PAVED SERVICE ROAD

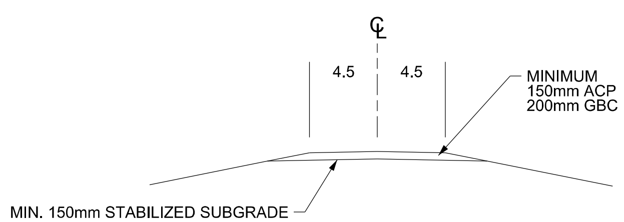
LOCAL RESIDENTIAL



PAVED SERVICE ROAD with CURB & GUTTER

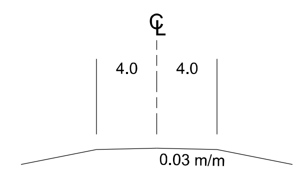
CURB w/500mm GUTTER

RAISED MEDIAN DETAIL

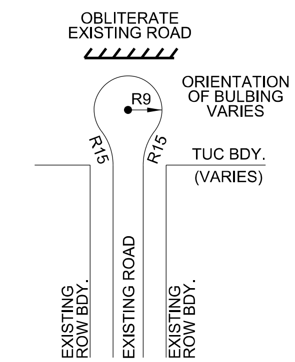


PAVED SERVICE ROAD

LOCAL INDUSTRIAL

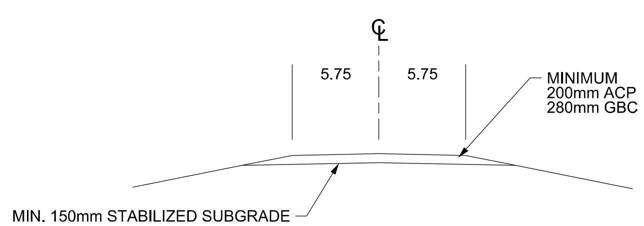


GRAVELED SERVICE ROAD



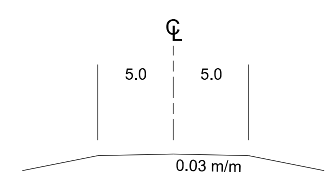
ROAD CLOSURE CUL-DE-SAC DETAIL

LOCAL ROADS - (LR)



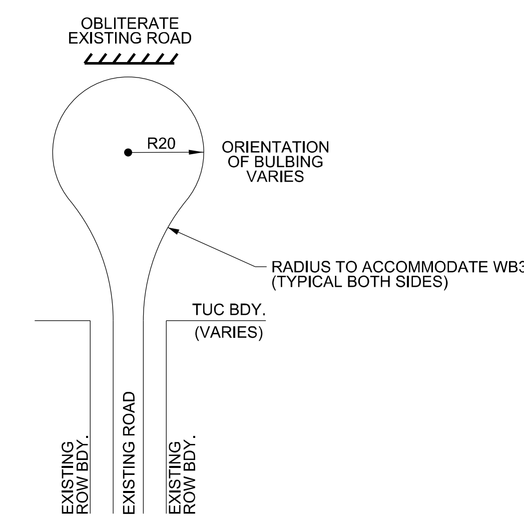
PAVED SERVICE ROAD

INDUSTRIAL COLLECTOR



GRAVELED SERVICE ROAD TO GRAVEL PIT AREA

NORTH OF 130 AVE



ROAD CLOSURE CUL-DE-SAC DETAIL

INDUSTRIAL AREAS - (IR)

NOTE:
REFER TO SECTION 200.2.2 OF SCHEDULE 18
FOR SIDESLOPE AND BACKSLOPE REQUIREMENTS

CONSULTANT	
JOB No. 13010	PLAN No.

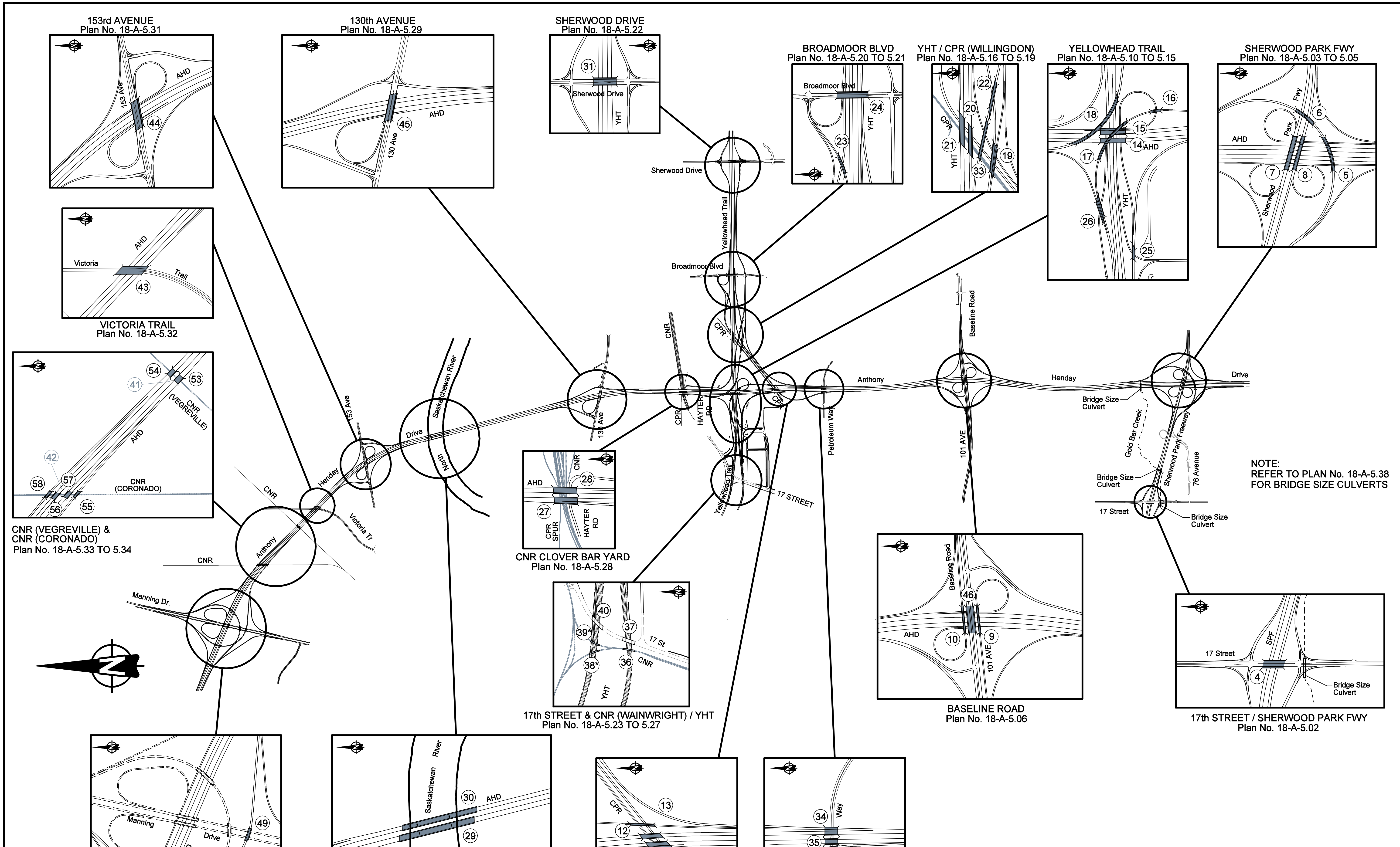
ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SCHEDULE 18 - APPENDIX A
TYPICAL SECTIONS AND DETAILS

Government of Alberta
Transportation

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-4.04	NE ANTHONY HENDAY DRIVE		4 of 4



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
BRIDGE DRAWING INDEX

Government of Alberta
Transportation

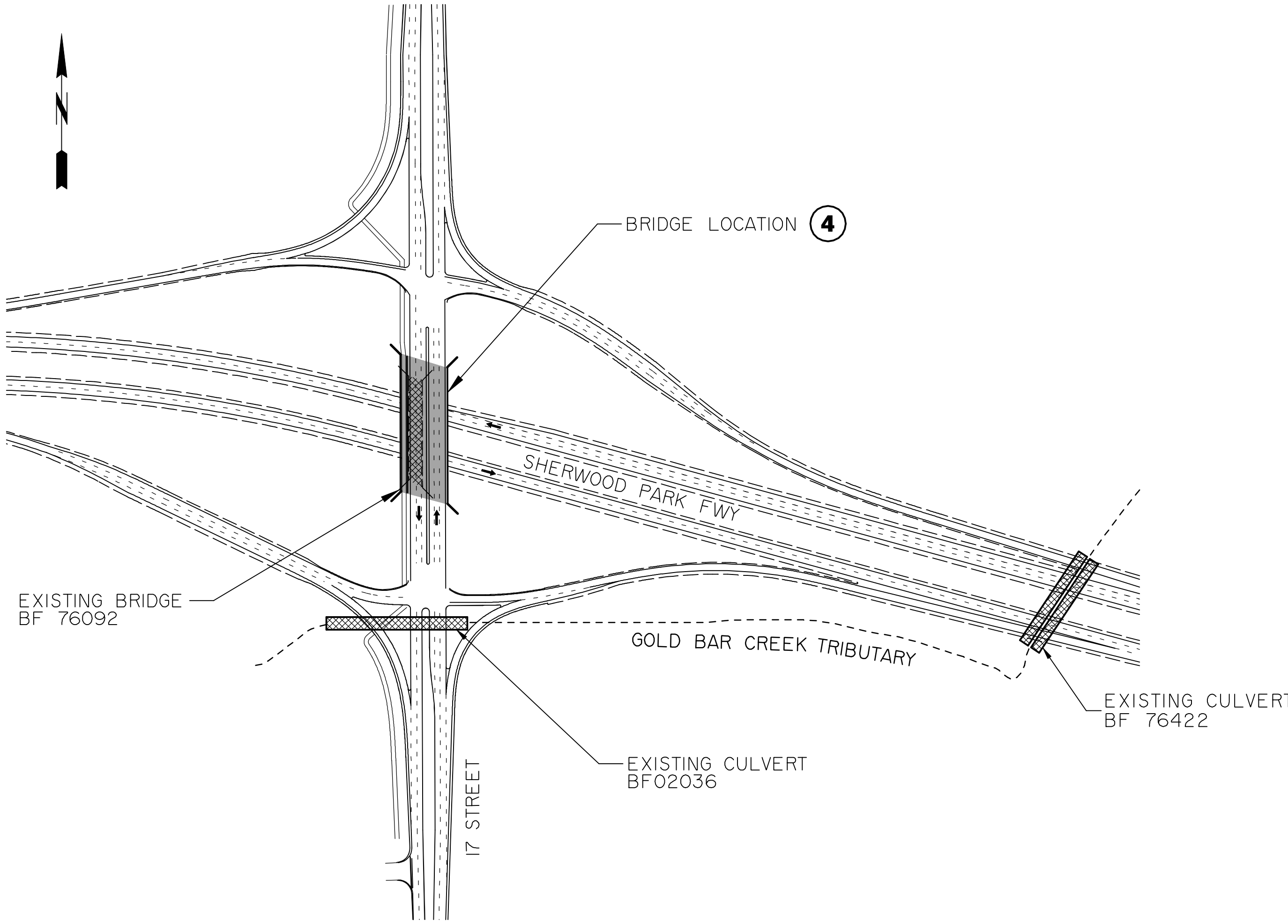
REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-A-5.01	NE ANTHONY HENDAY DRIVE		1 of 38

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED
DESIGNED J CHAPMAN
CHECKED W. KRAUSE
DRAWN NH

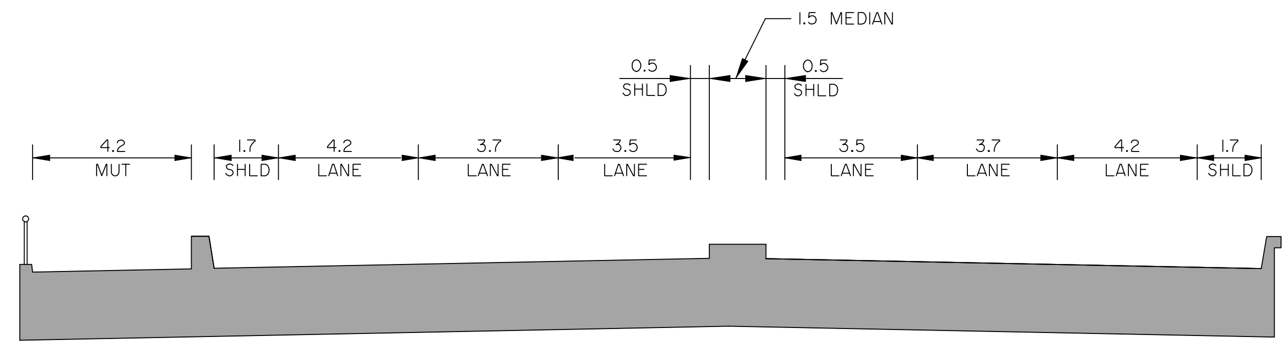
PLAN No. CONTRACT No. SITE No.
PHOTO No. TITLE SEARCH DATE GRAPHICS FILE
PLAN DESCRIPTION
BAR CODE

NH 18-A-5.01_INDEX_EX.DGN 2012-04-11 NEAHD COVER SHT



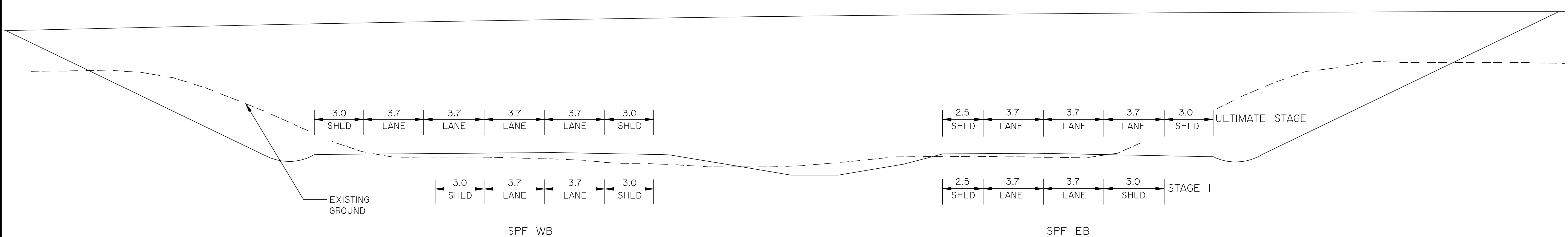
SITE PLAN - STAGE 1

NTS



BRIDGE SECTION - STAGE 1 & ULTIMATE STAGE

LOOKING NORTH - NTS



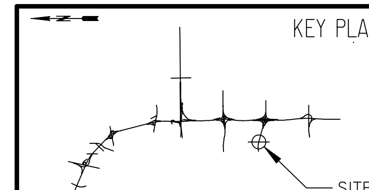
ELEVATION - 17 STREET

LOOKING EASTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76092.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

KEY PLAN



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS

17 STREET OVER
SHERWOOD PARK FWY

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 4	18-A-5.02	NE ANTHONY HENDAY DRIVE		2 of 38

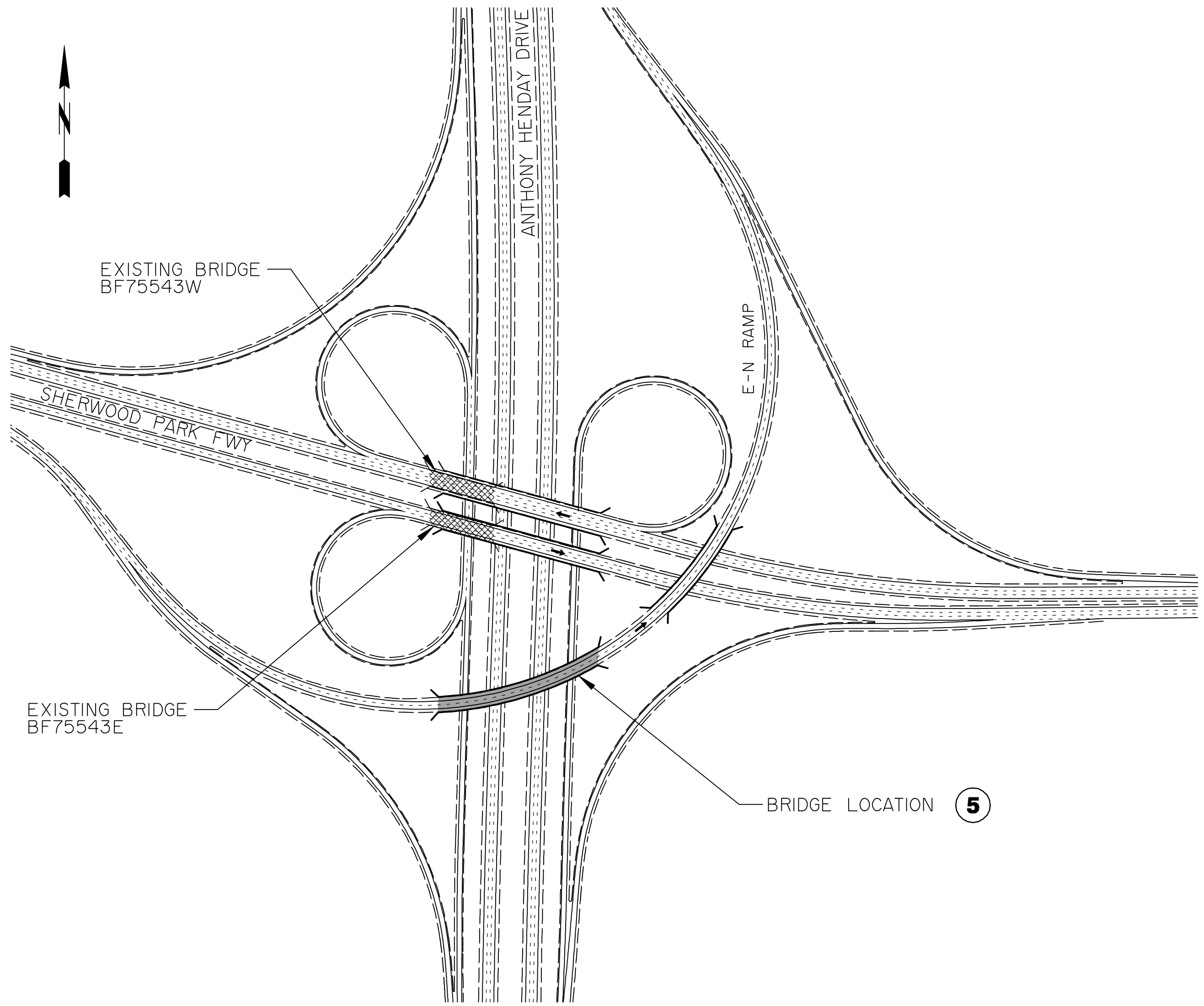
Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W. KRAUSE	
DRAWN	WTS	

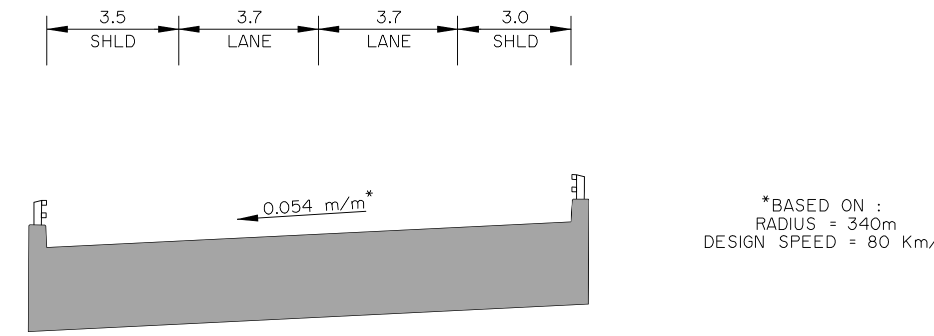
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE
PLAN No.
CONTRACT No.
SITE No.
BAR CODE
PLAN DESCRIPTION

18-A-5.02_EX.DGN
2012-04-11
SCHED18 BRIDGE
NH



SITE PLAN - STAGE I

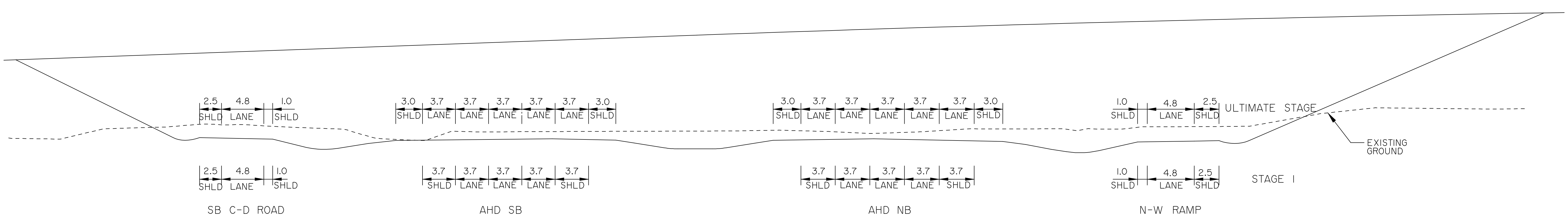
NTS



*BASED ON :
RADIUS = 340m
DESIGN SPEED = 80 Km/h

BRIDGE SECTION - STAGE I & ULTIMATE STAGE

LOOKING EASTERLY - NTS



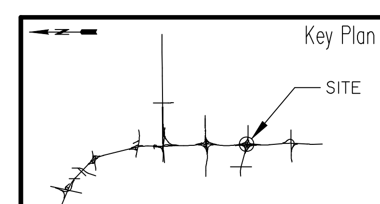
ELEVATION - E-N RAMP

LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
E-N RAMP OVER ANTHONY HENDAY DRIVE
AT SHERWOOD PARK FREEWAY

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 5	18-A-5.03		NE ANTHONY HENDAY DRIVE	3 of 38

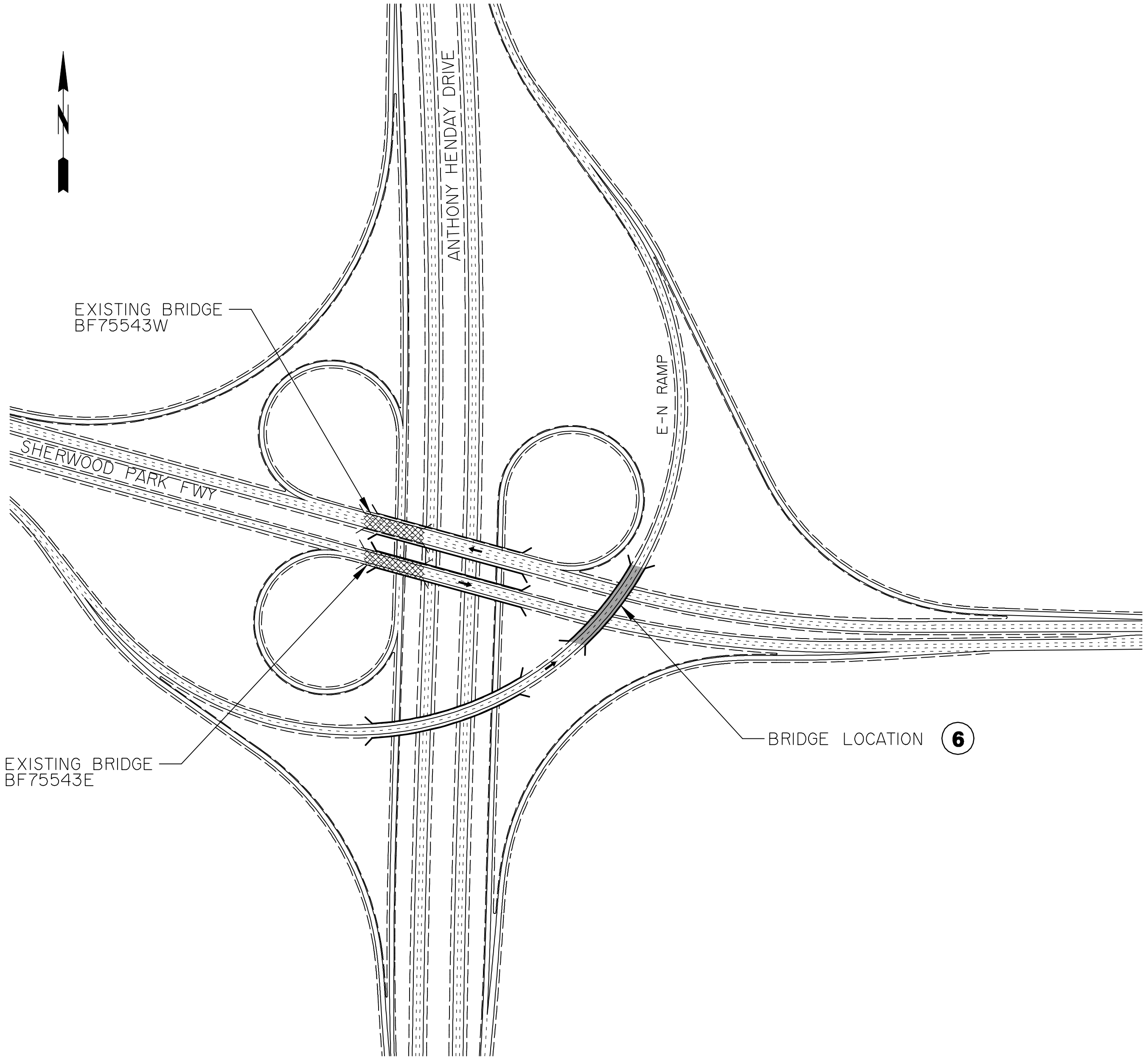
Government of Alberta ■
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED
DESIGNED J CHAPMAN
CHECKED W KRAUSE
DRAWN WTS

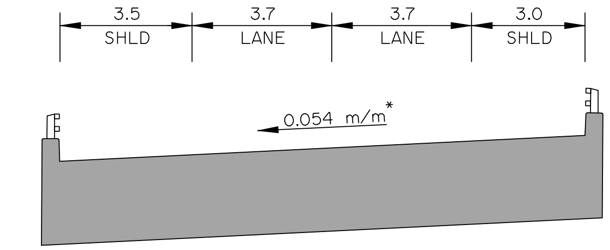
PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE | PLAN No. | CONTRACT No. | SITE No. | BAR CODE | PLAN DESCRIPTION

NH 18-A-5.03_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE 1

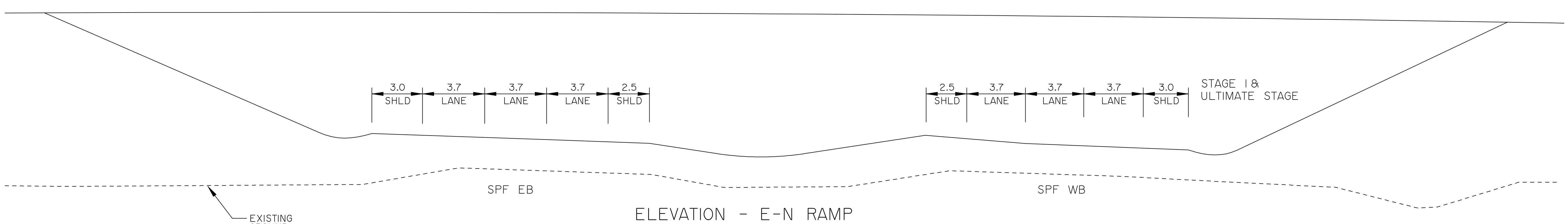
NTS



*BASED ON :
RADIUS = 340m
DESIGN SPEED = 80 Km/h

BRIDGE SECTION - STAGE 1 & ULTIMATE STAGE

LOOKING NORTHERLY - NTS

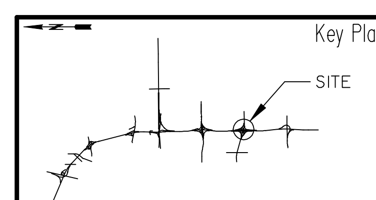


ELEVATION - E-N RAMP

LOOKING WESTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
E-N RAMP OVER
SHERWOOD PARK FWY

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 6	18-A-5.04	NE ANTHONY HENDAY DRIVE		4 of 38

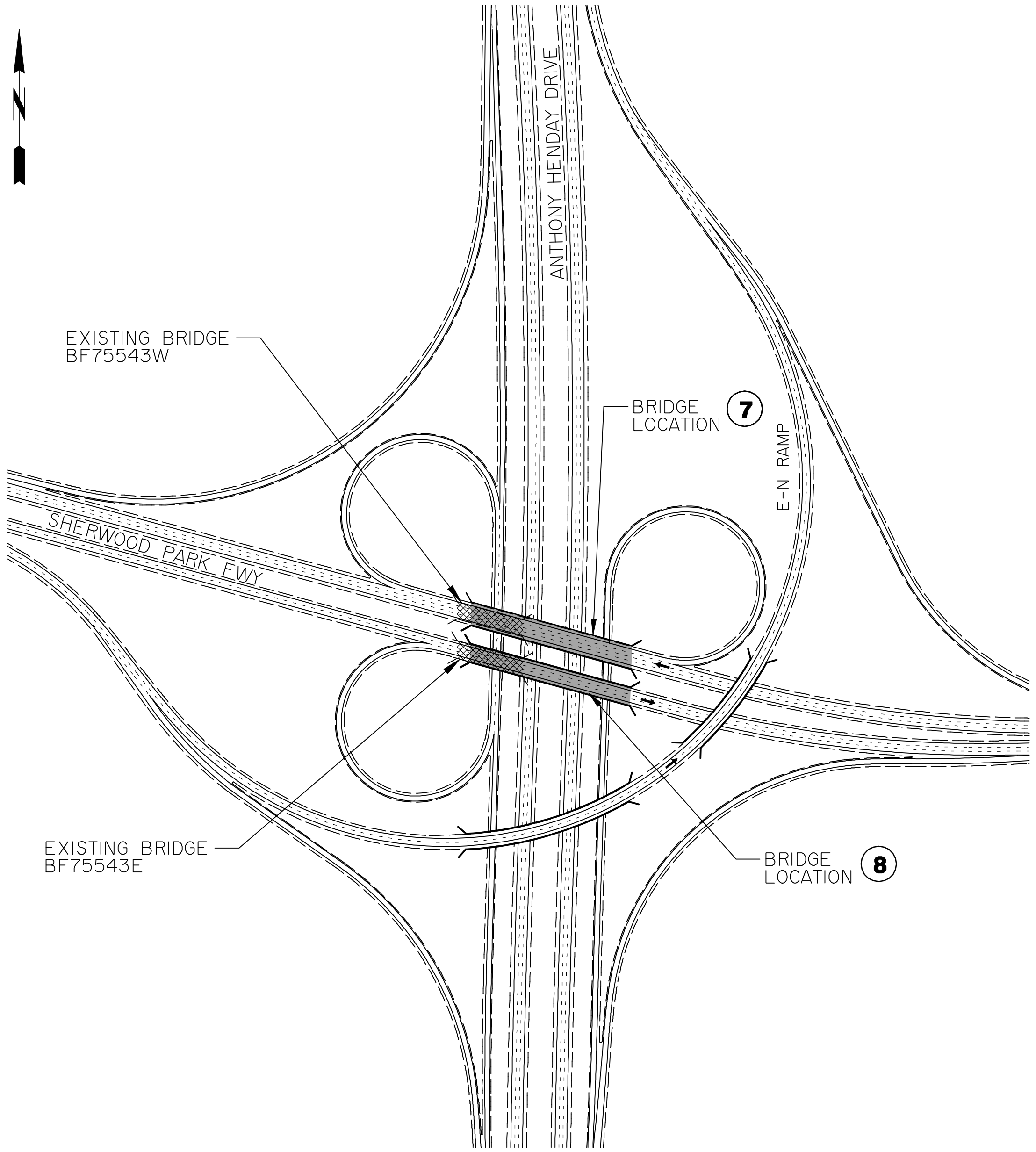
Government of Alberta
Transportation

PLAN DESCRIPTION
BAR CODE
PLAN No.
CONTRACT No.
SITE No.
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

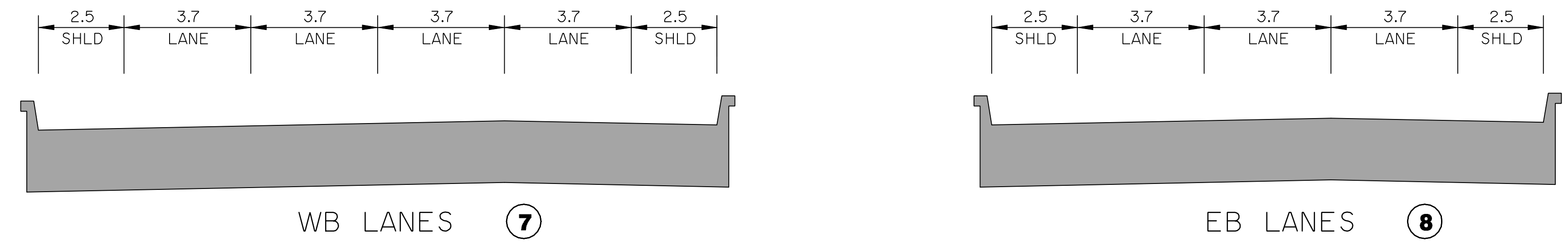
No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

NH 18-A-5.04_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE I

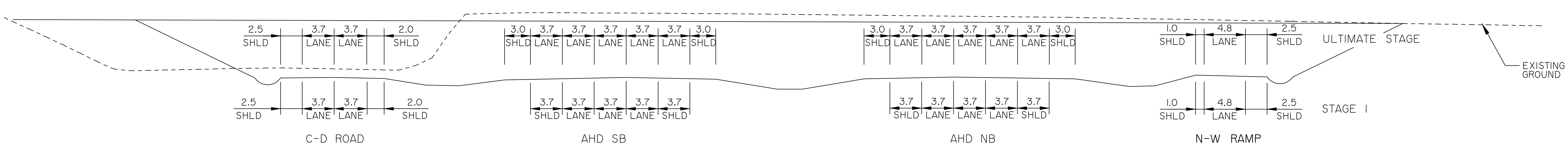
NTS



DESIGN SPEED 90 km/h

BRIDGE SECTIONS - STAGE 1 & ULTIMATE STAGE

LOOKING EASTERLY - NTS

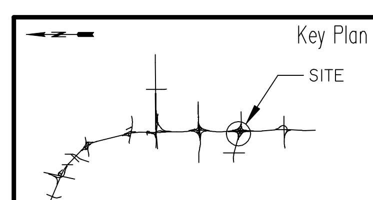


ELEVATION - SHERWOOD PARK FWY

LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF75543.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
SHERWOOD PARK FWY OVER
ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 7/8	18-A-5.05	NE ANTHONY HENDAY DRIVE		5 of 38

Government of Alberta ■ Transportation

PLAN DESCRIPTION

BAR CODE

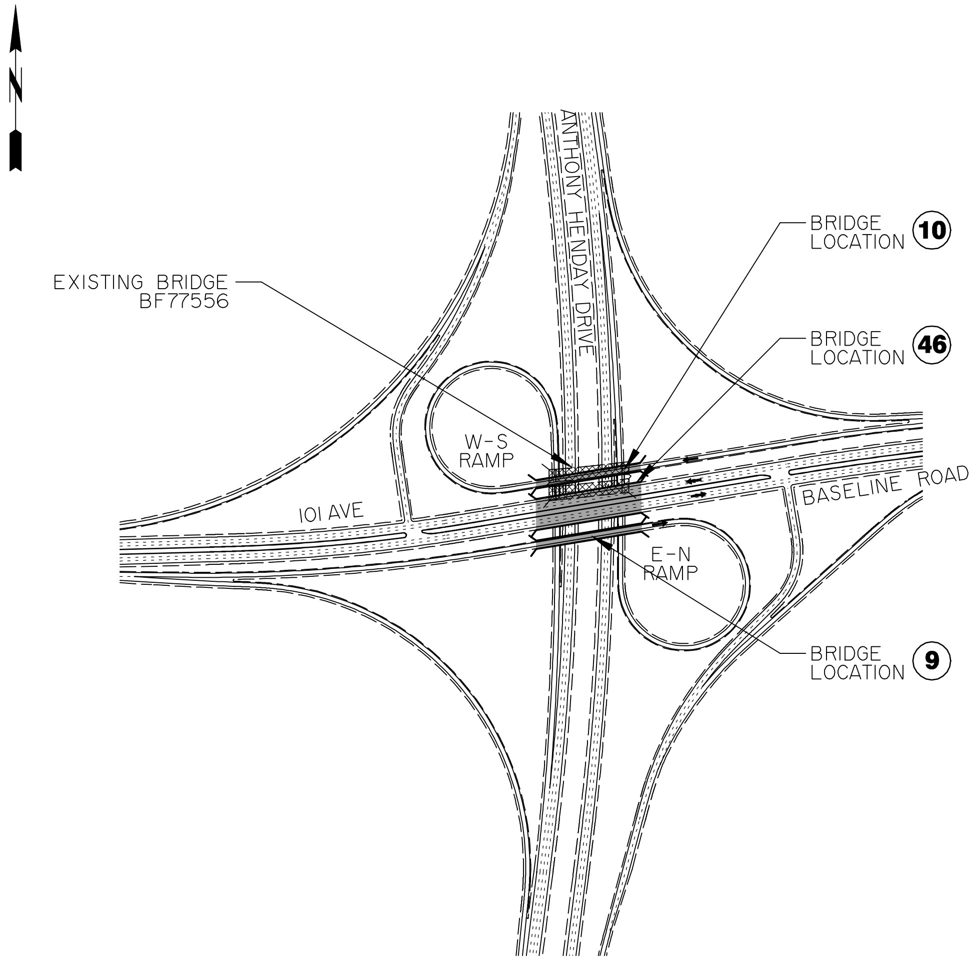
PLAN No.
CONTRACT No.
SITE No.

PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

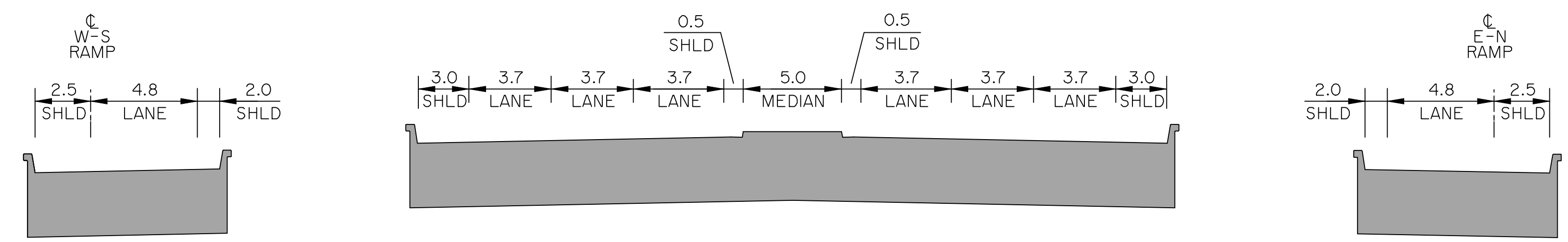
No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SCHED18 BRIDGE 2012-04-11 18-A-5.05_EX.DGN NH



SITE PLAN - STAGE 1

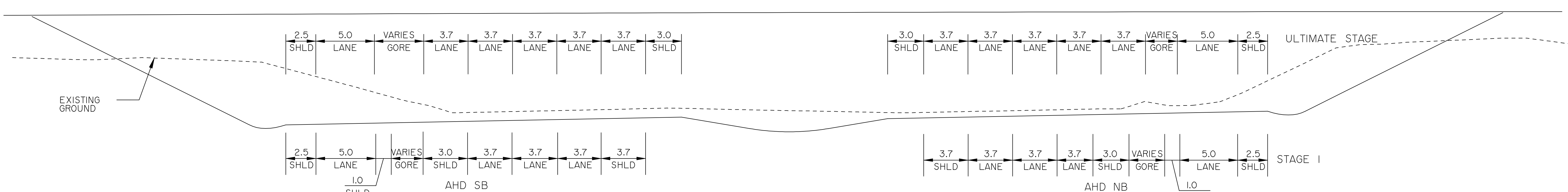
NTS



DESIGN SPEED 80 km/h

BRIDGE SECTIONS - STAGE 1 & ULTIMATE STAGE

LOOKING EASTERLY - NTS

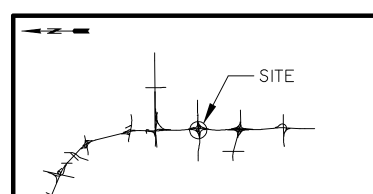


ELEVATION - BASELINE ROAD

LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF77556.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
BASELINE ROAD OVER
ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 9/10/46	18-A-5.06	NE ANTHONY HENDAY DRIVE		6 of 38

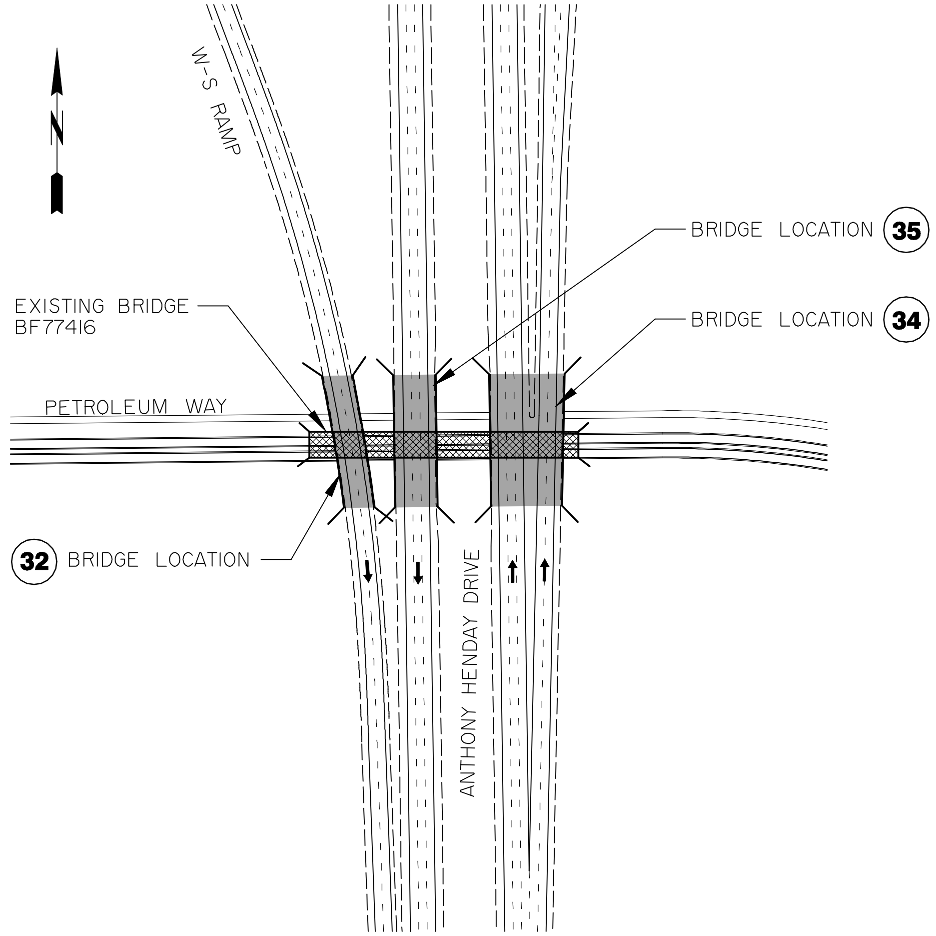
Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	
1			

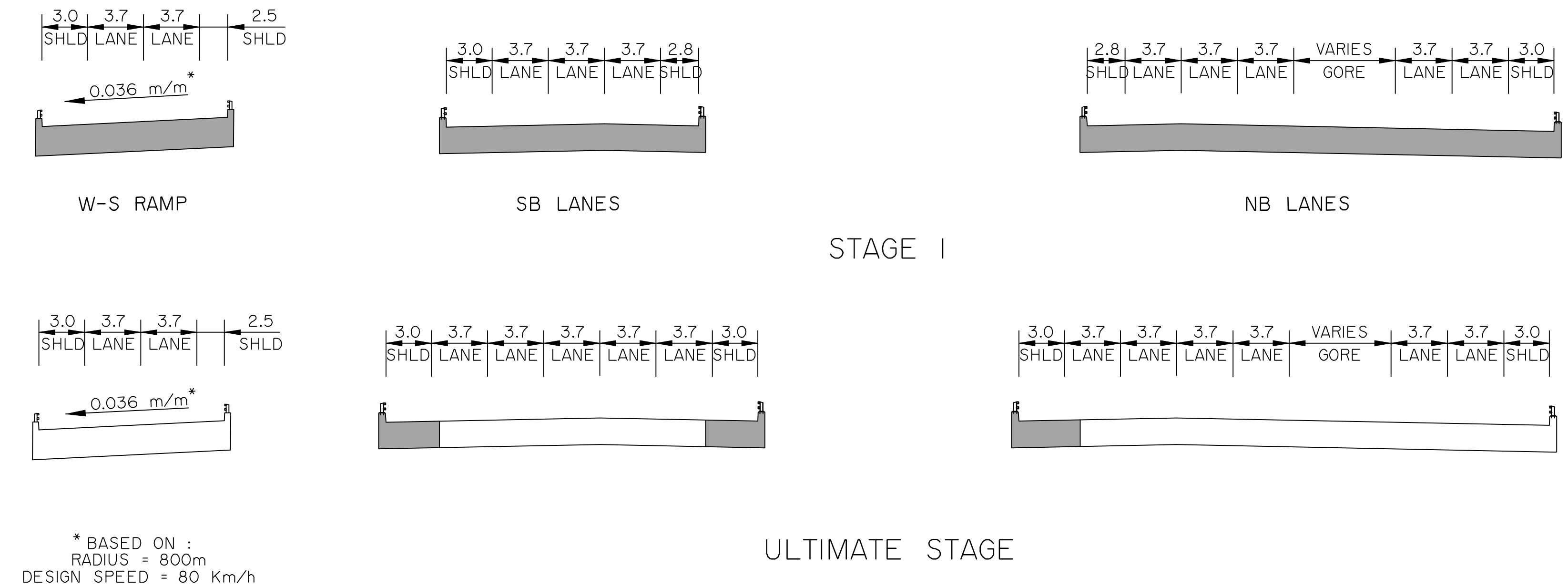
SURVEYED
DESIGNED J CHAPMAN
CHECKED W. KRAUSE
DRAWN WT SMITH

PLAN DESCRIPTION
BAR CODE
PLAN No.
CONTRACT No.
SITE No.
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

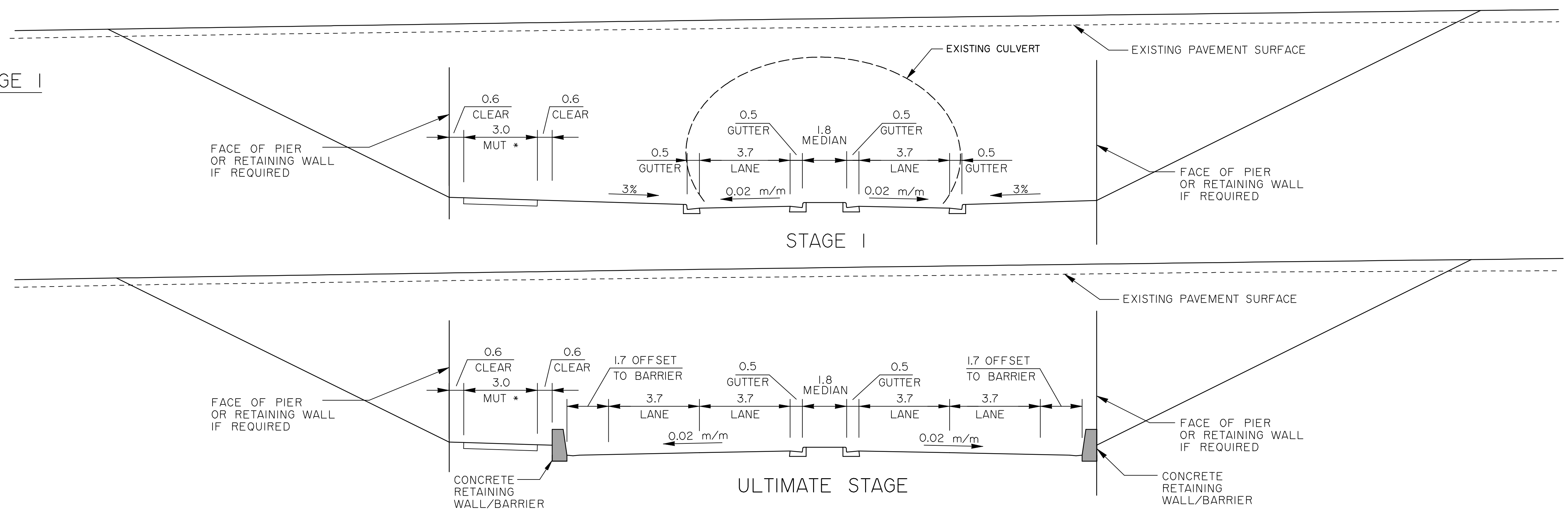
SCHED18 BRIDGE
18-A-5.06_EX.DGN 2012-04-11 NH



SITE PLAN - STAGE I
NTS



BRIDGES SECTION
LOOKING NORTH - NTS



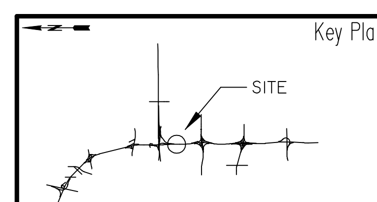
ELEVATION - ANTHONY HENDAY DRIVE
LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF77416.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

* MINIMUM VERTICAL CLEARANCE FOR THE MULTI USE TRAIL (MUT) IS 3.6m FROM THE TOP OF MUTS FINISHED SURFACE TO THE UNDERSIDE OF THE STRUCTURE.

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
ANTHONY HENDAY DRIVE & W-S RAMP OVER PETROLEUM WAY

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 32/34/35	18-A-5.07	NE ANTHONY HENDAY DRIVE		7 of 38

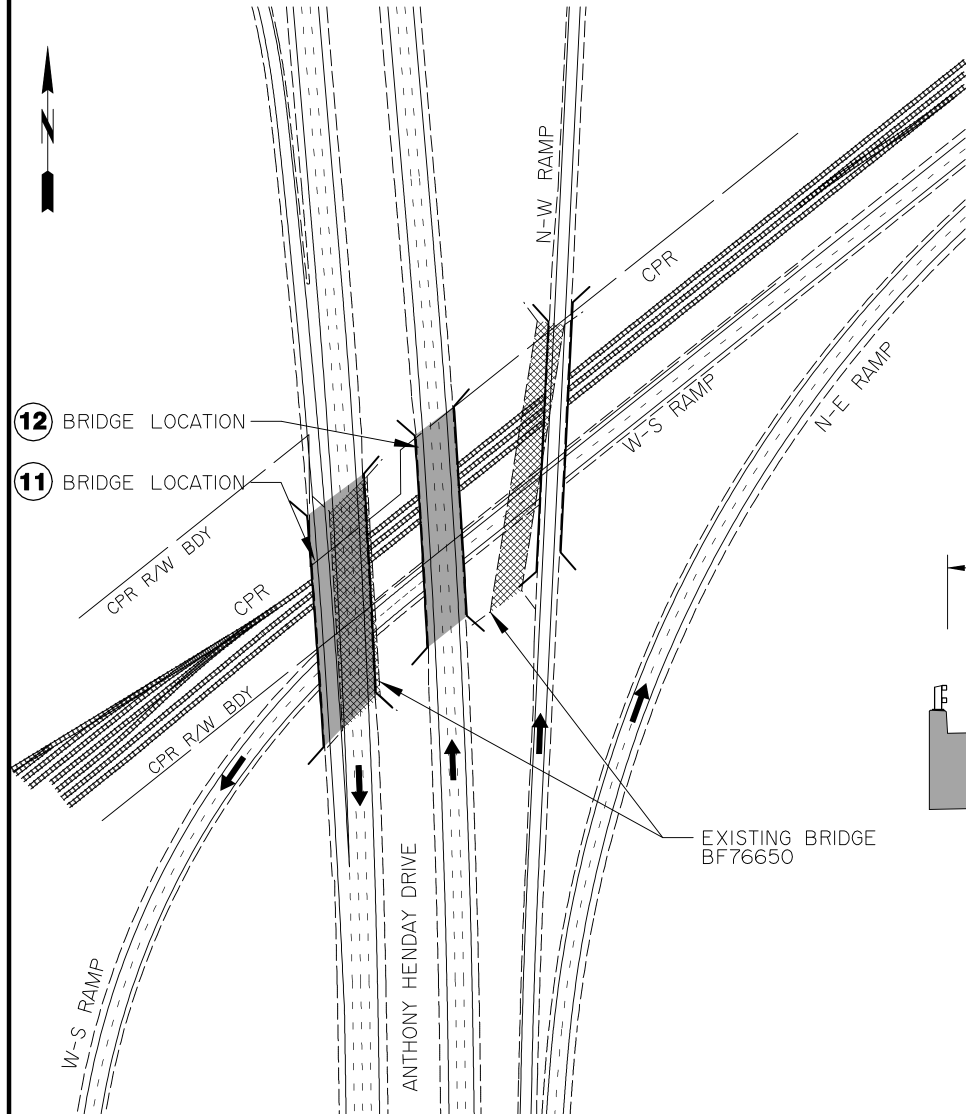
Government of Alberta
Transportation

No.	REVISION	DATE	BY
0	EXECUTION VERSION		NH

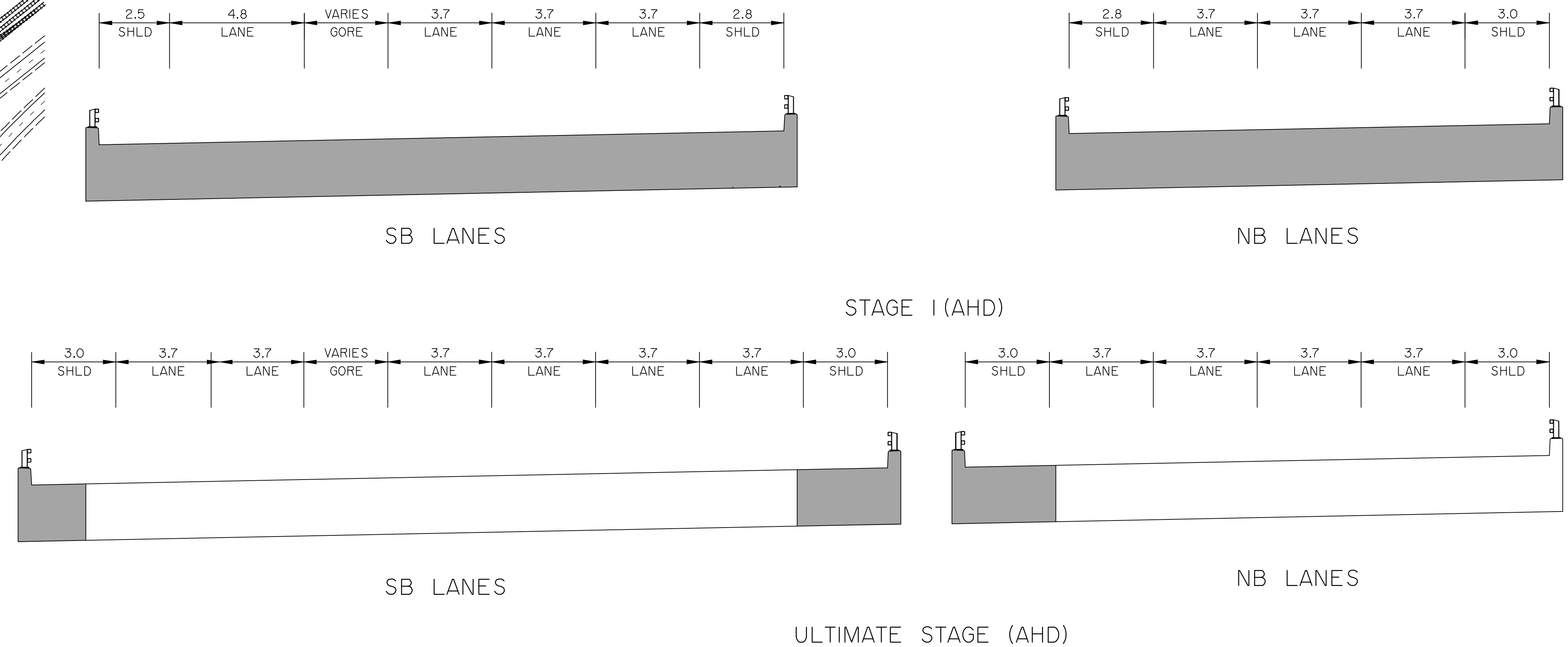
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

PLAN DESCRIPTION
BAR CODE
PLAN No.
CONTRACT No.
SITE No.
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

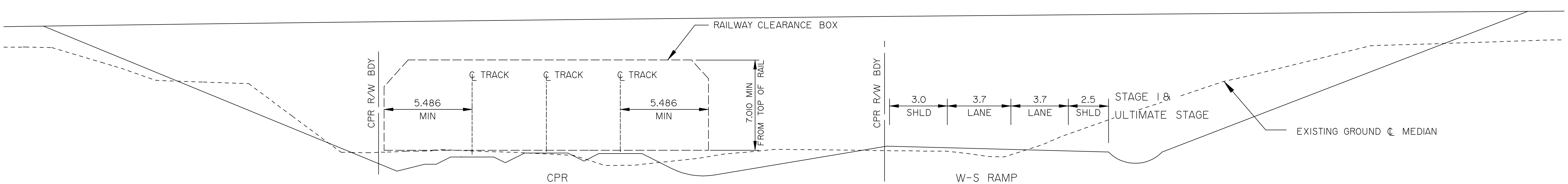
NH 18-A-5.07_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE I
NTS



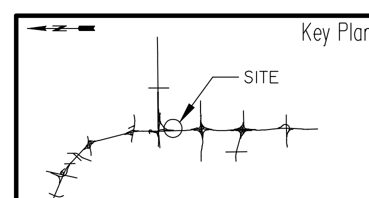
BRIDGES SECTION
LOOKING NORTH - NTS



ELEVATION - ANTHONY HENDAY DRIVE
LOOKING EASTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76650.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
ANTHONY HENDAY DRIVE OVER
W-S RAMP & CPR (WILLINGDON)

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 11/12	18-A-5.08	NE ANTHONY HENDAY DRIVE		8 of 38

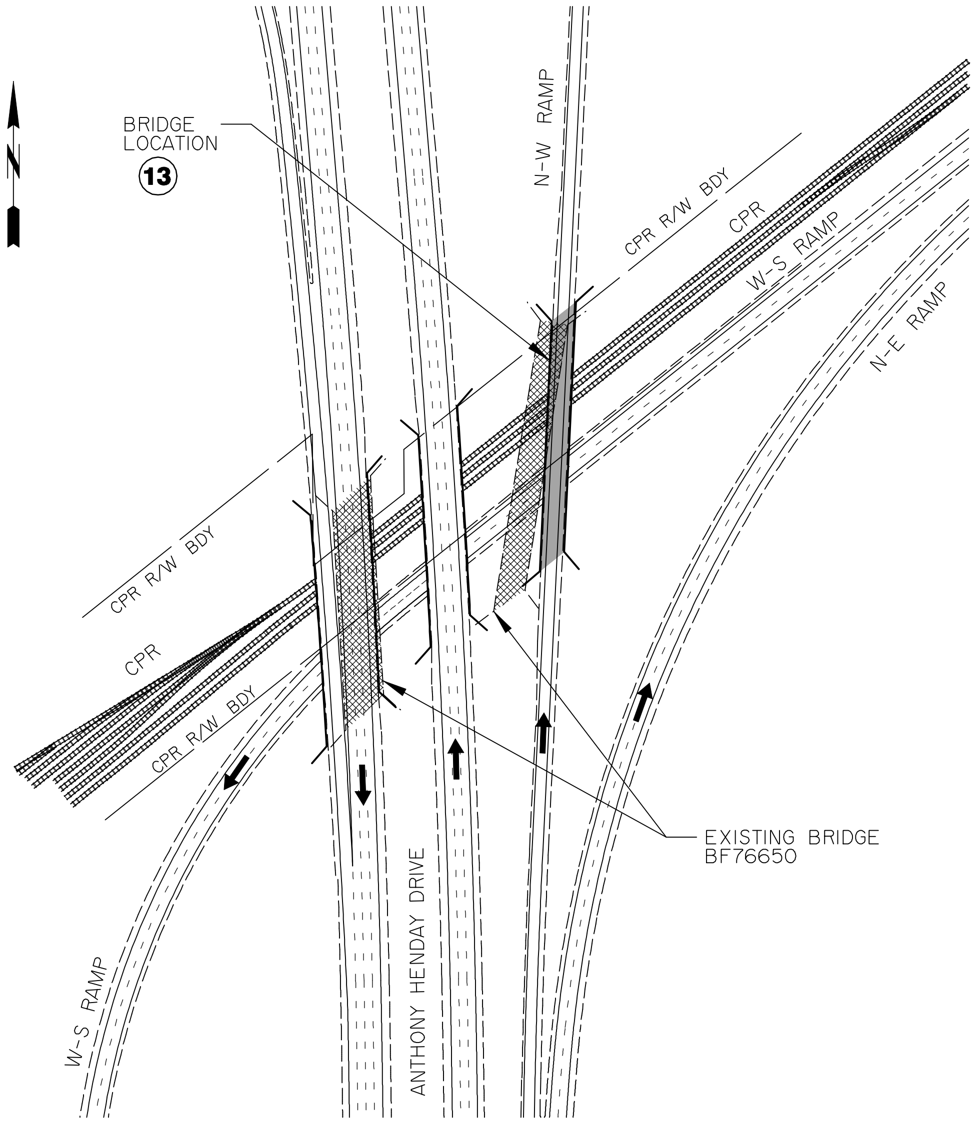
Government of Alberta ■
Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

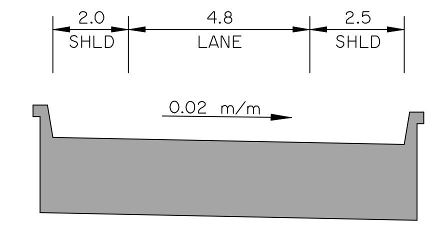
PHOTO NO.
TITLE SEARCH DATE
GRAPHICS FILE
PLAN NO.
CONTRACT NO.
SITE NO.
BAR CODE
PLAN DESCRIPTION

NH 18-A-5.08_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE I

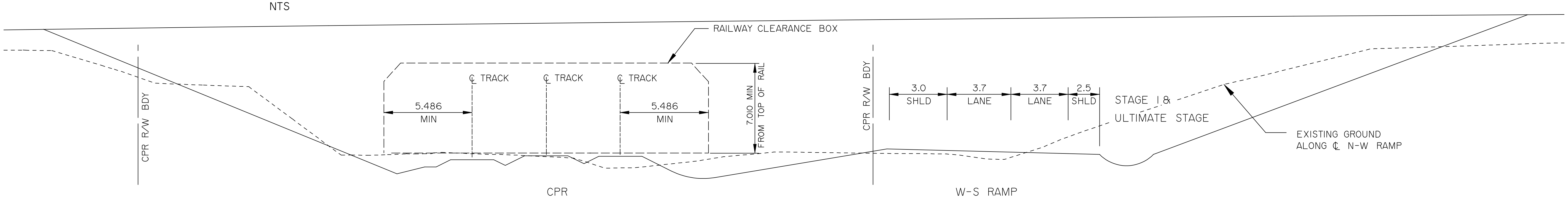
NTS



BRIDGE SECTION - STAGE I & ULTIMATE STAGE

LOOKING NORTH - NTS

DESIGN SPEED 80 km/h

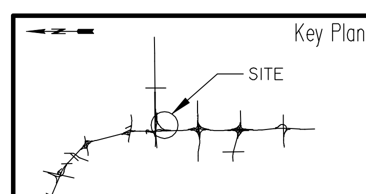


ELEVATION - N-W RAMP

LOOKING EASTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76650.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
N-W RAMP OVER
W-S RAMP & CPR (WILLINGDON)

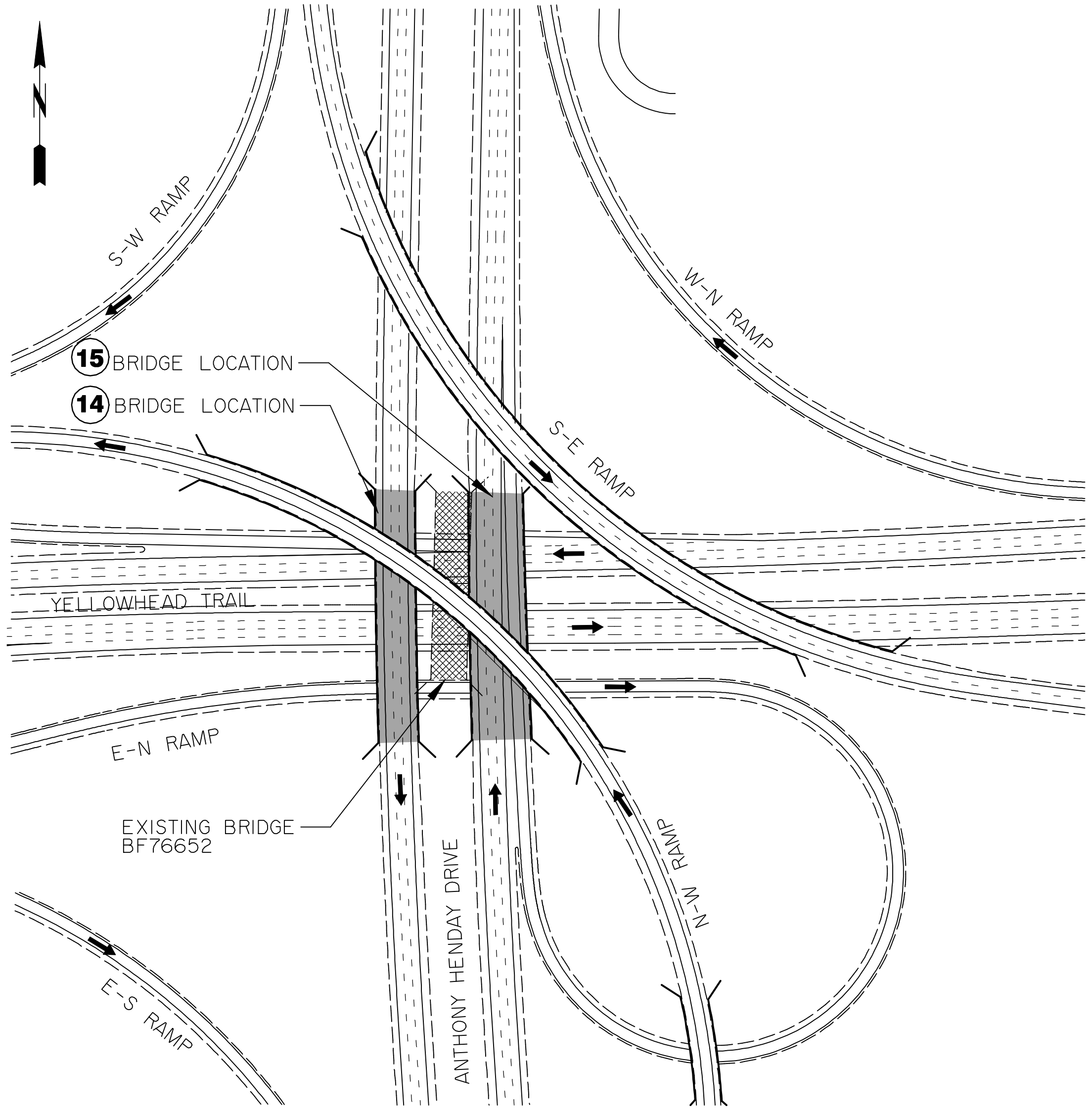
REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 13	18-A-5.09	NE ANTHONY HENDAY DRIVE		9 of 38

Government of Alberta
Transportation

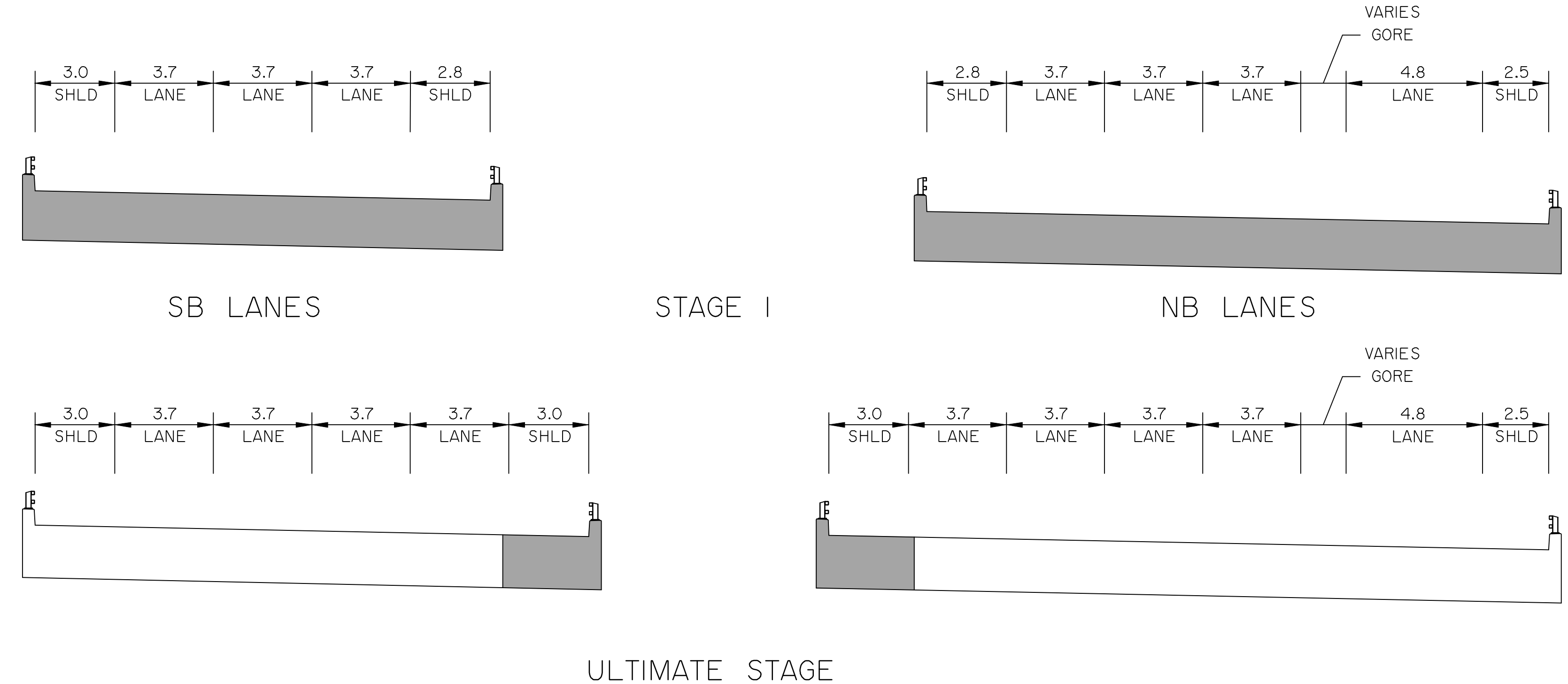
NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED / DESIGNED J CHAPMAN / CHECKED W KRAUSE / DRAWN WTS

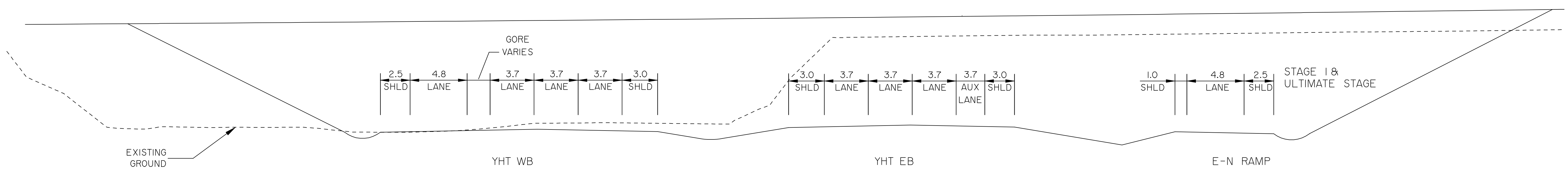
18-A-5.09_EX.dgn 2012-04-11 SCHED18 BRIDGE NH



SITE PLAN - STAGE I
NTS



BRIDGES SECTION
LOOKING NORTH - NTS

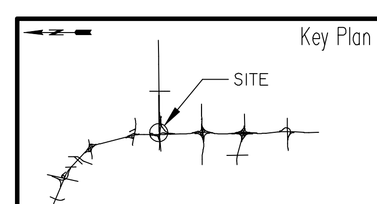


ELEVATION - ANTHONY HENDAY DRIVE
LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76652.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
ANTHONY HENDAY DRIVE OVER
YELLOWHEAD TRAIL

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 14/15	18-A-5.10	NE ANTHONY HENDAY DRIVE		10 of 38

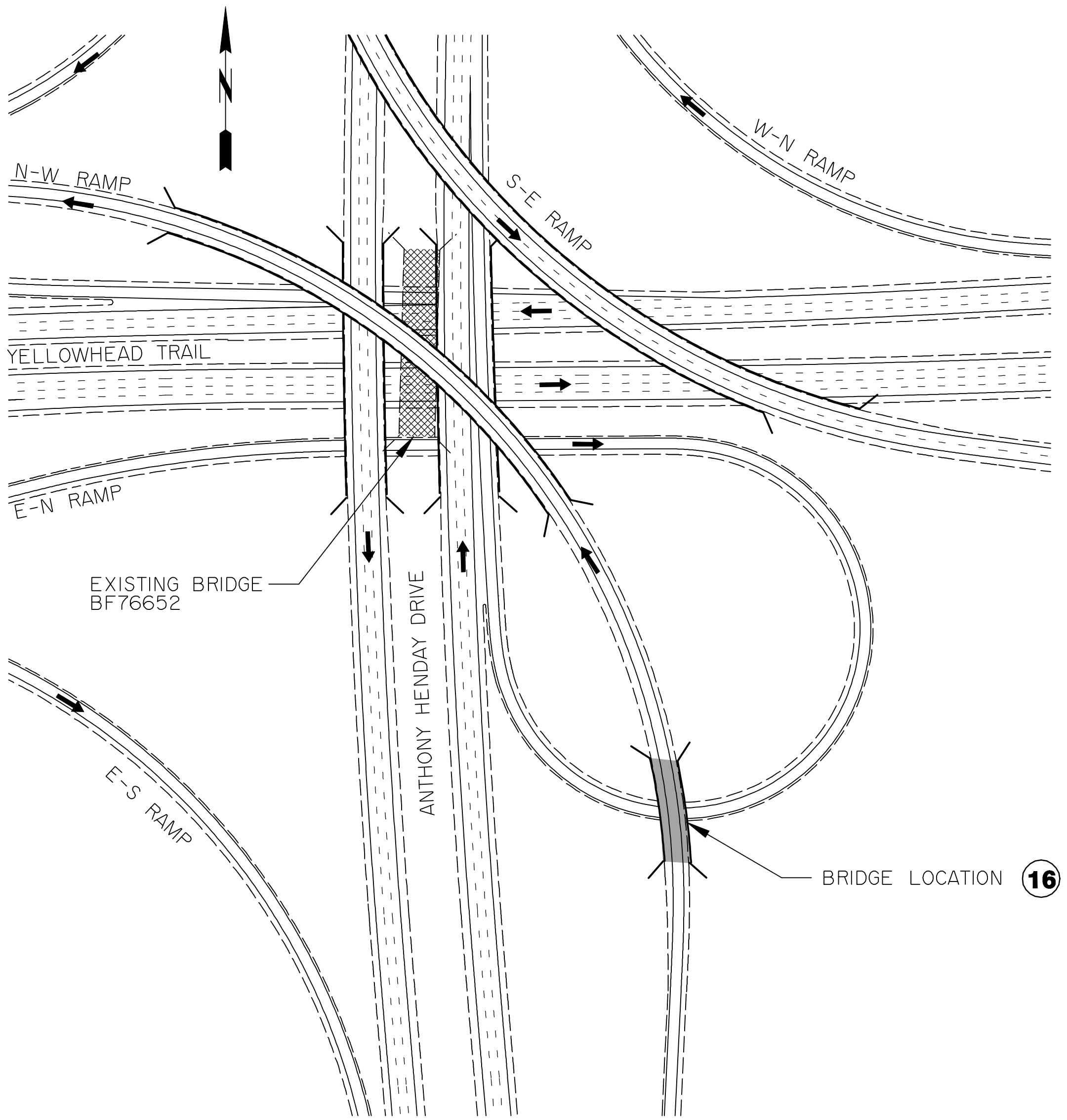
Government of Alberta
Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

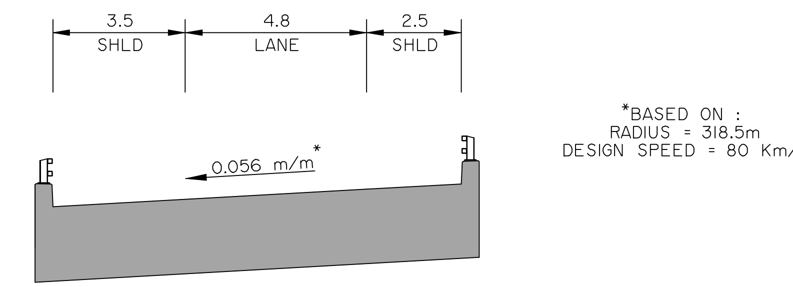
PLAN DESCRIPTION
BAR CODE
PLAN NO.
CONTRACT NO.
SITE NO.
PHOTO NO.
TITLE SEARCH DATE
GRAPHICS FILE

18-A-5.10_EX.DGN 2012-04-11 SCHED18 BRIDGE NH



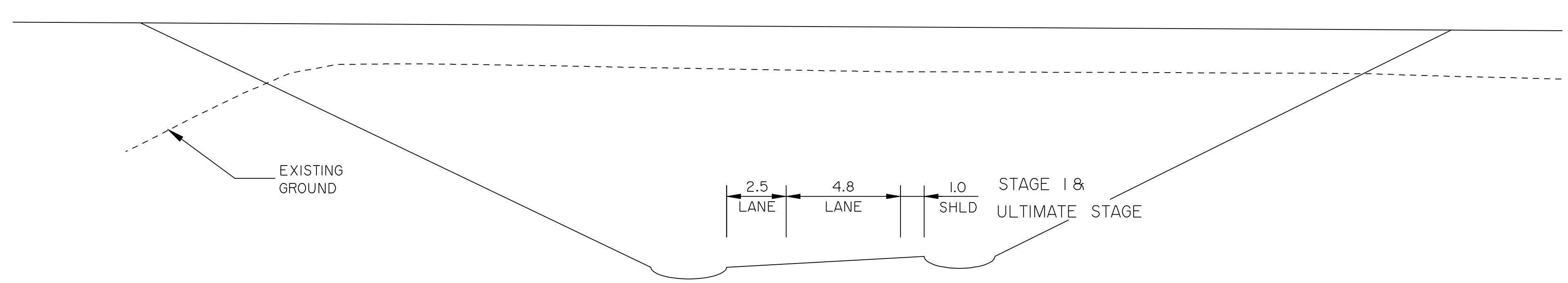
SITE PLAN - STAGE I

NTS



BRIDGE SECTION - STAGE I & ULTIMATE STAGE

LOOKING NORTH - NTS

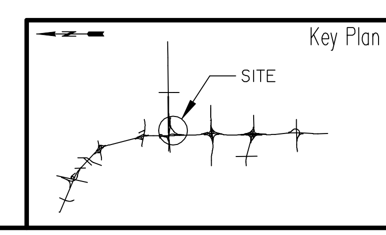


ELEVATION - N-W RAMP

LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
N-W RAMP OVER
E-N RAMP

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 16	18-A-5.11	NE ANTHONY HENDAY DRIVE		11 of 38

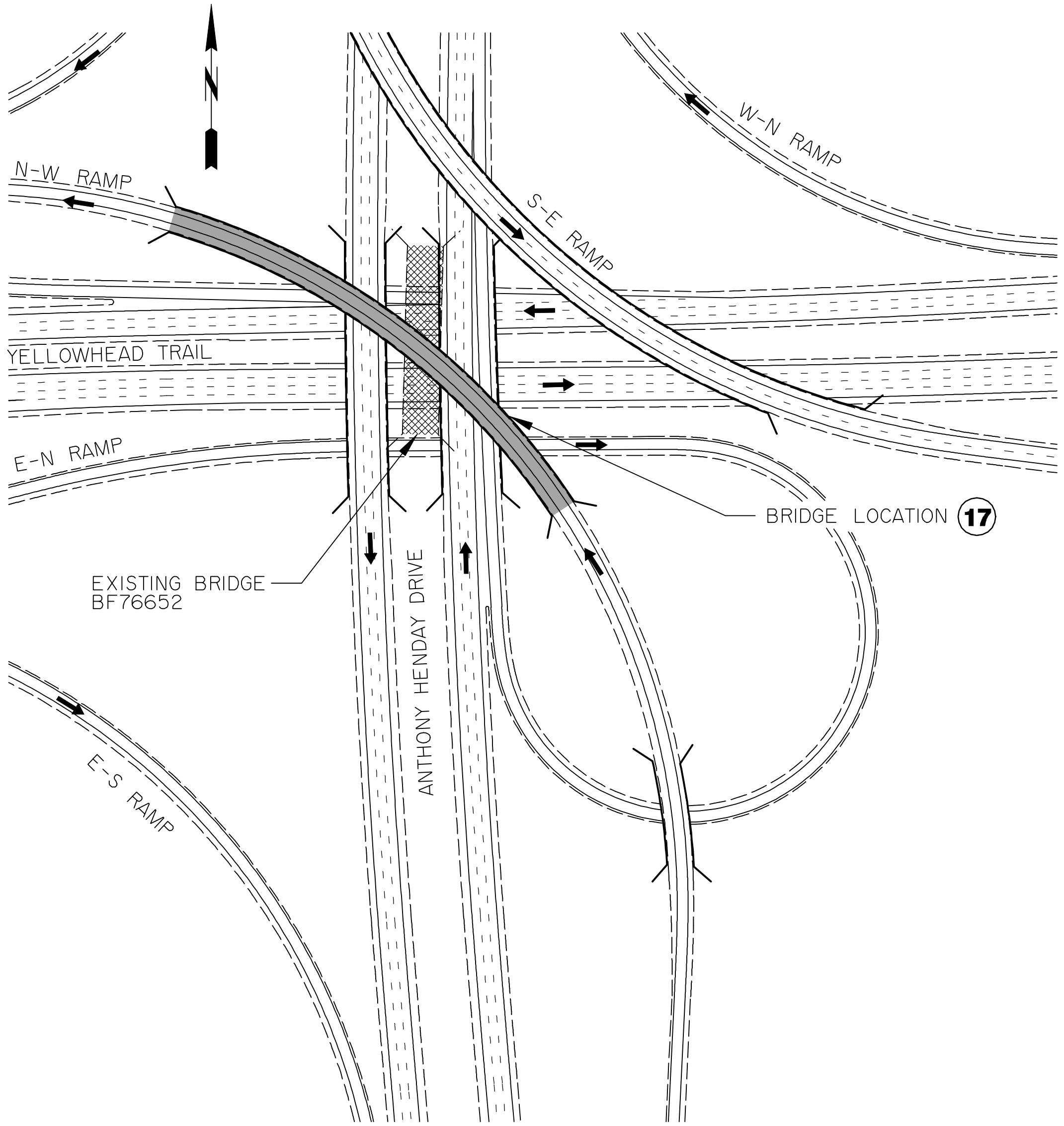
Government of Alberta
Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED
DESIGNED J CHAPMAN
CHECKED W KRAUSE
DRAWN WTS

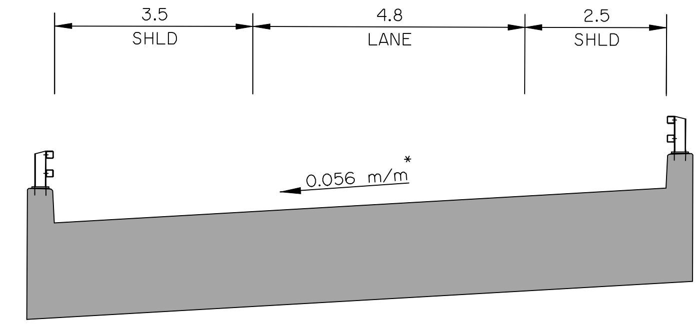
PLAN DESCRIPTION
BAR CODE
PLAN NO.
CONTRACT NO.
SITE NO.
PHOTO NO.
TITLE SEARCH DATE
GRAPHICS FILE

18-A-5.11_EX.DGN 2012-04-11
SCHED18 BRIDGE
NH



SITE PLAN - STAGE I

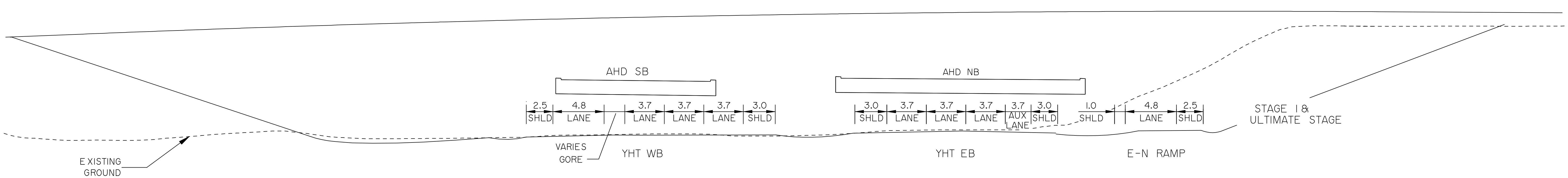
NTS



*BASED ON :
RADIUS = 318.5m
DESIGN SPEED = 80 Km/h

BRIDGE SECTION - STAGE I & ULTIMATE STAGE

LOOKING NORTHWEST - NTS



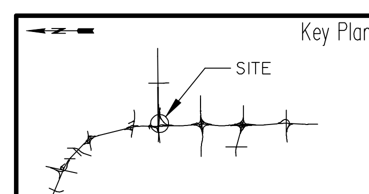
ELEVATION - N-W RAMP

LOOKING EASTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
N-W RAMP OVER
ANTHONY HENDAY DR & YELLOWHEAD TR

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 17	18-A-5.12	NE ANTHONY HENDAY DRIVE		12 of 38

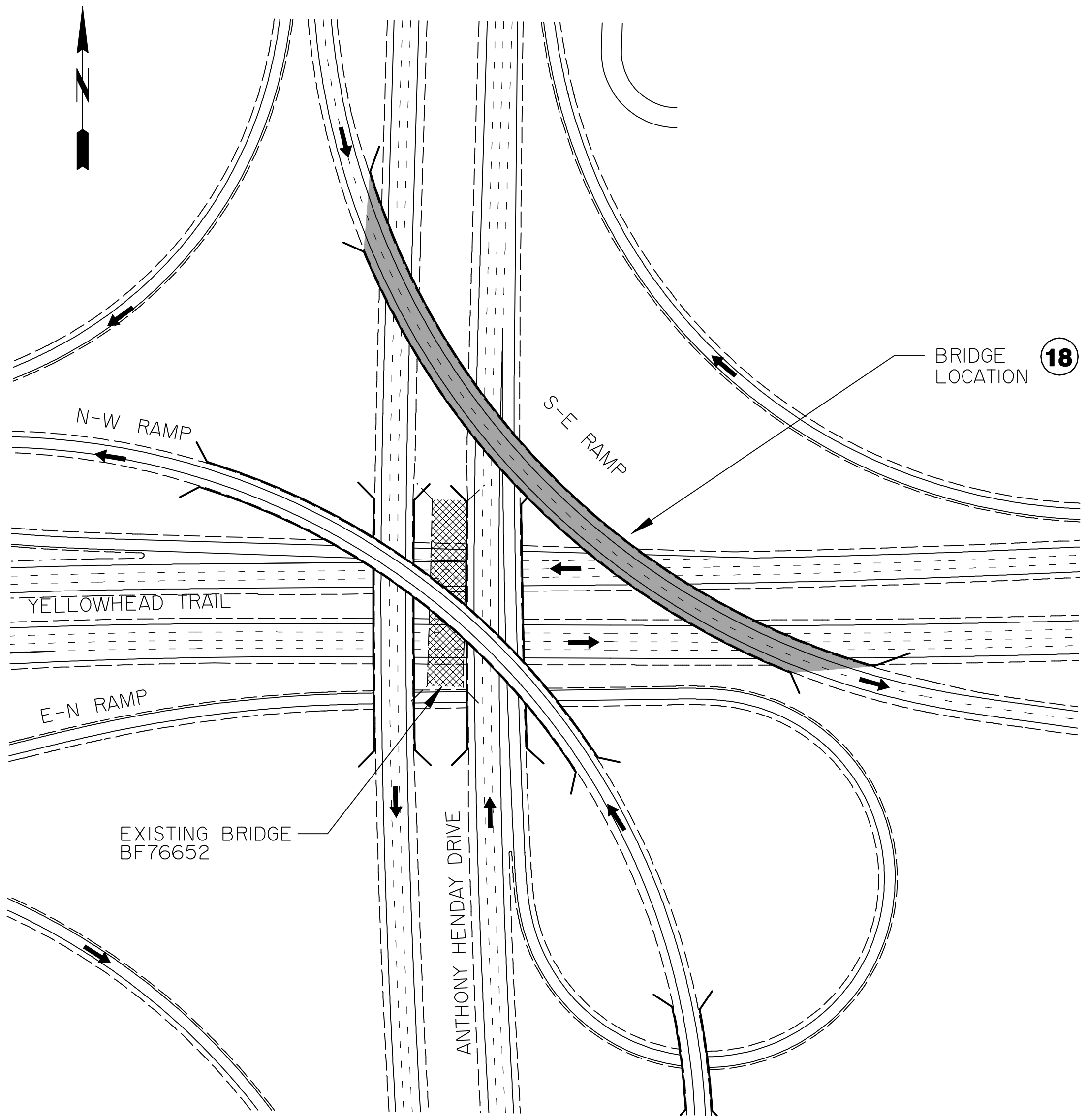
Government of Alberta ■
Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

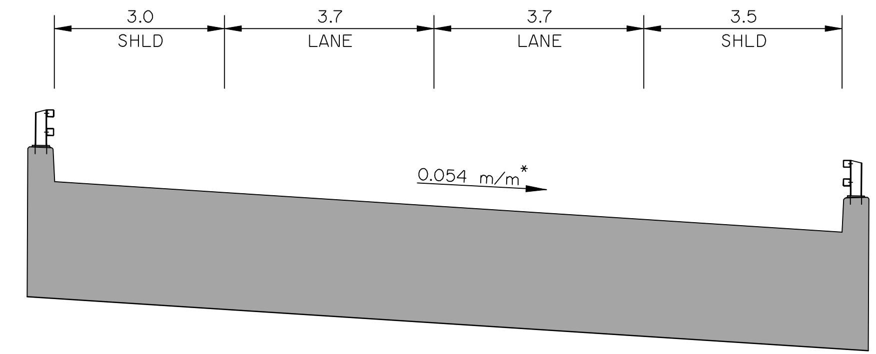
	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

PLAN DESCRIPTION
BAR CODE
PLAN NO.
CONTRACT NO.
SITE NO.
PHOTO NO.
TITLE SEARCH DATE
GRAPHICS FILE

SCHED18 BRIDGE
18-A-5.12_EX.DGN 2012-04-11
NH

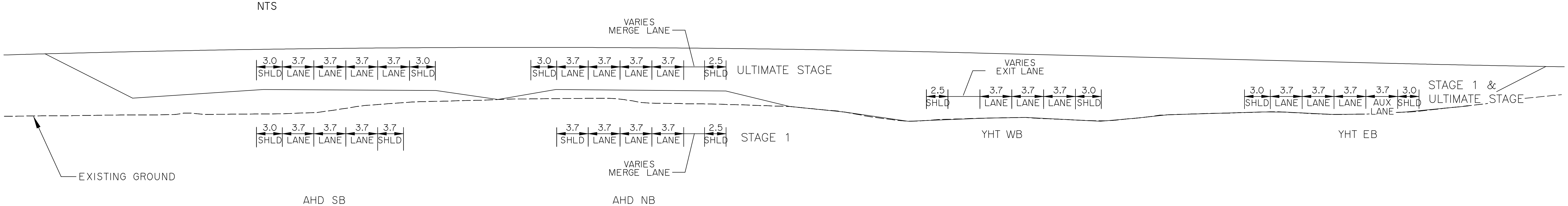


SITE PLAN - STAGE 1
NTS



*BASED ON :
RADIUS = 340m
DESIGN SPEED = 80 Km/h

BRIDGE SECTION - STAGE 1 & ULTIMATE STAGE
LOOKING NORTHWEST - NTS

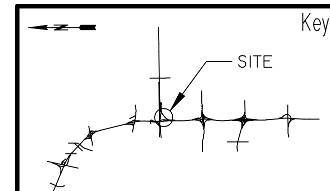


ELEVATION - S-E RAMP
LOOKING NORTHEAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
S-E RAMP OVER
ANTHONY HENDAY DR & YELLOWHEAD TR

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 18	18-A-5.13	NE ANTHONY HENDAY DRIVE		13 of 38

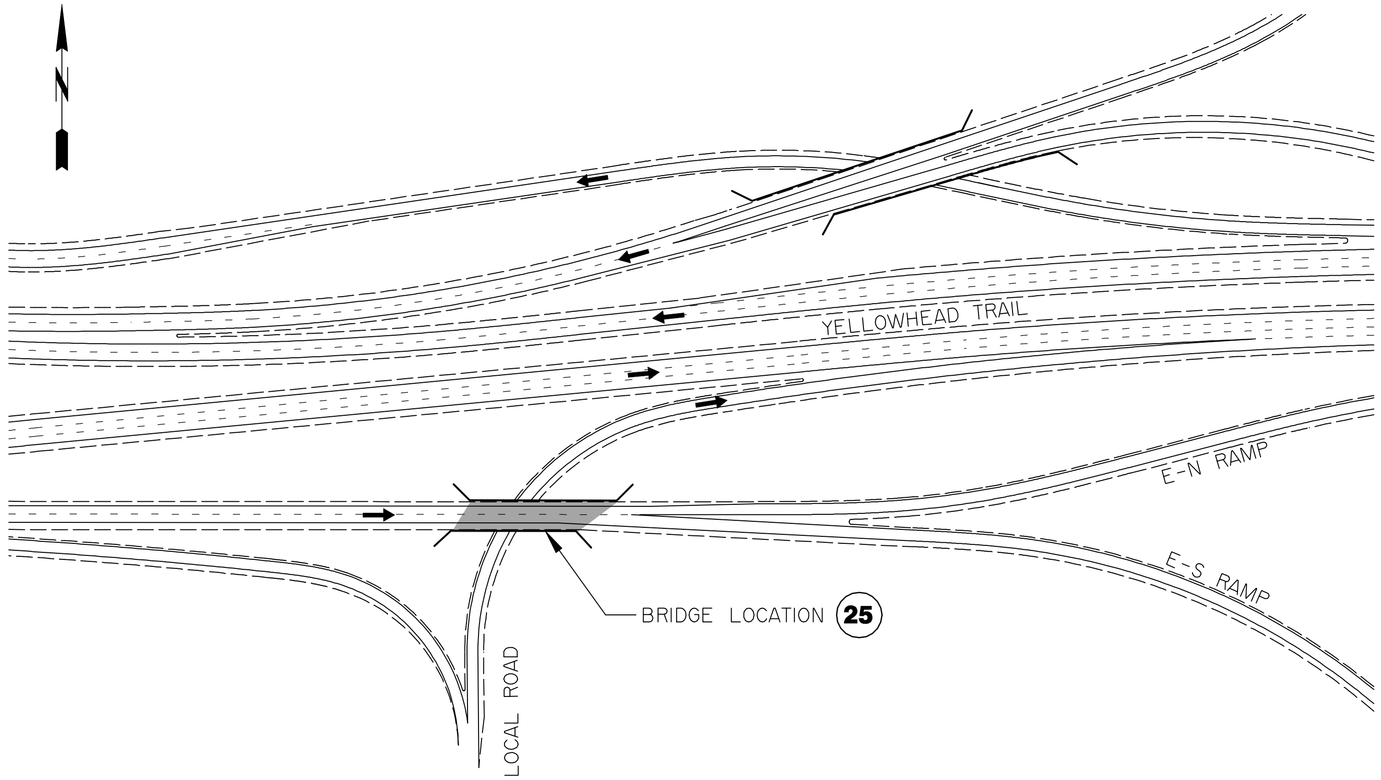
Government of Alberta
Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

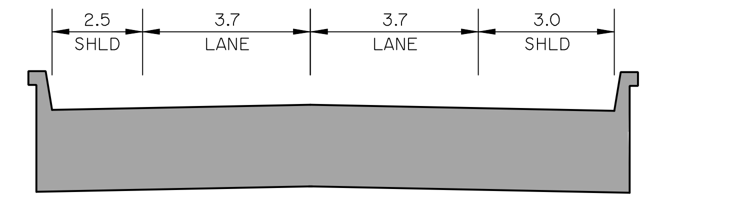
PHOTO NO. / TITLE SEARCH DATE / GRAPHICS FILE
PLAN NO. / CONTRACT NO. / SITE NO.
BAR CODE
PLAN DESCRIPTION

SCHED18 BRIDGE
18-A-5.13_EX.DGN 2012-04-11 NH

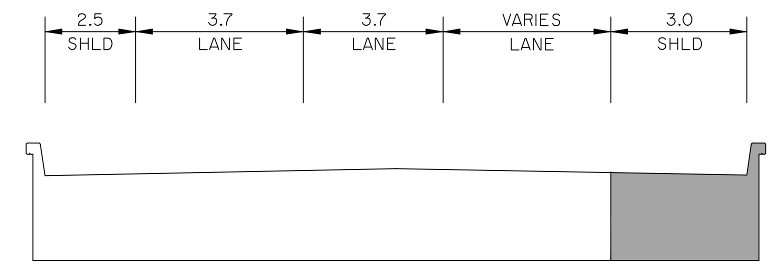


SITE PLAN - STAGE I

NTS



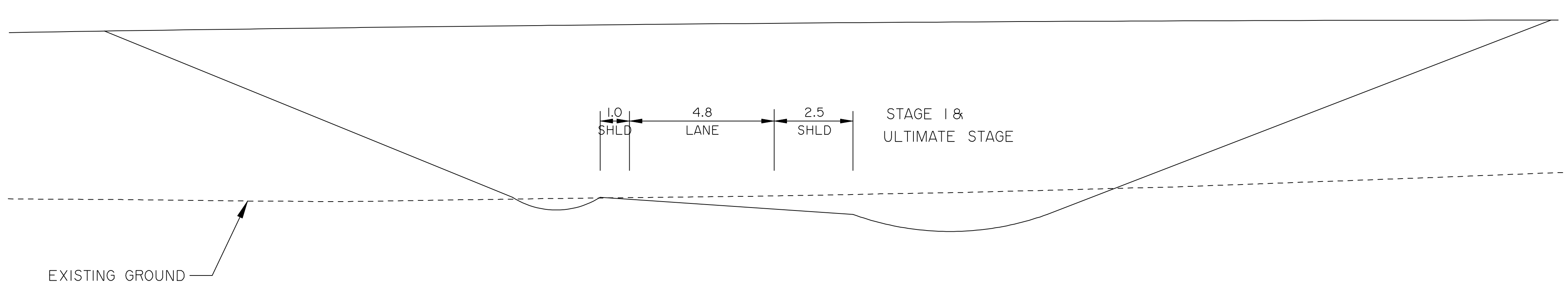
STAGE I



ULTIMATE STAGE

BRIDGE SECTION

LOOKING EAST - NTS

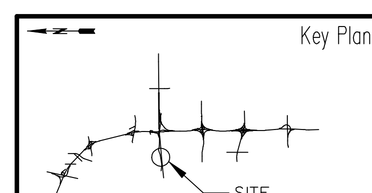


ELEVATION - ANTHONY HENDAY DRIVE E-S RAMP

LOOKING NORTH - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS

ANTHONY HENDAY DRIVE E-S RAMP
OVER LOCAL ROAD

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 25	18-A-5.14	NE ANTHONY HENDAY DRIVE		14 of 38

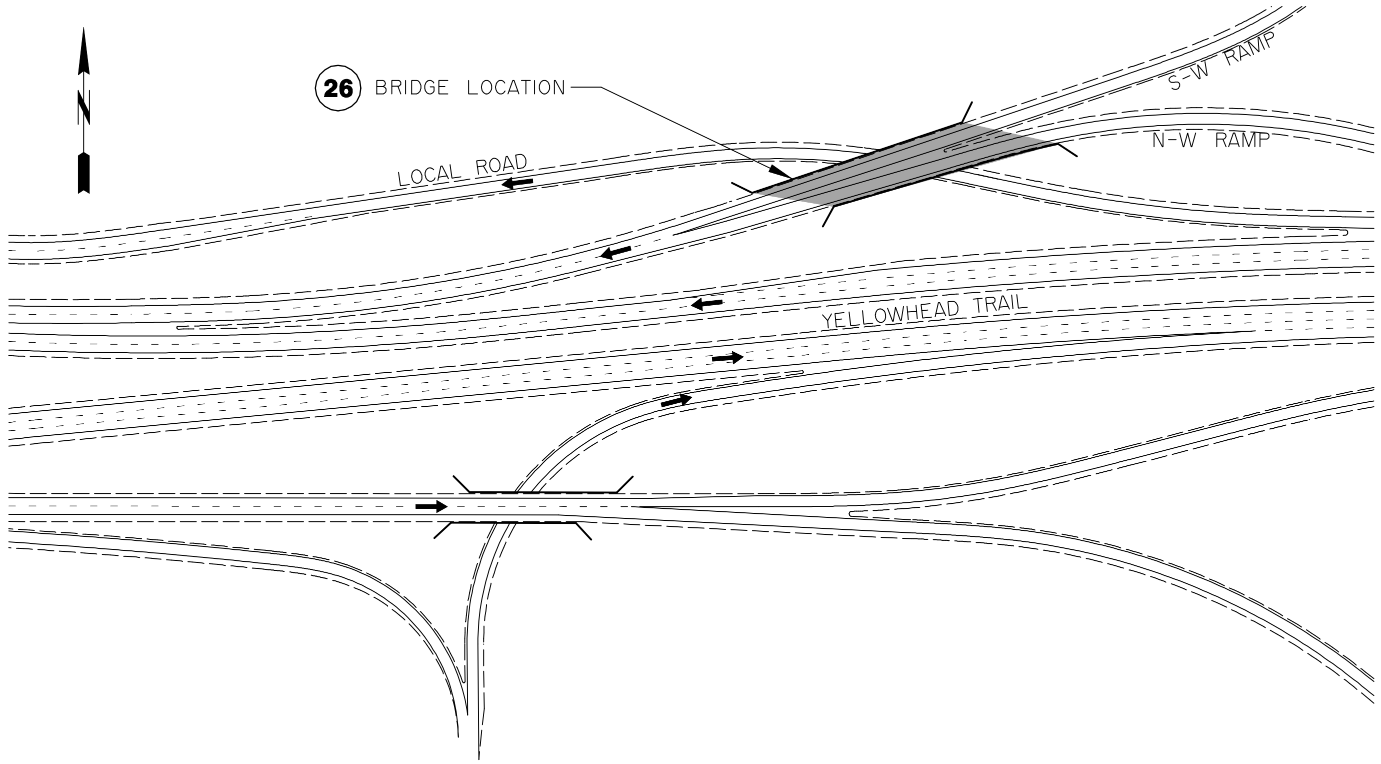
Government of Alberta ■
Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

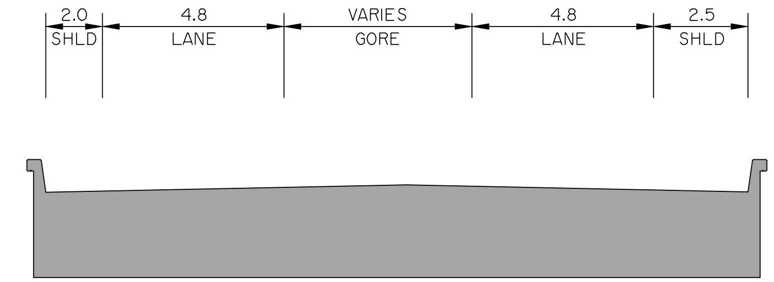
PHOTO NO.
TITLE SEARCH DATE
GRAPHICS FILE
PLAN NO.
CONTRACT NO.
SITE NO.
BAR CODE
PLAN DESCRIPTION

NH 18-A-5.14_EX.DGN 2012-04-11 SCHED18 BRIDGE



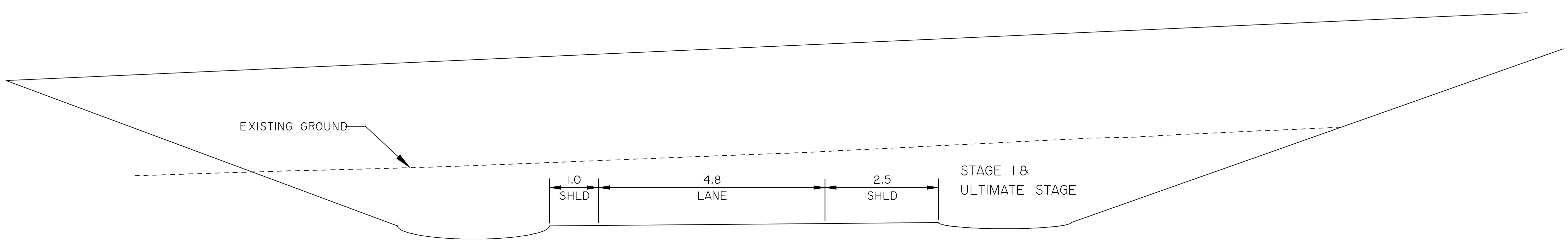
SITE PLAN - STAGE I

NTS



BRIDGE SECTION - STAGE I & ULTIMATE STAGE

LOOKING WEST - NTS



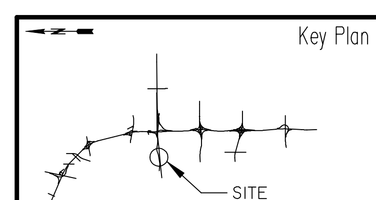
ELEVATION - ANTHONY HENDAY DRIVE N-W / S-W RAMP

LOOKING NORTHWEST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
ANTHONY HENDAY DRIVE N-W RAMP
OVER LOCAL ROAD

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 26	18-A-5.15	NE ANTHONY HENDAY DRIVE		15 of 38

Government of Alberta
Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

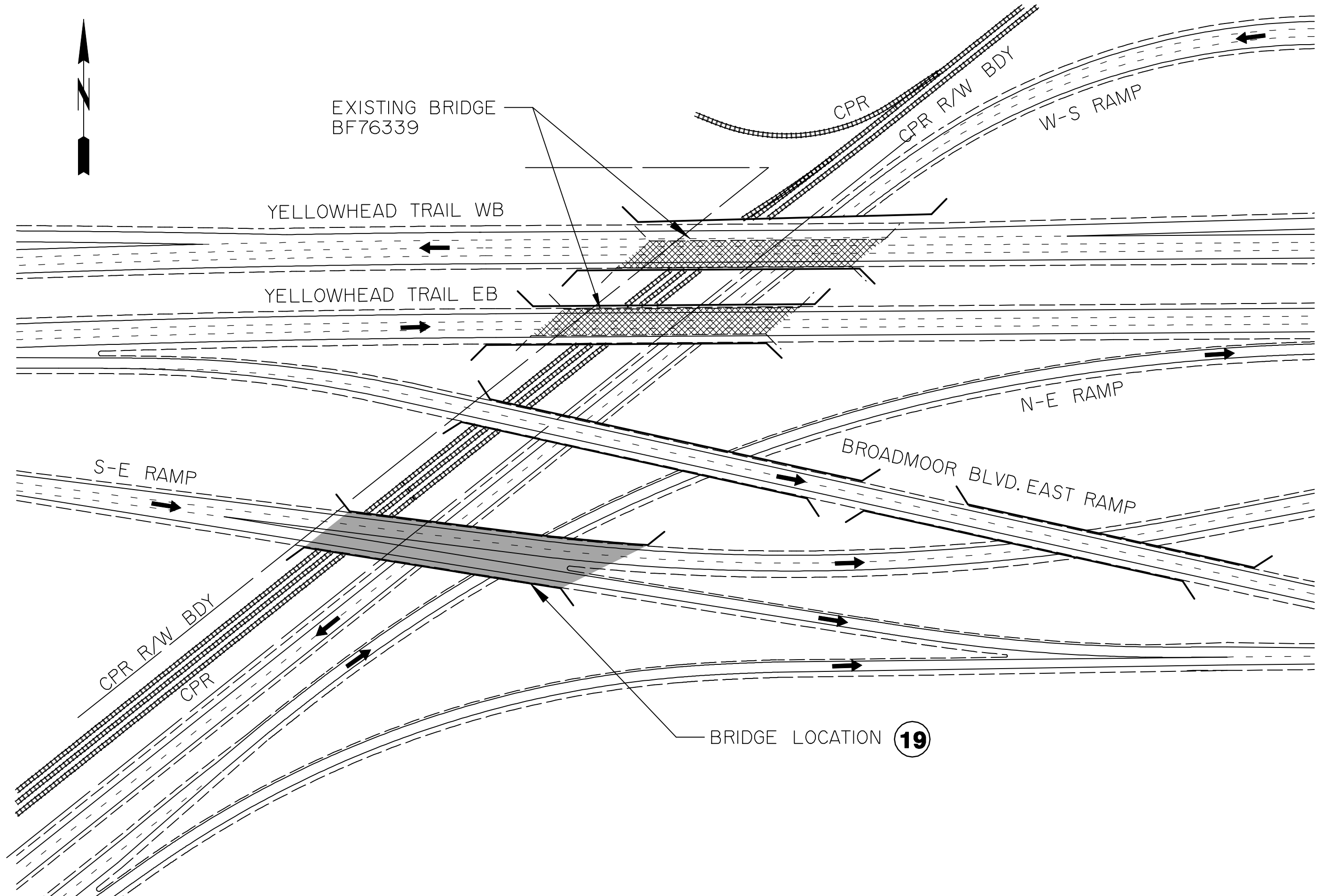
PHOTO NO. TITLE SEARCH DATE GRAPHICS FILE

PLAN NO. CONTRACT NO. SITE NO.

BAR CODE

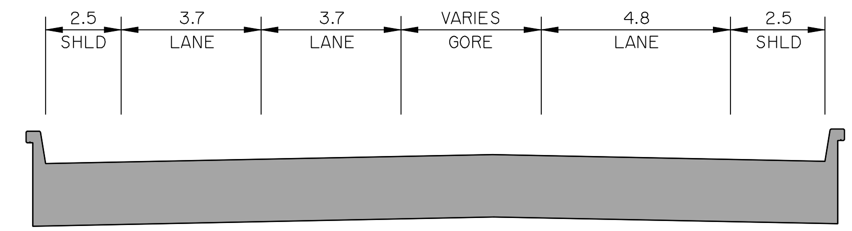
PLAN DESCRIPTION

NH 18-A-5.15_EX.DGN 2012-04-11 SCHED18 BRIDGE



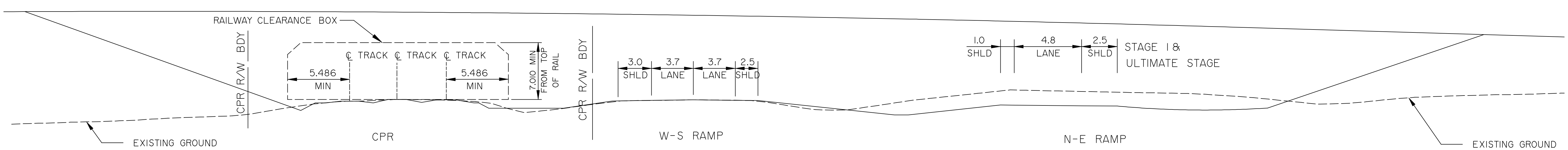
SITE PLAN - STAGE I

NTS



BRIDGE SECTION STAGE I & ULTIMATE STAGE

LOOKING EASTERLY - NTS

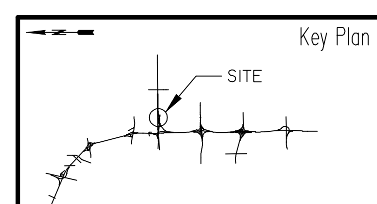


ELEVATION - S-E RAMP

LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
ANTHONY HENDAY DRIVE S-E RAMP OVER
W-S RAMP, N-E RAMP & CPR (WILLINGDON)

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 19	18-A-5.16	NE ANTHONY HENDAY DRIVE		16 of 38

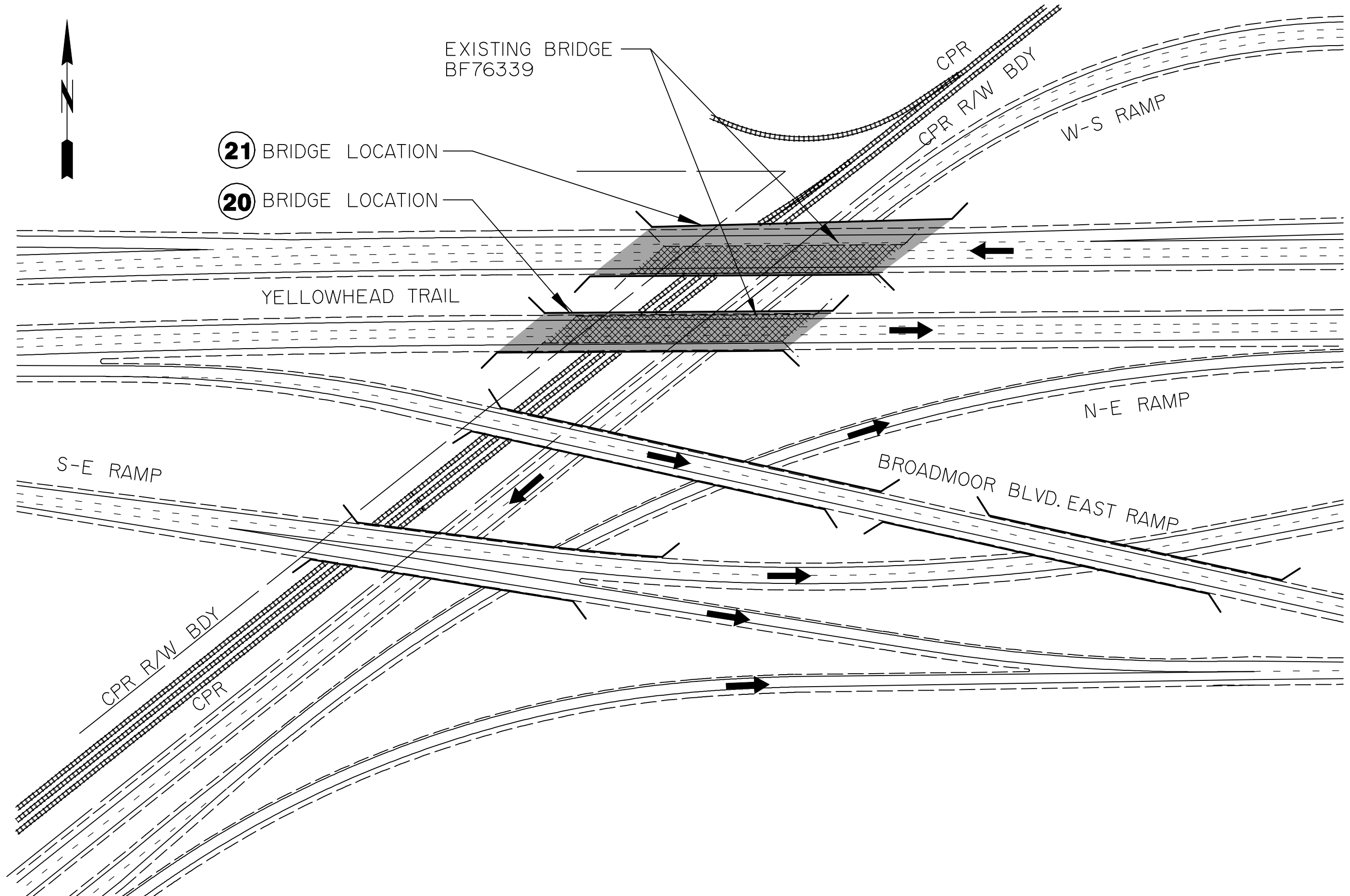
Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

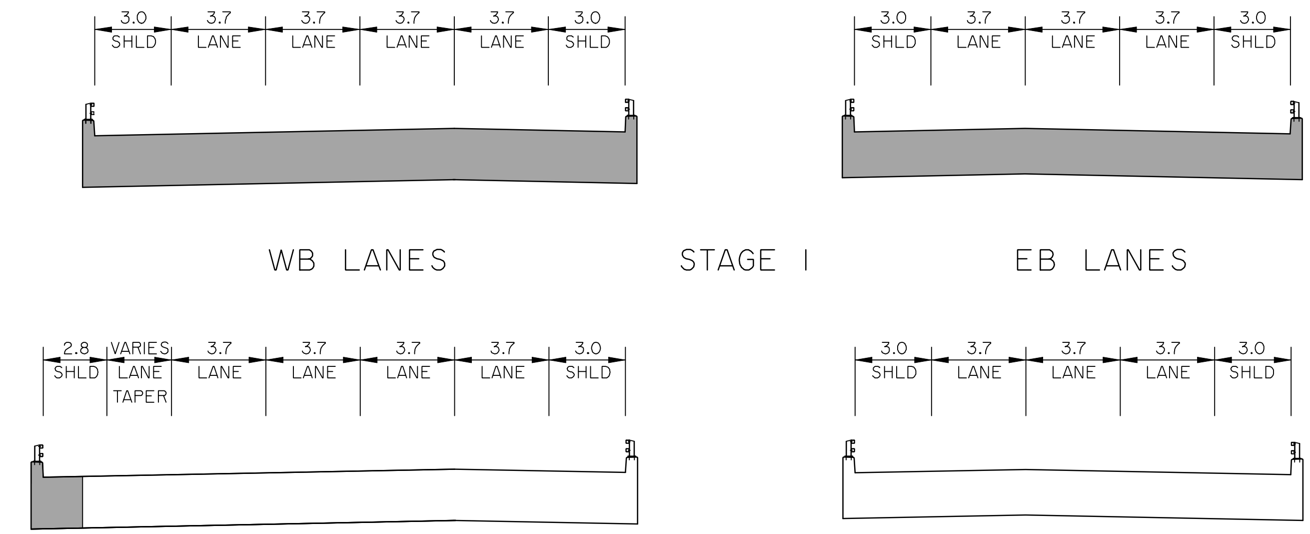
SURVEYED / DESIGNED J CHAPMAN / CHECKED W KRAUSE / DRAWN WTS

PLAN No. / CONTRACT No. / SITE No. / PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE / PLAN DESCRIPTION / BAR CODE

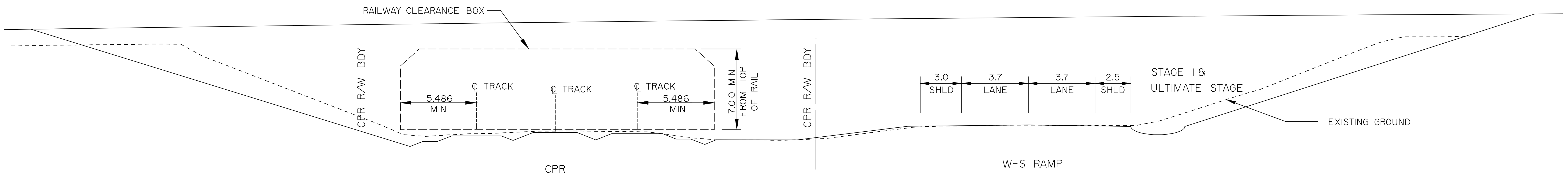
NH 18-A-5.16_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE I
NTS



BRIDGES SECTION
LOOKING EASTERLY - NTS

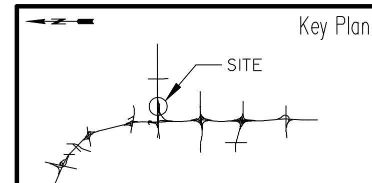


ELEVATION - YELLOWHEAD TRAIL EB
LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76339.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
YELLOWHEAD TR OVER ANTHONY HENDAY DR
W-S RAMP & CPR (WILLINGDON)

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 20/21	18-A-5.17	NE ANTHONY HENDAY DRIVE		17 of 38

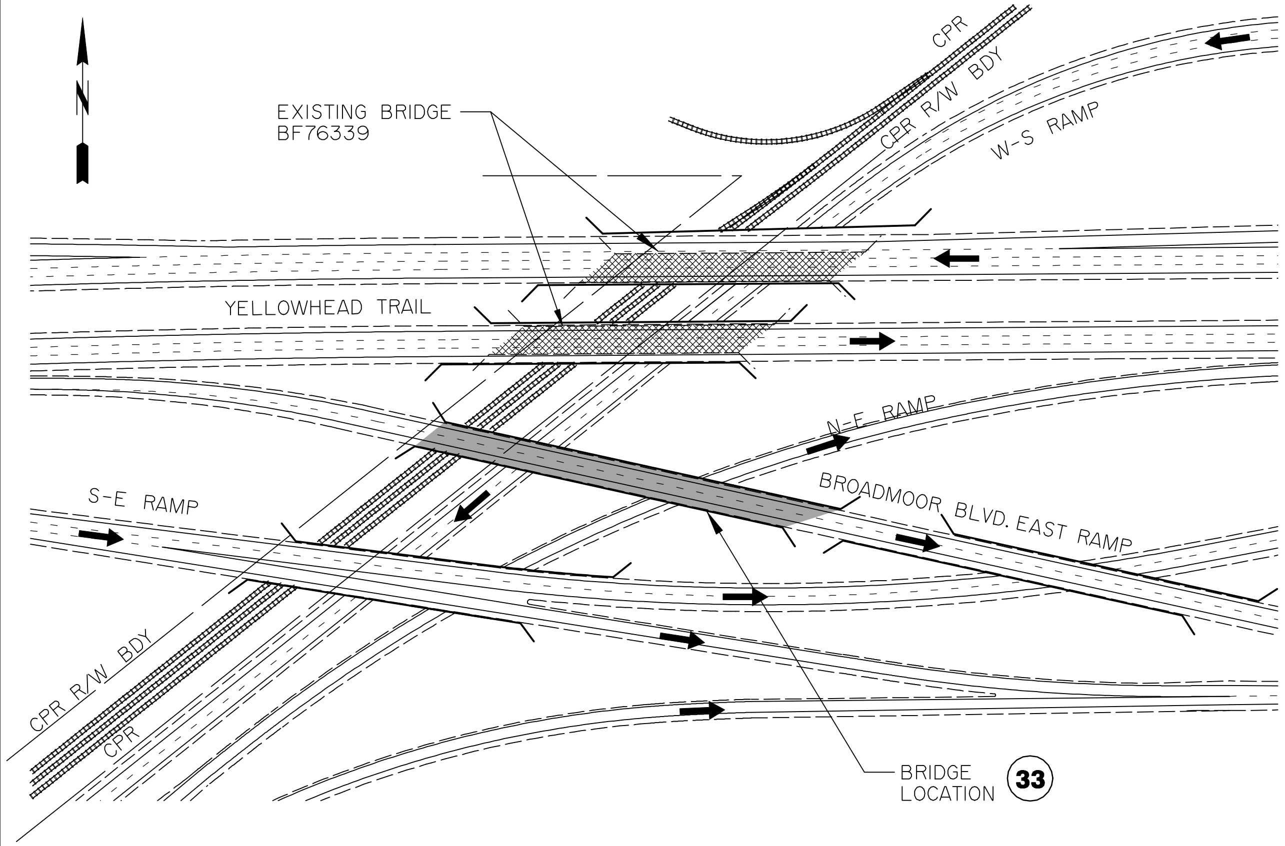
Government of Alberta
Transportation

No.	REVISION	DATE	BY
0	EXECUTION VERSION		NH

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

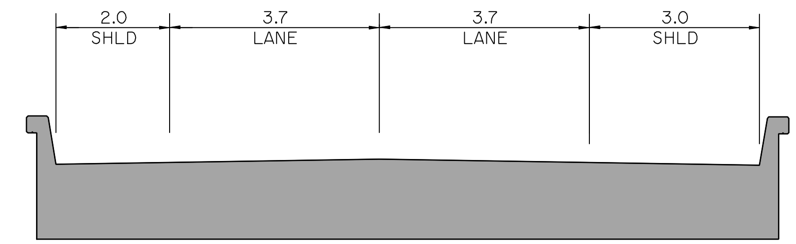
PLAN DESCRIPTION
BAR CODE
PLAN No.
CONTRACT No.
SITE No.
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

NH 18-A-5.17_EX.DGN 2012-04-11 SCHED18 BRIDGE



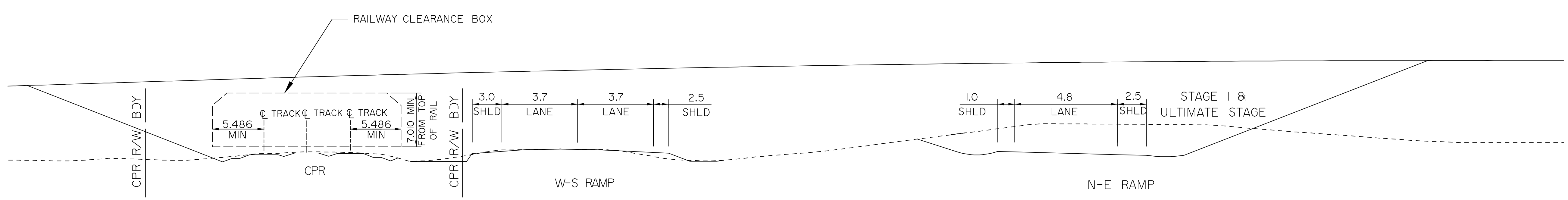
SITE PLAN - STAGE I

NTS



BRIDGE SECTION - STAGE I & ULTIMATE STAGE

LOOKING EASTERLY - NTS



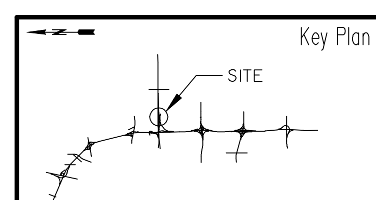
ELEVATION - BROADMOOR BLVD EAST RAMP

LOOKING EASTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
BROADMOOR BLVD EAST RAMP OVER
W-S RAMP, N-E RAMP & CPR (WILLINGDON)

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 33	18-A-5.18	NE ANTHONY HENDAY DRIVE		18 of 38

Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

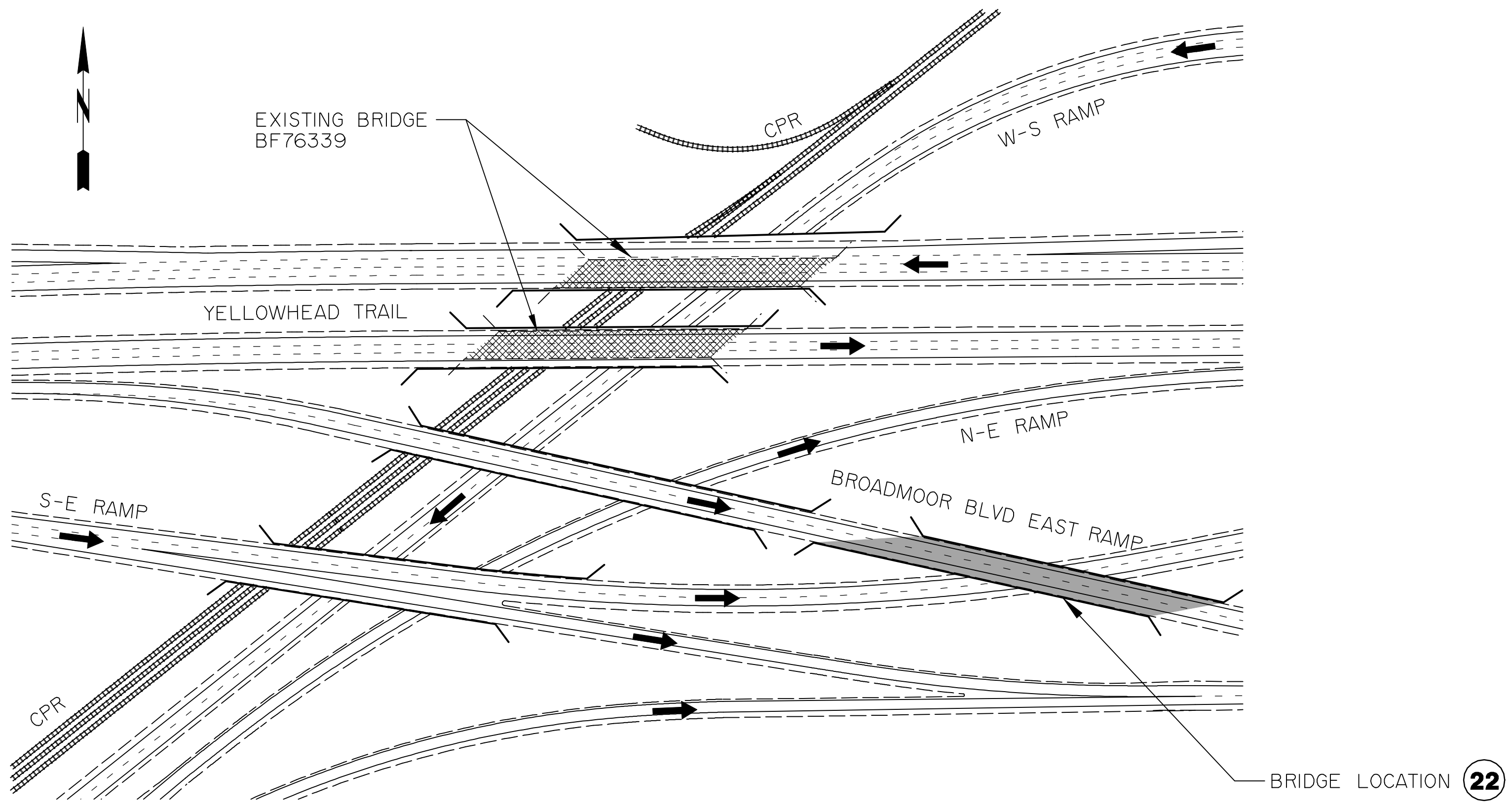
PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE

PLAN No. / CONTRACT No. / SITE No.

BAR CODE

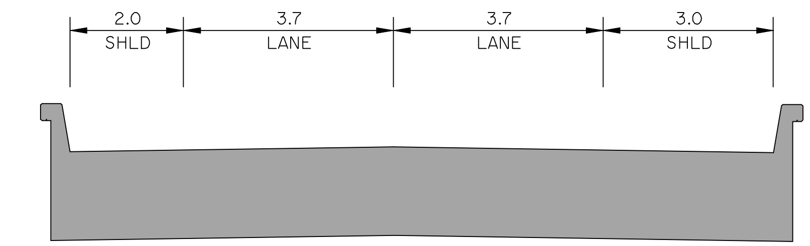
PLAN DESCRIPTION

NH 18-A-5.18_EX.DGN 2012-04-11 SCHED18 BRIDGE



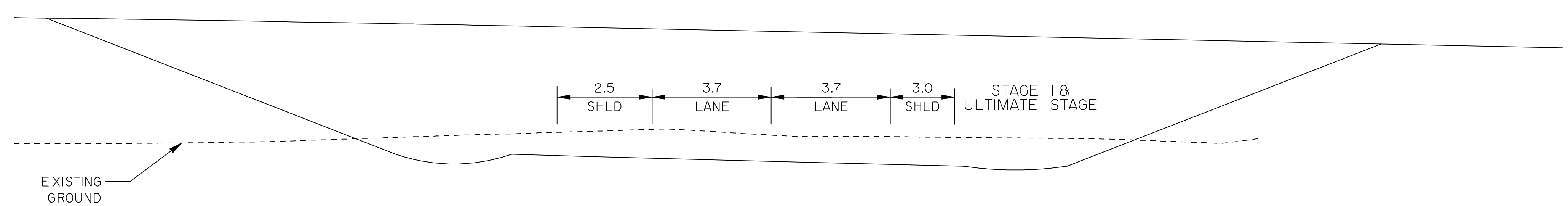
SITE PLAN - STAGE 1

NTS



BRIDGE SECTION - STAGE 1 & ULTIMATE STAGE

LOOKING EASTERLY - NTS



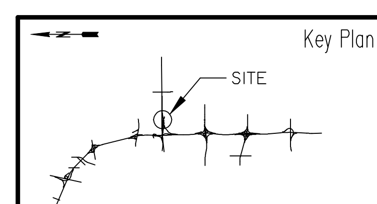
ELEVATION - BROADMOOR BLVD EAST RAMP

LOOKING EASTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
BROADMOOR BLVD EAST RAMP OVER
ANTHONY HENDAY DRIVE S-E RAMP

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 22	18-A-5.19	NE ANTHONY HENDAY DRIVE		19 of 38

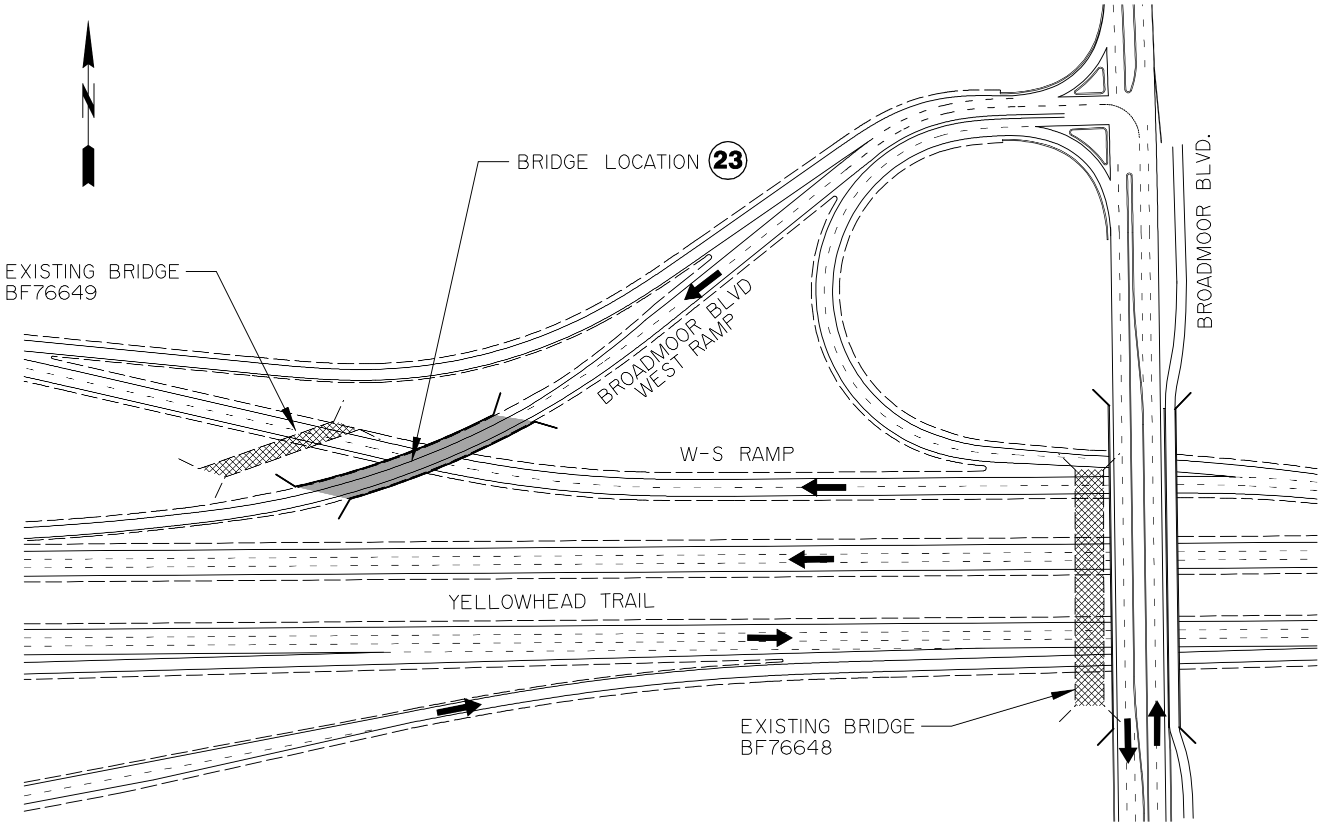
Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

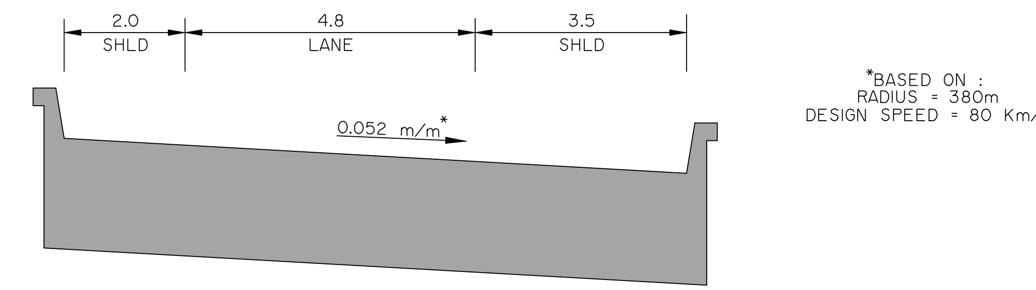
	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE
PLAN No.
CONTRACT No.
SITE No.
BAR CODE
PLAN DESCRIPTION

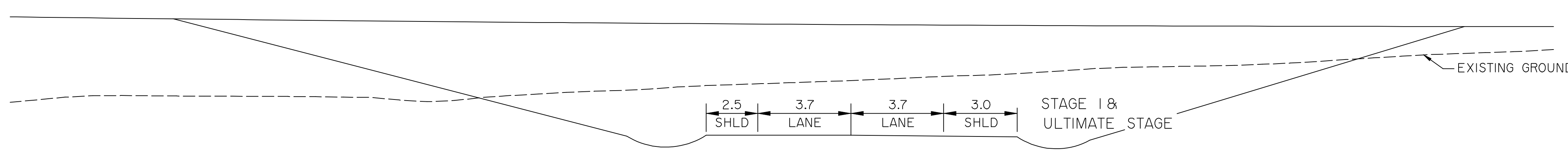
NH 18-A-5.19-EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE I
NTS



BRIDGE SECTION - STAGE I & ULTIMATE STAGE
LOOKING WEST - NTS



ELEVATION BROADMOOR BLVD WEST RAMP
LOOKING WESTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76649.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan
SITE

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
BROADMOOR BLVD WEST RAMP OVER
ANTHONY HENDAY DRIVE W-S RAMP

Government of Alberta
Transportation

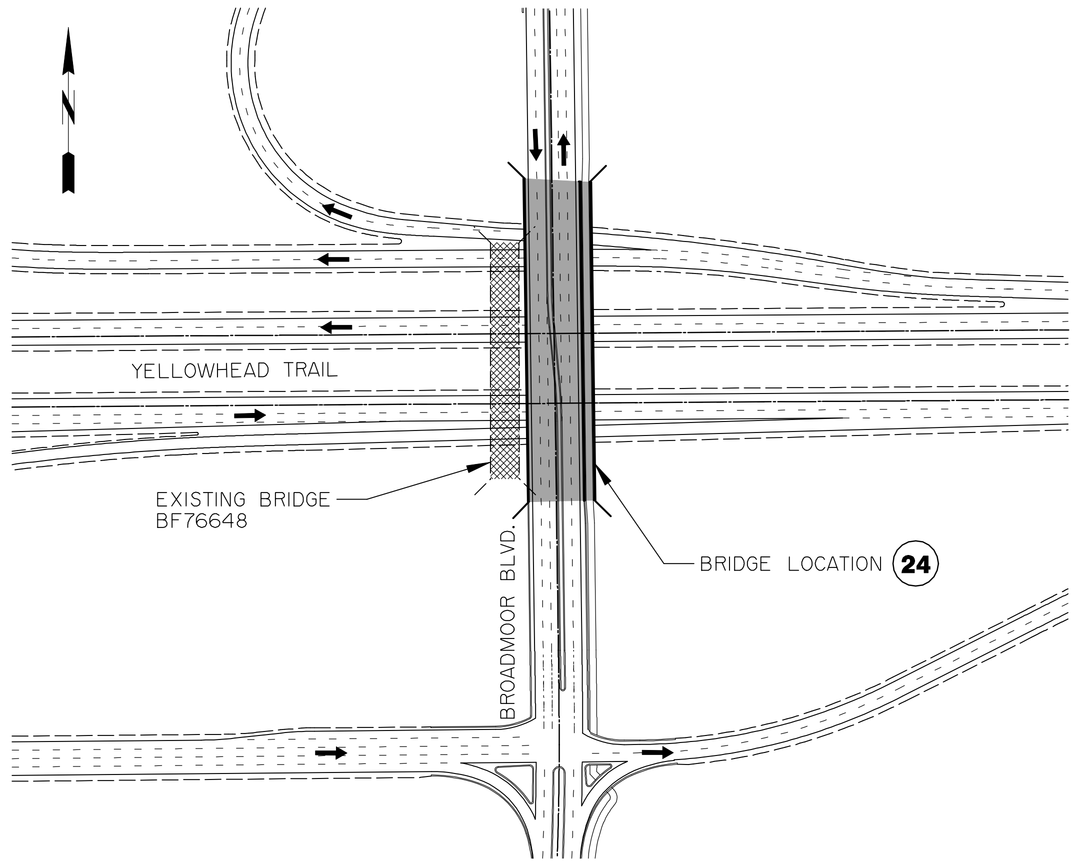
REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 23	18-A-5.20	NE ANTHONY HENDAY DRIVE		20 of 38

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

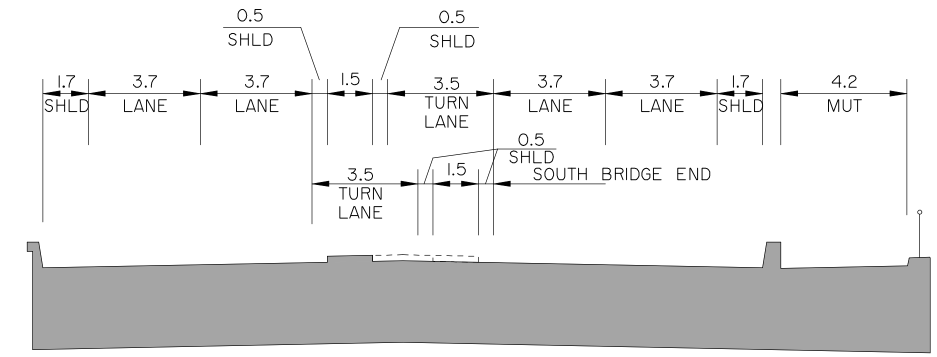
PLAN DESCRIPTION
BAR CODE
PLAN NO.
CONTRACT NO.
SITE NO.
PHOTO NO.
TITLE SEARCH DATE
GRAPHICS FILE

18-A-5.20_EX.DGN 2012-04-11 SCHED18 BRIDGE NH

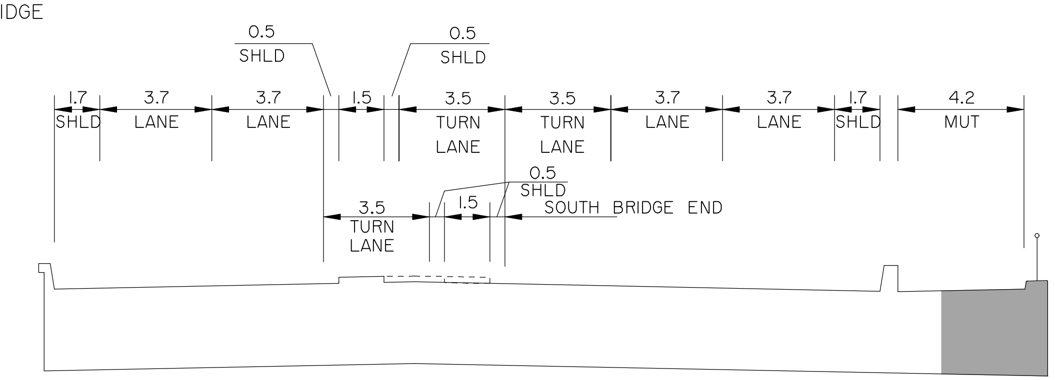


SITE PLAN - STAGE I
NTS

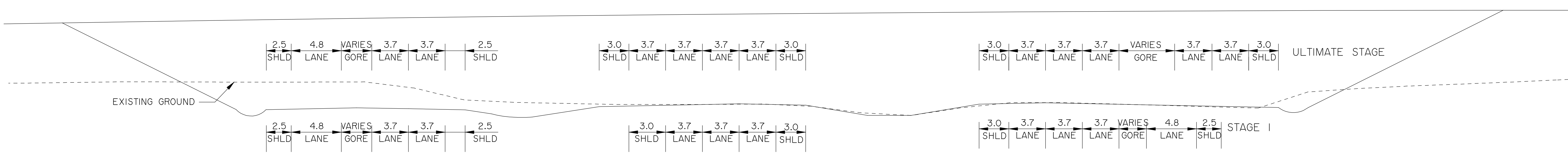
NOTE:
BRIDGE SECTION SHOWN IS AT THE NORTH END OF BRIDGE. THE RAISED MEDIAN ACROSS THE BRIDGE MOVES OVER TO THE EAST TO ALLOW FOR A 3.5 m SB TURNING LANE AT THE SOUTH END OF THE BRIDGE



BRIDGE SECTION - STAGE I
LOOKING NORTH - NTS



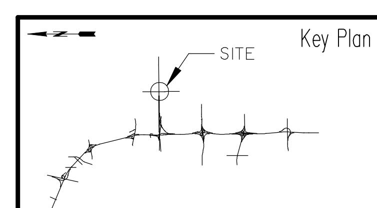
BRIDGE SECTION - ULTIMATE STAGE
LOOKING NORTH - NTS



ELEVATION - BROADMOOR BLVD.
LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76648.
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
BROADMOOR BLVD OVER
YELLOWHEAD TRAIL

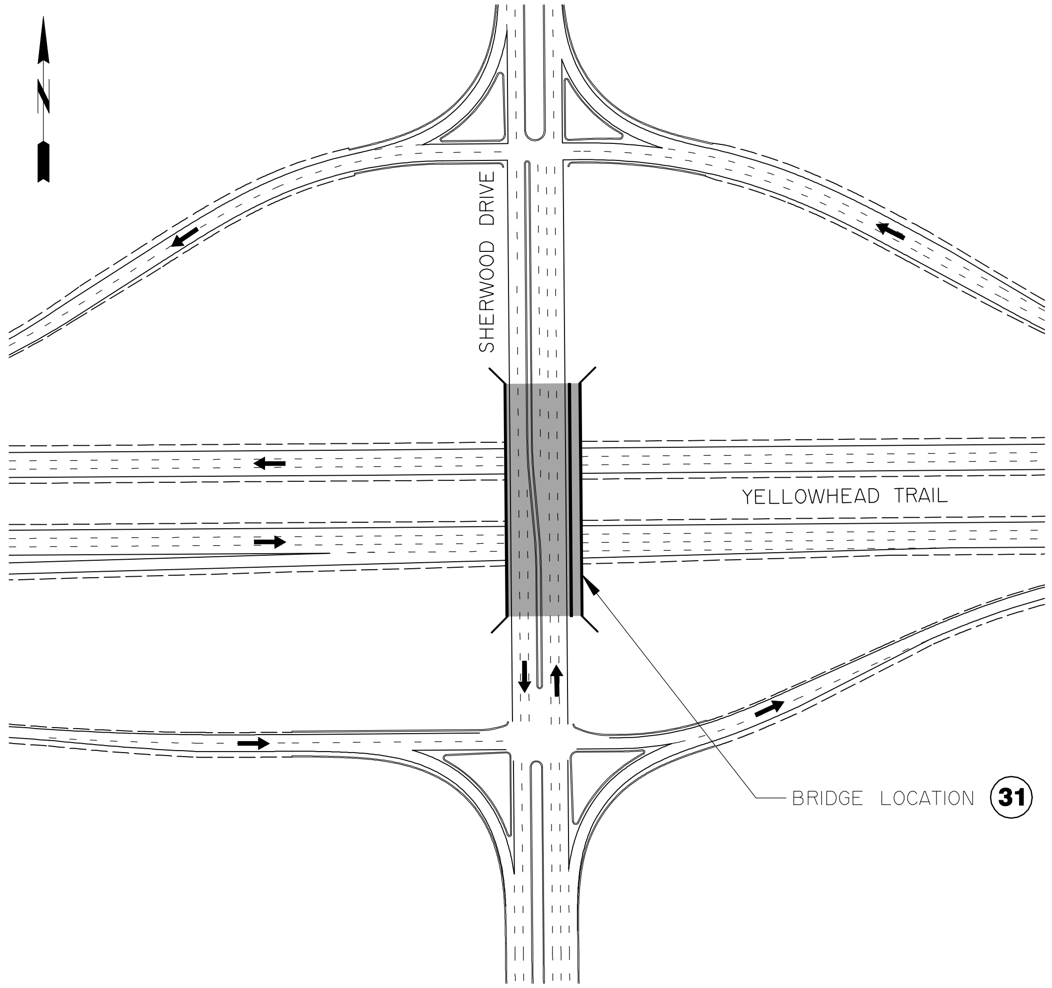
REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 24	18-A-5.21	NE ANTHONY HENDAY DRIVE		21 of 38

Government of Alberta
Transportation

PLAN DESCRIPTION
BAR CODE
PLAN NO. CONTRACT NO. SITE NO.
PHOTO NO. TITLE SEARCH DATE GRAPHICS FILE
DATE BY
SURVEYED J CHAPMAN
DESIGNED W KRAUSE
CHECKED WTS
DRAWN

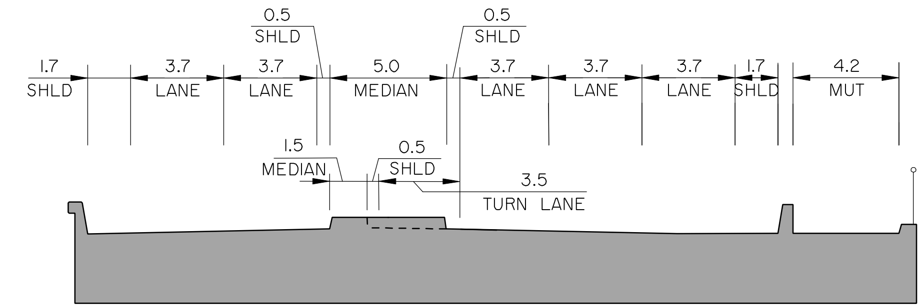
NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SCHED18 BRIDGE
2012-04-11
18-A-5.21_EX.DGN
NH



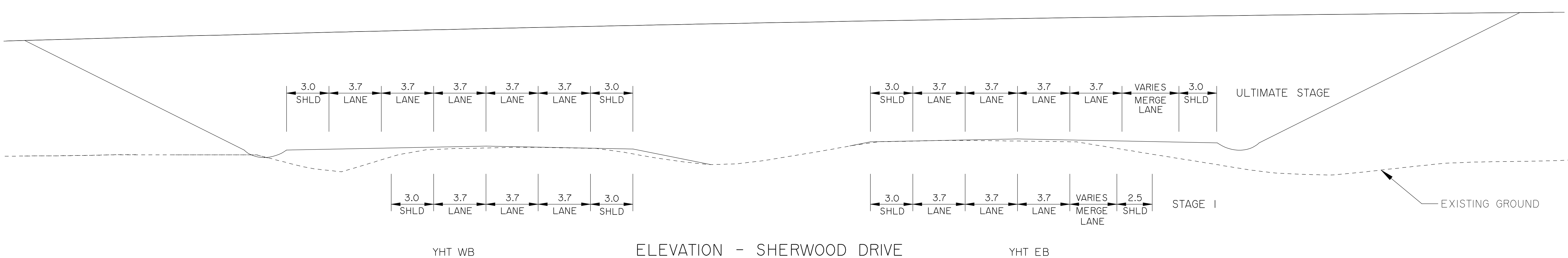
SITE PLAN - STAGE 1

NTS



BRIDGE SECTION - STAGE 1 & ULTIMATE STAGE

LOOKING NORTH - NTS

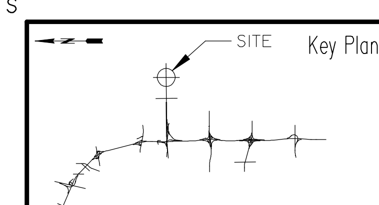


ELEVATION - SHERWOOD DRIVE

LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
SHERWOOD DRIVE OVER
YELLOWHEAD TRAIL

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 31	18-A-5.22	NE ANTHONY HENDAY DRIVE		22 of 38

Government of Alberta ■ Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

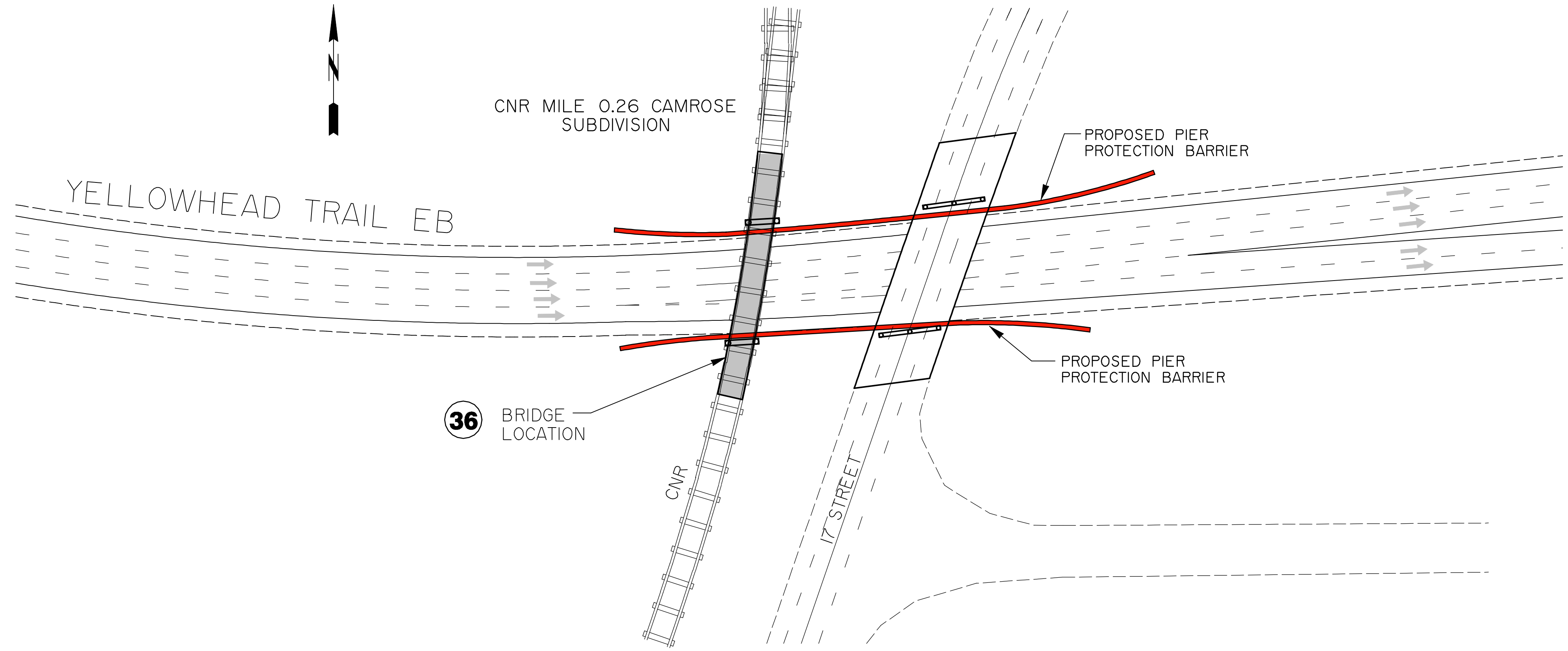
PHOTO NO. TITLE SEARCH DATE GRAPHICS FILE

PLAN NO. CONTRACT NO. SITE NO.

BAR CODE

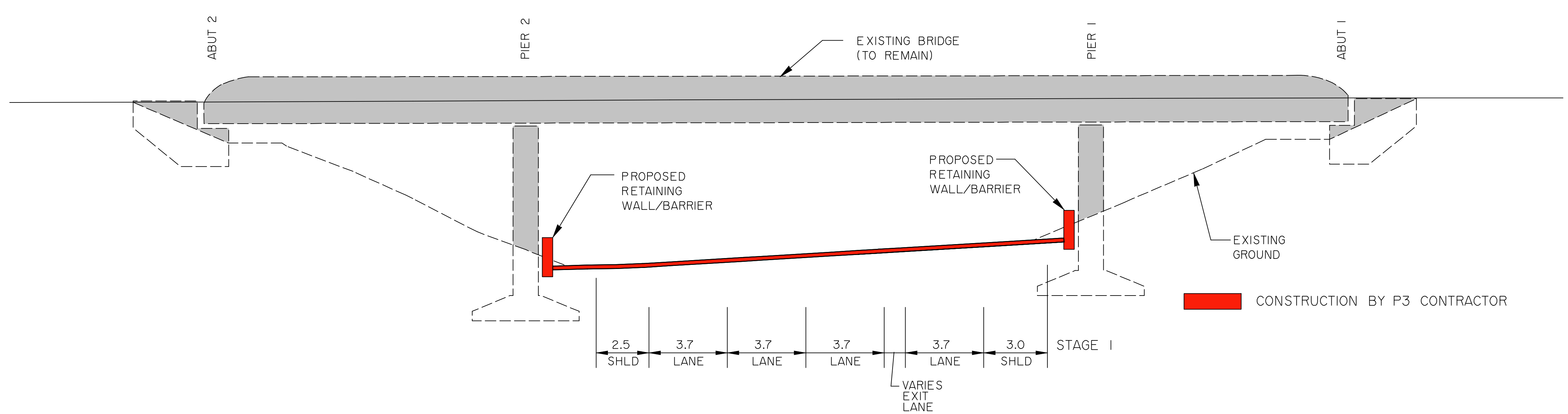
PLAN DESCRIPTION

NH 18-A-5.22_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE 1

NTS



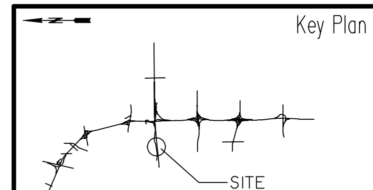
ELEVATION - CNR

LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA
3. ALL DIMENSIONS SHOWN IN METERS
4. BRIDGE IS ON AN APPROXIMATE 291 m HORIZONTAL CURVE
5. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76655
6. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY
7. REFER TO SCHEDULE 18 SECTION 200.2.3.7.6 FOR FURTHER DETAILS

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
CNR MILE 0.26 CAMROSE SUBDIVISION OVER
YELLOWHEAD TRAIL EB

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 36	18-A-5.23	NE ANTHONY HENDAY DRIVE		23 of 38

Government of Alberta
Transportation

PLAN DESCRIPTION

BAR CODE

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	NH	

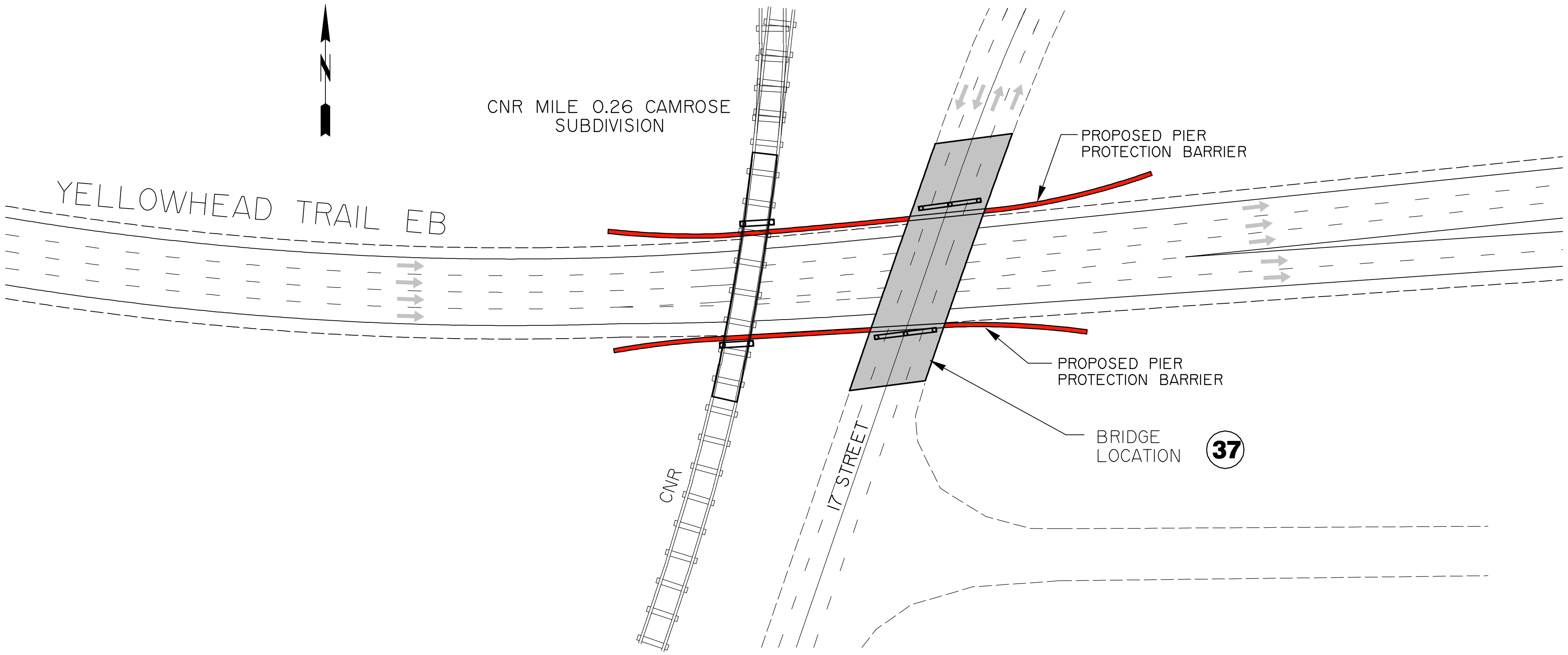
No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SCHED18 BRIDGE

2012-04-11

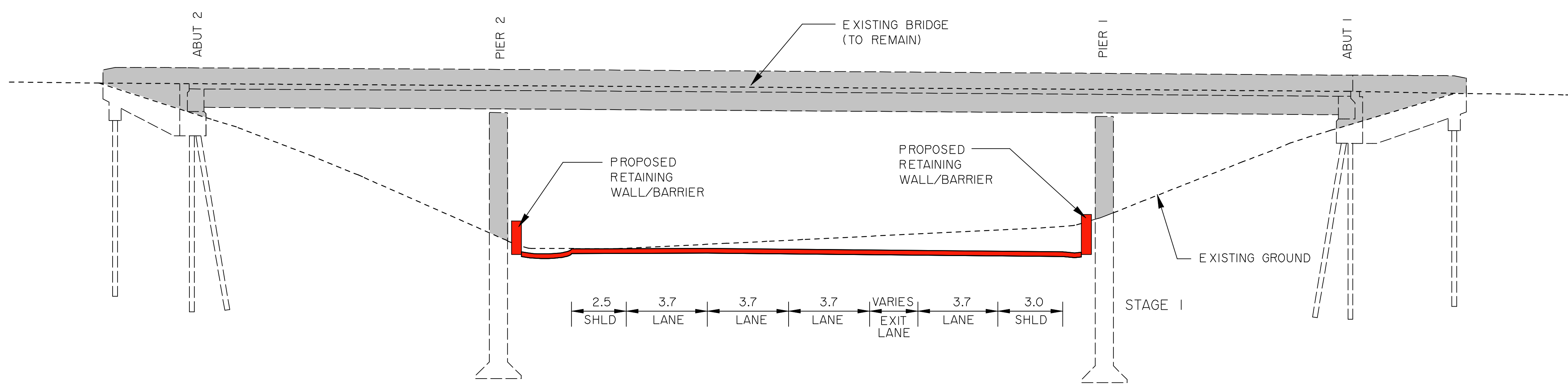
18-A-5.23_EX.DGN

NH



SITE PLAN - STAGE 1

NTS



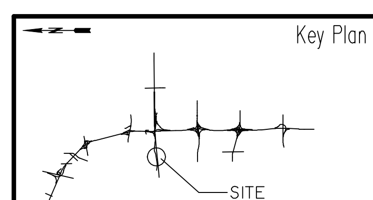
ELEVATION - 17 STREET

LOOKING EAST - NTS

CONSTRUCTION BY P3 CONTRACTOR

NOTES

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA
3. ALL DIMENSIONS SHOWN IN METERS
4. THERE IS AN EXISTING BRIDGE AT THIS SITE BF76654
5. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
17 STREET OVER
YELLOWHEAD TRAIL EB

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 37	18-A-5.24	NE ANTHONY HENDAY DRIVE		24 of 38

Government of Alberta ■
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	NH	

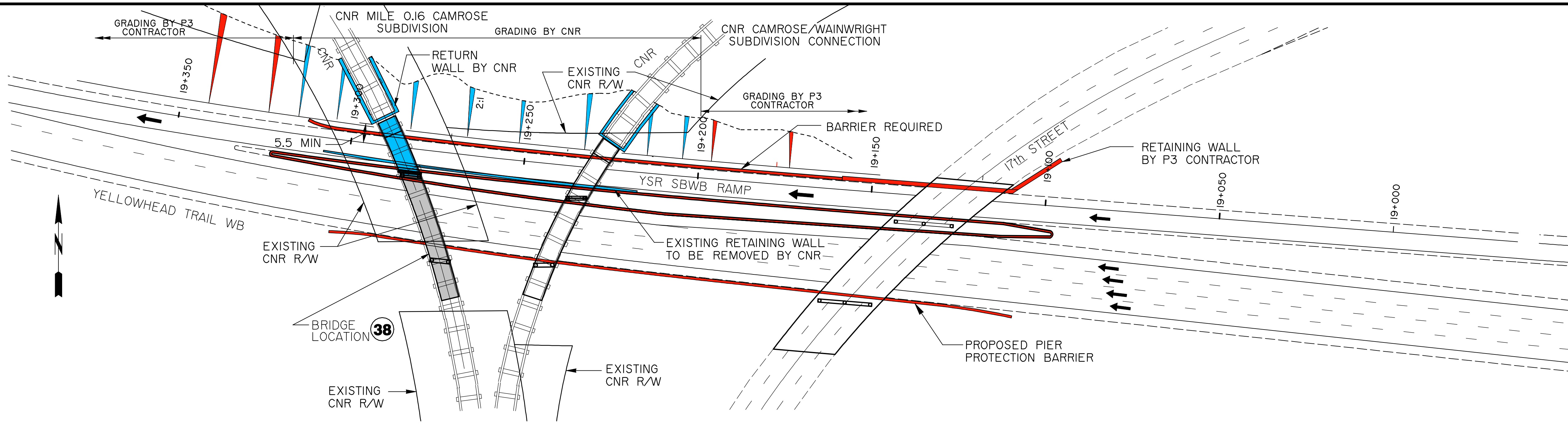
PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE

PLAN No. / CONTRACT No. / SITE No.

BAR CODE

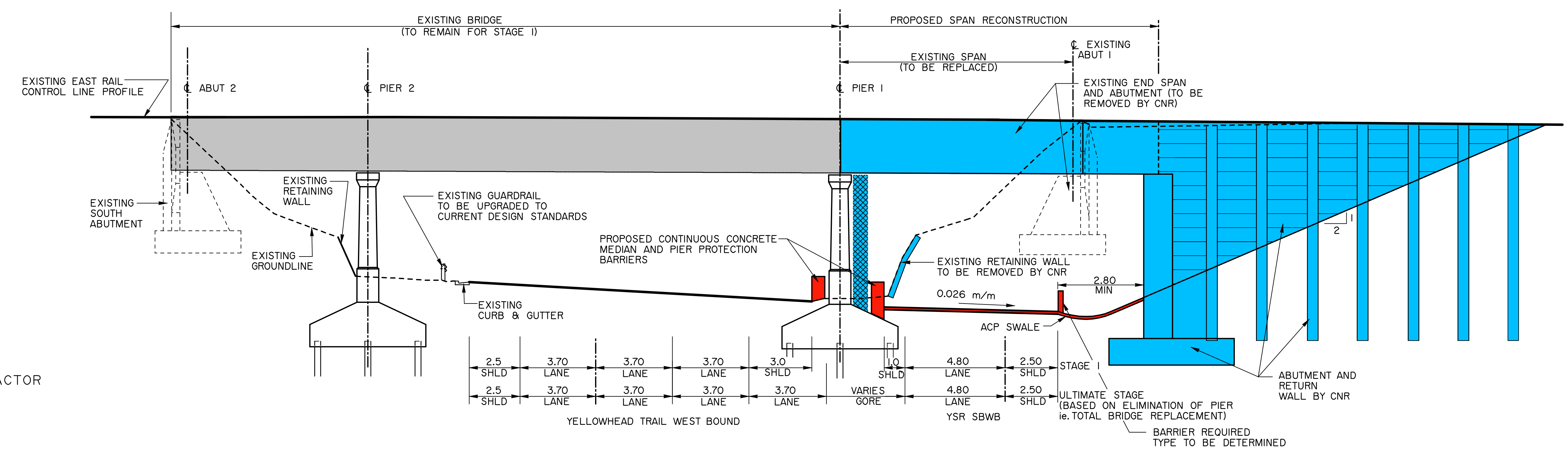
PLAN DESCRIPTION

NH 18-A-5.24_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN – STAGE I

NTS



CONSTRUCTION BY CNR

CONSTRUCTION BY P3 CONTRACTOR

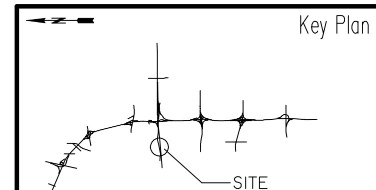
ELEVATION – CNR NORTHBOUND-WESTBOUND

LOOKING WESTERLY (WEST LEG OF WYE) NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA
3. ALL DIMENSIONS SHOWN IN METERS
4. BRIDGE IS ON AN APPROXIMATE 292 m HORIZONTAL CURVE
5. THERE IS AN EXISTING BRIDGE AT THIS SITE BF73798
6. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY
7. REFER TO SCHEDULE 18 SECTION 200.2.3.7.6 FOR FURTHER DETAILS
8. REFER TO CNR's DRAWINGS AA515-0.16-7.01 AND AA515-0.16-7.02 FOR ADDITIONAL DETAILS

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 – APPENDIX A
BRIDGE INFORMATION DRAWINGS
CNR MILE 0.16 CAMROSE SUBDIVISION OVER YELLOWHEAD TRAIL WB

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 38	18-A-5.25	NE ANTHONY HENDAY DRIVE		25 of 38

Government of Alberta ■ Transportation

No.	REVISION	DATE	BY
0	EXECUTION VERSION		NH

PLAN DESCRIPTION

BAR CODE

PLAN No. / CONTRACT No. / SITE No.

PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE

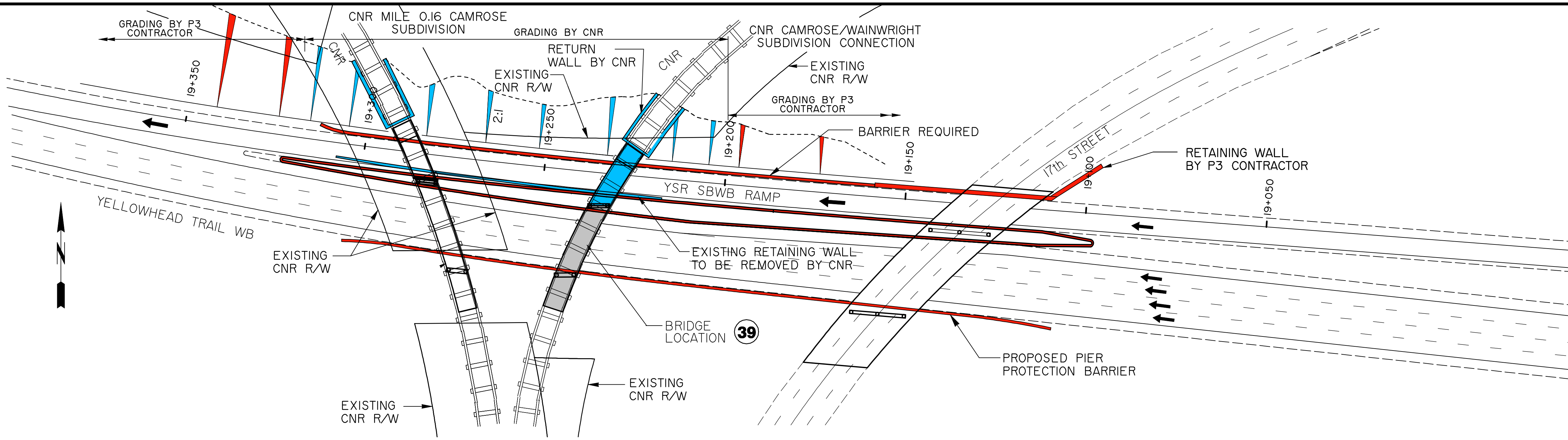
	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	NH	

SCHED18 BRIDGE

2012-04-11

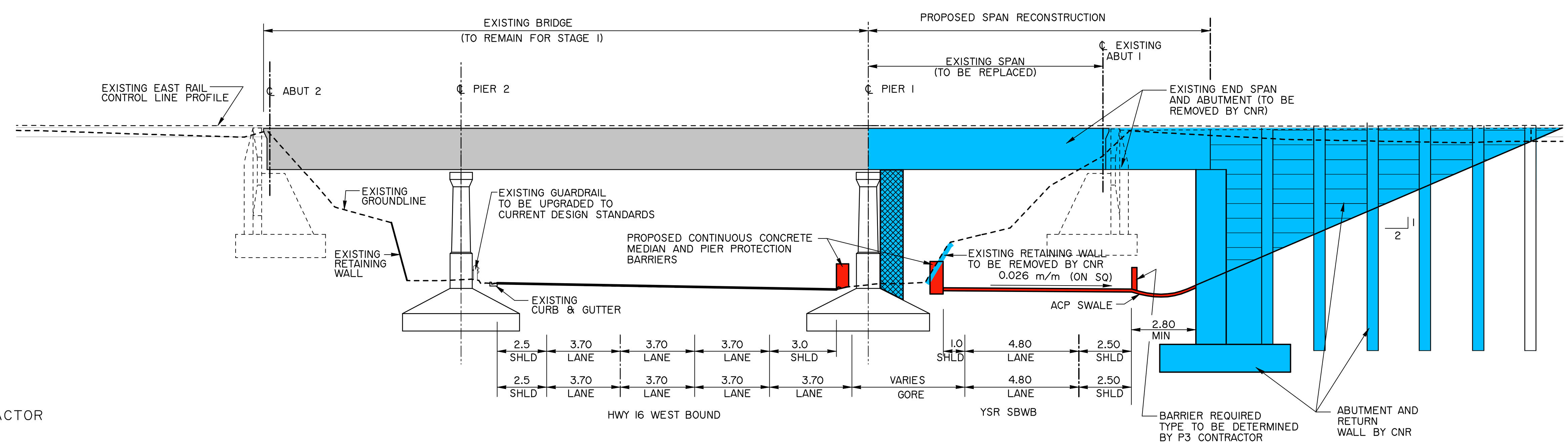
18-A-5.25_EX.DGN

NH



SITE PLAN – STAGE I

NTS



CONSTRUCTION BY CNR

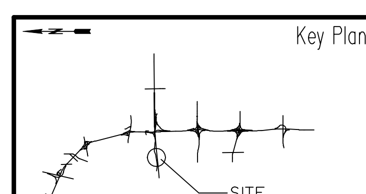
CONSTRUCTION BY P3 CONTRACTOR

ELEVATION – CNR NORTHBOUND-EASTBOUND

LOOKING WESTERLY — (EAST LEG OF WYE) — NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA
3. ALL DIMENSIONS SHOWN IN METERS
4. BRIDGE IS ON AN APPROXIMATE 175 m HORIZONTAL CURVE
5. THERE IS AN EXISTING BRIDGE AT THIS SITE BF82181
6. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY
7. REFER TO SCHEDULE 18 SECTION 200.2.3.7.6 FOR FURTHER DETAILS
8. REFER TO CNR's DRAWINGS AA515-0.16-6.01 AND AA515-0.16-6.02 FOR ADDITIONAL DETAILS



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
CNR CAMROSE/WAINWRIGHT SUBDIVISION CONNECTION OVER YELLOWHEAD TRAIL WB

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 39	18-A-5.26	NE ANTHONY HENDAY DRIVE		26 of 38

Government of Alberta ■ Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	NH	

PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE

PLAN No. / CONTRACT No. / SITE No.

BAR CODE

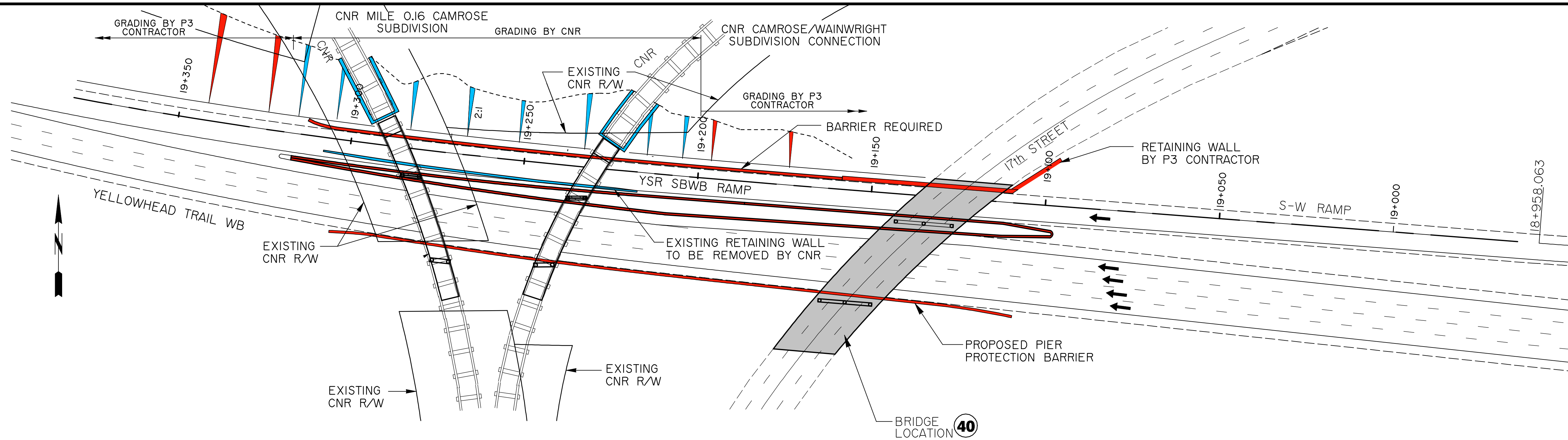
PLAN DESCRIPTION

SCHED18 BRIDGE

2012-04-11

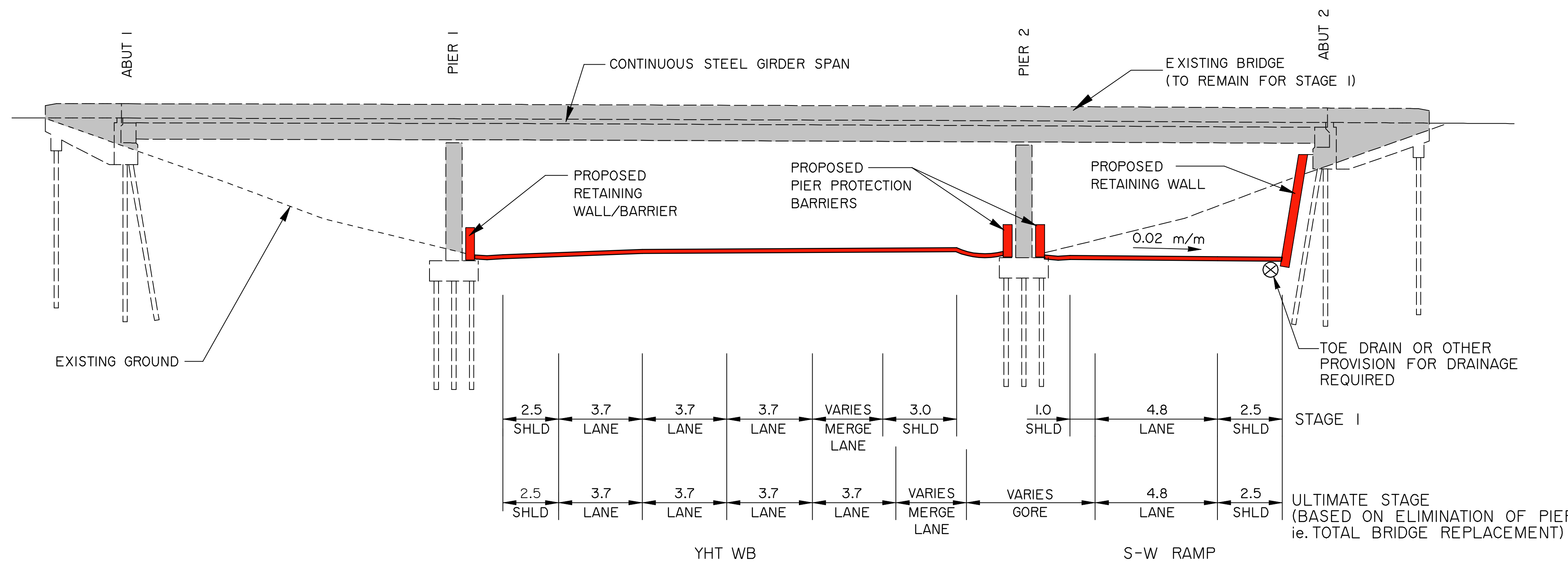
18-A-5.26_EX.DGN

NH



SITE PLAN – STAGE I

NTS



ELEVATION – 17 STREET

LOOKING WEST – NTS

CONSTRUCTION BY CNR

CONSTRUCTION BY P3 CONTRACTOR

NOTES:

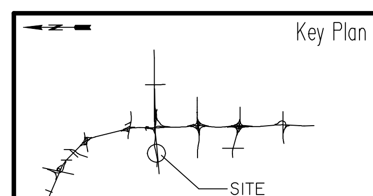
1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA
3. ALL DIMENSIONS SHOWN IN METERS

THERE IS AN EXISTING BRIDGE AT THIS SITE BF76653

SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

REFER TO SCHEDULE 18 SECTION 200.2.3.7.6 FOR FURTHER DETAILS

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 – APPENDIX A
BRIDGE INFORMATION DRAWINGS
17 STREET OVER
YELLOWHEAD TRAIL WB

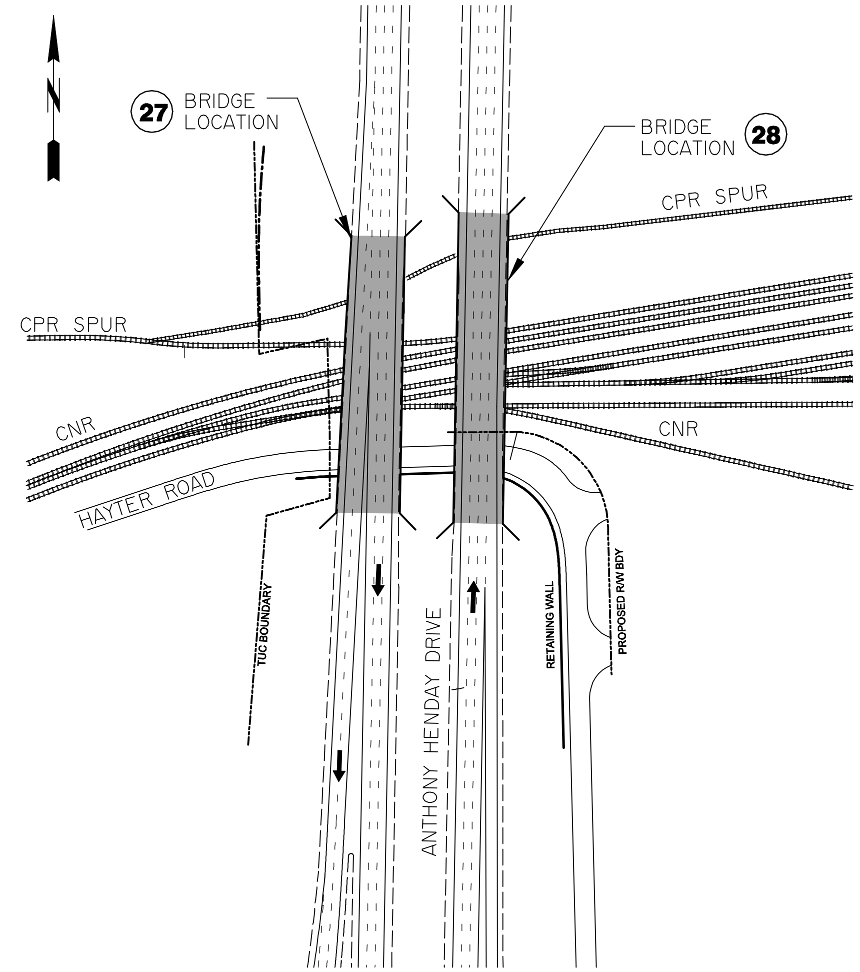
Government of Alberta ■ Transportation

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 40	18-A-5.27	NE ANTHONY HENDAY DRIVE		27 of 38

PLAN DESCRIPTION
BAR CODE
PLAN No.
CONTRACT No.
SITE No.
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE
DATE
BY
SURVEYED
DESIGNED J CHAPMAN
CHECKED W KRAUSE
DRAWN NH

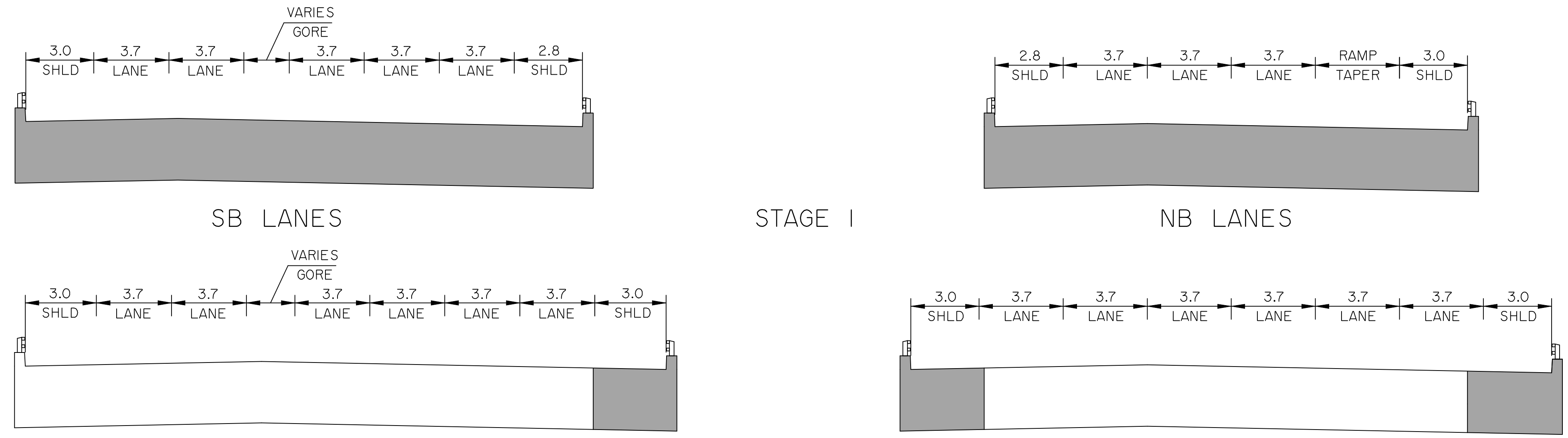
No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SCHED18 BRIDGE
2012-04-11
18-A-5.27_EX.DGN
NH



SITE PLAN - STAGE I

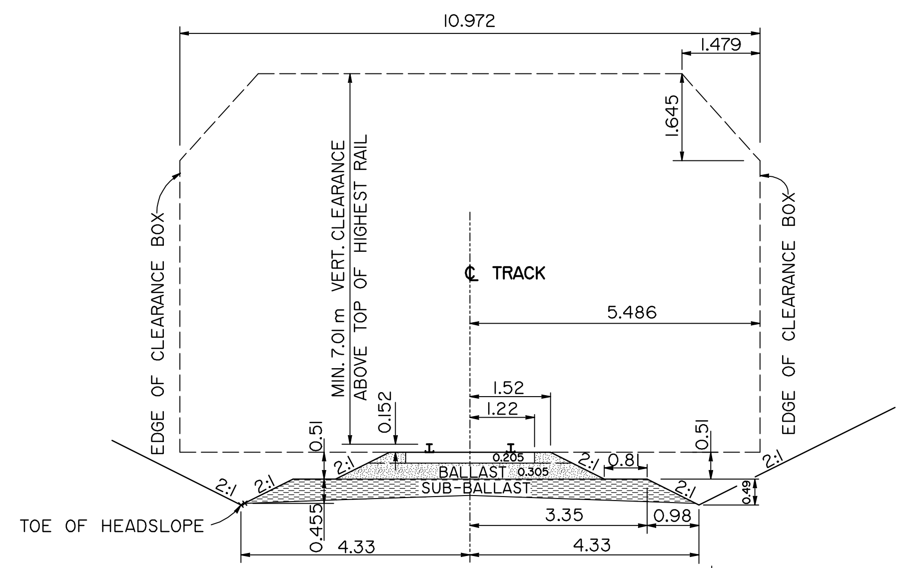
NTS



ULTIMATE STAGE

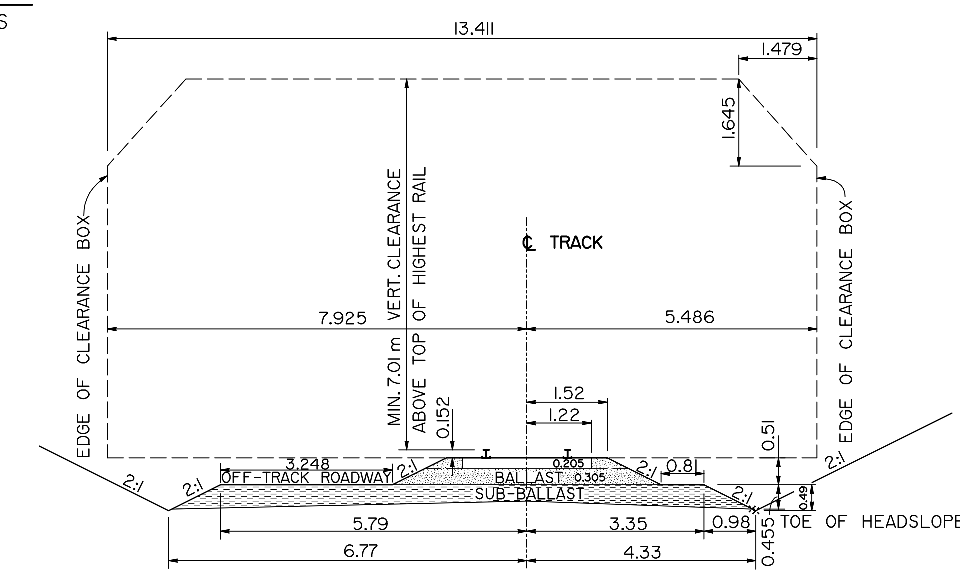
BRIDGES SECTION

LOOKING NORTH - NTS

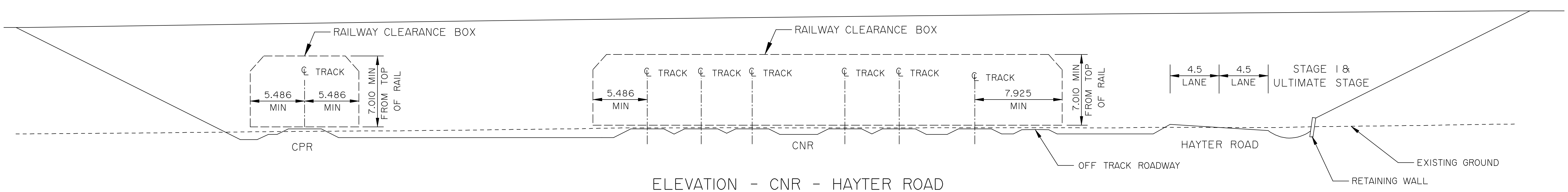


CLEARANCE REQUIREMENTS & DETAILS

(SQUARE TO TRACKS - REVISED 2007-04-26)



CLEARANCE REQUIREMENTS & DETAILS C/W OFF-TRACK ROADWAY (SQUARE TO TRACKS - REVISED 2007-04-26)

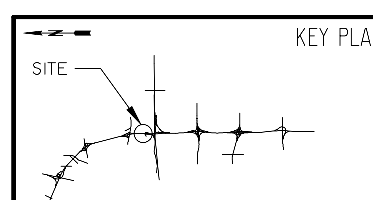


ELEVATION - CNR - HAYTER ROAD

LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY
5. REFER TO DRAWING 18-A-3.11 FOR YARD CONSTRUCTION DETAILS



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
ANTHONY HENDAY DRIVE OVER HAYTER ROAD, CPR SPUR & CNR (CLOVERBAR YARD)

REGION	SITE NO.	PLAN NO.	PROJECT	CONTRACT NO.	SHEET
NORTH CENTRAL	ISL 27/28	18-A-5.28	NE ANTHONY HENDAY DRIVE		28 of 38

Government of Alberta ■ Transportation

NO.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED
DESIGNED J CHAPMAN
CHECKED W KRAUSE
DRAWN WTS

PLAN DESCRIPTION

BAR CODE

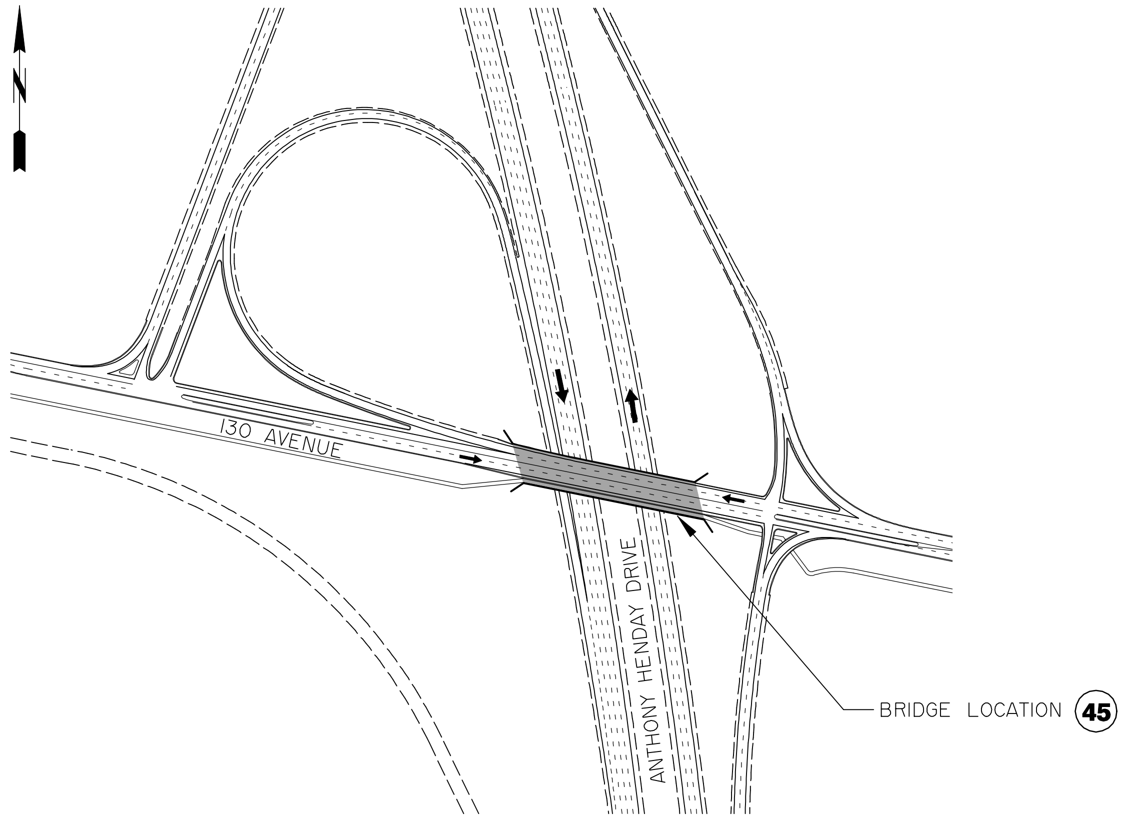
PLAN NO. CONTRACT NO. SITE NO.

PHOTO NO. TITLE SEARCH DATE GRAPHICS FILE

SCHED18 BRIDGE

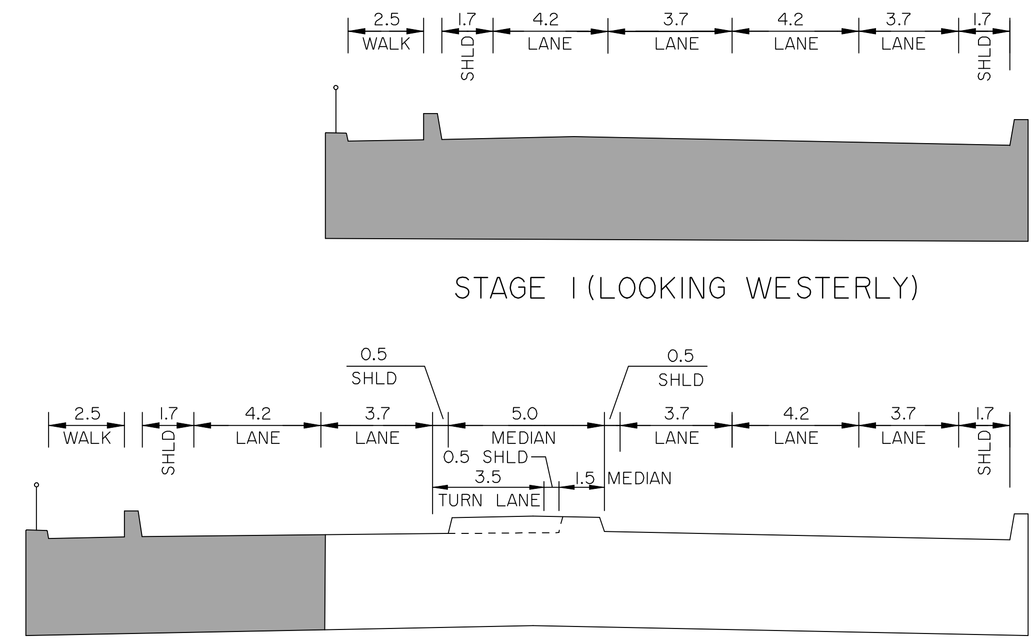
18-A-5.28_EX.DGN 2012-04-11

NH



SITE PLAN - STAGE I

NTS

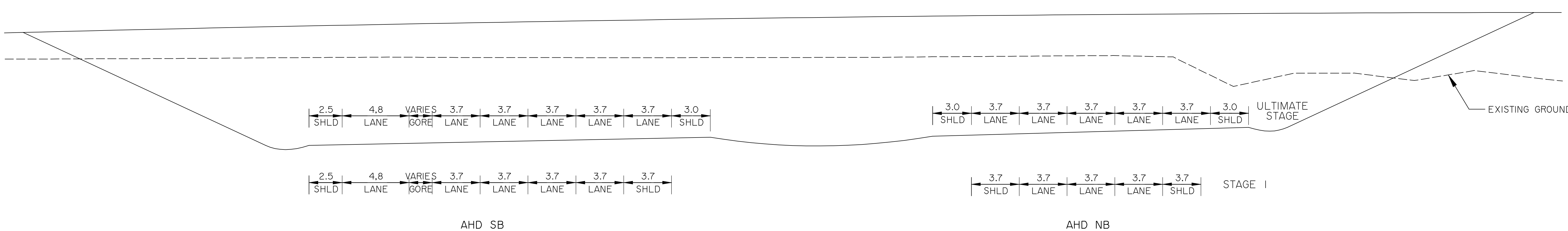


FUTURE (ULTIMATE) STAGE

REFER TO SCHEDULE 18 SECTION 200.2.3.6.5 130 AVENUE INTERCHANGE

BRIDGE SECTION

LOOKING WESTERLY - NTS

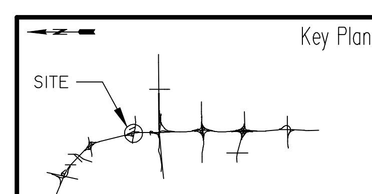


ELEVATION - 130 AVENUE

LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY
5. DESIGN SPEED = 70 km/h



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
130 AVENUE OVER
ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 45	18-A-5.29	NE ANTHONY HENDAY DRIVE		29 of 38

Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

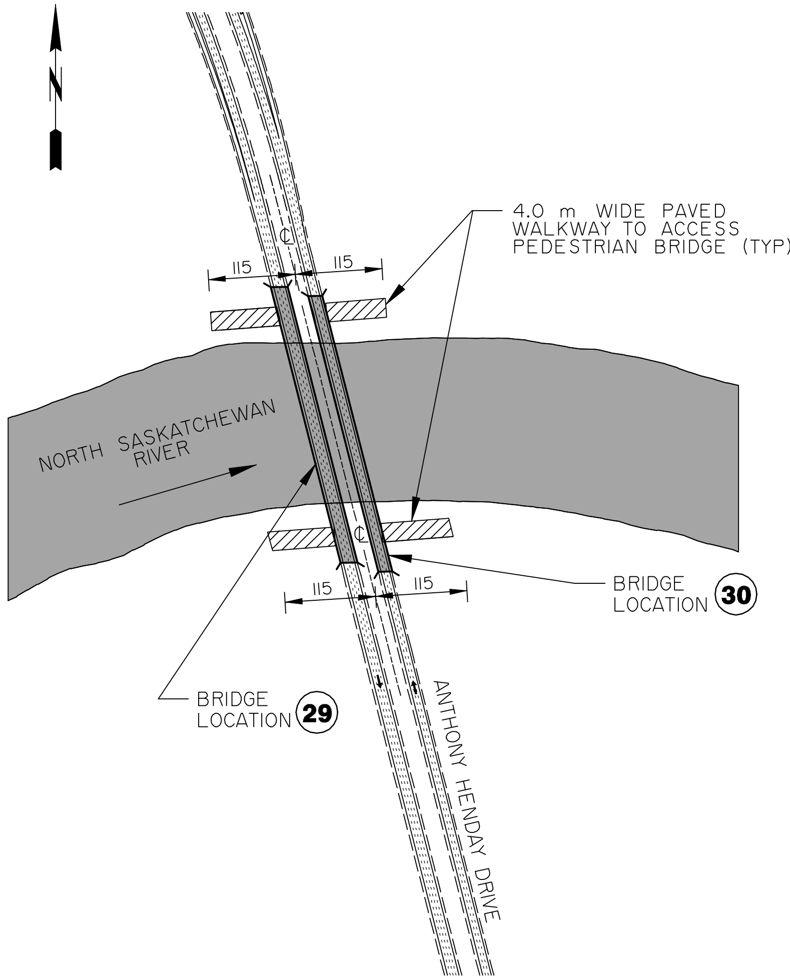
PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE

PLAN No. / CONTRACT No. / SITE No.

BAR CODE

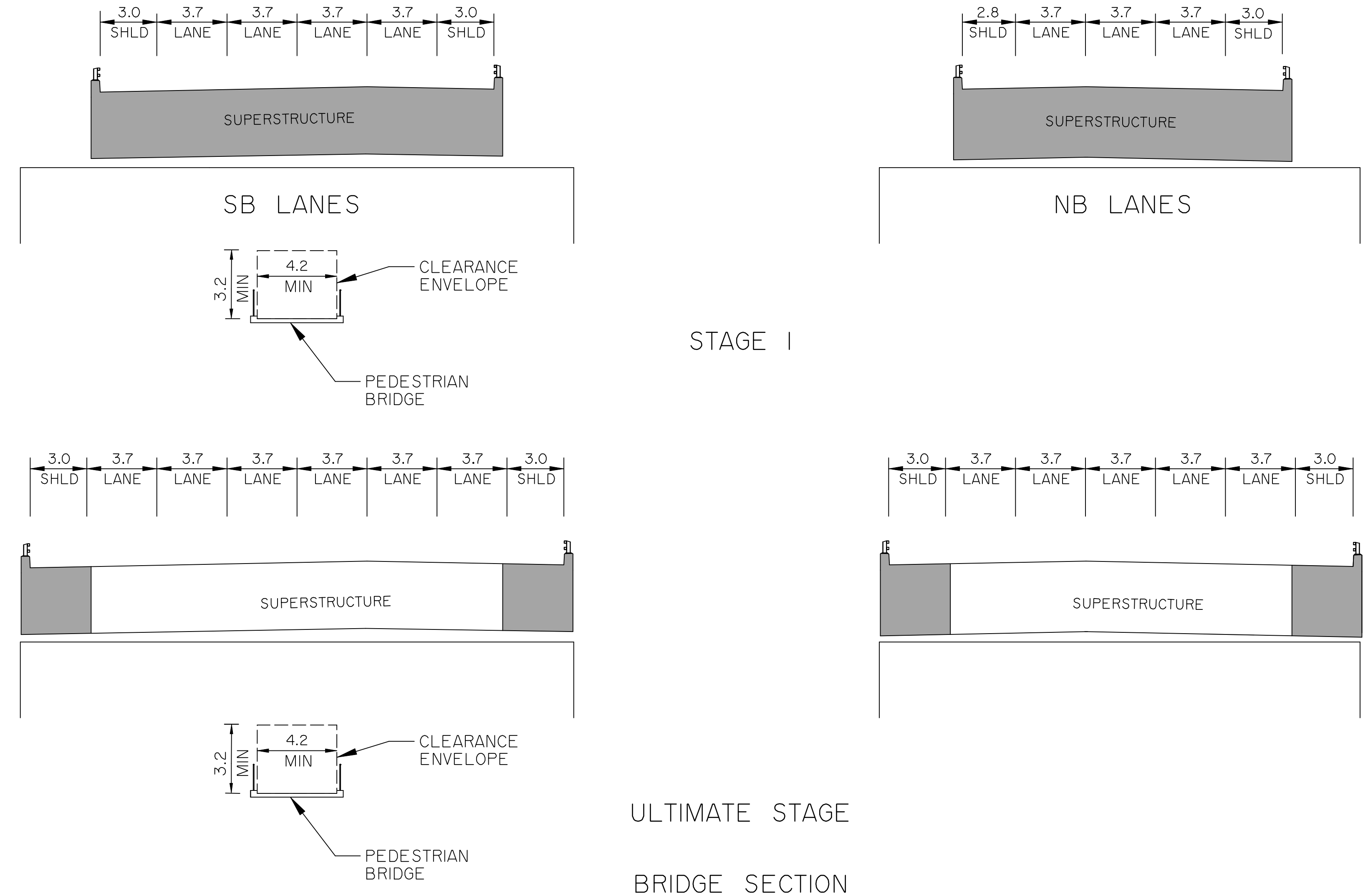
PLAN DESCRIPTION

NH 18-A-5.29_EX.DGN 2012-04-11 SCHED18 BRIDGE



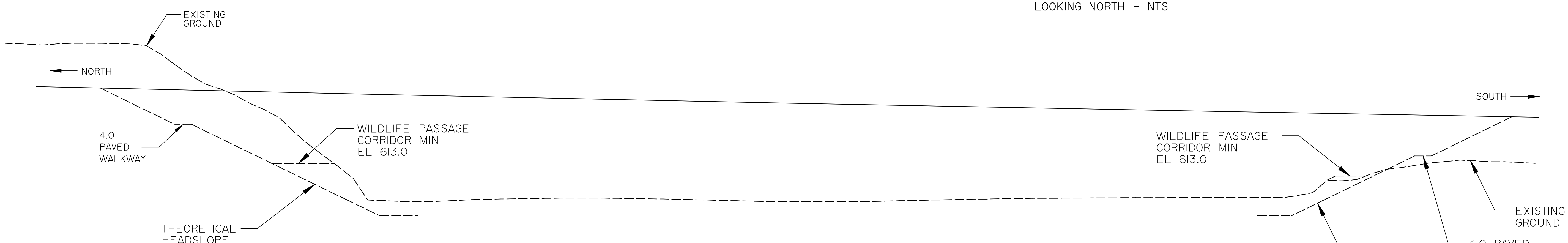
SITE PLAN - STAGE I

NTS



BRIDGE SECTION

LOOKING NORTH - NTS



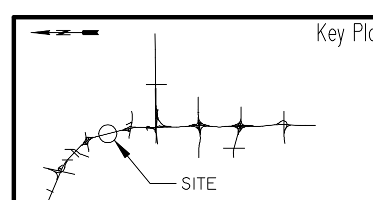
ELEVATION - ANTHONY HENDAY DR.

LOOKING EASTERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
ANTHONY HENDAY DRIVE OVER
NORTH SASKATCHEWAN RIVER

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 29/30	18-A-5.30	NE ANTHONY HENDAY DRIVE		30 of 38

Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	11-05-13

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

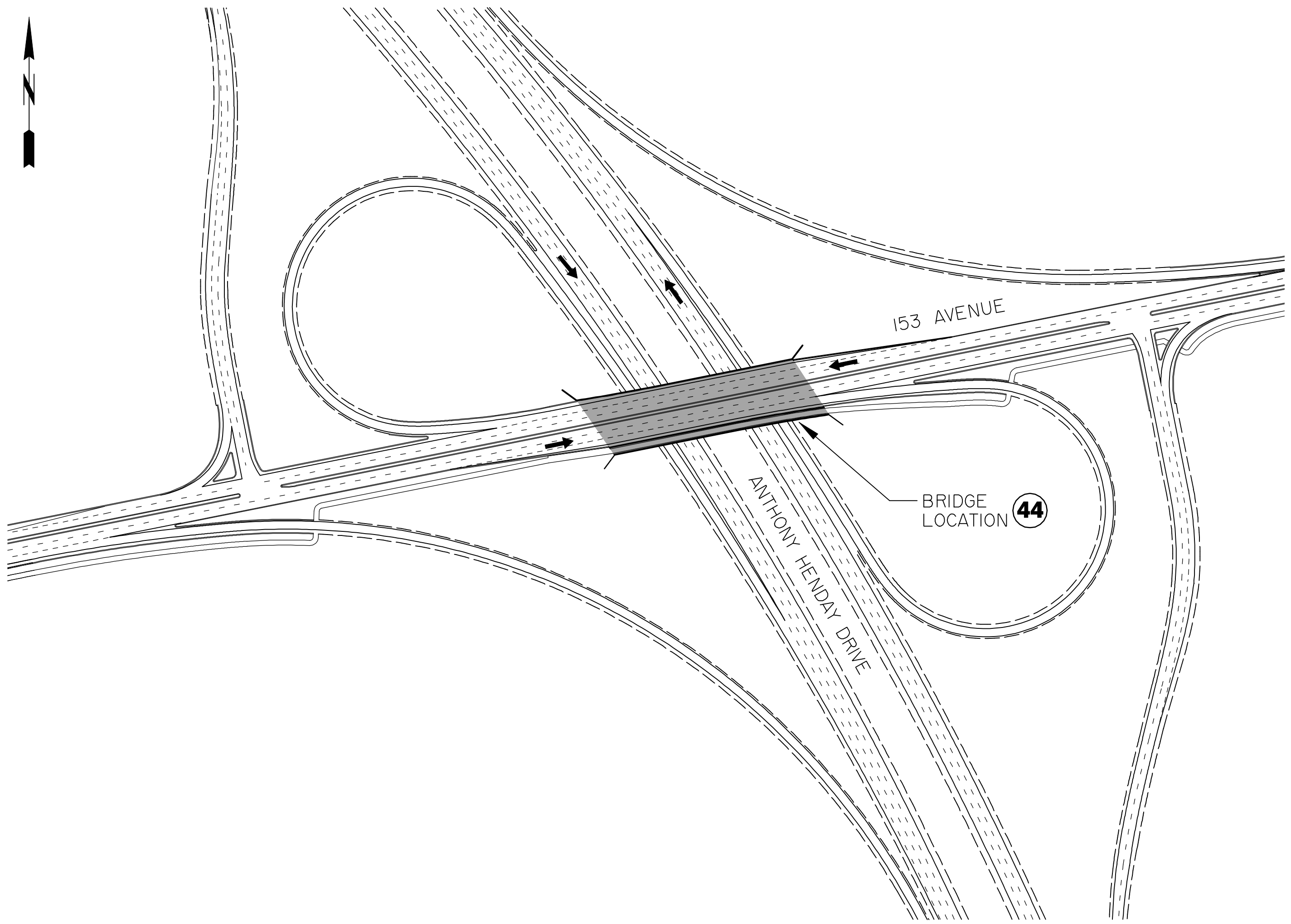
PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE

PLAN No. / CONTRACT No. / SITE No.

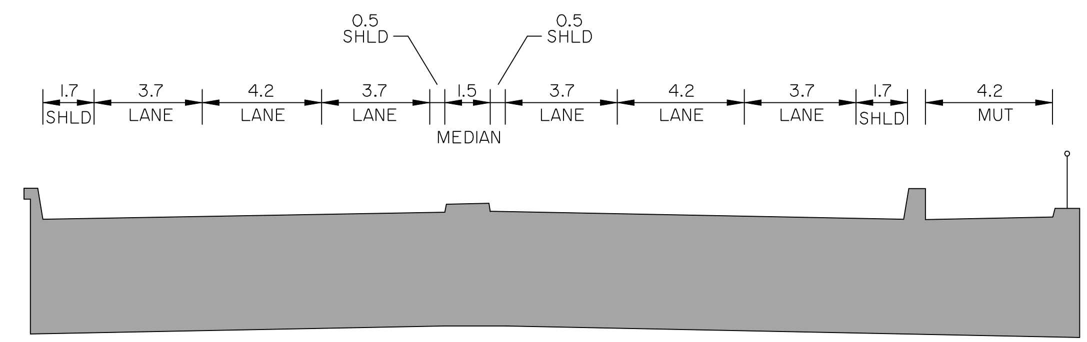
BAR CODE

PLAN DESCRIPTION

18-A-5.30_EX.DGN 2012-04-11 SCHED18 BRIDGE NH

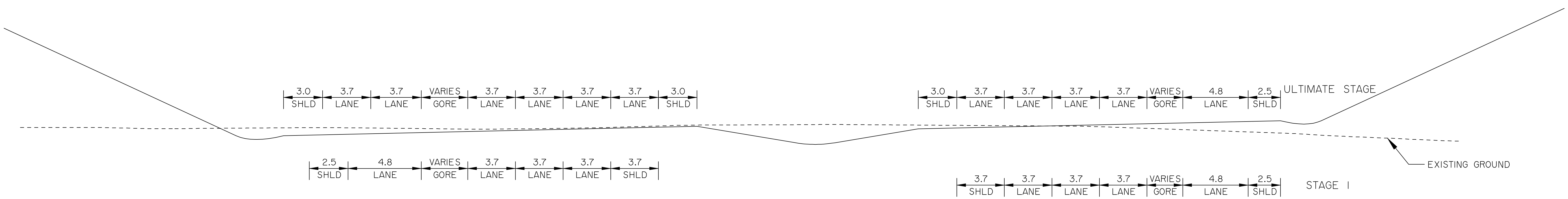


SITE PLAN - STAGE I AND ULTIMATE STAGE
NTS



STAGE I AND ULTIMATE STAGE

BRIDGE SECTION
LOOKING EASTERLY - NTS



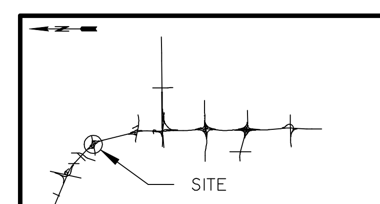
AHD SB

AHD NB

ELEVATION - 153 AVENUE
LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
153 AVE OVER
ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 44	18-A-5.31	NE ANTHONY HENDAY DRIVE		31 of 38

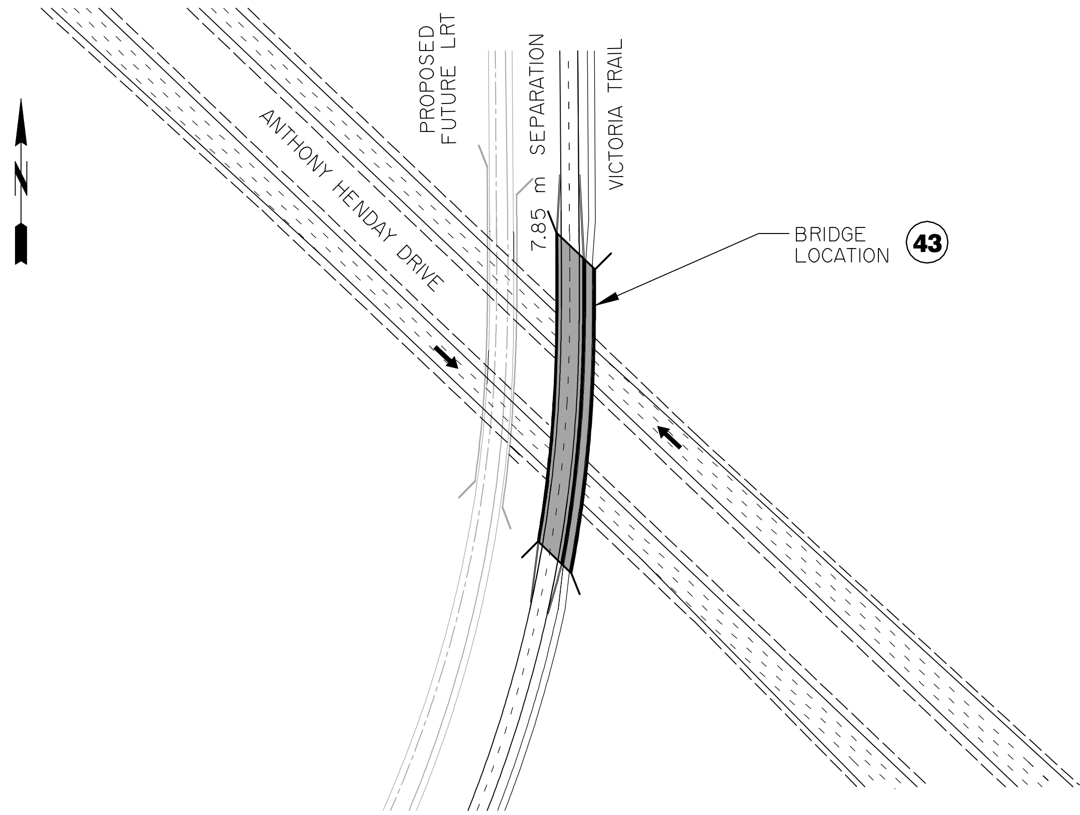
Government of Alberta
Transportation

No.	REVISION	DATE	BY
0	EXECUTION VERSION		NH

SURVEYED
DESIGNED J CHAPMAN
CHECKED W KRAUSE
DRAWN WTS

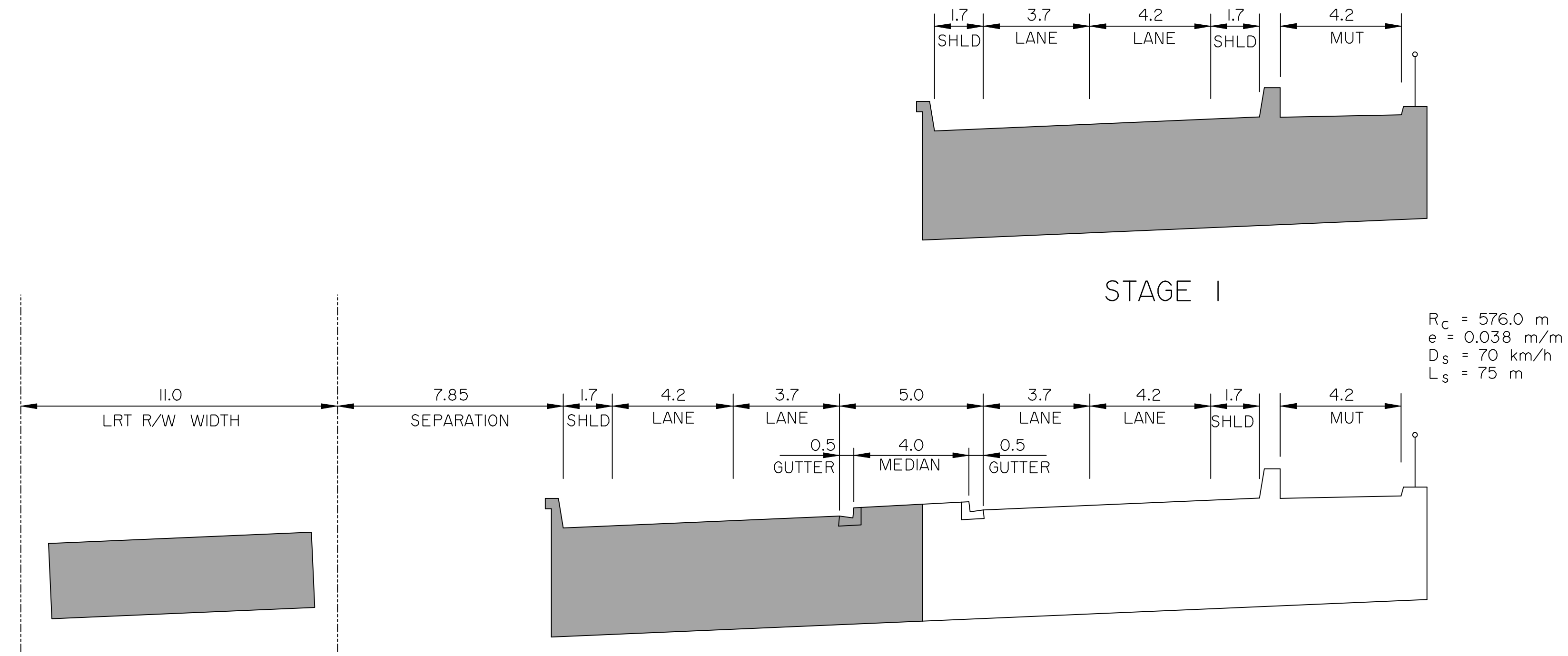
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE
PLAN No.
CONTRACT No.
SITE No.
BAR CODE
PLAN DESCRIPTION

NH 18-A-5.31_EX.DGN 2012-04-11 SCHED18 BRIDGE



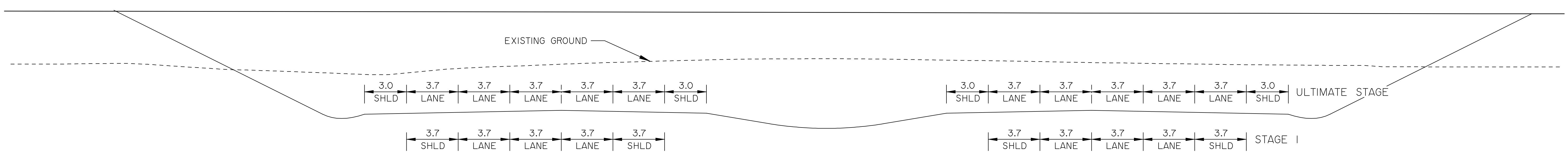
SITE PLAN - STAGE I

NTS



BRIDGE SECTION

LOOKING NORTHERLY - NTS

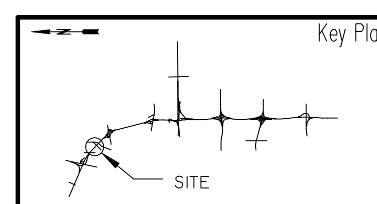


ELEVATION - VICTORIA TRAIL

LOOKING NORTH - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
VICTORIA TRAIL OVER
ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 43	18-A-5.32	NE ANTHONY HENDAY DRIVE		32 of 38

Government of Alberta
Transportation

PLAN DESCRIPTION

BAR CODE

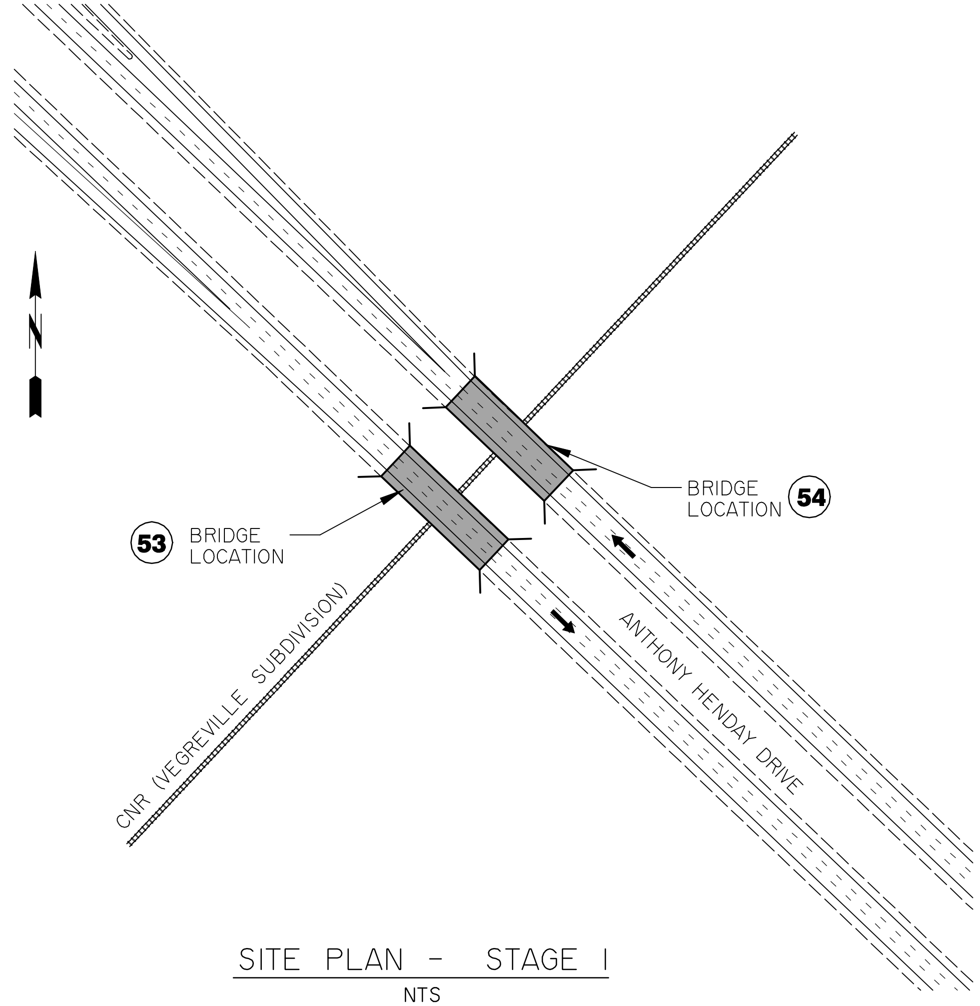
PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

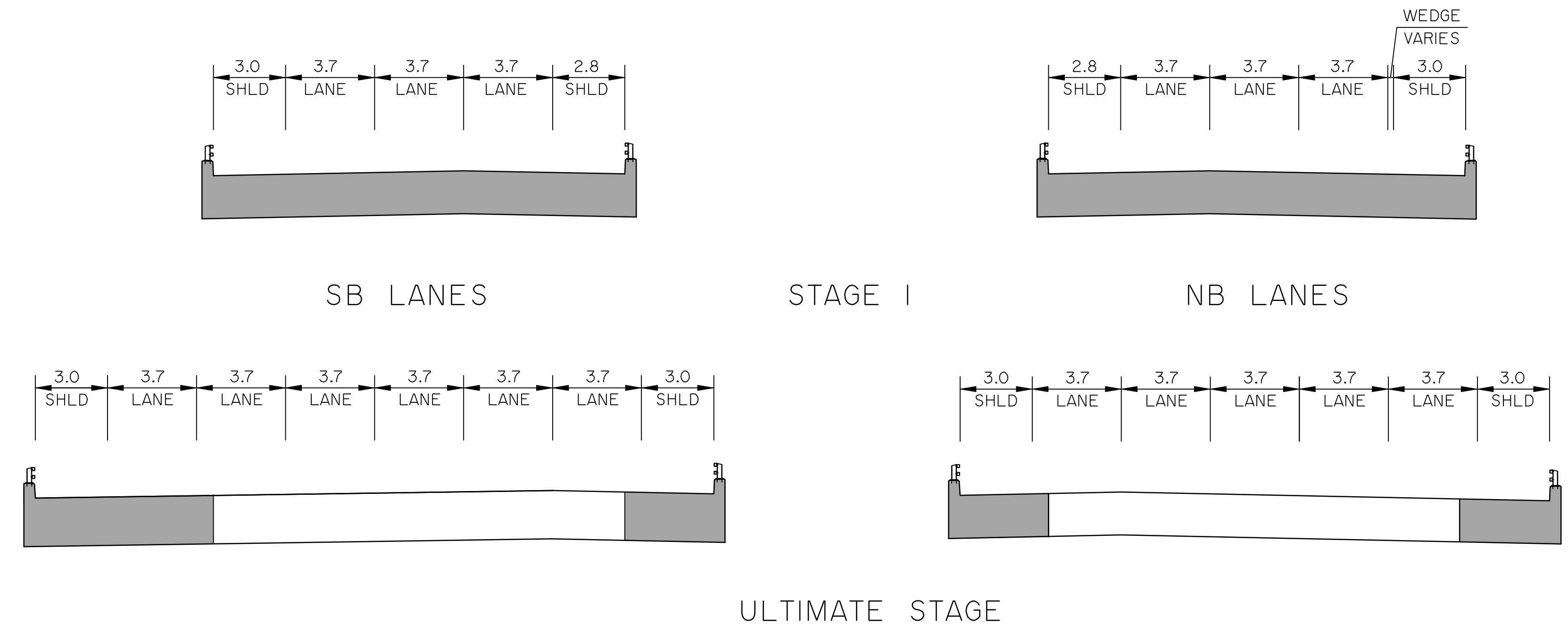
No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

NH 18-A-5.32_EX.DGN 2012-04-11 SCHED18 BRIDGE



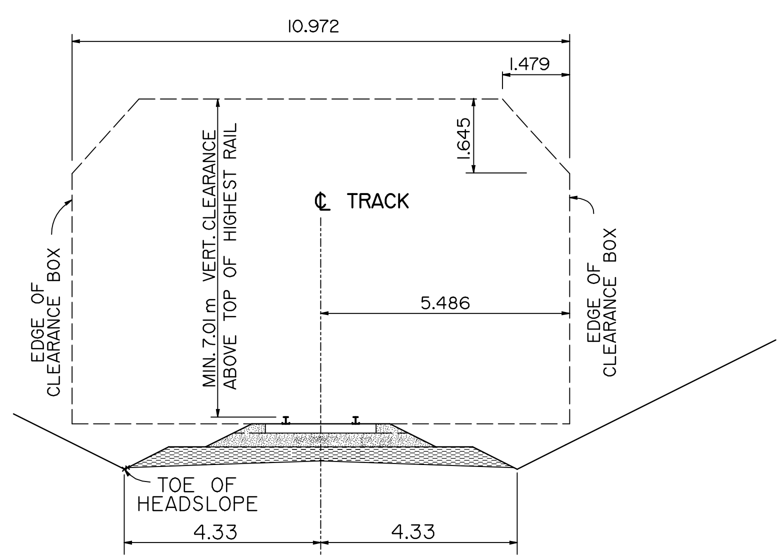
SITE PLAN - STAGE I

NTS



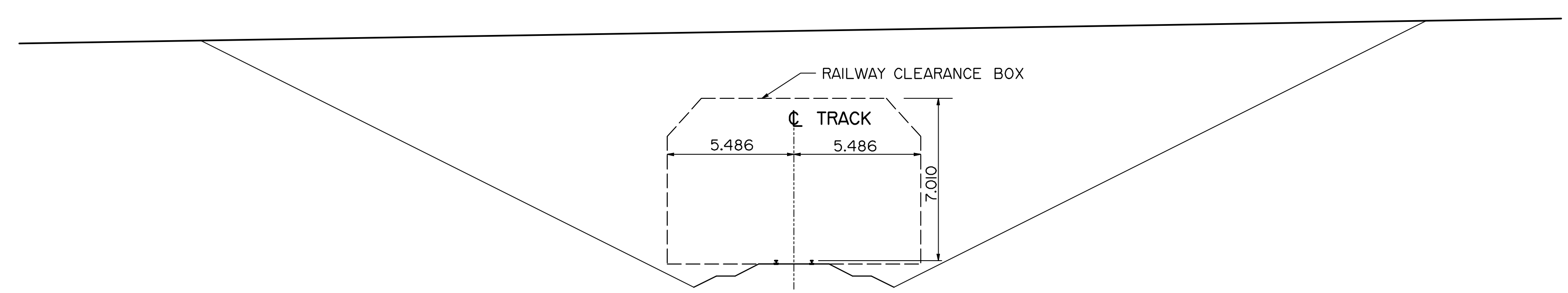
BRIDGES SECTION

LOOKING NORTHERLY - NTS



CLEARANCE REQUIREMENTS & DETAILS

(SQUARE TO TRACK - REVISED 2007-04-26) NTS

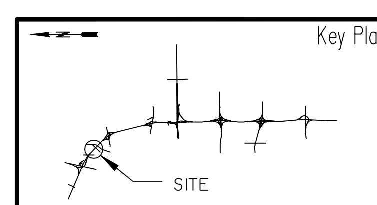


ELEVATION - CNR MILE 123.5 VEGREVILLE SUBDIVISION

LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SCHEDULE 18 - APPENDIX A

BRIDGE INFORMATION DRAWINGS

CNR MILE 123.5 VEGREVILLE SUBDIVISION OVER ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 41	18-A-5.33	NE ANTHONY HENDAY DRIVE		33 of 38

Government of Alberta ■ Transportation

PLAN DESCRIPTION

BAR CODE

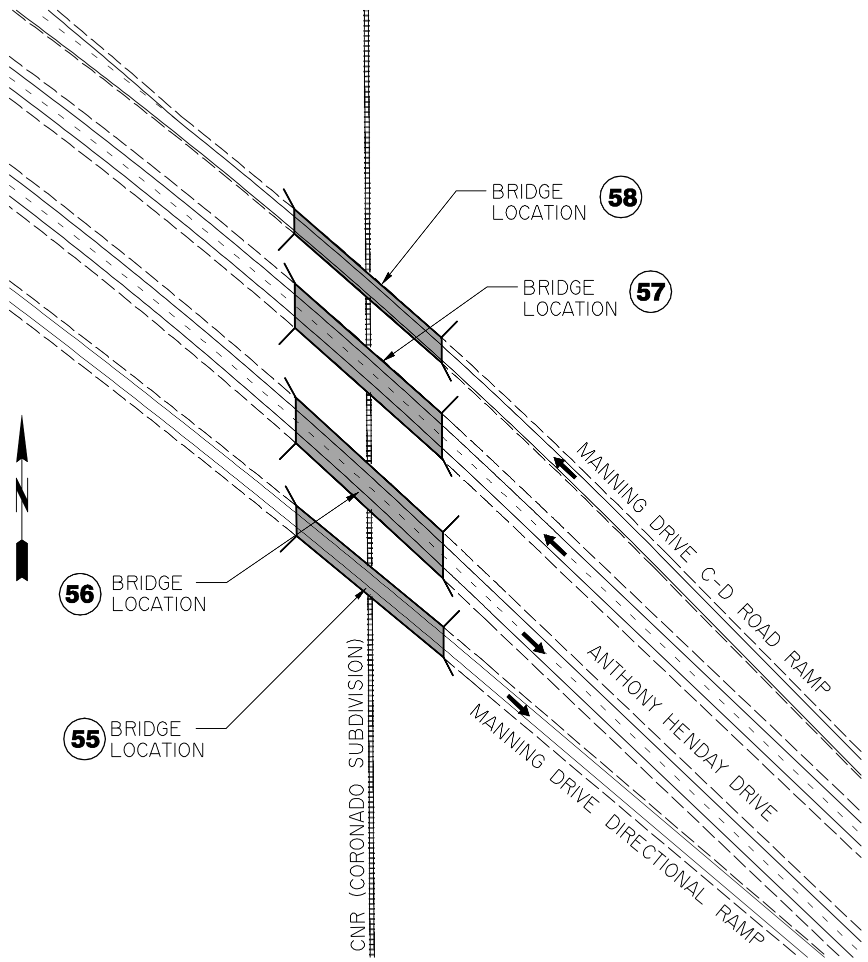
PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

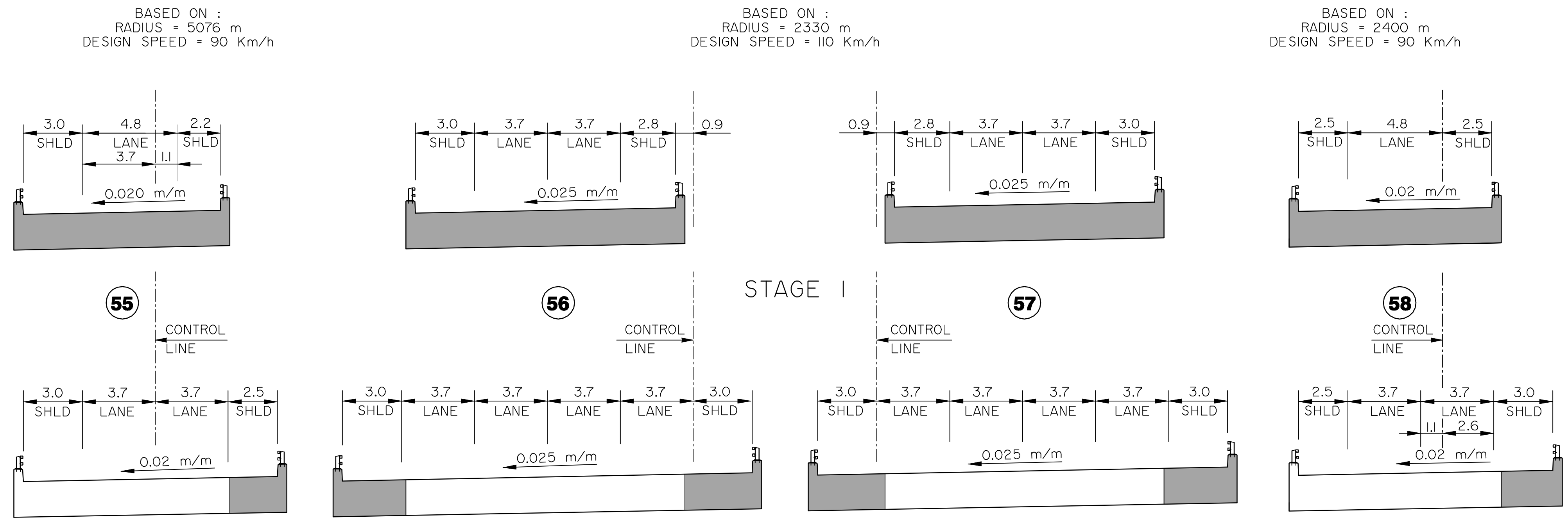
No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

18-A-5.33_EX.DGN 2012-04-11 SCHED18 BRIDGE NH



SITE PLAN - STAGE 1

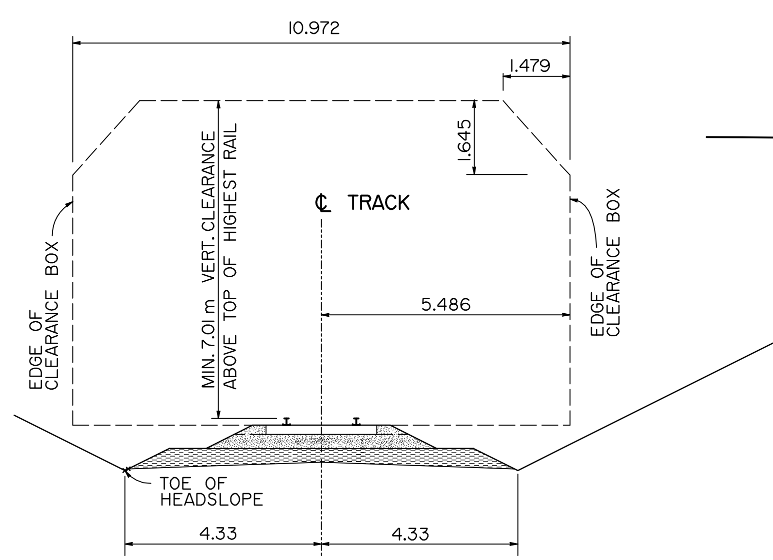
NTS



ULTIMATE STAGE

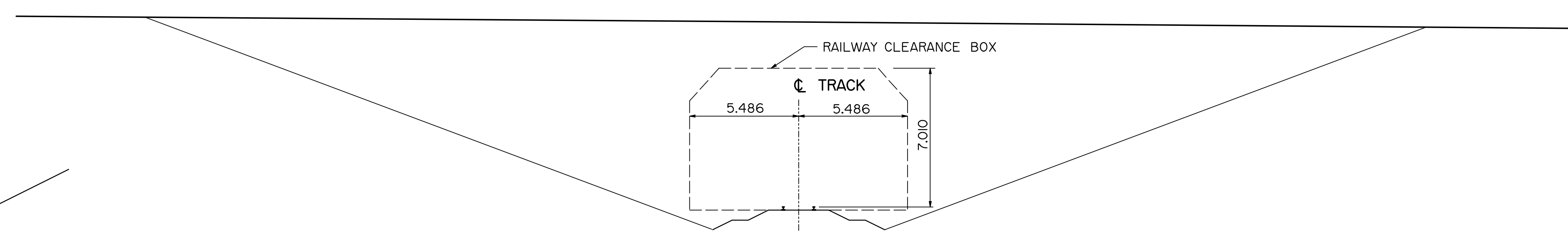
BRIDGES SECTION

LOOKING WEST - NTS



CLEARANCE REQUIREMENTS & DETAILS

(SQUARE TO TRACK - REVISED 2007-04-26) NTS

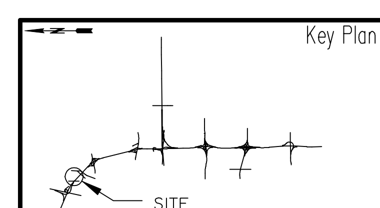


ELEVATION - CNR MILE 0.85 CORONADO SUBDIVISION

LOOKING NORTH - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
CNR MILE 0.85 CORONADO SUBDIVISION OVER
ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 42	18-A-5.34	NE ANTHONY HENDAY DRIVE		34 of 38

Government of Alberta ■ Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

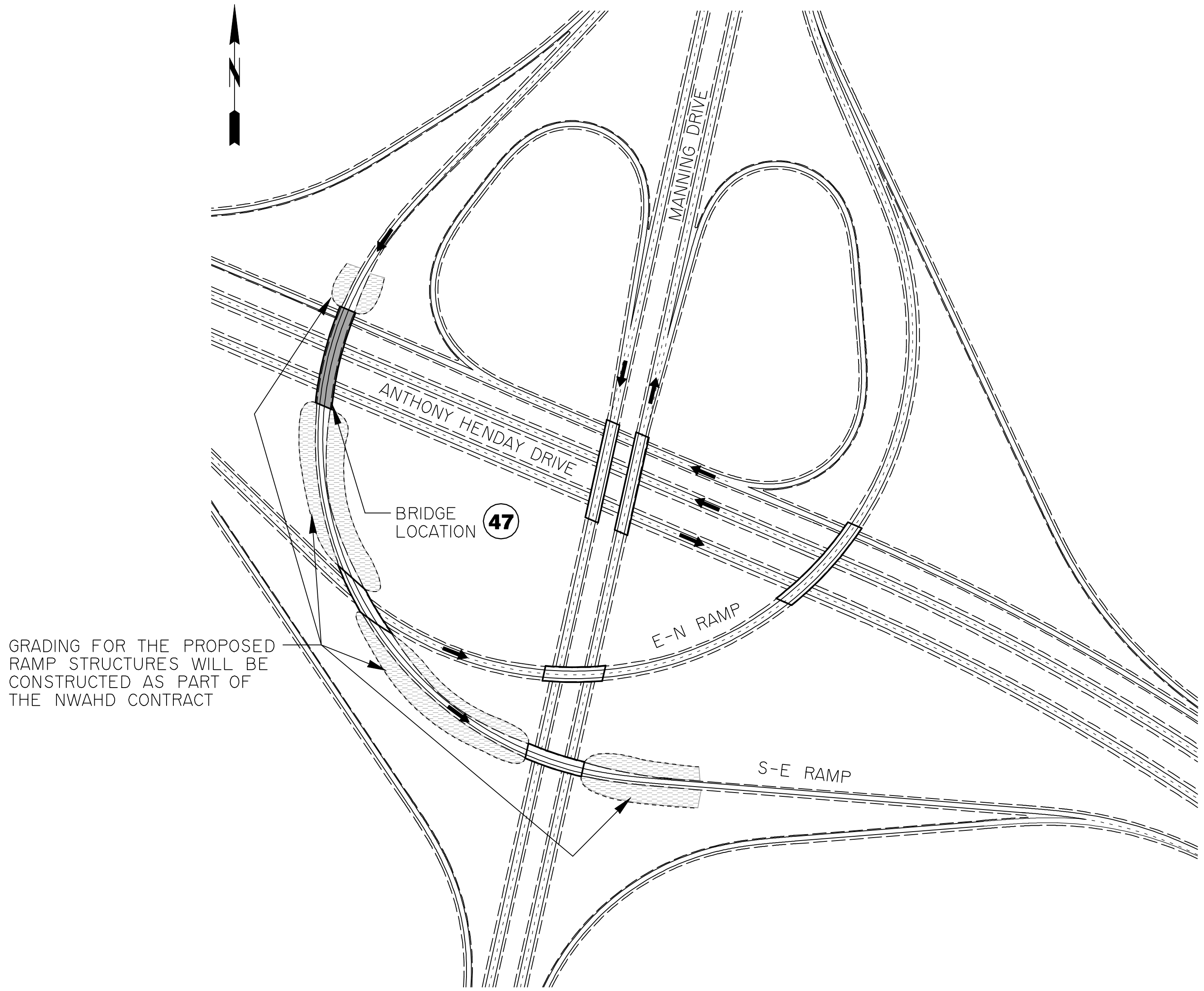
PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE

PLAN No. / CONTRACT No. / SITE No.

BAR CODE

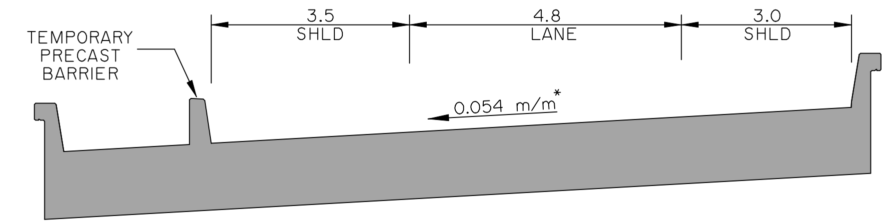
PLAN DESCRIPTION

NH 18-A-5.34_EX.DGN 2012-04-11 SCHED18 BRIDGE



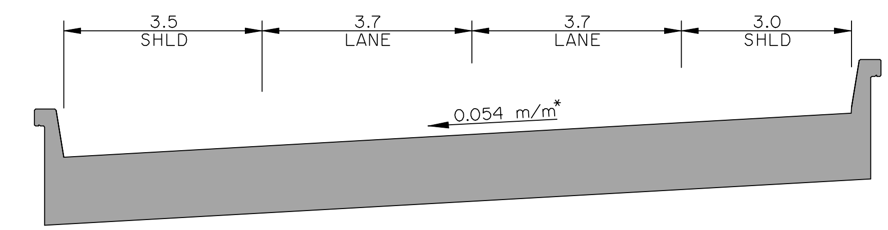
SITE PLAN - STAGE I

NTS



STAGE I

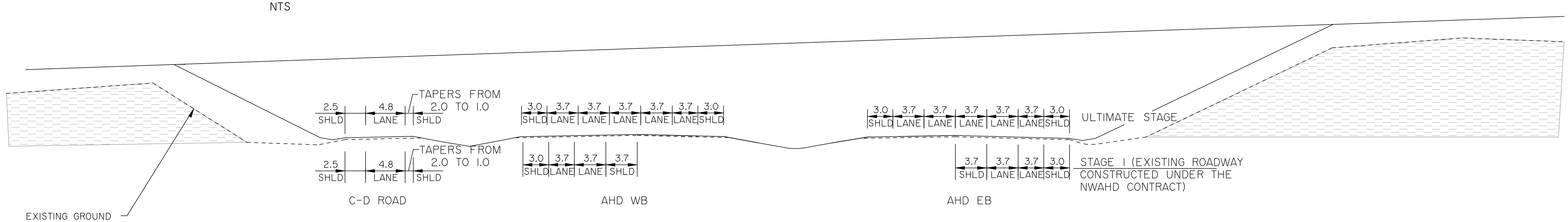
*BASED ON :
RADIUS = 340m
DESIGN SPEED = 80 Km/h



ULTIMATE STAGE

BRIDGE SECTIONS

LOOKING SOUTH - NTS



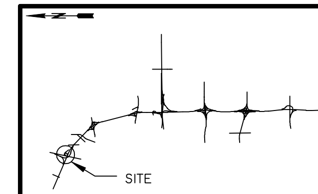
ELEVATION - S-E RAMP

LOOKING EAST - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
MANNING DRIVE S-E RAMP OVER
ANTHONY HENDAY DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 47	18-A-5.35	NE ANTHONY HENDAY DRIVE		35 of 38

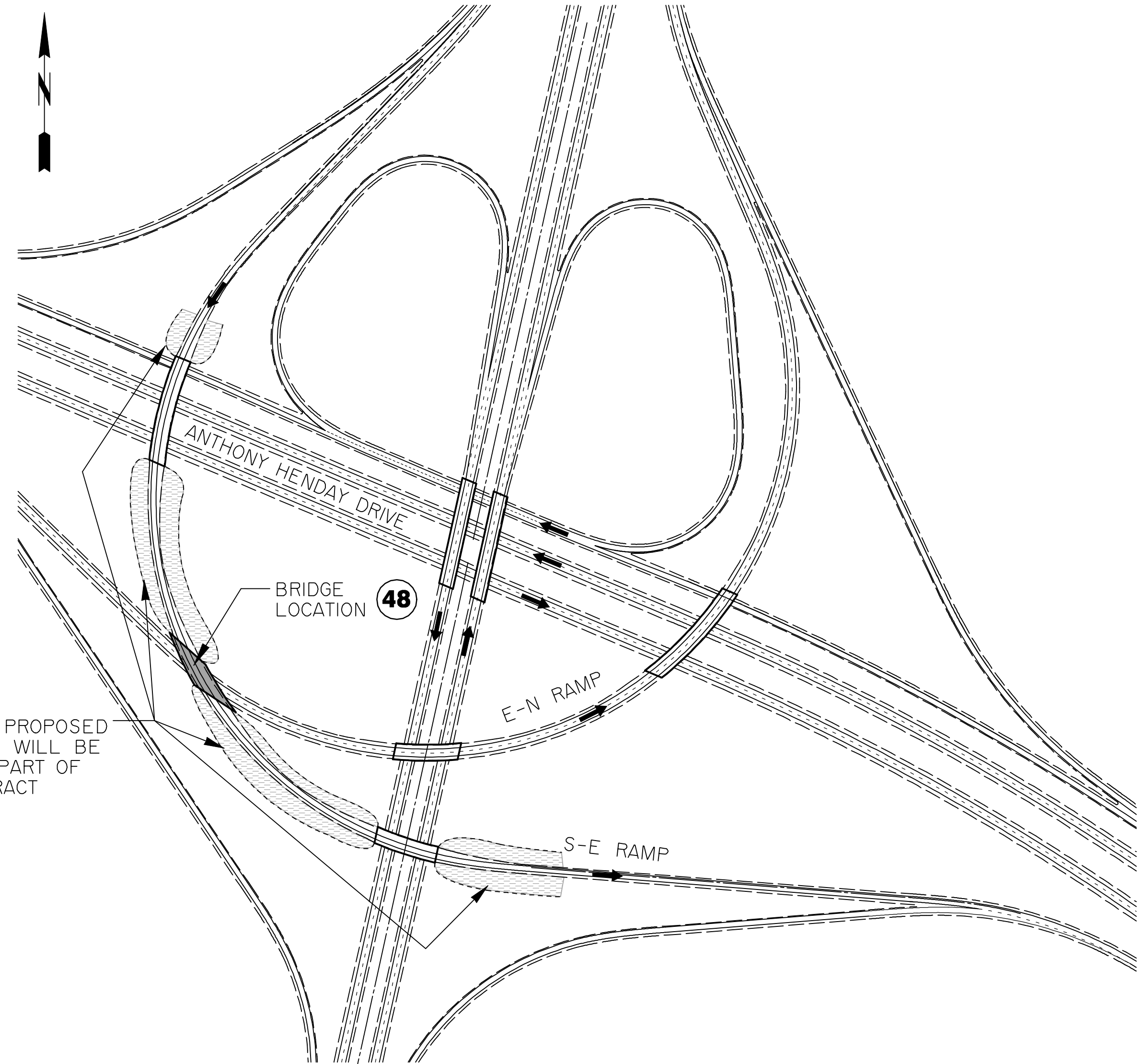
Government of Alberta ■ Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

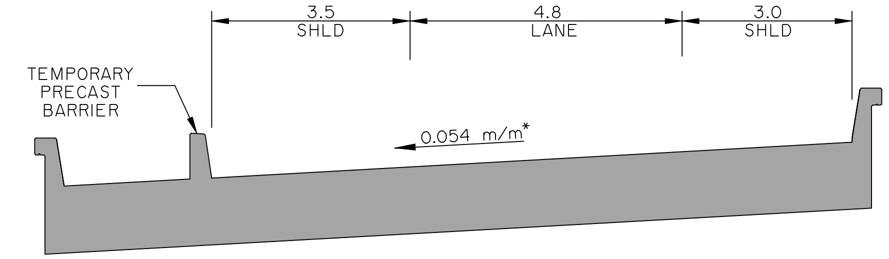
	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE
PLAN No.
CONTRACT No.
SITE No.
BAR CODE
PLAN DESCRIPTION

NH 18-A-5.35_EX.DGN 2012-04-11 SCHED18 BRIDGE

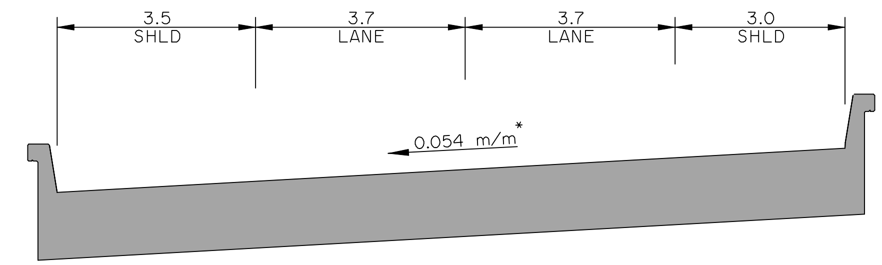


SITE PLAN - STAGE I



STAGE I

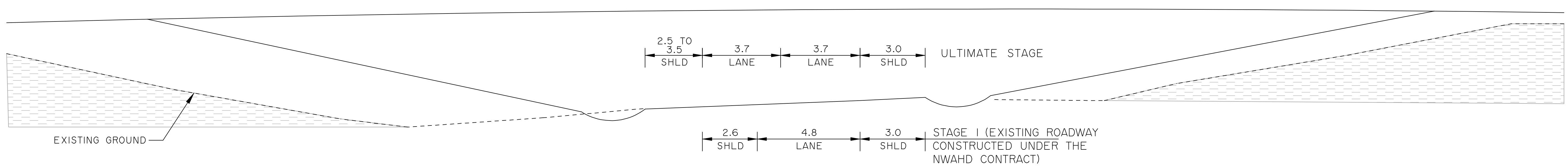
*BASED ON :
RADIUS = 340m
DESIGN SPEED = 80 Km/h



ULTIMATE STAGE

BRIDGE SECTIONS

LOOKING SOUTH - NTS



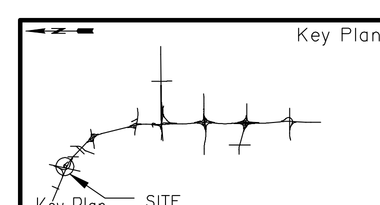
ELEVATION - S-E RAMP

LOOKING NORTHEAST - NTS

KEY PLAN

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
MANNING DRIVE S-E RAMP OVER
MANNING DRIVE E-N RAMP

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 48	18-A-5.36	NE ANTHONY HENDAY DRIVE		36 of 38

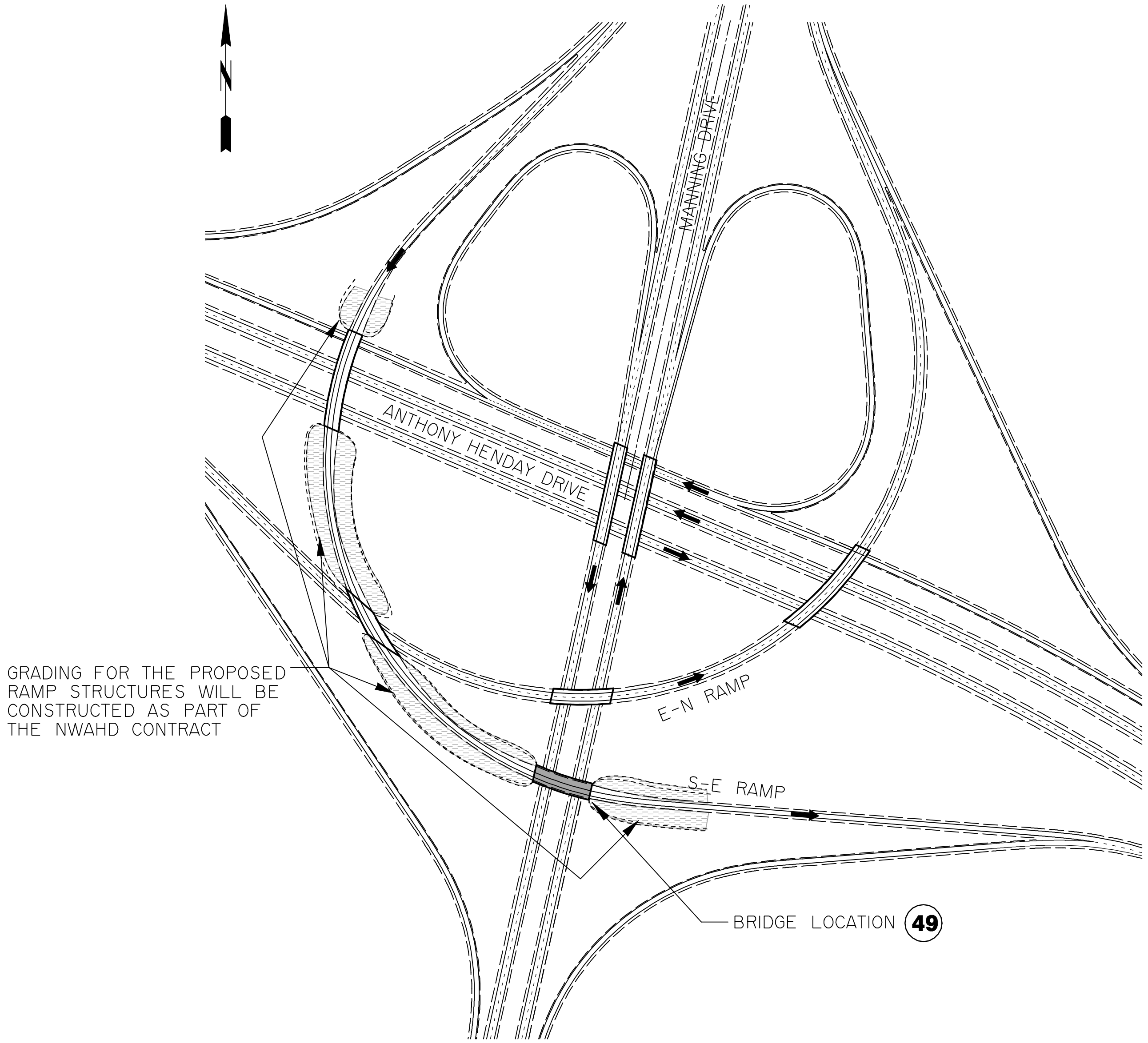
Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

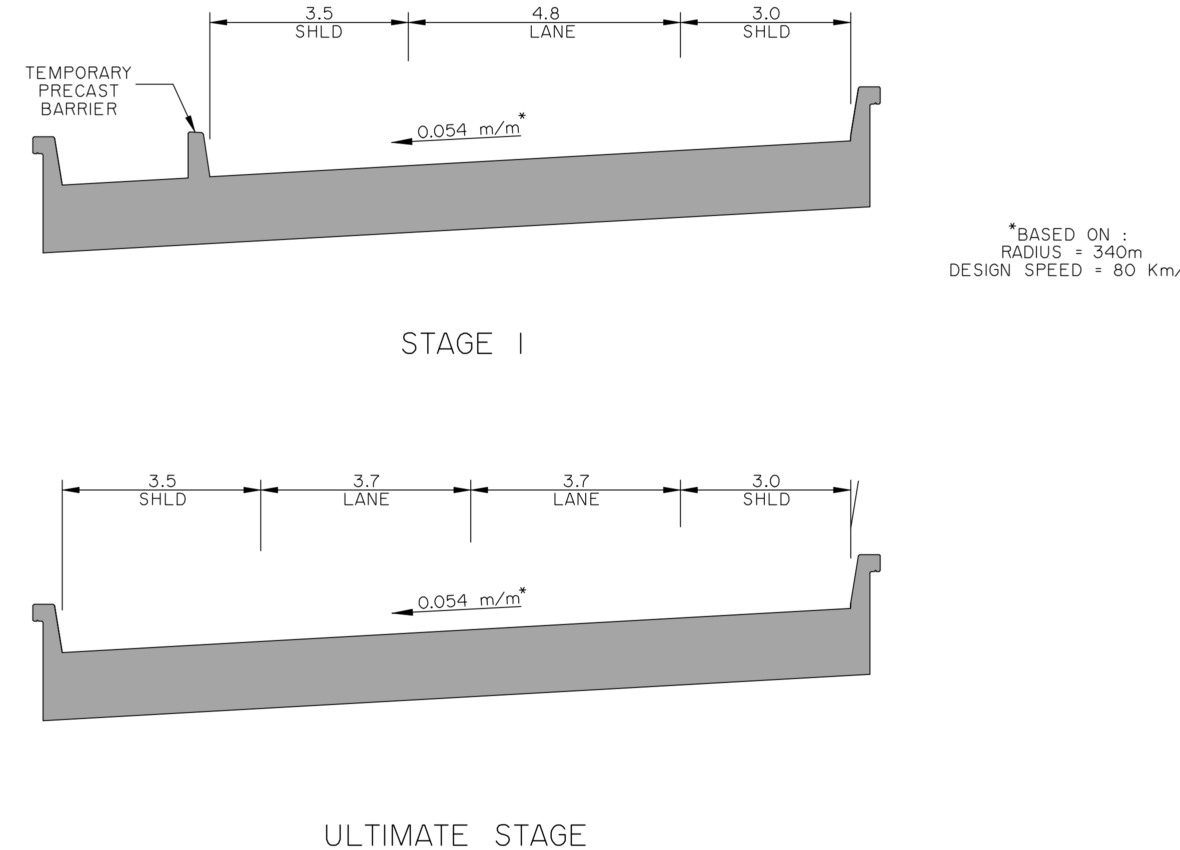
	BY	DATE
SURVEYED		
DESIGNED	J CHAPMAN	
CHECKED	W KRAUSE	
DRAWN	WTS	

PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE
PLAN No.
CONTRACT No.
SITE No.
BAR CODE
PLAN DESCRIPTION

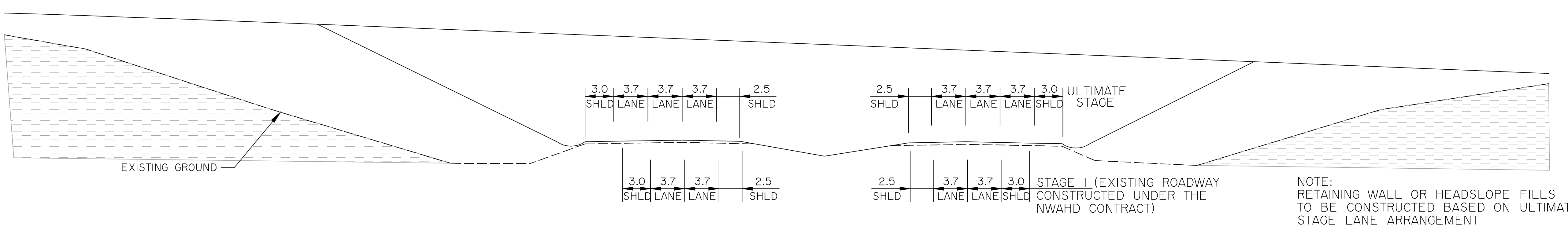
NH 18-A-5.36_EX.DGN 2012-04-11 SCHED18 BRIDGE



SITE PLAN - STAGE I
NTS



BRIDGE SECTIONS
LOOKING SOUTH - NTS

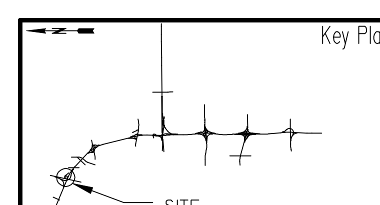


ELEVATION - S-E RAMP
LOOKING NORTHERLY - NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY

Key Plan



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS
MANNING DRIVE S-E RAMP OVER
MANNING DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	ISL 49	18-A-5.37	NE ANTHONY HENDAY DRIVE		37 of 38

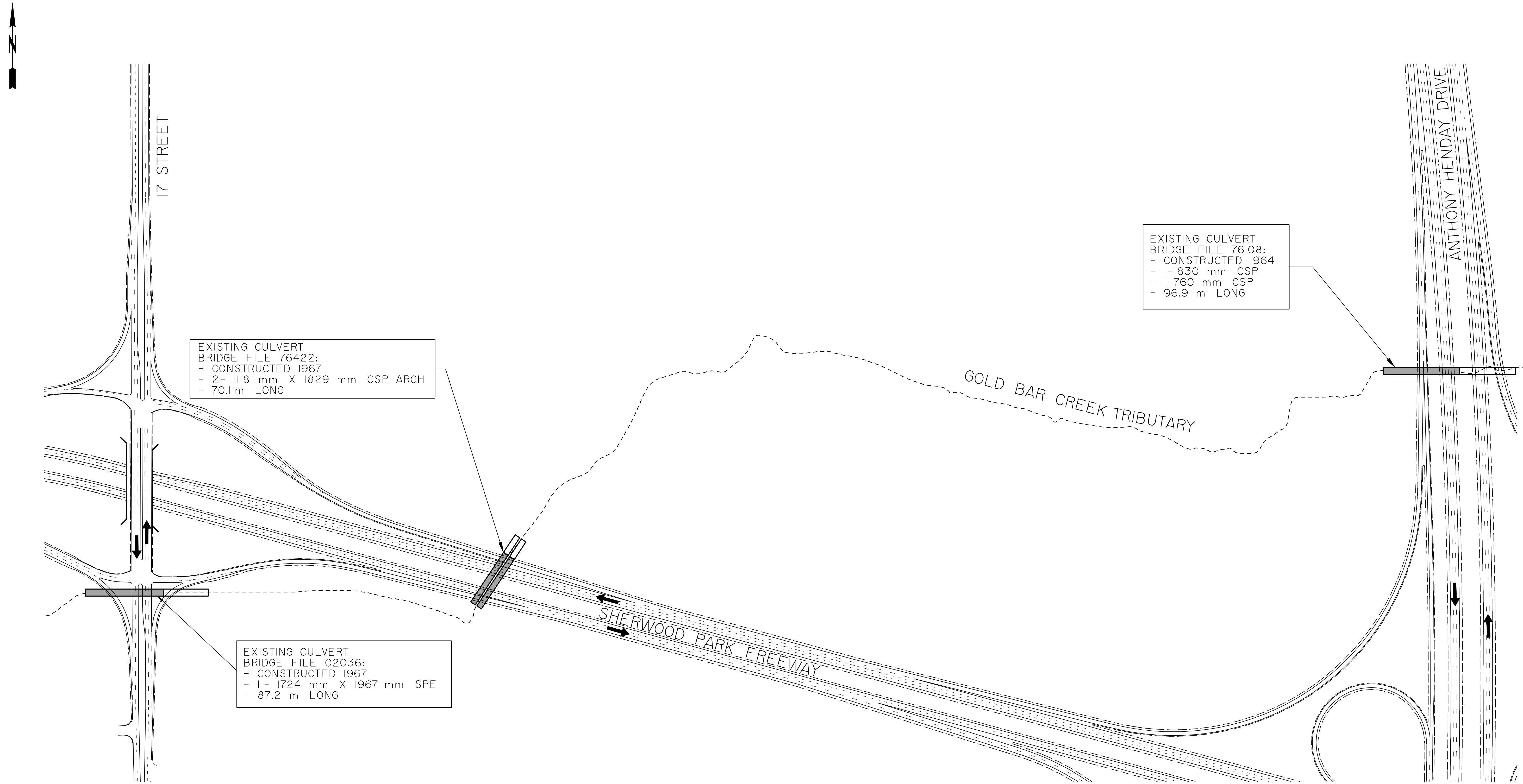
Government of Alberta
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED / DESIGNED J CHAPMAN / CHECKED W KRAUSE / DRAWN WTS

PHOTO No. / TITLE SEARCH DATE / GRAPHICS FILE / PLAN No. / CONTRACT No. / SITE No. / BAR CODE / PLAN DESCRIPTION

NH 18-A-5.37_EX.DGN 2012-04-11 SCHED18 BRIDGE

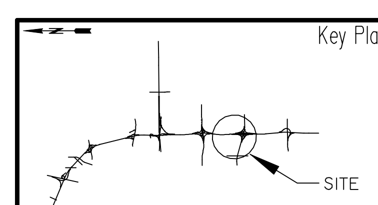


SITE PLAN

NTS

NOTES:

1. ALL DIMENSIONS SHOWN ARE ON SQUARE AND DO NOT ACCOUNT FOR THE SKEW OF THE STRUCTURE.
2. REFER TO SCHEDULE 18 TECHNICAL REQUIREMENTS FOR DESIGN CRITERIA.
3. ALL DIMENSIONS SHOWN IN METERS.
4. SEE ROADWAY SCHEDULE 18, APPENDIX A DRAWINGS FOR ROAD GEOMETRY



ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SCHEDULE 18 - APPENDIX A
BRIDGE INFORMATION DRAWINGS

BRIDGE SIZE CULVERTS

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL	CULVERTS	18-A-5.38	NE ANTHONY HENDAY DRIVE		38 of 38

Government of Alberta ■
Transportation

No.	REVISION	BY	DATE
0	EXECUTION VERSION	NH	

SURVEYED | DESIGNED J CHAPMAN | CHECKED W KRAUSE | DRAWN WTS

PLAN DESCRIPTION | BAR CODE | PLAN No. | CONTRACT No. | SITE No. | PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

NH 18-A-5.38_EX.DGN 2012-04-11 SCHED18 BRIDGE

APPENDIX B -
SELECT DEPARTMENT STANDARD DRAWINGS AND REFERENCE TABLES

Part 1

The following Department Standard Drawings are referenced in Schedule 18 and are not included in Appendix B but can be found on the Department's website:

Standard Drawing No.	Rev.	Standard Drawing Title
S-1401	1	1150mm Vertical Bar Type Handrail
S-1411-87	6	Standard Concrete Joints
S-1412-99	3	Standard Construction Joints
S-1414-87	5	Standard Pipe Pile Splice
S-1415-87	6	Standard H-Pile Splice
S-1418-03	2	Installation Of Large Steel Pipes
S-1426	1	1150mm Staggered Vertical Bar Type Handrail
S-1443-11	1	Deck Water Proofing System With 80mm Two Course Hot-Mix ACP
S-1477-04	1	Standard Large Bridge Plaque Installation Details
S-1479	3	Standard Closed Pipe Pile End Plate
S-1617-04	2	Standard Large Bridge Plaque Casting Details (Drafting Standards)
S-1638	2	Standard Finger Plate Deck Joint Assembly, General Layout
S-1639	2	Standard Finger Plate Deck Joint Assembly Typical Cross-Sections
S-1640	2	Standard Finger Plate Deck Joint Assembly Typical Drain Trough Details
S-1642-00	5	PL-2 Double Tube Type Bridgerail Bridgerail Details
S-1643-00	5	PL-2 Double Tube Type Bridgerail Approach Rail Transition Details
S-1650-00	6	PL-2 Single Slope Concrete Bridge Barrier Details

Standard Drawing No.	Rev.	Standard Drawing Title
S-1651-00	2	PL-2 Single Slope Concrete Bridge Barrier Approach Rail Transition Details
S-1680-07	2	Standard Curb Details
S-1681-07	1	Bridgerail to Modified Thrie Beam Transition Details
S-1682-04	-	Sign Structure Steel Identification Plaque
S-1700-06	1	PL-2 Combination Barrier Bridgerail Details
S-1701-06	2	PL-2 Combination Barrier Barrier End Details
S-1702-06	1	PL-3 Double Tube Type Bridgerail Bridgerail Details
S-1703-06	1	PL-3 Double Tube Type Bridgerail Barrier End Details
S-1704-06	1	PL-3 Double Tube Type Bridgerail Concrete Barrier Details
S-1705-06	1	PL-3 Double Tube Type Bridgerail Approach Rail Transition Details
S-1721-07	1	Sign Structure Sample General Layout
S-1757-08	1	NU Girder Bridges Typical Details - Sheet 1
S-1758-08	2	NU Girder Bridges Typical Details - Sheet 2
S-1759-08	1	Steel Plate Girder Bridge Typical Details – Sheet 1
S-1760-08	1	Steel Plate Girder Bridge Typical Details - Sheet 2
S-1761-08	1	Typical Expansion Bearing
S-1798-09	1	PL-2 Single Slope Concrete and Double Tube Type Barriers along Top of MSE Wall
S-1800	-	Cover Plated V-Seal Deck Joint – Sheet 1
S-1801	-	Cover Plated V-Seal Deck Joint – Sheet 2
S-1802-11	-	Cover Plated V-Seal Deck Joint – Sheet 3

Standard Drawing No.	Rev.	Standard Drawing Title
S-1810-12	-	Type 1 Strip Seal Deck Joint - Sheet 1
S-1811-12	-	Type 1 Strip Seal Deck Joint - Sheet 2
S-1812-12	-	Type 1 Strip Seal Deck Joint - Sheet 3

Part 2

The following drawings are included in Appendix B:

Details of Standard 2:1 Sloped End Sections For CSP Round Culverts - Table A

Details of Standard 2:1 Sloped End Sections For CSP Arch Culverts - Table B

Details of Standard 2:1 Sloped End Sections For SPCSP Round Culverts - Table C

Drawing SK-1 (Finishes and Sealing for Exterior Concrete Girders)

Drawing SK-2 (Vehicle 1 – 32 Wheel Trailer)

Drawing SK-3 (Vehicle 2 – 48 Wheel Trailer)

Drawing SK-4 (Vehicle 3 – 64 Wheel Trailer)

Drawing SK-5 (Vehicle 4 – 10 Line 2 File Road Style Scheurle Trailer)

Drawing SK-6 (Vehicle 5 - 12 Line 2 File Road Style Scheurle Trailer)

Drawing SK-7 (Vehicle 6 - Mobile Crane)

Drawing SK-8 (Different Axle Type and Tire Spacing)

Drawing SK-9 (Standard Details for Fully-Integral Abutment)

Drawing SK-10 (Standard Details for Semi-Integral Abutment)

Drawing SK-11 (Standard Details for Conventional Abutment)

Drawing SK-12 (Standard Details for Conventional Abutment with Roof Slab)

Drawing SK-13 (Cycle Control Joint Details for Integral Abutments)

Drawing SK-14 (Drain Trough Details for Conventional Abutments)

Drawing SK-15 (Drain Trough Details for Integral Abutments)

Drawing SK-16 (Wall layout and Site Drainage for Bridge Skew Angles $\leq 45^o$)

Drawing SK-17 (Wall Layout and Site Drainage for Bridge Skew Angles $> 45^o$)

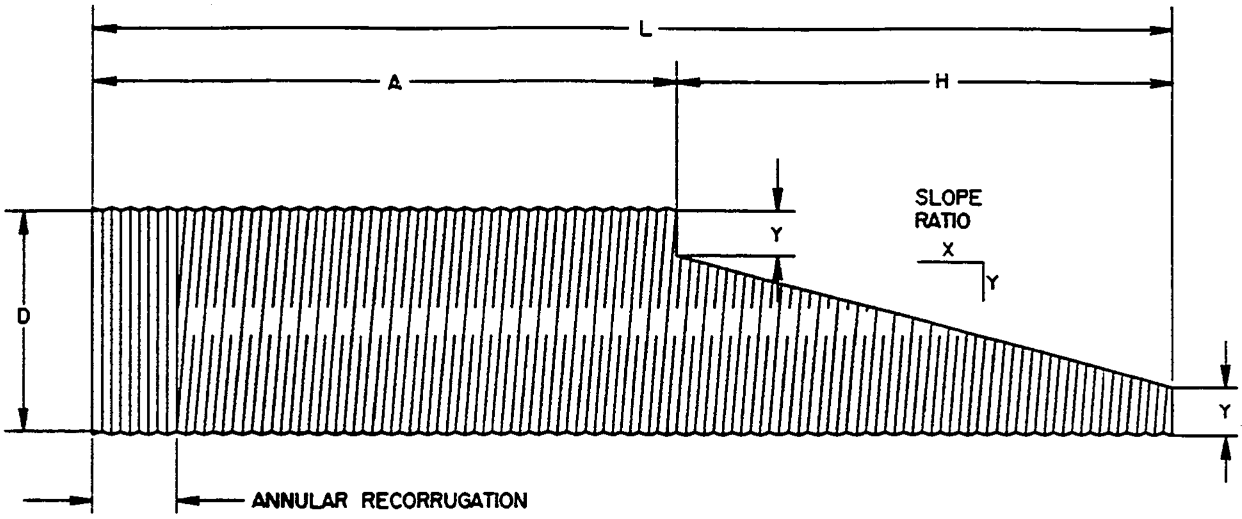
Drawing SK-18 (Turned Back Wingwall Details for Bridge Skew Angles $> 45^o$)

Drawing SK-19 (Standard Details Associated with MSE Walls)

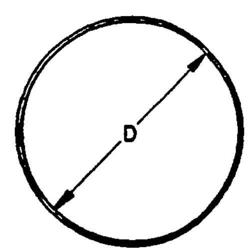
“Concrete Testing Summary at Site” Sheet

Exhibit 200.2.3.23-1 (Typical Mainline Detour)

TABLE A
DETAILS OF STANDARD 2:1 SLOPED END SECTIONS FOR CSP ROUND CULVERTS

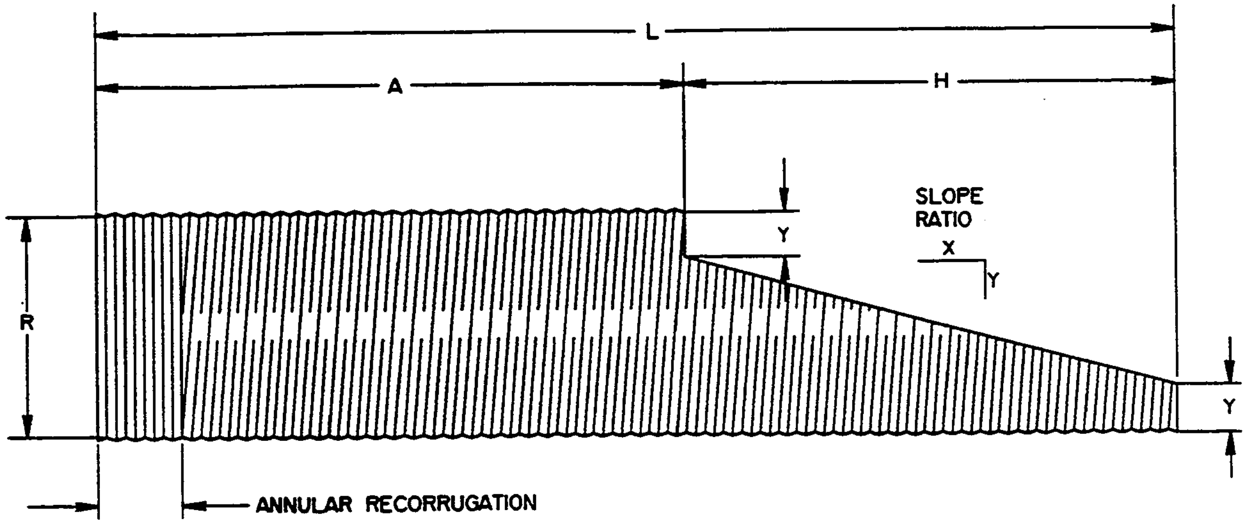


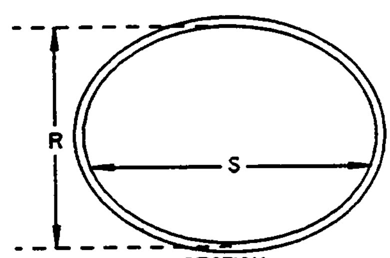
INSIDE DIAMETER "D" mm	SLOPE RATIO X:Y	"Y" mm	"A" m	"H" m	INVERT LENGTH OF SLOPED END SECTION "L" m
1200	2:1	150	4.2	1.800	6.0
1400	2:1	200	4.0	2.000	6.0
1600	2:1	200	3.6	2.400	6.0
1800	2:1	300	3.6	2.400	6.0
2000	2:1	300	5.2	2.800	8.0
2200	2:1	300	4.8	3.200	8.0
2400	2:1	400	4.8	3.200	8.0
2700	2:1	400	6.2	3.800	10.0
3000	2:1	500	6.0	4.000	10.0
3300	2:1	500	5.4	4.600	10.0
3600	2:1	600	5.2	4.800	10.0



SECTION

TABLE B
DETAILS OF STANDARD 2:1 SLOPED END SECTIONS FOR CSP ARCH CULVERTS





SECTION

EQUIVALENT INSIDE DIAMETER "D" mm	SPAN "S" mm	RISE "R" mm	SLOPE RATIO X:Y	"Y" mm	"A" m	"H" m	INVERT LENGTH OF SLOPED END SECTION "L" m
1200	1390	970	2:1	150	4.660	1.340	6.0
1400	1630	1120	2:1	200	4.560	1.440	6.0
1600	1880	1260	2:1	250	4.480	1.520	6.0
1800	2130	1400	2:1	300	4.400	1.600	6.0

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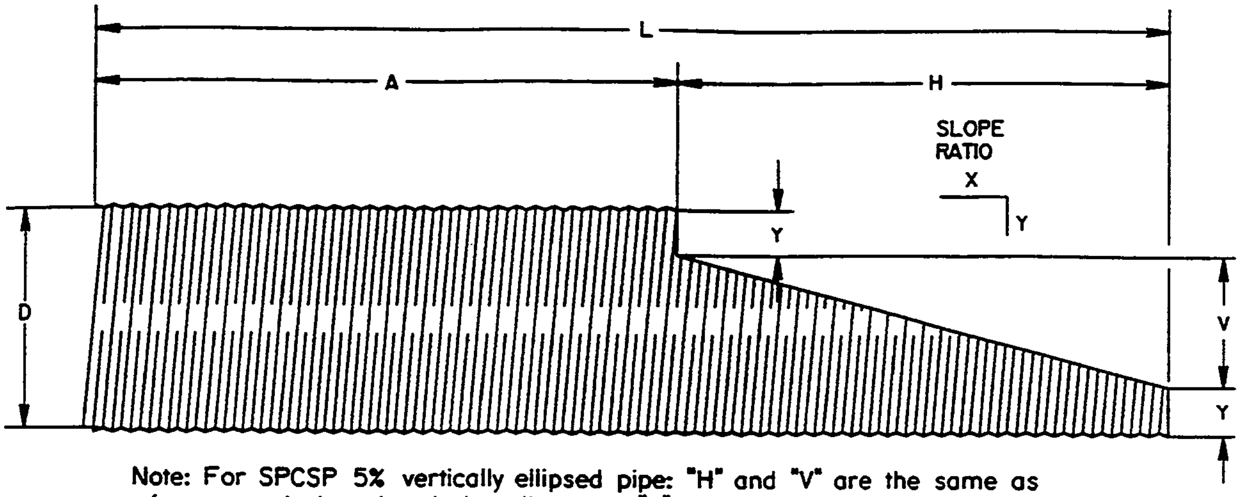
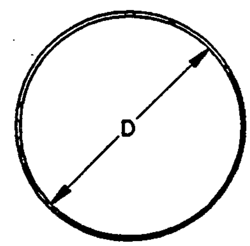
TABLE C
DETAILS OF STANDARD 2:1 SLOPED END SECTIONS FOR SPCSP ROUND CULVERTS



Note: For SPCSP 5% vertically ellipsed pipe: "H" and "V" are the same as for a round pipe of equivalent diameter; "Y" is variable with the increase in rise.

INSIDE DIAMETER "D" mm	SLOPE RATIO X:Y	"Y" mm	"H" m
1500	2:1	293	1.828
1660	2:1	373	1.828
1810	2:1	295	2.440
1970	2:1	375	2.440
2120	2:1	298	3.048
2280	2:1	378	3.048
2430	2:1	453	3.048
2590	2:1	533	3.048
2740	2:1	455	3.658
3050	2:1	610	3.658
3360	2:1	765	3.658
3670	2:1	920	3.658
3990	2:1	1080	3.658
4300	2:1	1235	3.658
4610	2:1	1390	3.658
4920	2:1	936	6.096
5230	2:1	1091	6.096
5540	2:1	1246	6.096
5850	2:1	1095	7.320
6160	2:1	1250	7.320
6470	2:1	1405	7.320
6780	2:1	1560	7.320
7090	2:1	1715	7.320
7400	2:1	1870	7.320
7710	2:1	2025	7.320
8020	2:1	2180	7.320



SECTION

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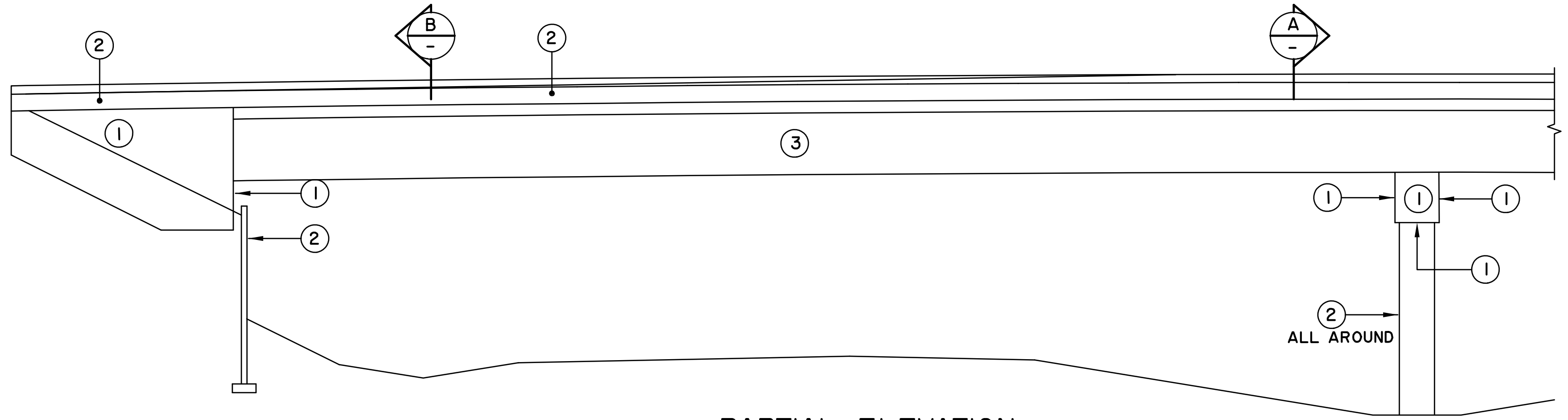


PARTIAL ELEVATION
NTS

GENERAL NOTES:

- CONCRETE FINISHES SHALL BE AS INDICATED IN THE CONTRACT DOCUMENTS
- SEALERS SHALL BE TYPE 1C SEALER AND TYPE 3 PIGMENTED SEALER MEETING THE REQUIREMENTS OF B388
- SEALERS SHALL EXTEND TO 600 mm BELOW GRADE ON ALL COMPONENTS

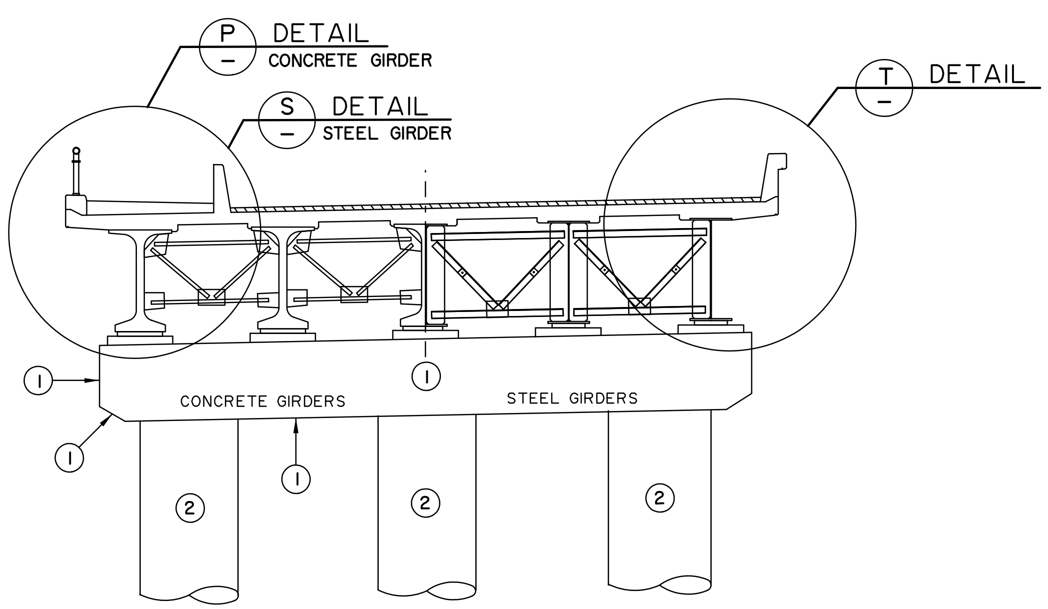
SEALERS:

(1) TYPE 3 - FEDERAL 595 COLOUR NUMBER 36415
- ICI COLOUR NUMBER 30YY 36/185
- SURREY BEIGE

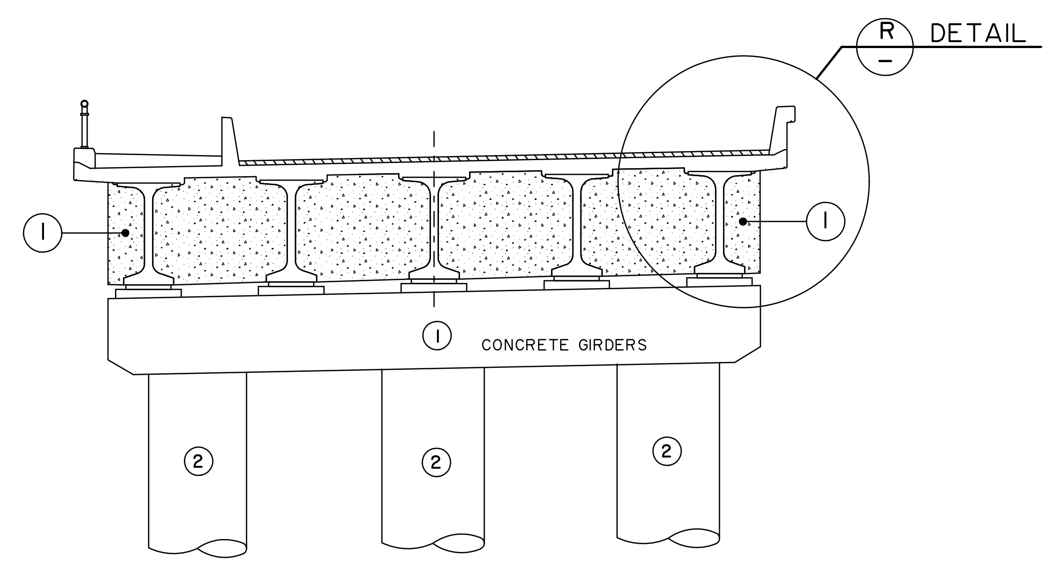
(2) TYPE 3 - FEDERAL 595 COLOUR NUMBER 33510
- ICI COLOUR NUMBER 30YY 50/156
- HISTORIC TAN

(3) TYPE 3 - FEDERAL 595 COLOUR NUMBER 27769
- ICI COLOUR NUMBER 40YY 62/134
- GEORGIAN IVORY

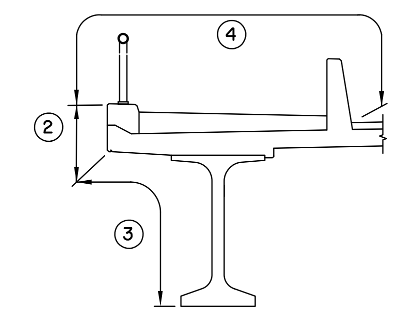
(4) TYPE 1C



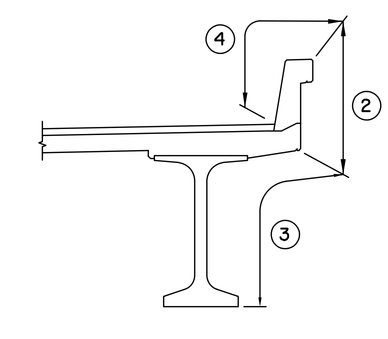
A PIER SECTION
(STEEL DIAPHRAGMS) NTS



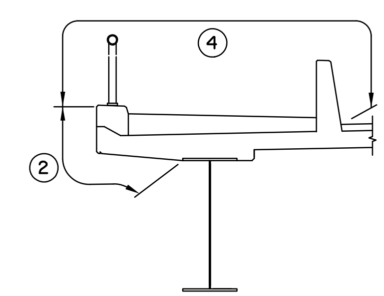
A PIER SECTION
(CONCRETE DIAPHRAGMS) NTS



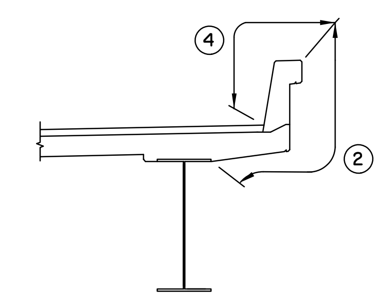
P DETAIL
NTS



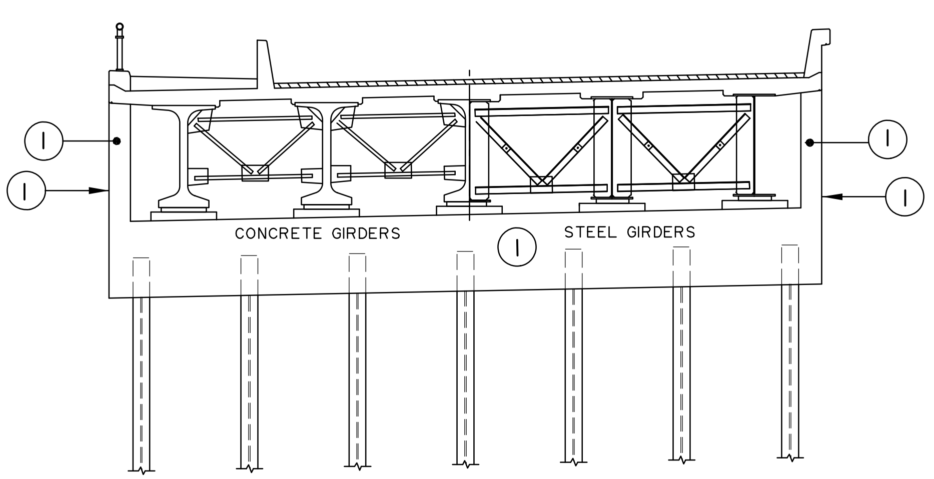
R DETAIL
NTS



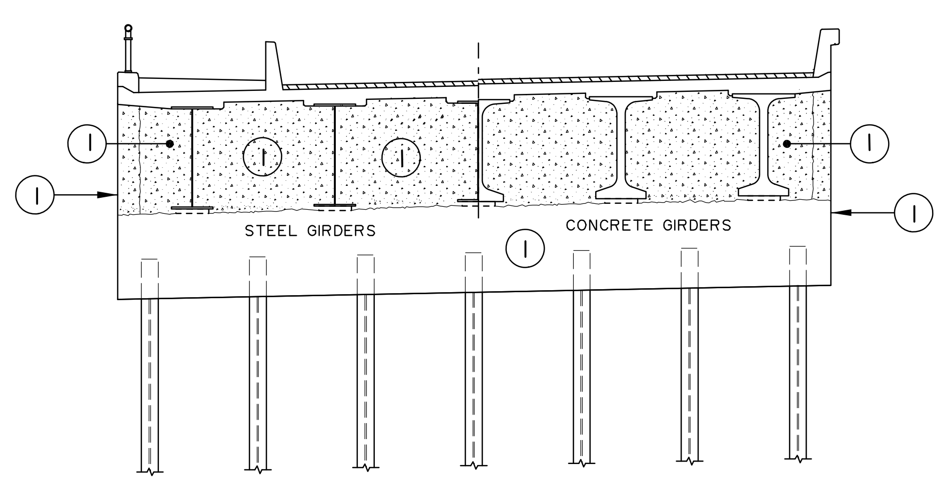
S DETAIL
NTS



T DETAIL
NTS



B ABUTMENT SECTION
(STEEL DIAPHRAGMS) NTS
CONVENTIONAL ABUTMENTS



B ABUTMENT SECTION
(CONCRETE DIAPHRAGMS) NTS
SEMI / FULLY INTEGRAL ABUTMENTS

REV	DATE	REVISIONS	BY
4			
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1	2011-11-07	MAJOR REVISIONS	TL

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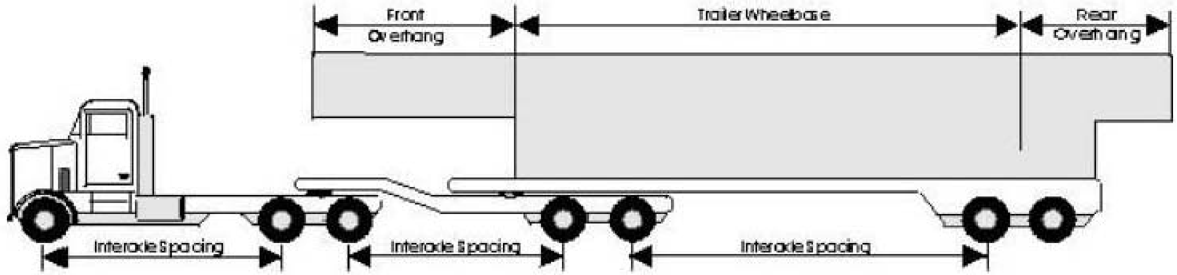
NORTHEAST ANTHONY HENDAY DRIVE
STANDARD DETAILS FOR
SEALER SURFACE TREATMENTS

AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
-	2011-09-23	1 OF 1	SK-1

WTS NOV 07, 2011 SEALER-SK-1.DGN

Vehicle 1: 32 wheel Trailer (Tractor, 16 wheel Jeep, 16 wheel trailer)



Axle No	1	2	3	4	5	6	7
Wheel per axle	2	4	4	8	8	8	8
Axle Type	1	2	2	3	3	3	3
Axle load (kN)	71.6	122.6	122.6	181.5	181.5	181.5	181.5

Axle spacing(m)	5.0	1.4	3.65	1.4	11.0	1.4

Gross vehicle weight: 1043 kN (~106,300 kg)

Note: For lateral spacing of tires of different axle types see diagrams on page SK-8

REV	DATE	REVISIONS	BY
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Government of Alberta ■ Transportation

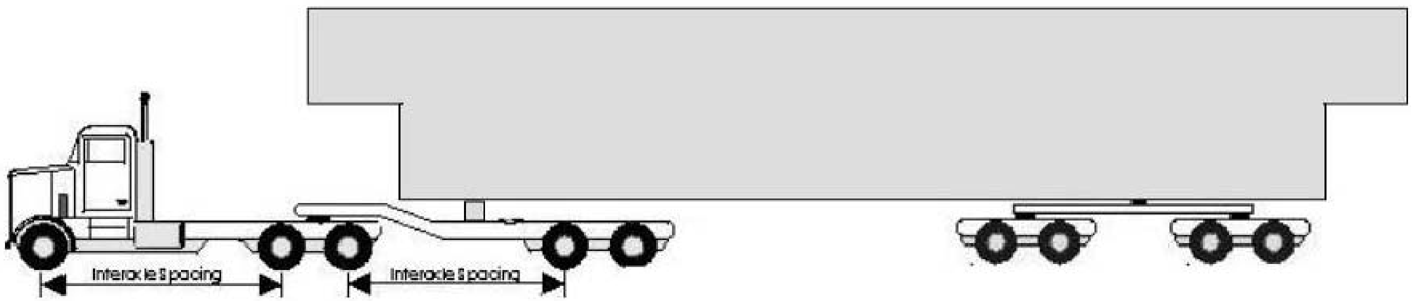
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18

APPENDIX B
VEHICLE 1 – 32 WHEEL TRAILER

DEPARTMENT BAR CODE	DATE	SHEET	DRAWING
–	2010–06–11	-	SK–2

RWK JUN.14, 2010 SK–2.DWG

Vehicle 2: 48 wheel Trailer (Tractor, 16 wheel Jeep, 32 wheel dolly)



Axle No	1	2	3	4	5	6	7	8	9
Wheel per axle	2	4	4	8	8	8	8	8	8
Axle Type	1	2	2	3	3	3	3	3	3
Axle load(kN)	71.6	122.6	122.6	181.5	181.5	181.5	181.5	181.5	181.5

Axle spacing (m): 5.0 | 1.4 | 3.65 | 1.4 | 15.0 | 1.4 | 3.65 | 1.4

Gross vehicle weight: 1406 kN (~143,300 kg)

Note: For lateral spacing of tires of different axle types see diagrams on page SK-8

REV	DATE	REVISIONS	BY
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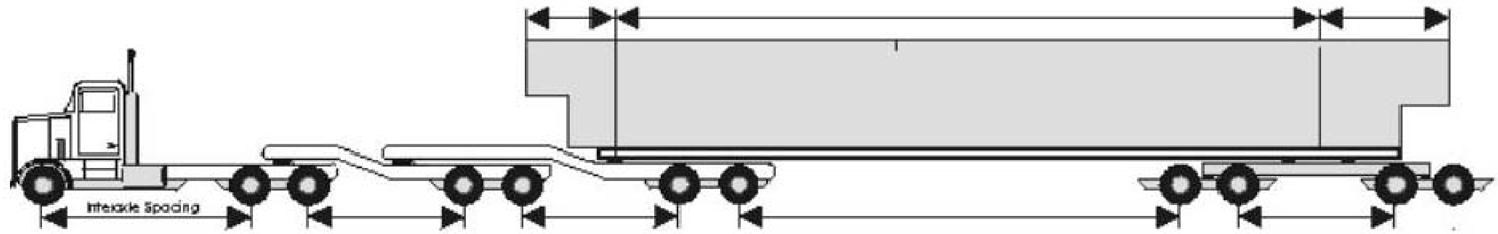
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18

APPENDIX B
VEHICLE 2 – 48 WHEEL TRAILER

DEPARTMENT BAR CODE	DATE	SHEET	DRAWING
–	2010–06–11	-	SK–3

RWK JUN.14, 2010 SK–3.DWG

Vehicle 3: 64 wheel Trailer (Tractor, 16 wheel Jeep, 16 wheel jeep 32 wheel dolly)



Axle No	1	2	3	4	5	6	7	8	9	10	11
Wheel per axle	2	4	4	8	8	8	8	8	8	8	8
Axle Type	1	2	2	3	3	3	3	3	3	3	3
Axle load (kN)	71.6	122.6	122.6	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5

Axle spacing(m): 5.0 | 1.4 | 3.65 | 1.4 | 3.65 | 1.4 | 17.0 | 1.4 | 3.65 | 1.4

Gross vehicle weight: 1767 kN (~180,300 kg)

Note: For lateral spacing of tires of different axle types see diagrams on page SK-8

REV	DATE	REVISIONS	BY
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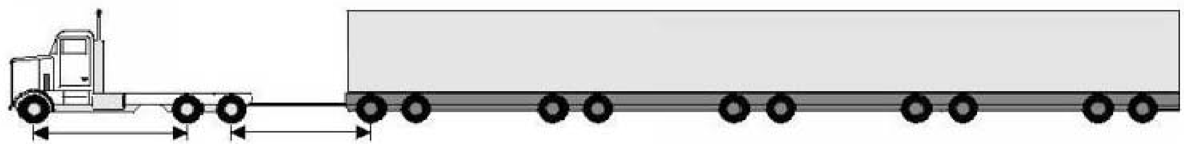
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18

APPENDIX B
VEHICLE 3 – 64 WHEEL TRAILER

DEPARTMENT BAR CODE	DATE	SHEET	DRAWING
-	2010-06-11	-	SK-4

RWK JUN.14, 2010 SK-4.DWG

Vehicle 4: 10 Line 2 File Road Style Scheurle Trailer (Tractor, 5 sets of 16 wheel)



Axle No	1	2	3	4	5	6	7	8	9	10	11	12	13
Wheel per axle	2	4	4	8	8	8	8	8	8	8	8	8	8
Axle Type	1	2	2	3	3	3	3	3	3	3	3	3	3
Axle load (kN)	71.6	122.6	122.6	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5

Axle spacing(m): 5.0 | 1.5 | 5.0 | 1.5 | 4.5 | 1.5 | 4.5 | 1.5 | 4.5 | 1.5 | 4.5 | 1.5

Gross vehicle weight: 2132 kN (~217,300 kg)

Note: For lateral spacing of tires of different axle types see diagrams on page SK-8

REV	DATE	REVISIONS	BY
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Government of Alberta ■ Transportation

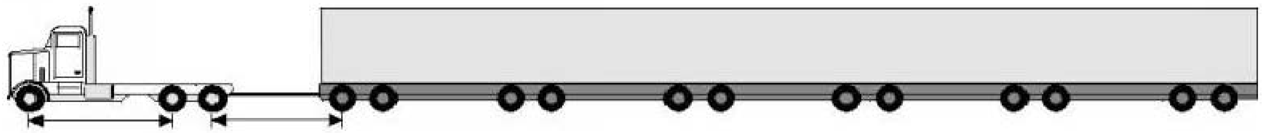
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18

APPENDIX B
VEHICLE 4–10 LINE 2 FILE ROAD STYLE SCHEURLE TRAILER

DEPARTMENT BAR CODE	DATE	SHEET	DRAWING
–	2010–06–11	-	SK–5

RWK JUN.14, 2010 SK–5.DWG

Vehicle 5: 12 Line 2 File Road Style Scheurle Trailer (Tractor, 6 sets of 16 wheel)



Axle No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Wheel per axle	2	4	4	8	8	8	8	8	8	8	8	8	8	8	8
Axle Type	1	2	2	3	3	3	3	3	3	3	3	3	3	3	3
Axle load(kN)	71.6	122.6	122.6	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5	181.5

Axle spacing(m) 5.0 1.5 5.0 1.5 4.5 1.5 4.5 1.5 4.5 1.5 4.5 1.5 4.5 1.5

Gross vehicle weight: 2495 kN (~254,300 kg)

Note: For lateral spacing of tires of different axle types see diagrams on page SK-8

REV	DATE	REVISIONS	BY
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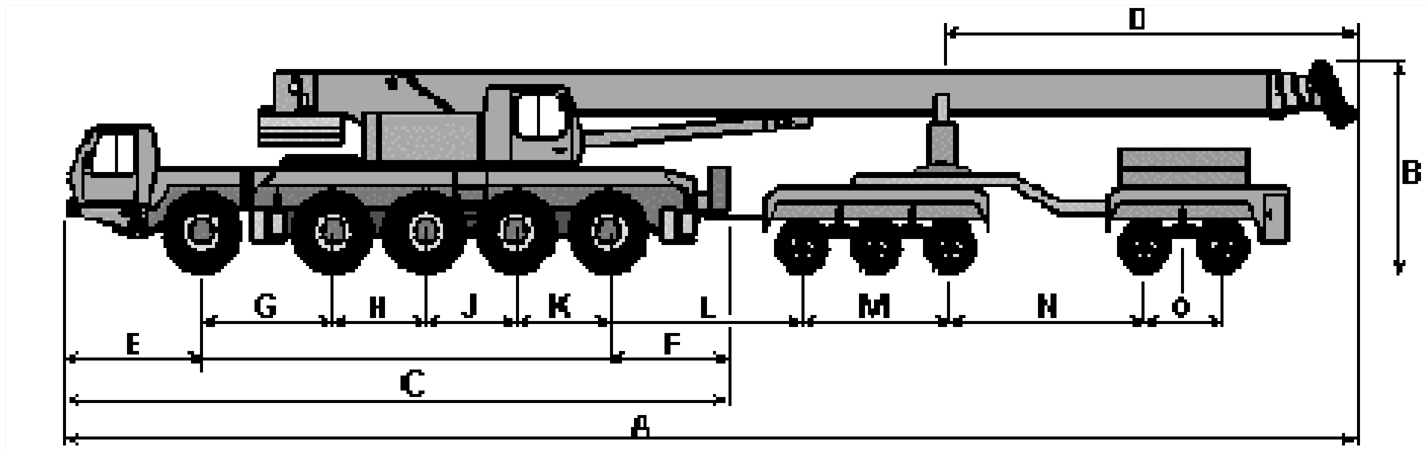
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18

APPENDIX B
VEHICLE 5-12 LINE 2 FILE ROAD STYLE SCHEURLE TRAILER

DEPARTMENT BAR CODE	DATE	SHEET	DRAWING
-	2010-06-11	-	SK-6

RWK JUN.14, 2010 SK-6.DWG

Vehicle 6: Mobile Crane



Axle No	1	2	3	4	5	6	7	8	9	10
Wheel per axle	2	2	2	2	2	4	4	4	4	4
Axle Type Case 1	1	1	1	1	1	2	2	2	2	2
Axle Type Case 2	2	2	2	2	2	2	2	2	2	2
Axle Load (kN)	98.1	98.1	98.1	98.1	98.1	88.3	88.3	88.3	112.8	112.8

Axle Spacing (m): 2.0, 1.6, 1.6, 1.8, 4.2, 3.0, 4.2, 1.2

Gross vehicle weight: 981 kN (~100,000 kg)

Note: For lateral spacing of tires of different axle types see diagrams on SK-8

REV	DATE	REVISIONS	BY
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Government of Alberta ■ Transportation

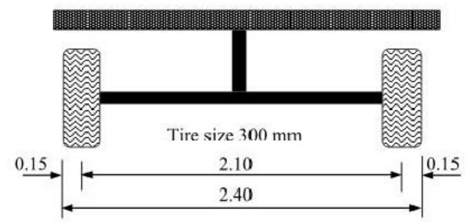
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18

APPENDIX B
VEHICLE 6 – MOBILE CRANE

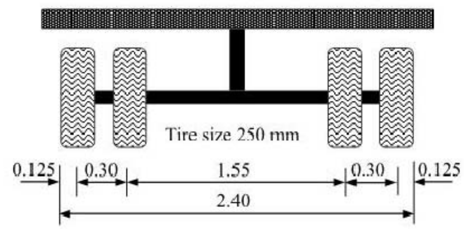
DEPARTMENT BAR CODE	DATE	SHEET	DRAWING
–	2010–06–11	-	SK–7

RWK JUN.14, 2010 SK–7.DWG

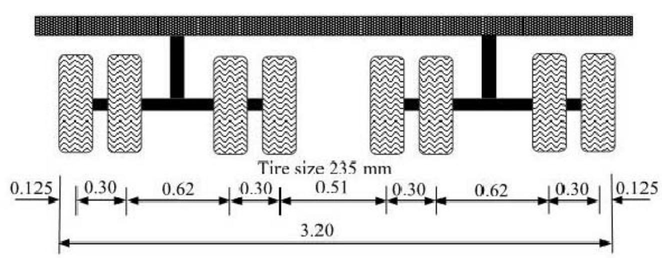
Different axle type and tire spacing (m)



Axle type 1 (Steering Axle)



Axle type 2 (Drive or any 4 Wheel Single Axle, 8 Wheel Tandem, 12 Wheel Tridem)



Axle type 3 (16 Wheel Tandem, 24 Wheel Tridem)

REV	DATE	REVISIONS	BY
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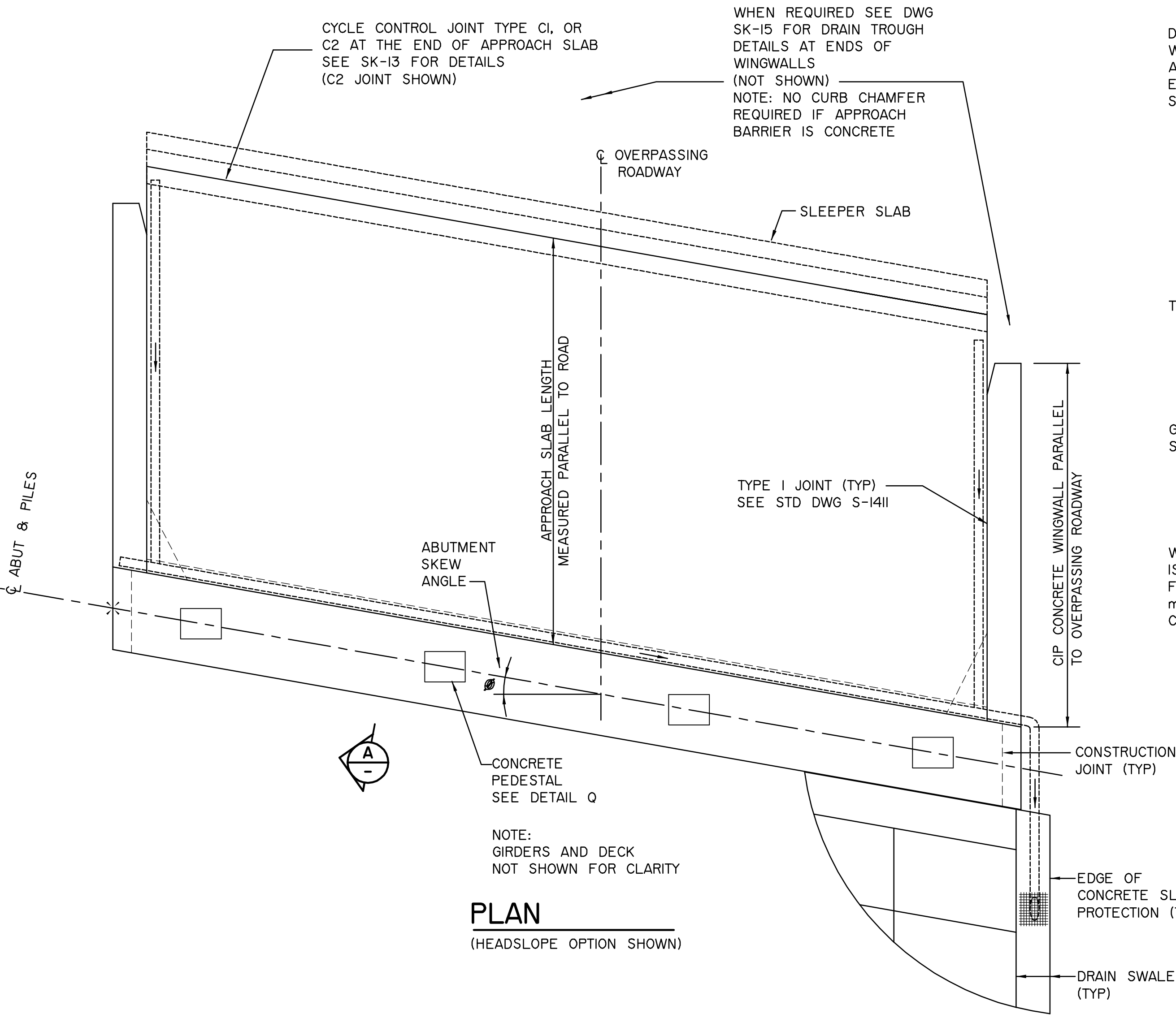
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18

APPENDIX B
DIFFERENT AXLE TYPE AND TIRE SPACING

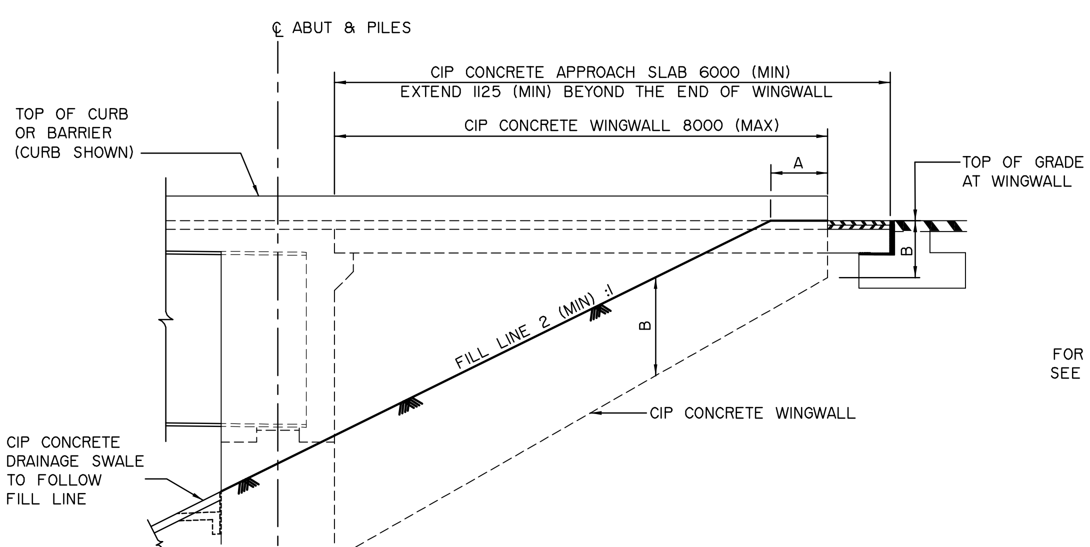
DEPARTMENT BAR CODE	DATE	SHEET	DRAWING
–	2010–06–11	–	SK–8

RWK JUN.14, 2010 SK–8.DWG



PLAN

(HEADSLOPE OPTION SHOWN)

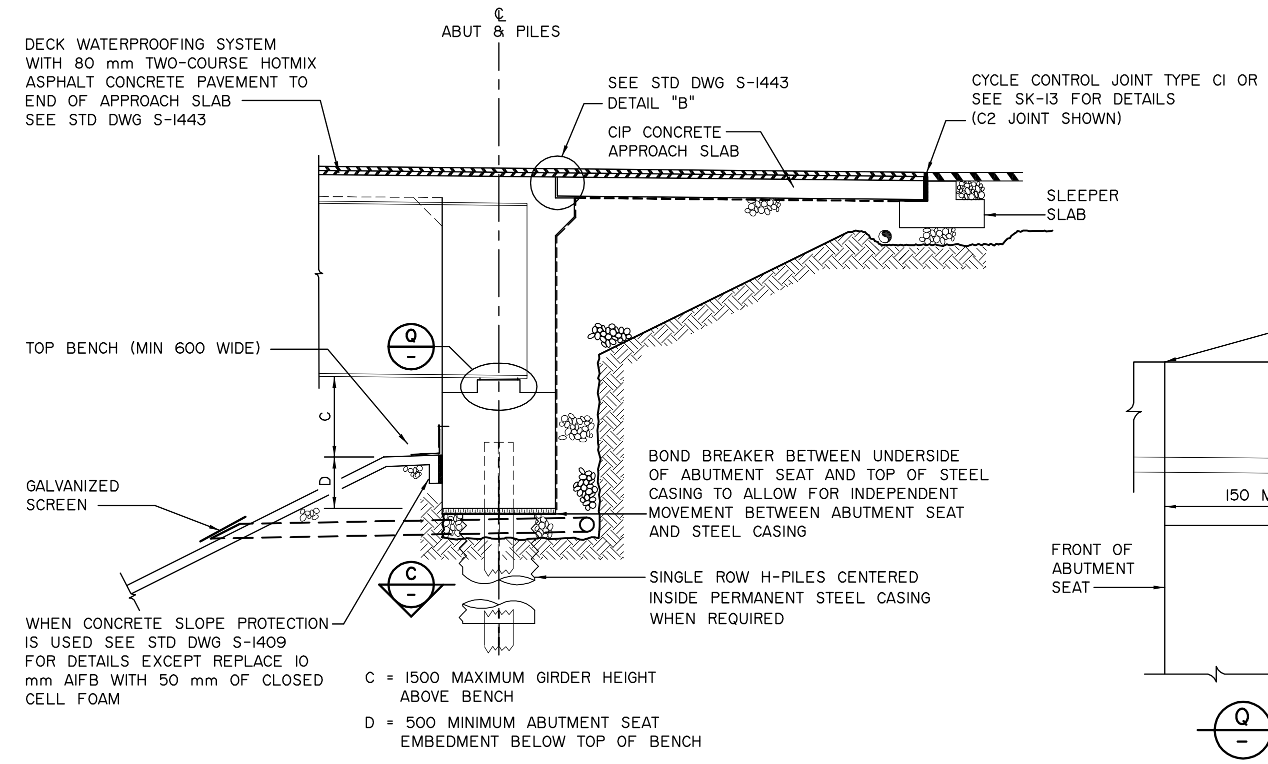


A = 600 MINIMUM LENGTH OF THE CIP CONCRETE WINGWALL REQUIRED BEYOND THE TOP OF FILL LINE

B = 600 MINIMUM DEPTH OF THE CIP CONCRETE WINGWALL BELOW TOP OF GRADE

ELEVATION

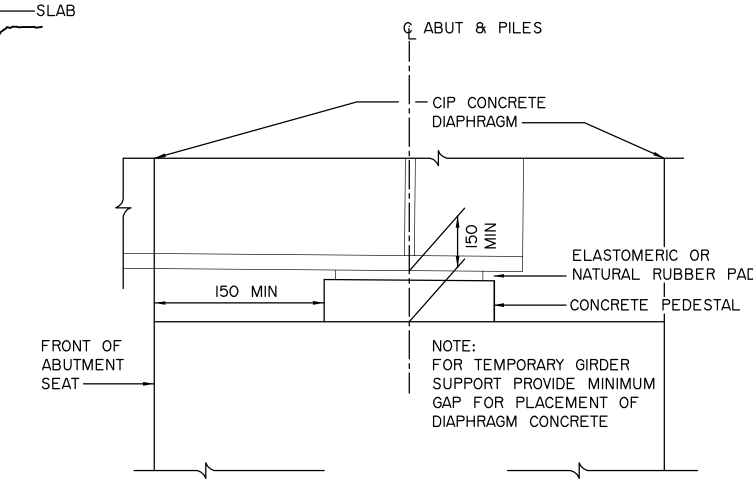
(HEADSLOPE OPTION SHOWN)



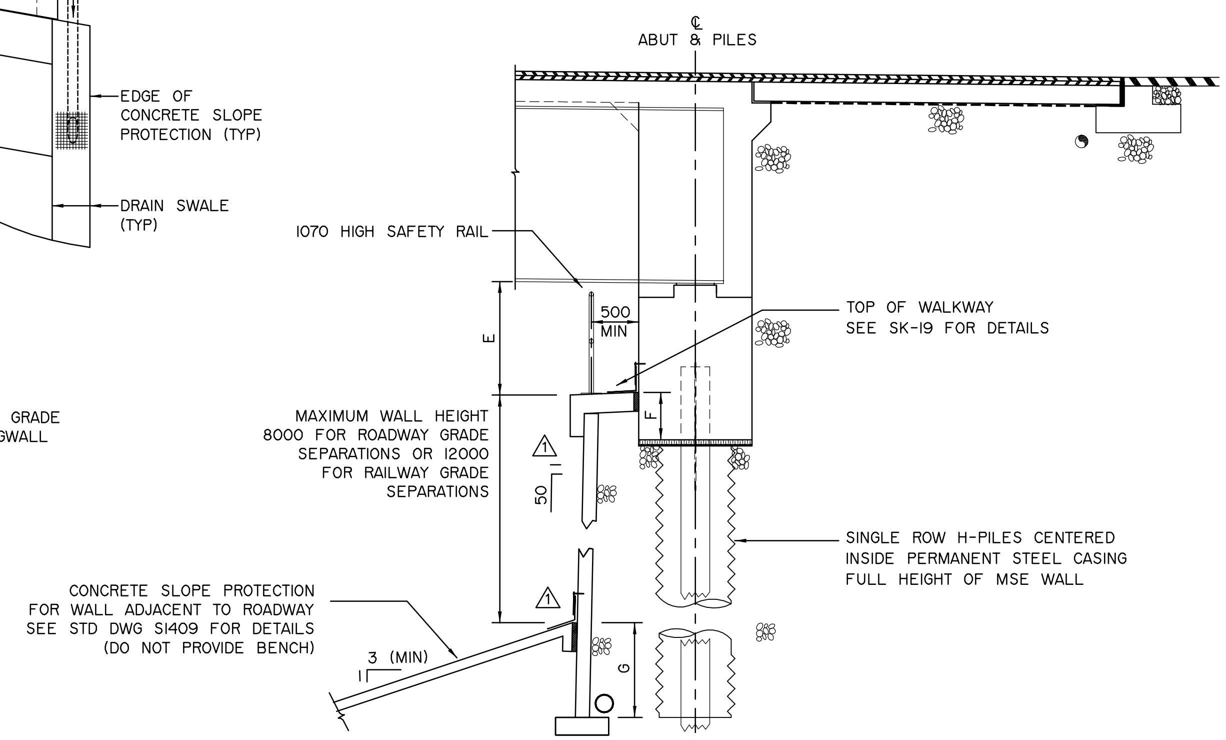
C = 1500 MAXIMUM GIRDER HEIGHT ABOVE BENCH

D = 500 MINIMUM ABUTMENT SEAT EMBEDMENT BELOW TOP OF BENCH

A SECTION HEADSLOPE OPTION



Q PEDESTAL DETAIL



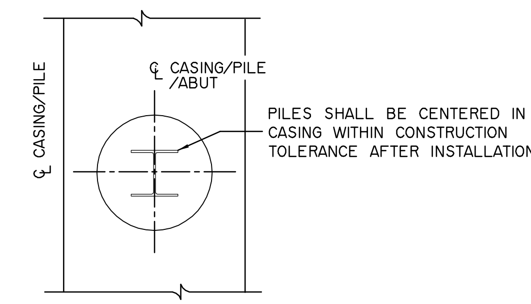
E = 1500 MAXIMUM GIRDER HEIGHT ABOVE TOP OF WALKWAY

F = 500 MINIMUM ABUTMENT SEAT EMBEDMENT BELOW TOP OF WALKWAY

G = 1000 MINIMUM DEPTH OF THE MSE WALL BURIED BELOW TOP OF CONCRETE SLOPE PROTECTION

NOTE: MSE WALL SIMILAR TO HEADSLOPE OPTION EXCEPT AS NOTED

A SECTION MSE WALL OPTION



C PILE POSITON INSIDE CASING

NOTES

- ALL DIMENSIONS ARE IN MILLIMETERS
- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING SELECTED SCHEDULE 18 REQUIREMENTS. THEY INTENTIONALLY OMIT DETAILS THAT MIGHT DETRACT FROM THIS PURPOSE

REV	DATE	REVISIONS	BY
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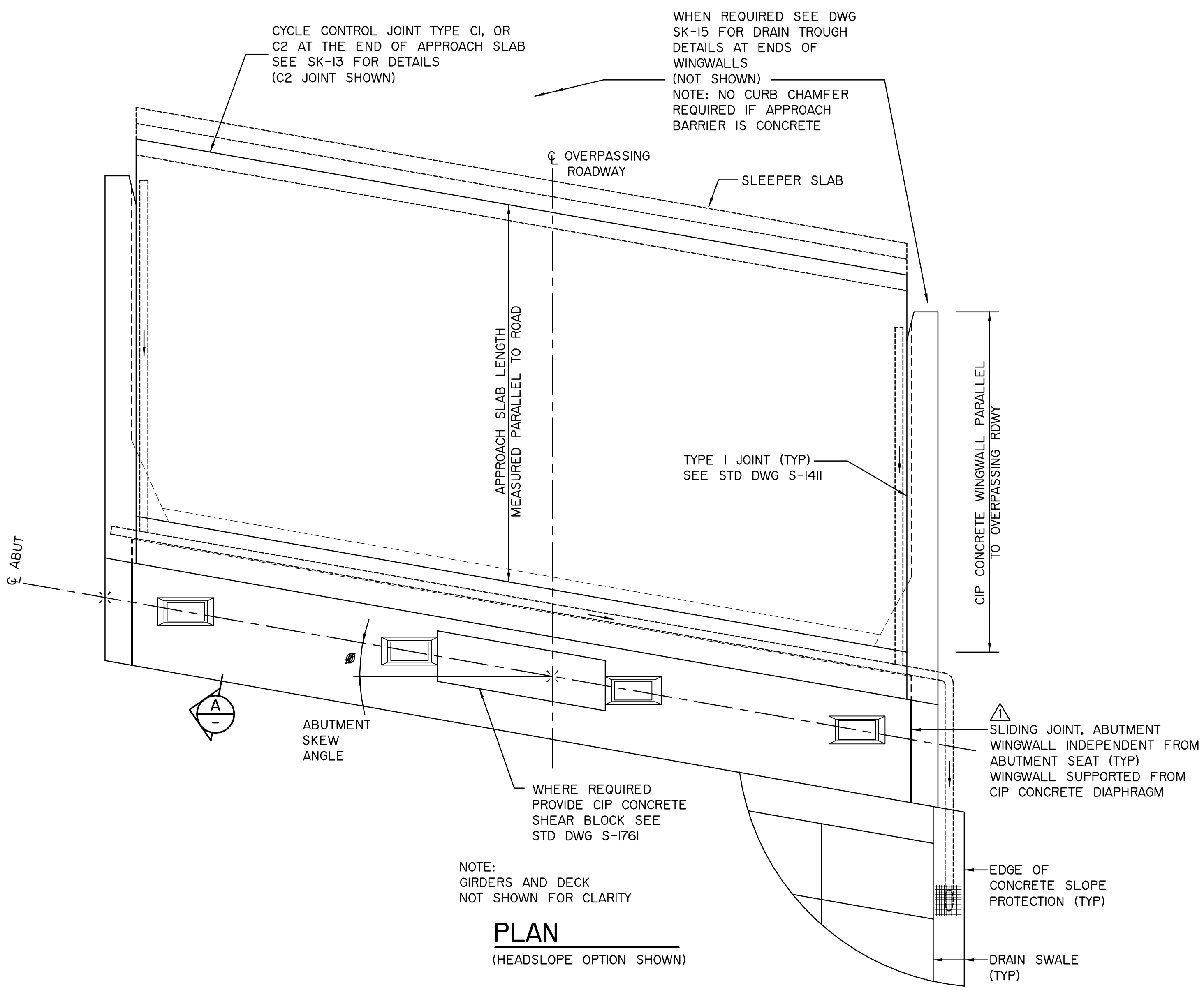
1	2011.10.31	WALL SLOPE & FLASHING	TL

Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE
STANDARD DETAILS FOR
FULLY–INTEGRAL ABUTMENT

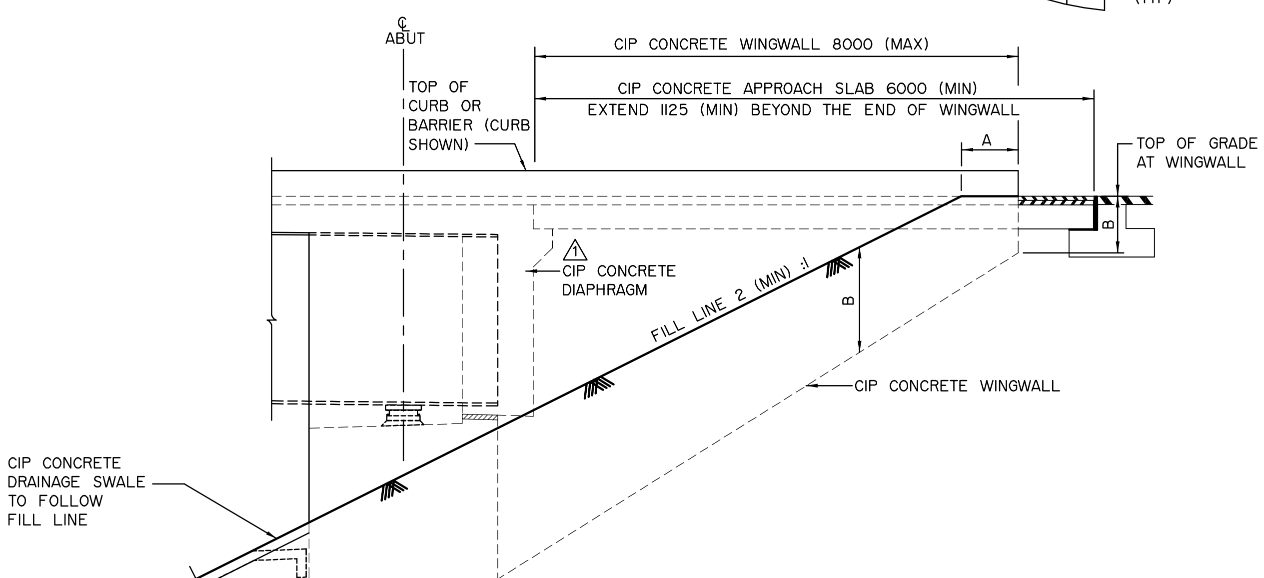
AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011–05–11	1 OF 11	SK–9

RWK NOV.01, 2011 13010-SK09-RV1.DWG



PLAN

(HEADSLOPE OPTION SHOWN)

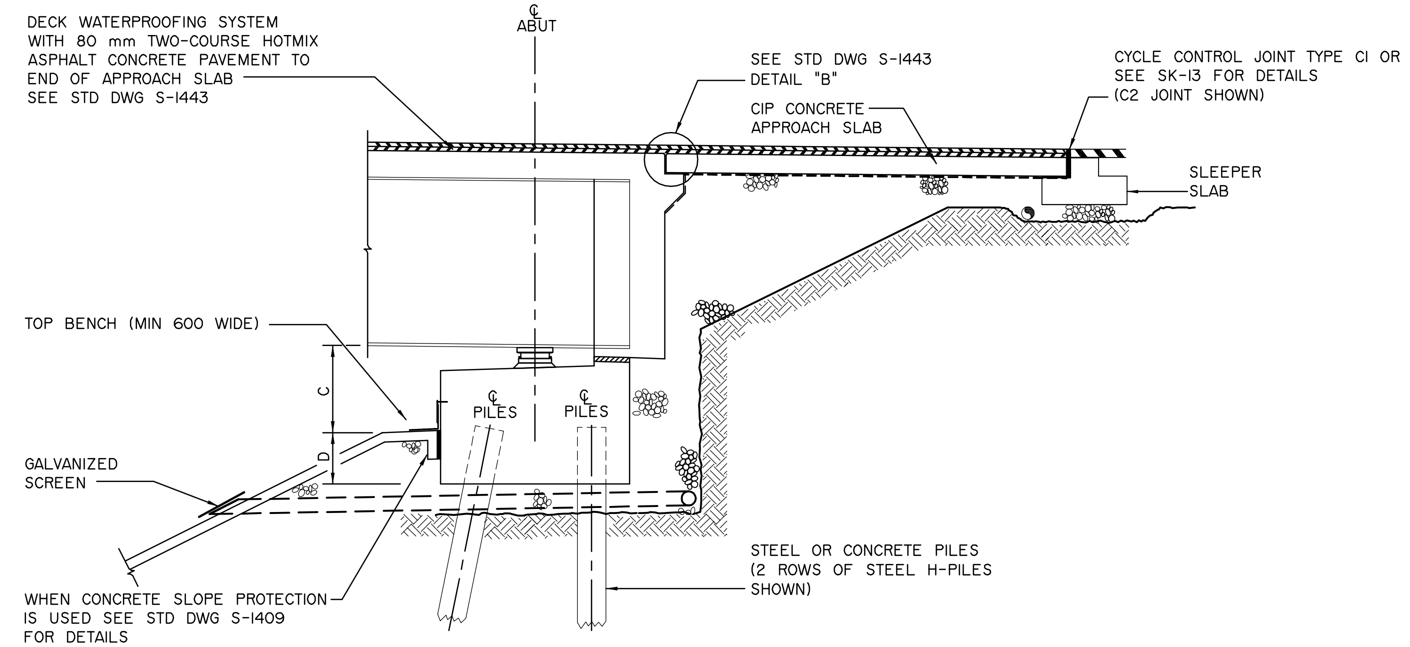


A = 600 MINIMUM LENGTH OF THE CIP CONCRETE WINGWALL REQUIRED BEYOND THE TOP OF FILL LINE

B = 600 MINIMUM DEPTH OF THE CIP CONCRETE WINGWALL BELOW TOP OF GRADE

ELEVATION

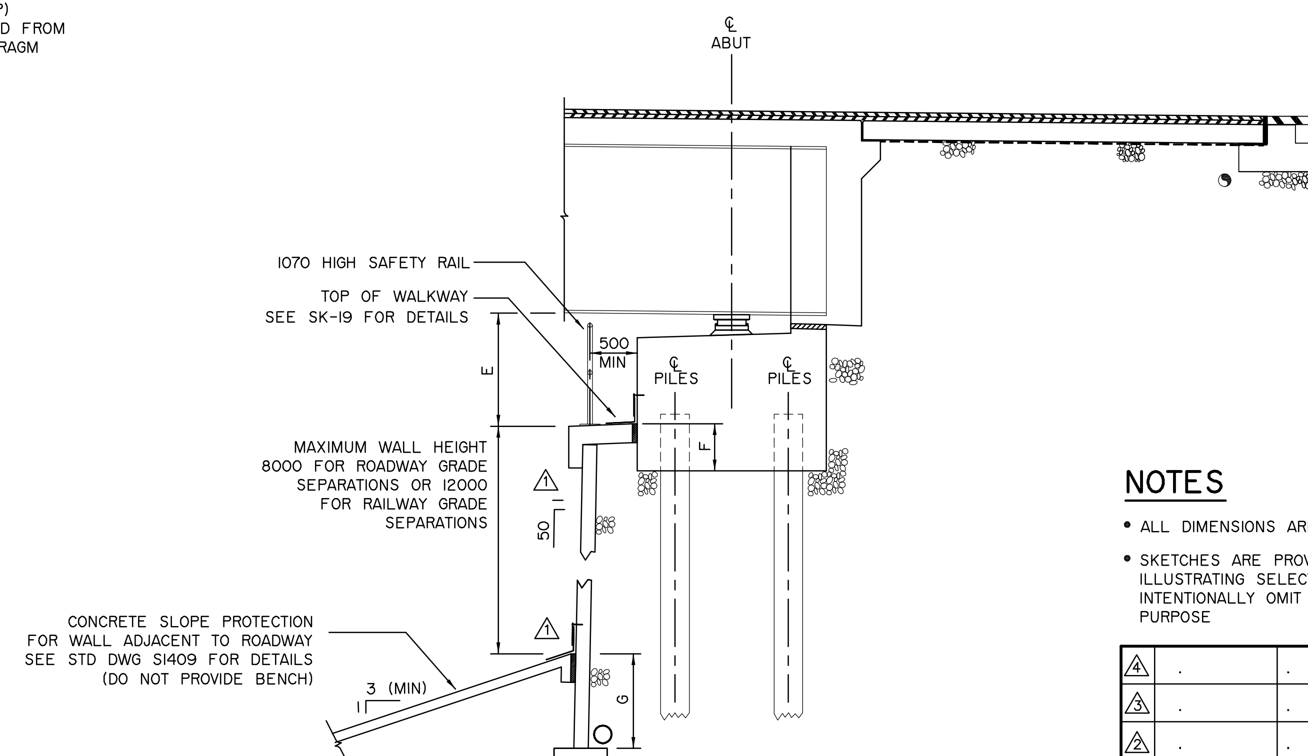
(HEADSLOPE OPTION SHOWN)



C = 1500 MAXIMUM GIRDER HEIGHT ABOVE BENCH

D = 500 MINIMUM ABUTMENT SEAT EMBEDMENT BELOW TOP BENCH

(A) SECTION HEADSLOPE OPTION



E = 1500 MAXIMUM GIRDER HEIGHT ABOVE TOP OF WALKWAY

F = 500 MINIMUM ABUTMENT SEAT EMBEDMENT BELOW TOP OF WALKWAY

G = 1000 MINIMUM DEPTH OF THE MSE WALL BURIED BELOW TOP OF CONCRETE SLOPE PROTECTION

NOTE: MSE WALL SIMILAR TO HEADSLOPE OPTION EXCEPT AS NOTED

(A) SECTION MSE WALL OPTION

NOTES

- ALL DIMENSIONS ARE IN MILLIMETERS
- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING SELECTED SCHEDULE 18 REQUIREMENTS. THEY INTENTIONALLY OMIT DETAILS THAT MIGHT DETRACT FROM THIS PURPOSE

REV	DATE	REVISIONS	BY
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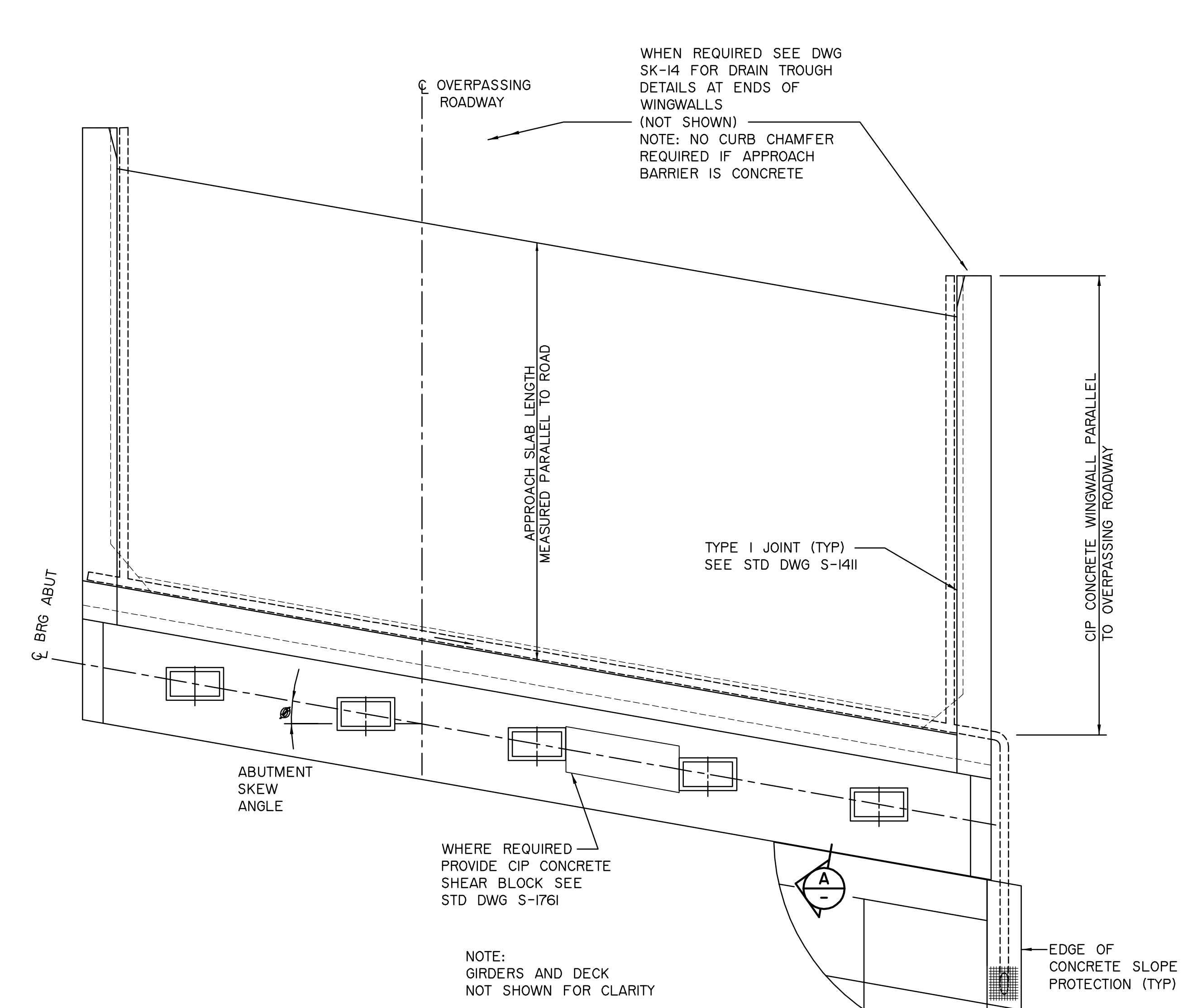
1	2011.10.31	WALL SLOPE, FLASHING & SLIDING JOINT	TL

Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE
STANDARD DETAILS FOR
SEMI-INTEGRAL ABUTMENT

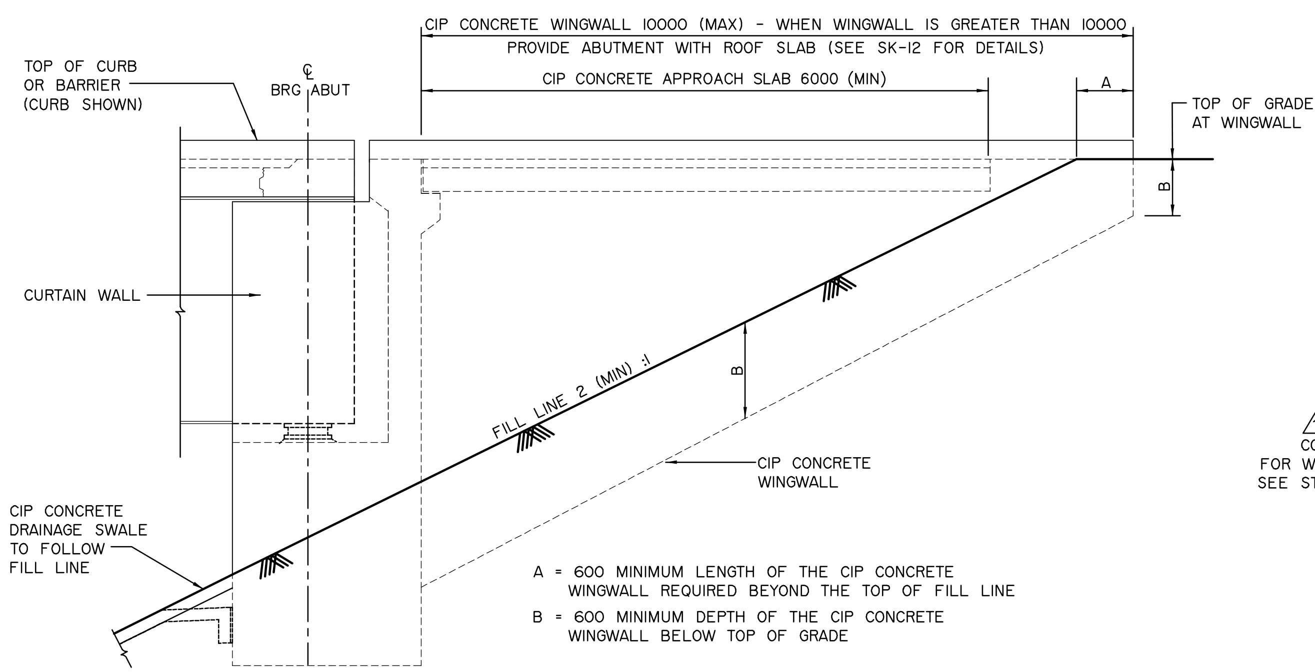
AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011-05-11	2 of 11	SK-10

RWK NOV.01, 2011 13010-SK10-RV1.DWG



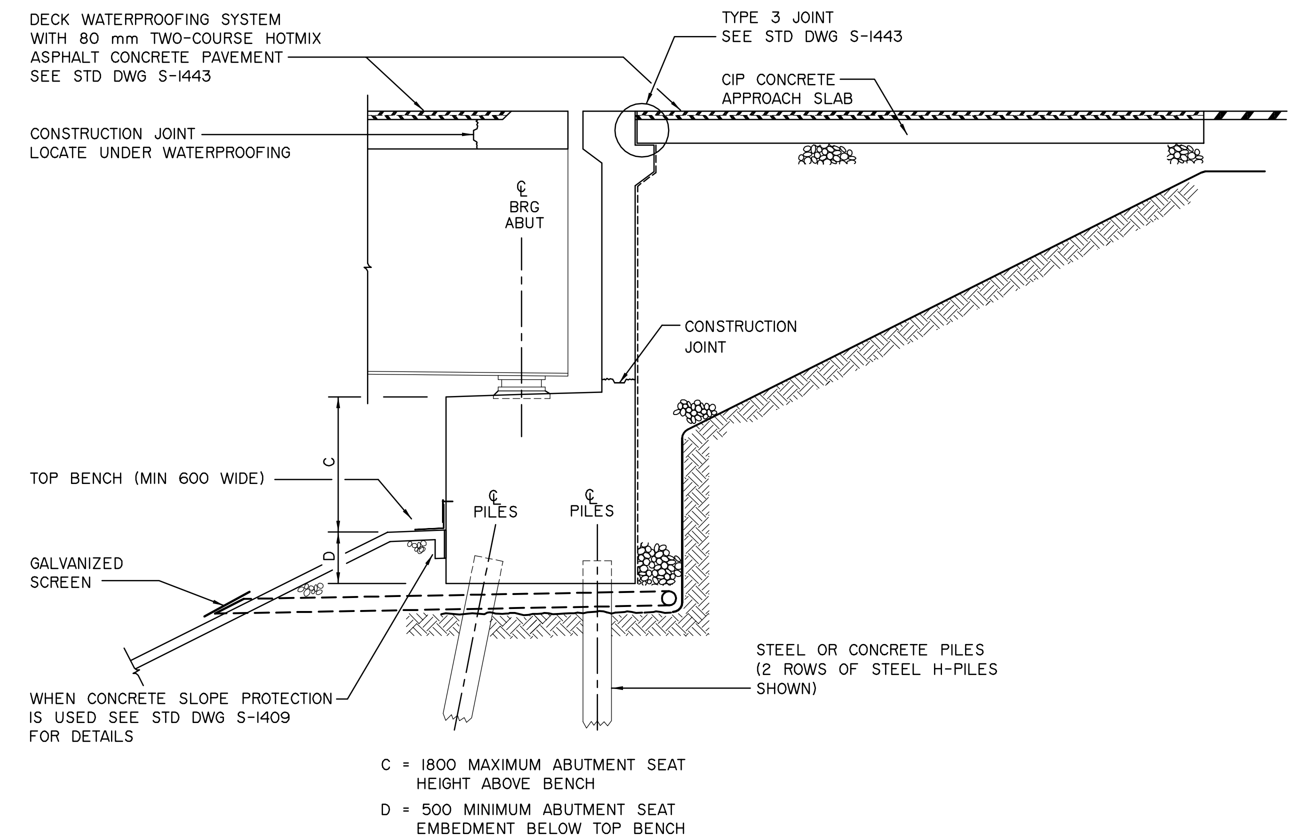
PLAN

(HEADSLOPE OPTION SHOWN)

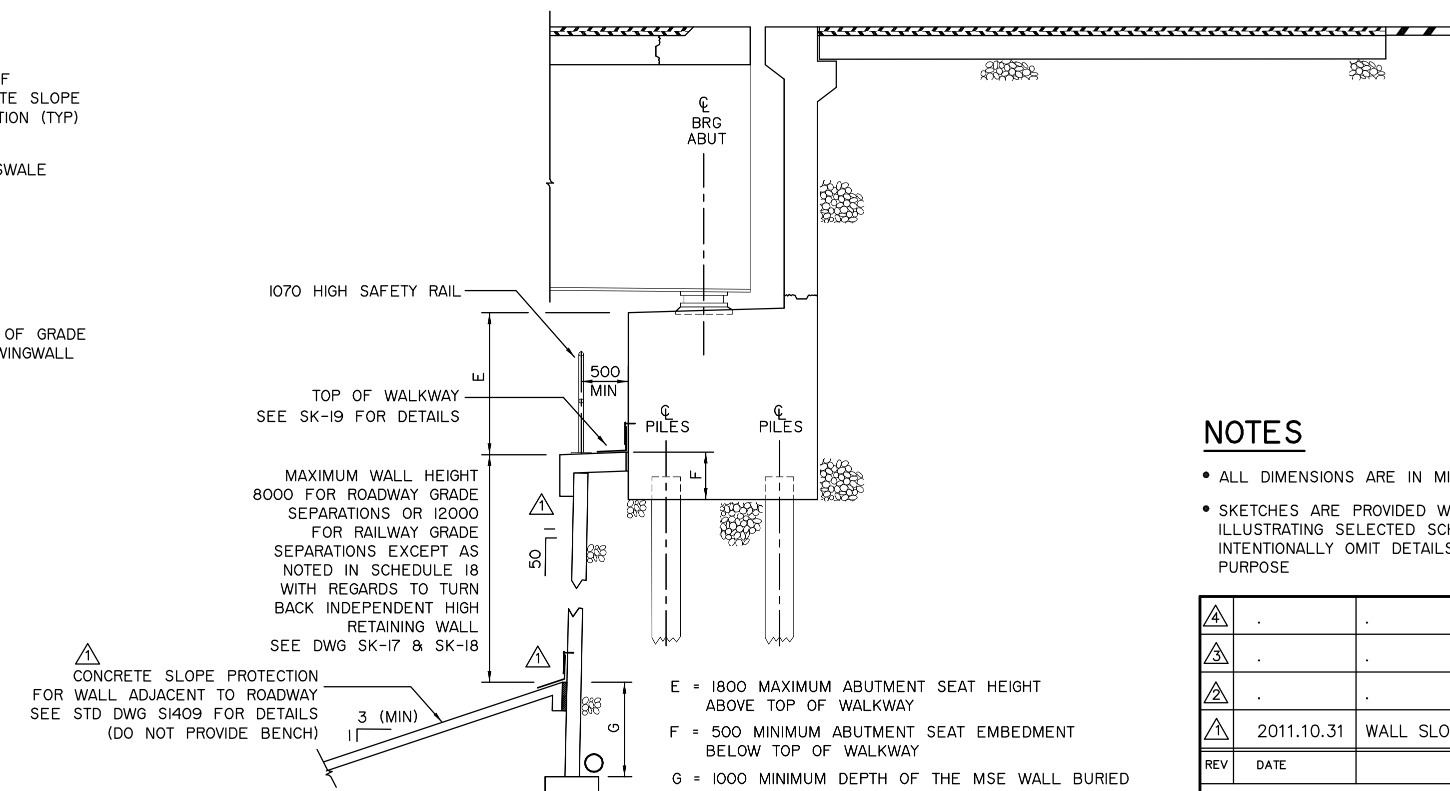


ELEVATION

(HEADSLOPE OPTION SHOWN)



A SECTION HEADSLOPE OPTION



NOTE: MSE WALL SIMILAR TO HEADSLOPE OPTION EXCEPT AS NOTED

A SECTION MSE WALL OPTION

NOTES

- ALL DIMENSIONS ARE IN MILLIMETERS
- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING SELECTED SCHEDULE 18 REQUIREMENTS. THEY INTENTIONALLY OMIT DETAILS THAT MIGHT DETRACT FROM THIS PURPOSE

REV	DATE	REVISIONS	BY
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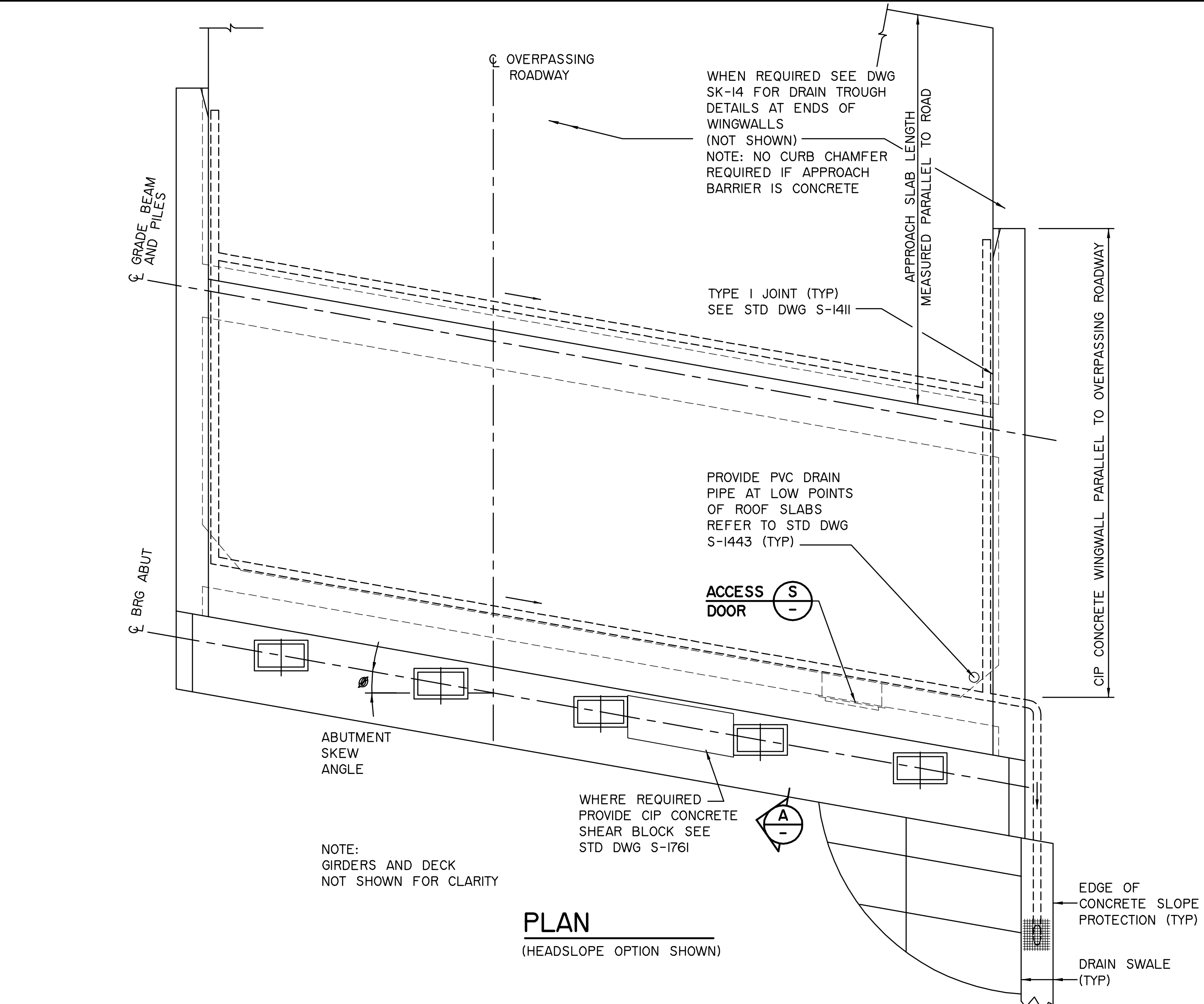
2	.	.	.
1	2011.10.31	WALL SLOPE, FLASHING & SLOPE NOTE	TL

Government of Alberta ■ Transportation

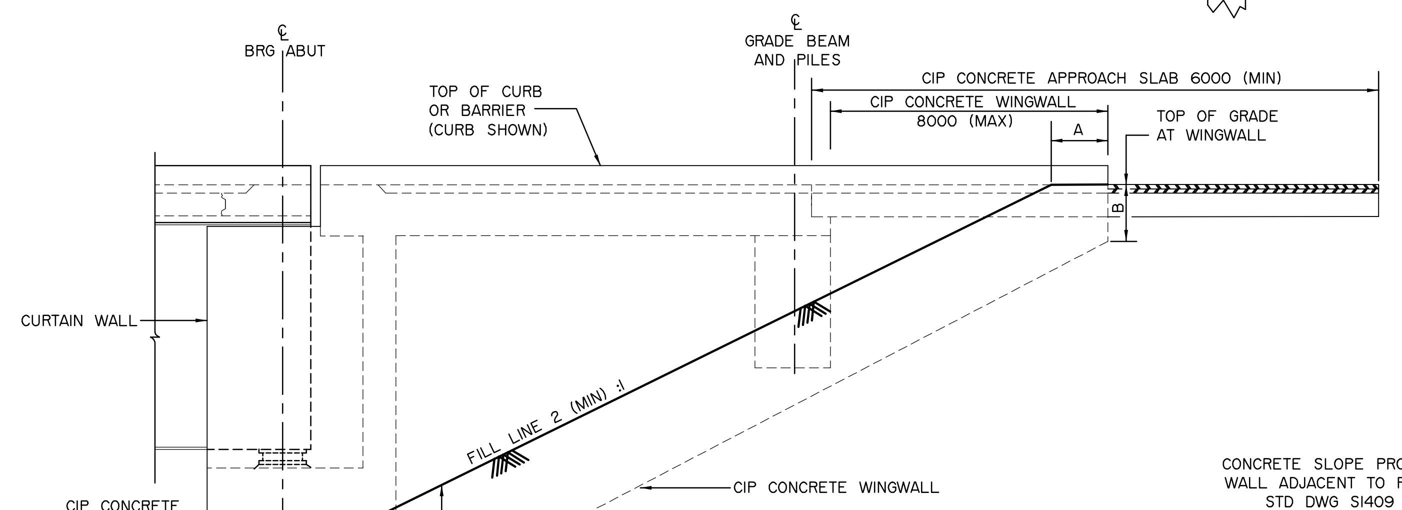
NORTHEAST ANTHONY HENDAY DRIVE
STANDARD DETAILS FOR
CONVENTIONAL ABUTMENT

AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011–05–11	3 OF 11	SK–11

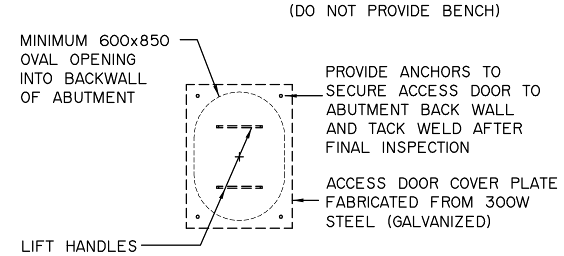
RWK NOV.01, 2011 13010-SK11-RV1.DWG



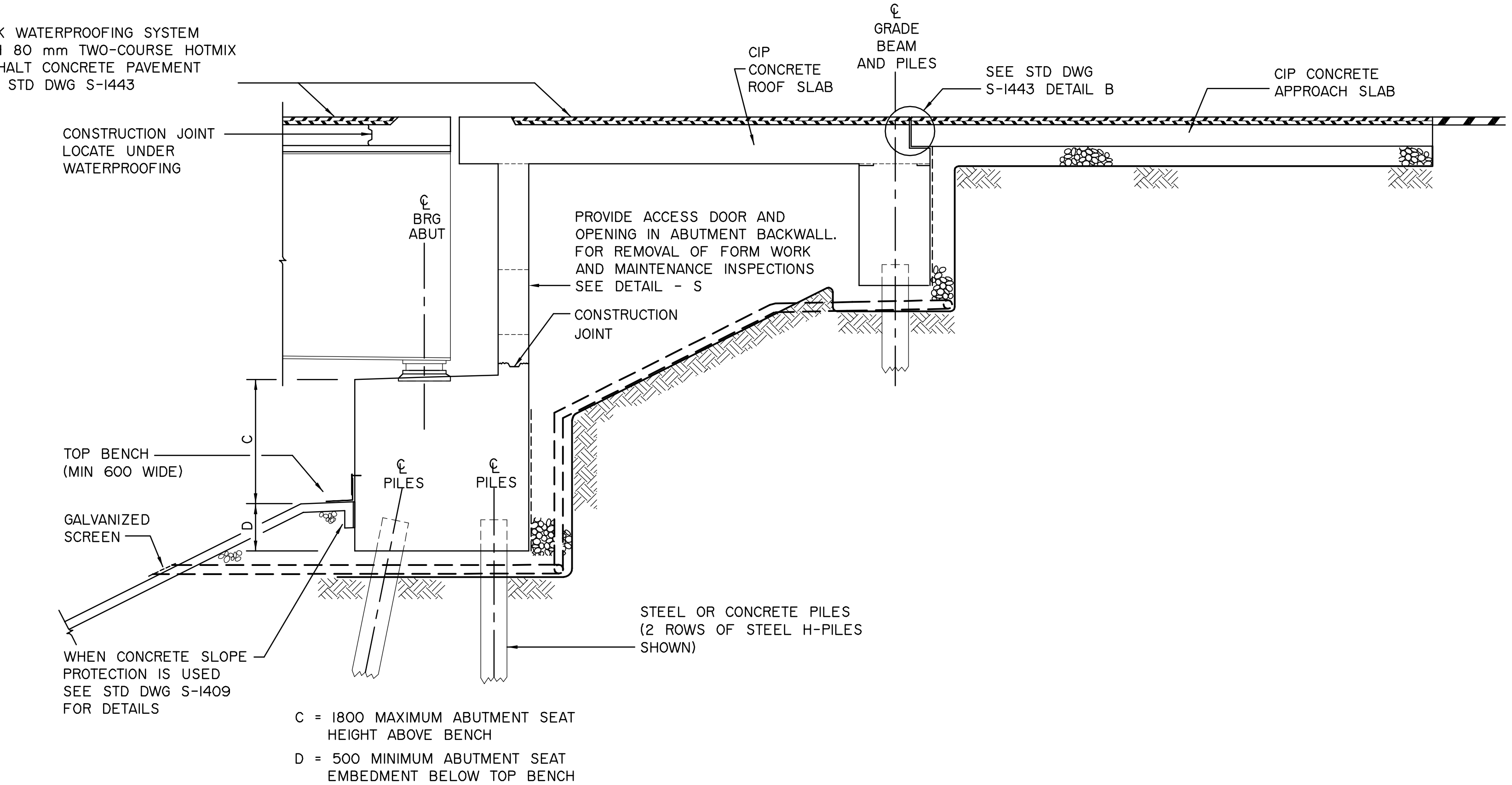
PLAN
(HEADSLOPE OPTION SHOWN)



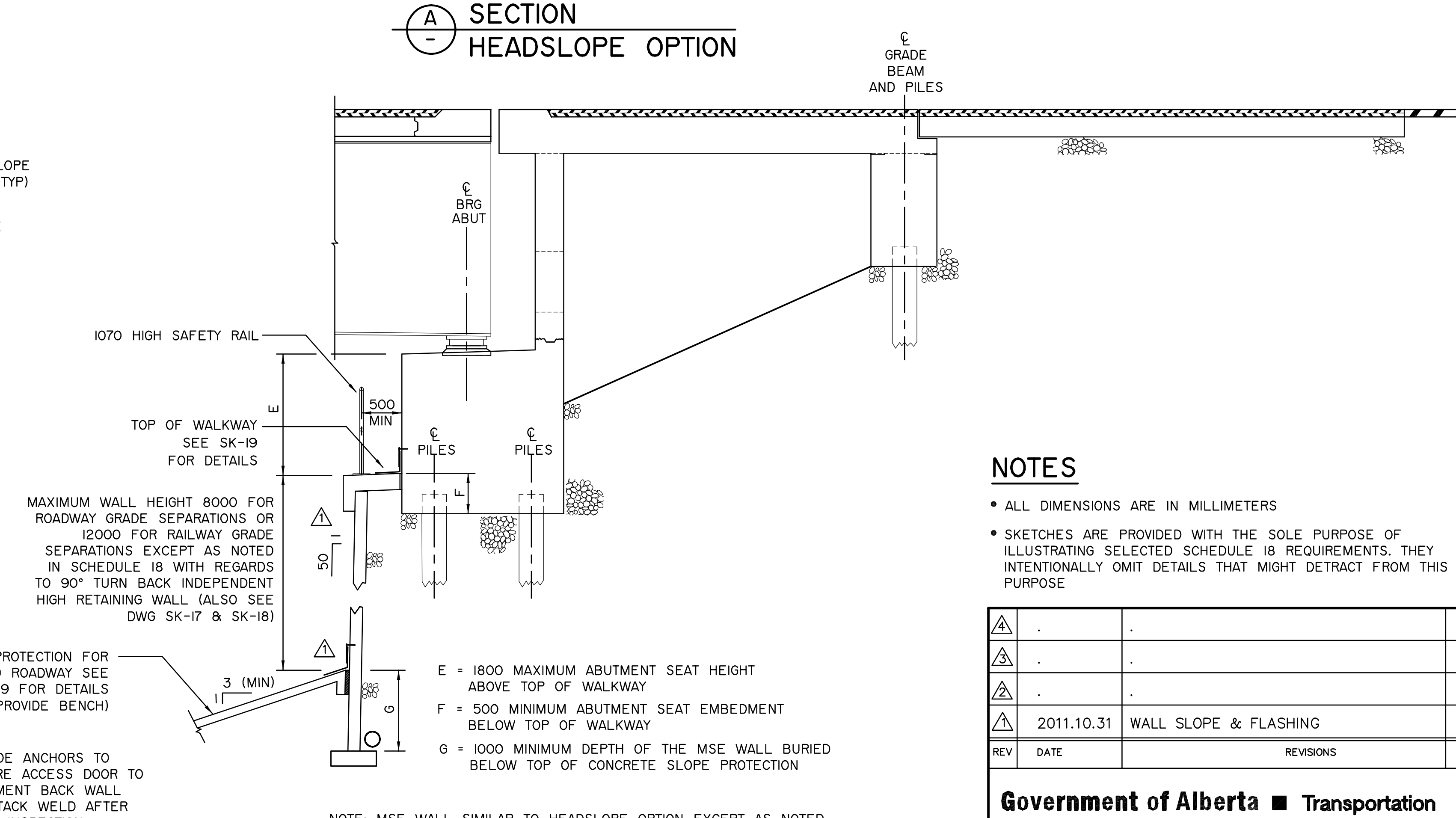
ELEVATION
(HEADSLOPE OPTION SHOWN)



S ACCESS DOOR



A SECTION HEADSLOPE OPTION



A SECTION MSE WALL OPTION

NOTES

- ALL DIMENSIONS ARE IN MILLIMETERS
- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING SELECTED SCHEDULE 18 REQUIREMENTS. THEY INTENTIONALLY OMIT DETAILS THAT MIGHT DETRACT FROM THIS PURPOSE

REV	DATE	REVISIONS	BY
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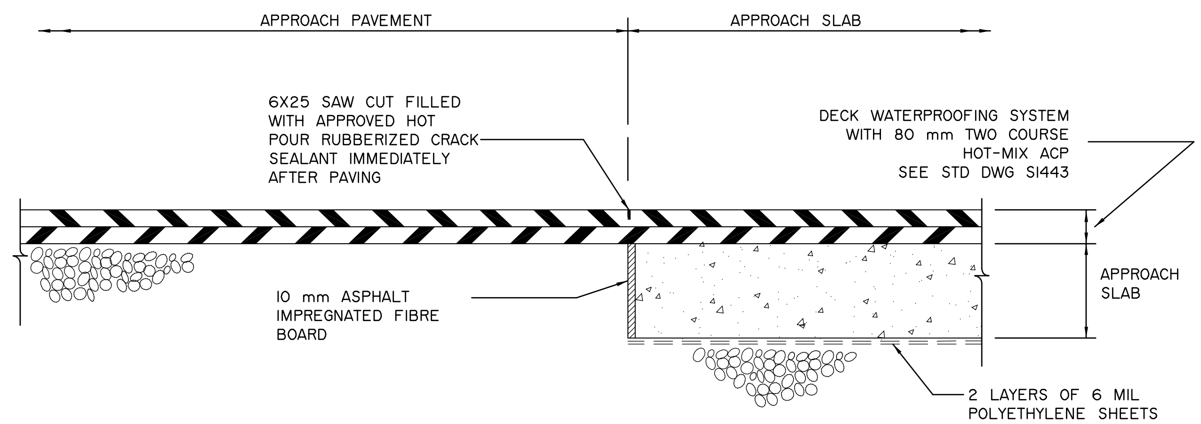
3	.	.	.
2	.	.	.
1	2011.10.31	WALL SLOPE & FLASHING	TL

Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE
STANDARD DETAILS FOR CONVENTIONAL ABUTMENT WITH ROOF SLAB

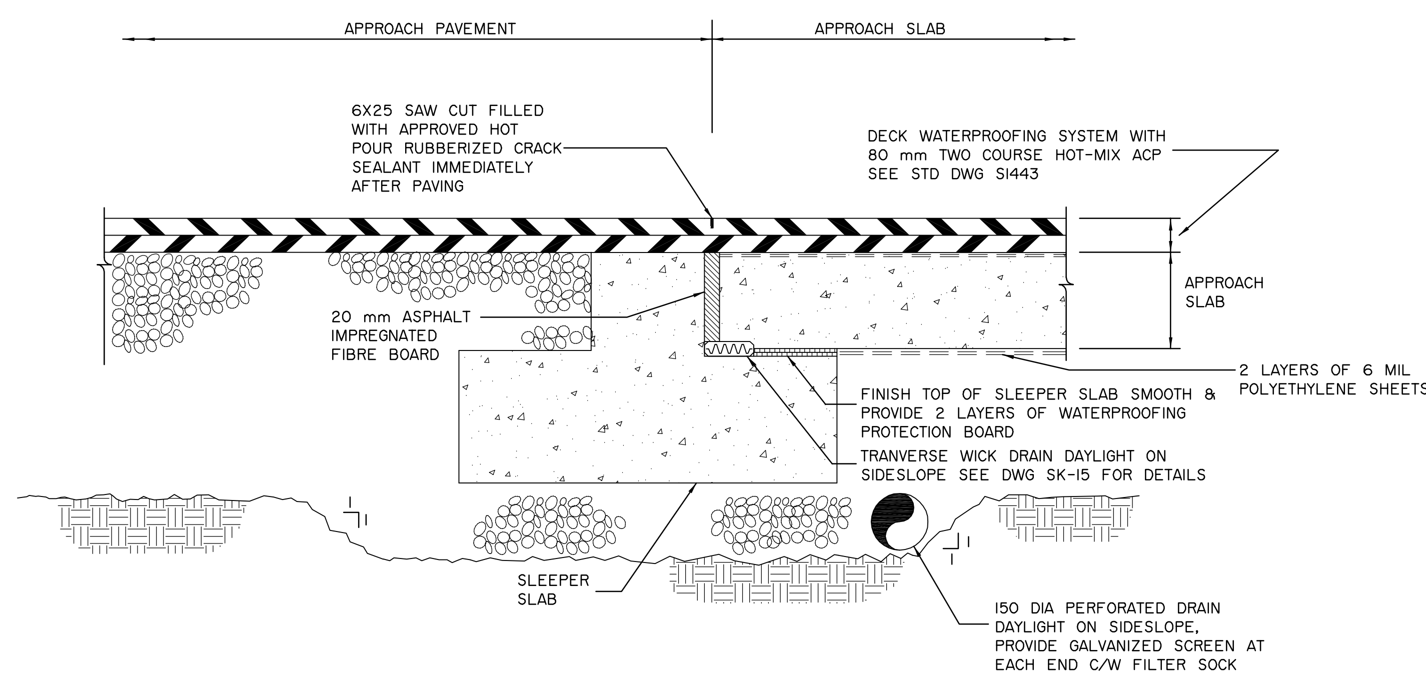
AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011–05–11	4 OF 11	SK–12

RWK NOV.01, 2011 13010-SK12-RV1.DWG



CYCLE CONTROL JOINT TYPE 1

1:10



CYCLE CONTROL JOINT TYPE 2

1:10

NOTES

- STANDARD CYCLE CONTROL JOINT TYPE C1 AND C2 DETAILS AT THE END OF APPROACH SLABS FOR INTEGRAL BRIDGES
- SEE DRAWING SK-9 AND SK-10 FOR ILLUSTRATIONS

REV	DATE	REVISIONS	BY
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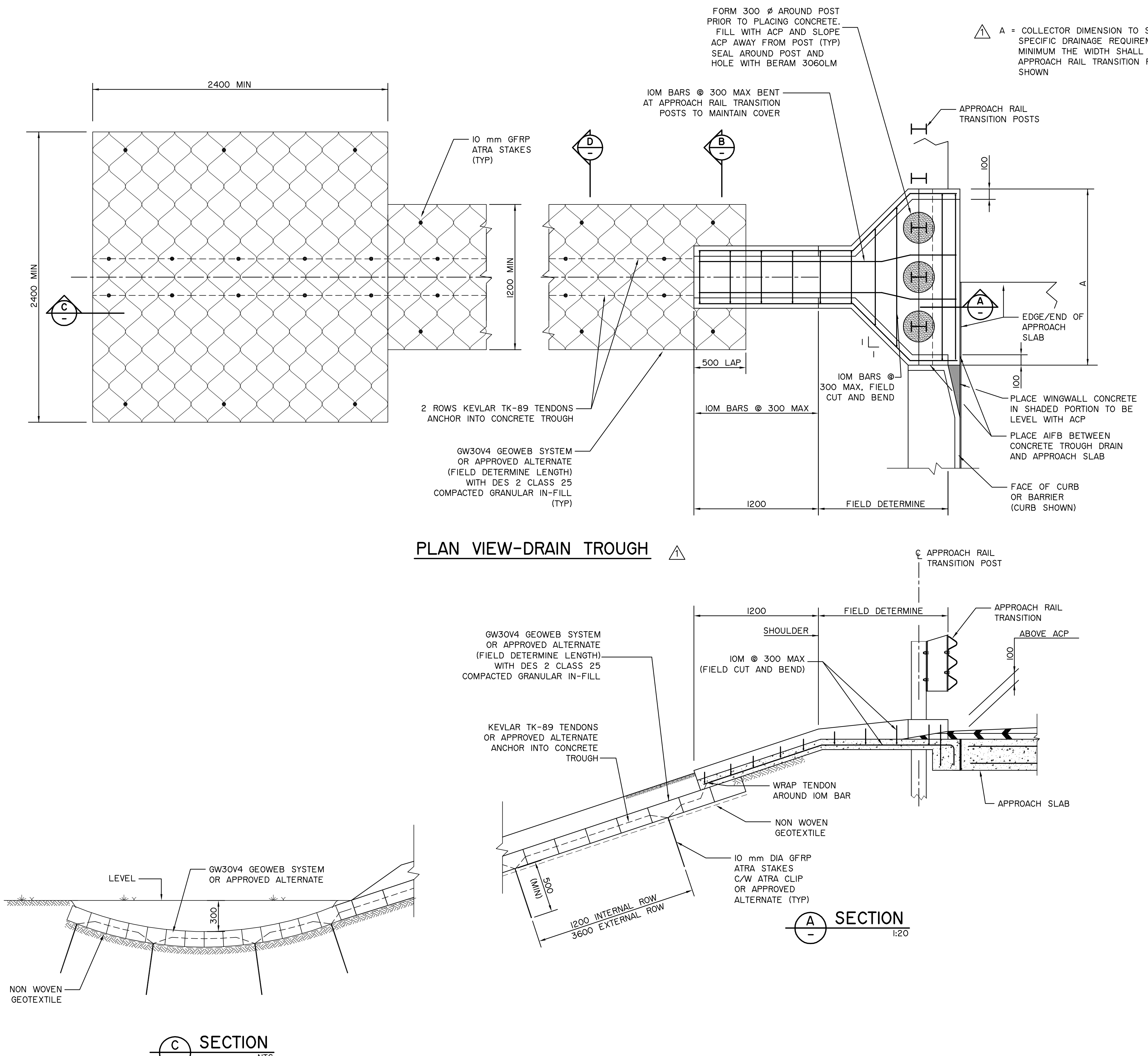
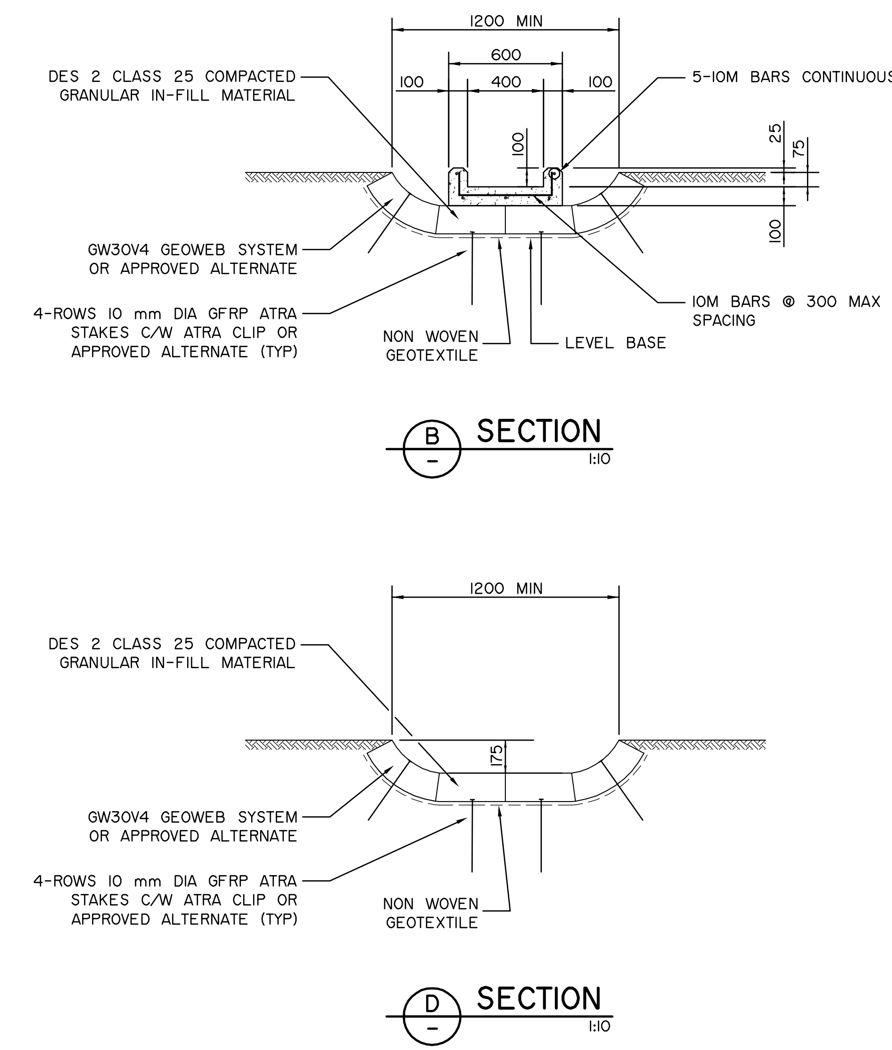
Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE
CYCLE CONTROL JOINT DETAILS
FOR INTEGRAL ABUTMENTS

AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2010-09-13	5 of 11	SK-13

TL MAY 31, 2011 13010-SK13.DWG





NOTES

- ALL DIMENSIONS ARE MILLIMETERS
- STANDARD DRAIN TROUGH DETAILS AT THE END OF WINGWALLS FOR CONVENTIONAL ABUTMENTS

REV	DATE	REVISIONS	BY
4	.	.	.
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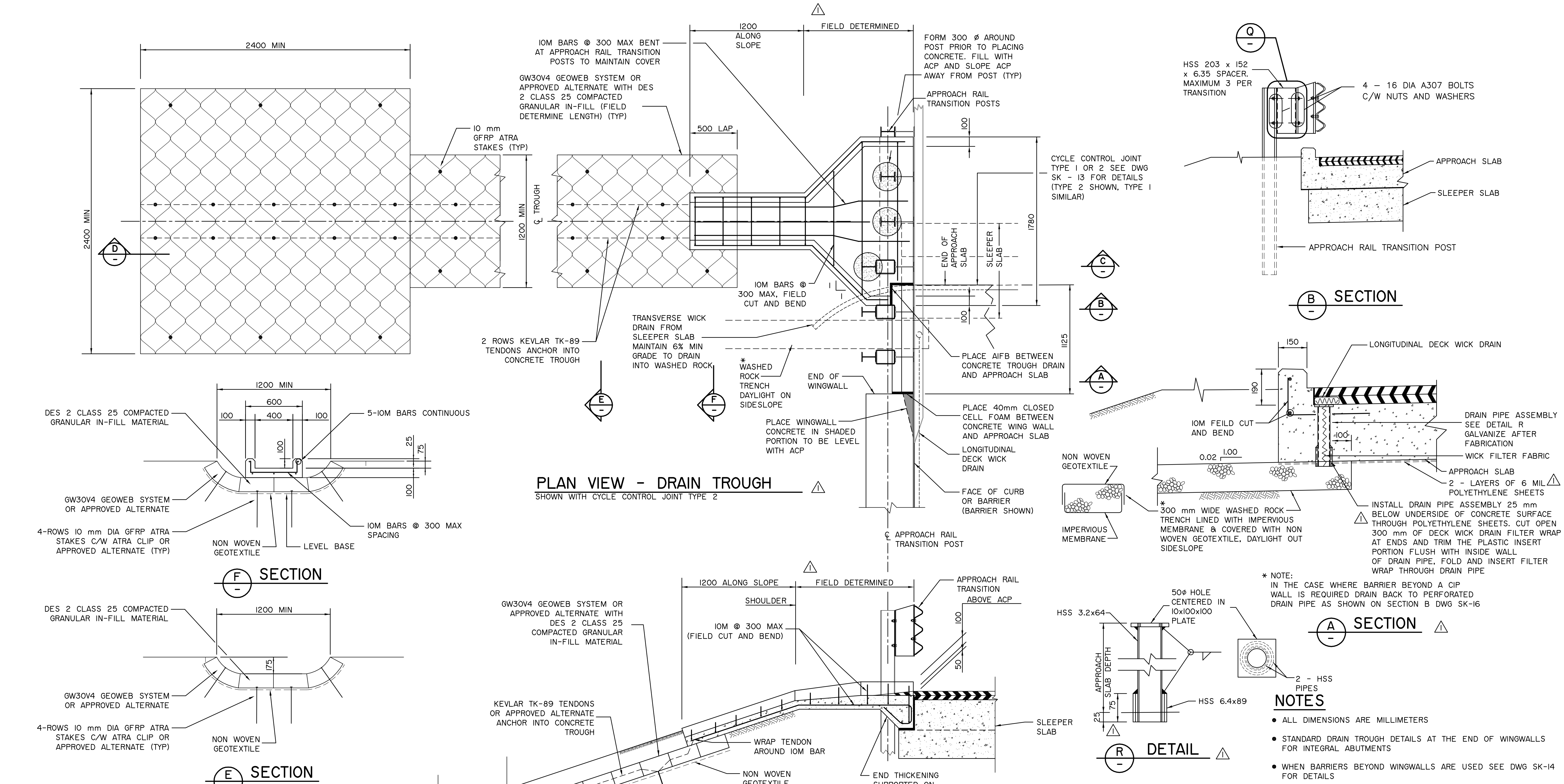
2	.	.	.
1	2011-08-03	NOTE ADDITION	TL

Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE
DRAIN TROUGH DETAILS
FOR CONVENTIONAL ABUTMENTS

AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2010-08-04	6 of 11	SK-14

WTS AUG 03, 2011 13010SK-14.DWG



NOTES

- ALL DIMENSIONS ARE MILLIMETERS
- STANDARD DRAIN TROUGH DETAILS AT THE END OF WINGWALLS FOR INTEGRAL ABUTMENTS
- WHEN BARRIERS BEYOND WINGWALLS ARE USED SEE DWG SK-14 FOR DETAILS

REV	DATE	REVISIONS	BY
4	.	.	.
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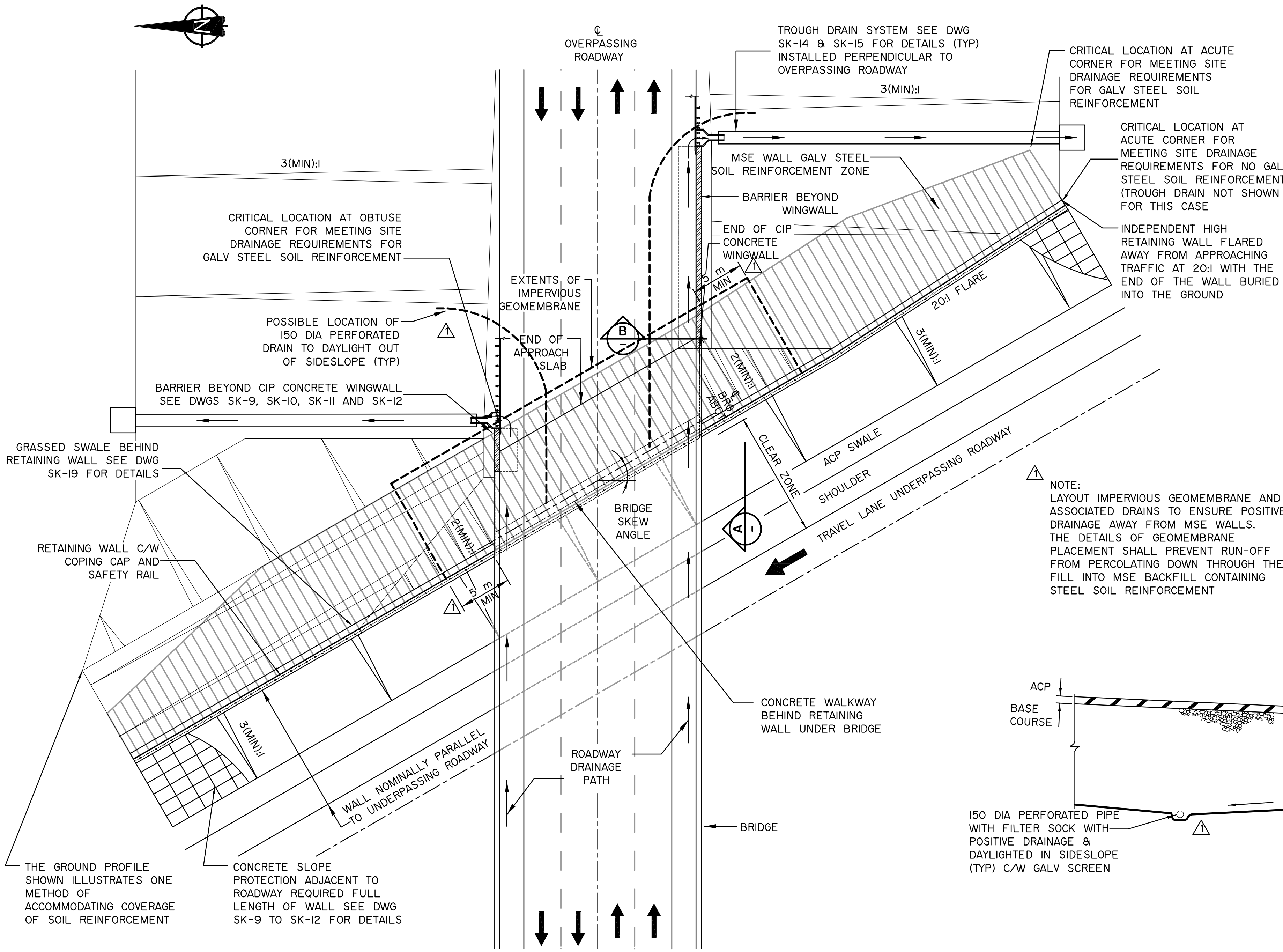
1	2011-08-03	DRAIN PIPE ASSEMBLY, TROUGH LENGTH	TL

Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE
DRAIN TROUGH DETAILS
FOR INTEGRAL ABUTMENTS

AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011-05-19	7 OF 11	SK-15

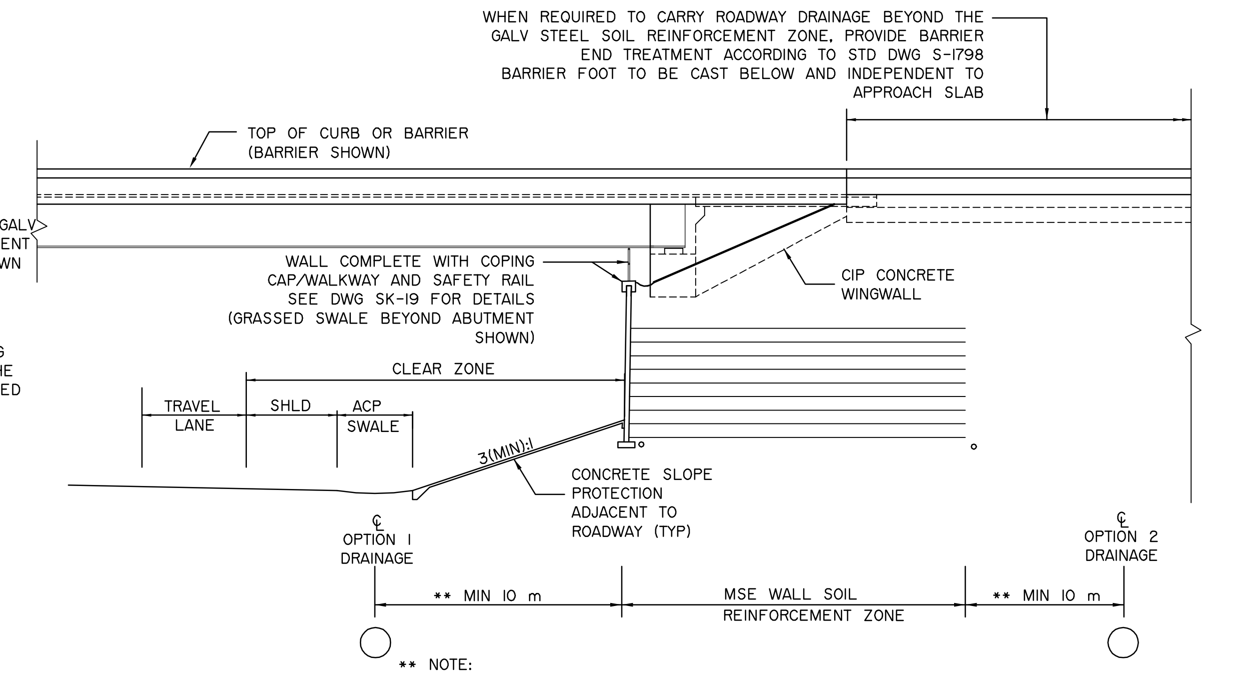
WTS AUG 03, 2011 13010-SK15_RV1.DWG



NOTE:
LAYOUT IMPERVIOUS GEOMEMBRANE AND ASSOCIATED DRAINS TO ENSURE POSITIVE DRAINAGE AWAY FROM MSE WALLS. THE DETAILS OF GEOMEMBRANE PLACEMENT SHALL PREVENT RUN-OFF FROM PERCOLATING DOWN THROUGH THE FILL INTO MSE BACKFILL CONTAINING STEEL SOIL REINFORCEMENT

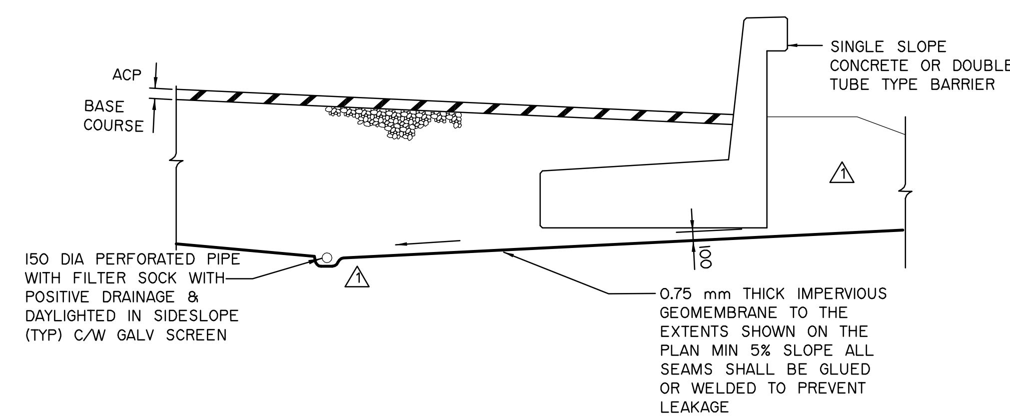
PLAN

NOTE: DITCH DRAINAGE AROUND INDEPENDENT WALLS NOT SHOWN FOR CLARITY

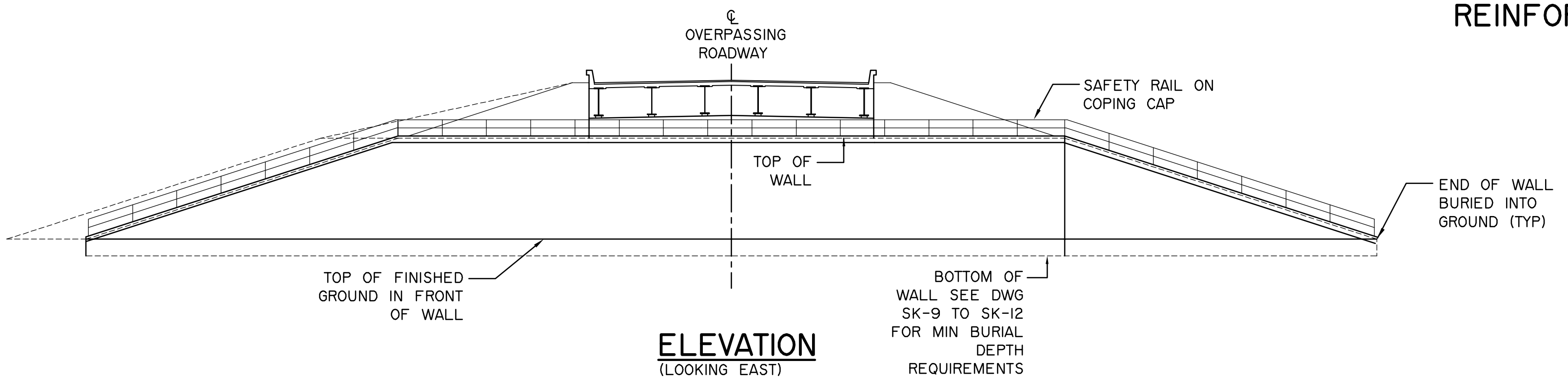


** NOTE:
- DITCH DRAINAGE TO BE LOCATED A MINIMUM 10 m BEYOND MSE WALL SOIL REINFORCEMENT ZONE
- DISTANCES ARE MEASURED PERPENDICULAR TO THE MSE WALL AND/OR END OF SOIL REINFORCEMENT ZONE

A SECTION



B SECTION (SHOWING GEOMEMBRANE REQUIREMENT OVER GALVANIZED STEEL SOIL REINFORCEMENT)



ELEVATION
(LOOKING EAST)

GENERAL NOTES:

- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING SELECTED SCHEDULE 18 REQUIREMENTS. THEY INTENTIONALLY OMIT DETAILS THAT MIGHT DETRACT FROM THIS PURPOSE
- SKETCH ILLUSTRATES WALL LAYOUT TO BE USED FOR SKEW ANGLES LESS THAN OR EQUAL TO 45°
- FOR WALL LAYOUT TO BE USED FOR BRIDGE SKEW ANGLES GREATER THAN 45° SEE DRAWING SK-17 AND SK-18
- ROADWAY DRAINAGE TO BE DIRECTED PAST END OF WALL AND END OF STEEL SOIL REINFORCEMENT
- DRAIN TROUGHS SHALL NOT DRAIN ACROSS SLOPE

REV	DATE	REVISIONS	BY
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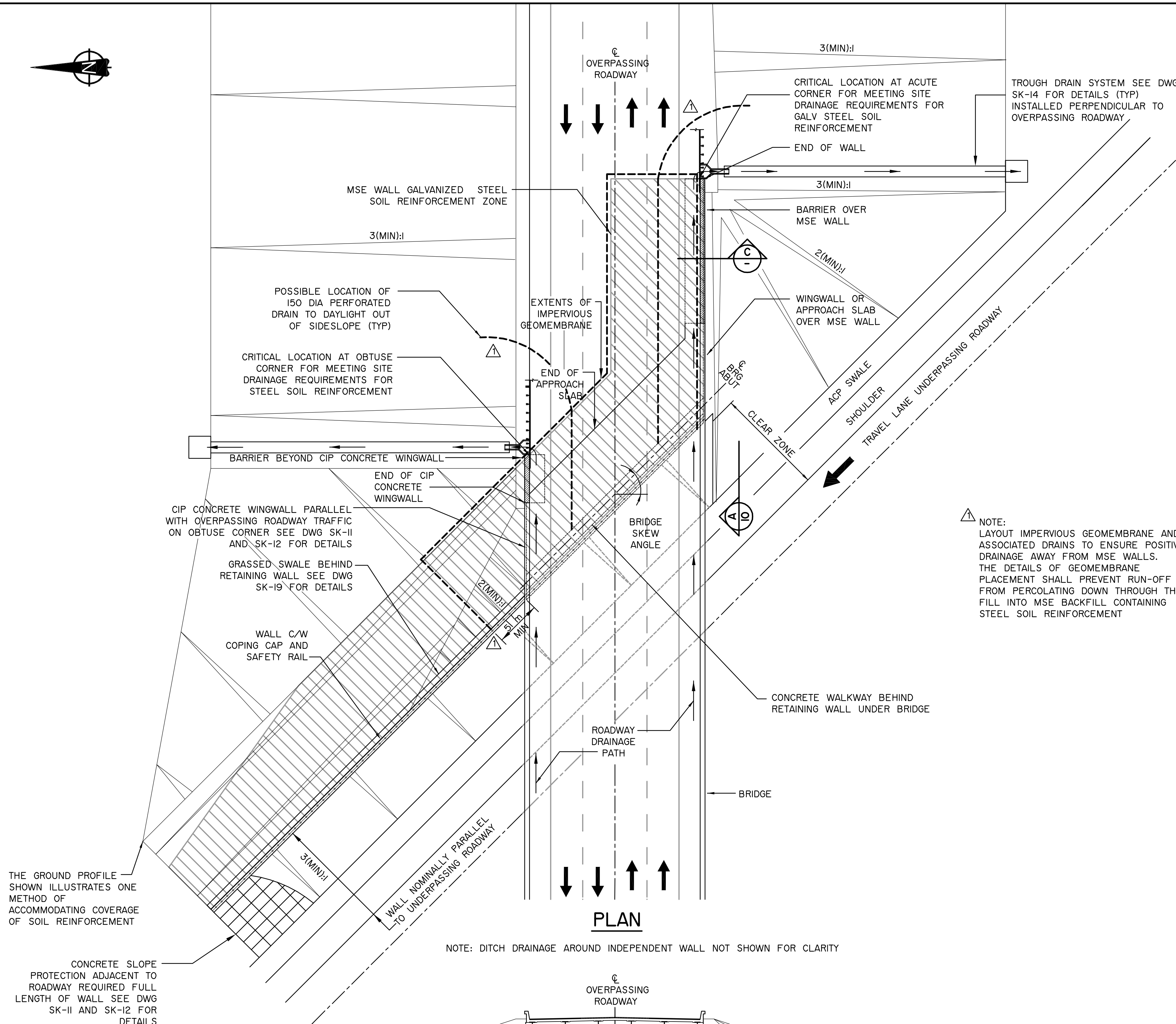
2	.	.	.
1	2011.11.31	GEOMEMBRANE, DRAIN PIPE, NOTE	TL

Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE
WALL LAYOUT AND SITE DRAINAGE
FOR BRIDGE SKEW ANGLES ⩽ 45°

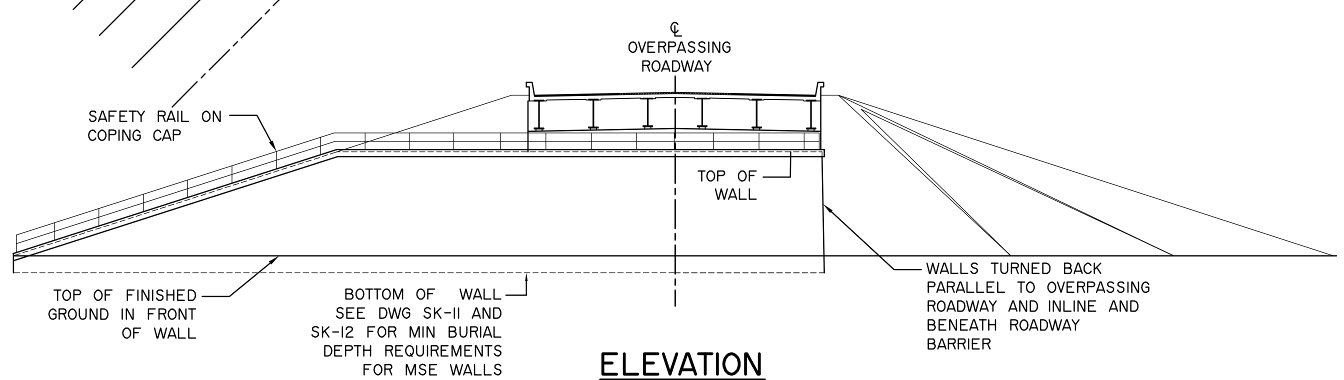
AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011-05-13	8 of 11	SK-16

TL NOV. 1, 2011 13000-SK16-RVI.DWG



PLAN

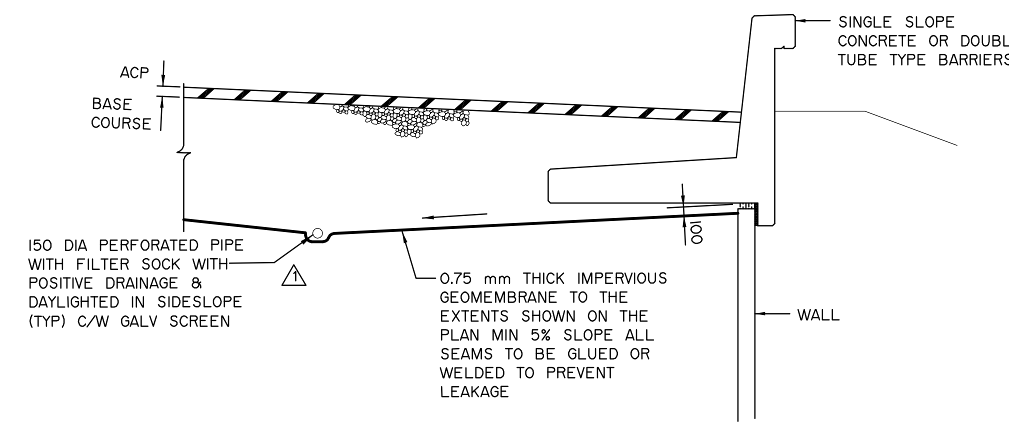
NOTE: DITCH DRAINAGE AROUND INDEPENDENT WALL NOT SHOWN FOR CLARITY



ELEVATION

(LOOKING EAST ON SQ)

NOTE:
LAYOUT IMPERVIOUS GEOMEMBRANE AND ASSOCIATED DRAINS TO ENSURE POSITIVE DRAINAGE AWAY FROM MSE WALLS. THE DETAILS OF GEOMEMBRANE PLACEMENT SHALL PREVENT RUN-OFF FROM PERCOLATING DOWN THROUGH THE FILL INTO MSE BACKFILL CONTAINING STEEL SOIL REINFORCEMENT



C SECTION
(SHOWING GEOMEMBRANE REQUIREMENT OVER GALVANIZED STEEL SOIL REINFORCEMENT)

GENERAL NOTES:

- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING SELECTED SCHEDULE 18 REQUIREMENTS. THEY INTENTIONALLY OMIT DETAILS THAT MIGHT DETRACT FROM THIS PURPOSE
- SKETCH ILLUSTRATES WALL LAYOUT TO BE USED FOR SKEW ANGLES GREATER THAN 45°
- FOR WALL LAYOUT TO BE USED FOR SKEW ANGLES LESS THAN OR EQUAL TO 45° SEE DRAWING SK-16
- ROADWAY DRAINAGE TO BE DIRECTED PAST END OF WALL AND END OF STEEL SOIL REINFORCEMENT
- DRAIN TROUGHS SHALL NOT DRAIN ACROSS SLOPE
- INTEGRAL ABUTMENTS NOT PERMITTED WITH TURNBACK WALLS

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1	11.10.31	GEOMEMBRANE, DRAIN PIPE, & NOTE	TL

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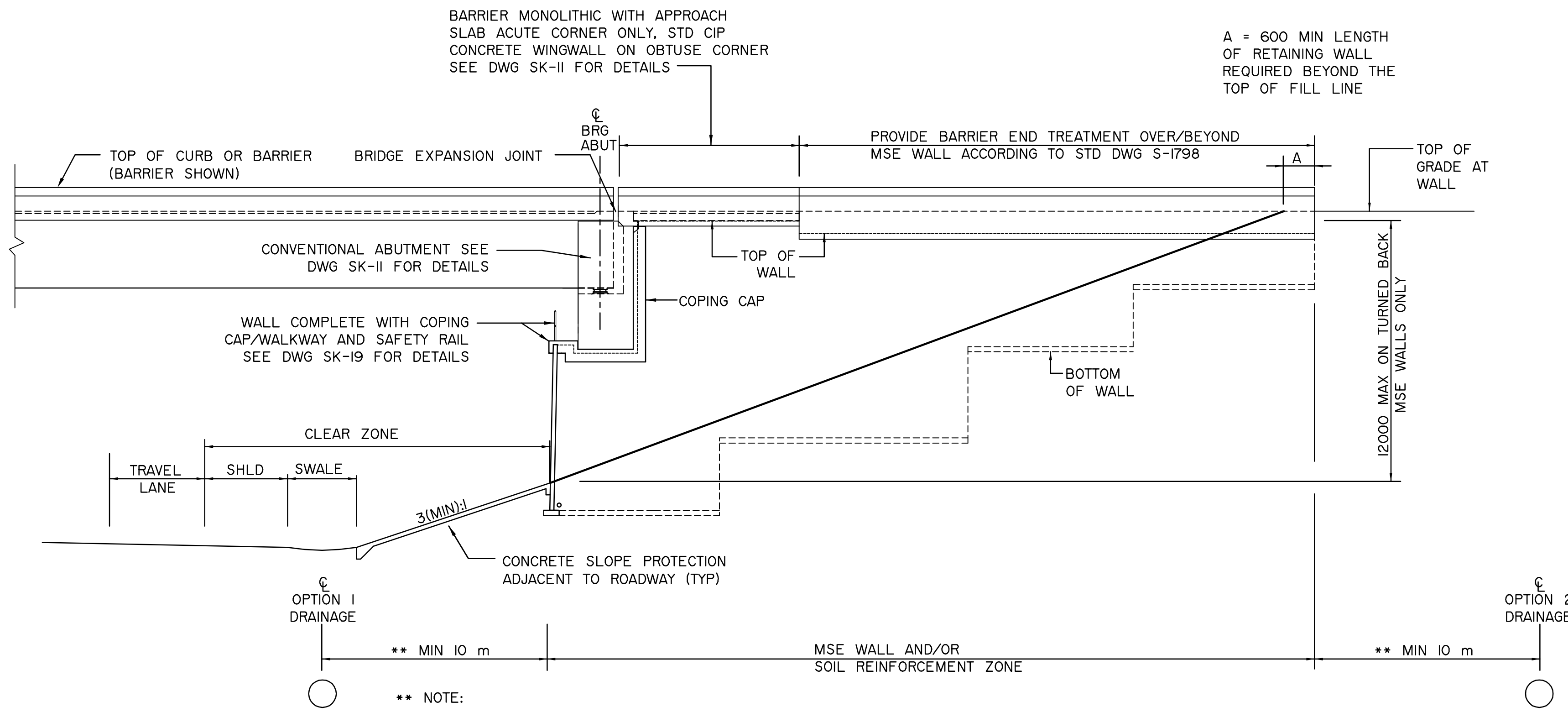
NORTHEAST ANTHONY HENDAY DRIVE
WALL LAYOUT AND SITE DRAINAGE
FOR BRIDGE SKEW ANGLES > 45°

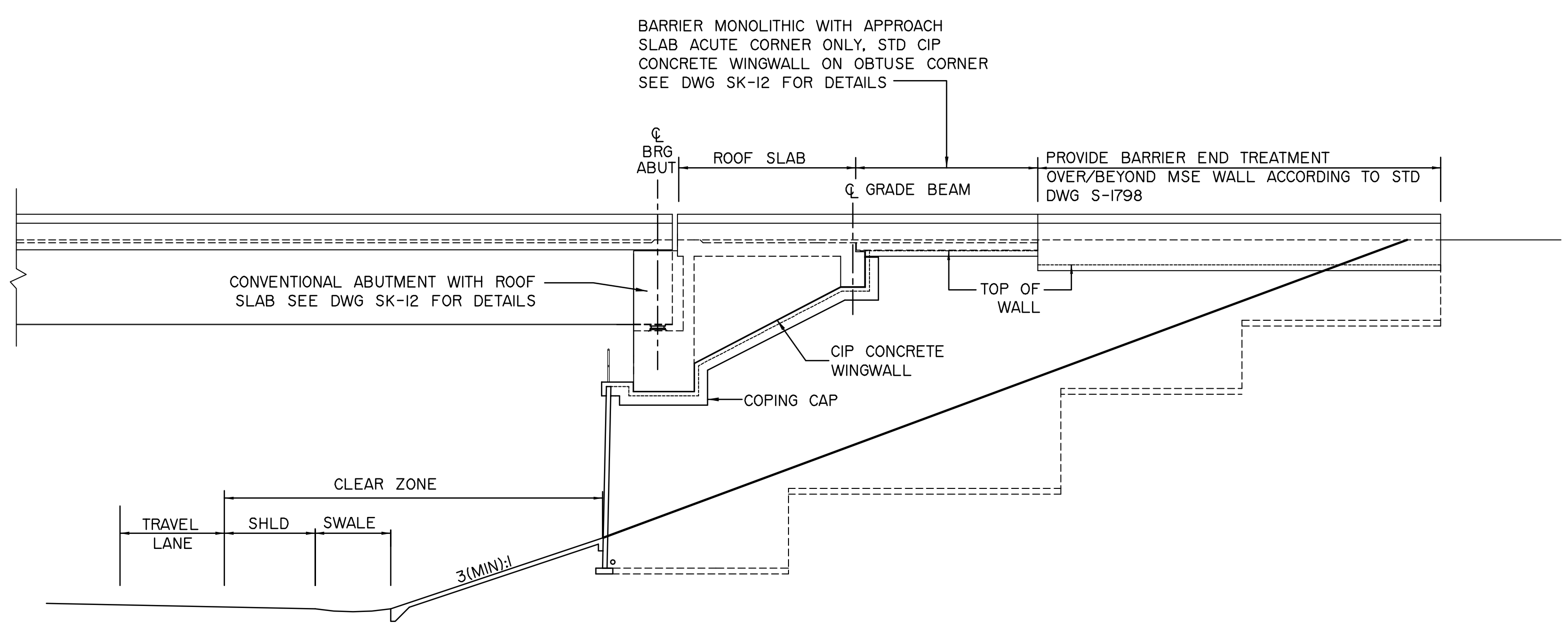
AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011-05-13	9 of 11	SK-17

TAL NOV 1, 2011 13010-SK17-RV.DWG



** NOTE:
- DITCH DRAINAGE TO BE LOCATED A MINIMUM 10 m BEYOND MSE WALL AND/OR SOIL REINFORCEMENT ZONE
- DISTANCES ARE MEASURED PERPENDICULAR TO THE MSE WALL AND/OR END OF SOIL REINFORCEMENT ZONE

A/9 SECTION
MSE WALL OPTION FOR CONVENTIONAL ABUMTENT



NOTE: ROOF SLAB OPTION SIMILAR TO CONVENTIONAL OPTION EXCEPT AS NOTED

A/9 SECTION
MSE WALL OPTION FOR CONVENTIONAL ABUTMENT WITH ROOF SLAB

NOTES

- DRAWING TO BE READ IN CONJUNCTION WITH DWG SK-17
- SEE GENERAL NOTES ON DRAWING SK-17

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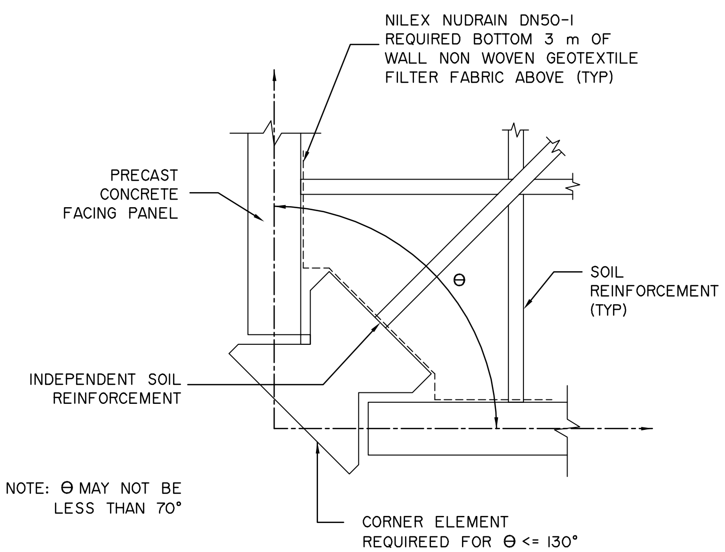
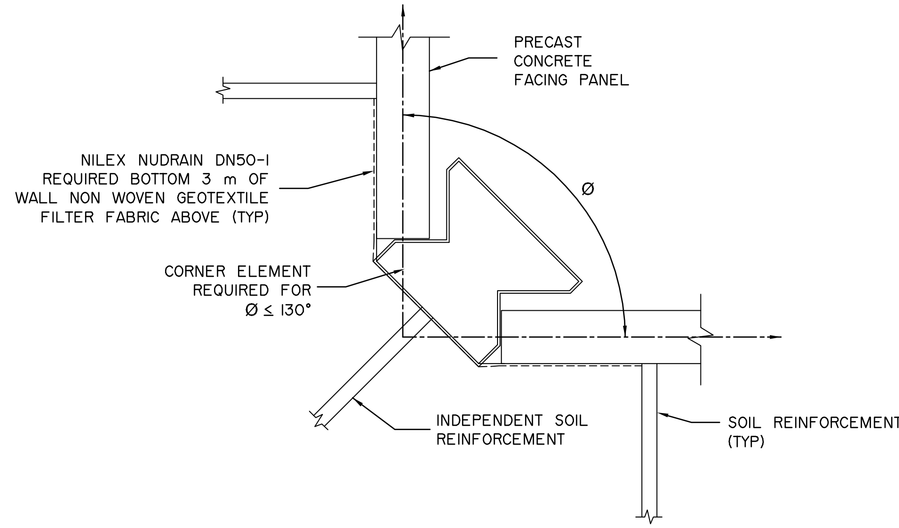
NORTHEAST ANTHONY HENDAY DRIVE
TURNED BACK WINGWALL DETAILS
FOR BRIDGE SKEW ANGLES > 45°

AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011–05–13	10 of 11	SK–18

RMK JUN.02, 2011 1300-SK17.DWG

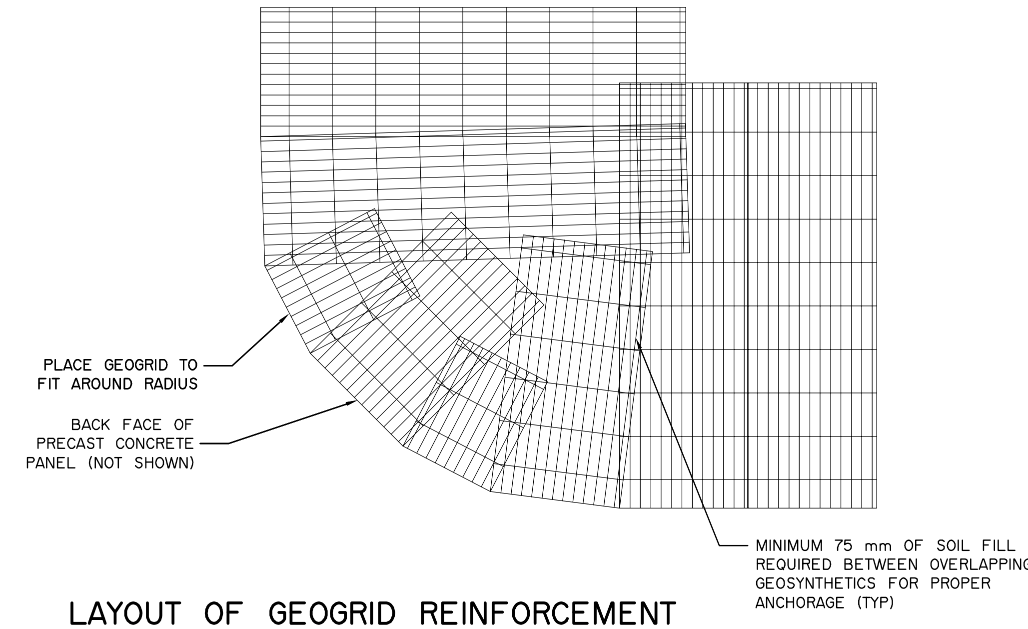


EXTERNAL CORNER

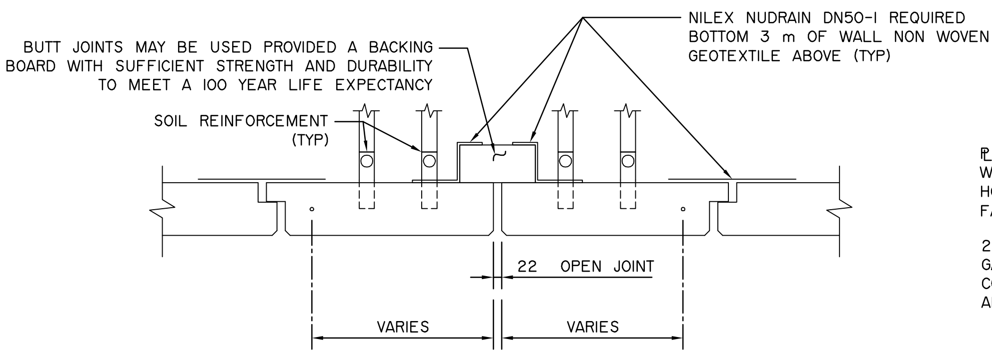


INTERNAL CORNER

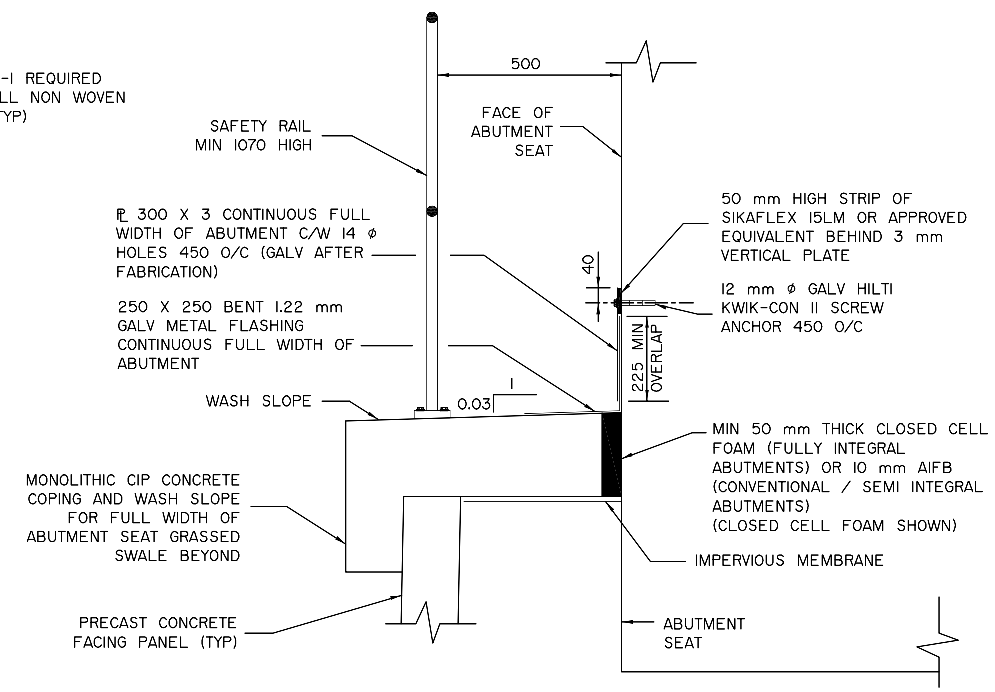
MSE WALL CORNER DETAILS



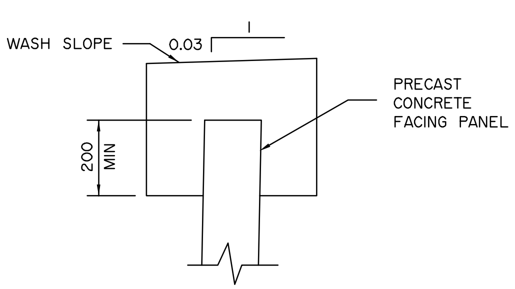
LAYOUT OF GEOGRID REINFORCEMENT FOR CURVED WALLS



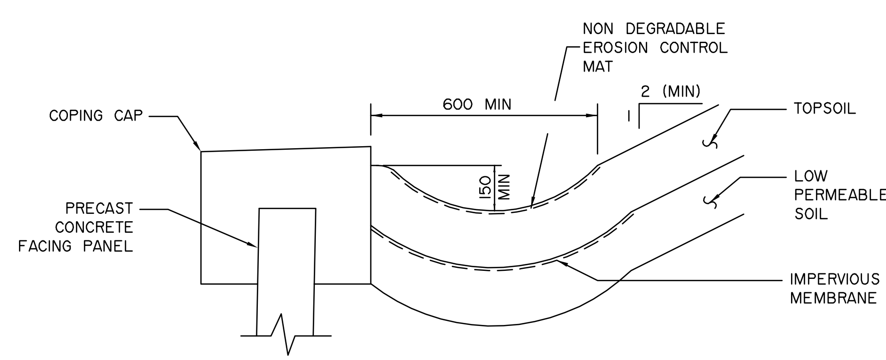
TYPICAL BUTT JOINT AND LIP AND RECESS (SHIP LAP) DETAIL FOR SEGMENTAL PRECAST PANEL FACINGS



WALKWAY BEHIND MSE WALL AT ABUTMENT



P/- COPING CAP DETAIL



GRASSED SWALL TOP OF MSE WALL OUTSIDE OF BRIDGE ABUTMENTS

GENERAL NOTES:

- SKETCHES ARE PROVIDED WITH THE SOLE PURPOSE OF ILLUSTRATING SELECTED SCHEDULE 18 REQUIREMENTS. THEY INTENTIONALLY OMIT DETAILS THAT MIGHT DETRACT FROM THIS PURPOSE

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Government of Alberta ■ Transportation

NORTHEAST ANTHONY HENDAY DRIVE STANDARD DETAILS ASSOCIATED WITH MSE WALLS

AT FILE NUMBER	DATE DRAWN	SHEET	DRAWING
–	2011-05-13	11 OF 11	SK-19

T6K MAY 30, 2011 1300-SK19.DWG

Government of Alberta ■ Transportation

Concrete Testing Summary at Site

Bridge File #: ____________________
Bridge Project: ____________________
Location: ____________________
Contract #: ____________________
Contractor: ____________________
Concrete Supplier: ____________________
Plant Location: ____________________
Consultant: ____________________

Date Tested: ____________________
Weather: ____________________ °C
Tested By: ____________________
Certification: ☐ CSA ☐ ACI
Date of Certification / Expiry: __________ __________
Cylinder Curing Facilities / Initial Temp: __________ __________
Placing Method / Sampling Location __________ __________
Volume of Pour: ________ m^3

Specification Requirements	Concrete Class :	Strength: MPa @ 28 Days		
	Slump (mm)	Air Content (%)	Number of Cylinder Sets Required	
	Min.: Max.:	Min.: Max.:	Min of 1 set per : Trucks	**or** Min of 1 set per: m^3

Pour Location	Cylinder Identification Labels*	Delivery Ticket No.	Load Amount	Time			Slump	Air Content	Unit Weight	Temperature	
			(m^3)	Batched	Tested	Off-Load	(mm)	(%)	(kg/m^3)	Air (°C)	Conc (°C)

Sketch of Test Cylinder Location:

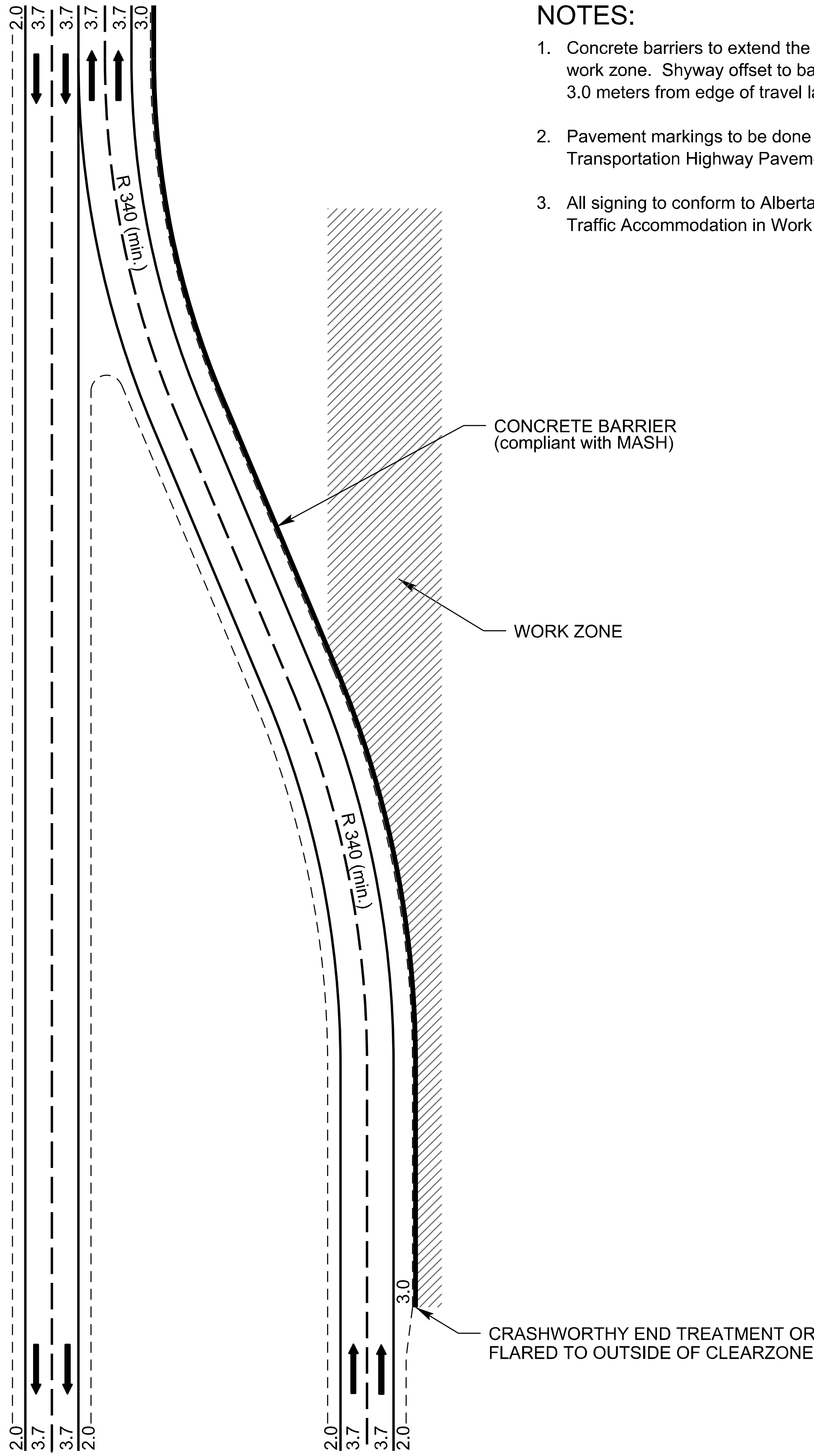
Deck Section #'s:

Comments:

* See Concrete Cylinder Coding Sheet for Suggested Cylinder Identification Label(s)

NOTES:

1. Concrete barriers to extend the entire length of the work zone. Shyway offset to barrier shall be 3.0 meters from edge of travel lane.
2. Pavement markings to be done as per Alberta Transportation Highway Pavement Marking Guide.
3. All signing to conform to Alberta Transportation Traffic Accommodation in Work Zones 2008 (1st Edition).



PLAN SHOWING
TYPICAL MAINLINE DETOUR

NOTE: This Exhibit replaces Dwg No. TCS-B-1.29B in the Alberta Transportation Traffic Accommodation in Work Zones 2008 (1st Edition) manual, specifically for the Northeast Anthony Henday Drive DBFO Project.

EXHIBIT - 200.2.3.23 - 1

APPENDIX C - REPORTING SUMMARY

1. GENERAL

1.1 Section References

References to section numbers in this Appendix C are to section numbers of the Technical Requirements.

1.2 Priority

In the event of any inconsistency between the listing of, criteria for and the descriptions of the reporting obligations set out in the body of Schedule 18 and the listing of such criteria included in this Appendix C, the more detailed provisions of the body of Schedule 18 shall govern.

2. REPORTING

Included in the reporting requirements set out in the Technical Requirement are the following:

Quality Management System (Section 100.2.1)

QMS - External Audit Results and Deficiencies List Correction Results (Section 100.2.1.4.2)

Environmental Management System (Section 100.2.2)

Environmental Construction Operations (ECO) Plan including Spill Management Plan (Section 100.2.2)

Road Salt Management Plan (Section 100.2.2)

Animal-Vehicle Collision Monitoring Plan (Section 100.2.2)

EMS - External Audit Results and Deficiencies List Correction Results (Section 100.2.2.3)

Handling of QMS/EMS Non-Conformance (Section 100.2.3)

Project Schedule (Section 100.2.4)

Traffic Management Plan (Section 100.2.5)

Safety Plan (Section 100.2.6)

Public Communications Strategies (Section 100.2.7)

Construction Management Plan (Section 100.2.8)

Operations and Maintenance Plan (Section 100.2.9)

Infrastructure Wholelife Management Plan (Section 100.2.10)

Evaluation of GVW for Bridge Structures (Section 200.2.3.5)

Guide Signing (Section 200.2.7)

Utility Agreements (Section 200.2.10)

Railway Agreements (Section 200.2.11)

Environmental (Section 200.2.13)

Fencing (Section 200.2.15)

Preferential Bridge Deck Icing (Section 200.2.16)

Wetland Replacement and Compensation Agreements (Section 200.2.17.1)

Weed Control (Section 200.3.4)

Survey (Section 200.4.10)

Design Documentation (Section 300.2.3)

Roadway Safety Audits (Section 300.2.6)

Reclamation Certificates (Section 300.3.1)

As-Built and Record Information (Section 300.3.3)

Geotechnical Reports (Section 300.4.1.3)

Pavement Design Report (Section 300.4.1.8.1)

Traffic Control Devices - Warrant Calculations (Section 300.4.1.9.2)

Bridge Structures Design Report Requirements (Section 300.5.3)

Bridge Structures Final Design Report Requirements (Section 300.5.4)

Cast-In-Place Concrete – Submissions (Section 300.5.7.2)

Class HPC and Class HPC with Steel Fibres (Sections 300.5.7.5.2, 300.5.7.15.3 & 300.5.7.15.4)

Concrete Mix Designs (Section 300.5.7.5.4)

Concrete Mix Design Adjustments (Section 300.5.7.5.5)

Concrete Inspection and Testing (Section 300.5.7.7)

Structural Steel – Submissions (Section 300.5.8.2)

Engineering Data (Section 300.5.8.3.3)

Welding (Section 300.5.8.4.1)

Fabrication (Section 300.5.8.4.2)

Bridge Girders (Section 300.5.8.5.2)

Precast Concrete Units – Submissions (Section 300.5.9.2)

Post-Tensioning – Submissions (Section 300.5.9.10.12.2)

Construction (Section 300.5.9.11.7)

Construction of CSP and SPCSP Structures – Submissions (Section 300.5.10.2)

Mechanically Stabilized Earth Walls - Submissions (Section 300.5.11.2.2)

Construction - Conformance Criteria (Section 300.5.11.4.3)

Sign Structures – Submissions (Section 300.5.12.2)

Piling Submittals (Section 300.5.13.2)

Piling Capacity Testing (Section 300.5.13.8)

Reinforcing Steel (Section 300.5.14.1)

Heavy Rock Riprap - Rock Material Submittal (Section 300.5.17.1)

Bearings – Submissions (Section 300.5.18.2)

Rehabilitation As-Built Construction Reports (Section 400.1.2)

Schedule for Lane Closures (Section 400.1.6)_

Daily Road Reports (Section 400.2.1.2)

Maintenance Reporting Procedures (Section 400.2.6)

Snow Clearing and Ice Control Operations Plan (Section 400.3.1)

Regular Winter Condition Reporting (Section 400.3.1)

Winter Maintenance Operations Requirements Reporting (Section 400.3.3.1)

Preferential Bridge Deck Icing Plan (Section 400.3.4)

Preferential Bridge Deck Icing Reporting (Section 400.3.4.1)

Pavement Geometric Requirements (New Infrastructure Only) (Section 400.4.2)

Smoothness Requirements (New Infrastructure Only) (Section 400.4.3)

Rutting Performance Requirements (New Infrastructure Only) (Section 400.4.4)

Skid Resistance Requirements (New Infrastructure Only) (Section 400.4.5)

General Pavement Maintenance Requirements (Section 400.4.6)

Miscellaneous - Operation and Performance Requirements (Section 400.4.7)

Traffic Control Devices - Operation and Performance Requirements (Section 400.4.8)

Road Traffic Noise Mitigation (New Infrastructure Only) (Section 400.4.9)

Testing Conducted with an Inertial Profiler (Existing Infrastructure Only) (Section 400.4.10)

Bridges Structures Inspection/Testing Notification and Inspection Reporting (Sections 400.5.1.3.4 and 400.5.1.3.5)

Bridge Structure Maintenance and Rehabilitation Requirements Notification and Reporting (New Infrastructure Only) (Sections 400.5.2.6 and 400.5.2.7)

Performance Requirements (New Infrastructure Only) (Section 400.5.3)

Traffic Modeling and Traffic Signals Guidelines (Appendix J) (see also Section 300.4.1.9.2 – Traffic Signals)

APPENDIX D - *HISTORICAL RESOURCES ACT* (ALBERTA) CLEARANCE LETTERS

Letters Dated:

1. February 3, 1997 issued by Alberta Community Development;
2. January 17, 2005 issued by Alberta Community Development; and
3. May 7, 2007 issued by Alberta Tourism, Parks, Recreation and Culture.

Alberta
Tourism, Parks, Recreation and Culture
Historic Resources Management Branch

Old St. Stephen's College
8820 – 112 Street
Edmonton, Alberta T6G 2P8

Tel: (780) 431-2300
Fax (780) 422-3106

RECEIVED
MAY 11 2007
ISL Engineering and Land Services

May 7, 2007

Project File: 4953-06-024
Permit Number: 2006-322

Mr. Rod Peacock
ISL Engineering and Land Services Ltd.
Suite 100, 7909 – 51 Avenue
Edmonton, Alberta
T6E 5L9

Dear Mr. Peacock:

**SUBJECT: ALBERTA INFRASTRUCTURE AND TRANSPORTATION
AGENT BEING ISL ENGINEERING AND LAND SERVICES LTD.
NORTH EDMONTON RING ROAD
TRANSPORTATION AND UTILITIES CORRIDOR
WITHIN TOWNSHIPS 53 & 54, RANGES 23 TO 25, W4M
HISTORICAL RESOURCES ACT CLEARANCE**

The Archaeology Group has provided Alberta Tourism, Parks, Recreation and Culture with a final report discussing the results of the Historic Resources Impact Assessment of the Transportation and Utilities Corridor for the North Edmonton Ring Road (Anthony Henday Drive) from Highway 216 to Highway 16 East. Forty-four archaeological sites were newly recorded, six archaeological sites were revisited, and one hundred and three historical structures were recorded during the conduct of this impact assessment. The Historic Resources Management Branch has no further concerns regarding these sites. Therefore *Historical Resources Act* clearance is granted for the transportation and utilities corridor for the North Edmonton Ring Road.

HISTORICAL RESOURCES ACT REQUIREMENTS

Reporting the discovery of historical resources: Pursuant to Section 31 of the *Historical Resources Act*, should any historical resources be encountered during land disturbance activities, please contact Margret Ingibergsson at (780) 431-2374, (Historic Resources Management Branch, 8820 - 112 Street, Edmonton, Alberta, T6G 2P8), fax (780) 422-3106 or by e-mail at margret.ingibergsson@gov.ab.ca. It will then be necessary for further instructions to be issued regarding the documentation of these resources.

On behalf of Alberta Tourism, Parks, Recreation and Culture, I would like to thank ISL Engineering and Land Services Ltd. for their cooperation in our endeavour to conserve Alberta's past.

Sincerely,

David Link, PhD
Director

Attachment

cc: Walt Kowal, The Archaeology Group

4953-06-024

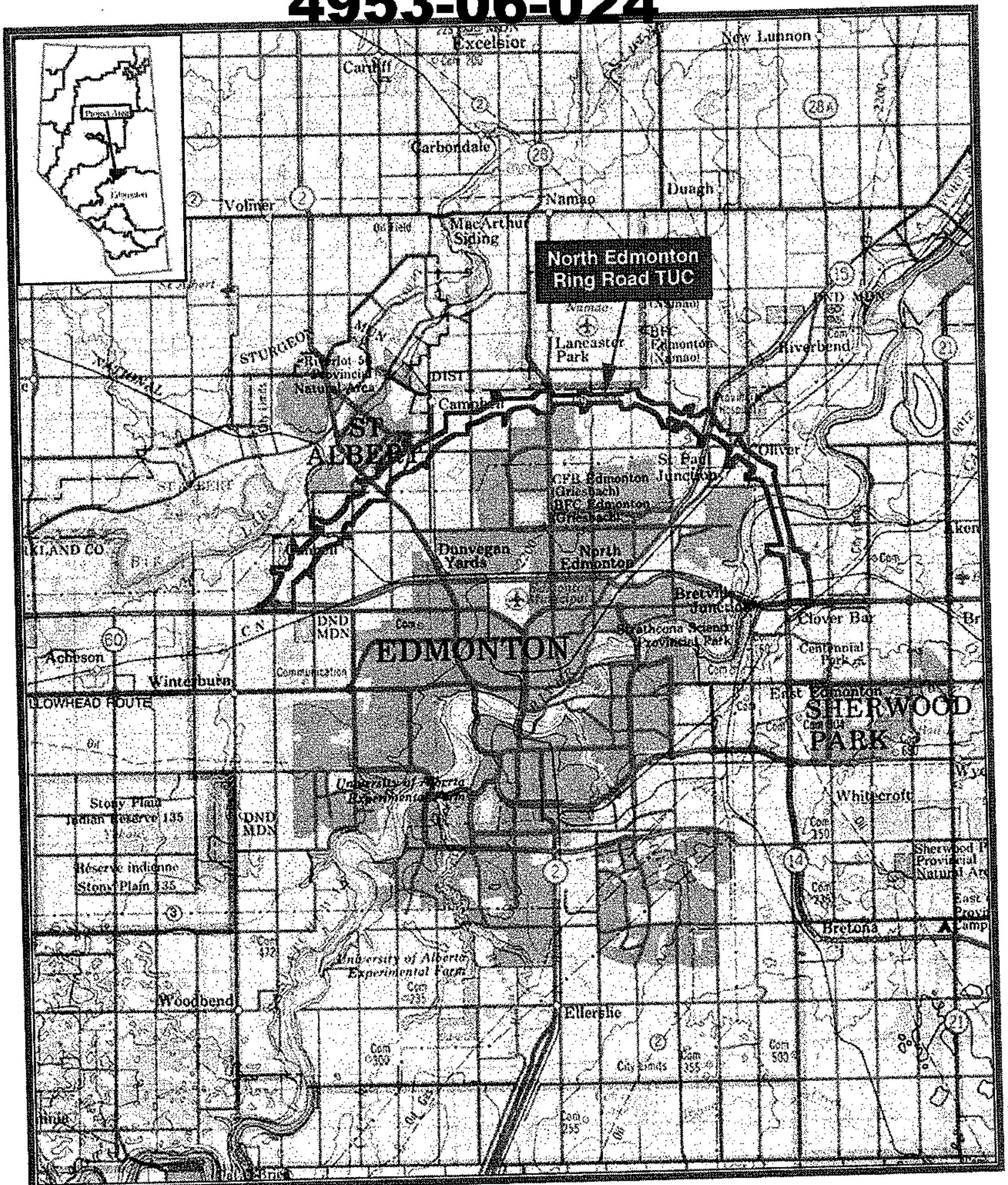


Figure 1. Location of the NERR TUC study area (after 1:250,000 NTS Map 83H – Edmonton).

Permit 2006-322

Alberta

COMMUNITY DEVELOPMENT

Cultural Facilities & Historical Resources Division

Memorandum

From Mark Rasmussen
Assistant Deputy Minister

Our File Reference 4946-216
Permit 2003-071

Your File Reference

To Don Snider
Manager, Transportation Projects
Environmental Section
Alberta Transportation

Date January 17, 2005

Telephone 431-2309

Subject **SOUTHEAST ANTHONY HENDAY TRAIL**
***HISTORICAL RESOURCES ACT* CLEARANCE**

All of the Cultural Facilities and Historical Resources Division's requirements regarding the Southeast Anthony Henday Trail have been satisfactorily addressed by the historical resource studies that have been completed by Altamira Consulting Ltd. Therefore, *Historical Resources Act* clearance is provided for this project.

Should you require additional information or have any questions concerning the above, please contact Dean Wetzel at (780) 431-2332 (East Region, Resource Management Planner, Protection and Stewardship Section, Heritage Resource Management Branch, Cultural Facilities and Historical Resources Division, Alberta Community Development, 8820 – 112 Street, Edmonton, Alberta, T6G 2P8); or fax (780) 427-3956, or by e-mail dean.wetzel@gov.ab.ca.

On behalf of the Cultural Facilities and Historical Resources Division, I would like to thank officials of Alberta Transportation for their continued cooperation in our endeavour to conserve Alberta's past.

Sincerely,

Mark Rasmussen
Assistant Deputy Minister

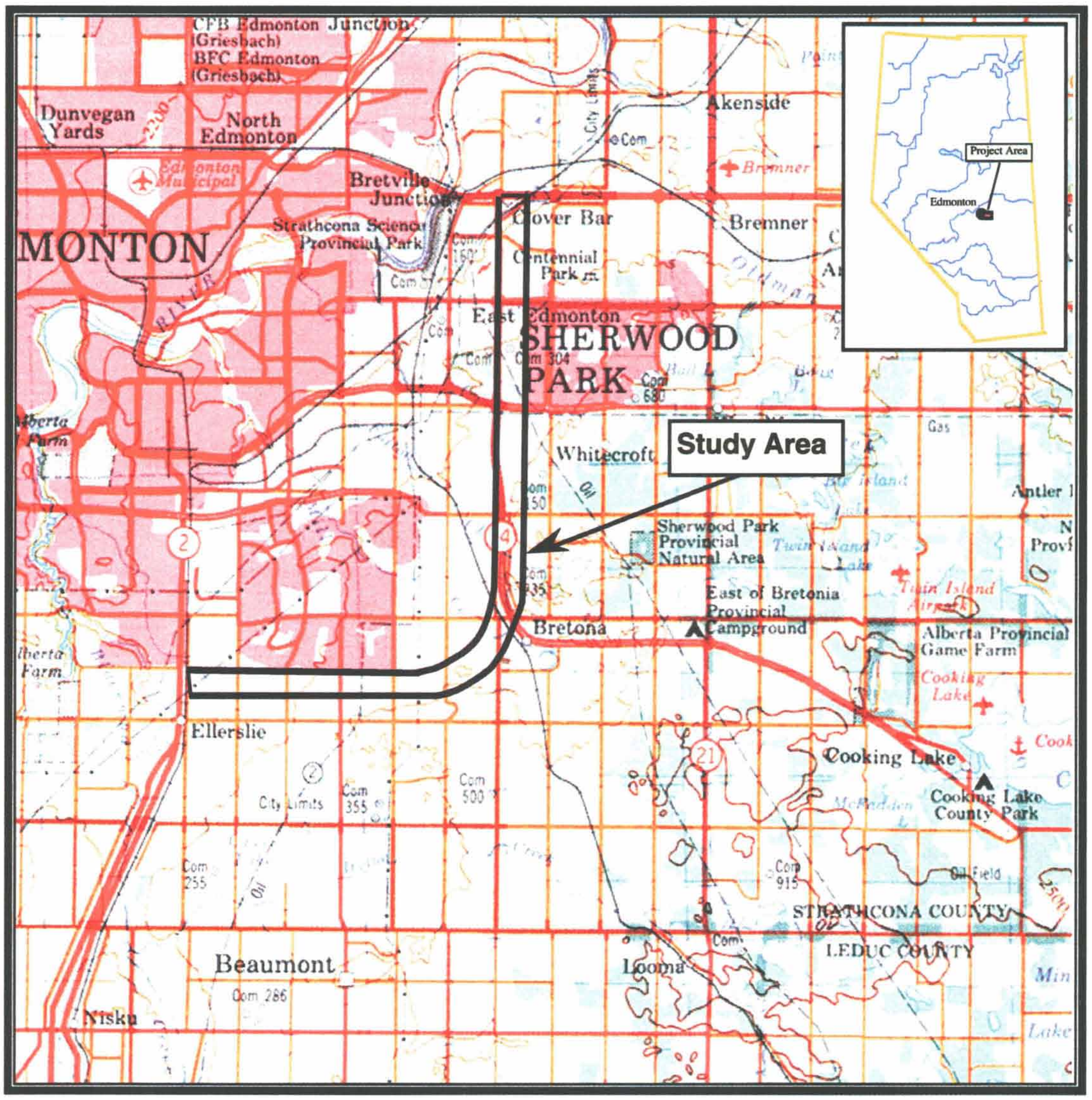


Figure 1. Location of the study area within Alberta (after 1:250,000 NTS Map 83H – Edmonton).

Alberta
COMMUNITY DEVELOPMENT

1995
Premier's
Award *of*
Excellence

Cultural Facilities and
Historical Resources Division
Office of the Assistant
Deputy Minister

Old St. Stephen's College
8820 - 112 Street
Edmonton, Alberta
Canada T6G 2P8

Telephone 403/431-2300
Fax 403/427-5598

February 3, 1997

Our File(s): 4945-16-20

Mr. Steve Quiring
Infrastructure Systems Ltd.
Suite 100
5008 - 86 Street
Edmonton, Alberta
T6E 5S2

Dear Mr. Quiring:

SUBJECT: HIGHWAY 16-20
E. OF N. SASKATCHEWAN RIVER TO W. BOUNDARY
ELK ISLAND NATIONAL PARK
HISTORICAL RESOURCES OVERVIEW

The Archaeological Survey, Provincial Museum of Alberta, has received a copy of the overview report prepared by your historical resources consultants, Alberta Archaeology Company, for the captioned project.

HISTORICAL RESOURCES OVERVIEW

Terms of Reference

The Alberta Archaeology Company prepared an Historical Resources Overview Assessment for the captioned project through a review of records held by the Archaeological Survey of Alberta, and the Historic Sites Service, as well as a review of biophysical and topographic mapping.

HISTORICAL RESOURCES ACT CLEARANCE

Based on this overview, it has been determined that Alberta Community Development has no concerns with or objections to development proceeding on this project.

...cont.

Should you require additional information or have any questions concerning the above, please contact Barry Newton at 431-2330.

On behalf of Alberta Community Development, I would like to thank you for your cooperation in our endeavour to conserve Alberta's past.

Sincerely,

W. J. Byrne
Assistant Deputy Minister
Cultural Facilities and Historical Resources Division

cc: Bruce Ball, Alberta Archaeology Company
Dianne George, Land Administration Division, Alberta Environmental Protection
John W. Ives, Provincial Archaeologist, PMA
Barry Newton, Historic Sites Service, TRANS-97\16-20.OVR

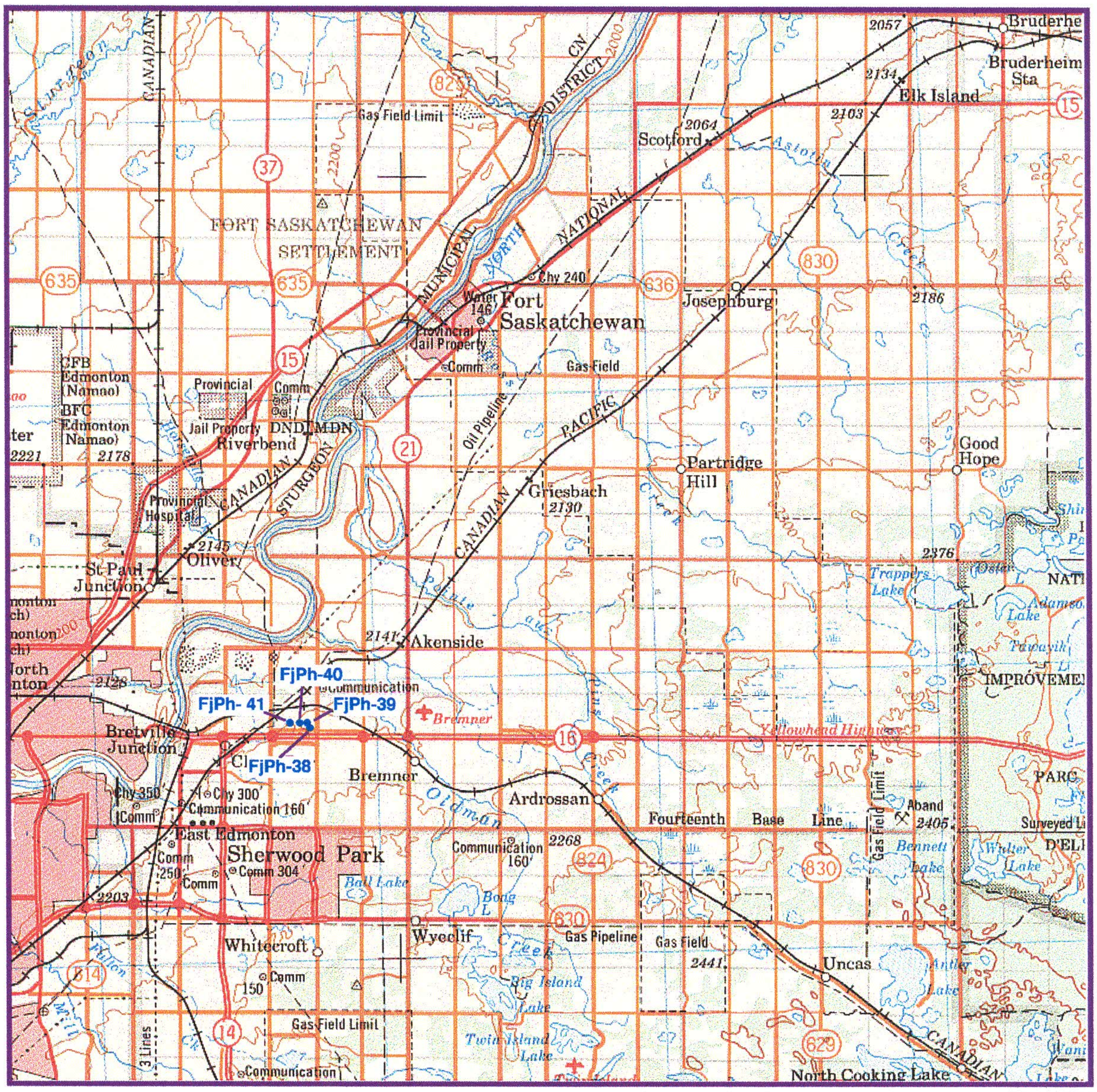


Figure 4. Map showing the location of four sites near the study area.

APPENDIX E - GUIDE SIGNING FOR NEW INFRASTRUCTURE

Drawings:

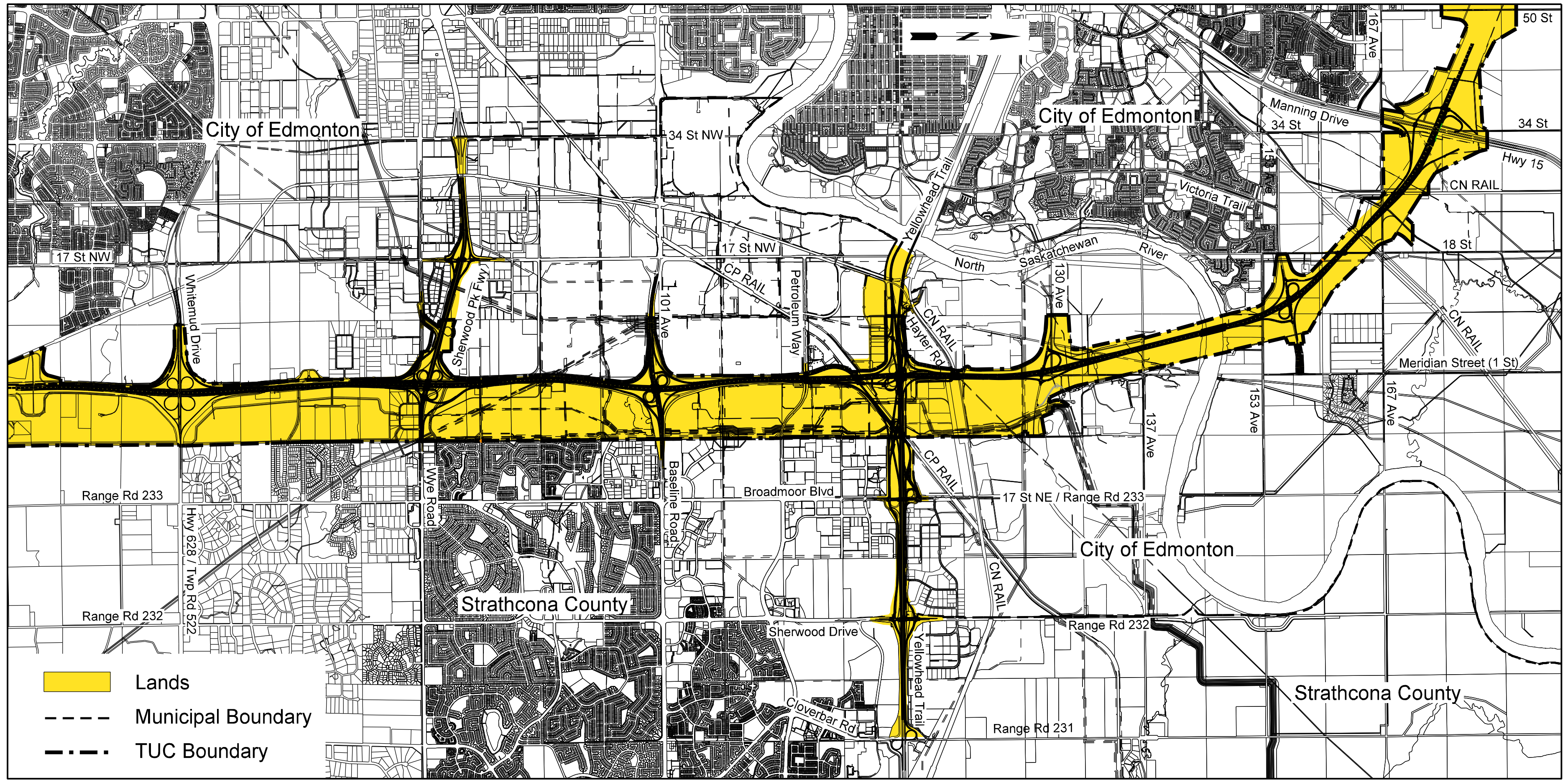
18-E-1.01 - COVER SHEET

18-E-1.02 - DRAWING INDEX

18-E-2.01 – SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE
18-E-2.02 - NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY
18-E-2.03 - SHERWOOD PARK FREEWAY 17 STREET TO ORDZE CRESCENT
18-E-2.04 - NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY
18-E-2.05 - PETROLEUM WAY TO NORTH OF 130 AVENUE
18-E-2.06 - NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE
18-E-2.07 - NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE
18-E-2.08 - WEST OF MANNING DRIVE TO WEST OF 66 STREET
18-E-2.09 YELLOWHEAD TRAIL / HIGHWAY 16, NORTH SASKATCHEWAN RIVER TO BROADMOOR BOULEVARD
18-E-2.10 YELLOWHEAD TRAIL / HIGHWAY 16, BROADMOOR BOULEVARD TO CLOVER BAR ROAD

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX E
COVER SHEET

18-E-1.01



DESIGN, BUILD, FINANCE and OPERATE
NORTHEAST ANTHONY HENDAY DRIVE
EDMONTON, ALBERTA, CANADA

SCHEDULE 18
APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE
EXECUTION VERSION

No.	REVISION	BY	DATE
0	EXECUTION VERSION		

ISL Engineering and Land Services

Government of Alberta Transportation

DRAWING INDEX		
18-E-1.01	1 of 2	COVER SHEET
18-E-1.02	2 of 2	DRAWING INDEX
GUIDE SIGNING FOR NEW INFRASTRUCTURE		
18-E-2.01	1 of 10	SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE
18-E-2.02	2 of 10	NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY
18-E-2.03	3 of 10	SHERWOOD PARK FREEWAY - 17 STREET TO ORDZE CRESCENT
18-E-2.04	4 of 10	NORTH OF SHERWOD PARK FREEWAY TO PETROLEUM WAY
18-E-2.05	5 of 10	PETROLEUM WAY TO NORTH OF 130 AVENUE
18-E-2.06	6 of 10	NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE
18-E-2.07	7 of 10	NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE
18-E-2.08	8 of 10	WEST OF MANNING DRIVE TO WEST OF 66 STREET
18-E-2.09	9 of 10	YELLOWHEAD TRAIL - NORTH SASKATCHEWAN RIVER TO BROADMOOR BOULEVARD
18-E-2.10	10 of 10	YELLOWHEAD TRAIL - BROADMOOR BOULEVARD TO CLOVER BAR ROAD

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX E
DRAWING INDEX

BAR CODE

PLAN No. 18-E-1.02
CONTRACT No.
SITE No.
PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

DATE | BY | SURVEYED | DESIGNED | CHECKED | DRAWN

No. | REVISION | BY | DATE
0 | EXECUTION VERSION

LEGEND

- STAGE 1 SIGN
- ULTIMATE ST. SIGN
- EXISTING SIGN
- TUC BOUNDARY
- GRADING FOR ULTIMATE STAGE
- OVERHEAD BRIDGE
- CANTILEVER
- GROUND MOUNT
- SIGN POST

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE

SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

Government of Alberta Transportation

SCALE 1:5000 HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-E-2.01	NE ANTHONY HENDAY DRIVE		1 of 10

PLAN DESCRIPTION: SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.01

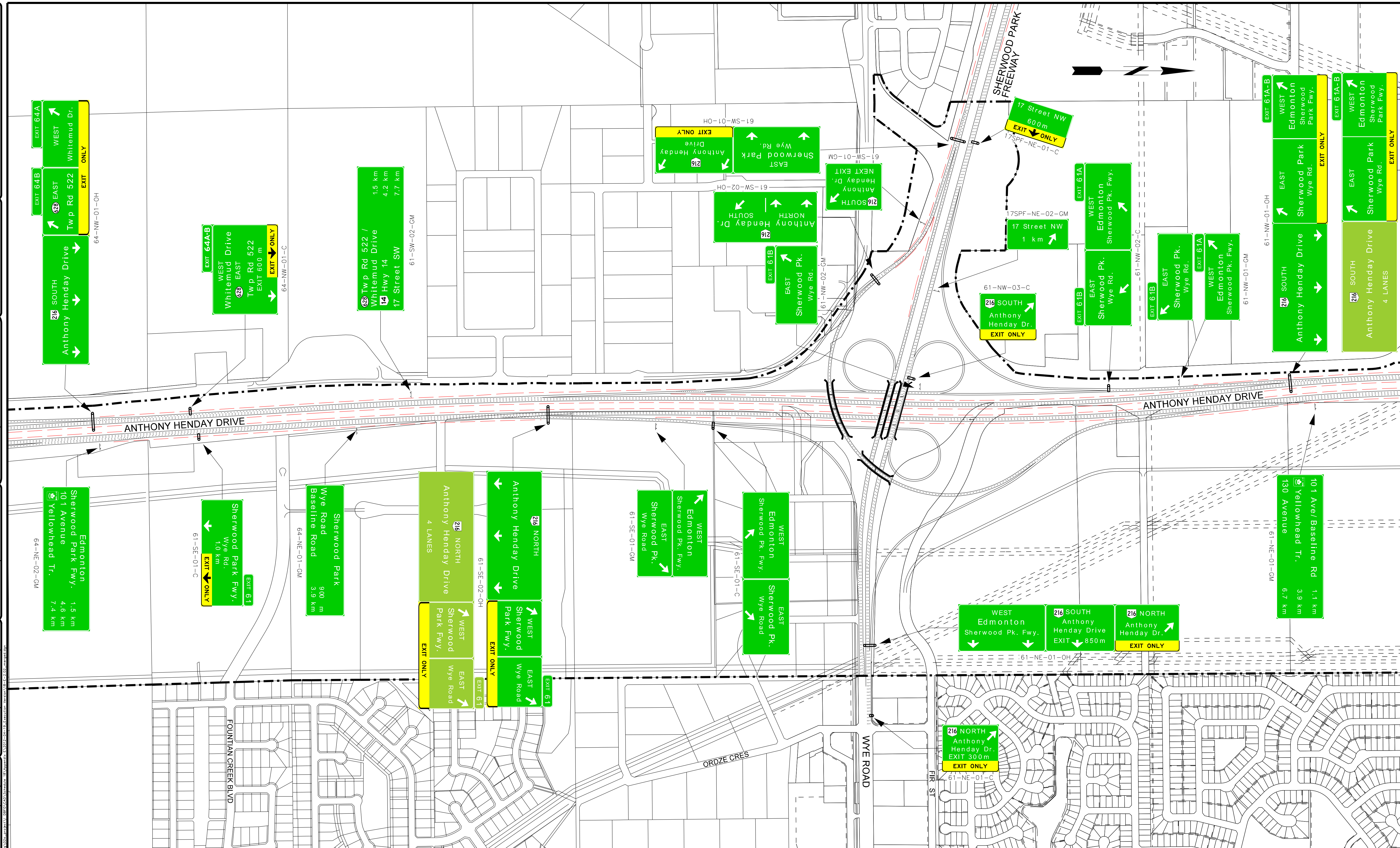
PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

No. REVISION DATE BY

0 EXECUTION VERSION



LEGEND

STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
	OVERHEAD BRIDGE
	CANTILEVER
EXISTING SIGN	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

NORTH OF WHITEMUD DRIVE TO
NORTH OF SHERWOOD PARK FREEWAY

SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

Government of Alberta Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-E-2.02	NE ANTHONY HENDAY DRIVE		2 of 10

PLAN DESCRIPTION
NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.02

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN DATE BY

No. REVISION
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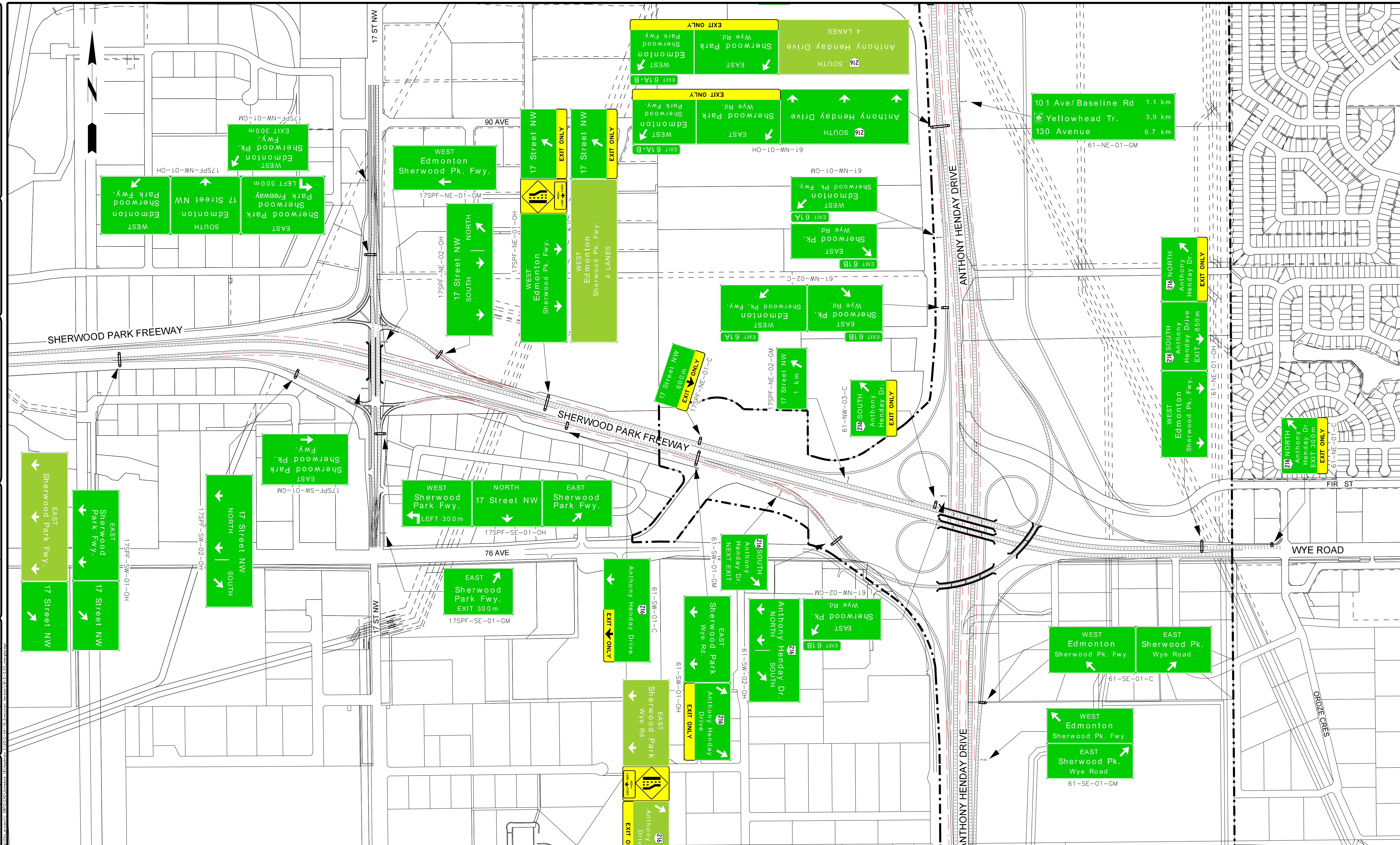


LEGEND

STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
EXISTING SIGN	OVERHEAD BRIDGE
	CANTILEVER
	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

SHERWOOD PARK FREEWAY
17 STREET TO ORDZE CRESCENT
SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-E-2.03	NE ANTHONY HENDAY DRIVE		3 of 10

PLAN DESCRIPTION
SHERWOOD PARK FREEWAY
17 STREET TO ORDZE CRESCENT
SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.03

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY

No. REVISION
0 EXECUTION VERSION

LEGEND

STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
EXISTING SIGN	OVERHEAD BRIDGE
	CANTILEVER
	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY

SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-E-2.04	NE ANTHONY HENDAY DRIVE		4 of 10

Government of Alberta Transportation

SCALE 1:5000 HORIZONTAL

PLAN DESCRIPTION: NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

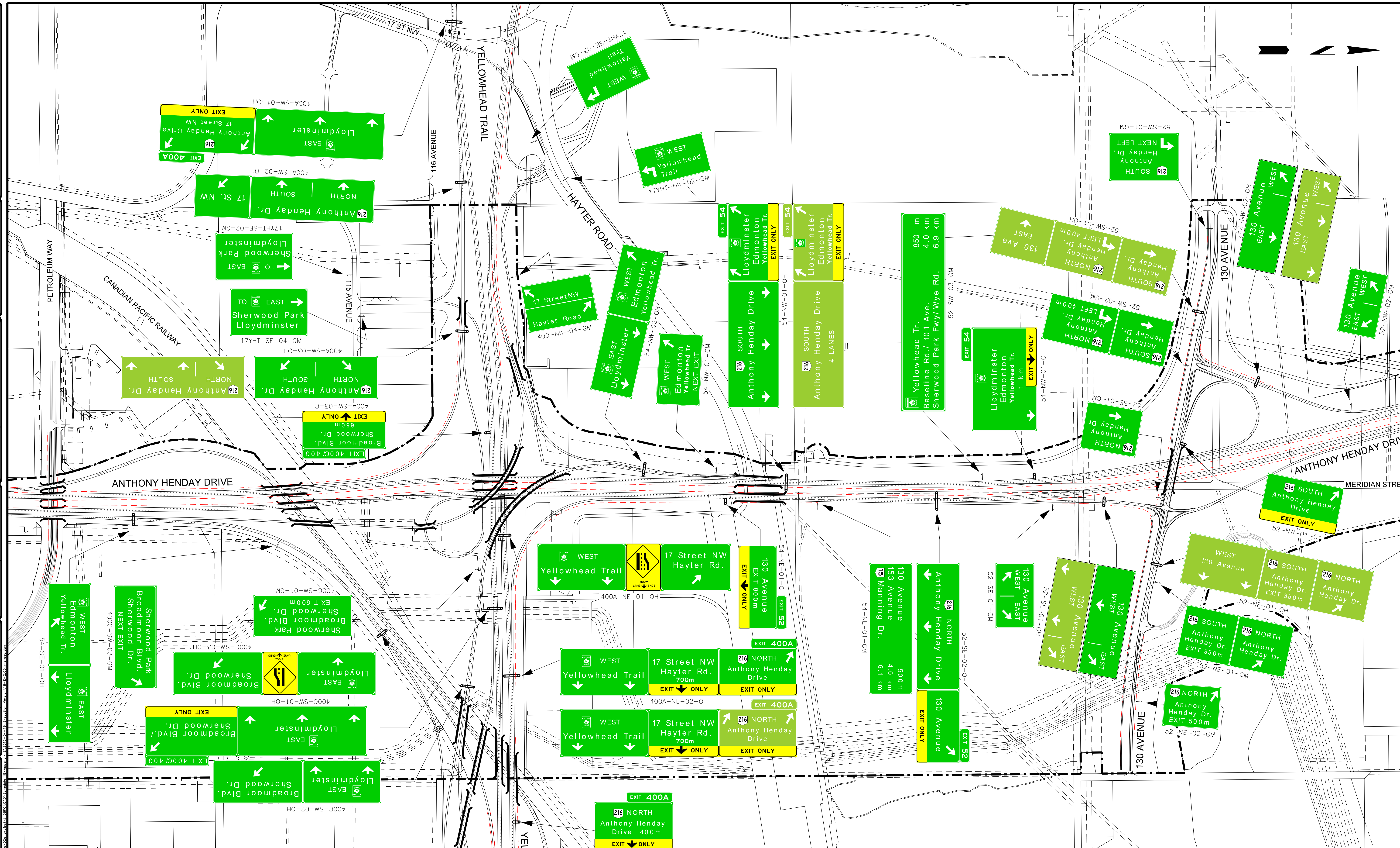
18-E-2.04

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

SURVEYED DESIGNED CHECKED DRAWN

No. 0 REVISION EXECUTION VERSION



LEGEND

STAGE 1 SIGN

ULTIMATE ST. SIGN

EXISTING SIGN

TUC BOUNDARY

GRADING FOR ULTIMATE STAGE

OVERHEAD BRIDGE

CANTILEVER

GROUND MOUNT

SIGN POST

CONSULTANT

JOB No. 13010 | PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

PETROLEUM WAY TO NORTH OF 130 AVENUE

SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-E-2.05	NE ANTHONY HENDAY DRIVE		5 of 10

Government of Alberta Transportation

SCALE 1:5000 HORIZONTAL

PLAN DESCRIPTION: PETROLEUM WAY TO NORTH OF 130 AVENUE SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.05

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY

REVISION

No. 0 EXECUTION VERSION

PLAN DESCRIPTION

NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE
SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.06

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

No.	REVISION	DATE	BY
0	EXECUTION VERSION		

SURVEYED | DESIGNED | CHECKED | DRAWN

LEGEND

STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
EXISTING SIGN	OVERHEAD BRIDGE
	CANTILEVER
	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No. 13010 | PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

NORTH OF 130 AVENUE TO NORTH OF153 AVENUE

SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-E-2.06	NE ANTHONY HENDAY DRIVE		6 of 10

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

LEGEND

STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
EXISTING SIGN	OVERHEAD BRIDGE
	CANTILEVER
	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE

SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-E-2.07	NE ANTHONY HENDAY DRIVE		7 of 10

Government of Alberta ■ Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE
SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.07

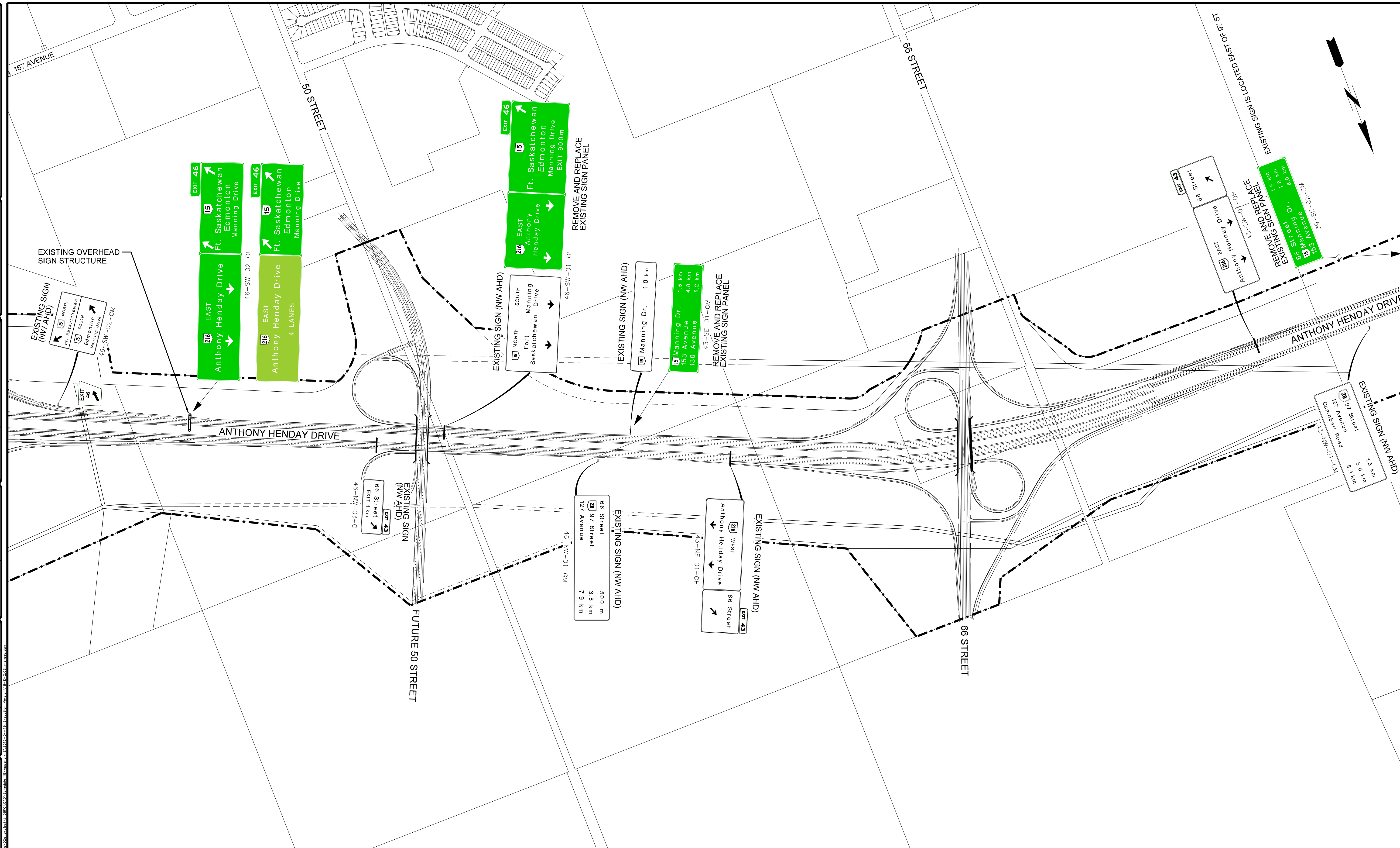
PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

SURVEYED DESIGNED CHECKED DRAWN

No. REVISION BY DATE

0 EXECUTION VERSION



LEGEND	
STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
EXISTING SIGN	OVERHEAD BRIDGE
	CANTILEVER
	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

WEST OF MANNING DRIVE TO WEST OF 66 STREET

SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-E-2.08	NE ANTHONY HENDAY DRIVE		8 of 10

Government of Alberta ■ Transportation

SCALE 1:5000 HORIZONTAL

PLAN DESCRIPTION

WEST OF MANNING DRIVE TO WEST OF 66 STREET SCHEDULE 18 - APPENDIX E GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.08

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

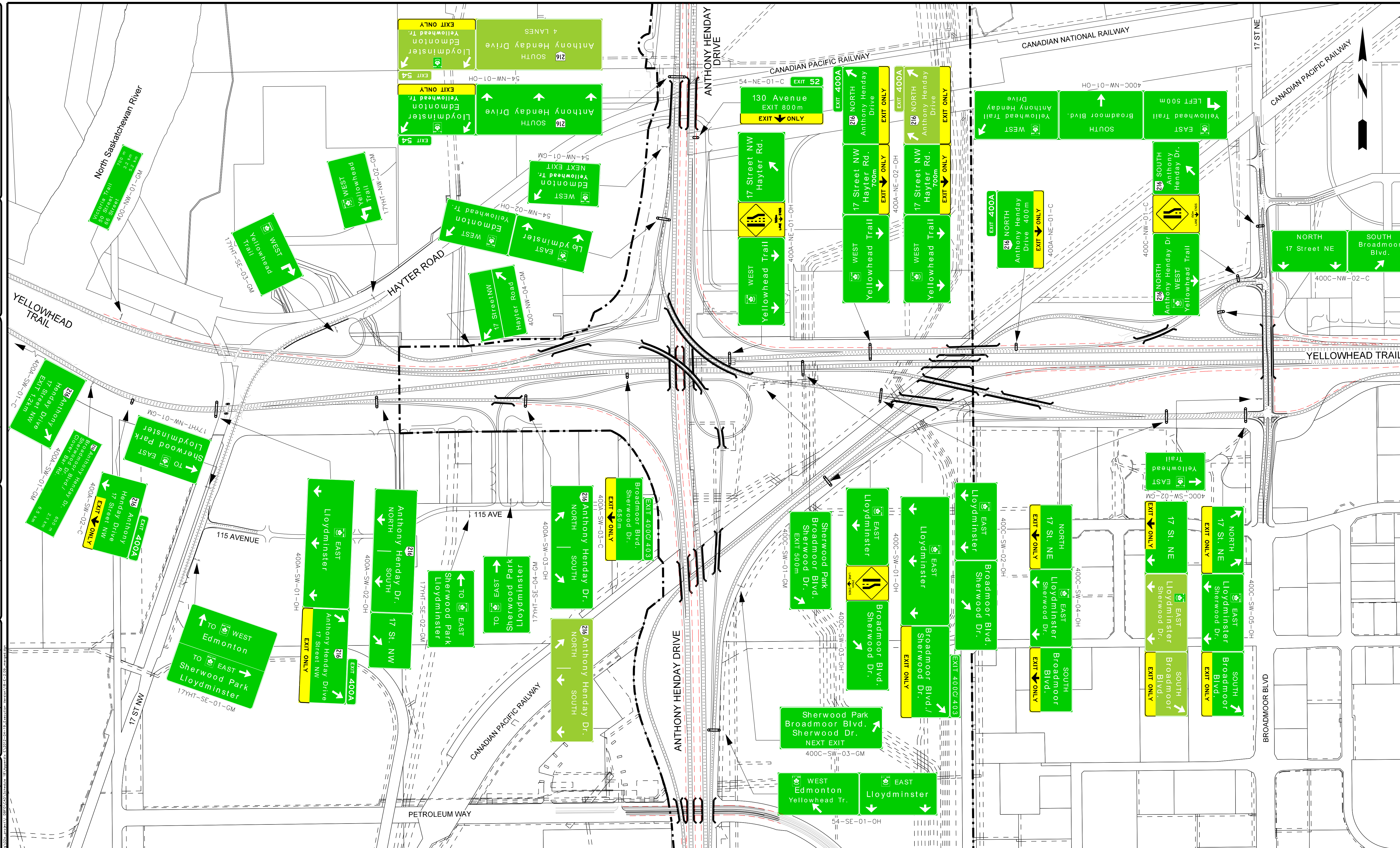
DATE BY

SURVEYED DESIGNED CHECKED DRAWN

DATE BY

No. REVISION

0 EXECUTION VERSION



LEGEND

STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
EXISTING SIGN	OVERHEAD BRIDGE
	CANTILEVER
	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE
YELLOWHEAD TRAIL / HIGHWAY 16
NORTH SASKATCHEWAN RIVER TO
BROADMOOR BOULEVARD
SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-E-2.09	NE ANTHONY HENDAY DRIVE		9 of 10

PLAN DESCRIPTION
YELLOWHEAD TRAIL/HIGHWAY 16
NORTH SASKATCHEWAN RIVER TO
BROADMOOR BOULEVARD
SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.09

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH | DATE | GRAPHICS FILE

SURVEYED | DESIGNED | CHECKED | DRAWN | BY | DATE

No. | REVISION | BY | DATE
0 | EXECUTION VERSION | |

PLAN DESCRIPTION
YELLOWHEAD TRAIL / HIGHWAY 16
BROADMOOR BLVD. - CLOVERBAR ROAD
SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

BAR CODE

18-E-2.10

REVISION		
No.	EXECUTION VERSION	
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BY	DATE	
SURVEYED	DESIGNED	CHECKED	DRAWN
PHOTO No.	TITLE SEARCH DATE	GRAPHICS FILE
PLAN No.	CONTRACT No.	SITE No.

LEGEND

STAGE 1 SIGN	TUC BOUNDARY
ULTIMATE ST. SIGN	GRADING FOR ULTIMATE STAGE
EXISTING SIGN	OVERHEAD BRIDGE
	CANTILEVER
	GROUND MOUNT
	SIGN POST

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE

YELLOWHEAD TRAIL / HIGHWAY 16
BROADMOOR BOULEVARD TO CLOVER BAR ROAD

SCHEDULE 18 - APPENDIX E
GUIDE SIGNING FOR NEW INFRASTRUCTURE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-E-2.10	NE ANTHONY HENDAY DRIVE		10 of 10

Government of Alberta ■
Transportation

SCALE 1:5000
HORIZONTAL

APPENDIX F - LIST OF ACRONYMS

AAR:	Alkali-Aggregate Reactivity
AADT:	Average Annual Daily Traffic
AASHTO:	American Association of State Highway and Transportation Officials
ACI:	American Concrete Institute
ACP:	Asphalt Concrete Pavement
AGC:	Associated General Contractors
AHDGA:	American Hot Dip Galvanizers Association
AISI:	American Iron and Steel Institute
AMA:	Alberta Motor Association
ANSI:	American National Standards Institute
APEGGA:	Association of Professional Engineers, Geologists and Geophysicist of Alberta
ARTBA:	American Road and Transportation Builders Association
ASCII:	American Standard Code for Information Interchange
AWS:	American Welding Society
ASTM:	American Society for Testing and Materials
BIM:	Bridge Inspection and Maintenance
CAP:	Corrugated Aluminum Pipe
CEAA:	Canadian Environmental Assessment Act
CECAB:	Canadian Environmental Certification Appeals Board
CGSB:	Canadian General Standards Board
CN:	Canadian National Railway Company
CP:	Canadian Pacific Railway Limited
CSA:	Canadian Standards Association
CSE:	Copper Sulphate Electrode
CSP:	Corrugated Steel Pipe
CSV:	Comma Separated Value
CTA:	Canada Transportation Act
CWB:	Canadian Welding Bureau
DCMS:	Dynamic Changeable Message Signs
DD:	Design Data

DFO:	Department of Fisheries and Oceans
DFT:	Dry Film Thickness
ESAL:	Equivalent Single Axle Load
EEMAC:	Electrical and Electronic Manufacturer’s Association of Canada
EMS:	Environmental Management System
HERP:	Herbicide Exemption Request Program
HPC:	High Performance Concrete
ICP:	Inductively Coupled Plasma Spectrometry
IFI:	International Friction Index
IMU:	Inertial Measurement Unit
IRCA:	International Register for Certificated Auditors
IRI:	International Roughness Index
ISL:	Infrastructure Systems Limited
ISO:	International Standards Organization
Leq_{24}:	Weighted 24 hour equivalent sound level
LRFD:	Load and Resistance Factor Design
MAPP:	Medical Alert Pesticide Program
MSE:	Mechanically Stabilized Earth
MTO:	Ministry of Transportation Ontario
NCHRP:	National Cooperative Highway Research Program
NEMA:	National Electrical Manufactures Association
NQI:	National Quality Institute
NWPA:	Navigable Waters Protection Act
OSCAM:	On-Street Construction and Maintenance
PDF:	Portable Document Format
PG:	Performance Grade
PTFE:	Polytetrafluoroethylene
PTI:	Post Tensioning Institute
PVC:	Polyvinyl Chloride
QMS:	Quality Management System
RAP:	Reclaimed Asphalt Pavement
RAB:	Registrar Accreditation Board
RWIS:	Road Weather Information System
SHRP:	Strategic Highway Research Program
SPCSP:	Structural Plate Corrugated Steel Pipe
SSPC:	Society for Protective Coating Standards
TAC:	Transportation Association of Canada

APPENDIX G - ALBERTA INFRASTRUCTURE LAND LEASE SUMMARY AND DRAWINGS

- **Table**
- **Drawings**
  - 18-G-2.01 – SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE;
  - 18-G-2.02 - NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY;
  - 18-G-2.03 – NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY;
  - 18-G-2.04 – PETROLEUM WAY TO NORTH OF 130 AVENUE;
  - 18-G-2.05 – NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE;
  - 18-G-2.06 – NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE; AND
  - 18-G-2.07 - ANTHONY HENDAY DRIVE TO SHERWOOD DRIVE

The description of the improvements to be demolished by the Contractor under the "Demolition Requirements" column below is provided for information only and must be confirmed by the Contractor. The Province makes no representation as to the completeness or accuracy of the description herein. No error or omission herein shall relieve the Contractor of its obligations under Section 200.2.3.24 (Demolition) of Schedule 18.

Lease	Type of Agreement / Description	Legal	Lease Status	Lease Termination Date	Total Acres	Affected Areas (as defined in Section 200.2.3.24 (Demolition) of Schedule 18 (Technical Requirements))	Demolition Requirements	Drawing Number
901A	Agricultural	NE-31-53-23-W4	To Remain	n/a	2.47	Not one of the Affected Areas	None	18-G-2.06
917G	Agricultural	NE & NW-29-53-23-W4	Cancelled	31-Dec-11	59.53	One of the Affected Areas	Two 400 sq. ft. bins.	18-G-2.05
918S	Agricultural	NE-29-53-23-W4	To Remain	n/a	0.49	Not one of the Affected Areas	Not Applicable	18-G-2.05
907D	Agricultural	SW-28-52-23-W4	Cancelled	31-Dec-11	29.09	One of the Affected Areas	150 sq. ft. bin.	18-G-2.02
931Z	Agricultural	NW-21-52-23-W4	Cancelled	31-Dec-11	8.52	One of the Affected Areas	150 sq. ft. bin.	18-G-2.02
925L	Agricultural	SW-16-52-23-W4	Cancelled	31-Dec-11	39.85	One of the Affected Areas	2600 sq. ft. barn, 900 sq. ft. house, 1600 sq. ft. shed, 1500 sq. ft. shed, 500 sq. ft. shed	18-G-2.01
924L	Commercial	NW & SW-16-53-23-W4	Cancelled	31-Dec-11	8.85	One of the Affected Areas	16000 sq. ft. shop and two 4000 sq. ft. quonsets	18-G-2.04 & 18-G-2.07
925T	Commercial	SW-16-53-23-W4	To be Cancelled	15-Jun-12	5.44	One of the Affected Areas	10000 sq. ft. shop	18-G-2.04 & 18-G-2.07
905Q	Commercial	SW-16-53-23-W4	Portion within Road Right of Way to be Cancelled	01-Jul-12	29.54	One of the Affected Areas	5600 sq. ft. shop and 3600 sq. ft. shop	18-G-2.04 & 18-G-2.07
922Z	Commercial	SW-16-53-23-W4	Cancelled	31-Dec-11	3.76	One of the Affected Areas	4000 sq. ft. shop and 3000 sq. ft. mobile office trailers	18-G-2.04 & 18-G-2.07
934J	Commercial	SW-28-52-23-W4	To be Cancelled	01-Sep-12	4.94	One of the Affected Areas	440 ft x 200 ft gravel parking facility	18-G-2.02
924U	Commercial	SW-21-52-23-W4	To Remain	n/a	2.36	Not one of the Affected Areas	None	18-G-2.02
924C	Commercial	NW-16-52-23-W4	Cancelled	31-Aug-12	1.40	One of the Affected Areas	16000 sq. ft. shop, 3700 sq. ft. shop, 1500 sq. ft. shop, 500 sq. ft. shop, 800 sq. ft. garage, 300 sq. ft. shed	18-G-2.01 & 18-G-2.02
934G	Land	SE-20-53-23-W4	To Remain	31-Dec-11	0.001	Not one of the Affected Areas	Not Applicable	18-G-2.04 & 18-G-2.05
932X	Land	SW-21-53-23-W4	To Remain	31-Dec-11	0.55	Not one of the Affected Areas	Not Applicable	18-G-2.04
933C	Land	SW-21-53-23-W4	To Remain	31-Dec-11	0.72	Not one of the Affected Areas	Not Applicable	18-G-2.04
933Q	Land	NW-21-52-23-W4 & SE-32-51-23-W4	To Remain	31-Dec-11	0.42	Not one of the Affected Areas	Not Applicable	18-G-2.02

Lease	Type of Agreement / Description	Legal	Lease Status	Lease Termination Date	Total Acres	Affected Areas (as defined in Section 200.2.3.24 (Demolition) of Schedule 18 (Technical Requirements))	Demolition Requirements	Drawing Number
937F	License	SW-16-53-23-W4	To Remain	31-Dec-11	1.64	Not one of the Affected Areas	Not Applicable	18-G-2.04 & 18-G-2.07
938E	License	SW-04-53-23-W4	To Remain	31-Dec-11	0.38	Not one of the Affected Areas	Not Applicable	18-G-2.03
937Z	License	SW-09-53-23-W4 & W1/2-4-53-23-W4	To Remain	31-Dec-11	1.16	Not one of the Affected Areas	Not Applicable	18-G-2.03
901S	Mobile Home	NE-31-53-23-W4	Portion within Road Right of Way Cancelled	31-Dec-11	11.88	One of the Affected Areas	1000 sq. ft. barn	18-G-2.06
925B	Recreation	NW & SW-28-52-23-W4 SW-33-52-23-W4	To Remain	30-Jun-12	31.16	Not one of the Affected Areas	None	18-G-2.02 & 18-G-2.03
928R	Recreation	NW-28-52-23-W4	To Remain	n/a	30.00	Not one of the Affected Areas	Not Applicable	18-G-2.02
922K	Residential	NE-31-53-23-W4	Cancelled	31-Dec-11	4.70	One of the Affected Areas	700 sq. ft. house, 600 sq. ft. double detached garage, 1900 sq. ft. barn, 100 sq. ft. out building, water well and septic system	18-G-2.06
900Z	Residential	NE-31-53-23-W4	To Remain	31-Dec-11	9.93	Not one of the Affected Areas	None	18-G-2.06
912N	Residential	NW-32-53-23-W4	Cancelled	31-Dec-11	11.17	One of the Affected Areas	1000 sq. ft. house, 600 sq. ft. double detached garage, 3500 sq. ft. shop, 2 small out buildings and two 500 sq. ft. greenhouse frames	18-G-2.05 & 18-G-2.06
901M	Residential	SE-32-53-23-W4	Cancelled	31-Dec-11	3.60	One of the Affected Areas	850 sq. ft. house, 400 sq. ft. detached garage, 8 small sheds/bins (100 sq. ft. to 20 sq. ft.), two 16 ft steel bins, 1000 sq. ft. barn, water well and septic system	18-G-2.05
905V	Residential	NE-29-53-23-W4	Cancelled	31-Dec-11	0.74	One of the Affected Areas	2000 sq. ft house with attached garage and septic system	18-G-2.05
906C	Residential	NW-28-52-23-W4	Cancelled	31-Dec-11	8.02	One of the Affected Areas	1700 sq. ft. barn, 600 sq. ft. house, 200 sq. ft. detached garage, 500 sq. ft. shed, four 100 sq. ft. out buildings, 300 sq. ft. detached garage, 1200 sq. ft. house, 600 sq. ft. house, 700 sq. ft. mobile home, water well and septic system	18-G-2.02
900Y	Residential	SW-28-52-23-W4	Cancelled	31-Dec-11	2.01	One of the Affected Areas	3000 sq. ft. house and double attached garage, 100 sq. ft. shed, 750 sq. ft. barn, 500 sq. ft. metal quonset, water well and septic system	18-G-2.02
915T	Residential	SW-28-52-23-W4	To be Cancelled	30-Jun-12	36.01	One of the Affected Areas	2000 sq. ft. house, 800 sq. ft. garage, 1000 sq. ft. barn, 200 sq. ft. shed, four 100 sq. ft. animal shelters and septic system	18-G-2.02
904X	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	2.66	One of the Affected Areas	1000 sq. ft. house, 600 sq. ft. garage, two stone firepits, water well and septic system	18-G-2.02
926J	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.00	One of the Affected Areas	900 sq. ft. house, 800 sq. ft. garage, 400 sq. ft. lean to, water well and septic system	18-G-2.02

Lease	Type of Agreement / Description	Legal	Lease Status	Lease Termination Date	Total Acres	Affected Areas (as defined in Section 200.2.3.24 (Demolition) of Schedule 18 (Technical Requirements))	Demolition Requirements	Drawing Number
903J	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.00	One of the Affected Areas	1000 sq. ft. house, 250 sq. ft. detached garage, water well and septic system	18-G-2.02
903G	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	2.99	One of the Affected Areas	1000 sq. ft. house, 600 sq. ft. detached garage, three 100 sq. ft. outbuildings and septic system	18-G-2.02
903D	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	2.25	One of the Affected Areas	2200 sq. ft. house and double attached garage, 80 sq. ft. shed, 200 sq. ft. garage, water well and septic system	18-G-2.02
930S	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.00	One of the Affected Areas	2000 sq. ft. house and attached garage, 600 sq. ft. shelter, water well and septic system	18-G-2.02
903H	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.00	One of the Affected Areas	900 sq. ft. house, 400 sq. ft. detacahed garage, 100 sq. ft. barn, water well and septic system	18-G-2.02
929U	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	1.48	One of the Affected Areas	900 sq. ft. house, 100 sq. ft. shed, 200 sq. ft. garage, water well and septic system	18-G-2.02
900X	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	2.99	One of the Affected Areas	Three 100 sq. ft. out buildings, 2500 sq. ft. house with double attached garage, water well and septic system	18-G-2.02
903E	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.00	One of the Affected Areas	2000 sq. ft. house and attached garage, 600 sq. ft. house, water well and septic system	18-G-2.02
930T	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.00	One of the Affected Areas	1200 sq. ft. house, 400 sq. ft. vehicle shelter, 500 sq. ft. detached garage, water well and septic system	18-G-2.02
904W	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	2.53	One of the Affected Areas	1000 sq. ft. house, 400 sq. ft. garage, 60 sq. ft. out building, water well and septic system	18-G-2.02
903A	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.50	One of the Affected Areas	2500 sq. ft. house with double attached garage, 600 sq. ft. out building, water well and septic system	18-G-2.02
905T	Residential	NW-21-52-23-W4	Cancelled	31-Dec-11	3.01	One of the Affected Areas	2700 sq. ft. house and double semi-attached garage, water well and septic system	18-G-2.02
934U	Residential	N-16-52-23-W4 & SW-21-52-23-W4	To Remain	n/a	6.18	Not one of the Affected Areas	Not Applicable	18-G-2.02
935T	Residential	NW-16-52-23-W4	Cancelled	31-Dec-11	1.04	One of the Affected Areas	1400 sq. ft. house, 900 sq. ft. triple detached garage, 2000 sq. ft. shed, water well and septic system	18-G-2.02
935U	Residential	NW-16-52-23-W4	Cancelled	31-Dec-11	1.14	One of the Affected Areas	1400 sq. ft. house, water well and septic system	18-G-2.02
904P	Residential	NW-16-52-23-W4	Cancelled	31-Dec-11	0.69	One of the Affected Areas	1200 sq. ft. house, 730 sq. ft. triple detached garage. Water well and septic system	18-G-2.01 & 18-G-2.02
914K	Residential	SW-16-52-23-W4	Cancelled	31-Dec-11	0.62	One of the Affected Areas	900 sq. ft. house, 2000 sq. ft. shop, water well and septic system	18-G-2.01
914J	Residential	SW-16-52-23-W4	Cancelled	31-Dec-11	0.38	One of the Affected Areas	2100 sq. ft. house and garage on cement basement, water well and septic system	18-G-2.01

Appendix G
Alberta Infrastructure Land Lease Summary Table (5 Pages)

Lease	Type of Agreement / Description	Legal	Lease Status	Lease Termination Date	Total Acres	Affected Areas (as defined in Section 200.2.3.24 (Demolition) of Schedule 18 (Technical Requirements))	Demolition Requirements	Drawing Number
915L	Storage	SW-16-53-23-W4	To Remain	n/a	10.41	Not one of the Affected Areas	Not Applicable	18-G-2.04 & 18-G-2.07
926Y	Storage	NW-21-52-23-W4	Cancelled	31-Dec-11	1.43	One of the Affected Areas	1000 sq. ft. shop.	18-G-2.02
938O	Surface	SW-06-54-23-W4	To Remain	n/a	0.34	Not one of the Affected Areas	Not Applicable	18-G-2.06
905G	Surface	NW-16-53-23-W4	To Remain	n/a	0.45	Not one of the Affected Areas	Not Applicable	18-G-2.04
930J	Surface	NW-16-53-23-W4	To Remain	n/a	0.03	Not one of the Affected Areas	Not Applicable	18-G-2.04 & 18-G-2.07
932N	Surface	NW-16-53-23-W4	To Remain	n/a	0.065	Not one of the Affected Areas	Not Applicable	18-G-2.04
938C	Surface	SW-04-53-23-W4	To Remain	n/a	0.02	Not one of the Affected Areas	Not Applicable	18-G-2.03
936B	Surface	SW-16-53-23-W4 & SW-09-53-23-W4	To Remain	n/a	0.03	Not one of the Affected Areas	Not Applicable	18-G-2.04 & 18-G-2.07
938J	Surface	NW-04-53-23-W4	To Remain	n/a	3.60	Not one of the Affected Areas	Not Applicable	18-G-2.03
921W	Surface	NW-04-53-23-W4	To Remain	n/a	0.14	Not one of the Affected Areas	Not Applicable	18-G-2.03
931C	Surface	NW-04-53-23-W4	To Remain	n/a	0.311	Not one of the Affected Areas	Not Applicable	18-G-2.03
938D	Surface	SW-04-53-23-W4	To Remain	n/a	0.25	Not one of the Affected Areas	Not Applicable	18-G-2.03
938F	Surface	SW-04-53-23-W4	To Remain	n/a	4.52	Not one of the Affected Areas	Not Applicable	18-G-2.03
937Y	Surface	SW-04-53-23-W4	To Remain	n/a	0.06	Not one of the Affected Areas	Not Applicable	18-G-2.03
929S	Surface	SW-04-53-23-W4	To Remain	n/a	0.14	Not one of the Affected Areas	Not Applicable	18-G-2.03
931Y	Surface	NW-33-52-23-W4	To Remain	n/a	0.03	Not one of the Affected Areas	Not Applicable	18-G-2.03
923L	Surface	SW-33-52-23-W4	To Remain	n/a	1.07	Not one of the Affected Areas	Not Applicable	18-G-2.03
938G	Surface	SW-21-52-23-W4	To Remain	n/a	0.12	Not one of the Affected Areas	Not Applicable	18-G-2.02
300C	Commercial	SE-15-53-23-W4	To be Cancelled	15-Jun-12	1.55	One of the Affected Areas	1600 sq. ft. cement pad, 2000 sq. ft quonset, 300 sq. ft. weigh scale and cement ramp, 1000 sq. ft. mobile trailer and 3000 sq. ft. open cement foundation.	18-G-2.07
932S	Residential	SW 9-52-23-W4	Cancelled	31-Dec-11	18.02	One of the Affected Areas	4500 sq. ft. house on cement pad, 3200 sq. ft. house on cement pad, 750 sq. ft. pool house, inground cement swimming pool and decking (1300 sq. ft.), tennis court (6600sq. ft.), water well and septic system	18-G-2.01

Appendix G
Alberta Infrastructure Land Lease Summary Table (5 Pages)

Lease	Type of Agreement / Description	Legal	Lease Status	Lease Termination Date	Total Acres	Affected Areas (as defined in Section 200.2.3.24 (Demolition) of Schedule 18 (Technical Requirements))	Demolition Requirements	Drawing Number
932T	Agricultural	SW 9-52-23-W4	Cancelled	31-Dec-11	49.81	One of the Affected Areas	Concrete Footings for buildings, 2100 sq. ft. barn, 7500 sq. ft. metal quonset, 3000 sq. ft. animal shelter, 880 sq. ft. shed, 140 sq. ft. shed, 2200 sq. ft. shop, 140 sq. ft. shed, 10,000 sq. ft. barn, 2300 sq. ft. animal shelter, apprx. 2500 linear feet of metal corral fencing, water well	18-G-2.01
904V	Agricultural	SW 9-52-23-W4	To Remain	n/a	36.30	Not one of the Affected Areas	Not Applicable	18-G-2.01
936Z	Residential	SW 9-52-23-W4	To Remain	n/a	16.49	Not one of the Affected Areas	Not Applicable	18-G-2.01
938H	Surface	NW 21-52-23-W4	To Remain	n/a	0.22	Not one of the Affected Areas	Not Applicable	18-G-2.02
938M	Surface	SW 4-53-23-W4	To Remain	n/a	1.85	Not one of the Affected Areas	Not Applicable	18-G-2.03
938P	Surface	NW 4-53-23-W4	To Remain	n/a	0.06	Not one of the Affected Areas	Not Applicable	18-G-2.03
938Q	Surface	NW 4-53-23-W4	To Remain	n/a	0.07	Not one of the Affected Areas	Not Applicable	18-G-2.03

NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX G
COVER SHEET

18-G-1.01

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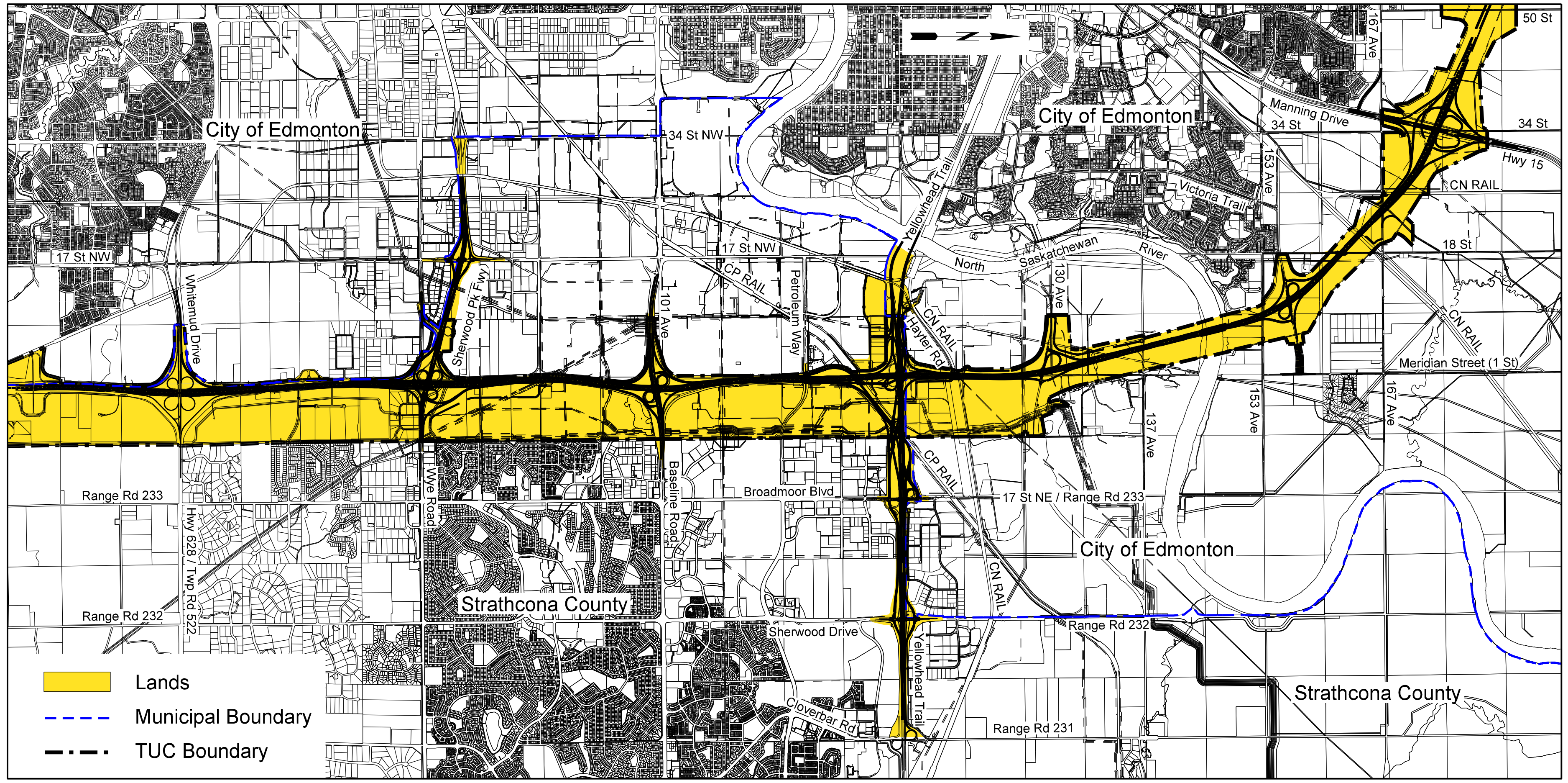

DESIGN, BUILD, FINANCE and OPERATE
NORTHEAST ANTHONY HENDAY DRIVE
EDMONTON, ALBERTA, CANADA

SCHEDULE 18

APPENDIX G - LEASE HOLDERS
EXECUTION VERSION

ISL Engineering and Land Services

Government of Alberta
Transportation

DRAWING INDEX		
18-G-1.01	1 of 2	COVER SHEET
18-G-1.02	2 of 2	DRAWING INDEX
LEASE HOLDERS		
18-G-2.01	1 of 7	SOUTH OF WHITEMUD DRIVE TO NORTH OF WHITEMUD DRIVE
18-G-2.02	2 of 7	NORTH OF WHITEMUD DRIVE TO NORTH OF SHERWOOD PARK FREEWAY
18-G-2.03	3 of 7	NORTH OF SHERWOOD PARK FREEWAY TO PETROLEUM WAY
18-G-2.04	4 of 7	PETROLEUM WAY TO NORTH OF 130 AVENUE
18-G-2.05	5 of 7	NORTH OF 130 AVENUE TO NORTH OF 153 AVENUE
18-G-2.06	6 of 7	NORTH OF 153 AVENUE TO WEST OF MANNING DRIVE
18-G-2.07	7 of 7	ANTHONY HENDAY DRIVE TO SHERWOOD DRIVE

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE
SCHEDULE 18 - APPENDIX G
DRAWING INDEX

BAR CODE

PLAN No. 18-G-1.02
CONTRACT No.
SITE No.

PHOTO No.
TITLE SEARCH DATE
GRAPHICS FILE

SURVEYED | BY | DATE
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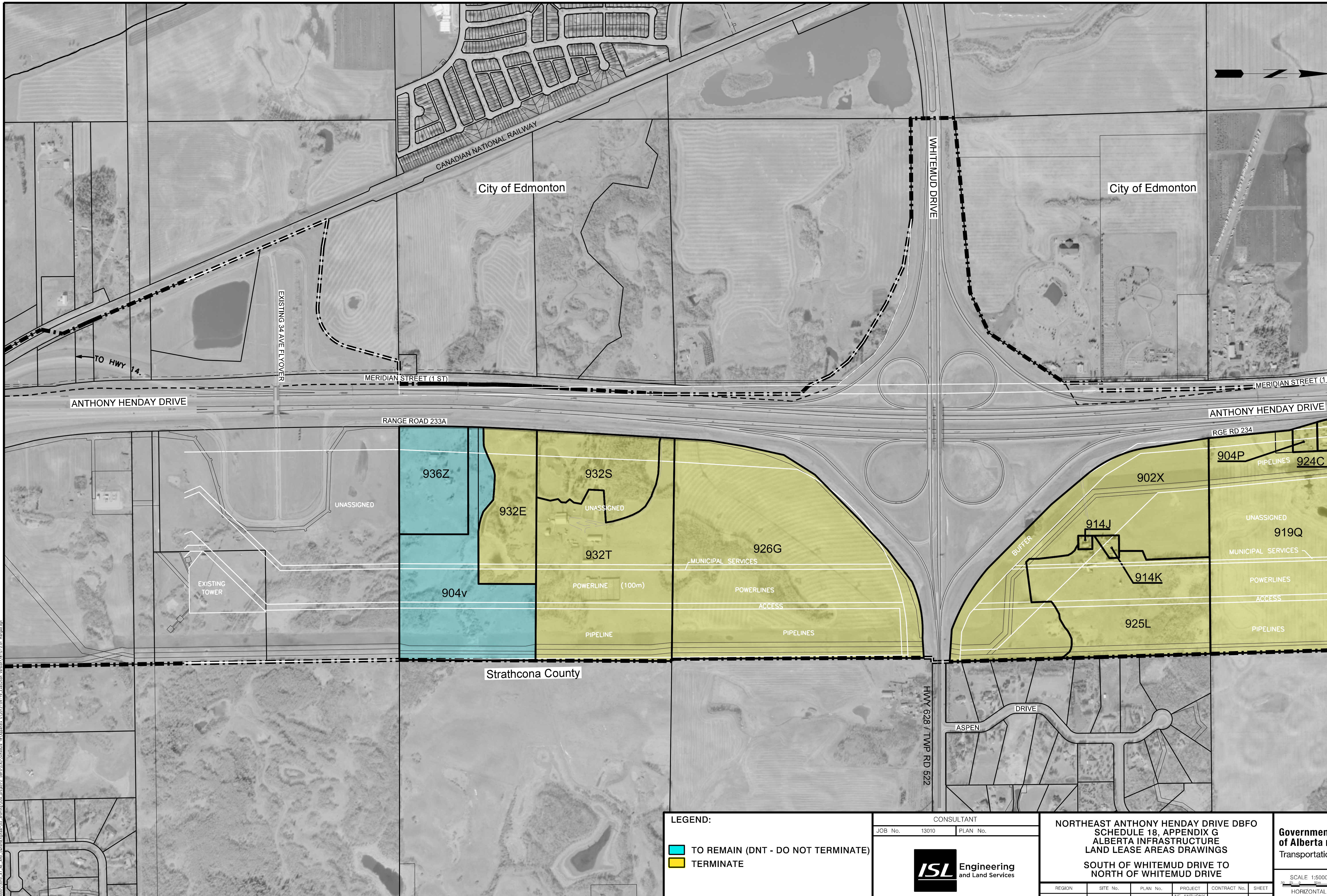

LEGEND:

- TO REMAIN (DNT - DO NOT TERMINATE)
- TERMINATE

CONSULTANT

JOB No. 13010 PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS

SOUTH OF WHITEMUD DRIVE TO
NORTH OF WHITEMUD DRIVE

Government of Alberta ■
Transportation

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH-CENTRAL		18-G-2.01	NE ANTHONY HENDAY DRIVE		1 of 7

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS
SOUTH OF WHITEMUD DRIVE TO
NORTH OF WHITEMUD DRIVE

BAR CODE

18-G-2.01

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

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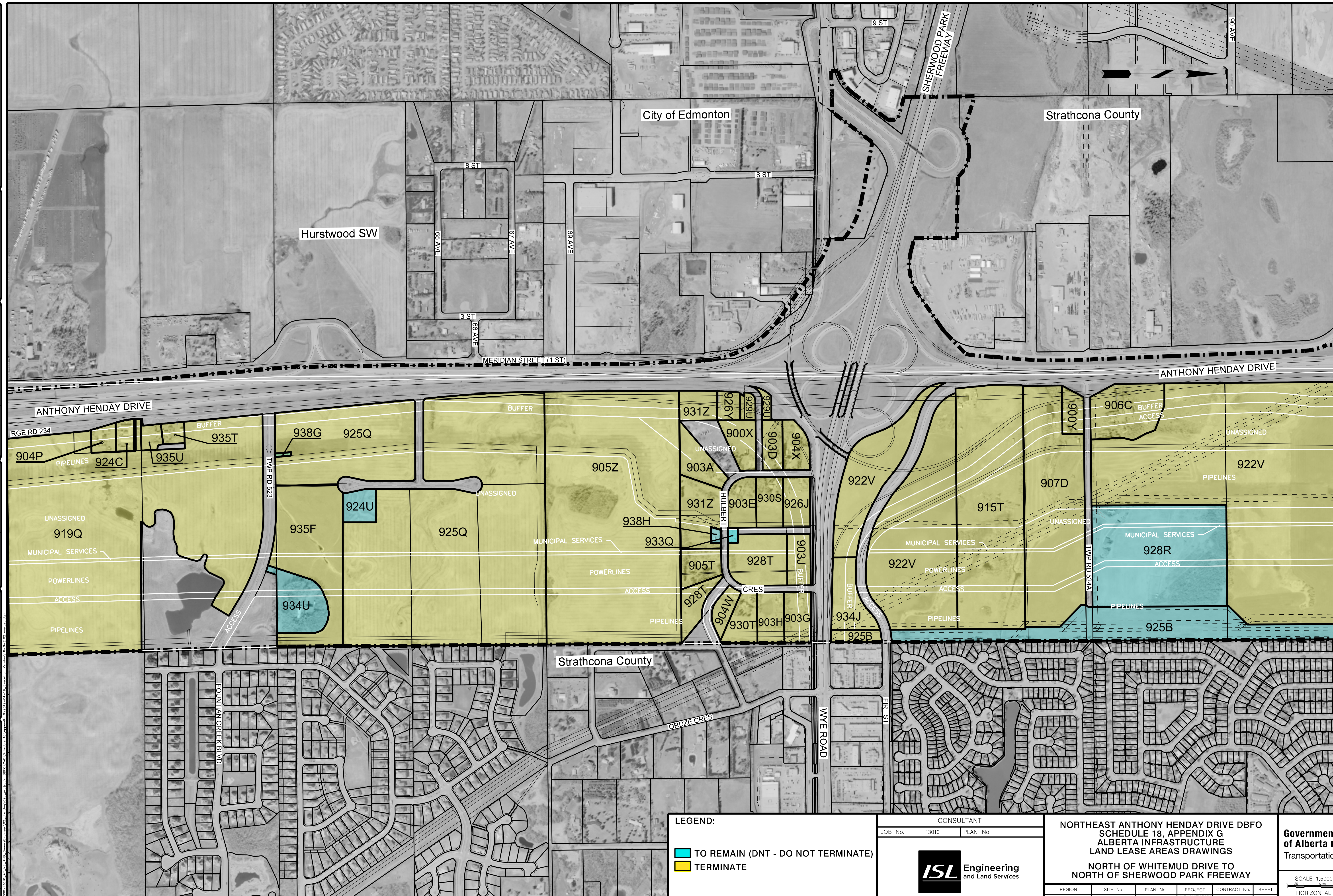

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NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS

NORTH OF WHITEMUD DRIVE TO
NORTH OF SHERWOOD PARK FREEWAY

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-G-2.02	NE ANTHONY HENDAY DRIVE		2 of 7

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS
NORTH OF WHITEMUD DRIVE TO
NORTH OF SHERWOOD PARK FREEWAY

BAR CODE

18-G-2.02

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

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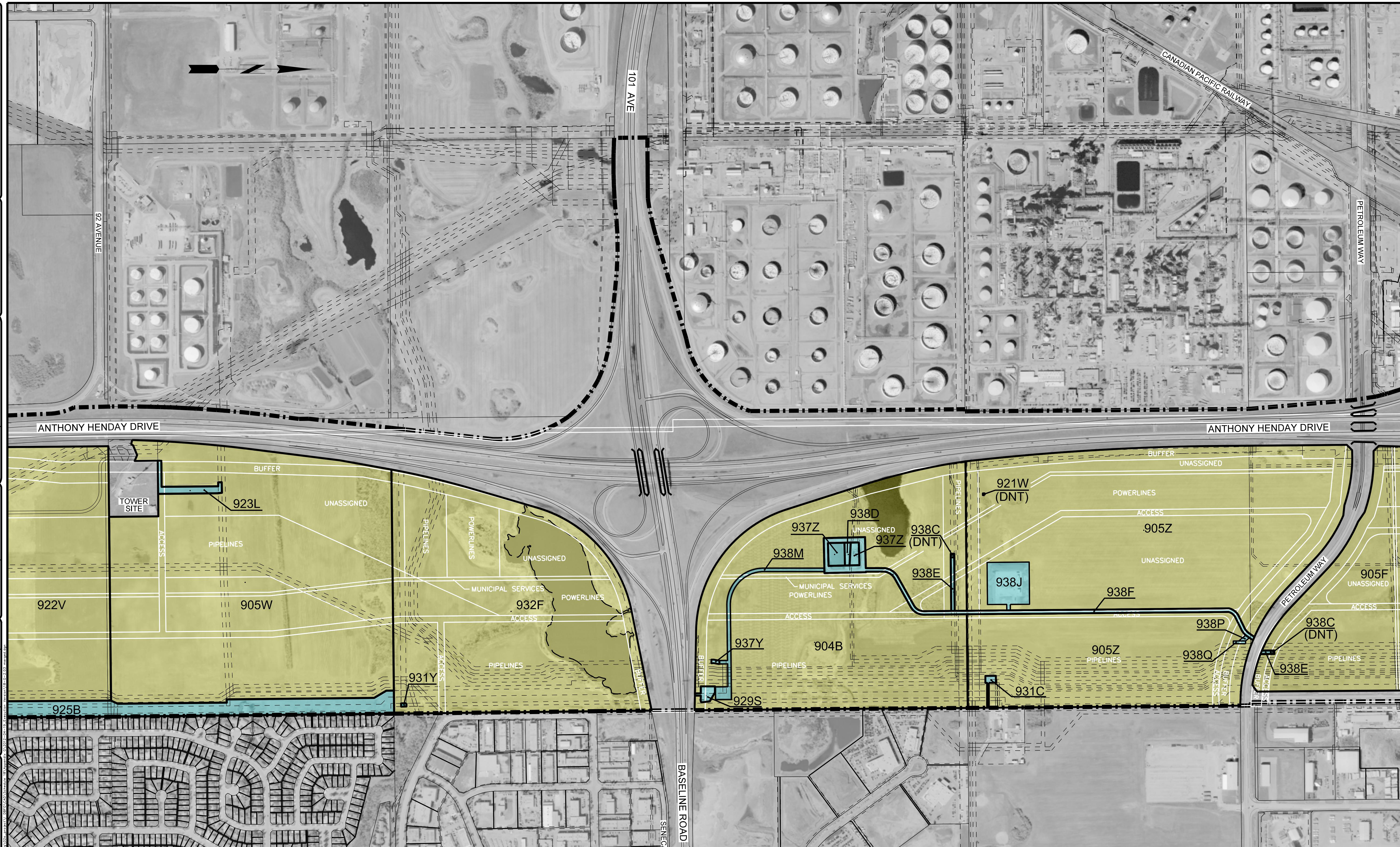

LEGEND:

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TERMINATE

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JOB No. 13010 | PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS

NORTH OF SHERWOOD PARK FREEWAY
TO PETROLEUM WAY

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-G-2.03	NE ANTHONY HENDAY DRIVE		3 of 7

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS
NORTH OF SHERWOOD PARK FREEWAY
TO PETROLEUM WAY

BAR CODE

18-G-2.03

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

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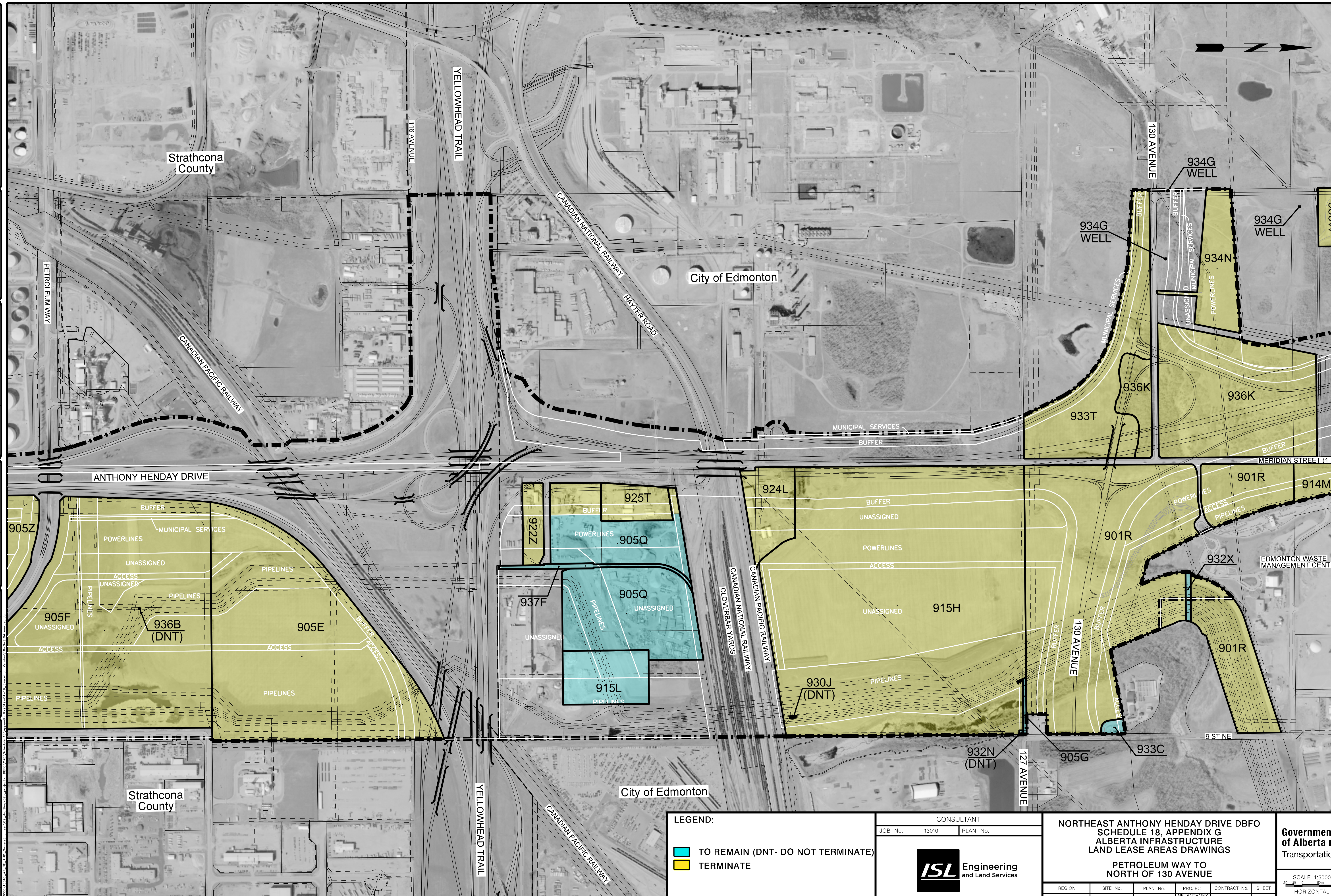

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TERMINATE

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS

PETROLEUM WAY TO
NORTH OF 130 AVENUE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-G-2.04	NE ANTHONY HENDAY DRIVE		4 of 7

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS
PETROLEUM WAY TO
NORTH OF 130 AVENUE

BAR CODE

18-G-2.04

PLAN No. | CONTRACT No. | SITE No.

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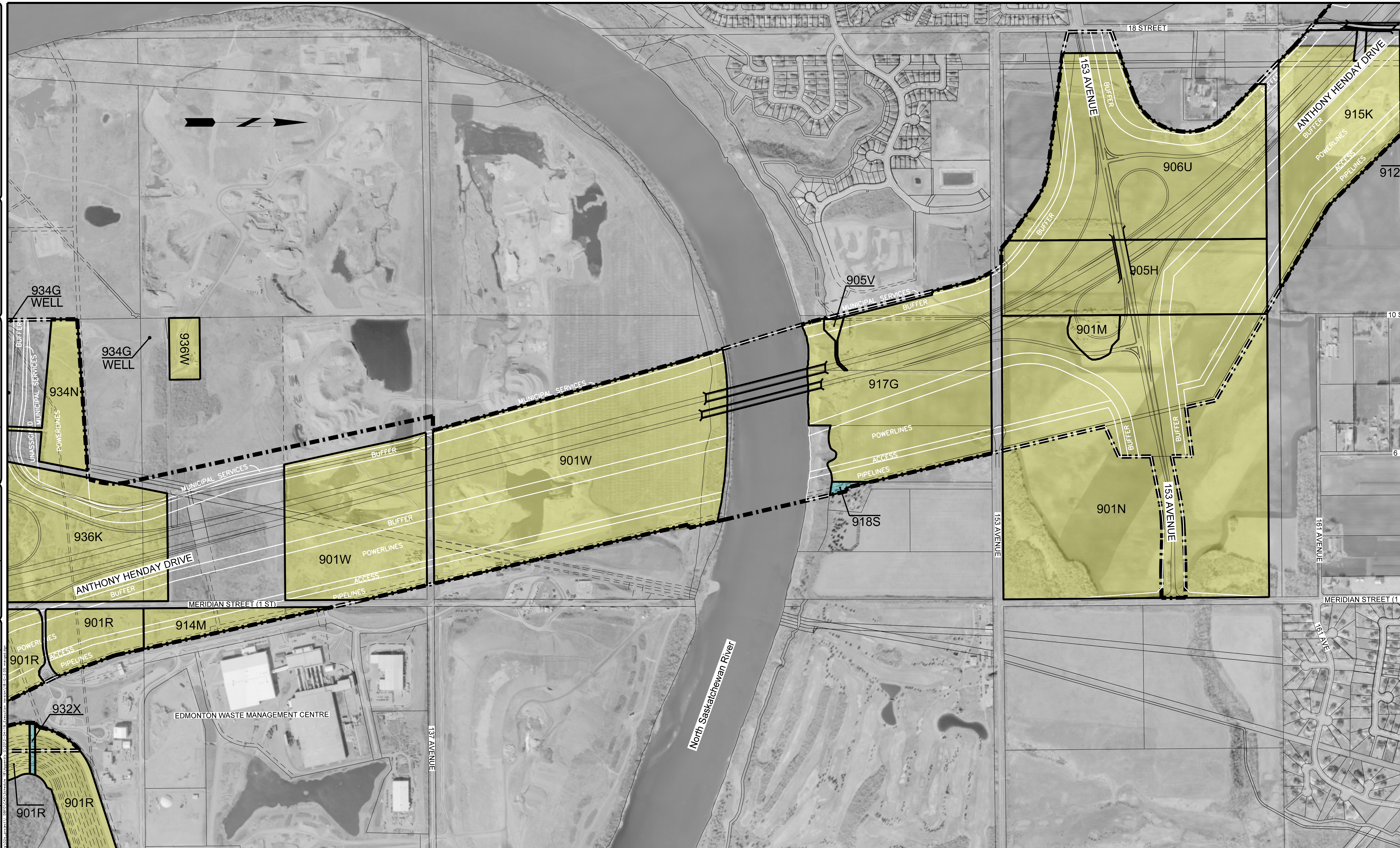

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CONSULTANT

JOB No. 13010 | PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS

NORTH OF 130 AVENUE TO
NORTH OF 153 AVENUE

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-G-2.05	NE ANTHONY HENDAY DRIVE		5 of 7

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS
NORTH OF 130 AVENUE TO
NORTH OF 153 AVENUE

BAR CODE

18-G-2.05

PLAN No. | CONTRACT No. | SITE No.

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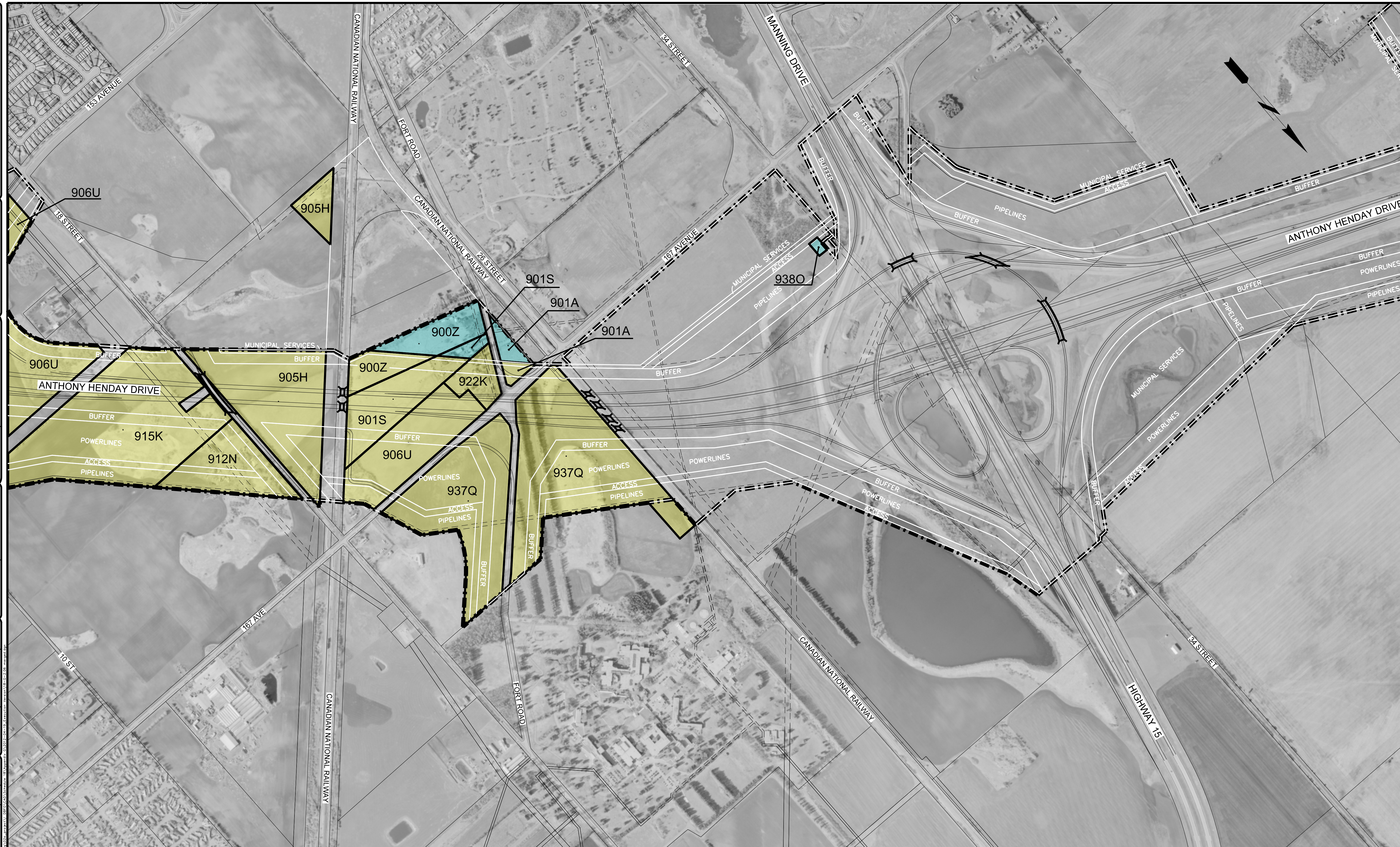


LEGEND:

TO REMAIN (DNT - DO NOT TERMINATE)

TERMINATE

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS

NORTH OF 153 AVENUE TO
WEST OF MANNING DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-G-2.06	NE ANTHONY HENDAY DRIVE		6 of 7

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS
NORTH OF 153 AVENUE TO
WEST OF MANNING DRIVE

BAR CODE

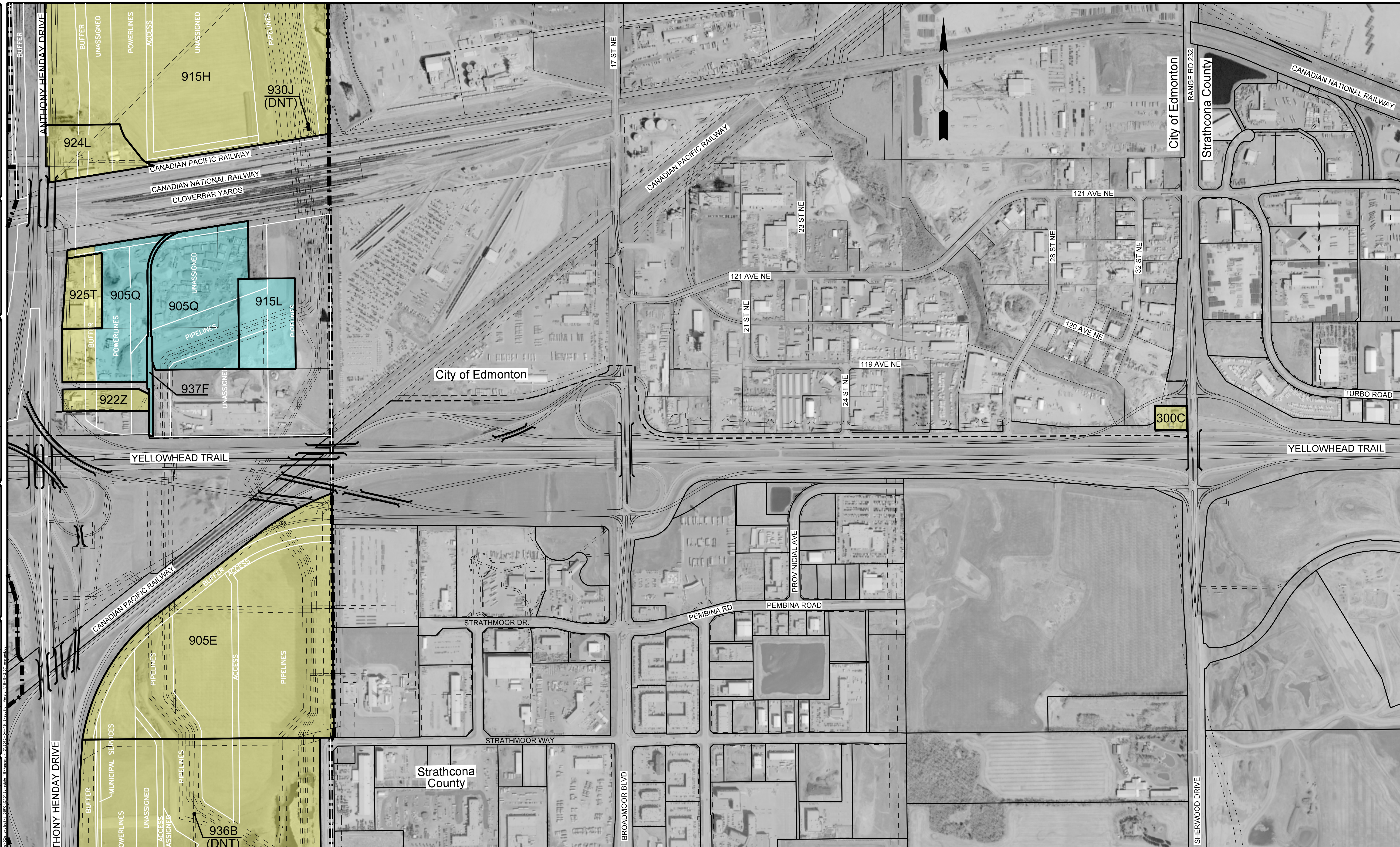
18-G-2.06

PLAN No. | CONTRACT No. | SITE No.

PHOTO No. | TITLE SEARCH DATE | GRAPHICS FILE

DATE | BY | SURVEYED | DESIGNED | CHECKED | DRAWN

No.	REVISION	BY	DATE
0	EXECUTION VERSION		



LEGEND:

- TO REMAIN (DNT - DO NOT TERMINATE)
- TERMINATE

CONSULTANT

JOB No.	13010	PLAN No.

ISL Engineering and Land Services

NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS

ANTHONY HENDAY DRIVE TO
SHERWOOD DRIVE

REGION	SITE No.	PLAN No.	PROJECT	CONTRACT No.	SHEET
NORTH CENTRAL		18-G-2.07	NE ANTHONY HENDAY DRIVE		7 of 7

Government of Alberta
Transportation

SCALE 1:5000
HORIZONTAL

PLAN DESCRIPTION
NORTHEAST ANTHONY HENDAY DRIVE DBFO
SCHEDULE 18, APPENDIX G
ALBERTA INFRASTRUCTURE
LAND LEASE AREAS DRAWINGS
ANTHONY HENDAY DRIVE TO
SHERWOOD DRIVE

BAR CODE

18-G-2.07

PLAN No. CONTRACT No. SITE No.

PHOTO No. TITLE SEARCH DATE GRAPHICS FILE

DATE BY SURVEYED DESIGNED CHECKED DRAWN

DATE BY

No. REVISION

0 EXECUTION VERSION

APPENDIX H -
AUTOMATIC TRAFFIC RECORDER (ATR) SPECIFICATIONS

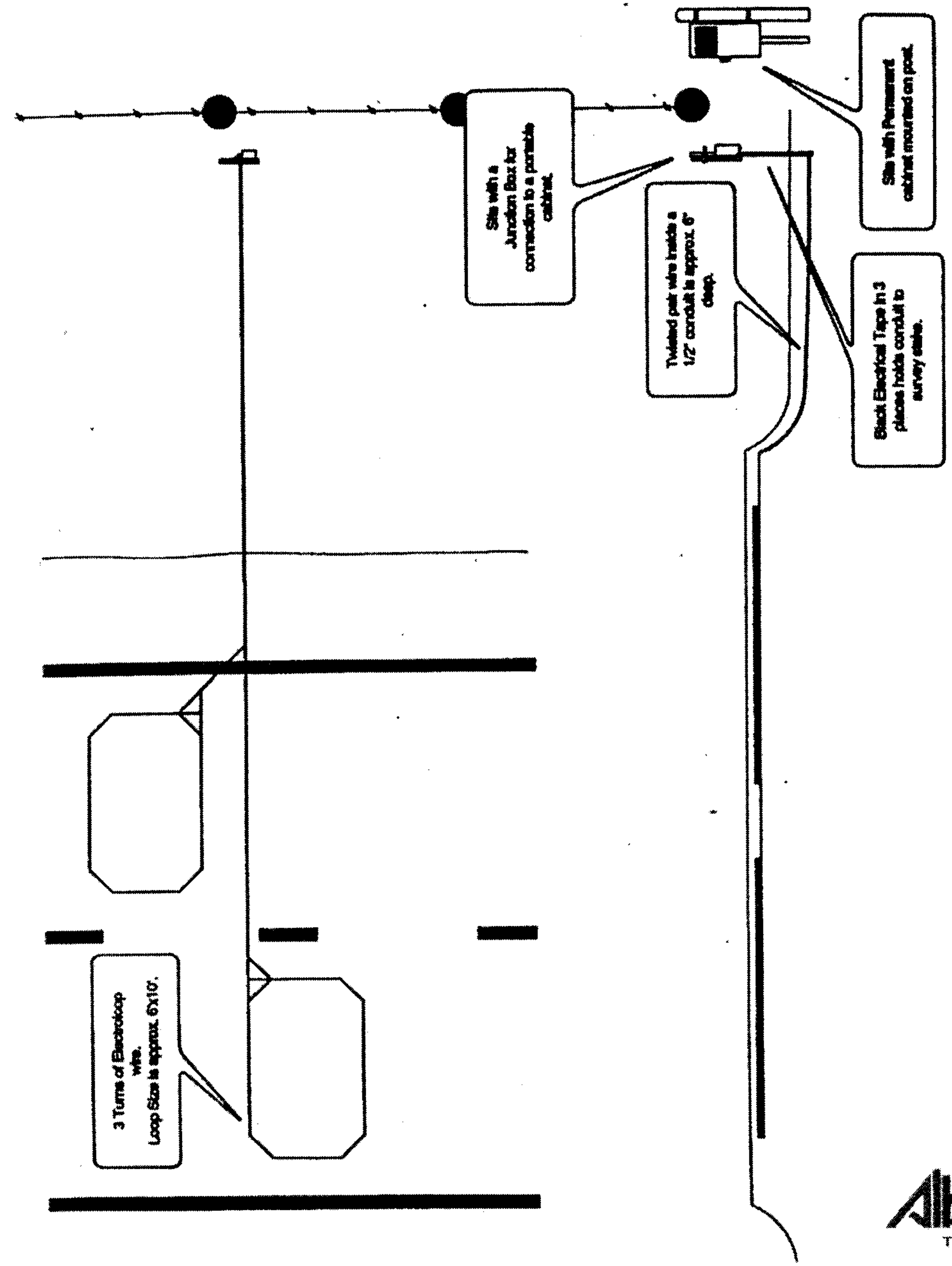
APPENDIX H

DRAWING NUMBER		TITLE
1	LOOP2001 - 1.0	LOOP INSTALLATION SPECIFICATIONS
2	LOOP2001 - 2.0	GENERIC LOOP INSTALLATION
3	LOOP2001 - 2.1	LOOP LAYOUT 2-LANE
4	LOOP2001 - 2.2	LOOP LAYOUT 4-LANE DIVIDED
5	LOOP2001 - 2.3	LOOP LAYOUT 6-LANE DIVIDED
6	LOOP2001 - 3.0	LOOP DETAIL
7	LOOP2001 - 4.0	ATR CABINET
8	LOOP2001 - 4.1	ATR CABINET
9	LOOP2001 - 4.2	ATR CABINET
10	LOOP2001 - 4.3	ATR CABINET
11	LOOP2001 - 4.4	ATR CABINET
12	LOOP2001 - 5.0	ATR BOX
13	LOOP2001 - 5.1	ATR BOX (INSIDE)
14	LOOP2001 - 6.0	BURIED CABLE SIGN
15	LOOP2001 - 6.1	SIGN MOUNTING POST
16	LOOP2001 - 6.2	JUNCTION BOX
17	LOOP2001 - 7.0	LOOP CABLE WIRING
18	LOOP2001 - 7.1	TERMINAL STRIP PIN OUT IN ATR BOX
19	LOOP2001 - 8.0	MODEM CABLE WIRING
20	LOOP2001 - 9.0	VOLTAGE REGULATOR
21	LOOP2001 - 9.1	VOLTAGE REGULATOR
22	LOOP2001 - 9.2	VOLTAGE REGULATOR CONNECTION

The specifications listed are guidelines only
Alberta Transportation assumes no responsibility for the completeness or the accuracy of the specifications contained in this document

Alberta
TRANSPORTATION

LOOP INSTALLATION SPECIFICATIONS		No.	Revision	Date
		1		
		2		
Date: 2001 08 28	Approved By	3		
Drawing Number: LOOP2001 - 1.0		4		



Alberta TRANSPORTATION

GENERIC LOOP INSTALLATION		No.	Revision	Date
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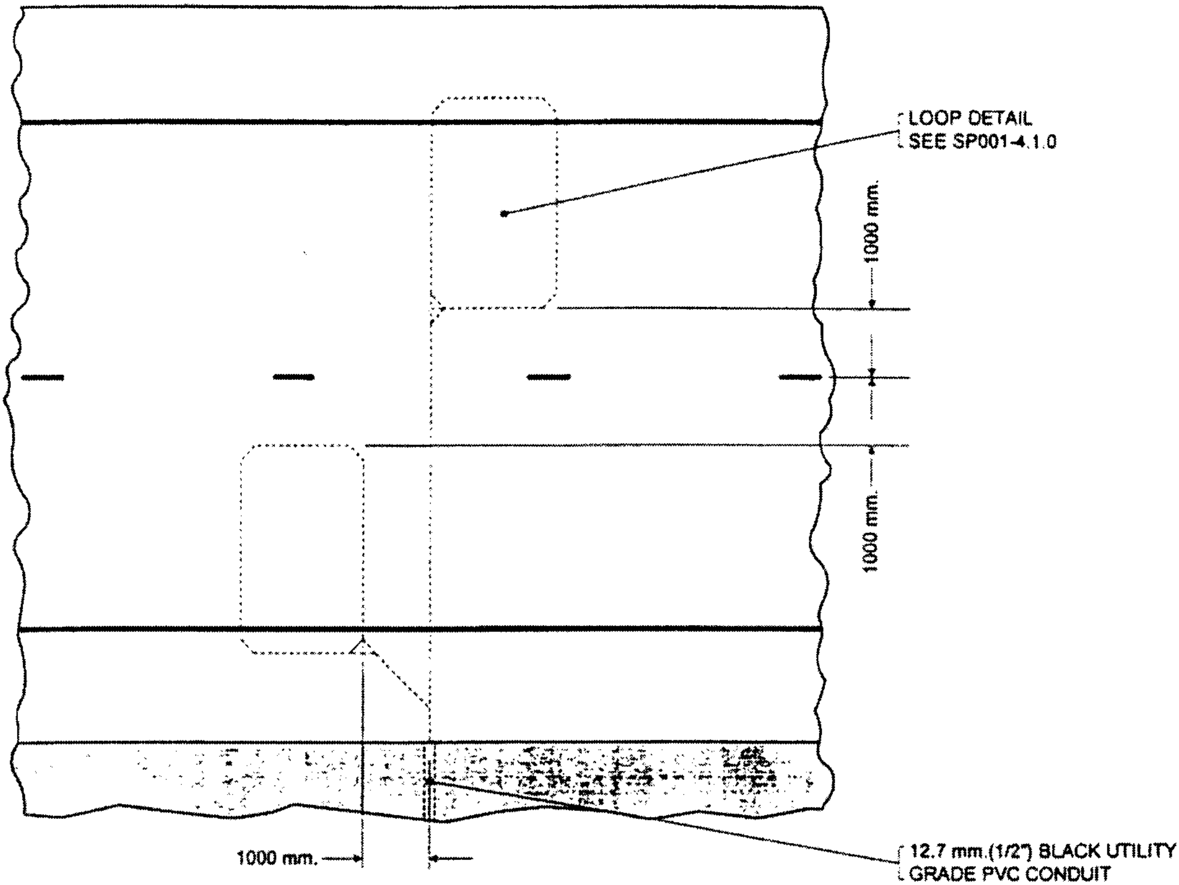
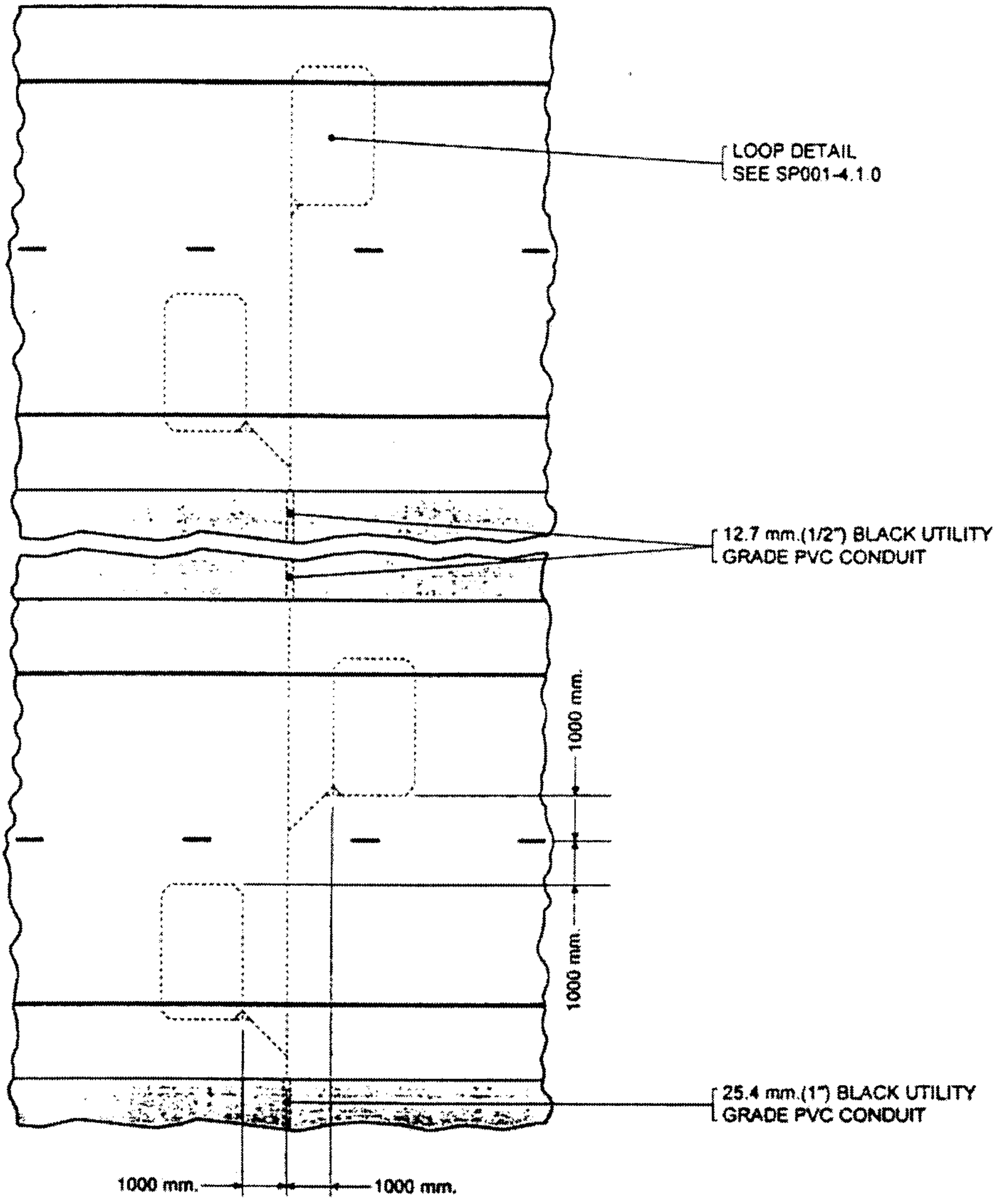
		2		
Date 2001.08.27 Approved By [signature]	Drawing Number LOOP2001 - 2.0	3		
		4		



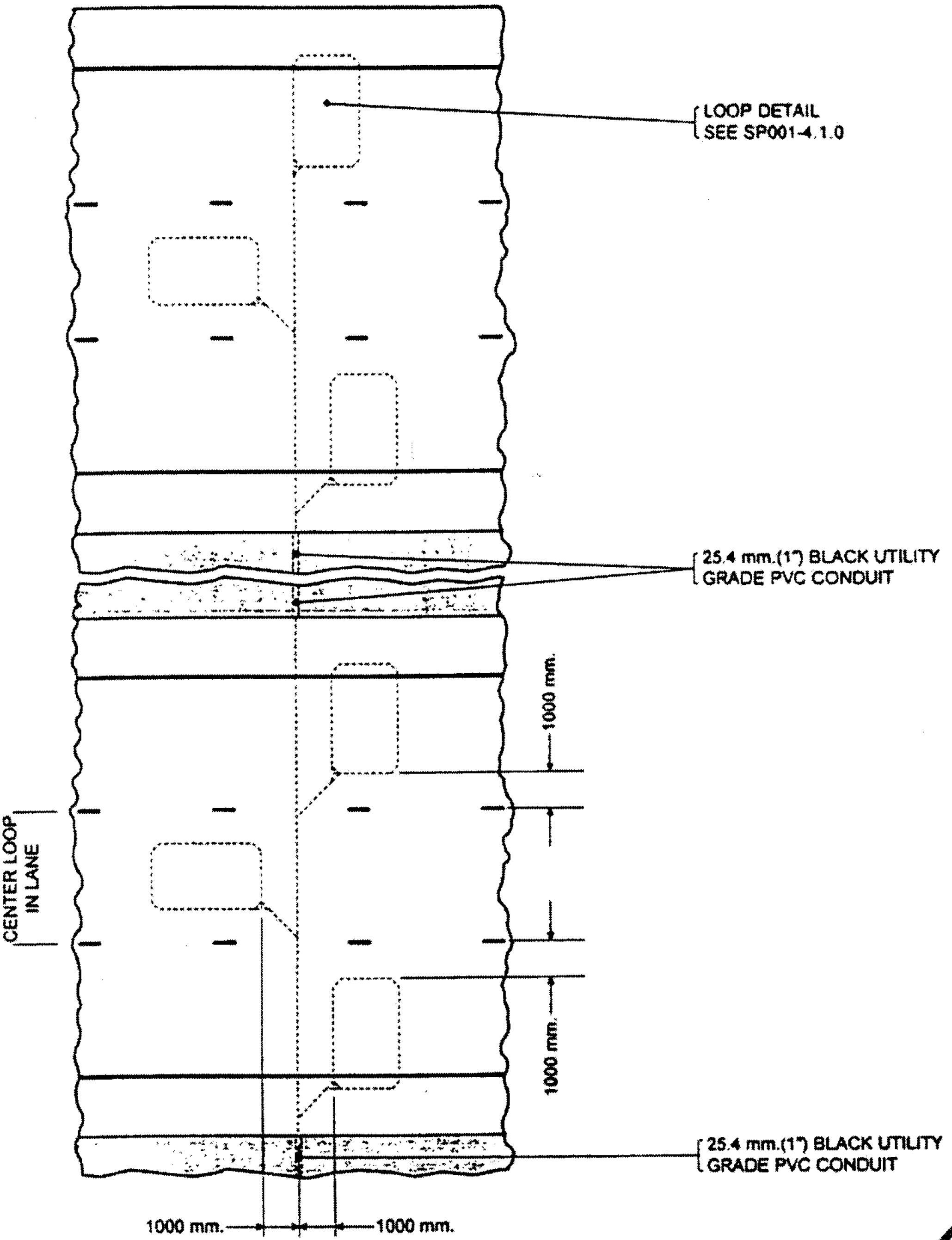
Alberta
TRANSPORTATION

		No.	Revision	Date
LOOP LAYOUT 2-LANE		1		
		2		
Date	Approved By	Drawing Number	3		
2001.08.27	[signature]	LOOP2001 - 2.1	4		



Alberta
TRANSPORTATION

LOOP LAYOUT 4 - LANE DIVIDED		No.	Revision	Date
		1		
		2		
Date / Approved By	Drawing Number	3		
2001 0827 [signature]	LOOP2001 - 2.2	4		



Alberta
TRANSPORTATION

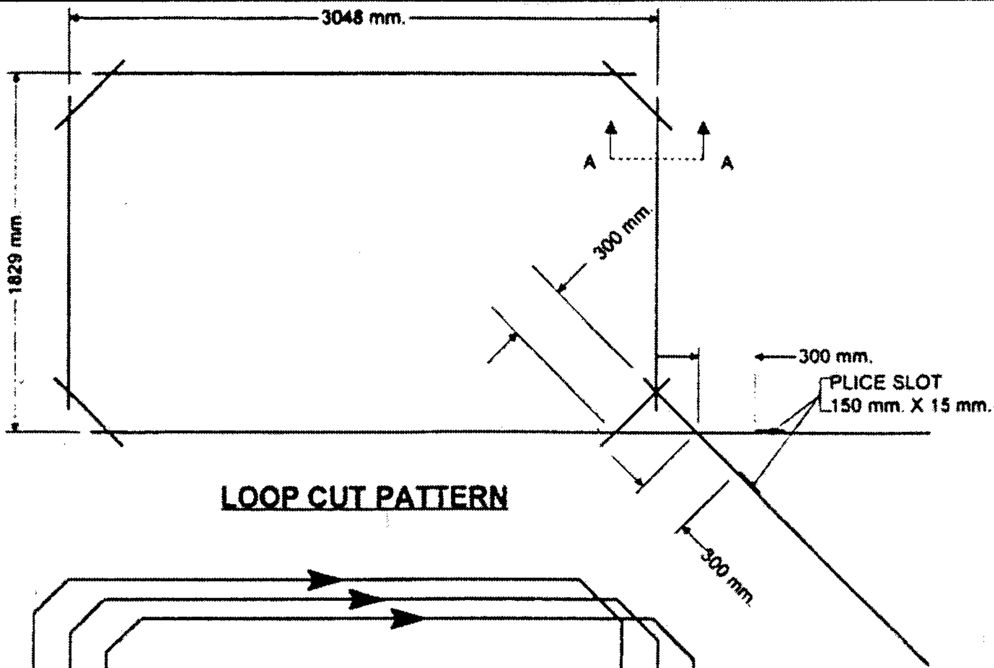
LOOP LAYOUT 6 - LANE DIVIDED

No.	Revision	Date
1		
2		
3		
4		

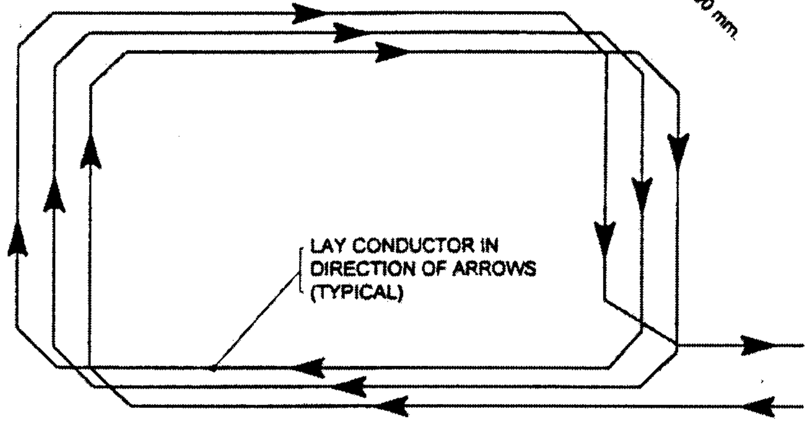
Date: 2001 08 27

Approved By: [signature]

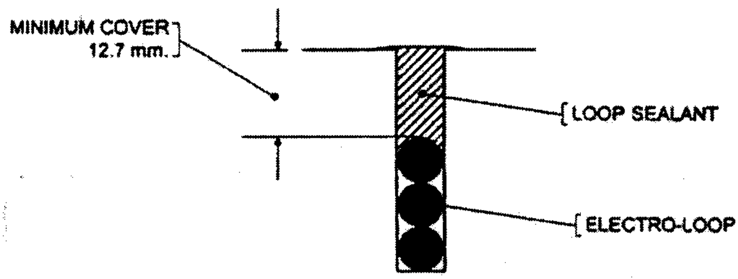
Drawing Number: LOOP2001 - 2.3



LOOP CUT PATTERN



ELECTRO-LOOP LAYOUT

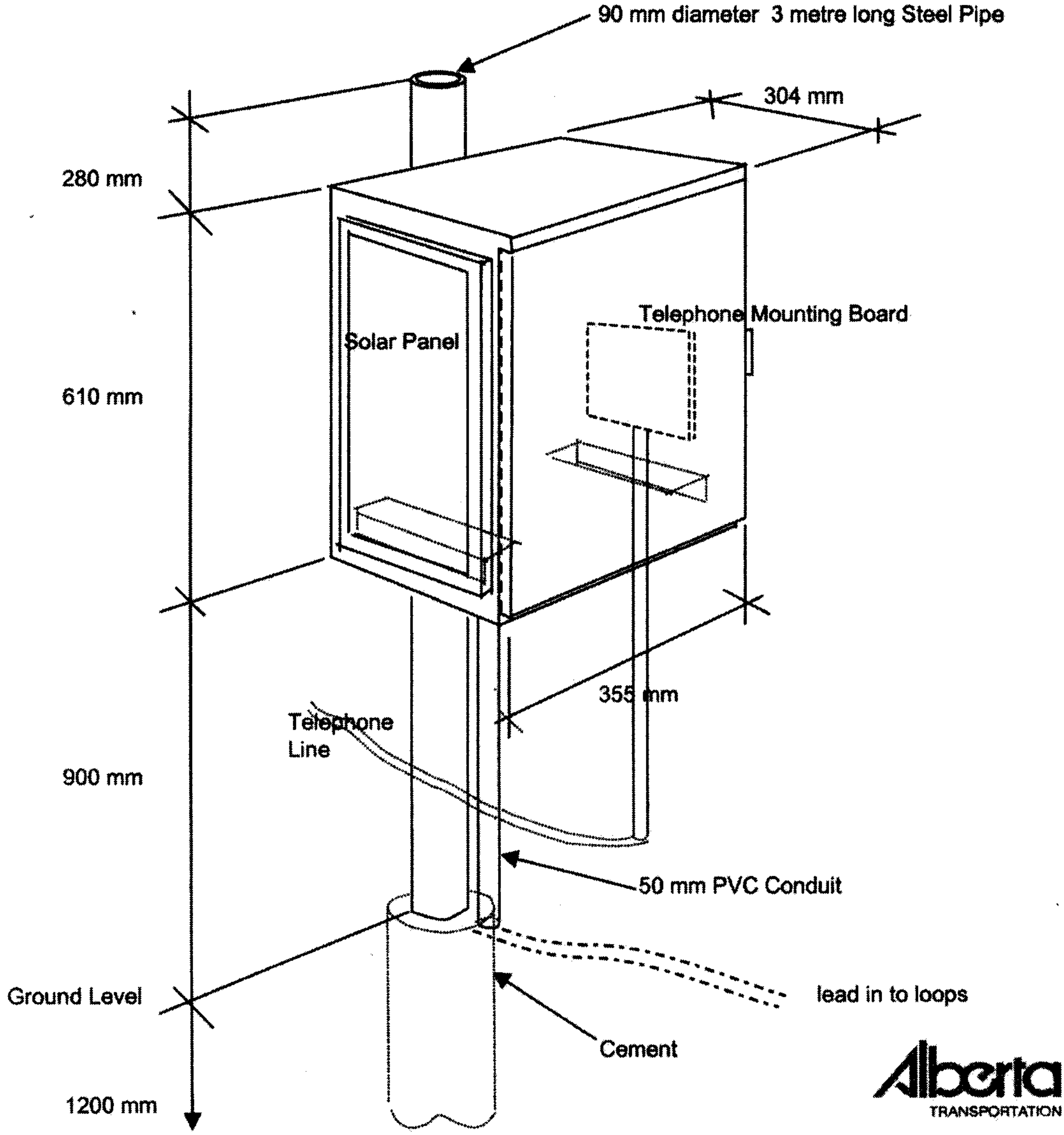


SECTION A-A

Alberta
TRANSPORTATION

		No.	Revision	Date
LOOP DETAIL		1		
		2		
Date 20010827	Drawing Number LOOP2001 - 3.0	3		
Approved By		4		

CABINET DIMENSIONS



ATR CABINET		No.	Revision	Date
		1		
		2		
Date: 2001 08 28	Approved By: [signature]	Drawing Number: LOOP2001 - 4.0	3		
		4		

CABINET DIMENSIONS

BOX	OUTSIDE	360 mm	Wide (Cabinet Opening on this side)
		283 mm	Deep
		616 mm	High
		2 mm	Thick Steel Sheet
BOX	INSIDE	538 mm	High
		300 mm	Wide
		22 mm	Rain Lip
LID		333 mm	Deep
		362 mm	Wide
		25 mm	Rain Lip
DOOR		559 mm	High
		352 mm	Wide
		24 mm	Rain Lip
HINGE PINS		546 mm	Long
		16 mm	Wide Each 1/2 Hinge
			Located on Left Side of Cabinet Opening
LATCH	is located on the right side of the opening		
		279 mm	hole location up from bottom on the rain lip
		10 mm	lock hole diameter (inside)
		305 mm	latch distance from cabinet bottom
BOLTS (2)		152 mm	Distance from top of Cabinet
		152 mm	apart centered on left wall of cabinet
		29 mm	x 6 mm bolts
SHELF SUPPORTS (2)		25 mm	Wide
		25 mm	High
		273 mm	Long
		102 mm	distnce from botttom of cabinet
WEATHER STRIP		19 mm	Wide
		5 mm	Deep

Weather Strip on the door (inside) lines up with the rainlip or opening of cabinet.
All four edges of the door are to be weatherstripped with black foam rubber

Alberta
TRANSPORTATION

ATR CABINET		No.	Revision	Date
		1		
		2		
Date: 20010828 Approved By: [signature]	Drawing Number: LOOP2001 - 4.1	3		
		4		

CABINET DIMENSIONS

SHELF	346 mm	Wide
	257 mm	Deep
	13 mm	Thick Plywood

MOUNTING BOARD	254 mm	Long
	254 mm	Wide
	13 mm	Thick Plywood

Centered holes 38 mm from top of board for two bolts,flat washer and nut

TERMINAL STRIP 16 postion or a 12 + 4 postion

152 mm location from bottom of board

two 229 mm x 19 mm diameter bolts (Robertson Head) per strip

TELEPHONE JACK BOX 51 mm x 57 mm

center mounted 51 mm from bottom of board with adhesive backing or
two 229 mm x 13 mm diameter bolts (Robertson Head)

TELUS MOUNTING BOARD located on bottom right outside of cabinet

254 mm	High
203 mm	Wide
19 mm	Thick Plywood

two 25 mm x 5 mm diameter bolts located 25 mm from each side centered

HOLE FOR LOOP WIRES

64 mm dia. in center of cabinet bottom

TELUS WIRE HOLE 19 mm diameter

Located 64 mm from the back and 127 mm from the right side
13 mm diameter flex coil sheild is used through opening
The flex coil is fastened to the cabinet with a threaded connector
A locking ring is threaded on the inside of the cabinet

SOLAR PANEL MX5 - 6 VOLT located on door or left side 25 mm from top

two 8 mm diameter bolt holes located 235 mm apart and 152 mm from top of cabinet centered
two 25 mm x 8 mm diameter bolt, lock washer, washer, and nut
the bolt heads are located in the channels of the solar panel
6 mm diameter hole for solar panel wire is located 51 mm off centre of bolt holes

Alberta
TRANSPORTATION

ATR CABINET		No.	Revision	Date
		1		
		2		
Date: 2010828 / Approved By: [signature]	Drawing Number: LOOP2001 - 4.2	3		
		4		

CABINET DIMENSIONS

STEEL PIPE	3000 mm High
	90 mm Diameter
	5 mm Thick Steel
MOUNTING	1200 mm In Ground (Cemented in Place)
	1800 mm Above Ground
CABINET LOCATION	900 mm Between Ground and Cabinet
CABINET MOUNTS	64 mm from bottom of cabinet
	152 mm from top of cabinet

two 10 mm diameter "U" bolts, with 4 washers, 4 lock washers and 4 nuts

LOOP WIRES

come up through a 51 mm diameter, 991 mm long rigid PVC conduit
The conduit is fastened to the cabinet with a threaded sleave
which is glued to the end of the PVC conduit and screwed in place
with a locking ring on the inside of the cabinet

WIRING

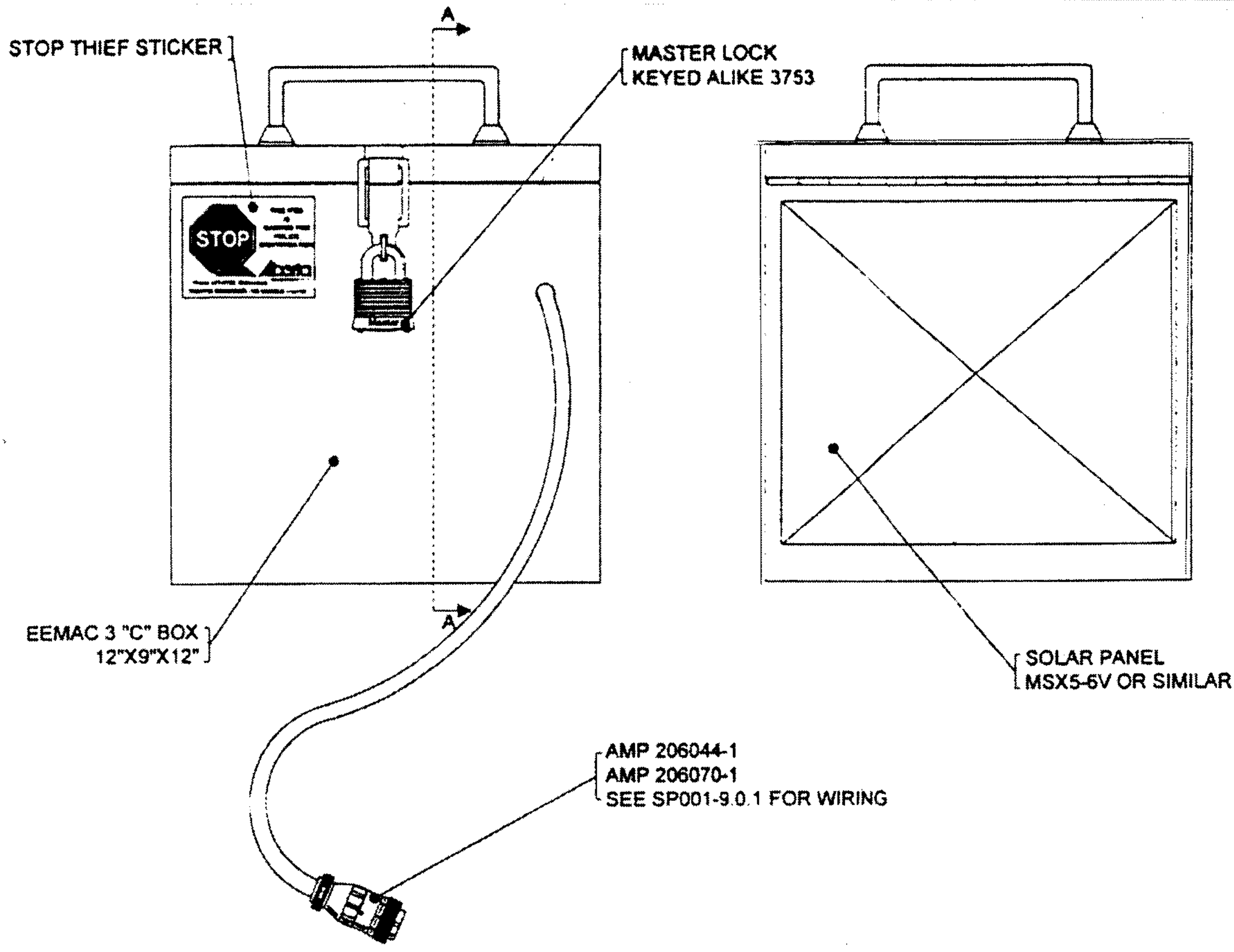
All wires running from the bottom of the cabinet to the mounting board are to be tie wrapped to a tie block in one group of wires to the back of the cabinet behind the shelf.
Tie blocks should be located every 150 mm to 200 mm
This also applies to the solar panel wire.
Excess wire should be kept to a minimum
The exception is loop wire where 900 mm to 1200 mm should be coiled below the shelf.
The wire running from the telephone jack should be 100 mm long and be 4 condutor telephone wire. The excess should be left outside the cabinet
The excess should be left outside the cabinet fro TELUS to connect to.
All wires that mount to the terminal strip will have
8 mm terminal ends which are crimped and soldered

Alberta
TRANSPORTATION

ATR CABINET		No.	Revision	Date
		1		
		2		
Date: 20010828	Approved By: [signature]	Drawing Number: LOOP2001 - 4.3	3		
		4		

Alberta
TRANSPORTATION

	No.	Revision	Date
ATR CABINET	1	[signature]	2004.10.19
	2		
Date: 20010828 Approved By: [signature] — Drawing Number: LOOP2001 -4.4	3		
	4		



BACK VIEW

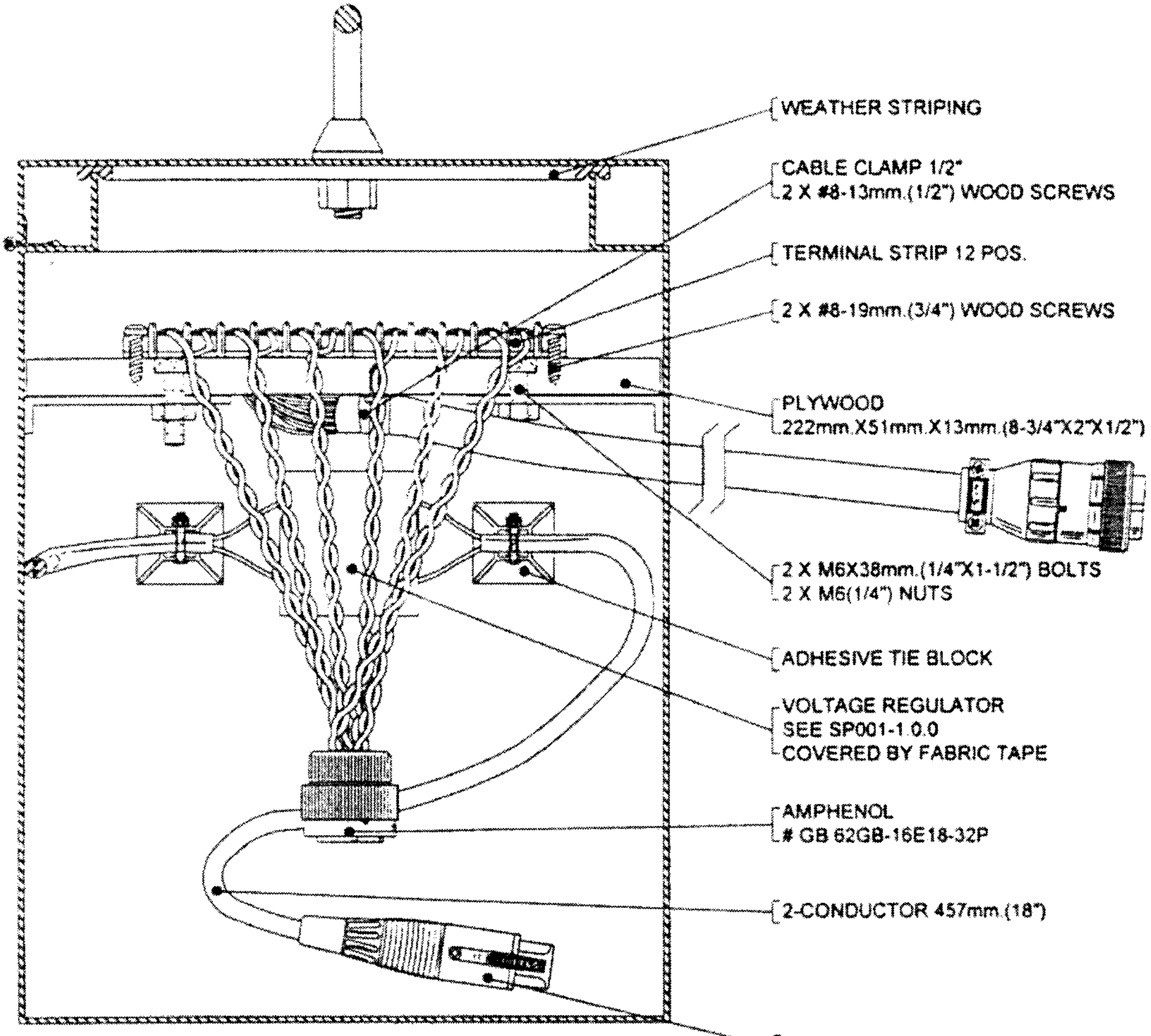
FRONT VIEW

Notes:

1. SECTION A-A, SEE SP001-6.0.1

Alberta
TRANSPORTATION

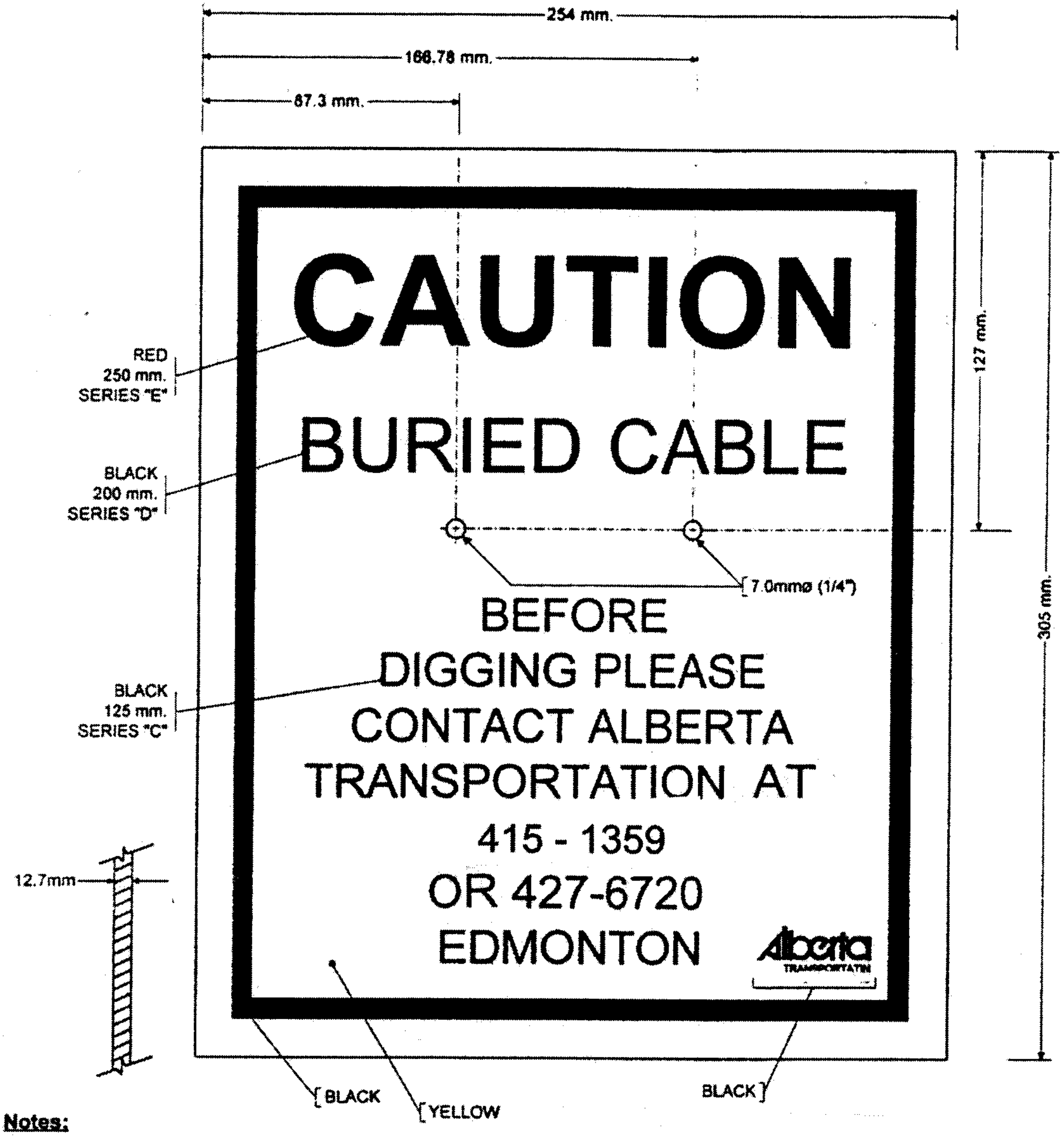
ATR BOX		No.	Revision	Date
		1		
		2		
Date 20010827	Approved By	Drawing Number LOOP2001 - 5.0	3	
			4	



SECTION A-A

Alberta
TRANSPORTATION

ATR BOX (INSIDE)		No.	Revision	Date
		1		
		2		
Date: 2001.08.27 Approved By: [signature]	Drawing Number: LOOP2001 - 5.1	3		
		4		

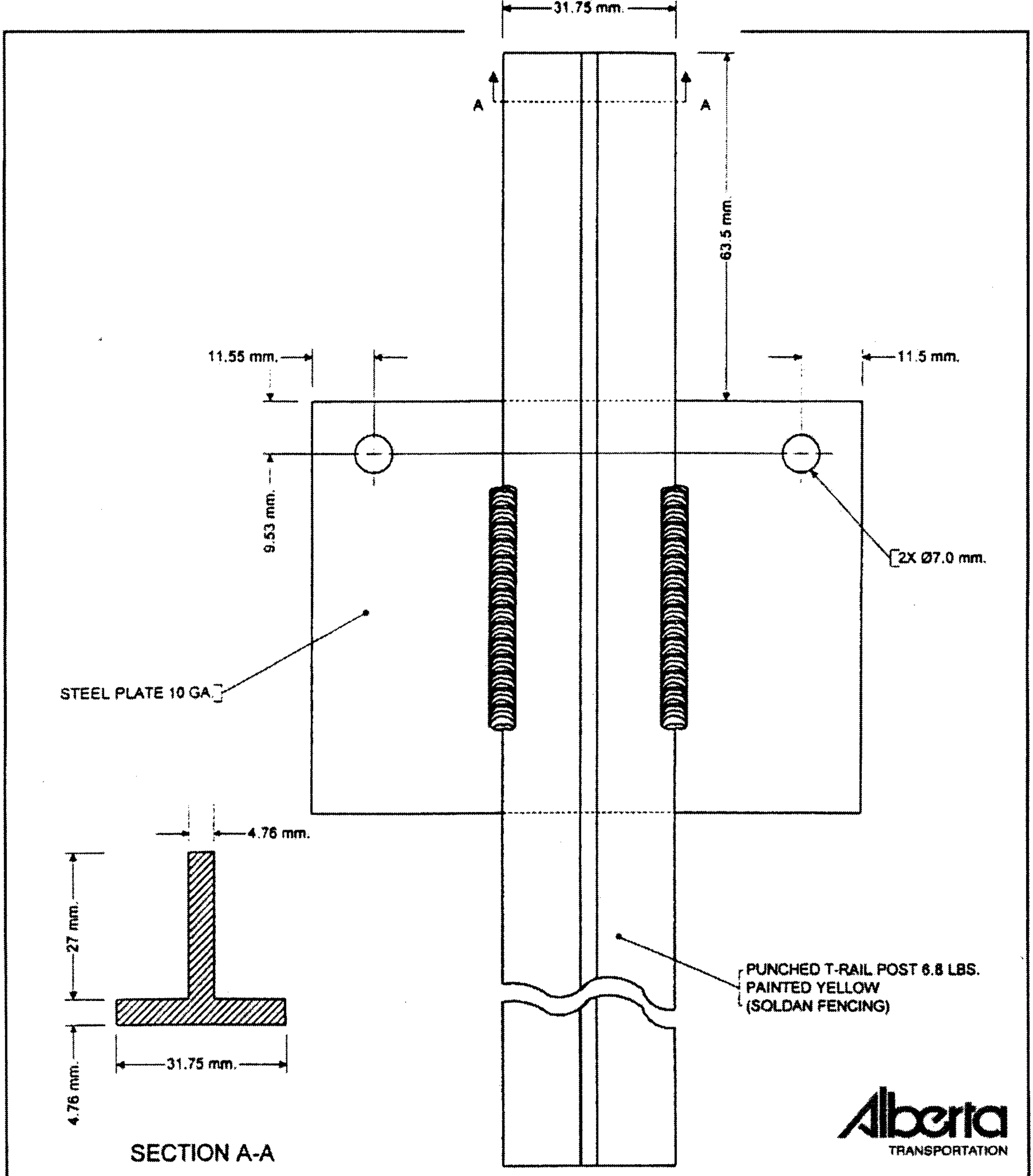


Notes:

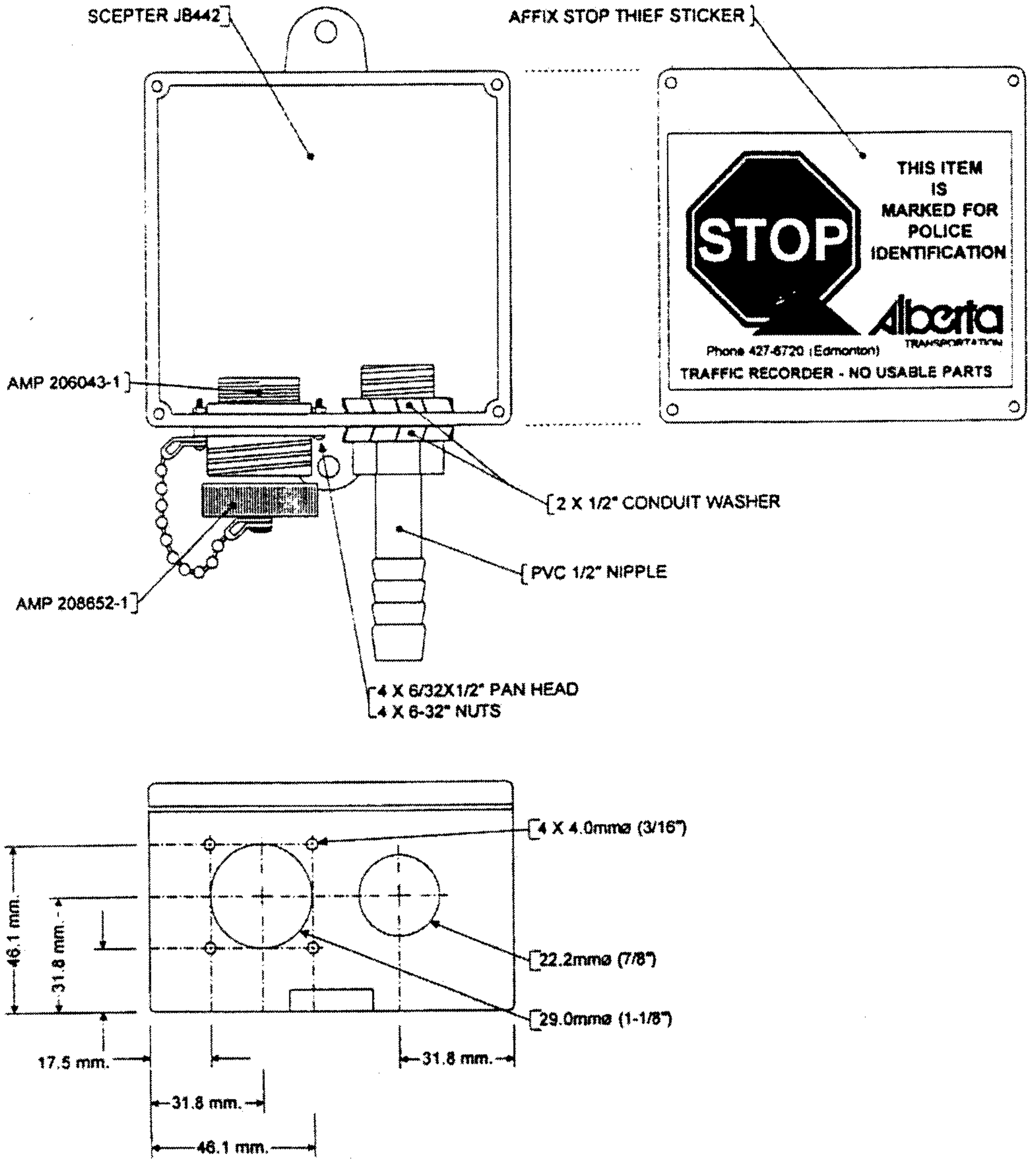
1. ALL WRITING IN BLACK UNLESS OTHERWISE NOTED.

Alberta
TRANSPORTATION

BURIED CABLE SIGN		No.	Revision	Date
		1		
		2		
Date: 2001.08.27	Approved By	Drawing Number: LOOP2001 - 6.0	3		
		4		

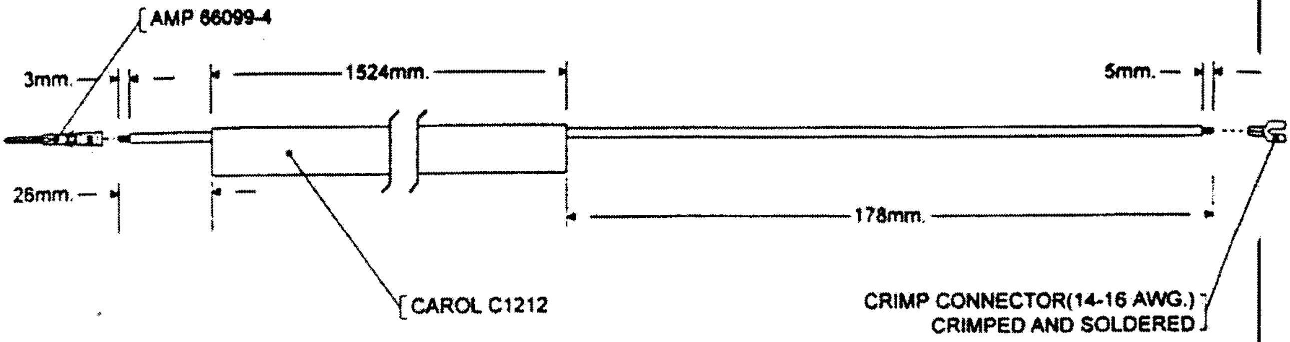


SIGN MOUNTING POST		No.	Revision	Date
		1		
		2		
Date 2001,08,27 / Approved By	Drawing Number LOOP2001 - 6.1	3		
		4		

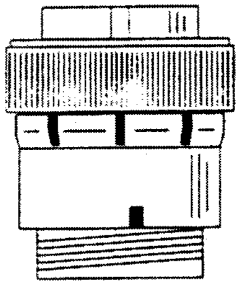


Alberta
TRANSPORTATION

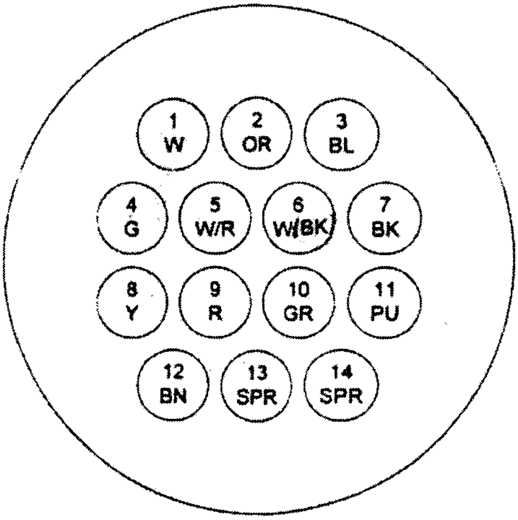
JUNCTION BOX (4x4x2)			No.	Revision	Date
			1		
			2		
Date	Approved By	Drawing Number	3		
2001.08.27		LOOP2001 - 6.2	4		



AMP 206044-1



AMP 206044-1
REAR VIEW



Color Table	
G	- Green
R	- Red
W	- White
Y	- Yellow
BK	- Black
BL	- Blue
BN	- Brown
GR	- Grey
PU	- Purple
OR	- Orange

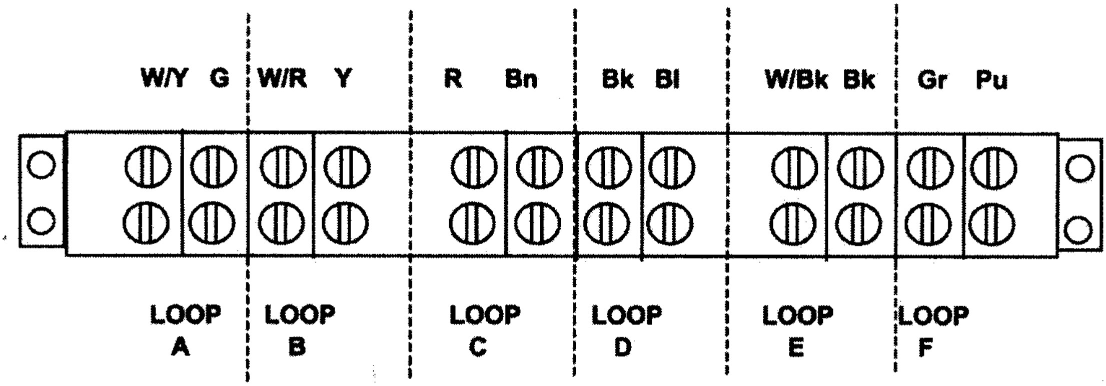
INPUT	PIN #
A	1,4
B	5,8
C	9,12
D	2,3
E	6,7
F	10,11

Alberta
TRANSPORTATION

No.	Revision	Date
1		
2		
3		
4		

LOOP CABLE WIRING

Date	Approved By	Drawing Number
2001.08.27	[signature]	LOOP2001 - 7.0



COLOUR TABLE	
G	Green
R	Red
W	White
Y	Yellow
Bk	Black
Bl	Blue
Bn	Brown
Gr	Grey
Pu	Purple
Or	Orange

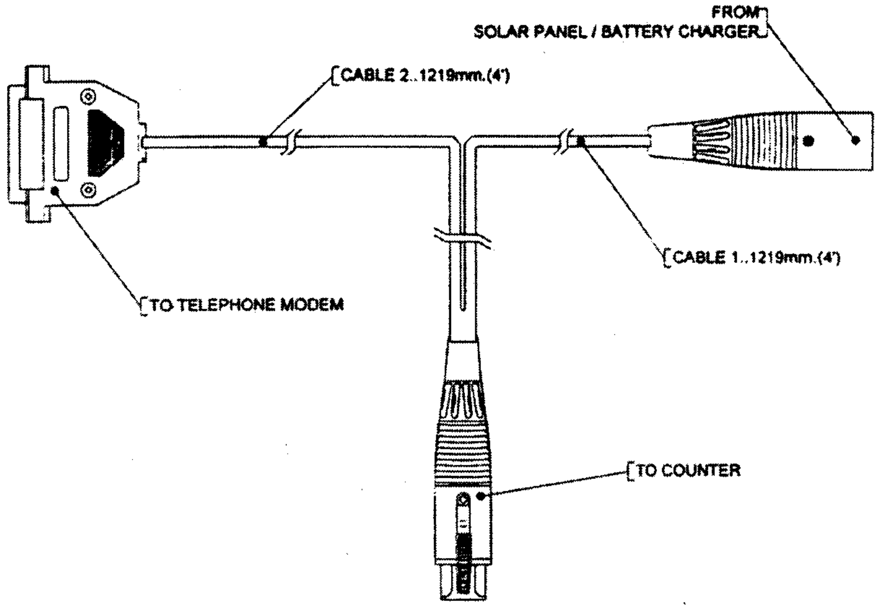
The wires that go to the Golden River ATR need to be on the side of the terminal strip closest to the ATR. The pin out stays the same.

Alberta
TRANSPORTATION

TERMINAL STRIP PINOUT IN ATR BOX

Date	Approved By	Drawing Number
2001 0827		LOOP2001 - 7.1

No.	Revision	Date
1		
2		
3		
4		



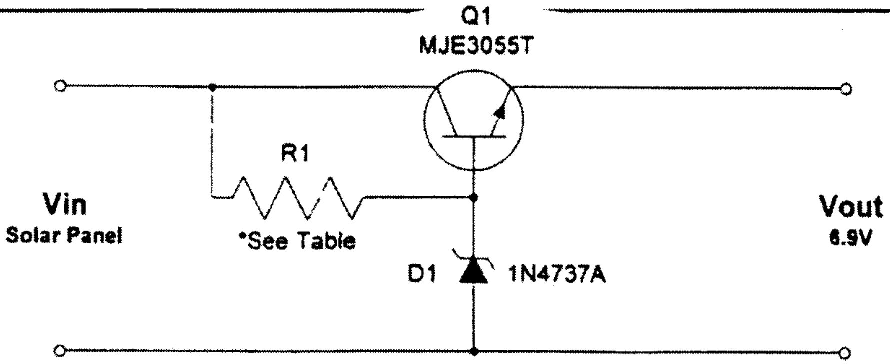
CABLE 2		CABLE 1
MODEM 25-Pin (Female)	**COUNTER** 5-Pin XLR (Female)	**CHARGER** (6-Volt) 5-Pin XLR (Male)
1,7 - Green 2 - Black 3 - White 4,20 - Red	1 - Red② 2 - White② 3 - White①/Green② 4 - Black② 5 - Black①/Red②	1,2,4 - N.C. 3 - White ⊖ 4 - Black ⊕
1,7 - Green 2 - Blue 3 - Yellow 4,20 - Red	1 - Red② 2 - Yellow② 3 - White①/Green② 4 - Blue② 5 - Black /Red②	1,2,4 - N.C. 3 - White ⊖ 5 - Black ⊕

Notes:

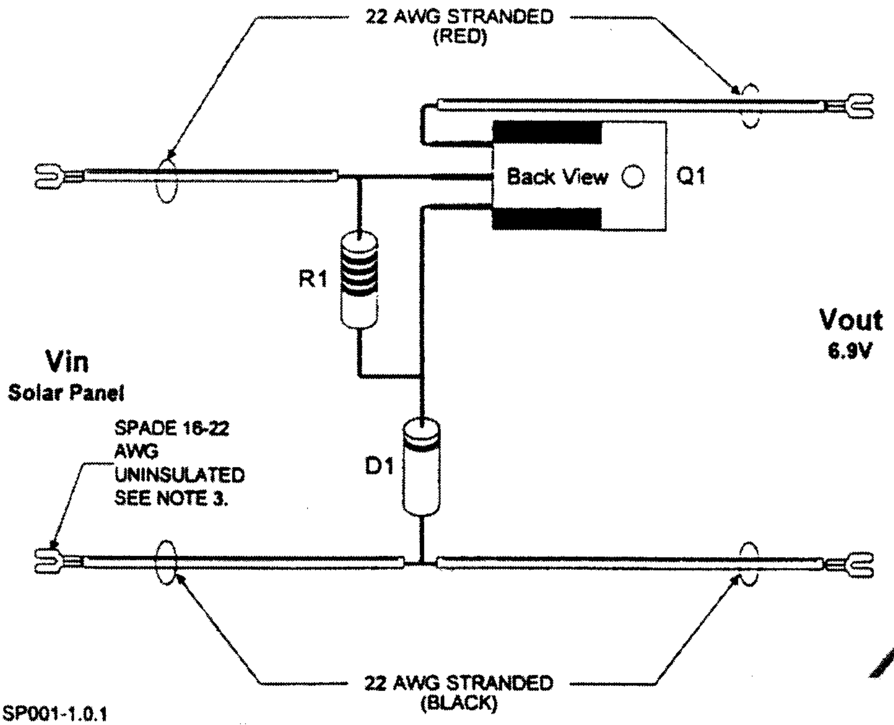
1. ① - INDICATES FROM CABLE 1.
2. ② - INDICATES FROM CABLE 2.

Alberta
TRANSPORTATION

MODEM CABLE WIRING		No.	Revision	Date
		1		
		2		
Date: 2001 08 27 / Approved By: [signature]	Drawing Number: LOOP2001 - 8.0	3		
		4		



*Resistor(R1) Selection	
Panel Voltage	**R1**
6V	120 Ohm,1/2W
12V	560 Ohm, 1/2W



Notes:

REFER TO SP001-1.0.1

Alberta TRANSPORTATION

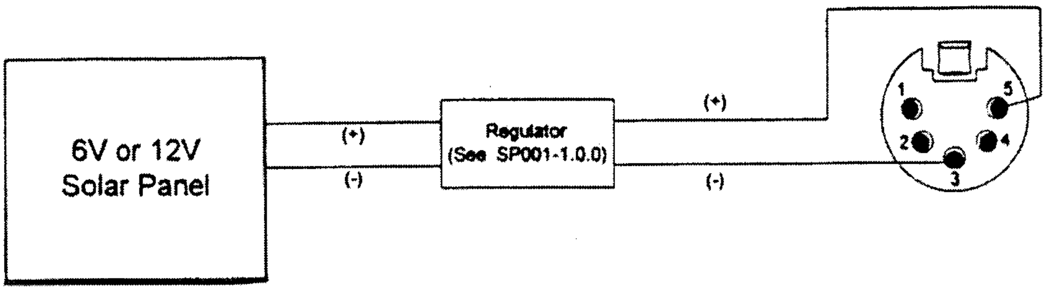
VOLTAGE REGULATOR		No.	Revision	Date
		1		
		2		
Date: 2001 0827	Approved By	Drawing Number: LOOP2001 - 9.0	3		
		4		

Notes:

1. ALL CONNECTIONS TO BE SOLDERED.
2. REGULATOR SHALL BE SPRAYED WITH LACQUER TO PREVENT SHORTING AND CORROSION.
3. SPADES TO BE CRIMPED AND SOLDERED WHERE CALLED FOR IN APPLICATION, OTHERWISE CONNECTIONS TO BE SOLDERED AND PROTECTED WITH SHRINK TUBING.
4. RED AND BLACK WIRES TO BE CUT TO SUITABLE LENGTH.

Alberta
TRANSPORTATION

VOLTAGE REGULATOR			No.	Revision	Date
			1		
			2		
Date	Approved By	Drawing Number	3		
2001_08.27	[signature]	LOOP2001 - 9.1	4		



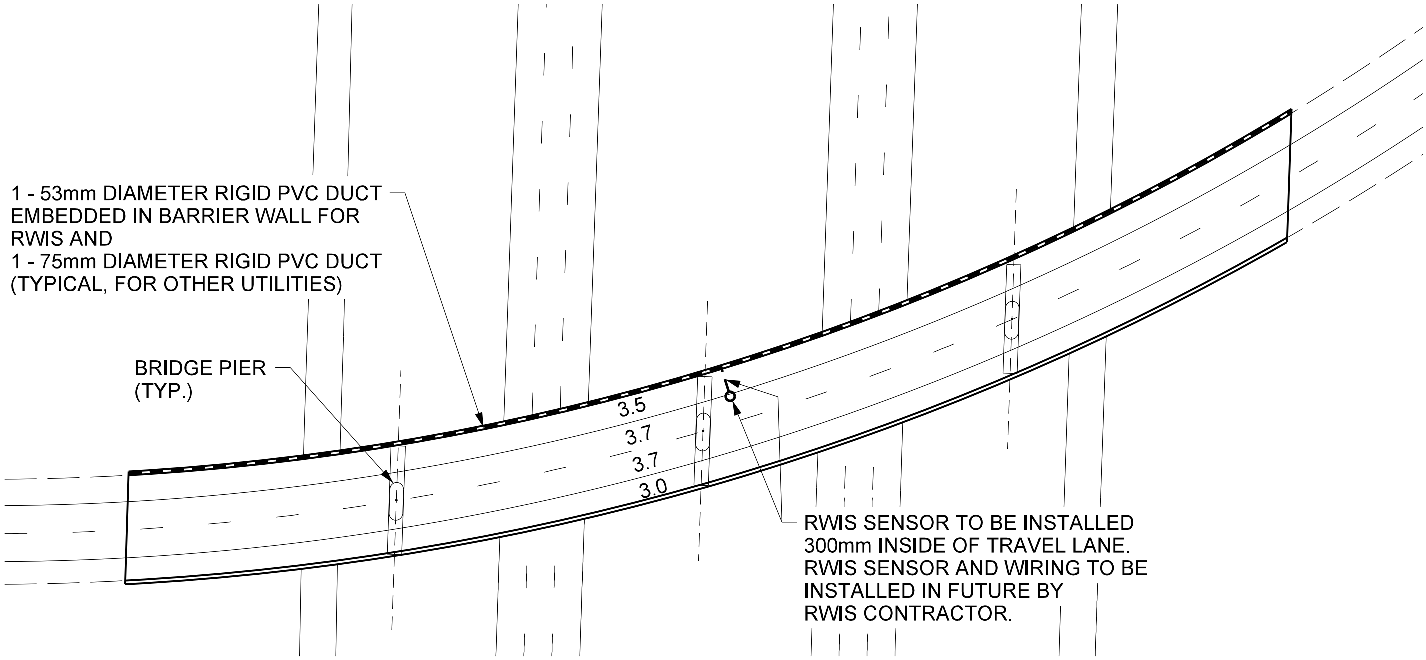
Alberta
TRANSPORTATION

VOLTAGE REGULATOR CONNECTION

No.	Revision	Date
1		
2		
3		
4		

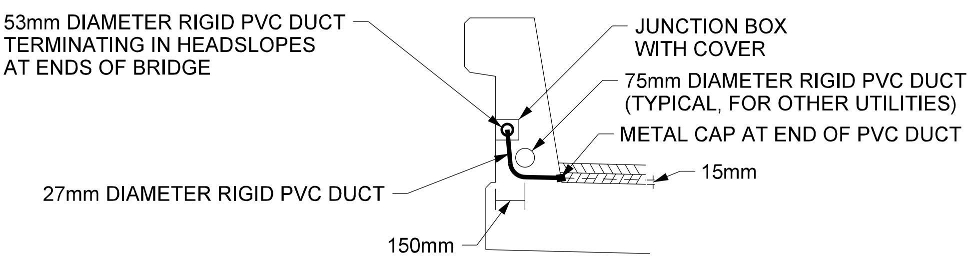
Date	Approved By	Drawing Number
2001.08.27		LOOP2001 - 9.2

APPENDIX I - ROAD WEATHER INFORMATION SYSTEM - Drawing 18-I-01



NOTE: THE RWIS SENSOR IS TO BE LOCATED AT MIDSPAN
(ON ONE SPAN ONLY FOR MULTISPAN BRIDGES)

PLAN (TYPICAL)



SECTION

N.T.S.

NOTE:
- FISH WIRE TO BE INSTALLED IN EACH DUCT FOR PURPOSE OF PULLING RWIS ELECTRONIC CABLE.
- THE CONTRACTOR SHALL COMPLETE GRADING AND LANDSCAPING TO ENABLE THE INSTALLATION OF THE RWIS TOWER STRUCTURE.
- THE CONTRACTOR SHALL PROVIDE POWER FOR THE RWIS EQUIPMENT FROM THE POWER SOURCE. USED FOR THE INTERCHANGE LIGHTING.
- DIMENSIONS ARE IN METERS UNLESS SHOWN OTHERWISE.

ISL Engineering and Land Services

Government of Alberta

Project: Northeast Anthony Henday Drive

Title: RWIS DUCTING FOR PBD BRIDGES SCHEDULE 18 - APPENDIX I

Figure No. 18-I-01

Date

APPENDIX J - TRAFFIC MODELING AND TRAFFIC SIGNAL GUIDELINES Packages A - I

A. Guidelines for DBFO Synchro/SimTraffic Modeling – for Service Interchanges

Detailed configurations of service interchanges and at signalized intersections were determined and confirmed by traffic simulation using the Synchro/SimTraffic Studio 7 suite of programs. **Synchro** is used to establish basic model programming of the Synchro/SimTraffic model, as well as provide preliminary assessment of signal split timing and the effectiveness of the lane configuration in accommodating traffic demands. **SimTraffic** is used to provide simulation statistics in the assessment of interchange performance. The measures of effectiveness used in interchange operation analysis are SimTraffic output parameters. **Synchro / Sim Traffic files** for the service interchanges below were included in **Package B in Appendix J**:

Interchange Location (I/C No)	Ultimate Stage Models (to handle 2.5M model volumes)	Stage 1 Models (to handle 30 Year volumes – 1.6M model)
01 – 153 Ave & AHD	ULT	-
02 – 130 Ave & AHD	ULT	STG1
04 – Baseline Rd & AHD	ULT	STG1
07 – Sherwood Pk Fwy & 17 St	ULT	-
08 – YHT & Broadmoor Blvd	ULT	STG1
09 – YHT & Sherwood Dr	ULT	-

A.1 Criteria for Failed Interchange Operations

Criteria for failed interchange operations for the DBFO project are:

1) Excessive queue in turn bay spilling out of bay and blocking adjacent through lane
2) Excessive queue in through lane blocking turn bay
3) Successive cycle failure (vehicles need to wait for multiple signal cycles to clear an intersection)
4) Substantial consecutive stops (undesirable traffic progression performance)

A.2 Synchro / SimTraffic Models

Synchro / SimTraffic models were created to demonstrate that the recommended interchange configurations would satisfy the following requirements:

1) Storage Requirement – to accommodate maximum queue of turning traffic so that the queues in the turn bay will not spill out of the turn bay and block the through traffic movement
2) Blocking Prevention Requirement – to prevent blockage of access to turn bay by queue of through traffic
3) In addition, the minimum deceleration requirement was also checked for compliance for the turn bay design at interchange ramp intersections.

The following Synchro/SimTraffic Files were prepared:

a) Stage 1 - AM Peak Hour Model (Synchro/SimTraffic models named STG1)
b) Stage 1 - PM Peak Hour Model (Synchro/SimTraffic models named STG1)
c) Ultimate Stage - AM Peak Hour Model (Synchro/SimTraffic models named ULT or ULT-DE)
d) Ultimate Stage - PM Peak Hour Model (Synchro/SimTraffic models named ULT or ULT-DE)

A.3 Determination of Crossroad Turn Bay Dimensions at Service Interchanges

The **required turn bay length** shall satisfy all three requirements below:

1) Deceleration Requirement – based on the specified Design Speed of the crossroad
2) Storage Requirement – to accommodate maximum queue of turning traffic
3) Blocking Pavement Requirement – to prevent blockage of access to turn bay by queue of through traffic

Notes:

a) The **length of a turn bay** is to be measured from the start of bay taper to the stop line at the end of the turn bay.
b) In determining the **storage requirements of a turn bay**, the portion of the taper where the turn bay lane width is narrower than 3.0m will be considered unusable for vehicle storage. This initial unusable portion of the bay taper, therefore, shall not be included as the available storage distance calculation. For the purposes of this project, the lengths of the unavailable portion of the bay taper for storage are as follows:

Length of unusable bay taper:

(i) Design Speed of 60 km/h – 50m for single lane turn lane & 70m for double lane turn lanes
(ii) Design Speed of 70 km/h – 60m for single lane turn lane & 80m for double lane turn lanes
(iii) Design Speed of 80 km/h – 70m for single lane turn lane & 90m for double lane turn lanes

Accordingly, the **turn bay length provided** shall therefore meet the following criteria in **Table 1**:

Table 1 – Criteria for Determination of Turn Bay Lengths at Crossroad Ramp Intersections

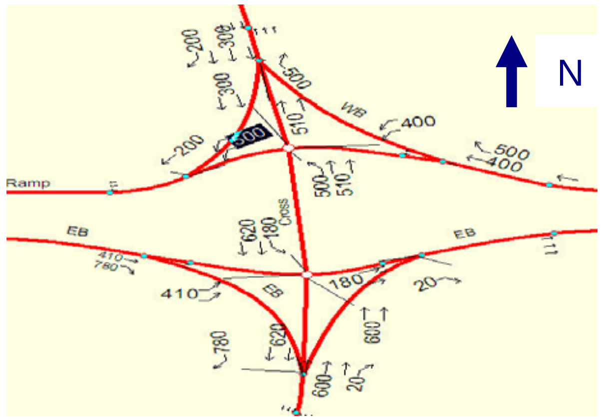
Crossroad Design Speed	Required Turn Bay Length (Use the largest value of the following 3 criteria to design for the turn bay) (measured from start of bay taper to stopline at the end of turn bay)				
	Criteria # 1 - Deceleration Requirement	Criteria # 2 - Storage Requirement (turn bay length)		Criteria # 3 - Blocking Prevention Requirement	
		Single-Lane Turn Lane	Double-Lane Turn Lane	Single-Lane Turn Lane	Double-Lane Turn Lane
60 km/h	90 m	SimTraffic Maximum Queue in turn bay + 50m	SimTraffic Maximum Queue in turn bay + 70m	SimTraffic Maximum Queue in through lane + 50m	SimTraffic Maximum Queue in through lane + 70m
70 km/h	110 m	SimTraffic Maximum Queue in turn bay + 60m	SimTraffic Maximum Queue in turn bay + 80m	SimTraffic Maximum Queue in through lane + 60m	SimTraffic Maximum Queue in through lane + 80m
80 km/h	130 m	SimTraffic Maximum Queue in turn bay + 70m	SimTraffic Maximum Queue in turn bay + 90m	SimTraffic Maximum Queue in through lane + 70m	SimTraffic Maximum Queue in through lane + 90m

A.3.1 Example - Diamond Interchange on North / South Crossroad (with 70 km/h Design Speed)

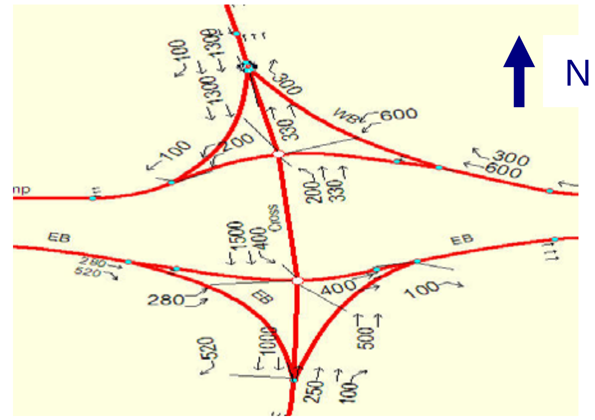
A.3.1.1 Lane Configurations and Peak Hour Volumes

(Note: The ramp intersection spacing is assumed to be 240m)

AM Peak Hour

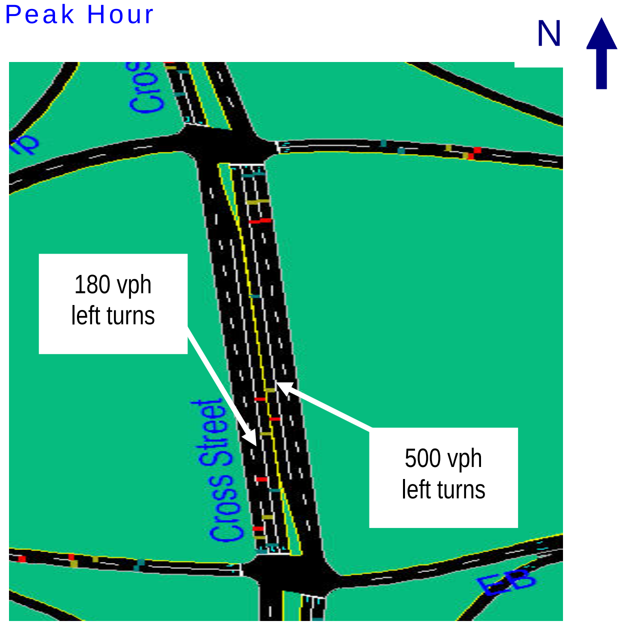


PM Peak Hour

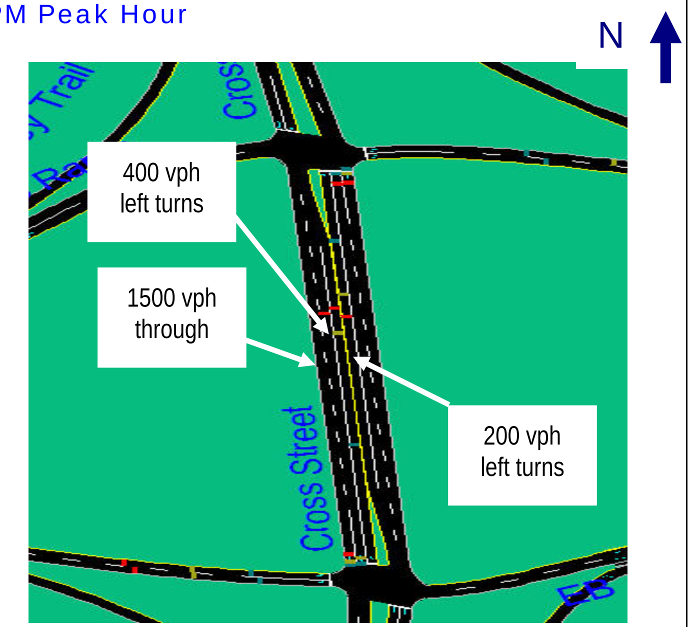


A.3.1.2 SimTraffic Maximum Queue Plot

AM Peak Hour



PM Peak Hour



Observations:

a) The northbound left turns are more critical during the AM peak hour.
b) The southbound left turns are more critical during the PM peak hour.
c) Queues for southbound through traffic are also long in the PM peak hour.

A.3.1.3 SimTraffic Queuing and Blocking Report

AM Peak Hour (Critical Intersection: North Intersection – Node 3)

Intersection: 3: WB Ramp & Cross Street

Movement	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	L	L	T	T	T	T
Maximum Queue (m)	64.0	65.4	146.7	34.0	33.3	55.5	37.3
Average Queue (m)	41.2	35.3	76.5	7.2	6.7	30.2	18.0
95th Queue (m)	62.0	55.9	130.3	22.8	22.0	46.4	33.3
Link Distance (m)	110.2	110.2		222.2	222.2	111.5	111.5
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)			180.0				
Storage Blk Time (%)							
Queuing Penalty (veh)							

PM Peak Hour (Critical Intersection: South Intersection – Node 6)

Intersection: 6: EB Ramp & Cross Street

Movement	EB	EB	NB	NB	SB	SB	SB
Directions Served	L	L	T	T	L	T	T
Maximum Queue (m)	70.7	66.5	59.9	38.9	145.6	142.9	6.4
Average Queue (m)	27.7	24.2	32.9	21.4	68.2	0.5	0.2
95th Queue (m)	47.5	46.6	49.7	37.2	131.6	3.8	2.2
Link Distance (m)	112.3	112.3	110.6	110.6		222.2	222.2
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)					180.0		
Storage Blk Time (%)							
Queuing Penalty (veh)							

North Ramp Intersection:

1) Deceleration requirement for the northbound left turns is 110m (from Table 1)
2) The northbound left turns have maximum queue of 146.7m in the AM peak hour (critical traffic period). At 70 km/h design speed, unusable taper length is 60m. Storage requirement for northbound left turns is therefore 147m+60m=207m
3) During the AM peak hour, the through lane queue is considerably shorter at 34m. Bay length requirement to allow left turn traffic to drive around the through lane queue is therefore 34m+60m=94m
4) Conclusion: Left Turn Storage of 207m is more critical - Use 210m turn bay length in design

South Ramp Intersection:

1) Deceleration requirement for the northbound left turns is 110m (from Table 1)
2) The southbound left turns have maximum queue of 145.6m in the PM peak hour (critical traffic period). At 70 km/h design speed, unusable taper length is 60m. Storage requirement for northbound left turns is therefore 146m+60m=206m
3) During the PM peak hour, the through lane queue is slightly shorter at 142.9m. Bay length requirement to allow left turn traffic to drive around the through lane queue is therefore 143m+60m=203m
4) Conclusion: Left Turn Storage of 206m is more critical – Use 210m turn bay length in design

A.4 Synchro Modeling Approach – For Service Interchanges

1) Ramp intersections at an interchange must be **coordinated** and share the same cycle length
2) **Cycle length** should be realistic and shall be at least 70 s and perhaps a minimum of 100s to 120s on major corridors, depending on the number of signal phases, the amount of traffic, and congestion along the arterial (longer cycle length for heavier traffic). Use 5s increments (preferably 10s increments) for signal cycle lengths
3) If the arterial is a major thoroughfare, the **minimum green timing** for the main street phase shall be at least 30 s. If the roadway is neither a major arterial nor a thoroughfare, the minimum green timings can be reduced to 20 s.
4) **Minimum green band** along arterials (through the two interchange ramp intersections) shall be at least 30s, preferably significantly more so that there will be a reasonable level of progression along that arterial. If the roadway is neither a major arterial nor a thoroughfare, the minimum green band can be reduced to 20 s.

5) **Lead or lag for any given signal left turn phase** shall be consistent during a particular peak traffic period (i.e. may be different in the AM and PM periods)
6) **Avoid consecutive stops**. This includes through movements along the arterial, as well as heavy left turns from ramps onto the arterial.
7) Need to examine **both AM and PM peak hour** needs. The more critical condition governs the intersection geometry and signal timing requirements. Turn bay storage, spill back, and blocking requirements must be satisfied for both AM and PM peak periods.
8) Adjust for **link OD** for trips between 2 ramp intersections to eliminate freeway trips utilizing the interchange to make U-turns.
9) For left turn volumes greater than 500 vph, **double left turn lanes** should be considered.
10) **Two lane approaches** shall be used for ramp approaches for arterials with 2 or more lanes receiving the double left turns from the ramp approach
11) **Protected-Only** (i.e. Protected-Prohibited) left turns shall be used for double left turn movements
12) **Shared through/left turn lanes** shall **not** be used along the arterials, **unless** there are only 1 opposing through lane; or when the following 3 criteria are met - (i) the opposing through traffic volumes are light (less than 200 vph per lane); (ii) the concurrent through traffic volumes are light (less than 200 vph per lane); (iii) the interchange is not located near an industrial area where more than 5% trucks are expected in the traffic streams.
13) **Split signal phasing** shall **not** be used on major arterials or thoroughfares.

A.4.1 Synchro Modeling Parameters – for Service Interchanges

Synchro Factors		Parameters	Recommended Values (* - non-adjustable)
a.4.1.1 Ideal Saturation Flow		Left Turns	1900 pc/h/ln *
		Through	1900 pc/h/ln *
		Right Turns	1900 pc/h/ln *
A.4.1.2 Lane Width		Left & Right Turns	3.5 m *
		Through	3.7 m *
A.4.1.3 Lost Time Adjustment			0 s *
A.4.1.4 Detectors	Left Turn Lane	No of Detectors	1 *
		Leading Detector	2 m *
		Trailing Detector	0 m *
		Detector 1 Position	0.0 m *
		Detector 1 Size	2.0 m *
		Detector 1 Type	Call + Extension *
	Through Lane	No of Detectors	1 *
		Leading Detector	10 m *
		Trailing Detector	0 m *
		Detector 1 Position	0.0 m *
		Detector 1 Size	0.6m *
		Detector 1 Type	Call + Extension *
	Right Turn Lane	No of Detectors	1 *
		Leading Detector	2 m *
		Trailing Detector	0 m *
		Detector 1 Position	0.0 m *
		Detector 1 Size	2.0 m *
		Detector 1 Type	Call + Extension

Synchro Factors		Parameters	Recommended Values (* - non-adjustable)
A.4.1.5 Turning Speed		Left Turns	40 km/h (use higher speeds at locations where turn angle is > 100 degrees)
		Right Turns	30 / 40 / 50 km/h (use higher speeds if turning radii are designed for higher speeds)
A.4.1.6 Lane Utilization			Defaults *
A.4.1.7 Conflicting Peds			0 ped (ignore) *
A.4.1.8 Conflicting Bikes			0 bike (ignore) *
A.4.1.9 Peak Hour Factor			0.95 *
A.4.1.10 Heavy vehicles			5% * (unless specified or noted otherwise)
A.4.1.11 Signal Timing	Min. Initial	Main Street	Major Arterial / Thoroughfare - 30 s * Minor Arterial / Non Thoroughfare / Design Exceptions – 20 s *
		Side Street	10 s *
		Left Arrows	7s *
	Amber	Through	<u>Posted Speed:</u> 5.0s for 80 km/h; 4.5s for 70 km/h; 4.0s for 60 km/h; 3.5s for 50 km/h *
		Lagging Left Arrow	3.0s amber *
		Leading Left arrow (Prot-Proh)	3.0s amber *
		Leading Left arrow (Prot-Perm)	3.0s amber *
	All Red	Through	From Major Road (Arterial) – 2.0 s * From Minor Road (Ramps), crossing 6 lanes – 2.5s * From Minor Road (Ramps), crossing 4 lanes – 2.0s *
		Lagging Left Arrow	Same as concurrent through phase *
		Leading Left arrow (Prot-Proh)	2.0s all red *
		Leading Left arrow (Prot-Perm)	1.0s al red *
A.4.1.12 Recall Mode		Major Street	C-Min or C-Max
		Minor Street	None (can be adjusted to min recall with the appropriate min Green setting if it is needed to create a desirable signal coordination pattern)
		Left Turns	None (can be adjusted to min recall with the appropriate min Green setting if it is needed to create a desirable signal coordination pattern)
A.4.1.13 Lead / Lag			Lead or Lag as demonstrated by operational benefits
A.4.1.14 Pedestrian Timings (generally not set except noted otherwise specifically. If that's the case, use these parameters)		Walk Time	7 s
		Walking Speed	1.2 m/s
		Flashing Don't Walk Time (FDW)	FDW = Crosswalk Distance / 1.2 – amber – Red; Crosswalk distance to be measured along the centre of crosswalk, measure to ~ 2 m beyond edge of conflicting through lane
A.4.1.15 Block Intersection		Signal Controlled	Block Intersection not allowed
		Yield / Stop / Free-Flow	Block Intersection allowed

A.5 SimTraffic Modeling Approach – for Service Interchanges

1) SimTraffic model must **represent the proposed interchange accurately** i.e. link length, bay length, turn radius, link speed, turn speed, etc
2) **Consider longer external links at boundary** to avoid potential denied entry occurring outside the model network
3) **Headway factor** shall be adjusted for **ramp segments or ramp approaches** – apply adjustment factor using ratio of road segment capacity over ideal link capacity... The headway factors for the following ramp / C-D lane operating speeds are provided in A.5.1.6 in the table below.
4) Potential strategies to help **eliminate or alleviate operational observed problems in SimTraffic** are:
   a. If there are long queues, add feeder intersection to simulate effects of upstream traffic signals (metering effect)
   b. May consider using signal coordination to dictate progression pattern so that arrival patterns of conflicting platoons can be separated. Longer ramp minimum green may be used to create gaps at downstream intersection
   c. If there is uneven lane distribution at double left turn lanes, the number of receiving lanes may be increased (in the model) to improve the downstream traffic flow in the SimTraffic model.

A.5.1 SimTraffic Modeling Parameters – For Service Interchanges

SimTraffic Simulation Settings	Parameters	Recommended Values (* - non-adjustable)
A.5.1.1 Interval Parameters	Seeding Interval	One 15 minutes interval *
	Recording Interval	Four 15 minutes intervals *
	PHF Adjust	Yes for Third Recording Interval *
	Anti-PHF Adjust	Yes for First, second and Fourth Recording Intervals *
A.5.1.2 Vehicle Parameters	Truck Percentage by Class	Use 0.05 Semi-1; 0.02 Semi-2; 0.03 Bus * (unless specifically stated otherwise)
A.5.1.3 Driver Parameters	All parameters	Use default values *
A.5.1.4 Enter Blocked Intersection?	Signalized Intersection	No *
	Unsignalized Intersection	Yes *
	Ramp Merge / Diverge Terminal	Yes *
A.5.1.5 Median Width	Single Left Turn Lane Without median	3.5m
	Single Left Turn Lane with Median	6.0m (= 3.5m + 2.5m)
	Double Left Turn Lanes with Median	9.5m (=3.5m + 3.5m + 2.5m)
A.5.1.6 Headway Factor	Ramp/C-D Lane with Operating Speed	Headway Factor
	> 80 km/h	0.97
	66 to 80 km/h	0.93
	51 to 65 km/h	0.88
	31 to 50 km/h	0.84
	≤ 30 km/h	0.80
A.5.1.7 Turning Speed	Left Turns	40 km/h (use higher speeds at locations where turn angle is > 100 degrees)
	Right Turns	30 / 40 / 50 km/h (use higher speeds if turning radii are designed for higher speeds)

A.5.2 SimTraffic Output Evaluation Criteria – For Service Interchanges

1) **Average Delay Per Vehicle** - Flag (for operational problems) raised when value > 60 s/veh
2) **Queue Length** – view static queue plot or maximum queue length in simulation report. In cases where the maximum queue in the simulation report is very long and yet this level of queue is not observed in the simulation, the simulation visual observation will be used. The maximum queue length can be estimated by scaling (from plot of the maximum observed simulated queue) the observed maximum queue length.
3) **Denied Entries** – need to confirm at the end of the simulation run that there are minimum denied entries
4) **Lane Distribution** – Check simulation for lane distribution in double left turn lanes to see if simulation is reasonable
5) Optimum design is a **balance** between signal split timing allocation and bay storage / approach LOS (queue management / control)

1. Synchro / SimTraffic Files – for Service Interchanges

The names of the Synchro and SimTraffic files provided by AT are as follows:

Interchange No. [Interchange Location]	Ultimate Stage Models (to handle 2.5M model volumes)	Stage 1 Models (to handle 1.6M model or 30-Year volumes)
01 [153 Ave & AHD]	01 – 153Av_AHD–ULT AM 01 – 153Av_AHD–ULT PM	
02 [130 Ave & AHD]	02 – 130Av_AHD-ULT AM 02 – 130Av_AHD-ULT PM	02 – 130Av_AHD–STG1 AM 02 – 130Av_AHD–STG1 PM
04 [Baseline Rd & AHD]	04 – BLR_AHD-ULT AM 04 – BLR_AHD-ULT PM	04 – BLR_AHD–STG1 AM 04 – BLR_AHD–STG1 PM
07 [Sherwood Pk Fwy & 17 St]	07 – SPF_17St-ULT AM 07 – SPF_17St-ULT PM	-
08 [YHT & Broadmoor Blvd]	08 – YHT_BrBv-ULT AM 08 – YHT_BrBv-ULT PM	08 – YHT_BrBv–STG1 AM 08 – YHT_BrBv–STG1 PM
09 [YHT & Sherwood Dr]	09 – YHT_ShDr-ULT AM 09 – YHT_ShDr-ULT PM	

Legend:
- (yellow) Design requirements for Traffic Availability
- (light blue) Ultimate Stage compatibility requirements

The Synchro and SimTraffic filename nomenclatures are as follows:

XX - Interchange Name - STAGE AM / PM

Where

XX - Interchange Name	Interchange Number - Name shall as abbreviated exactly as per the table above	
STAGE	STG1	– Stage 1
	ULT	– Ultimate Stage
AM /PM	AM	– AM Peak Hour
	PM	– PM Peak Hour

2. Synchro Background Files

The directions for linking Synchro files to their respective interchange background image files are provided in this section.

1. The interchange background image files are provided in the directory, "NE AHD Synchro Backgrounds". This directory shall be saved directly under the root directory of the local hard drive as a sub-directory ("C:\NE AHD Synchro Backgrounds"). This allows the simulation files to be located anywhere on the computer, and the link to the interchange background image files will still be accessible (i.e. properly linked) to the Synchro programs.

2. To link the interchange background image files (jpeg files) to a Synchro file, the following steps are required. (The **highlighted** words correspond to keystrokes within the Synchro program)

    a) **"Remove"** linkage to any existing jpegs.
    b) **"Add"** linkage to the appropriate jpeg file, using the file requestor.
    c) Double-click on the any of the parameters to open the "Set Bitmap Scale & Offset" window.
    d) Set the World Coordinates to match those found at the "X" on the background jpeg image. The X-coordinate is the smaller number. Use a negative number if it is negative on the jpeg. The numbers are typed into the World Coordinate boxes.
    e) To Set the Bitmap coordinates, press the **"Find"** button, and then click on the center of the "X". Zooming in on the "X" will be necessary.
    f) Set Scale to **200m = 474** pixels
    g) Select "**OK**", and the background should be visible behind the Synchro Link / Node file. If not, go through the steps again.

1. Minimum Requirements for Synchro / SimTraffic Modeling – for Service Interchanges

Proposal for alternative service interchange types (e.g. Change from Parclo A4 to Diamond) or modifications to the interchange lane configurations as shown on the plans in **Appendix A of Schedule 18** (e.g. use of shorter turn bays, deletion of number of turn lanes or through lanes) shall be accompanied by Synchro / SimTraffic files (using Synchro Studio 7 package). The Synchro / SimTraffic files serve to demonstrate that the proposed alternative interchange configurations will satisfy the following requirements:

a) Storage Requirement – to accommodate maximum queue of turning traffic so that the queue in the turn bay will not spill out of the turn bay and blocks the through traffic movement

b) Blocking Prevention Requirement – to prevent blockage of access to turn bay by queue of through traffic.

c) In addition, the Minimum Deceleration Requirement was also checked for compliance for the turn bay design at interchange ramp intersections.

The Synchro / SimTraffic files shall be prepared using the traffic volumes used in the Synchro / SimTraffic files in **Package B of Appendix J**. The Proponent shall not adjust these traffic volumes.

The same Synchro / SimTraffic modeling parameters shall be used in preparing the new Synchro / SimTraffic files for the alternative interchange types or the alternative interchange lane configurations.

In total, the following files are required when alternative interchange types are prepared by the Proponent (The Synchro filename of the proposed alternative interchange types shall come with a **–AD** suffix to denote that they are Alternative Designs):

- For 153 Ave & AHD (I/C # 01)
  - Traffic Availability: Ultimate Stage AM & PM peak hour models (ULT AM-AD, ULT PM-AD)
- For 130 Ave & AHD (I/C # 02)
  - Traffic Availability: Stage 1 AM & PM peak hour models (STG1 AM-AD, STG1 PM-AD)
  - End of Term: Ultimate Stage AM & PM peak hour models (ULT AM-AD, ULT PM-AD)
- For Baseline Rd & AHD (I/C # 04)
  - Traffic Availability: Stage 1 AM & PM peak hour models (STG1 AM-AD, STG1 PM-AD)
  - Ultimate Stage Compatibility: Ultimate Stage AM & PM peak hour models (ULT AM-AD, ULT PM-AD)
- For Sherwood Park Fwy & 17 St (I/C # 07)
  - Traffic Availability: Ultimate Stage AM & PM peak hour models (ULT AM-AD, ULT PM-AD)

- For YHT & Broadmoor Blvd (I/C # 08)
  - Traffic Availability: Stage 1 AM & PM peak hour models (STG1 AM-Ad, STG1 PM-AD)
  - Ultimate Stage Compatibility: Ultimate Stage AM & PM peak hour models (ULT AM-AD, ULT PM-AD)
- For YHT & Sherwood Dr (I/C # 09)
  - Traffic Availability: Ultimate Stage AM & PM peak hour models (ULT AM-AD, ULT PM-AD)

2. Evaluating Synchro/SimTraffic Models

The following is a sample approach to evaluate if the interchange layout plan is prepared consistent with the requirements determined by the Synchro / SimTraffic files:

The following three checks are made and the check results are shaded in the table: (refer to **Table 1 in Package A of Appendix J**)

(i) Check if there is **queue failure** in the simulation (i.e. simulated maximum queue is longer than the queue storage provided in the Synchro/SimTraffic models)

(ii) Check if the **turn bay length** shown on the interchange layout plans is sufficiently long to contain the maximum queue length

(iii) Check if the turn bay length on the interchange layout plans meets the **deceleration distance requirement**.

Example 1 – Design meet minimum operational requirements (factitious numbers used):

Example of design that meets minimum operational requirements – Interchange # 1	Stage 1	Ultimate Stage	Remarks
a) Simulated Max Queue	125m	142m	
b) Storage provided in Synchro	250m	250m	
c) Is the storage in the Synchro file adequate?	OK	OK	Turn bay provided in Synchro is acceptable
d) Bay length needed	185m	202m	= simulated maximum queue + 60m
e) Bay length provided in the interchange layout plan	250m	250m	
f) Is the bay length in the interchange layout plan adequate?	OK	OK	Turn bay provided in the interchange layout plan is acceptable – i.e. meets or exceeds minimum operational requirements
g) Deceleration requirement	130m	130m	
h) Does the turn bay satisfy deceleration requirement?	OK	OK	Turn bay length in interchange layout plan meets minimum deceleration requirement

Example 2 – Design does not meet minimum operational requirements (factitious numbers used):

Example of design that meets minimum operational requirements – Interchange # 2	Stage 1	Ultimate Stage	Remarks
a) Simulated Max Queue	106m	142m	
b) Storage provided in Synchro	130m	130m	
c) Is the storage in the Synchro file adequate?	OK	Short	Need to revise Synchro file so that the turn bay can accommodate the anticipated maximum queue length
d) Bay length needed	166m	202m	= simulated maximum queue + 60m
e) Bay length provided in the interchange layout plan	130m	130m	
f) Is the bay length in the interchange layout plan adequate?	Short	Short	Queue failure expected with the 130m bay length provided in the interchange layout plan. Need to extend turn bay pass the 202m required minimum bay length
g) Deceleration requirement	130m	130m	
h) Does the turn bay satisfy deceleration requirement?	OK	OK	Turn bay length in interchange layout plan meets minimum deceleration requirement

Example 3 – Design in the Interchange Layout Plan is inconsistent with the Synchro/SimTraffic models provided:

Example of design that meets minimum operational requirements – Interchange # 3	Stage 1	Ultimate Stage	Remarks
a) Simulated Max Queue	125m	142m	
b) Storage provided in Synchro	250m	250m	
c) Is the storage in the Synchro file adequate?	OK	OK	Turn bay provided in Synchro is acceptable
d) Bay length needed	185m	202m	= simulated maximum queue + 60m
e) Bay length provided in the interchange layout plan	150m	150m	
f) Is the bay length in the interchange layout plan adequate?	Fail	Fail	The 150m bay length provided in the interchange layout plan is not consistent with the required bay length determined by Synchro.
g) Deceleration requirement	130m	130m	
h) Does the turn bay satisfy deceleration requirement?	OK	OK	Turn bay length in interchange layout plan meets minimum deceleration requirement

3. Eliminating Queue Failures

Queue failure may be eliminated by implementing one or more of the following measures:

a) Increase length of turn bay storage
b) Change signal timings including signal coordination timings or lead-lag arrangements for left turn signal phases
c) Change signal cycle length
d) Change signal phasing
e) Adjust the traffic control (e.g. change from yield to free flow)
f) Adjust the number of lanes at the intersection approach
g) For lane distribution problems at double left turn lanes, it may be necessary to create a longer section of receiving lanes or even increase the number of receiving lanes downstream (in the model) to avoid a situation where SimTraffic avoids assigning vehicles to the outside left turn lane (in anticipation of lane merge shortly after the left turn maneuver)
h) Add feeder intersection to simulate effects of upstream traffic signals (to create a metering effect or generate more compact platoons of arrival traffic)
i) Adjust interchange configuration
j) Change interchange type

4. Using AT's Synchro/SimTraffic Models (in Package B of Appendix J)

The Proponent may choose to use the original AT-supplied Synchro/SimTraffic models (provided in **Package B of Appendix J**) to determine the turn bay requirements using the same process shown above. To achieve reasonably optimal turn bay length requirements, it is recommended that the signal timings in the original Synchro/SimTraffic models be retained or at least be used as a starting point.

D. Guidelines for DBFO Synchro/SimTraffic Modeling – For At-Grade Intersections

The guidelines in Package D are applicable for the following 3 at-grade intersections:

- 153 Ave & Meridian St
- 121 Ave & Broadmoor Bv
- 115 Ave & 17 St

Detailed configurations of the above 3 at-grade signalized intersections were determined and confirmed by traffic simulation using the Synchro/SimTraffic Studio 7 suite of programs. **Synchro** is used to establish basic model programming of the Synchro/SimTraffic model, as well as provide preliminary assessment of signal split timing and the effectiveness of the lane configuration in accommodating traffic demands. **SimTraffic** is used to provide simulation statistics in the assessment of intersection performance. The measures of effectiveness used in intersection operation analysis are SimTraffic output parameters. Synchro / Sim Traffic files for the 3 at-grade intersections were included in **Package E of Appendix J**.

In preparing the geometry for these 3 at-grade intersections, 5-year AM and PM peak hour traffic forecasts were used for the 153 Ave & Meridian St intersection, and 15-year Am and PM peak hour traffic forecasts were used for the other two intersections. The traffic forecasts can be obtained from the Synchro files.

D.1 Criteria for Failed Intersection Operations

Criteria for failed intersection operations for at-grade signalized intersections in the DBFO project are:

1) Excessive queue in turn bay spilling out of bay and blocking adjacent through lane
2) Excessive queue in through lane blocking turn bay
3) Successive cycle failure (vehicles need to wait for multiple signal cycles to clear an intersection)

D.2 Synchro / SimTraffic Models

Synchro / SimTraffic models were created to demonstrate that the recommended intersection lane configurations would satisfy the following requirements:

1) Storage Requirement – to accommodate maximum queue of turning traffic so that the queues in the turn bay will not spill out of the turn bay and block the through traffic movement
2) Blocking Prevention Requirement – to prevent blockage of access to turn bay by queue of through traffic
3) In addition, the minimum deceleration requirement was also checked for compliance for the turn bay design at intersections.

The following Synchro/SimTraffic Files were prepared:

a) AM Peak Hour Model
b) PM Peak Hour Model

D.3 Determination of Turn Bay Dimensions at At-Grade Intersections

The **required turn bay length** shall satisfy all three requirements below:

1) Deceleration Requirement – based on the specified Design Speed of the approach
2) Storage Requirement – to accommodate maximum queue of turning traffic
3) Blocking Pavement Requirement – to prevent blockage of access to turn bay by queue of through traffic

Notes:

a) The **length of a turn bay** is to be measured from the start of bay taper to the stop line at the end of the turn bay.
b) In determining the **storage requirements of a turn bay**, the portion of the taper where the turn bay lane width is narrower than 3.0m will be considered unusable for vehicle storage. This initial unusable portion of the bay taper, therefore, shall not be included as the available storage distance calculation. For the purposes of this project, the lengths of the unavailable portion of the bay taper for storage are as follows:

Length of unusable bay taper:

(i) Design Speed of 60 km/h – 50m for single lane turn lane & 70m for double lane turn lanes
(ii) Design Speed of 70 km/h – 60m for single lane turn lane & 80m for double lane turn lanes
(iii) Design Speed of 80 km/h – 70m for single lane turn lane & 90m for double lane turn lanes

Accordingly, the **turn bay length provided** shall therefore meet the following criteria in **Table 1**:

Table 1 – Criteria for Determination of Turn Bay Lengths at At-Grade Intersections

Approach Design Speed	Required Turn Bay Length (Use the largest value of the following 3 criteria to design for the turn bay) (measured from start of bay taper to stopline at the end of turn bay)				
	Criteria # 1 - Deceleration Requirement	Criteria # 2 - Storage Requirement (turn bay length)		Criteria # 3 - Blocking Prevention Requirement	
		Single-Lane Turn Lane	Double-Lane Turn Lane	Single-Lane Turn Lane	Double-Lane Turn Lane
60 km/h	90 m	SimTraffic Maximum Queue in turn bay + 50m	SimTraffic Maximum Queue in turn bay + 70m	SimTraffic Maximum Queue in through lane + 50m	SimTraffic Maximum Queue in through lane + 70m
70 km/h	110 m	SimTraffic Maximum Queue in turn bay + 60m	SimTraffic Maximum Queue in turn bay + 80m	SimTraffic Maximum Queue in through lane + 60m	SimTraffic Maximum Queue in through lane + 80m
80 km/h	130 m	SimTraffic Maximum Queue in turn bay + 70m	SimTraffic Maximum Queue in turn bay + 90m	SimTraffic Maximum Queue in through lane + 70m	SimTraffic Maximum Queue in through lane + 90m

D.4 Synchro Modeling Approach – for At-Grade Intersections

1) **Cycle length** should be realistic and shall be at least 60 s and perhaps a minimum of 100s to 120s on major corridors, depending on the number of signal phases, the amount of traffic, and congestion along the arterial (longer cycle length for heavier traffic). Use 5s increments (preferably 10s increments) for signal cycle lengths
2) If the arterial is a major thoroughfare, the **minimum green timing** for the main street phase shall be at least 30 s. If the roadway is not a major arterial or only the initial phase of a future major arterial, the minimum green timings can be reduced to 15 s.
3) **Lead or lag** for any given signal left turn phase shall be consistent during a particular peak traffic period (i.e. may be different in the AM and PM periods)

4) Need to examine **both AM and PM peak hour needs**. The more critical condition governs the intersection geometry and signal timing requirements. Turn bay storage, spill back, and blocking requirements must be satisfied for both AM and PM peak periods.
5) For left turn volumes greater than 500 vph, **double left turn lanes** should be considered.
6) **Protected-Only** (i.e. Protected-Prohibited) left turns shall be used for double left turn movements
7) **Shared through/left turn lanes** shall **not** be used along the arterials, unless there are only 1 opposing through lane; or when the following 3 criteria are met - (i) the opposing through traffic volumes are light (less than 200 vph per lane); (ii) the concurrent through traffic volumes are light (less than 200 vph per lane); (iii) the intersection is not located near an industrial area where more than 5% trucks are expected in the traffic streams.
8) **Split signal phasing** shall **not** be used on major arterials or thoroughfares.

D.4.1 Synchro Modeling Parameters – For At-Grade Intersections

Synchro Factors		Parameters	Recommended Values (* - non-adjustable)
D.4.1.1 Ideal Saturation Flow		Left Turns	1900 pc/h/ln *
		Through	1900 pc/h/ln *
		Right Turns	1900 pc/h/ln *
D.4.1.2 Lane Width		Left & Right Turns	3.5 m *
		Through	3.7 m *
D.4.1.3 Lost Time Adjustment			0 s *
D.4.1.4 Detectors	Left Turn Lane	No of Detectors	1 *
		Leading Detector	2 m *
		Trailing Detector	0 m *
		Detector 1 Position	0.0 m *
		Detector 1 Size	2.0 m *
		Detector 1 Type	Call + Extension *
	Through Lane	No of Detectors	1 *
		Leading Detector	10 m *
		Trailing Detector	0 m *
		Detector 1 Position	0.0 m *
		Detector 1 Size	0.6m *
		Detector 1 Type	Call + Extension *
	Right Turn Lane	No of Detectors	1 *
		Leading Detector	2 m *
		Trailing Detector	0 m *
		Detector 1 Position	0.0 m *
		Detector 1 Size	2.0 m *
		Detector 1 Type	Call + Extension
D.4.1.5 Turning Speed		Left Turns	40 km/h (use higher speeds at locations where turn angle is > 100 degrees)
		Right Turns	30 / 40 / 50 km/h (use higher speeds if turning radii are designed for higher speeds)
D.4.1.6 Lane Utilization			Defaults *
D.4.1.7 Conflicting Peds			0 ped (ignore) *

Synchro Factors		Parameters	Recommended Values (* - non-adjustable)
D.4.1.8 Conflicting Bikes			0 bike (ignore) *
D.4.1.9 Peak Hour Factor			As per parameters in the Synchro files provided *
D.4.1.10 Heavy vehicles			As per parameters in the Synchro files provided *
D.4.1.11 Signal Timing	Min. Initial	Main Street	As per parameters in the Synchro files provided *
		Side Street	12 s *
		Left Arrows	7s *
	Amber	Through	Posted Speed: 5.0s for 80 km/h; 4.5s for 70 km/h; 4.0s for 60 km/h; 3.5s for 50 km/h *
		Lagging Left Arrow	3.0s amber *
		Leading Left arrow (Prot-Proh)	3.0s amber *
		Leading Left arrow (Prot-Perm)	3.0s amber *
	All Red	Through	From Major Road (Arterial) – 2.0 s * From Minor Road (Ramps), crossing 6 lanes – 2.5s * From Minor Road (Ramps), crossing 4 lanes – 2.0s *
		Lagging Left Arrow	Same as concurrent through phase *
		Leading Left arrow (Prot-Proh)	2.0s all red *
		Leading Left arrow (Prot-Perm)	1.0s al red *
D.4.1.12 Recall Mode		Major Street	Min
		Minor Street	None
		Left Turns	None
D.4.1.13 Lead / Lag			Lead or Lag as demonstrated by operational benefits
D.4.1.14 Pedestrian Timings (generally not set except noted otherwise specifically. If that's the case, use these parameters)		Walk Time	7 s
		Walking Speed	1.2 m/s
		Flashing Don't Walk Time (FDW)	FDW = Crosswalk Distance / 1.2 – amber – Red; Crosswalk distance to be measured along the centre of crosswalk, measure to ~ 2 m beyond edge of conflicting through lane
D.4.1.15 Block Intersection		Signal Controlled	Block Intersection not allowed
		Yield / Stop / Free-Flow	Block Intersection allowed

D.5 SimTraffic Modeling Approach – For At-Grade Intersections

1) SimTraffic model must **represent the proposed intersection accurately** i.e. link length, bay length, turn radius, link speed, turn speed, etc
2) **Consider longer external links at boundary** to avoid potential denied entry occurring outside the model network

D.5.1 SimTraffic Modeling Parameters – For At-Grade Intersections

SimTraffic Simulation Settings	Parameters	Recommended Values (* - non-adjustable)
A.5.1.1 Interval Parameters	Seeding Interval	One 15 minutes interval *
	Recording Interval	Four 15 minutes intervals *
	PHF Adjust	Yes for Third Recording Interval *
	Anti-PHF Adjust	Yes for First, second and Fourth Recording Intervals *
A.5.1.2 Vehicle Parameters	Truck Percentage by Class	Use 0.05 Semi-1; 0.02 Semi-2; 0.03 Bus * (unless specifically stated otherwise)
A.5.1.3 Driver Parameters	All parameters	Use default values *
A.5.1.4 Enter Blocked Intersection?	Signalized Intersection	No *
	Unsignalized Intersection	Yes *
	Ramp Merge / Diverge Terminal	Yes *
A.5.1.5 Median Width	Single Left Turn Lane Without median	3.5m
	Single Left Turn Lane with Median	6.0m (= 3.5m + 2.5m)
	Double Left Turn Lanes with Median	9.5m (=3.5m + 3.5m + 2.5m)
A.5.1.6 Headway Factor	Ramp/C-D Lane with Operating Speed	Headway Factor
	> 80 km/h	0.97
	66 to 80 km/h	0.93
	51 to 65 km/h	0.88
	31 to 50 km/h	0.84
	≤ 30 km/h	0.80
A.5.1.7 Turning Speed	Left Turns	40 km/h (use higher speeds at locations where turn angle is > 100 degrees)
	Right Turns	30 / 40 / 50 km/h (use higher speeds if turning radii are designed for higher speeds)

D.5.2 SimTraffic Output Evaluation Criteria – For At-Grade Intersections

1) **Average Delay Per Vehicle** - Flag (for operational problems) raised when value > 60 s/veh
2) **Queue Length** – view static queue plot or maximum queue length in simulation report. In cases where the maximum queue in the simulation report is very long and yet this level of queue is not observed in the simulation, the simulation visual observation will be used. The maximum queue length can be estimated by scaling (from plot of the maximum observed simulated queue) the observed maximum queue length.
3) **Denied Entries** – need to confirm at the end of the simulation run that there are minimum denied entries
4) **Lane Distribution** – Check simulation for lane distribution in double left turn lanes to see if simulation is reasonable
5) Optimum design is a **balance** between signal split timing allocation and bay storage / approach LOS (queue management / control)

1. Synchro / SimTraffic – for At-Grade Intersections

The names of the Synchro and SimTraffic files provided by AT are as follows:

Intersection No. [Intersection Location]	Synchro Models (to handle 5-year design volumes)	Synchro Models (to handle 15-year design volumes)
51 [153 Ave & Meridian St]	51 – 153Av_MerSt–05 Yr AM 51 – 153Av_MerSt–05 Yr PM	51 – 153Av_MerSt–05 Yr AM 51 – 153Av_MerSt–15 Yr PM
52 [121 Ave & Broadmoor Blvd]		52 – 121Av_BrBv–15 Yr AM 52 – 121Av_BrBv–15 Yr PM
53 [115v Ave & 17 St]		53 – 115Av_17St–15 Yr AM 53 – 115Av_17St–15 Yr PM

Legend:

(yellow)	Design requirements for Traffic Availability
(light blue)	15-year compatibility requirements

The Synchro and SimTraffic filename nomenclatures are as follows:

XX - Intersection Name - Horizon - AM / PM

Where

XX - Intersection Name	Intersection Number - Name shall be abbreviated exactly as per the table above	
Horizon	05 Yr	– 5 Year Design Horizon
	15 Yr	– 15 Year Design Horizon
AM /PM	AM	– AM Peak Hour
	PM	– PM Peak Hour

2. Synchro Background Files

Synchro background files are not provided for the 3 at-grade intersections.

The objective of Package F is to provide guidelines to the Contractor in achieving consistency in the design, layout and operation of traffic signals installed in the NE AHD DBFO Project.

This Package considers all aspects of the design of the physical traffic signal - from the below ground conduit system design to above ground pole selection, signal indications, signing, pavement markings and other signal control related areas.

A thorough design check using a design checklist will be required as part of the signal design process. The design check should be carried out by a qualified professional traffic engineer or a registered traffic engineering technologist to identify potential design issues that may negatively impact safety and operations. A Design Checklist is provided at the end of this package.

1. Signal Layout and Design

1.1 Sight Distance

The following sight distances are required at proposed and future traffic signal locations:

Sight Distances	Applicable Areas
Stopping Sight Distance	Minimum turn bay lengths at intersections
Decision Sight Distance	Visibility of signal heads
Intersection Sight Distance	Visibility of vehicles at unsignalized intersection approaches

The above sight distance requirements are summarized in Table 1.

Table 1 Sight Distances

Design Speed	Assumed Posted Speed	Minimum Stopping Sight Distance	Decision Sight Distance (Urban Roadway)	Intersection Sight Distance (Left turns at unsignalized ramp terminals)
50 km/h	50 km/h	65 m	160 m	195 m
60 km/h	50 km/h	85 m	205 m	235 m
70 km/h	60 km/h	110 m	250 m	275 m
80 km/h	70 km/h	140 m	300 m	315 m

The intersection sight distance measurements at interchange ramp terminals are illustrated in Figure 1.

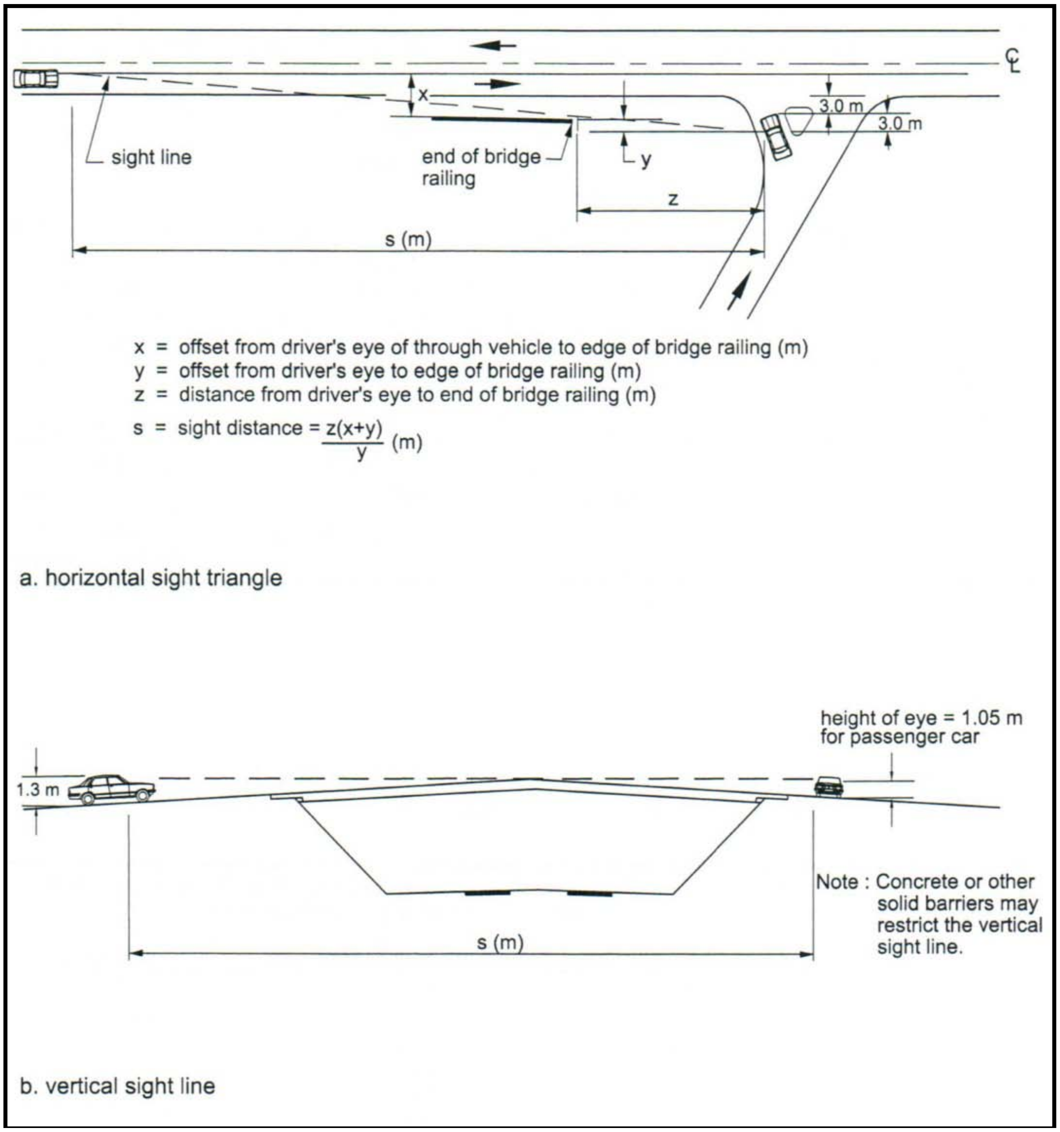


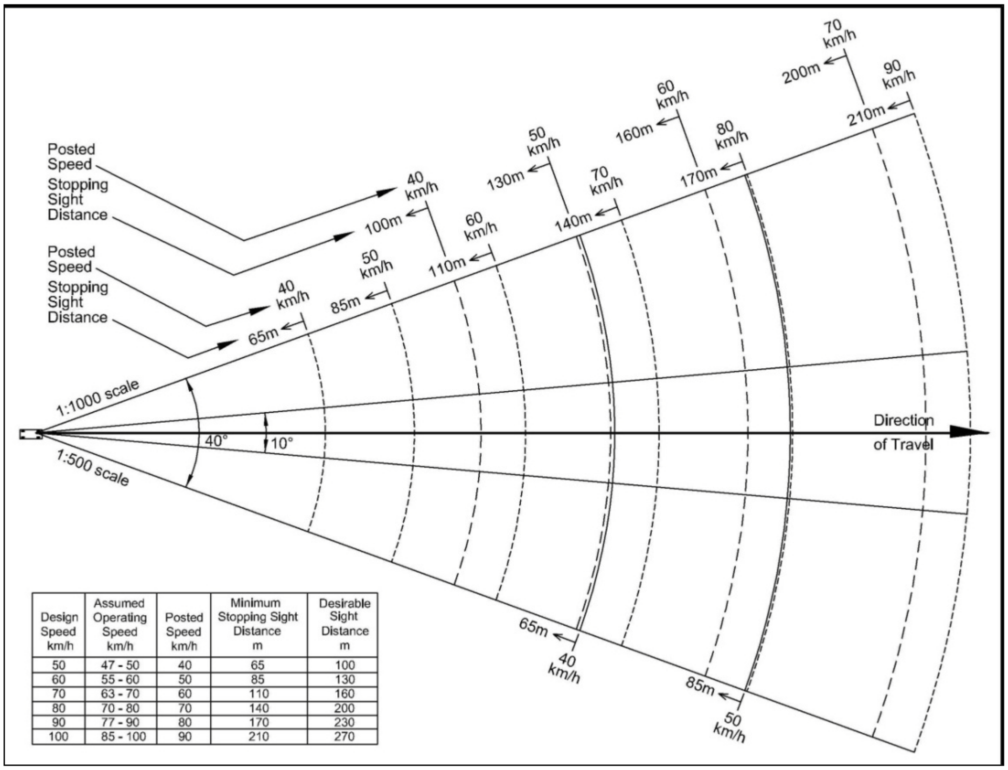
Figure 1 Intersection Sight Distance at Interchange Ramp Terminals

1.2 Cone of Vision

At least one primary signal head (mounted overhead on the mast arm of the signal pole) shall be placed within the 10 degrees cone of vision for each lane of travel.

The secondary signal heads shall be placed within the 40 degrees cone of vision.

A cone of vision template is provided in Figure 2.



Design Speed km/h	Assumed Operating Speed km/h	Posted Speed km/h	Minimum Stopping Sight Distance m	Desirable Sight Distance m
50	47 - 50	40	65	100
60	55 - 60	50	85	130
70	63 - 70	60	110	160
80	70 - 80	70	140	200
90	77 - 90	80	170	230
100	85 - 100	90	210	270

Figure 2 **Cone of Vision** (figure is not to scale)

Pedestrians need be considered when applying the cone of vision at an intersection. A typical Alberta highway intersection consists of large corner turn radii, resulting in longer crossing distances for pedestrians. It is therefore important to place pedestrian signal heads where they are easily recognizable by crossing pedestrians.

A 15 degree vertical sight angle is also required so that the overhead signal head can be seen through the windshield of the car stopped at the stop line.

For Alberta highways, the required minimum vertical clearance of signal heads is 5.8 m. Additional clearance may be required in locations with frequent logging trucks and other high loads.

For a 5.8 m clearance, where a 4-section signal head is vertically mounted on the mast arm of a signal pole, the signal head is placed at least 21 m from the stop line. For signal heads that are mounted on a pedestal pole, the minimum pole placement distance from the stop line is 15 m.

Signal heads should be installed as close as practical to the projection of the driver's line of sight. Care should be taken to eliminate obstacles blocking the driver's line of sight, such as utility cables / wires, structures, or vegetation. Signal heads can also be aimed towards the driver in order to provide drivers with the maximum view of the signal.

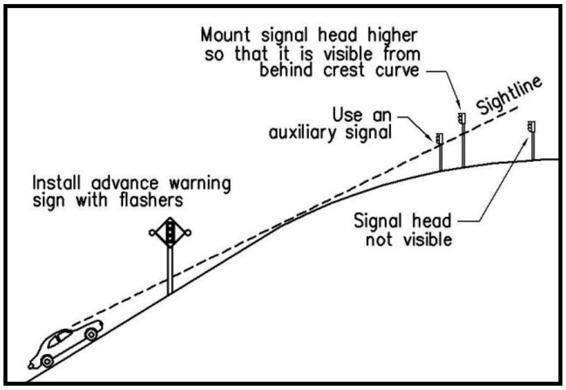


Figure 3 Sightline at Crest Curves

For intersections on a vertical crest curve, the sightline for the signal display may be affected, as illustrated in **Figure 3**. Potential solutions for these situations are to either:

- install an active advance warning flasher;
- install an auxiliary signal head; or
- raise the signal display.

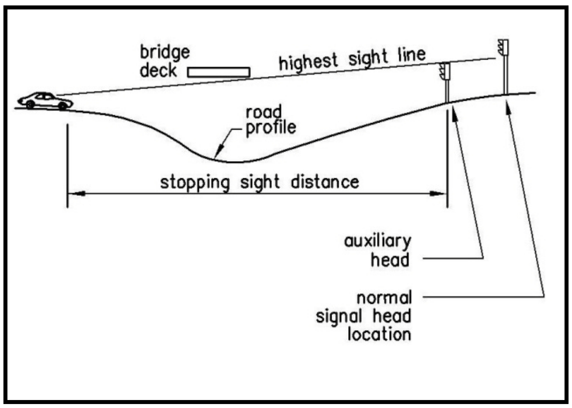


Figure 4 Sightline at Underpass

Likewise, sightline of signals located beyond an overpass structure may also be obstructed by the bridge deck, as illustrated in **Figure 4**. A potential solution for this situation is to install an auxiliary signal head or an active advance warning flasher.

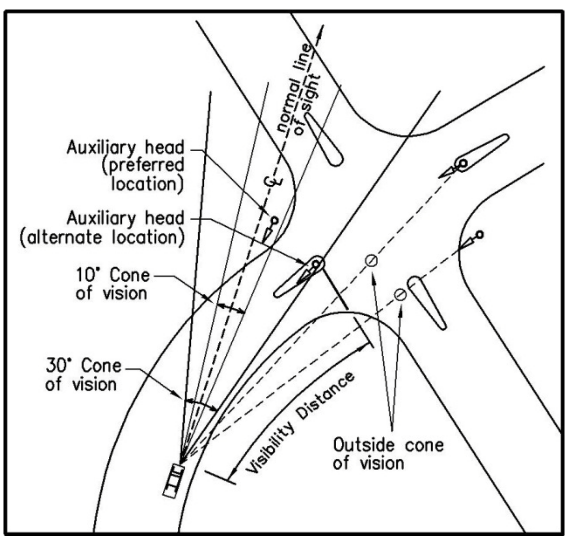


Figure 5 Sightline around Curves

Intersections on a curve can have sightline problems as the signal head display can be outside the cone of vision of approaching vehicles. In such cases, auxiliary signal heads should be installed as illustrated in **Figure 5**. An active advance warning flasher may also be used to alert drivers of the changing signal displays.

1.3 Roadside Hazards and Clear Zones

Signal poles are potential roadside hazards for errant vehicles leaving the roadway.

Clear zone requirements are measured from the edge of the through travel lanes to the object, and are based on posted speed, traffic volume and land use. Clear zone requirements on provincial highways are defined in the Alberta Highway Roadside Design Guide. Table 2 summarizes the minimum clear zone distances required in Alberta.

Table 2 Minimum Clear Zone Distances (in metres from edge of driving lane)

Design AADT	Design Speed				
	≤60 with curb	**≤60 km/h**	70 km/h	80 km/h	90 km/h
<750	0.5	2.0 – 3.0	3.0 – 3.5	3.0 – 3.5	3.5 – 4.5
750 - 1,500	0.5	3.0 – 3.5	4.5 – 5.0	4.5 – 5.0	5.0 – 5.5
1,500 - 6,000	0.5	3.5 – 4.5	5.0 – 5.5	5.0 – 5.5	6.0 – 6.5
>6,000	0.5	4.5 – 5.0	6.0 – 6.5	6.0 – 6.5	6.5 – 7.5

However, signal poles need to be placed reasonably close to an intersection so the signal mast arm doesn't exceed 15m in span, and pushbuttons on the pole are kept to a maximum distance of 5.5m from crosswalk locations.

<u>Rural Intersections</u>

At rural intersections, due to the typically large corner radii and often additional buffer due to the presence of deceleration and acceleration tapers, the optimal signal pole locations are most likely outside the required clear zones. Nonetheless, the clear zone requirements should be checked when designing for traffic signals at rural intersections.

However, in these cases, the signal poles will often be located to the far right of the centreline alignment of the approaching travel lanes. Special attentions should therefore be paid in areas such as cone of vision requirements, and the need to provide accessibility to pushbuttons for pedestrians. Secondary signal poles are sometimes required for pedestrian pushbuttons and / or pedestrian signals at the corner radii so that they are better aligned with the crosswalks. Median poles are also often used to better align with the traffic in the left turn lanes and also to avoid the need for signal with very long mast arms (e.g. longer than 15m), and consequently specially designed custom pole bases.

In rural environments where the design speed is≤ 60 km/h (with no curb), the minimum offset is 2.0m, measured from the centre of the pole to the edge of the adjacent travel lane. Placement of the pole and the positioning of the signal heads mounted on the vertical shaft of the pole shall be designed outside the swept path (both right and left turns) of the design vehicle and therefore minimizing potential encroachment of trucks to the signal poles and the traffic control devices mounted on the signal pole.

It is difficult to achieve the required clear zone distance at advance warning flasher locations on a rural, high speed roadway. Due to the side slope of the roadway at the advance warning flasher location, the advance warning flasher pole would end up considerably lower than the crown of the roadway if it was to be installed outside the clear zone, and result in insufficient vertical clearance between the advance warning flasher sign and the pavement surface. It would also require an AWF pole with a long mast arm. Therefore, advance warning flasher poles should be installed closer to the edge of pavement of the travel lanes and be protected by guardrails.

Urban Intersections

At urban intersections, it is impractical and often not feasible to meet the clear zone requirements for traffic signal poles at an intersection simply due to the narrower road widths of urban roads; as well as the need to provide accessibility of the pushbuttons to the pedestrians. Therefore, the placement requirements for signal poles at an urban intersection are recommended as follows:

- In urban areas where the signal poles are located on raised centre medians, the recommended practice is a minimum offset of 0.75 metres (measured from the centre of the pole to the face of curb) and the pole shall be located at least 3.0 metres from the median nose.
- In urban areas, for locations other than the centre median, the minimum offset is 1.5 metres; measured from the centre of the pole to the face of curb.
- In urban areas, along higher speed roadways (70 km/h or higher posted speeds), the minimum offset should be increased from 1.5m to 2.0m; measured from the centre of the pole to the face of the curb.
- Due to concern for secondary collisions, breakaway bases are not recommended for traffic signal cantilever poles. Also, the use of barriers can cause problems for pedestrian access to the push buttons on the pole.

1.4 Implementing Reduced Speed Zones

Many traffic signals on provincial highways are located along high speed roadways where the posted speeds are reduced to 80 km/h or less in the vicinity of the intersection. The reduction of posted speed is needed as traffic signal operations are typically effective up to these speed levels. Beyond these speed levels, very long amber clearance intervals will be needed, to the extent that it is perceived by the drivers as too long and often resulting in disrespect or non-compliance of the designed amber intervals.

1.5 Active Advance Warning Flashers (AAWF)

On higher speed roadways where the driver may not be expecting to slow down or stop, it is desirable to provide some advance warning of an impending traffic signal phasing change (from green to amber) at the approaching intersection. The Contractor shall carry out an AAWF warrant assessment using procedures provided in the TAC's Advance Warning Flasher Guidelines.

If AAWF is warranted, the placement of the AAWF and the AAWF timing shall be determined using the procedures outlined in the TAC Guidelines. A perception-reaction time of 1.5s, and a deceleration rate of 2.6 m/s^2 shall be used.

1.6 Vertical Clearance

Mast arm of signal poles shall provide a minimum of 5.8 metre clearance between the lowest point of all fixtures mounted on the mast arm and the crown of the roadway pavement surface.

The current Alberta standard for signal poles requires a mast arm mounting height of 6.5m. This requirement will typically provide sufficient flexibility in pole base placements to achieve the 5.8 metre vertical clearance requirement.

With the typical signal head mounting height needed to provide a 5.8 metre vertical clearance, the signal heads shall be installed at least 21 metres ahead of the stop line to satisfy the vertical cone of vision criteria.

The maximum heights the pole base can protrude from the surrounding surface are 150mm and 500mm respectively for urban and rural conditions.

For advance warning flasher poles, the mast arm mounting height is 7.0 metre to account for the height of the large overhead AWF signs.

1.7 Truck Turning Radii

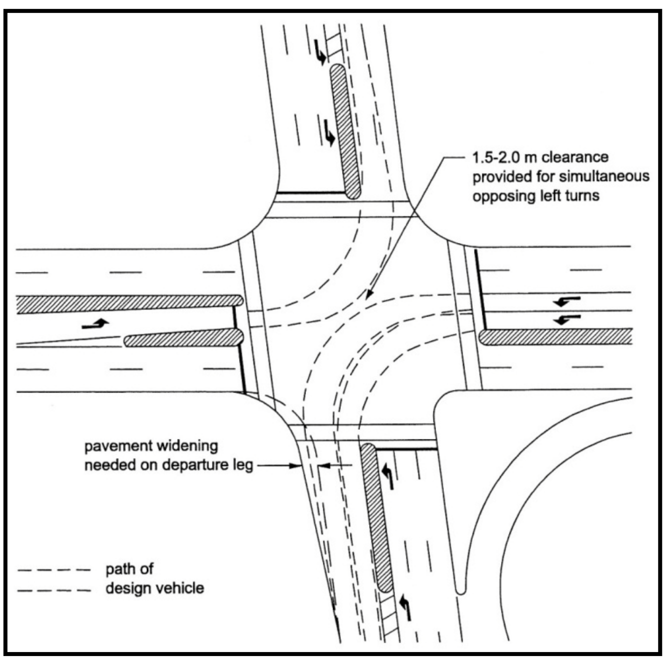


Figure 6 Opposing Left Turns with Double Left Turn Lanes

Turning sweep paths of large design vehicles often have severe geometric requirements at intersections. If not properly placed, signal poles located at corners with high turning truck volumes are often hit by turning trucks or force the turning vehicles to make a much wider turn to avoid the signal pole (and potentially encroaching into the adjacent travel lane). The receiving lanes for turning vehicles also need to be designed so that there will be sufficient width to receive the turning vehicles. The situation is more severe case when one or both of the opposing left turns consist of double left turn lanes (see Figure 6).

Figure 7 illustrates the turning template checks needed at a signalized intersection. The following design strategies are illustrated in the figure:

- The minimum right turn radius template for the WB-21 design vehicle is often used (WB-36 for the major interchanges in the Northeast Anthony Henday Drive DBFO Project) for checking if the turn radius is adequate. It is important that the swept path of the turning truck remains in the outside (curb) lane to avoid potential sideswipe collision with vehicles in the adjacent lane.
- The swept path of the right turning vehicle also determines if the width of the receiving approach is adequate. Often, the tail end of the right turn swept path determines the width of the receiving approach and the middle of the swept path determines the size of the corner turn radius.
- A larger right turn radius template is often used for right turn pork chop islands. The larger turn radius allows a higher right turn speed which is welcomed by larger trucks. Otherwise, the trucks will have to turn at a speed of 15 km/h or slower to make a 15m radius turn.
- A turning radius larger than the minimum turning template is often used for left turns.
- The turn paths of left turning vehicles can be made to the outside lane of the receiving approach. However, the swept path should be kept within the through lanes and not encroaching into the acceleration taper.
- Another criterion in checking the left turn swept path is that there should be a minimum of 1.5 to 2.0 metre of separation between opposing swept paths. At locations where it is expected to have low to sporadic truck traffic, a lower limit of 1.0 m can be used for the opposing swept path separation.
- The left turn swept path also determines the location of the median nose of the cross street.

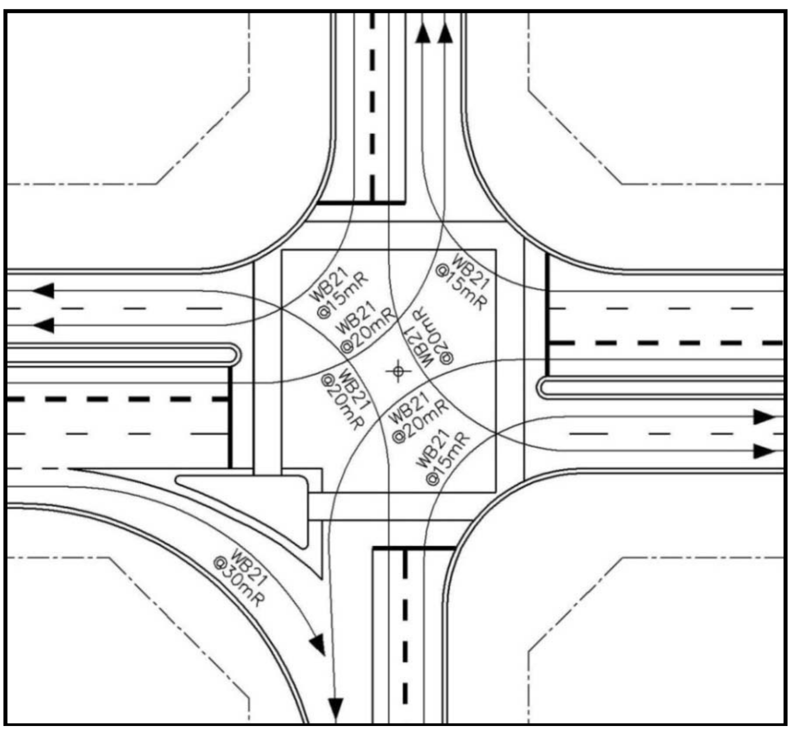


Figure 7 Design Vehicle Turning Template Checks (WB-36 for the Major Interchanges in the Northeast Anthony Henday Drive DBFO Project)

Figures 8 and 9 illustrate two examples of the check needed at urban intersections in order to satisfy all right and left turn swept paths of the design vehicle.

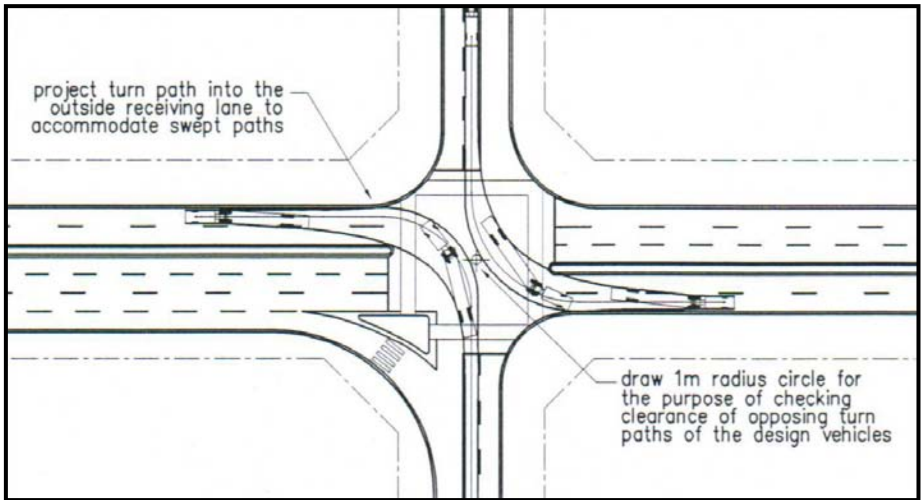


Figure 8 Urban Intersection – Swept Path Check (turns made from Minor Road)

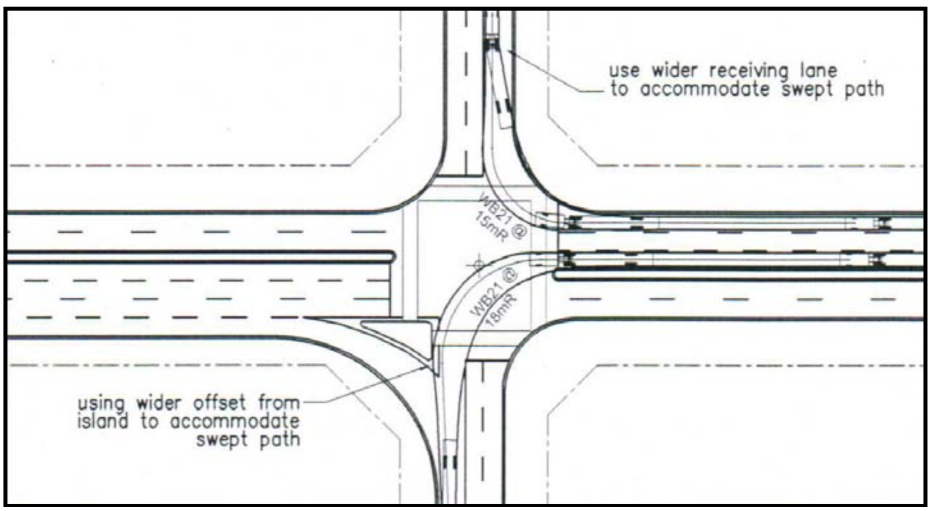


Figure 9 Urban Intersection – Swept Path Check (Turns made from Major Road)

1.8 Signing at Signalized Intersections

Drivers approaching a signalized intersection require guidance on the name of the crossing street, the lane configuration, and in some situations either trailblazing or destination signing. Signing treatments to consider at signalized intersections include:

- **Increasing the size of signs**: Signs located on wide streets are more difficult to read from the far lane. Likewise, signs located overhead on mast arms appear smaller to drivers and therefore need to be substantially larger than ground mounted signs to have the same target visibility.
- **Use of overhead lane designation signs:** On high volume approaches with multiple lanes, these signs provide improved visibility and may help correct a problem with sideswipe collisions on the

approach due to last minute lane changes. Ground mounted signs may be less visible in a typical urban environment due to visual clutter.

- **Use of overhead lane designation signs at interchange signalized ramp intersections:** At signalized ramp intersections at an interchange, overhead lane designation signs are required for <u>all</u> approaching lanes <u>if</u> there is insufficient intersection sight distance for the approach lane markings (i.e. with the object height adjusted to 0m). i.e. The supplementary overhead lane designation signs are needed whenever the lane markings at the intersection approach are not visible for approaching traffic from a distance equal to the intersection sight distance.
- **Use of large street name signs on mast arms:** Signs on a mast arm are within the driver's cone of vision and are significantly more conspicuous than ground mounted street name signs.
- **Advance street name signs:** Signs in advance of the intersection (either identifying the name of the crossing road), trailblazing signs (to significant traffic generators), and signs indicating destinations (in rural areas) will assist drivers in choosing the appropriate lane prior to arriving at the signalized intersection, reducing the likelihood of driver error such as last minute lane changes / signal indication.

Commonly used traffic control signs at an intersection are summarized in **Table 3**.

Table 3 Typical Signs at Traffic Signals

Sign No	Description	Location	Sign Size	Sign Material
WD-182	NEW (Sunburst)	100 m to 250 m upstream	90cm x 90cm	Diamond Grade
Custom	TRAFFIC SIGNAL (white on red)	100 m to 250 m upstream	60cm x 45cm	Diamond Grade
RB-17L	No Left Turn on Red	Beside protected-only left turn signal	60cm x 90cm	Diamond Grade
RB-25	Keep Right	At median nose	60cm x 75cm	Diamond Grade
RB-41L *	Left Turn Only	On mast arm or at median nose	75cm x 75cm	Diamond Grade
RB-41R *	Right Turn Only	On mast arm or at right turn lane	75cm x 75cm	Diamond Grade
RB-42L *	Straight Through or Left Turn Only	On mast arm	75cm x 75cm	Diamond Grade
RB-42R *	Straight Through or Right Turn Only	On mast arm	75cm x 75cm	Diamond Grade
RB-45 *	Straight Through Only	On mast arm	75cm x 75cm	Diamond Grade
RB-46L *	Double Left Turn	On mast arm or median nose	75cm x 75cm	Diamond Grade
WA-17	Double Arrow	At median nose or island	75cm x 75cm	Diamond Grade
WA-33R	Road Narrow Loss of Lane		75cm x 75cm	Diamond Grade
WA-36	Hazard Marker – Centre	Next to obstructions	30cm x 90cm	Diamond Grade
RA-4	Pedestrian Crosswalk	~ 1 to 5 m ahead of crosswalk	60cm x 75cm	Diamond Grade
WB-4	Signal Ahead	Advance of traffic signal	75cm x 75cm	Diamond Grade
WB-5	Prepared To Stop (2-20cm dia lights)	Advance of traffic signal	2.4m x 1.5m	Diamond Grade
ID-21L/R	For Walk Signal Push Button	Above pushbutton	13cm x 20cm	High Intensity
RB-66	Pedestrian Prohibited	Where crossing is not desired	60cm x 60cm	High Intensity
RC-4L/R	Stop Line Sign	Right or left of stop line	60cm x 75cm	High Intensity

* At interchange ramp intersections, often the profile of the overpass structure will not always provide the approaching traffic with adequate intersection sight distance to the intersection approach. As a result, drivers will not be able to distinguish ahead of time the lane designation of the approaching travel lanes. Therefore, overhead lane designation signs shall be used on all approaching lanes at interchange ramp intersection traffic signals, whenever the intersection sight distance cannot be achieved for the lane markings at the intersection approach.

1.9 Pavement Markings

Pavement markings are critical to the operations of a signalized intersection, especially where there is complex intersection geometry, heavy turning movements or non-standard intersection lane configuration. For complex intersection designs, a separate pavement marking plan should be prepared as part of the traffic signal drawing package. Typical pavement marking design requirements are shown in Figure 10. Durable pavement markings shall be used for stoplines, crosswalk lines and track lines (left turn guide lines) for left turns (where they are warranted such as between dual left turn lanes).

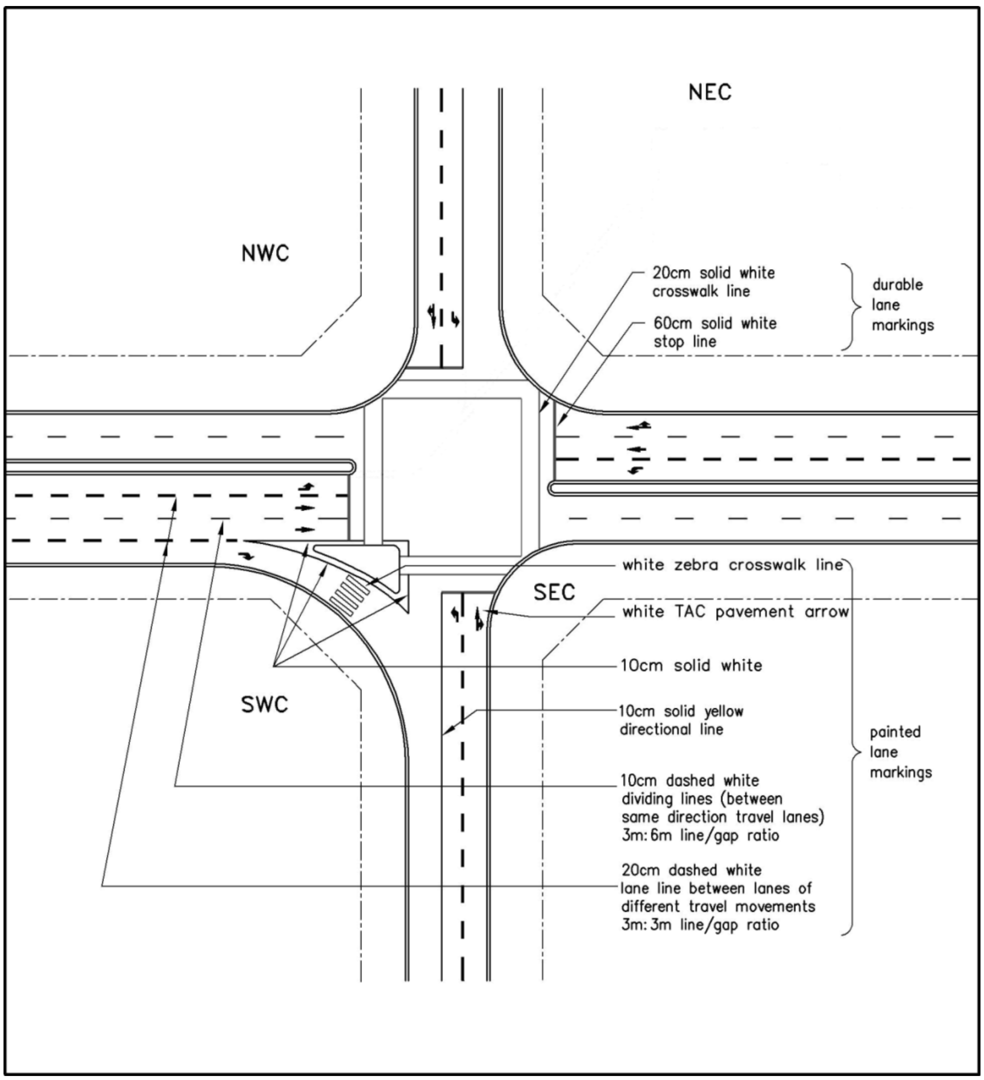


Figure 10 Intersection Pavement Markings

1.10 Signal Head and Overhead Lane Designation Sign Display Placement

The *Signal Head and Overhead Lane Designation Sign Display Placement Guidelines* for the NE AHD DBFO Project are illustrated in **Figures F1.1 to F14.2** attached at the end of **Package F**. **Table 4** below outlines the attributes of the various figures.

Table 4 Signal Head and Overhead Lane Designation Sign Display Placement Guidelines

Fig	Application	No of Lanes in approach	High Speed / Low Speed Roads	With Turn Bay?	With Centre Median?	Left Turn Signal Phase
F1.1	2-lane undivided road (low speed)	1 lane	Low speed	No	No	No
F1.2	2-lane undivided road (low speed)	1 lane	Low speed	No	No	left turn signal
F2.1	2-lane undivided road (low speed)	Flared	Low speed	short turn bay	No	No
F2.2	2-lane undivided road (low speed)	Flared	Low speed	short turn bay	No	left turn signal
F3.1	2-lane undivided road (all speeds)	2 lanes	All speeds	left turn bay	No	No
F3.2	2-lane undivided road (all speeds)	2 lanes	All speeds	left turn bay	No	left turn signal
F4.1	2-lane undivided road (low speed)	2 lanes	Low speed	left turn bay	No	No
F4.2	2-lane undivided road (low speed)	2 lanes	Low speed	left turn bay	No	left turn signal
F5.1a	2-lane undivided road (all speeds)	2 lanes	All speeds	left turn bay	painted	No
F5.1b	2-lane undivided road (all speeds)	2 lanes	All speeds	left turn bay	painted	left turn signal
F5.2a	2-lane undivided road (all speeds)	2 lanes	All speeds	left turn bay	concrete	No
F5.2b	2-lane undivided road (all speeds)	2 lanes	All speeds	left turn bay	concrete	left turn signal
F6.1	4-lane undivided road (low speed)	2 lanes	Low speed	No	No	No
F6.2	4-lane undivided road (low speed)	2 lanes	Low speed	No	No	left turn signal
F7.1	4-lane undivided road (high speed)	2 lanes	High speed	No	No	No
F7.2	4-lane undivided road (high speed)	2 lanes	High speed	No	No	left turn signal
F8.1	4-lane undivided road (low speed)	3 lanes	Low speed	left turn bay	No	No
F8.2	4-lane undivided road (low speed)	3 lanes	Low speed	left turn bay	No	left turn signal
F9.1	4-lane undivided road (high speed)	3 lanes	High speed	left turn bay	No	No
F9.2	4-lane undivided road (high speed)	3 lanes	High speed	left turn bay	No	left turn signal
F10.1a	4-lane divided road (all speeds)	3 lanes	All speeds	left turn bay	painted	No
F10.1b	4-lane divided road (all speeds)	3 lanes	All speeds	left turn bay	painted	left turn signal
F10.2a	4-lane divided road (all speeds)	3 lanes	All speeds	left turn bay	concrete	No
F10.2b	4-lane divided road (all speeds)	3 lanes	All speeds	left turn bay	concrete	left turn signal
F11.1	4-lane divided road (all speeds)	3 lanes	All speeds	left turn bay	concrete	Prot/Permissive
F11.2	4-lane divided road (all speeds)	3 lanes	All speeds	left turn bay	concrete	Prot/Prohibited
F12.1	4-lane divided road w/ wide median	4 lanes	High speed	left & right	depressed	No
F12.2	4-lane divided road w/ wide median	4 lanes	High speed	left & Right	depressed	left turn signal
F13.1	4-lane divided road w/ wide median	4 lanes	High speed	left & right	slotted left	No
F13.2	4-lane divided road w/ wide median	4 lanes	High speed	left & right	slotted left	Prot/Permissive
F13.3	4-lane divided road w/ wide median	4 lanes	High speed	left & right	slotted left	Prot/Prohibited
F13.4	4-lane divided road w/ wide median	5 lanes	High speed	dbl-left & right	slotted left	Prot/Prohibited
F14.1	6-lane divided road w/ wide median	5 lanes	All speeds	left & right	concrete	Prot/Prohibited
F14.2	6-lane divided road w/ wide median	5 lanes	All speeds	left & Right	slotted left	Prot/Prohibited

2. Traffic Signal Detailed Design & Drawing Preparation

2.1 Base Plan Preparation

The design of a new signalized intersection begins with the preparation of a base plan. The base plan defines the general geometric characteristics of the intersection and provides the designer with the context for which to develop the detailed design.

The base plan for a traffic signal design shall consist of at least the following information:

- North Arrow and SWC, NWC, NEC, SEC (identifying the 4 corners of the intersection)
- Street names
- Right of way (ROW) or property lines
- Curb lines (or edge of pavement)
- Ramps, sidewalks or pathways
- Medians and islands
- Utility lines, poles, power source
- Pavement markings (locations and dimensions)
- Signs (location and message)

Figure 11 illustrates a typical base plan for an urban intersection. .

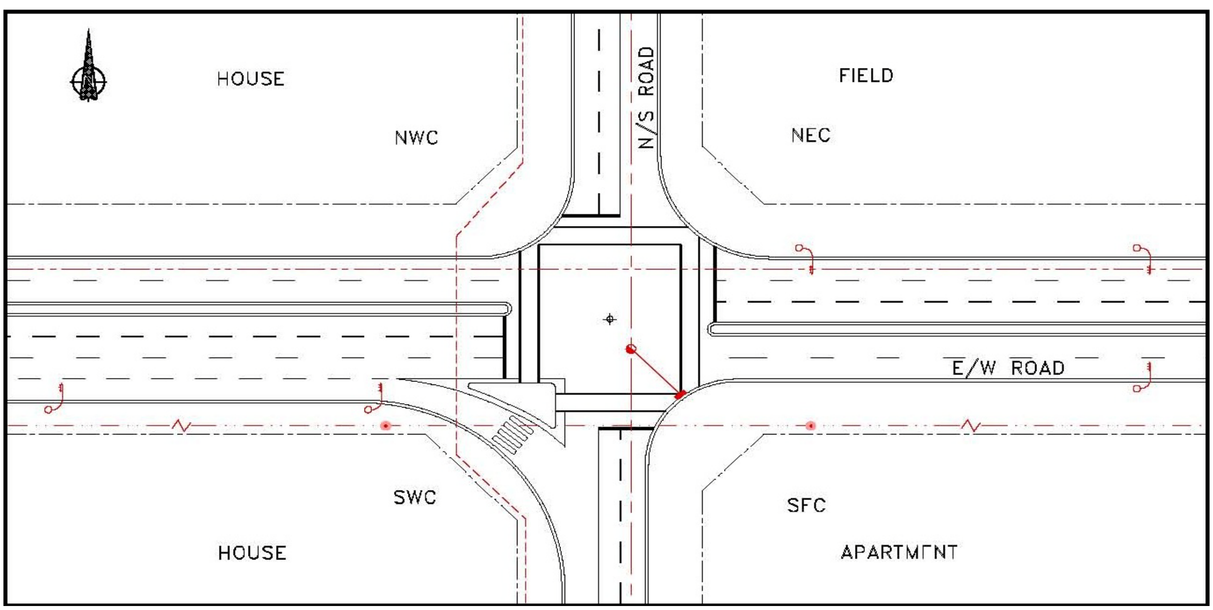


Figure 11 Base Plan for Traffic Signal Design

2.2 Traffic Signal Drawings - General

A complete set of traffic signal drawings have a minimum of 4 drawings – Above Ground, Below Ground, Pole Elevations, and Tables and Schedules. A fifth drawing for pavement markings may be used for locations where the intersection layout is more complex or non-conventional.

2.2.1 Above Ground Installations Drawing

Information required on an Above Ground Installations drawing is illustrated in Figure 12. The above ground installations design includes:

- signal pole size (length of mast arm) and placements
- type of signal display (phasing)
- position and orientation of vehicle and pedestrian signal heads
- signing
- pavement markings (including stopline and crosswalk lines locations)
- location, orientation and mounting position of detection devices such as cameras and pedestrian pushbuttons
- traffic detection zones (number, location, size)

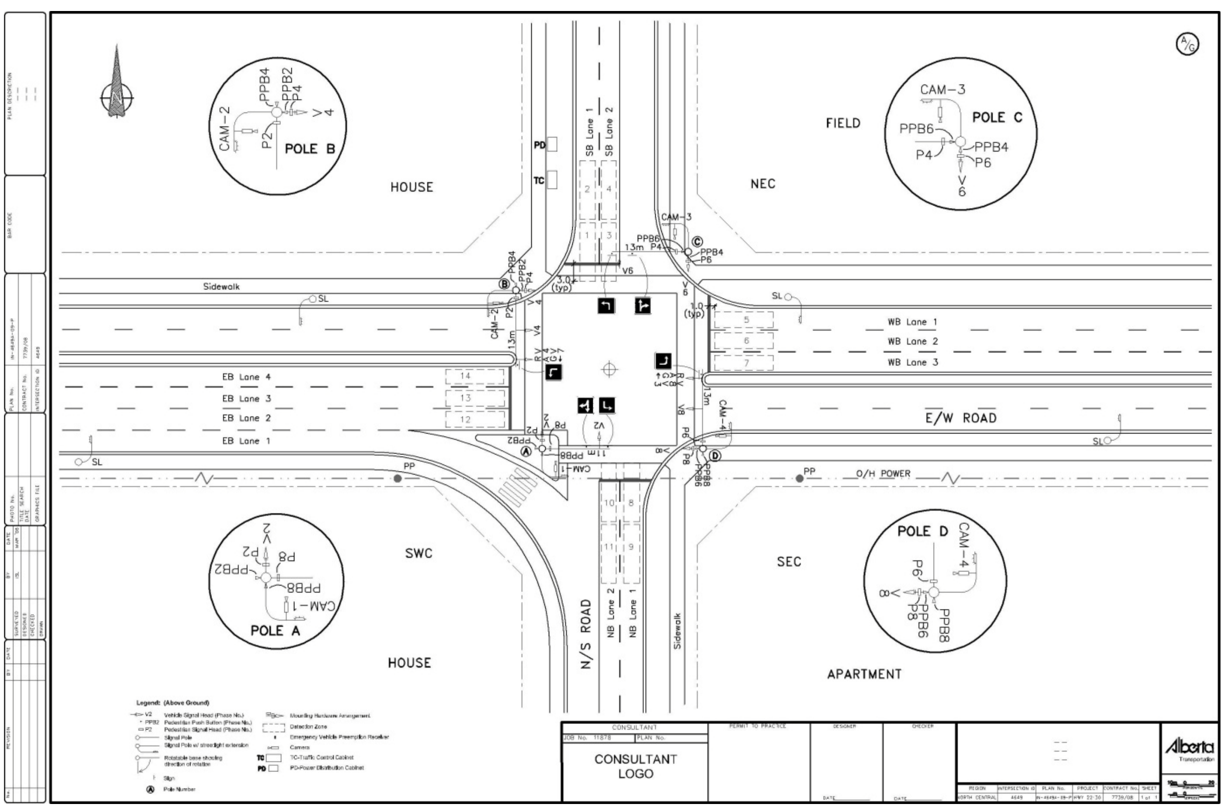


Figure 12 Traffic Signal - Above Ground Installations

2.2.2 Below Ground Installations Drawing

The below ground installation design is normally done after the above ground installation design is completed, as shown in **Figure 13**. The below ground installations design includes:

- Location, quantity and alignment of the below ground conduit system
- Location and size of the junction boxes
- Locations where ground rods or lightning electrodes are needed
- A layout location table is provided to assist the field engineer or surveyor to lay out the locations of the pole bases and junction boxes. (it can be replaced by a coordinate table)

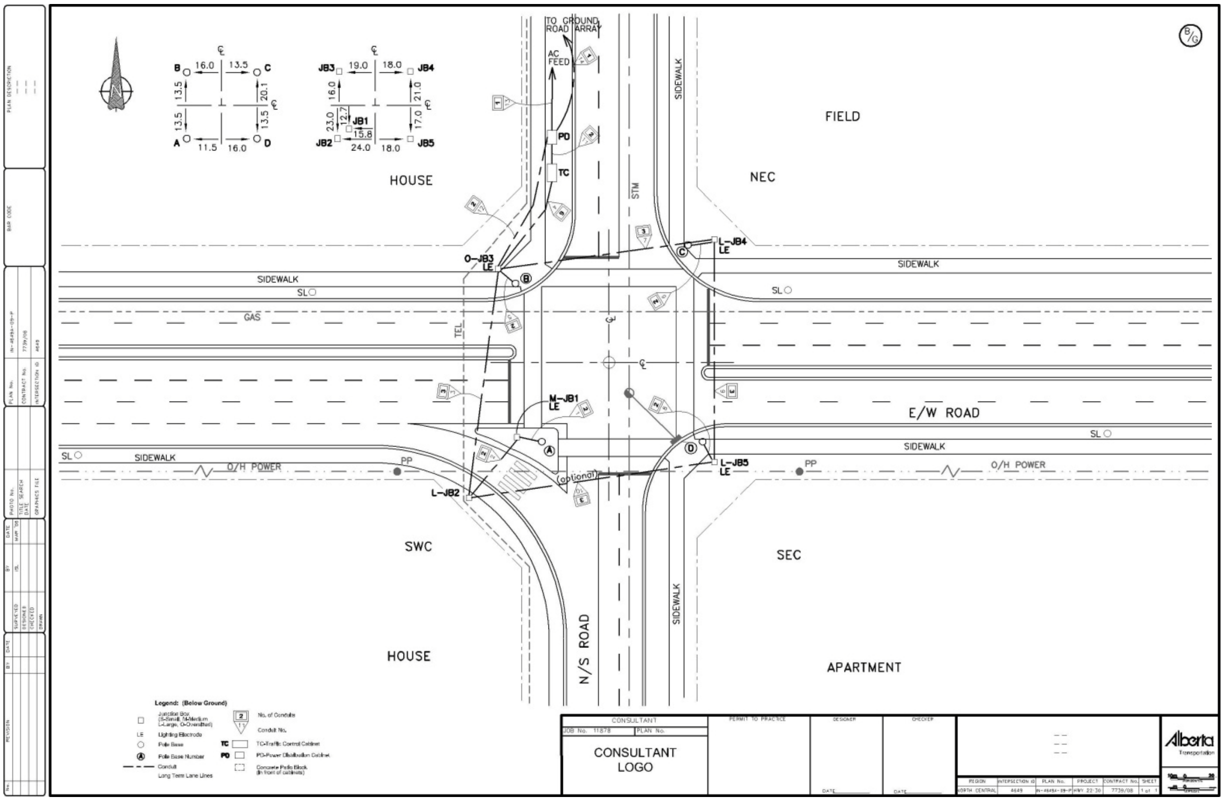


Figure 13 Traffic Signal - Below Ground Installations

2.2.3 Pole Elevations Drawing

The Pole Elevation drawing is often relied on in field inspection as it clearly shows the location, size and shape of the traffic control devices of the traffic signal design, as shown in **Figure 14**. In addition, it also shows the mounting or alignment requirements of the overhead traffic control devices mounted on the mast arm of the signal pole. It also shows information such as pole base type and sizes, pole anchor bolt dimensions (bolt circle diameter, or B.C.D.), streetlight davit orientation, mounting position of traffic cameras, and mounting height of traffic signal heads, pedestrian signal heads and pedestrian pushbuttons.

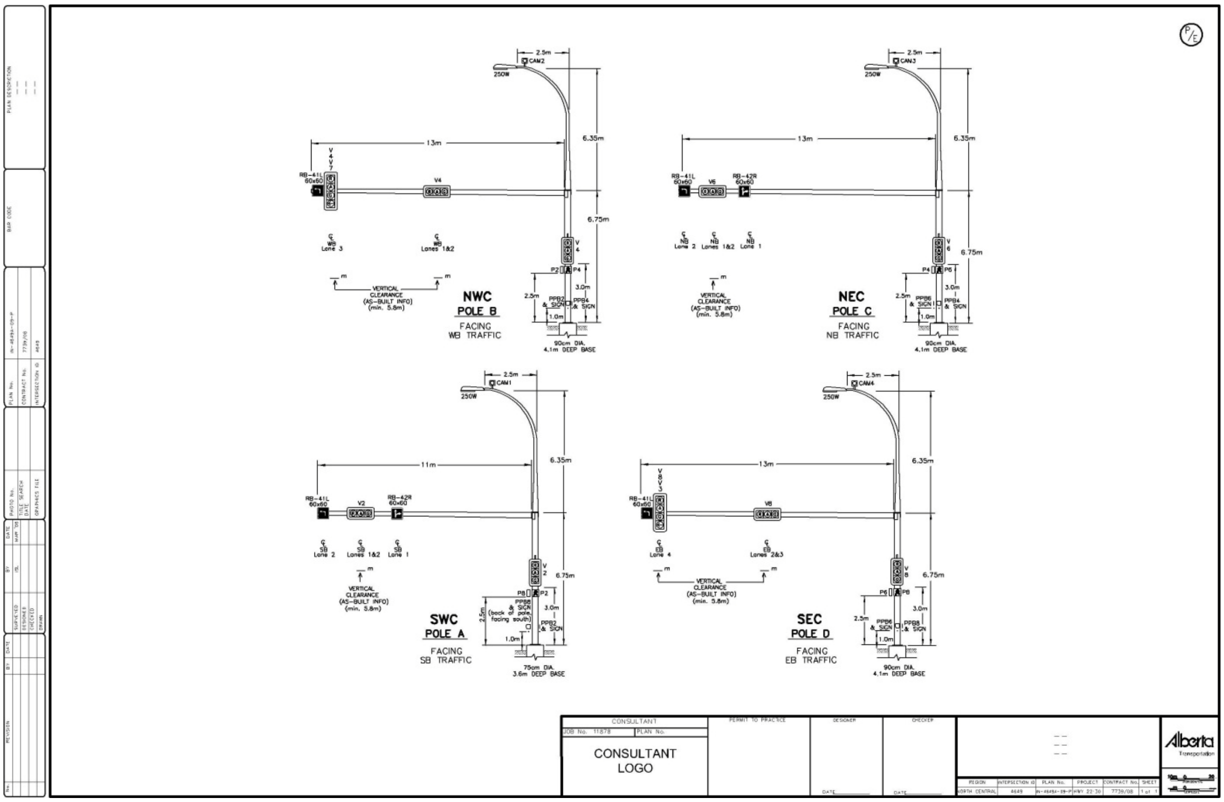


Figure 14 Traffic Signal – Pole Elevations

2.2.4 Tables and Schedules

The Table and Schedules drawing provides crucial information on signal phasing, signal timings (initial timings), cabling requirements, detection setting requirements, conduit schedule, as well as an equipment list. An example is shown in **Figure 15.**

The function of these tables and schedules are as follows:

- **Signal Phasing –** to be used by traffic cabinet manufacturer in configuring the cabinet; also used by the traffic signal contractor in confirming the signal operating sequence requirements. Information such as posted speeds, and potential needs for back-up protection (or anti-backup, needed in some cases to prevent left turn entrapment), and advance warning flasher requirements should also be provided.
- **Signal Timings –** these are initial settings to be programmed in by the traffic controller manufacturer or the traffic signal contractor. The timing values are normally basic timing settings that are calculated based on the design requirements such as posted speed, crosswalk widths, clearance distances, and detector settings (locking or non-locking mode, extension time, etc.). Information such as controller model type, pre-commissioning flash program, emergency flash setup, start-up flash set-up, emergency vehicle preemption (present or not), railway preemption (present or not), and advance warning flasher (location, advance warning time) should also be provided.

- Cabling Requirement – to be used as a guide by the traffic signal contractor in planning for cable requirements for the traffic signal. This information ensures compliance with the cable requirements in the traffic signal specifications. This table should be used in conjunction with the Department's Traffic Signal Standard Drawings TCS-F-101, Wiring Assigning for Traffic Control Signal, and TCS-F-105, Schematic Wiring Diagram.
- Detector Setting – to be used by the traffic signal contractor in configuring or programming the detectors in the controller. It should provide information such as detection zone setting, assignment of detection zones to respective detectors, size and location of the detection zones, detection zone call phase, and detection zone delay settings. (as per the Detection Zone Design Guidelines in Appendix G)
- Conduit Schedule – to be used by the traffic signal contractor in planning for conduit and junction box requirements for the traffic signal. It should provide information such as size and quantity of conduits, conduit installation method (push vs auger)and junction box size and quantity for each specific conduit number and junction box number labelled on the below ground installations drawing.
- Equipment List (Optional)

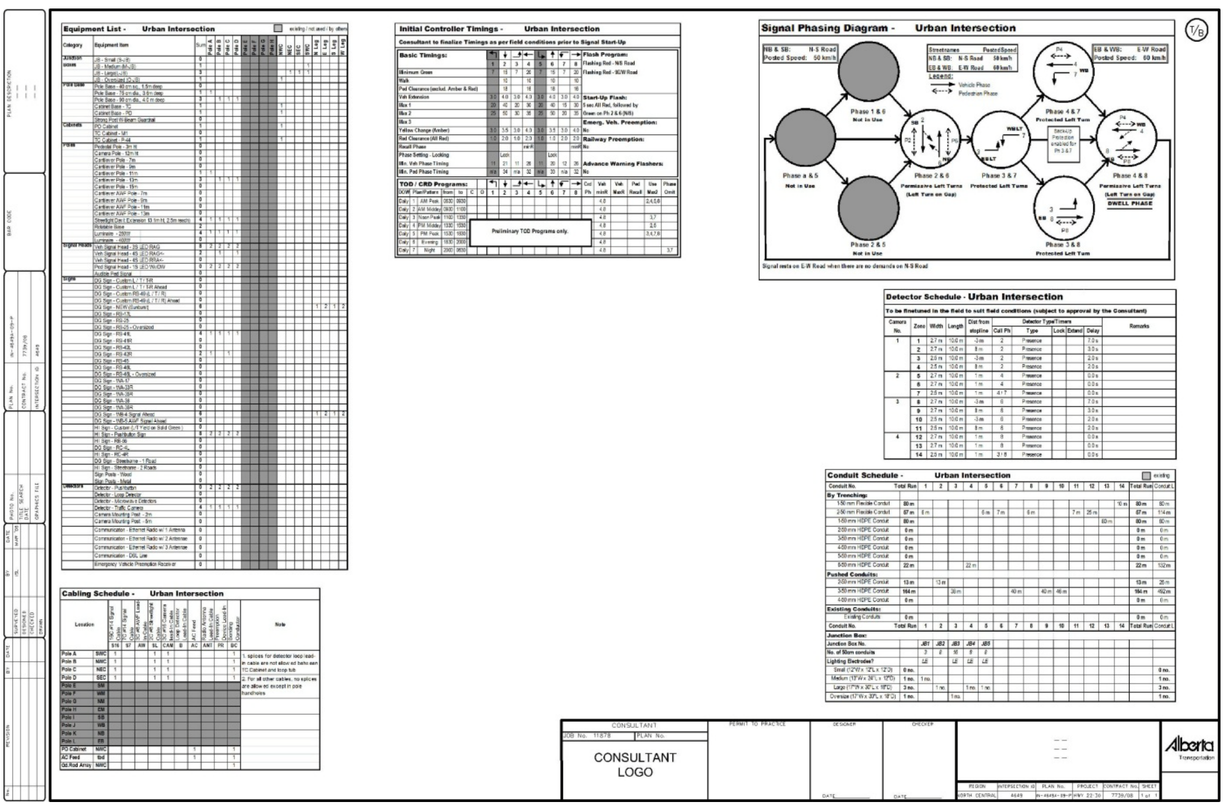


Figure 15 Traffic Signal – Tables and Schedules

2.2.5 Signs and Pavement Markings

The minimum pavement marking requirements needed for traffic signal drawings are:

- Stoplines (accurate locations)
- Crosswalks (accurate locations)
- Left turn guide lines for double left turn lanes and for left turns that require supplementary guidance (e.g. wide, long intersections with tight opposing left turn swept paths)

The minimum signing requirements needed for traffic signals drawings are:

- Stopline signs (especially at wide rural intersections with large corner radii and for locations where stopline locations are critical to prevent encroachment of the stopped vehicles into the left turn vehicle swept paths)
- Overhead lane designation signs (as per the Traffic Signal Display Guidelines in Appendix F)
- Signs that are crucial for use in combination with traffic signal displays (e.g. left turn signs adjacent to left turn signal heads, No Left Turn On Red signs adjacent to protected-prohibited left turn signal heads)

2.2.6 Drawing Scales

The standard drawing size for a traffic signal drawing is 559mm x 864mm (22" x 34") when prepared at a scale of 1:250.

Plotted at half size or at a scale of 1:500, this will result in a more portable drawing size of 279mm x 432mm (11"x 17"). At this drawing size, the Above Ground and Below Ground drawings will be plotted at a scale of 1:500 whereas the Pole Elevation drawing will be plotted at a scale of 1:150. The Tables and Schedules drawing is not set to any particular scale.

The 279mm x 432mm (11"x 17") format will allow all the intersection details fit onto one sheet for most if not all signalized intersection types, and still keeping the design details legible. The general guideline is that key design details and design information in the design drawings, tables and schedules shall be legible when plotted at half scale on 279mm x 432mm (11"x 17") sheets.

2.3 Traffic Signal Drawings – Detailed Design Guidelines

Prior to starting the layout of the traffic signal hardware, the designer should consider a number of operational components which influence the design and operation of the traffic signal. These components include signal phasing requirements, lane requirements and detection requirements, and the need for signal coordination with adjacent traffic signals.

2.3.1 Below Ground Design

2.3.1.1 Base Plan and Conventions

The base plan for the Below Ground Installations drawings has the following information:

- Layout plan as per the previous section
- All underground utilities
- Overhead utilities such as streetlights, power poles, etc.

Figure 16 illustrates the base plan needed to prepare for a below ground signal installation design.

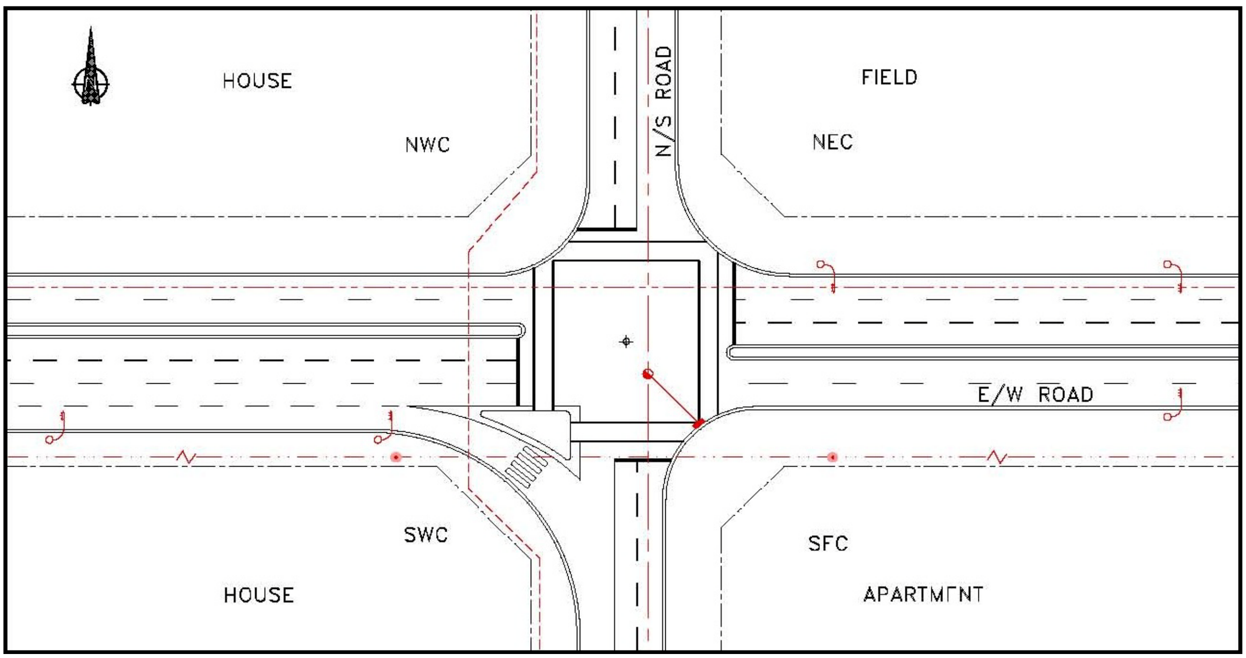


Figure 16 Base Plan for Traffic Signal Below Ground Installation Design

In order to determine the optimum pole locations, the designer must strike a balance between desirable cone of vision of the signal display, the proximity of the poles to the intersection vs. clearance from road traffic, and the economical design of pole structures (poles farther away means longer and larger poles will be needed). Pole selection is based on standardized mast arm lengths of 7m, 9m, 11m, 13m and 15m. These poles share the same bolt circle diameter (BCD) of 400 cm. To provide further flexibility, the pole base plate shall provide anchor bolt slots to fit pole base BCD's of 395mm diameter and 405mm diameter.

To provide further flexibility, the arm flange on all poles should have the same bolt pattern design. In addition, the design of the vertical pole shaft shall be such that it can handle various mast arm lengths, as illustrated in Table 5.

Table 5 Cantilever Poles and Bases

Pole Type	Arm	Pole Shaft can carry Mast Arms with reach of	Pole Shall Fit in Pole Base Size of
15m cantilever pole	15m	15m, 13m, 11m, 9m	90 cm diameter base
13m cantilever pole	13m	15m, 13m, 11m, 9m	90 cm diameter base
11m cantilever pole	11m	13m, 11m, 9m	75 cm diameter base
9m cantilever pole	9m	11m, 9m	75 cm diameter base

The Below Ground Installations drawing shall include the following information:

- Pole bases (with Pole numbers)
- Cabinet bases (with labelling)
- Junction Boxes (with Junction Box Number, Grounding / Lightning Electrode needs, size)
- Conduits (size, quantity, Conduit Number)
- Power Source location
- Layout information for the main pole bases and main junction boxes

The following legends (Figure 17) are used for Below Ground Installations drawings.

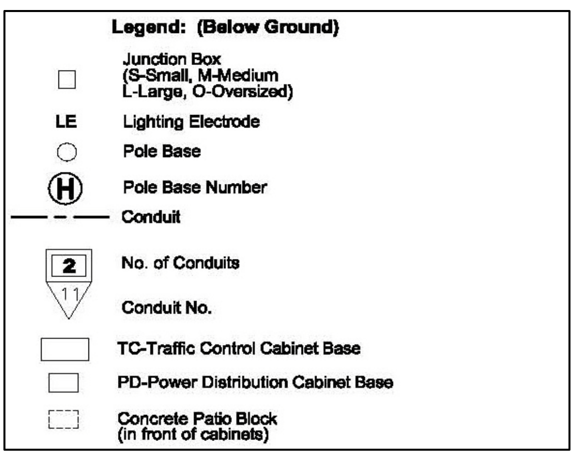


Figure 17 Legend for Below Ground Installation

An example of the resulting Below Ground Installations drawing is shown in Figure 18:

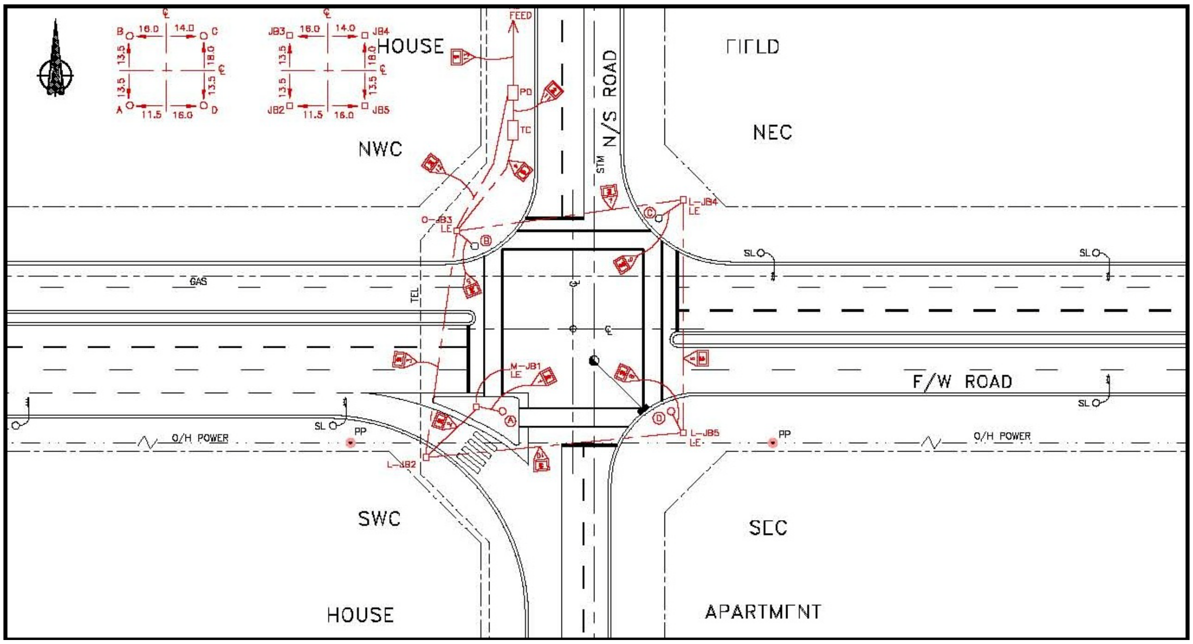


Figure 18 Below Ground Installation Design

Below ground installation design guidelines are as follows:

2.3.1.2 Conduits

When installing junction boxes, the designer should:

- Avoid low areas where water may collect inside the box.
- Avoid placing junction boxes within sidewalks as they become potential tripping hazards.
- Construct a complete conduit ring (i.e. conduit crossings on all approaches). In the event of a collapse in one of the conduit crossings, cabling can be re-routed through another conduit. At least 2-50mm conduits are used for cross-road conduit runs, terminated in corner junction boxes. Additional conduits are included where necessary to meet cabling requirements.
- 2-50mm conduits are used between pole bases and the adjacent junction boxes.
- 2-50mm conduits are used between the traffic controller (TC) cabinet and the power distribution (PD) cabinet.
- 1-50mm conduit is used between the PD cabinet and the power source.
- 2-50mm conduits are used between the PD cabinet and the adjacent junction box for housing the streetlight cables (Note: This allows the streetlight cable to be connected directly to the signal poles without routing through the TC cabinet).
- 1-50mm conduit is used to connect to the junction box beside the advance warning flasher (AWF) pole.

- All conduits are labelled and numbered on the drawing. Conduit numbering begins with the conduit run for Pole A, from the pole to the TC cabinet, then Pole B, etc. The number of conduits in the conduit run is shown on the plan.
- A minimum of 6-50mm conduits are needed between the TC cabinet and the junction box adjacent to it (main cabling run) for a typical 4 pole traffic signal intersection.
- A minimum of 8-50mm conduits are needed between the TC cabinet and the junction box adjacent to it (main cabling run) for a large 8 pole traffic signal intersection (e.g. 4 corner poles, 2 median poles, and 2 AAWF poles).
- All conduits shall be HDPE conduits, except for conduits between pole bases and junction boxes located in close proximity of the pole bases. Flexible conduits or polytubes can be used between pole bases and adjacent junction boxes located within 7m of the pole base.
- Guidelines for conduit requirements are summarized in **Table 6.**

Table 6 Conduit Requirements

Application	No of Conduits Needed	Size (mm)	Type
Minor Road Crossing	2 (Minimum)	50	HDPE
Major Road Crossing	3 (Minimum), 4 (if streetlight cable included)	50	HDPE
Main Pole to Junction Box	2 (Minimum); 3 (if the streetlight davit is on the signal pole)	50	Flexible or Polytube
Minor Pole to Junction Box	1	50	Flexible or Polytube
TC Cabinet to PD Cabinet	2	50	HDPE
PD Cabinet to Power Source	n/a (direct burial using flexible armoured cable such as teck cable)	n/a	n/a
TC Cabinet to AAWF Pole	1	50	Polytube or HDPE
TC Cabinet to adjacent Junction Box (Main Run)	6 (Minimum) 8 (for larger traffic signals with additional median poles and AAWF poles)	50	HDPE

Conduits across road shall be buried to a minimum depth of 1.2 m. In cases where there will be imminent road construction or where there will be future road widening, the conduit depth shall be further increased to 1.5 m.

Conduits carrying communication cables shall be buried to a minimum depth of 0.6 m.

2.3.1.3 Junction Boxes

Junction boxes shall be either concrete boxes or polymer concrete boxes pre-installed with anchors to receive lid locking bolts. The lid locking bolts shall be made of high grade steel that can withstand regular nut screwing / unscrewing actions without visible wear and tear to the nut head or nut thread. Junction box with non-ferrous lid shall have a locator ball placed inside. Junction box with metal lid shall have the metal lid grounded.

Junction boxes are used in the following situations:

- Wherever conduit run exceeds approximately 150 metres in length
- Beside a signal pole for grounding purposes via lighting electrodes (LE)
- To avoid sharp bends on the conduit run alignment

Junction boxes are labelled and numbered on the drawing. Junction box number starts from the southwest corner of the intersection (SWC) and continue the numbering process clockwise. Junction box labelling also shows size of the box (S – Small, M – Medium., L – Large, O – Oversize) and the presence of lightning electrodes (LE). The minimum dimension and depth of the various junction boxes and the criteria for selection of junction boxes of various sizes are summarized in Table 7.

In a rural situation, junction boxes are placed in the median to provide access to the signal poles in the medians.

Table 7 Junction Box Sizes

JB Type	Width (mm)	Length (mm)	Depth (mm)	Maximum No. of Conduits (no Lightning Electrodes)	Maximum No. of Conduits (with Lightning Electrodes)
Small (S)	300 (12")	300 (12")	300 (12")	3	2
Medium (M)	330 (13")	600 (24")	300 (12")	8	6
Large (L)	430 (17")	760 (30")	450 (18")	12	10
Oversized (O)	600 (24")	910 (36")	450 (18")	22	20

Figures 19 and 20 illustrate the urban and rural below ground installation designs.

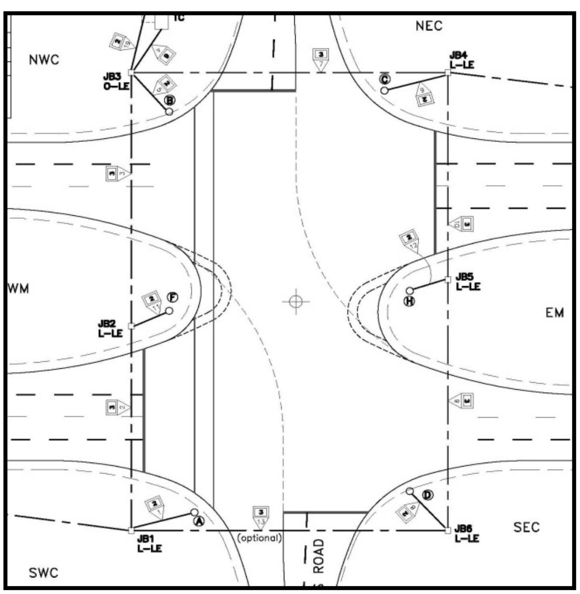


Figure 19 Rural Below Ground Installation Design

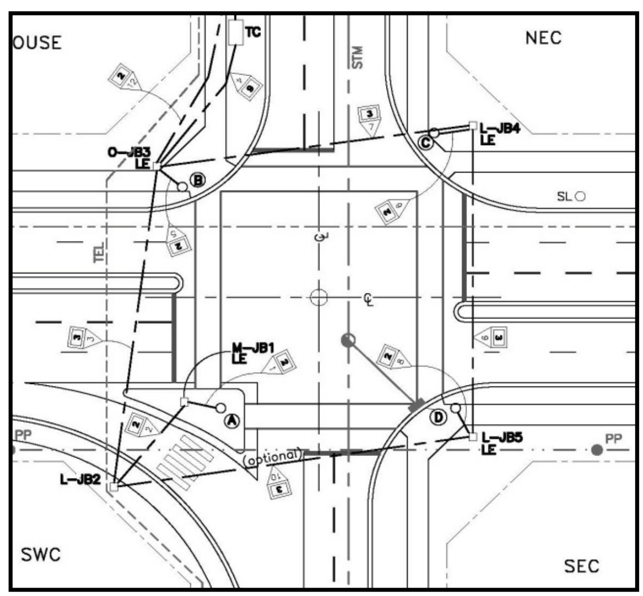


Figure 20 Urban Below Ground Installation Design

2.3.1.4 Traffic Controller Cabinet

The traffic controller cabinet (TC) should be located in accordance with the following principles:

- Strict attention should be paid to the principles of good grounding and relative freedom from interference from overhead power lines.
- In areas of 80 km/h posted speed or greater, a traffic controller cabinet offset of 10 m from the edge of pavement is desirable (an offset of 7 m is acceptable).
- The traffic controller cabinet location should not interfere with storm water flows in ditches.
- The intersection approaches should be visible from the traffic controller cabinet site.
- The traffic signal displays on at least two conflicting directions should be visible from the traffic controller cabinet location.
- The orientation of the cabinet door of the traffic controller cabinet shall be such that technicians working in front of the cabinet shall be facing oncoming traffic or facing the intersection.
- The traffic controller cabinet location should be less than 75 m from the power supply. At the same time, the controller cabinet should be more than 11 m from the power supply source.
- The traffic controller cabinet location must not interfere with the sight lines of the drivers; and the controller cabinet location should consider proposed or existing landscaping.

All new traffic signal locations shall be equipped with the P-44 cabinets.

The TC Cabinet shall consist of the following equipment in addition to the requirements outlined in the Department's Traffic Signal Specifications:

- <u>LCD Monitor</u>: The Contractor shall set up the monitor in the TC Cabinet so that the monitor is accessible and can be viewed and inspected by the Department to verify camera setup and operations. The LCD monitor shall have a minimum diagonal screen measurement of 9 inches or 229 mm.
- <u>GPS Clock</u>: The antenna for the GPS unit shall be externally mounted on the TC Cabinet and the cabling for the GPS unit shall route through a grommet hole (predrilled by the cabinet manufacturer) on the wall or roof of the TC Cabinet.
- <u>UPS Unit</u>: All TC Cabinets shall be equipped with an uninterrupted power supply (UPS) unit to keep the signals functioning at all times, even when there is an interruption in the power supply source. The UPS Unit shall come with a red LED indicator light display mounted externally on the outside wall of the TC Cabinet. The indicator light shall light up (to provide notification of the power loss situation) whenever the UPS unit is being used due to power loss. The LED indicator light should be sized so that it is clearly visible from the through travel lane of the main roadway where the TC Cabinet is located adjacent to. The UPS unit shall consist of a corrosive-fume-free battery capable of supporting the stand alone operation of the traffic cabinet and the traffic signal displays for a minimum of 2 hours.

2.3.1.5 Power Distribution Cabinet

The power distribution cabinet (PD) should be located in accordance with the following principles:

- The cabinet may be located within a ground mounted pedestal designed for that purpose;
- The power distribution cabinet may be mounted on a separate pole suiting the purpose and may be fed aerially or underground. The cabinet must have an electrical energy meter;
- The power distribution cabinet should be within 75 m of the traffic controller cabinet and should be visible from both the traffic controller cabinet and the roadway; and
- The power distribution cabinet should also be located at least 7.0 m from the traffic controller cabinet.
- Ground rods for the power distribution cabinet shall be installed at least 11m from the cabinet.

Metering requirements at the power distribution cabinet are as follows:

- Meter shall connect to the main power disconnect of the power distribution cabinet.
- The main power disconnect shall then provide power connection to separate breakers for the traffic controller cabinet and for the luminaires installed on the streetlight extension davits sitting on top of the signal poles
- Other standalone streetlights in the vicinity of the signalized intersection shall be either connected and fed by the main power breaker (i.e. metered directly by the PD cabinet power meter) or bypass the PD cabinet meter and routed as part of the highway streetlight system.
- For isolated intersections where there are no adjacent streetlights on the highway other than the ones needed at the signalized intersection, it is recommended that the intersection streetlights be powered through the PD cabinet.
- For intersections located amidst an illuminated highway corridor, it is recommended that the stand alone streetlight poles shall be wired to the rest of the streetlights along the illuminated highway corridor. The exceptions are the luminaires installed on the streetlight extension davits on the traffic signal poles, where they shall be powered through the PD cabinet.

2.3.1.6 Pole and Cabinet Bases

Traffic signal cantilever poles are typically required for each highway approach and are located in the corner of the intersection to support the primary signal displays and secondary and pedestrian displays. In areas where there is a rural cross-section with an open shoulder, the signal pole should be located back far enough to meet the clear-zone requirements. In areas where there is an urban cross-section with curb and gutter and sidewalk, the cantilever poles are typically located behind the sidewalk, centrally located, and should be setback from the face of the curb by 1.5m, or 2.0m if the posted speed is 70 km/h or higher.

In locating the pole bases, it is necessary to strike a balance between having the poles sufficiently far from the edge of pavement to avoid being hit by turning vehicles, and having the poles relatively close to avoid the need for an overly long mast arm to provide the optimum signal display.

To minimize clutter at the intersection, pedestrian pushbuttons should be mounted on traffic signal poles wherever possible. Poles carrying pedestrian pushbuttons must be accessible and user friendly (not located beyond reach behind barriers or in grass (mud) areas or areas where snow windrows will occur. Some additional sidewalk or paved shoulder may have to be coordinated with road designers to ensure pedestrians have level and safe passage to the pole to reach the pushbuttons. Pole locations should be determined in accordance with the following guidelines:

- poles should be within the extended crosswalk lines or the poles should be located within 1.5 m of the edge of the crosswalk being served;
- If the primary signal pole is located more than 5.5m from the ramp of the crosswalk or the centre of the crosswalk, a secondary pedestal pole should be used to mount the pedestrian pushbuttons and perhaps the pedestrian signal heads.
- if poles are located within sidewalks the sidewalk is typically required to be widened to provide a minimum of 1.5m clearance from the face of the pole;
- poles should be located directly adjacent to, or within sidewalks or other hard surface areas
- where a separate pole is required, it should be installed near the intersection of the centrelines of the crosswalks;
- where cyclist actuation is required, a small pushbutton post, installed 600mm behind the curb allows cyclists to stop at the stop bar and push the button without having to leave the roadway to reach a button over at the main signal pole.
- Numbering of the pole bases shall be as per the following convention:
  - Corner Poles: start from the SWC, in a clockwise fashion:
    - A – SWC;
    - B – NWC,
    - C – NEC,
    - D – SEC
  - Median Poles: starting from the south median, in a clockwise fashion:
    - E – South Median;
    - F – West Median;
    - G – North Median;
    - H – East Median
  - AAWF Poles: starting from the north leg, in a clockwise fashion:
    - I – North Leg;
    - J – East Leg;
    - K – South Leg;
    - L – West Leg

Median pedestal style poles are used where there are advanced protected / prohibited and protected / permissive left turn phases, and there is room in the median to safely accommodate the median pole (raised medians of 1.5m wide in urban areas can be utilized to locate median poles). Where insufficient room in the median is available, a long-reach cantilever signal pole may be used to hang the primary display for the advanced left turn phase.

Tubular signal bridge structures are sometimes used in place of median pedestal poles where the required reach for the primary signal displays is greater than 15m (to suit clear-zone requirements and to provide ideal placement of the primary displays over the receiving through lanes). The median trunk support can double as a support structure for attaching the left turn signal display and associated signs.

Good practices for pole and TC and PD Cabinet base placement are as follows:

- The TC and PD cabinet bases shall be installed on the corner closest to the AC power source, and shall be located to provide operations personnel with a view of the intersection and minimize the potential of being struck by a vehicle.
- The TC and PD cabinet bases shall have sidewalk patio blocks placed in front of the cabinet door to provide a level area for operations personnel to work inside cabinets.
- Minimum separation between the TC and PD cabinet bases is 7m.
- The TC and PD base locations shall be placed in such a way that they can be shielded from potential run-off-road vehicles, or well outside the clear zones of the road / intersection.
- Pole and cabinet bases shall stay clear of underground utilities especially fibre-optic cables, power lines, and storm / sewer / water lines.
- Pole locations shall be well clear of overhead power lines (minimum 4.0m and preferably 5.0m from the closest overhead cable lines, preferably more if the signal pole is located near the mid-span of the overhead power line).

2.3.1.7 Wiring

The wiring for traffic signals shall be designed to minimize the requirement for splicing. Each signal pole shall have a separate multi-conductor signal cable which runs continuous from the traffic controller cabinet to the signal pole hand-hole. Splicing shall only occur inside the pole hand-hole. The standard multi-conductor size to use for the main cantilever signal poles is 19-conductor, No. 14 AWG (standard). This cable provides full flexibility for adding a full complement of vehicle and pedestrian phases at each pole to accommodate future changes, if and when required. Median poles that have a single signal head, or other poles that have a single head, only require a 7-conductor cable.

2.3.1.8 Layout Information

- Layout information for the main poles and key junction boxes at the 4 corners
- Layout reference is normally to the centerline of the 2 intersecting roadways, however it can be to the face of curb or island if the curbs or islands are already in place.

Figure 21 illustrates the layout information required on the Below Ground Installation drawing.

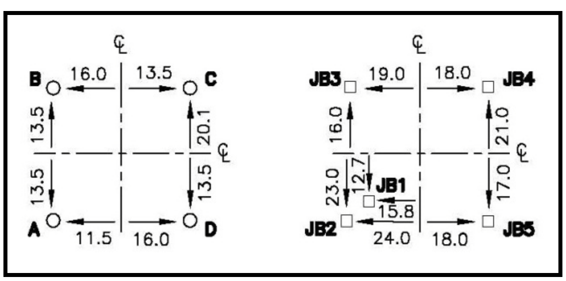


Figure 21 Example Layout Information (Signal Below Ground Installation drawings should also include coordinate tables for locations of pole bases, junction boxes, and TC & PD Cabinets)

2.3.2 Above Ground Design

2.3.2.1 Base Plan and Conventions

The Above Ground Installations drawing shall include the following information:

- Pole (with Pole numbers and Mast Arm Reach)
- Cabinets
- All traffic signal related signage (overhead sign alignment with positioning / alignment notes)
- All signal heads and traffic control devices (with phase number, signal head alignment for left turn signals, with positioning / alignment notes)
- Sidewalks and pedestrian ramp locations
- Guardrail design (typical design)
- Pavement markings and signs

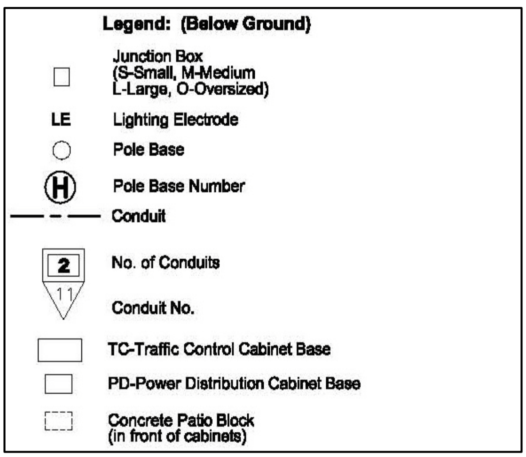


Figure 17 illustrates the legends used for Above Ground Installations drawings.

Above ground installation design guidelines are as follows:

2.3.2.2 Signal Phasing Convention

The following signal phasing conventions are used for new traffic signals on Alberta Highways:

- Southbound Through: Phase 2
- Westbound Through: Phase 4
- Northbound Through: Phase 6
- Eastbound Through: Phase 8

Refer to Package G of Appendix J in Schedule 18 for details related to signal phasing.

2.3.2.3 Poles

- Pole selection is based on standard mast arm length of 7m, 9m, 11m, 13m and 15m.

- Poles with mast arm longer than 15m should be avoided as these poles would require a special bolt circle diameter and/or more than 4 anchor bolts, and therefore would not fit onto the standard pole base anchor bolt pattern.
- Poles shall be labelled in the above ground installation drawing (poles) as well as in the below ground installation drawing (pole bases). The numbering sequence of the poles and pole bases shall be the same, as summarized below (the same numbering system is used for both the Below Ground Installations drawing and the Above Ground Installation drawing):

  - Corner Poles:
    - A – SWC;
    - B – NWC,
    - C – NEC,
    - D – SEC (clockwise)
  - Median Poles:
    - E – South Median;
    - F – West Median;
    - G – North Median;
    - H – East Median (clockwise)
  - AWF Poles:
    - I – North Leg;
    - J – East Leg;
    - K – South Leg;
    - L – West Leg

Median poles are typically 5.0 m tall except where video detection is to be used with median mounted cameras. Poles with video detection equipment should be 12.0 to 13.0 m tall to provide the height required to achieve the field of view needed for proper detection of vehicles and avoiding false detection from large trucks crossing the field of view (occlusion).

2.3.2.4 Pole Mounted Fixtures

- Fixtures to be shown on the AG Plans are: signal heads; signs; pedestrian signals; pushbuttons; street name signs; video cameras or microwave detectors; radio antenna; streetlight extension; rotatable base with direction of rotation.
- If the fixtures on the poles appear too cluttered, add a scaled up detail showing the fixture attachments at the pole as shown in Figure 21.
- Show all signs – both pole mounted and ground mounted. If the signs are installed by the roadway contractor, label them as “By R.C.” or “By Others”
- If video cameras are used as the detection devices, the video cameras shall be numbered in a clockwise fashion:
    - CAM1 – Southbound Traffic

- CAM2 – Westbound Traffic
- CAM3 – Northbound Traffic
- CAM4 – Eastbound Traffic

- Label the phasing of the signal heads, pedestrian signals, and pushbuttons. Horizontally mounted signal heads are labelled with horizontal labelling; likewise, vertical labelling for vertically mounted signal heads.
- Phasing for vehicle signals shall be labelled as V. Phasing for pedestrian signals shall be labelled as P. Phasing for pedestrian pushbuttons shall be labelled as PPB.
- For 4-section signal heads, the detailed colour and arrangement of the signal head shall be provided (i.e. RAG← or RA←G for horizontal 4-section signal heads; or RRA← or RAG← for vertical 4-section signal heads, etc.)
- If there are AAWF poles, details should be provided for the AAWF pole and the accompanying guardrail location and placement. The plan view of the pole should also show the permitted range of the pole rotation as well as the location of the pipe sleeve on the pole for pole rotation purposes.

An example of the resulting Above Ground Installations drawing is shown in **Figure 22**.

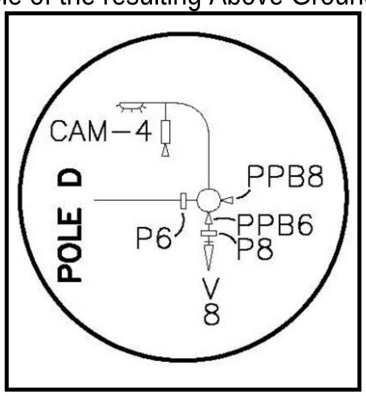


Figure 21 Signal Head and Pushbutton Mounting Locations

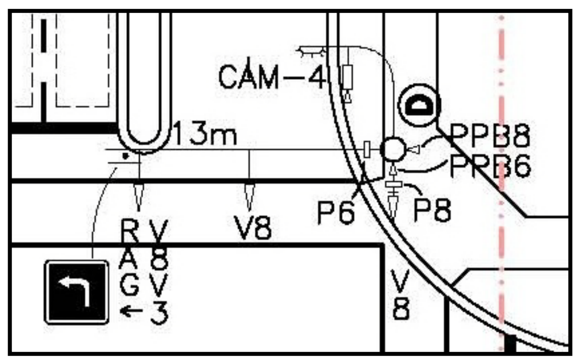


Figure 22 Above Ground Installation

2.3.2.5 Vehicle Signal Head Indications and Locations

This section provides a more in-depth discussion on the design requirements related to signal display design. The following **Figure 23** illustrates the types of signal heads to be used for vehicle and pedestrian signal indications and the intended operation. The size of the signal heads are dictated by the MUTCDC [ref #22] and ITE standards for LED traffic signal displays. The province uses a standard size of 300 mm diameter for primary and secondary vehicle displays.

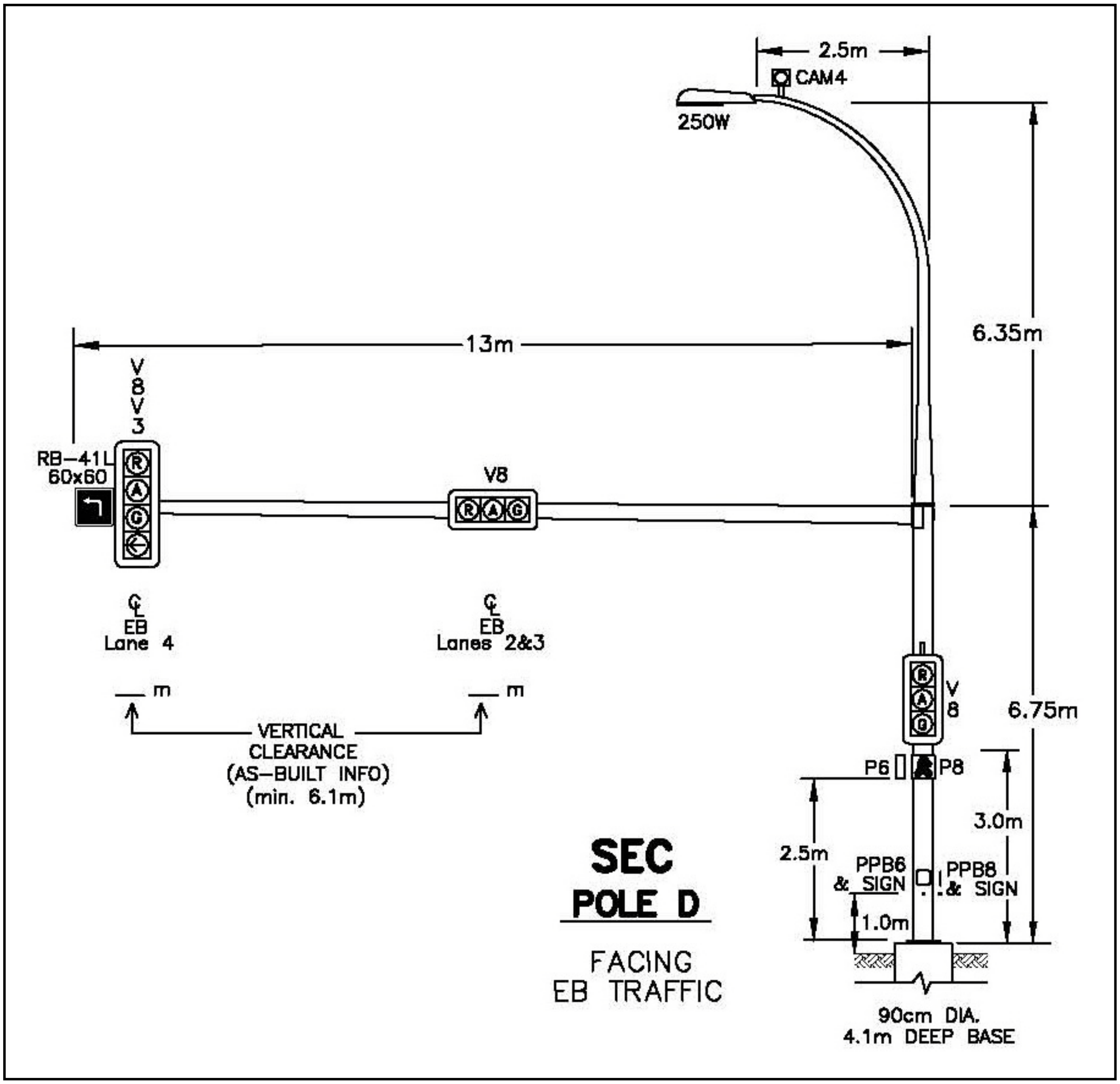


Figure 23 Signal Head Configurations

Number / Placement of Signal Indications

- Refer to **Figures F.1 to F.14** at the end of this Package (Package F) for recommended signal and sign display standards at signalized intersections.
- **Standard Through Phase Movements** A minimum of two signal heads (a primary head and a secondary head) face each approach of the intersection, including public-use driveways within the intersection. This is to provide a backup display in the event of a bulb burnout and to provide a different viewing angle if one signal head is blocked by a vehicle or washed out by the sun.

  At typical intersections, the primary signal heads are mounted on poles with mast arms suspended over the pavement. The secondary signal head is mounted on the right side on the signal pole trunk.

Where there are 2 or more receiving lanes, there shall be 2 primary signal displays mounted on the mast arm.

Where geometric conditions make it necessary, a far left secondary signal head may be used. To minimize confusion to motorists, the far left secondary signal head should be shielded. One situation where the use of a far left secondary signal head may be acceptable is where a wide median exists without a slotted left turn.

- **Left Turn Phases** For approaches where there are separate left turn lanes, the signal heads are vertically mounted on the median pole or the end of the mast arm. For approaches where there is a shared left / through lane, the signal heads are horizontally mounted.

- **Protected / Permissive Left Turn Phases** A minimum of one signal display. At intersections where the left turn slot is offset from the adjacent through lanes, the one signal display shall be vertically mounted centered with the left turn lane. At narrow cross-section intersections, one signal display should be horizontally mounted centered over the adjacent through receiving lane. At locations where there is a mixture of protected-permissive and protected-only signal display, it is recommended to have a "LEFT TURNS YIELD ON SOLID GREEN" sign (black lettering on white background) installed beside or below the protected-permissive signal head.

- **Protected / Prohibited Left Turn Phases** A minimum of one signal display (preferably two) with the left turn signal head centered with the approaching left turn traffic. This signal display shall accommodate the appropriate signal sequence (flashing green arrow, followed by yellow ball, followed by a red ball). When protected-only left turn signals are used, a "NO LEFT TURN ON RED, RB-17L) sign shall be installed besides the protected-only left turn signal head.

Visibility, Shielding, and Positioning of Signal Faces

The primary consideration in signal face placement, aiming, and adjustment shall be to optimize the visibility of signal indications to approaching traffic. Road users approaching a signalized intersection or other signalized area, such as a mid-block crosswalk, shall be given a clear and unmistakable indication of their right-of-way assignment.

Secondary signal heads mounted on the vertical pole shaft shall be positioned so that the bottom of the signal head is 3.0m above finished grade.

On centre median poles, the signal head is vertically mounted so that the bottom of the signal head is 3.5m to 4.0m above finish grade. This provides additional sightline for the signal display to the left turning vehicles.

The vertical, longitudinal, and lateral position of the signal faces are determined by typical driver-eye position in relation to:

- vertical grades,
- horizontal curves,

- obstructions, and
- lateral and vertical angles of sight toward a signal face.

In cases where irregular street design necessitates placing signal faces for different street approaches with a comparatively small angle between their respective signal lenses, each signal lens shall, to the extent practical, be shielded or directed by signal (cone or tunnel) visors, signal louvers, or other means so that an approaching road user can see only the signal lens(es) controlling the movements on the road user's approach.

The use of signal visors, or the use of signal faces or devices that direct the light without a reduction in intensity, should be considered as an alternative to signal louvers because of the reduction in light output caused by signal louvers.

- Backboards are used on all vehicle signal indications to improve the contrast and visibility of the signal indication to drivers. Backboards are black in colour.
- Visors are generally used on all vehicle signal indications. Full tunnel visors are used in most applications.
- Auxiliary Signal Head At locations where visibility of the signal head is restricted or reduced due to intersection width, curved road alignment, or potential sun glare situation, the use of auxiliary signal heads should be considered to improve the visibility of the signal display.
- Auxiliary Signal heads for wide intersections Near-side signal heads should be considered where the primary signal head is more than 60 m from the stop line, and should be placed as near as possible to the stop line. Alternatively, pork-chop islands can be installed to keep the distance from the stop line to the primary signal head to <60 m.

2.3.2.6 Pedestrian Signal Head Indications and Locations

Pedestrian signal displays follow the MUTCDC requirements for the walk and clearance symbols. They should be mounted lower than traffic signal heads but should not be lower than 2.5 m above the sidewalk. For best visibility to pedestrians, it should be placed directly in line with the pedestrian crosswalk which it controls.

The flashing Hand Outline should be used in all traffic signals as a clearance interval. It warns pedestrians that they should complete their crossing and not enter the crosswalk if they haven't already.

Pedestrian signal heads should be installed in conjunction with vehicular traffic signals wherever pedestrians are expected. They are included in the design under the following conditions:

- When pedestrians and vehicles are moving during the same phase and properly adjusted pedestrian clearance intervals are needed to minimize vehicle-pedestrian conflicts;
- When heavy vehicular turning movements require a semi-exclusive pedestrian phase for the protection and convenience of the pedestrian;
- When pedestrian movement on one side of an intersection is permissible while traffic from only one approach is moving;
- When an intersection is so large and complicated or a road so wide that vehicular signals would not adequately serve pedestrians;

- When the minimum green intervals for vehicles at intersections with traffic-actuated controls is less than the minimum crossing time for pedestrians and equipment is provided which extends the green time upon pedestrian actuation (normally by pushbutton);
- When complex phasing operation would tend to confuse pedestrians guided only by traffic signal indications;
- When traffic signal heads using arrows are used;
- When pedestrians cross only part of the road, to or from an island, during a particular phase; and
- When the traffic signal heads fall outside of the normal vision of pedestrians such as at "T" intersections, one-way streets or at large intersections.

The pedestrian signal display is typically 450 mm and must be clearly visible for a minimum distance of 30 m under normal conditions. It consists of overlay style LED outlines for the Hand and Walking Pedestrian, and can include a countdown timer within the display. Countdown timers provide the pedestrian with a positive indication of the time remaining before the signal phase ends. They should be considered in all locations where there is significant pedestrian activity. Warrants for their use are provided below.

Pedestrian signals come with countdown indications shall be used for the NE AHD DBFO Project.

Number and Placement

It may be desirable to eliminate pedestrian crosswalks across certain approaches, such as at interchange ramp terminals where there is no place for the pedestrians to go, or on the side of the intersection which receives left turning traffic from the side road. This may also apply to any intersection where it is desirable to ban particular pedestrian movements due to large left turn volumes. Such restrictions must be supported by proper signing (RB-66, RB-66T).

Mounting

Pedestrian heads shall be mounted 2.5 m from the finished grade to the bottom of the signal housing. Pedestrian heads are mounted below secondary displays.

The designer should consider clam-shell style mounting hardware for pedestrian signal heads. They are easier to install and do not require complex mounting hardware / piping.

If practical, pedestrian heads should be mounted directly behind the sidewalk facing along the crosswalk. Where necessary, the heads may be mounted within 3.0m of the edge of the sidewalk in the crosswalk-facing direction and within 1.5m of the edge of the crosswalk laterally. A check should be made that the pedestrian heads will not be hidden from pedestrians on the other side of the roadway or by vehicles at the stop line.

Pedestrian Pushbuttons

The use of pedestrian heads will require pedestrian pushbuttons at pedestrian actuated traffic signals. Pedestrian pushbuttons should be located with the following guidelines:

- Installed on the "through sidewalk" side of the pole (instead of roadside of the pole);

- Easy pedestrian / wheelchair access;
- Installed perpendicular to the crosswalk, within 5.5 m of the edge of the crosswalk;
- Mounting height of the pushbutton should be 1.0 m above surrounding ground; and
- Installed with a (ID-21-L/R) sign, mounted perpendicular to the main road with the arrow pointing to the crossing direction, mounted above the pushbutton.

2.3.2.7 Rotatable Bases

For signal supports attached to rotatable bases, the pipe sleeve used for pole turning shall be mounted at .2m above the surrounding ground. This can be achieved by pre-fabricating the pipe sleeve to the required height. If this mounting height is not achievable, supplementary pipe sleeve welded to the top of the rotatable base can be used, as long as the resulting pipe sleeve position is approximately 1.2m above the surrounding ground. If the resulting pipe sleeve position (when welded to the top of the rotatable base) is not close to the 1.2m mounting height requirement, the Contractor shall adjust the ground elevation locally around the pole base to achieve the 1.2m pipe sleeve mounting height requirement.

2.3.2.8 Signs and Markings

Signs and markings are an integral part of the traffic signal design and, as such, shall be included and shown on the traffic signal drawings. Signs are typically shown on the Above Ground Installations drawing, whereas pavement markings are shown on both Above and Below Ground drawings as an integral part of the intersection base plan.

2.3.2.9 Detection Design

The above ground installation drawing illustrates the design for the detection zones.

The detection design is based on requirements for various approach / road types and the type of left turn signal phasing.

The Detector Design on the Above Ground Installations drawing includes the following information:

- Detection Zones (detection zone number, shape, size and location, detector call phase, settings for locking and delays)
- Above Ground Detectors, if used (detector number, aiming alignment)

An example of the resulting detection design on the Above Ground Installation drawing is shown in Figure 24.

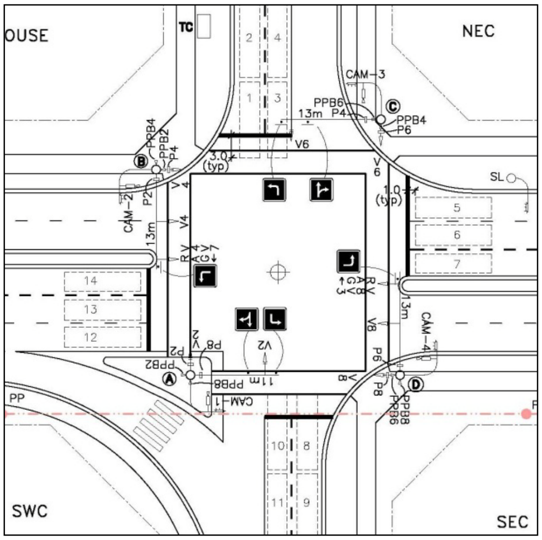


Figure 24
Detection Design

The numbering of the detection zones shall start from Lane No 1 of the southbound lanes (or Phase 2), and then assigned lane by lane in a clockwise fashion. If there are two detection zones in each lane, the front detection zone shall be numbered first.

2.3.3 Pole Elevation Design

An example of a Pole Elevation design is shown in **Figure 25**:

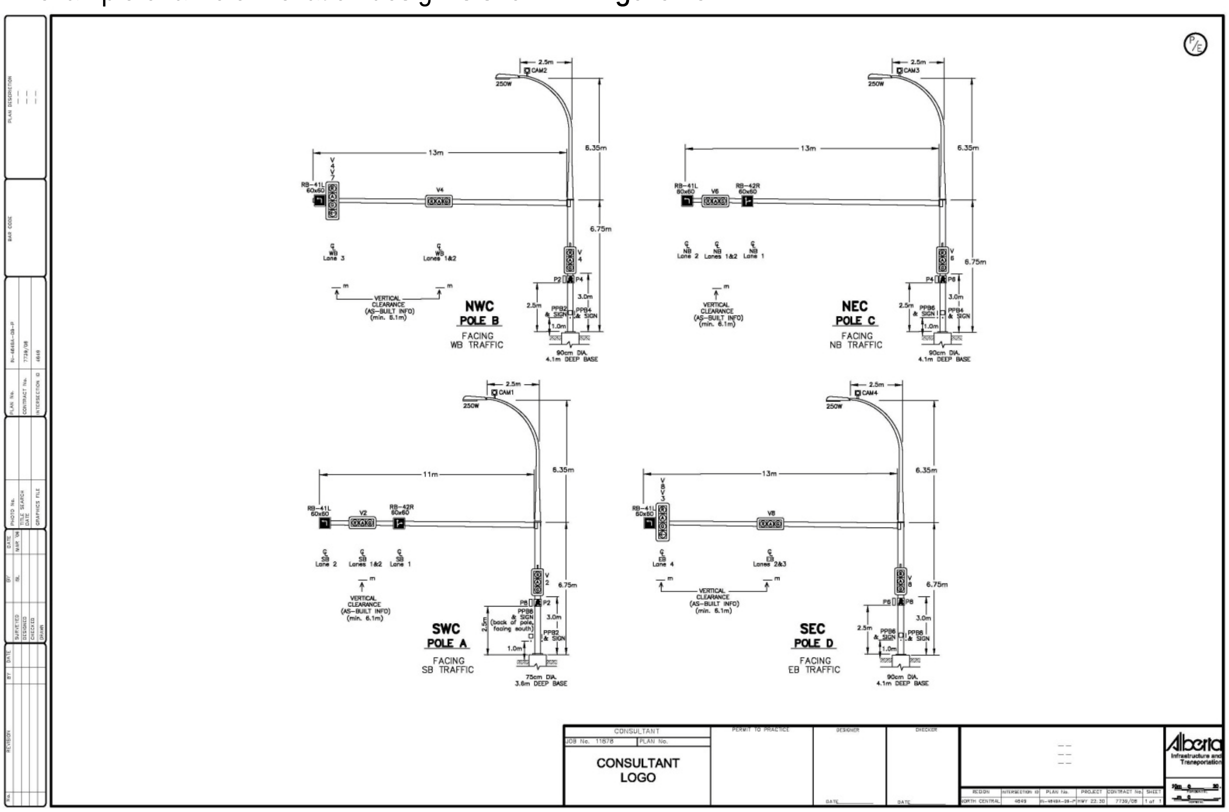


Figure 25 Pole Elevation Design

The Pole Elevation drawing provides a visual display of the outlook of the traffic signal. It provides the following information:

- Scaled (1:150) representation of a front elevation view of all signal poles with all pole mounted traffic control devices including signal heads, signs, pushbuttons, video cameras and radio antennae;
- Dimensions for mast arm, streetlight davit, sign placement, alignment and mounting heights for vehicle and pedestrian signal heads and pushbuttons, as well as the vertical clearance of the overhead traffic control devices (as-built information);
- Sign sizes, sign number, signal head phasing and lenses positioning;
- Mounting location and aiming direction of cameras and antenna;
- Pole number, quadrant where pole is located;
- Pole base size (depth, diameter and BCD);
- Rotatable base (if needed); and
- Location and placement of pipe sleeves used for pole turning (where a rotatable base is used)

2.3.4 Design Tables and Schedules

The following tables and schedules shall be included in the Tables and Schedule drawing:

- Signal Phasing Sequence Schedule;
- Controller Timings Table;
- Detector Schedule;
- Conduit Schedule;
- Cabling Schedule; and
- Equipment List (Optional)

2.3.4.1 Signal Phasing Sequence Schedule

The Signal Phasing Sequence Schedule (**Figure 26**) provides the following information:

- Signal phasing numbers and sequence for both vehicle and pedestrian phases (based on convention that southbound movement is Phase 2. Westbound is Phase 4, etc);
- Posted speeds of both intersecting roads;
- Name of the intersecting roads;
- Left turn phasing type (i.e. protected / permissive or protected / prohibited);
- Active Advance Warning Flashers timing;
- Phase recall design (i.e. which road is the green signal resting on); and
- Needs for signal coordination, signal communication, or pre-emption.

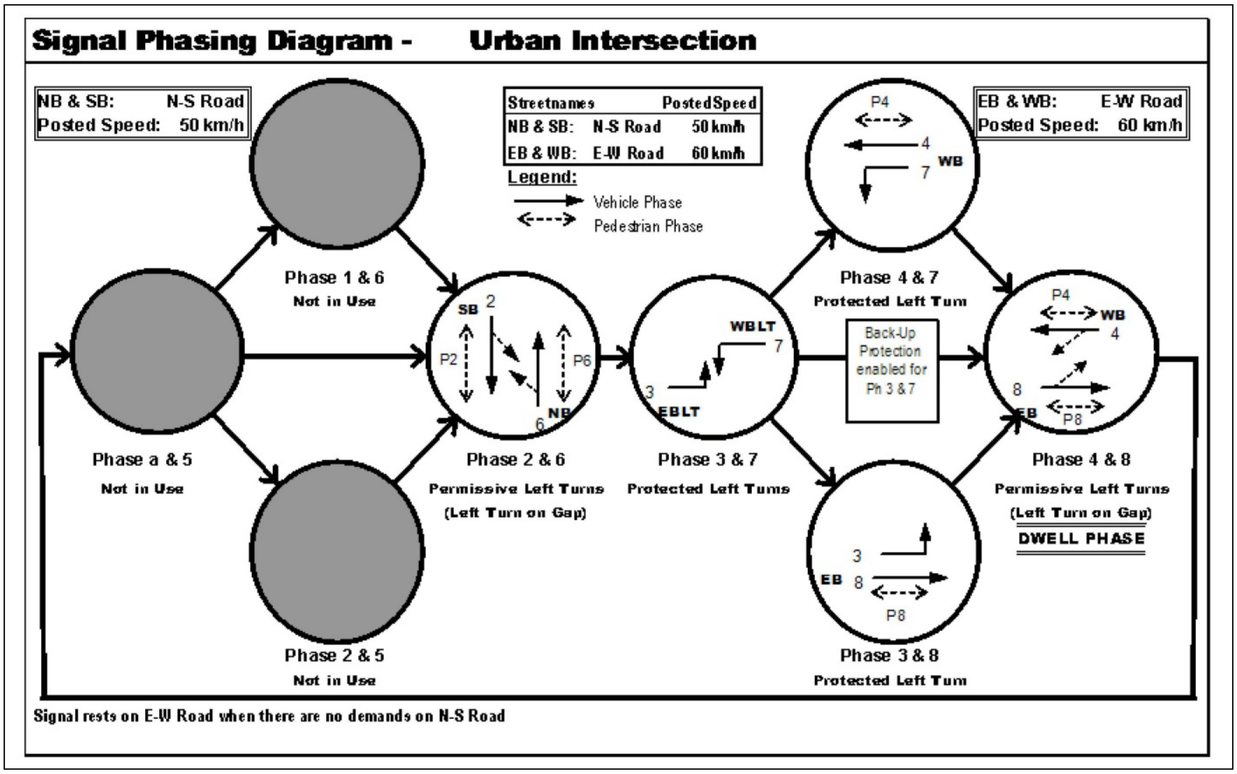


Figure 26 Signal Phasing Diagram

2.3.4.2 Controller Timings Table

The Controller Timings Table (Figure 27) provides the following information:

- A note stating the timings are initial timings only, subject to field adjustment following signal start-up;
- Information (as-built) stating the make and model number of the traffic controller;
- Flash programming (emergency flash);
- Start-Up Flash Programming;
- Emergency Vehicle / railway Pre-emption (present or not);
- Advance Warning Flashers (present / not, timings);
- Basic Timings (including min green, walk, ped clearance, veh extension, Max1, Max2, Max3, Yellow Change, Red Clearance, Recall Phase, Min Veh Phase timing, Min Ped Phase timing);
- Phase Recall setting;
- Phase Locking setting; and
- Time of Day (TOD) Program setting (including program number, program start / finish time, min recall phase, max recall phase, ped recall phase, Max2 enable phase, Phase omit).

Initial Controller Timings - Urban Intersection

Consultant to finalize Timings as per field conditions prior to Signal Start-Up

Basic Timings:	1	2	3	4	5	6	7	8	**Flash Program:**
									Flashing Red - N/S Road
Minimum Green	7	15	7	20	7	15	7	20	Flashing Red - 9E/W Road
Walk		10		10		10		10	
Ped Clearance (exclud. Amber & Red)		18		16		18		16	
Veh Extension	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0	**Start-Up Flash:**
Max 1	20	40	20	30	20	40	15	30	5 sec All Red, followed by
Max 2	25	50	30	35	25	50	20	35	Green on Ph 2 & 6 (N/S)
Max 3									**Emerg. Veh. Preemption:**
Yellow Change (Amber)	3.0	3.5	3.0	4.0	3.0	3.5	3.0	4.0	No
Red Clearance (All Red)	1.0	2.0	1.0	2.0	1.0	1.0	2.0	2.0	**Railway Preemption:**
Recall Phase				minR				minR	No
Phase Setting - Locking		Lock				Lock			
Min. Veh Phase Timing	11	21	11	26	11	20	12	26	**Advance Warning Flashers:**
Min. Ped Phase Timing	n/a	34	n/a	32	n/a	33	n/a	32	No

TOD / CRD Programs:															Crd	Veh	Veh	Ped	Use	Phase
DOW	Plan/Pattern		from	to	C	O	1	2	3	4	5	6	7	8	Ph	minR	MaxR	Recall	Max2	Omit
Daily	1	AM Peak	0630	0930												4,8			2,4,6,8	
Daily	2	AM Midday	0930	1100												4,8				
Daily	3	Noon Peak	1100	1330												4,8			3,7	
Daily	4	PM Midday	1330	1530												4,8			2,6	
Daily	5	PM Peak	1530	1830												4,8			3,4,7,8	
Daily	6	Evening	1830	2000												4,8				
Daily	7	Night	2000	0630												4,8				3,7

Preliminary TOD Programs only.

Figure 27 Initial Signal Timings

2.3.4.3 Detector Schedule

The Detector Schedule (Figure 28) provides the following information:

- Detector number (camera number or loop number);
- Detection zone number;
- Detection zone size (width, length);
- Detection zone position (distance from stop line); and
- Detector Type / Settings (delay timer, remarks) (Note: It is not advisable to program the Lock and Extend settings in the camera or at the detector amplifier. The Lock and Extend settings should be programmed in the controller instead)

Detector Schedule - Urban Intersection										
To be finetuned in the field to suit field conditions (subject to approval by the Consultant)										
Camera No.	Zone	Width	Length	Dist from stopline	Detector Type/Timers					Remarks
					Call Ph	Type	Lock	Extend	Delay	
1	1	2.7 m	10.0 m	-3 m	2	Presence			7.0 s	
	2	2.7 m	10.0 m	8 m	2	Presence			3.0 s	
	3	2.5 m	10.0 m	-3 m	2	Presence			2.0 s	
	4	2.5 m	10.0 m	8 m	2	Presence			2.0 s	
2	5	2.7 m	10.0 m	1 m	4	Presence			0.0 s	
	6	2.7 m	10.0 m	1 m	4	Presence			0.0 s	
	7	2.5 m	10.0 m	1 m	4 / 7	Presence			0.0 s	
3	8	2.7 m	10.0 m	-3 m	6	Presence			7.0 s	
	9	2.7 m	10.0 m	8 m	6	Presence			3.0 s	
	10	2.5 m	10.0 m	-3 m	6	Presence			2.0 s	
	11	2.5 m	10.0 m	8 m	6	Presence			2.0 s	
4	12	2.7 m	10.0 m	1 m	8	Presence			0.0 s	
	13	2.7 m	10.0 m	1 m	8	Presence			0.0 s	
	14	2.5 m	10.0 m	1 m	3 / 8	Presence			0.0 s	

Figure 28 Detector Setting Schedule

2.3.4.4 Conduit Schedule

The Conduit Schedule (Figure 29) provides the following information:

- Conduit number;
- Conduit type, quantity and length;
- Conduit installation method (trench vs. push);
- Conduit lengths (individual runs and total trenched / pushed lengths by type);
- Junction box number;
- Junction box size and lightning electrodes quantity;
- Number of conduits terminating at the junction box; and
- Junction box quantity by type.

2.3.4.5 Cabling Schedule

The Cabling Schedule (Figure 30) provides the following information:

- Pole number where signal cables are terminating to;
- Cabinet type where cables are terminating to;
- Cable type by function (e.g. main signal cable run, secondary signal cable run, advance warning flasher cable, streetlight cable, detector lead-in cable, AC Feed cable, radio Antenna cable, Pre-emption devices lead-in cable, bonding conductor cable (Note that the cable type for each function is standardized as per TRANS' Traffic Signal Specifications); and

- Wiring connection and routing is also standardized as per the Traffic Signal Standard Drawings of TRANS.

Conduit Schedule -		**Urban Intersection**															existing
Conduit No.	**Total Run**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**Total Run**	Conduit L
By Trenching:																	
1-50 mm Flexible Conduit	**80 m**														10 m	**80 m**	80 m
2-50 mm Flexible Conduit	**57 m**	6 m				6 m	7 m		6 m			7 m	25 m			**57 m**	114 m
1-50 mm HDPE Conduit	**80 m**													80 m		**80 m**	80 m
2-50 mm HDPE Conduit	**0 m**															**0 m**	0 m
3-50 mm HDPE Conduit	**0 m**															**0 m**	0 m
4-50 mm HDPE Conduit	**0 m**															**0 m**	0 m
5-50 mm HDPE Conduit	**0 m**															**0 m**	0 m
6-50 mm HDPE Conduit	**22 m**				22 m											**22 m**	132 m
Pushed Conduits:																	
2-50 mm HDPE Conduit	**13 m**		13 m													**13 m**	26 m
3-50 mm HDPE Conduit	**164 m**			38 m				40 m		40 m	46 m					**164 m**	492 m
4-50 mm HDPE Conduit	**0 m**															**0 m**	0 m
Existing Conduits:																	
Existing Conduits:	**0 m**															**0 m**	0 m
Conduit No.	**Total Run**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**Total Run**	Conduit L
Junction Box:																	
Junction Box No.		*JB1*	*JB2*	*JB3*	*JB4*	*JB5*											
No. of 50cm conduits		*3*	*8*	*16*	*8*	*8*											
Lighting Electrodes?		*LE*		*LE*	*LE*	*LE*											
Small (12"W x 12"L x 12"D)	**0 no.**																**0 no.**
Medium (13"W x 24"L x 12"D)	**1 no.**	1 no.															**1 no.**
Large (17"W x 30"L x 18"D)	**3 no.**		1 no.		1 no.	1 no.											**3 no.**
Oversize (17"W x 30"L x 18"D)	**1 no.**			1 no.													**1 no.**

Figure 29 Conduit Schedule

Cabling Schedule -		**Urban Intersection**									
Location		16C #14 Signal Cable	7C #14 Signal Cable	3C #8 AWF Lead-In Cable	2C #8 Streetlight Cable	3C #16 Camera lead-In Cable	Loop Detector Lead-In Cable	AC Feed	Radio Antenna Lead-In Cable	Preemption Device Lead-In	Bonding Conductor	**Note**
		S16	**S7**	**AW**	**SL**	**CAM**	**B**	**AC**	**ANT**	**PR**	**BC**	
Pole A	**SWC**	1			1	1					1	1. splices for detector loop lead-in cable are not allowed between TC Cabinet and loop tub
Pole B	**NWC**	1			1	1					1	
Pole C	**NEC**	1			1	1					1	
Pole D	**SEC**	1			1	1					1	2. For all other cables, no splices are allowed except in pole handholes
Pole E	**SM**											
Pole F	**WM**											
Pole G	**NM**											
Pole H	**EM**											
Pole I	**SB**											
Pole J	**WB**											
Pole K	**NB**											
Pole L	**EB**											
PD Cabinet	**NWC**							1			1	
AC Feed	**tbd**							1			1	
Gd.Rod Array	**NWC**										1	

Figure 30 Cabling Schedule

2.3.4.6 Equipment List

The Equipment List (Figure 30) provides the following information:

- Cabinet type, quantity by location;
- Pole type, size, quantity by location and pole number;
- Pole base type, size, quantity by location and pole base number;
- Signal head type, quantity by pole number;
- Detectors type and quantity by location / pole number (camera, loop, microwave detector);
- Junction box type and quantity by location;
- Sign type, size, quantity by location / pole number;
- Sign post size, quantity by location;
- Special devices quantity and location (e.g. guardrail, radio antennae, emergency vehicle pre-emption receivers, etc)

Equipment List - Urban Intersection   existing / not used / by others

Category	Equipment Item	Sum	Pole A	Pole B	Pole C	Pole D	Pole E	Pole F	Pole G	Pole H	NWC	NEC	SEC	SWC	N Leg	E Leg	S Leg	W Leg
Junction Boxes	JB - Small (S-JB)	0																
	JB - Medium (M-JB)	1												1				
	JB - Large(L-JB)	3										1	1	1				
	JB - Oversized (O-JB)	1									1							
Pole Base	Pole Base - 40 cm sq., 1.5m deep	0																
	Pole Base - 75 cm dia., 3.6m deep	1	1															
	Pole Base - 90 cm dia., 4.0 m deep	3		1	1	1												
	Cabinet Base - TC	1									1							
	Cabinet Base - PD	1									1							
	Strong Post W-Beam Guardrail	0																
Cabinets	PD Cabinet	1									1							
	TC Cabinet - M1	0																
	TC Cabinet - P-44	1									1							
Poles	Pedestal Pole - 3m ht	0																
	Camera Pole - 12m ht	0																
	Cantilever Pole - 7m	0																
	Cantilever Pole - 9m	0																
	Cantilever Pole - 11m	1	1															
	Cantilever Pole - 13m	3		1	1	1												
	Cantilever Pole - 15m	0																
	Cantilever AWF Pole - 7m	0																
	Cantilever AWF Pole - 9m	0																
	Cantilever AWF Pole - 11m	0																
	Cantilever AWF Pole - 13m	0																
	Streetlight Davit Extension 13.1m ht, 2.5m reach)	4	1	1	1	1												
	Rotatable Base	2																
	Luminaire - 250W	4	1	1	1	1												
	Luminaire - 400W	0																
Signal Heads	Veh Signal Head - 3S LED RAG	8	2	2	2	2												
	Veh Signal Head - 4S LED RAG<	2		1		1												
	Veh Signal Head - 4S LED RRA<	0																
	Ped Signal Head - 1S LED Wk/DW	0	2	2	2	2												
	Audible Ped Signal	0																
Signs	DG Sign - Custom L / T/ T-R	0																
	DG Sign - Custom L / T/ T-R Ahead	0																
	DG Sign - Custom RB-49 (L / T / R)	0																
	DG Sign - Custom RB-49 (L / T / R) Ahead	0																
	DG Sign - NEW (Sunburst)	6													1	2	1	2
	DG Sign - RB-17L	0																
	DG Sign - RB-25	0																
	DG Sign - RB-25 - Oversized	0																
	DG Sign - RB-41L	4	1	1	1	1												
	DG Sign - RB-41R	0																
	DG Sign - RB-42L	0																
	DG Sign - RB-42R	2	1		1													
	DG Sign - RB-45	0																
	DG Sign - RB-46L	0																
	DG Sign - RB-46L - Oversized	0																
	DG Sign - WA-17	0																
	DG Sign - WA-33R	0																
	DG Sign - WA-35R	0																
	DG Sign - WA-36	0																
	DG Sign - WA-36R	0																
	DG Sign - WB-4 Signal Ahead	6													1	2	1	2
	DG Sign - WB-5 AWF Signal Ahead	0																
	HI Sign - Custom (L/T Yield on Solid Green)	0																
	HI Sign - Pushbutton Sign	8	2	2	2	2												
	HI Sign - RB-66	0																
	DG Sign - RC-4L	0																
	HI Sign - RC-4R	0																
	DG Sign - Streetname - 1 Road	0																
	HI Sign - Streetname - 2 Roads	0																
	Sign Posts - Wood	0																
	Sign Posts - Metal	0																
Detectors	Detector - Pushbutton	0	2	2	2	2												
	Detector - Loop Detector	0																
	Detector - Microwave Detectors	0																
	Detector - Traffic Camera	4	1	1	1	1												
	Camera Mounting Post - 2m	0																
	Camera Mounting Post - 5m	0																
	Communication - Ethernet Radio w/ 1 Antenna	0																
	Communication - Ethernet Radio w/ 2 Antennae	0																
	Communication - Ethernet Radio w/ 3 Antennae	0																
	Communication - DSL Line	0																
	Emergency Vehicle Preemption Receiver	0																

Figure 30 Equipment List

2.3.5 Detection Design

2.3.5.1 Camera Mounting Locations

Camera mounting location and height are critical in the traffic signal design and operations. If installed at the wrong location, blockage by other vehicles and objects (occlusion) will affect the effectiveness of the camera in detecting the correct signal phases, resulting in inefficient signal operations.

Figure 31 illustrates the three key camera mounting locations at intersections. For best results, the camera should be mounted lining up with the lane line between the left turn lane and the through lane. This will allow best detection input results for both the left turn and through signal phases.

Location 1 (acceptable) is on top of the streetlight extension davit of the signal pole. It is most suitable for locations where:

- there are streetlight extensions on top of the signal pole,
- the road is relatively narrow
- main street traffic detection where the primary purpose of detection is for extension of the through signal phase
- no left turn signal phase (don't have to worry about trucks blocking other vehicles)

Location 2 (better) is with a 2m mounting arm on the mast arm of the signal pole. It is most suitable for locations where:

- there are no streetlight extensions on top of the signal pole
- the mast arm is long enough and extend into the left turn lane
- location with left turn signals
- cross-street does not have heavy truck volumes
- locations without a centre median

Location 3 (best) is on a dedicated 12m or 13m tall camera pole in the centre median. It is most suitable for locations where:

- there is a left turn signal phase, especially when the left turn signal phasing is protected-prohibited (therefore it is critical to have accurate detection for left turning traffic)
- there is a centre median, especially when the median is sufficiently wide (minimum 1.5m median width, preferably 3.0m width)
- wide roadways where mast arm of the primary signal pole cannot reach the left turn lane

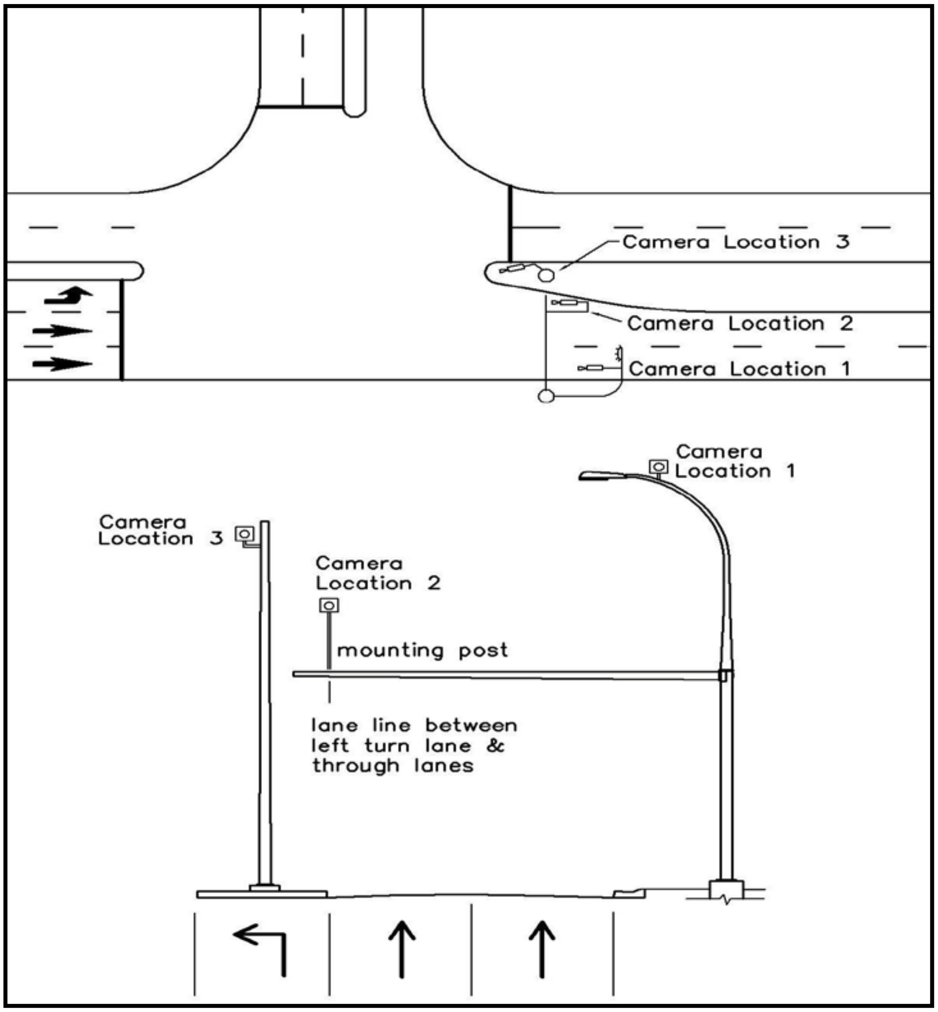


Figure 31 Camera Mounting Locations

2.4 Checklists for Designer and Checker

A checklist for the designer of the traffic signal is provided in Table 8 and a checklist for the checker of the design is provided in Table 9.

Table 8 Traffic Signal Design – Checklist for Designer

	Areas to be checked	Gather Data	Read Report	Site Visit / Meeting	Prepare Base Plan	Geometry Check	Operation / Safety Check	Preliminary Design	Detailed Design
		1	2	3	4	5	6	7	8
A	Basic Information / Safety Check								
1	Collision Patterns	❑	❑	❑			❑		
2	Road Classification	❑							
3	Posted Speed / Design Speed	❑		❑					
4	Design Vehicle	❑		❑		❑	❑	❑	
5	Sight Distance / Cone of Vision		❑	❑		❑	❑	❑	
6	Signal Visibility & Conspicuity						❑	❑	❑
7	Left Turn Traffic					❑	❑	❑	
8	Clear Zones						❑	❑	❑
9	Reduced Speed Zones		❑	❑					
10	Use of AAWF		❑	❑			❑	❑	❑
11	Adjacent Land Use	❑	❑	❑	❑				
12	Utilities	❑		❑	❑				
13	Property Limits, Landmarks	❑		❑	❑				
B	Geometry Check								
1	Horizontal / Vertical Alignments	❑	❑	❑			❑		
2	Corner Clearance		❑	❑			❑		
3	Intersection Geometry / Lane Configuration	❑	❑	❑	❑	❑	❑	❑	
4	Slotted Left Turn Bay				❑	❑	❑	❑	
5	Vertical Clearance		❑					❑	
6	Pedestrian Pathways, Crosswalks	❑	❑	❑	❑		❑	❑	❑
7	Cyclist Requirements	❑	❑	❑	❑		❑	❑	❑
8	Signs & Pavement Markings	❑		❑			❑	❑	❑
9	High / Wide Load		❑	❑		❑			
10	Access Control		❑	❑	❑				
C	Preliminary & Detailed Designs								
1	Operational Analysis		❑	❑		❑	❑	❑	
2	Clearance Intervals Calculation						❑		❑
3	Determine Signal Phasing Requirements		❑	❑			❑	❑	❑
4	Determine Actuation Types / Requirements		❑	❑			❑	❑	❑
5	Grounding / Lighting Electrodes Design								❑
6	Number of Conduits							❑	❑
7	Junction Box Sizes and Locations							❑	❑
8	PD Cabinet / Power Supply Location			❑				❑	
9	TC Cabinet Location			❑				❑	
10	Pole Base Location			❑		❑		❑	
11	Signal Pole Design							❑	❑
12	Pedestrian / Traffic Signal Heads Design			❑				❑	❑
13	Detector Design							❑	❑
14	Signal Phasing Table						❑		❑
15	Signal Timing Preparation						❑		❑
16	Conduit Schedule Design							❑	❑
17	Cabling Schedule								❑
18	Equipment List								❑
19	Preemption			❑			❑	❑	❑
20	Future Consideration			❑			❑	❑	

Table 9.a Traffic Signal Design – Checklist for Checker (page 1 of 5)

	Item	Check Items
	1	Review of Needs Assessment Report (RECOMMENDED, prior to checking the detailed traffic signal design)
❑	1.1	Background information
❑	1.2	Key issues
❑	1.3	Operational Analysis
❑	1.4	Comparison of shortlisted candidates
❑	1.5	Future considerations and staging considerations
❑	1.6	Recommendations
	2	Review Design Report (REQUIRED, prior to checking the detailed traffic signal design)
❑	2.1	Design Assumptions and parameters
❑	2.2	Geometry parameters
❑	2.3	Operation parameters
❑	2.4	Photos
❑	2.5	Key design features
❑	2.6	Future considerations
❑	2.7	Construction related issues
❑	2.8	Construction activities by others
❑	2.9	Are all issues identified in the Design Report addressed in the detailed traffic signal design?
	3	Drawings - General (REQUIRED on entire set of drawings)
❑	3.1	Are there any obvious non-conformity?
❑	3.2	Are the drawings signed by the designer and checker, and with permit signed?
❑	3.3	Are AT drafting guidelines followed?
❑	3.4	Is the print quality clear?
❑	3.5	Are revision numbers and descriptions correct and consistent across all sheets?
❑	3.6	Are title blocks correct and consistent across all sheets?
❑	3.7	Are scale and north arrows shown with corner label (SWC, NWC, NEC, SEC) ?
❑	3.8	Are correct roadway names shown?
❑	3.9	Are the names of the key landmarks shown?
❑	3.10	Are rights-of-way shown?
❑	3.11	Are the laning and geometrics consistent with the approved road drawings?
❑	3.12	Are pavement markings consistent with the approved road drawings?
❑	3.13	Are ramps, sidewalks or pathways shown?
❑	3.14	Are existing nearby driveways or access points shown?
❑	3.15	Are existing parking restrictions shown?

Table 9.b Traffic Signal Design – Checklist for Checker (page 2 of 5)

	Item	Check Items
	4	General Geometry Check (REQUIRED, prior to checking the detailed traffic signal design)
❑	4.1	Are road widths adequate for the right / left turn swept paths of the design vehicle(s)? (Use turning templates)
❑	4.2	Are the stopline located adequate and stay clear of the design vehicle turn paths? (Use turning templates)
❑	4.3	Is there a geometric conflict with opposing left turns? (Use turning templates)
❑	4.4	Are the crosswalk lines at least 1m off the face of curb of the adjacent travel lane?
❑	4.5	Are the major road stoplines at least 2m from the crosswalk lines?
❑	4.6	Are the minor road stoplines at least 1m from the crosswalk lines?
❑	4.7	Are the turn bay lengths adequate to store the anticipated turning vehicles?
	5	Drawing - Above Ground Installations Design
❑	5.1	Are legends shown?
❑	5.2	Is the correct scale used (1:500 scale on 11x17 sheets)
❑	5.3	Are the lane designations consistent with the intersection geometry? (check road drawings)
❑	5.4	Are all the lanes numbered (For easy reference to the Pole Elevations plan)?
❑	5.5	Are potential overhead conflicts shown? If so, are there caution notes?
❑	5.6	Are streetlights and street furniture shown?
❑	5.7	Are the locations of the traffic controller and power distribution cabinets shown?
❑	5.8	Are the traffic controller and power distribution cabinets protected, shielded or outside the clear zone?
❑	5.9	Are the traffic controller and power distribution cabinet located away from low spots such as bottom of ditch?
❑	5.10	Are there enough offset between poles and face of curb / edge of pavement?
❑	5.11	Are medians too narrow (<1.5m face-to-face measurement) for poles located in the median?
❑	5.12	Are clear zone requirements met? Is guardrail needed? (check clear zone needs)
❑	5.13	Are the pole size cost effective (not over-sized or over-designed)?
❑	5.14	Is pole numbering as per AT guidelines and consistent on the site plan and elevation?
❑	5.15	Do the length of the mast arms conform to AT guidelines on mast arm lengths, and shown on the plan?
❑	5.16	Are the orientation of the streetlight extension shown?
❑	5.17	Are rotatable pole base needed? If so, are there sufficient area near the pole to rotate the base?
❑	5.18	Do the signal phasing match that of the Signal Phasing Diagram?
❑	5.19	Are existing equipment or poles clearly identified?
❑	5.20	Are equipment or poles to be removed clearly identified?
❑	5.21	Are there AAWF?
❑	5.22	Does the signal head and overhead lane designation signs located as per AT guidelines?
❑	5.23	Are the traffic control devices displayed in a logical fashion that meets the expectation of the drivers?
❑	5.24	Does the signal and sign display comply with the signal head and sign display placement guideline?
❑	5.25	Are overhead lane designation signs used where approach lane markings are not visible from intersection sight distance?

Table 9.c Traffic Signal Design – Checklist for Checker (page 3 of 5)

	Item	Check Items
	5	Drawing - Above Ground Installations Design
❑	5.26	Has the stop bar to signal head distance been checked (> 20m)?
❑	5.27	Are the primary signal heads within 55m of the stop line? (i.e. Need for auxiliary signal head?)
❑	5.28	Are the pushbuttons accessible to pedestrians, are they located less than 5.5m from ramps or walkways?
❑	5.29	Do the left turn signals show the positions of the signal indications?
❑	5.30	Are the mounting position and orientation of the signal heads shown clearly on the pole shaft?
❑	5.31	Are the mounting position and orientation of the pushbuttons shown clearly on the pole shaft?
❑	5.32	Are fixtures mounted on the vertical pole shaft prone to potential encroachment by turning vehicles?
❑	5.33	Are the traffic signal heads labelled correctly with signal phasing and mounting arrangement?
❑	5.34	Are the pedestrian signals and pushbuttons labelled correctly with signal phasing and mounting arrangement?
❑	5.35	Are streetname signs correctly shown?
❑	5.36	Are lane designation signs correctly?
❑	5.37	Are the detection zone locations and numbering designed as per AT guidelines (Appendix G)
❑	5.38	Are the cameras numbering correct as per AT guidelines?
❑	5.39	Are the location of the stopline sign shown correctly?
	6	Below Ground Installations Design
❑	6.1	Are legends shown?
❑	6.2	Is the correct scale used (1:500 scale on 11x17 sheets)?
❑	6.3	Are notes provided re: underground utility conflicts?
❑	6.4	Are potential fibre optic cables, high pressure gas lines, or high voltage power lines shown? If so, are there caution notes?
❑	6.5	Are existing utilities shown and all conflicts identified and noted in the Design Report?
❑	6.6	Are the existing conduits, pole bases or junction boxes clearly identified?
❑	6.7	Are the pole bases or junction boxes to be removed clearly identified?
❑	6.8	Is the AC Feed location identified?
❑	6.9	Are there AAWF?
❑	6.10	Are the traffic controller and power distribution cabinet bases shown?
❑	6.11	Is the ground rod array shown? Is it at least 7m away from the TC Cabinet?
❑	6.12	Are junction boxes located adjacent to poles labeled with LE?
❑	6.13	Are the layout schematics provided for pole bases and junction boxes?
❑	6.14	Are conduit numbers comply with AT guidelines?
❑	6.15	Are junction box locations comply with AT guidelines?
❑	6.16	Are junction box sizes comply with AT guidelines?
❑	6.17	Is conduit numbering as per AT guidelines?

Table 9.d Traffic Signal Design – Checklist for Checker (page 4 of 5)

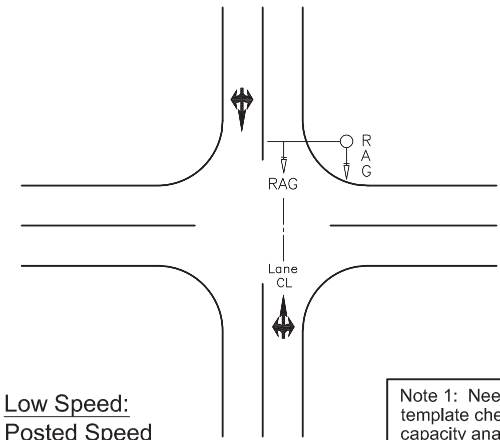
	Item	Check Items
	6	Below Ground Installations Design
❑	6.18	Is junction box numbering as per AT guidelines?
❑	6.19	Does the below ground design consider ease of construction?
❑	6.20	Are the below ground design cost effective?
❑	6.21	Does the below ground design consider potential road widening?
	7	Pole Elevations Design
❑	7.1	Is the correct scale used (1:150 scale on 11x17 sheets)?
❑	7.2	Are pole elevations for all poles shown? Are there AAWF poles?
❑	7.3	Are pole elevations dimensioned and labeled correctly?
❑	7.4	Is each pole elevation labelled with corner it is in, pole number, and which traffic direction it is facing?
❑	7.5	Are the pole dimension shown - mast arm length, arm mounting height, streetlight extension height?
❑	7.6	Are pole bases correctly show on elevations and?
❑	7.7	Are the streetlight davit orientation correct?
❑	7.8	Are luminaire wattages correct?
❑	7.9	Are the camera number and its mounting location shown?
❑	7.10	Does it show the mounting height and locations of all signal heads, pedestrian signals, and pushbuttons?
❑	7.11	Are the alignment instructions shown for all overhead signs and primary signal heads?
❑	7.12	Does it show the type, size and mounting locations of all signs
❑	7.13	Are the signal indication sequence and signal phase numbers shown for all signal heads?
❑	7.14	Is the position of the pipe sleeve for the rotatable base shown?
❑	7.15	Are there notes provided for as-built dimensions of the vertical clearances of the overhead signal heads?
❑	7.16	Has the phase designation of heads on Pole Elevations been checked for conformity?
❑	7.17	Are streetname signs correctly shown?
	8	Tables and Schedules - Signal Phasing Diagram
❑	8.1	Are the names of the roads correctly shown?
❑	8.2	Are the posted speeds of the roads correctly shown?
❑	8.3	Are the signal phases in use correctly shown?
❑	8.4	Are the left turn phasing type shown correctly (protected-permissive vs protected-prohibited)?
❑	8.5	Are the pedestrian phases in use correctly shown?
❑	8.6	Are back-up protection requirements stated (if needed)?
❑	8.7	Are the dwell phase stated correctly?
❑	8.8	Is the posted speed for each roadway shown?
❑	8.9	Is the advance warning requirements stated correctly (if used)?
❑	8.10	Are notes on signal coordination shown (if used)?

Table 9.e Traffic Signal Design – Checklist for Checker (page 5 of 5)

	Item	Check Items
	9	Tables and Schedules - Controller Timings
❑	9.1	Are the signal phases that are not in use shaded?
❑	9.2	Do the signal phasing match those shown on the signal phasing diagram?
❑	9.3	Do the basic controller timings match AT Guidelines (min green, walk, amber, red, etc)?
❑	9.4	Check for intergreen timings for vehicle and pedestrian phases
❑	9.5	Are the recall phases correctly stated?
❑	9.6	Are the locking phases correctly stated?
❑	9.7	Are there any advance warning flashers? If so, what are the AAWF location and the AAWF time?
❑	9.8	Are there any preliminary time-of-day program? If so, are the settings adequate?
❑	9.9	Is the start-up flash program correct?
❑	9.10	Are there any railway or emergency vehicle preemption? If so, for what directions?
	10	Tables and Schedules - Detector Schedule
❑	10.1	Does the numbering of the detection zones match that in the Above Ground Installations design?
❑	10.2	Are the call phases for the detection zones correct?
❑	10.3	Do the detection zone dimensions and locations follow AT guidelines
❑	10.4	Are the detection zone delay setting correct?
❑	10.5	If loop detectors are used, are inductance values provided?
❑	10.6	Have all right turn lane detection zones been programmed with delay?
	11	Tables and Schedules - Conduit Schedule
❑	11.1	Are all conduits shown on the BG plan listed in the schedule?
❑	11.2	Are conduit lengths shown correct (centre of fixture to centre of fixture, add 2m)?
❑	11.3	Are the sizing and quantity of the conduit as per AT guidelines?
❑	11.4	Is the number of conduits entering the JB's correct?
❑	11.5	Are the JB size designed as per AT guidelines?
❑	11.6	For JB with LE, is it shown in the schedule?
	12	Tables and Schedules - Cabling Schedule
❑	12.1	Are all cable destinations shown (poles, junction box adjacent to loops, PD Cabinet, AC Feed)?
❑	12.2	Are assigned cable size adequate as per AT guidelines?
	13	Tables and Schedules - Equipment List
❑	13.1	Are location, type and quantity of JB's correct (as per Below Ground Installations Plan)?
❑	13.2	Are location, type and quantity of poles, pole bases, cabinet bases and guardrail correct?
❑	13.3	Are location, type and quantity of cabinets correct?
❑	13.4	Are location, type and quantity of signal heads correct?

Figure F1.1

2-Lane Undivided Road (Low Speed)
1-Lane Approach (Note 1)
No Left Turn Signal Phase



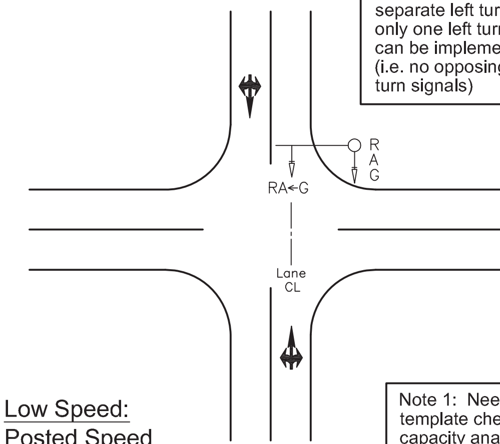
Low Speed:
Posted Speed
of 60 km/h or lower

Note 1: Need turning template check and capacity analysis

Figure F1.2

2-Lane Undivided Road (Low Speed)
1-Lane Approach (Note 1)
With Left Turn Signal Phase (Note 2)

Note 2: Without opposing separate left turnbays, only one left turn signal can be implemented (i.e. no opposing left turn signals)



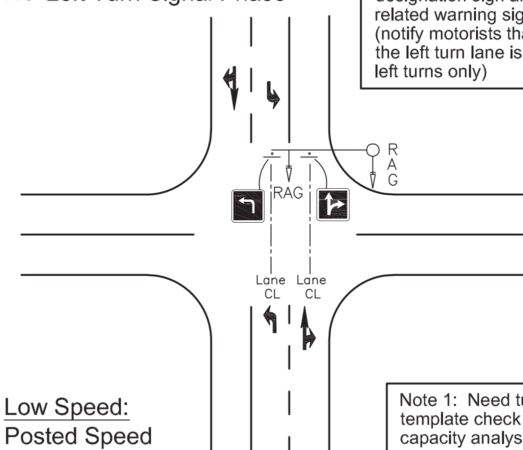
Low Speed:
Posted Speed
of 60 km/h or lower

Note 1: Need turning template check and capacity analysis

Figure F2.1

2-Lane Undivided Road (Low Speed)
2-Lane Flared Approach (Note 1)
With Short Left Turn Bays
Opposing Left Turn Bays (Note 2)
No Left Turn Signal Phase

Note 2: Recommend roadside RB-210L lane designation sign and related warning sign (notify motorists that the left turn lane is for left turns only)



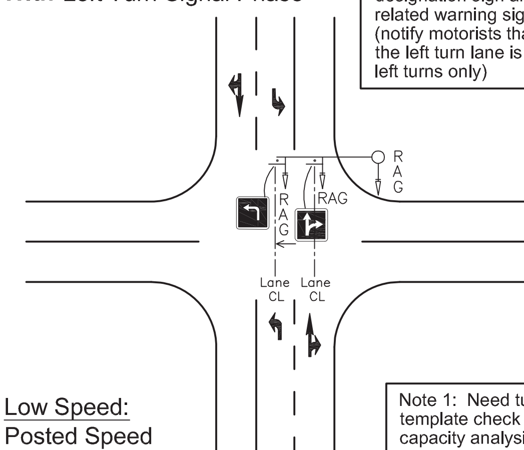
Low Speed:
Posted Speed
of 60 km/h or lower

Note 1: Need turning template check and capacity analysis

Figure F2.2

2-Lane Undivided Road (Low Speed)
2-Lane Flared Approach (Note 1)
With Short Left Turn Bays
Opposing Left Turn Bays (Note 2)
With Left Turn Signal Phase

Note 2: Recommend roadside RB-210L lane designation sign and related warning sign (notify motorists that the left turn lane is for left turns only)



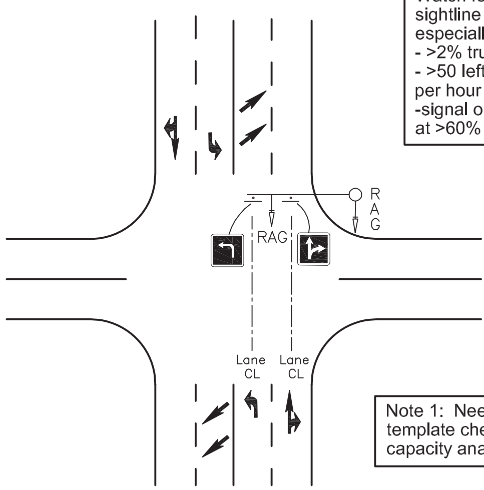
Low Speed:
Posted Speed
of 60 km/h or lower

Note 1: Need turning template check and capacity analysis

Figure F3.1

2-Lane Undivided Road (All Speeds)
2-Lane Approach (Note 1)
With Left Turn Lanes (offset)
No Left Turn Signal Phase

Watch for potential sightline problems, especially when
- >2% trucks
- >50 left turns per hour
-signal operating at >60% capacity

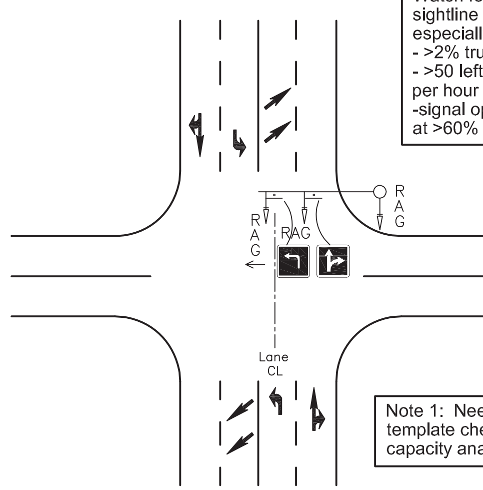


Note 1: Need turning template check and capacity analysis

Figure F3.2

2-Lane Undivided Road (All Speeds)
2-Lane Approach (Note 1)
With Left Turn Lanes (offset)
With Left Turn Signal Phase

Watch for potential sightline problems, especially when
- >2% trucks
- >50 left turns per hour
-signal operating at >60% capacity



Note 1: Need turning template check and capacity analysis

Figure F4.1

2-Lane Undivided Road (Low Speed)
2-Lane Approach (Note 1)
Opposing Left Turn Lane (Note 2)
No Centre Median (Note 3)
No Left Turn Signal Phase

Note 2: Recommend roadside RB-210L lane designation sign and related warning sign

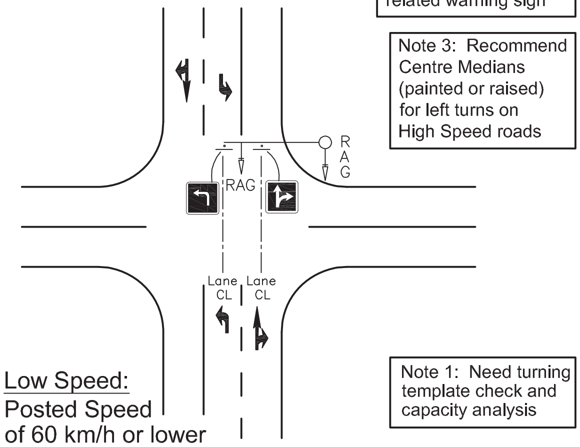


Figure F4.2

2-Lane Undivided Road (Low Speed)
2-Lane Approach (Note 1)
Opposing Left Turn Lane (Note 2)
No Centre Median (Note 3)
With Left Turn Signal Phase

Note 2: Recommend roadside RB-210L lane designation sign and related warning sign

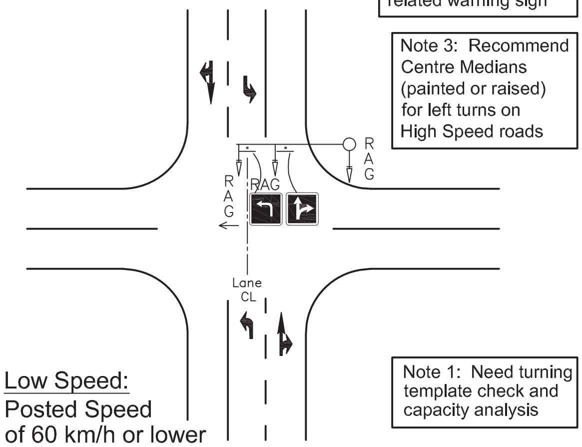


Figure F5.1a

2-Lane Undivided Road (All Speeds)
2-Lane Approach (Note 1)
With Left Turn Lanes
With Painted Centre Median
No Left Turn Signal Phase

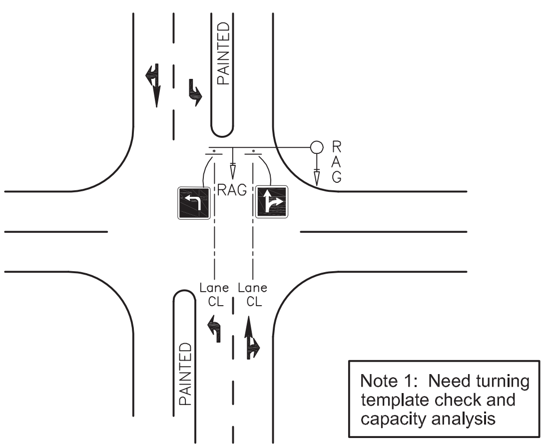


Figure F5.1b

2-Lane Undivided Road (All Speeds)
2-Lane Approach (Note 1)
With Left Turn Lanes
With Painted Centre Median
With Left Turn Signal Phase

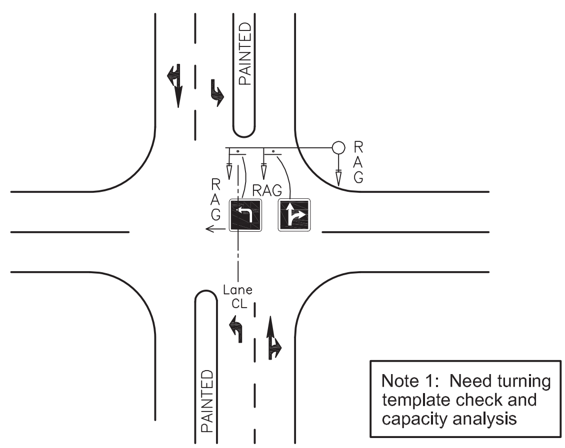


Figure F5.2a

2-Lane Divided Road (All Speeds)
2-Lane Approach (Note 1)
With Left Turn Lanes
With Concrete Centre Median (Note 2)
No Left Turn Signal Phase

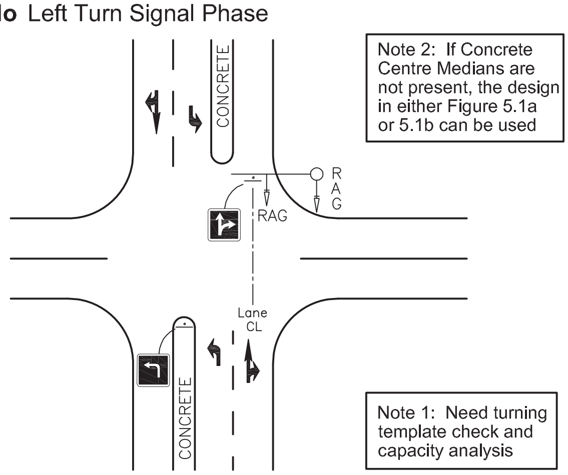
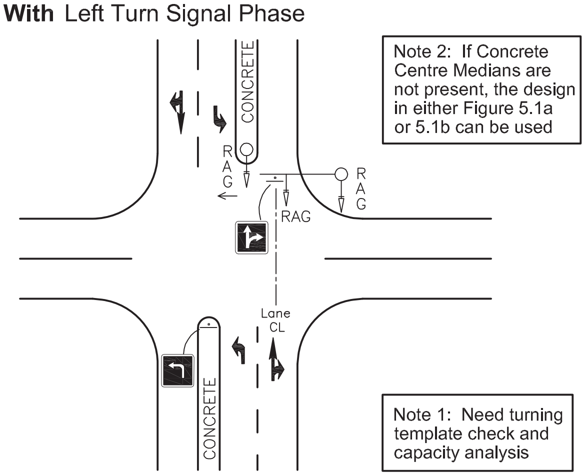


Figure F5.2b

2-Lane Divided Road (All Speeds)
2-Lane Approach (Note 1)
With Left Turn Lanes
With Concrete Centre Median (Note 2)
With Left Turn Signal Phase



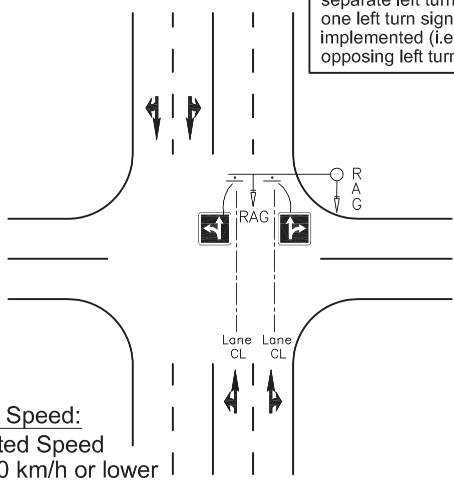
4-Lane Undivided Road (Low Speed) — **Figure F6.1**	**4-Lane Undivided Road (Low Speed)** — **Figure F6.2**

Figure F6.1

4-Lane Undivided Road (Low Speed)

2-Lane Approach
No Left Turn Lane (Note 1)
No Left Turn Signal Phase

Note 1: Without opposing separate left turnbays, only one left turn signal can be implemented (i.e. no opposing left turn signals)



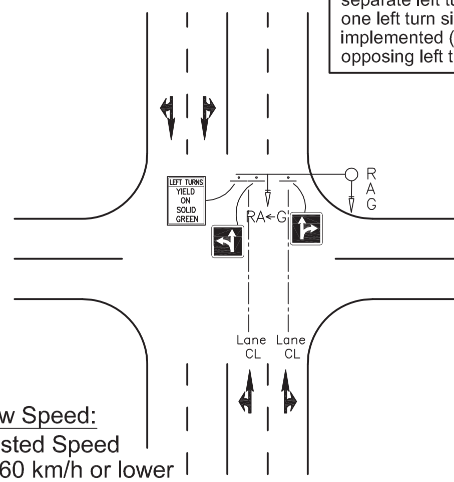
Low Speed:
Posted Speed of 60 km/h or lower

Figure F6.2

4-Lane Undivided Road (Low Speed)

2-Lane Approach
No Left Turn Lane (Note 1)
With Left Turn Signal Phase

Note 1: Without opposing separate left turnbays, only one left turn signal can be implemented (i.e. no opposing left turn signals



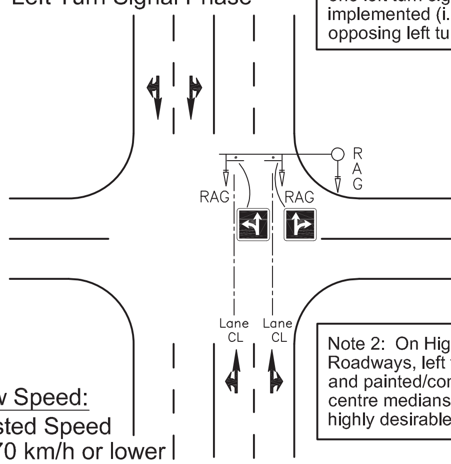
Low Speed:
Posted Speed of 60 km/h or lower

Figure F7.1

4-Lane Undivided Road (High Speed)

2-Lane Approach
No Left Turn Bay (Note 1&2)
No Centre Median
No Left Turn Signal Phase

Note 1: Without opposing separate left turnbays, only one left turn signal can be implemented (i.e. no opposing left turn signals



Note 2: On High Speed Roadways, left turn lanes and painted/concrete centre medians are highly desirable

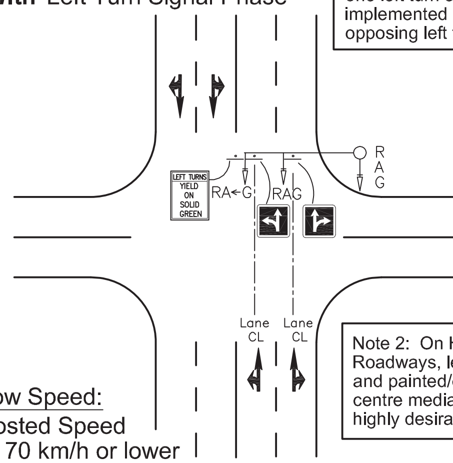
Low Speed:
Posted Speed of 70 km/h or lower

Figure F7.2

4-Lane Undivided Road (High Speed)

2-Lane Approach
No Left Turn Bay (Note 1&2)
No Centre Median
With Left Turn Signal Phase

Note 1: Without opposing separate left turnbays, only one left turn signal can be implemented (i.e. no opposing left turn signals



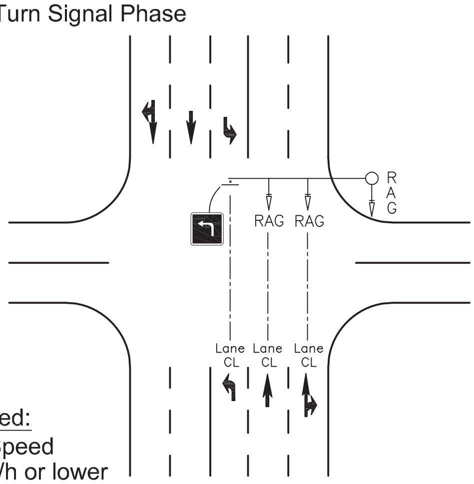
Note 2: On High Speed Roadways, left turn lanes and painted/concrete centre medians are highly desirable

Low Speed:
Posted Speed of 70 km/h or lower

Figure F8.1

4-Lane Undivided Road (Low Speed)

3-Lane Approach
With Left Turn Lane
No Centre Median
No Left Turn Signal Phase

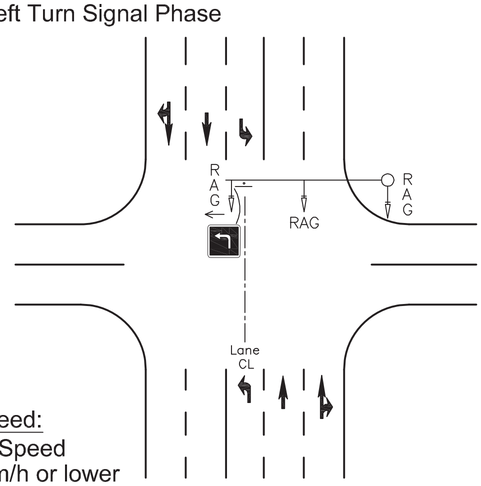


Low Speed:
Posted Speed of 60 km/h or lower

Figure F8.2

4-Lane Undivided Road (Low Speed)

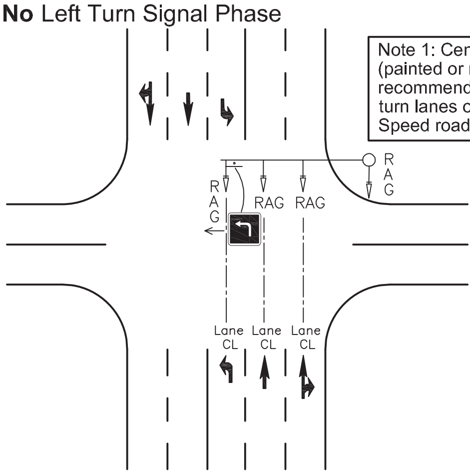
3-Lane Approach
With Left Turn Lane
No Centre Median
With Left Turn Signal Phase



Low Speed:
Posted Speed of 60 km/h or lower

Figure F9.1

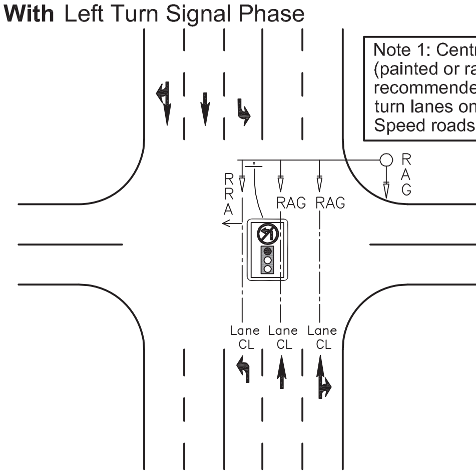
4-Lane Undivided Road (High Speed)
3-Lane Approach
With Left Turn Lanes
No Centre Medians (Note 1)
No Left Turn Signal Phase



Note 1: Centre medians (painted or raised) are recommended for left turn lanes on High Speed roads

Figure F9.2

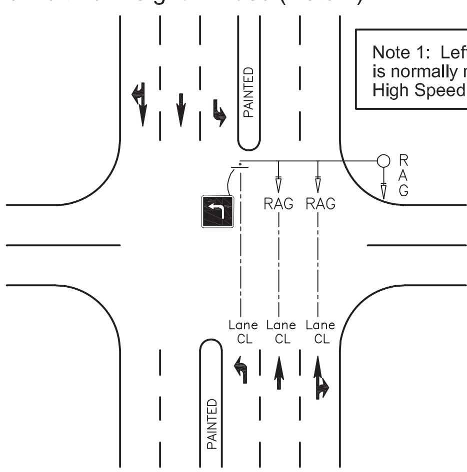
4-Lane Undivided Road (High Speed)
3-Lane Approach
With Left Turn Lanes
No Centre Medians (Note 1)
With Left Turn Signal Phase



Note 1: Centre medians (painted or raised) are recommended for left turn lanes on High Speed roads

Figure F10.1a

4-Lane Divided Road (All Speeds)
3-Lane Approach
With Left Turn Lanes
With Painted Medians
No Left Turn Signal Phase (Note 1)



Note 1: Left Turn Phase is normally needed on High Speed Roadways

Figure F10.1b

4-Lane Divided Road (All Speeds)
3-Lane Approach
With Left Turn Lanes
With Painted Medians
With Left Turn Signal Phase -
Protected / Permissive

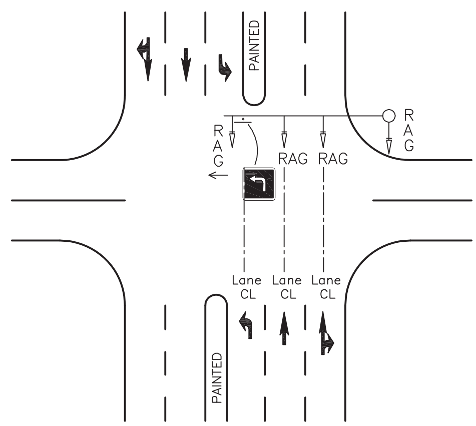
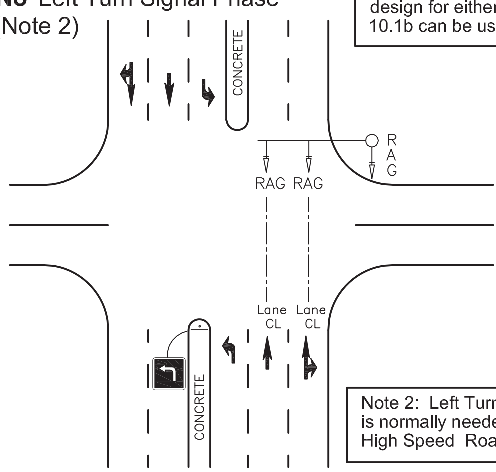


Figure F10.2a

4-Lane Divided Road (All Speeds)
3-Lane Approach
With Left Turn Lanes
With Concrete Medians (Note 1)
No Left Turn Signal Phase
(Note 2)

Note 1: If Concrete Centre Median is not present, the design for either 10.1a or 10.1b can be used



Note 2: Left Turn Phase is normally needed on High Speed Roadways

Figure F10.2b

4-Lane Divided Road (All Speeds)
3-Lane Approach
With Left Turn Lanes
With Concrete Medians (Note 1)
With Left Turn Signal Phase

Note 1: If Concrete Centre Median is not present, the design for either 10.1a or 10.1b can be used

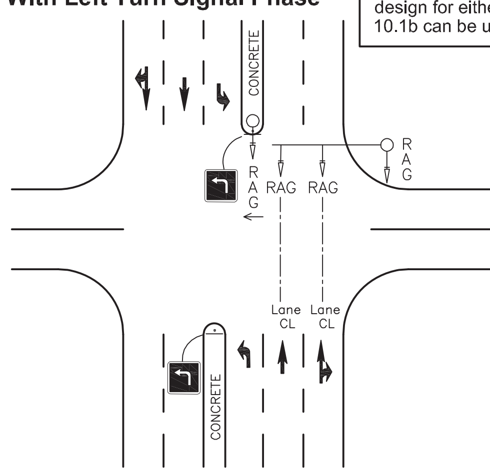


Figure F11.1

4-Lane Divided Road (All Speeds)
3-Lane Approach
With Left Turn Lanes
With Concrete Medians
With Protected / Permissive Left Turn
Signal Phase

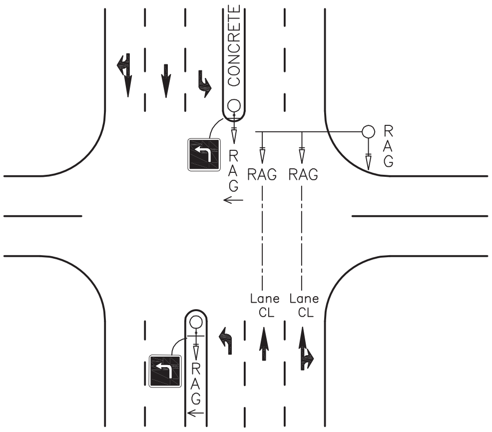


Figure F11.2

4-Lane Divided Road (All Speeds)
3-Lane Approach
With Left Turn Lanes
With Concrete Medians
With Protected Only Left Turn
Signal Phase (Note 1)

Note 1: For locations with sightline concerns or high number of left turn cross path collisions

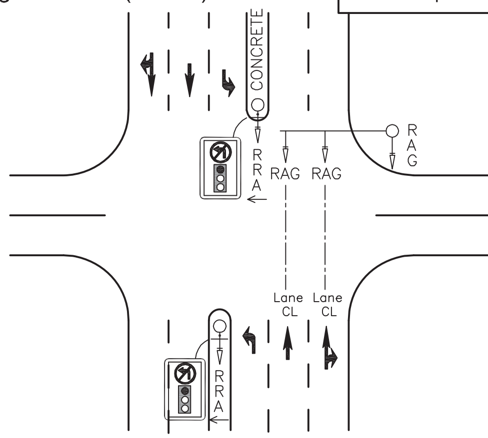
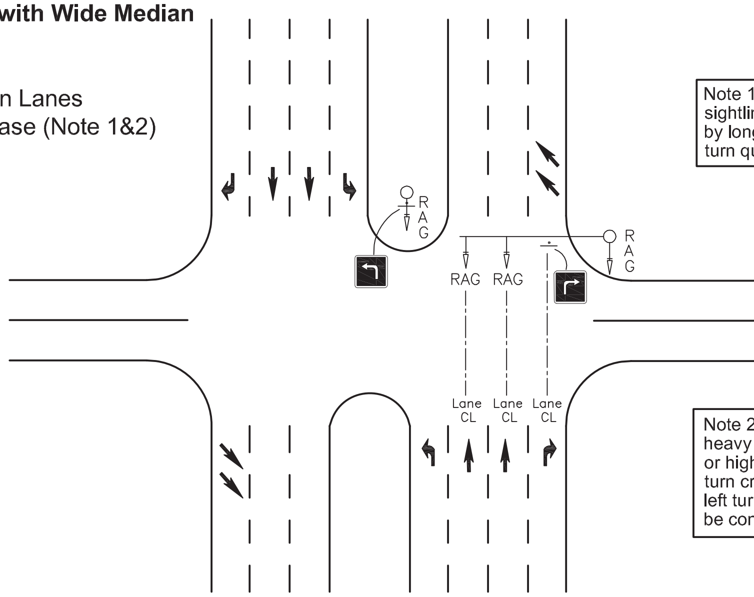


Figure F12.1

4-Lane Divided Road with Wide Median
(High Speed)
4-Lane Approach
With Left and Right Turn Lanes
No Left Turn Signal Phase (Note 1&2)

Note 1: Watch for potential sightline problems caused by long opposing left turn queues



Note 2: For locations with heavy left turn volumes or high number of left turn cross path collisions, left turn signal should be considered

Figure F12.2

4-Lane Divided Road with Wide Median
(High Speed)
4-Lane Approach
With Left and Right Turn Lanes
With Left Turn Signal Phase
Protected / Permissive) (Note 1)

Note 1: Watch for potential sightline problems caused by long opposing left turn queues

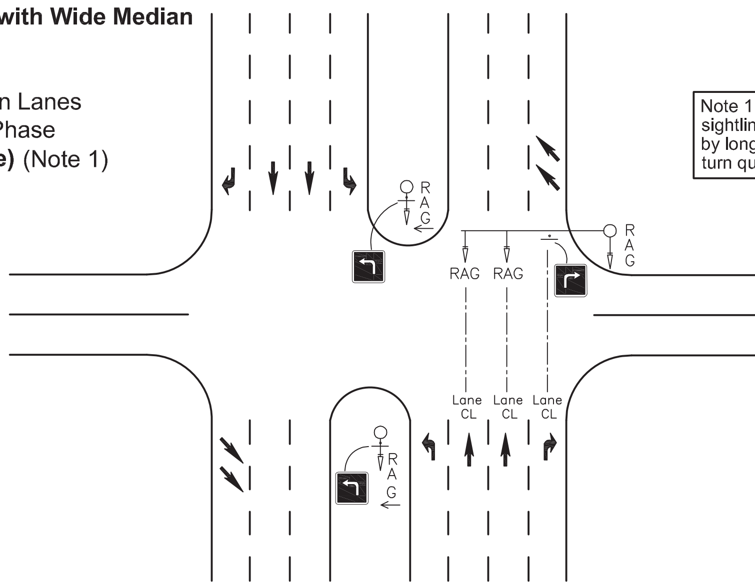


Figure F13.1

4-Lane Divided Road with Wide Median and Slotted Left Turn Lane (High Speed)
4-Lane Approach
With Left and Right Turn Lanes
No Left Turn Signal Phase

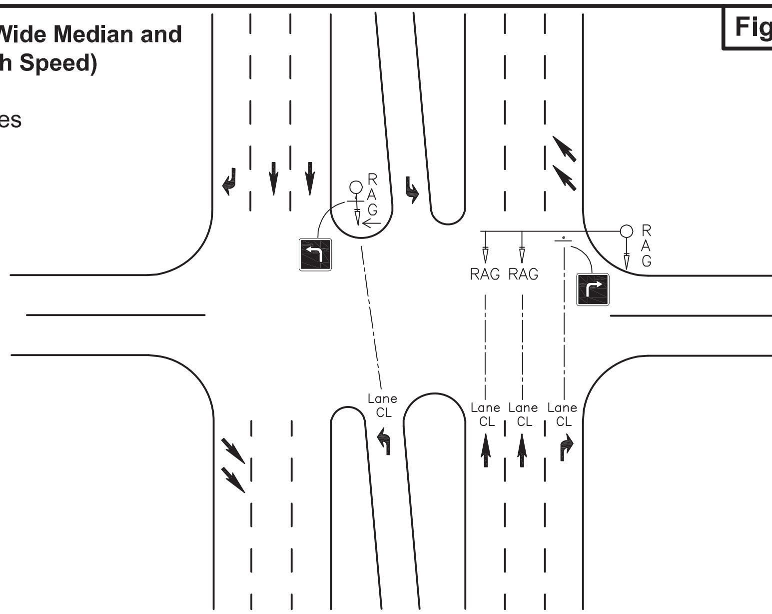


Figure F13.2

4-Lane Divided Road with Wide Median and Slotted Left Turn Lane (High Speed)
4-Lane Approach
With Left and Right Turn Lanes
With Left Turn Signal Phase -
Protected / Permissive

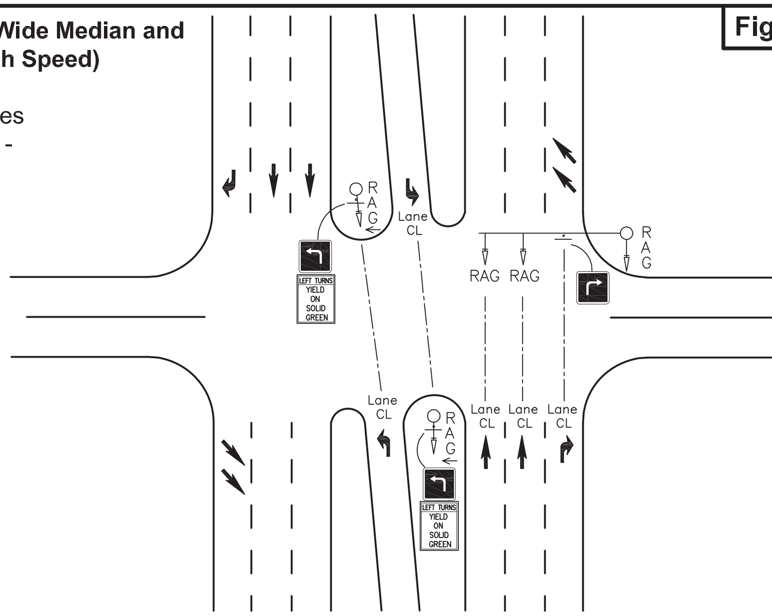


Figure F13.3

4-Lane Divided Road with Wide Median and Slotted Left Turn Lane (High Speed)
4-Lane Approach
With Left and Right Turn Lanes
With Left Turn Signal Phase - Protected Only
(Protected / Prohibited)

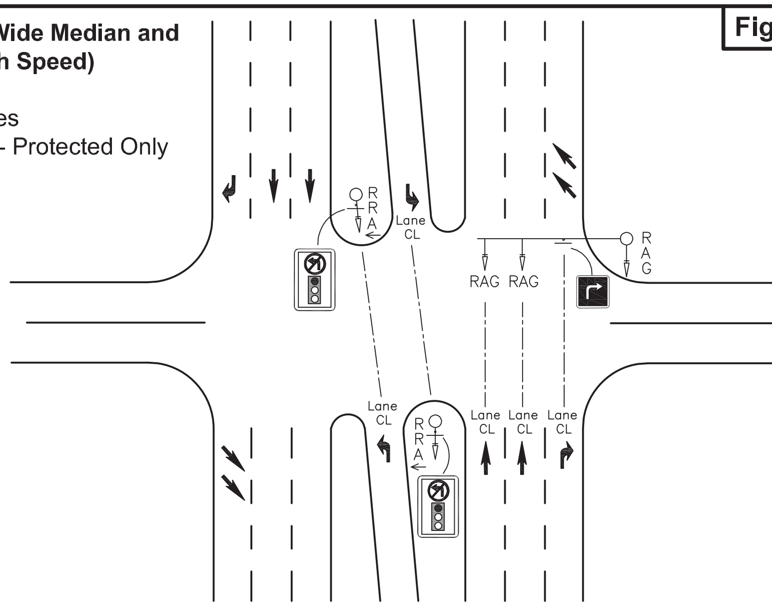


Figure F13.4

4-Lane Divided Road with Wide Median and Slotted Left Turn Lane (High Speed)
5-Lane Approach
With Right Turn Lane and Double Left Turn Lanes
With Left Turn Signal Phase -
Protected Only (Protected / Prohibited)
(Note 1)

Note 1: Double Left Turn Lanes normally require Protected-Only Left Turn Phasing

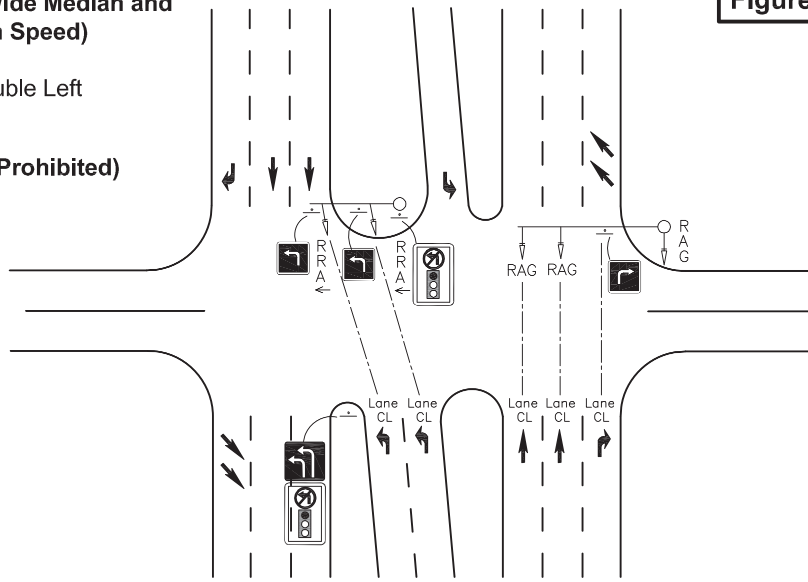


Figure F14.1

6-Lane Divided Road (all speeds)
5-Lane Approach
With Left Turn Lanes crossing 3 opposing through lanes (Note 1)
With Concrete Medians
With Protected Only Left Turn Signal Phase

Note 1: Left turns crossing 3 opposing through lanes normally require Protected-Only Left Turn Phasing

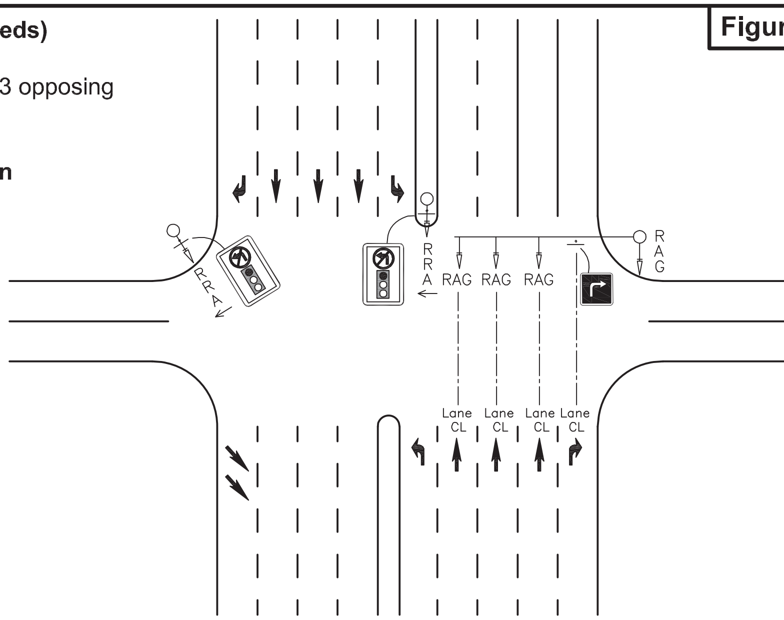
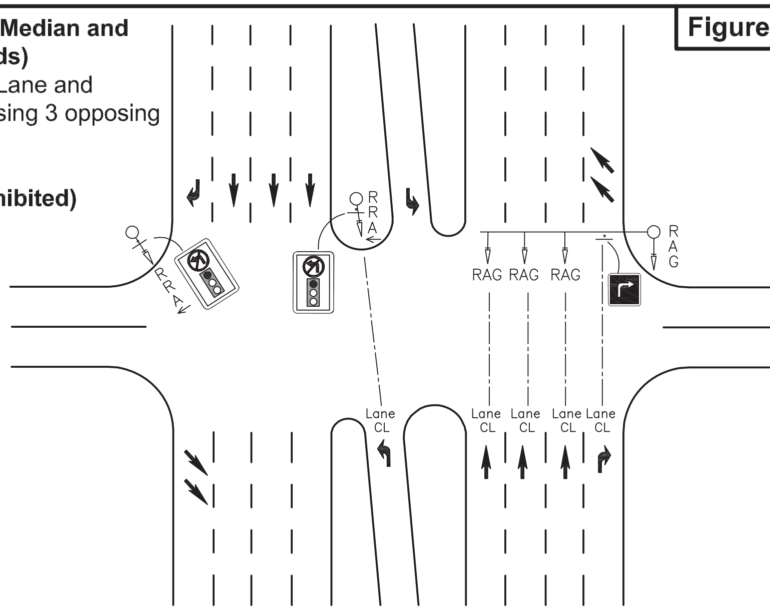


Figure F14.2

6-Lane Divided Road with Wide Median and Slotted Left Turn Lane (all speeds)
5-Lane Approach with Right Turn Lane and with Slotted Left Turn Lanes (crossing 3 opposing through lanes) (Note 1)
With Left Turn Signal Phase -
Protected Only (Protected / Prohibited)

Note 1: Left turns crossing 3 opposing through lanes normally require Protected-Only Left Turn Phasing



The Contractor shall prepare detailed signal timings for the traffic signals in the NE AHD DBFO Project by referring to the requirements in Package G. The timing guidelines listed in Package A and D are for Synchro modeling purposes only and shall not be followed for detailed signal timing preparation.

1. Alberta Signal Phasing Convention

Figure 1 illustrates the following signal phasing convention recommended for all traffic signals for the NE AHD DBFO Project:

Vehicle Through Movements (Even Number)

- Southbound: Phase 2
- Westbound: Phase 4
- Northbound: Phase 6
- Eastbound: Phase 8

Pedestrian Movements (Even Number)

- West Crosswalk: Phase 2
- North Crosswalk: Phase 4
- East Crosswalk: Phase 6
- South Crosswalk: Phase 8

Vehicle Left Turn Movements (Odd Number)

- Southbound Left Turns: Phase 5
- Westbound Left Turns: Phase 7
- Northbound Left Turns: Phase 1
- Eastbound Left Turns: Phase 3

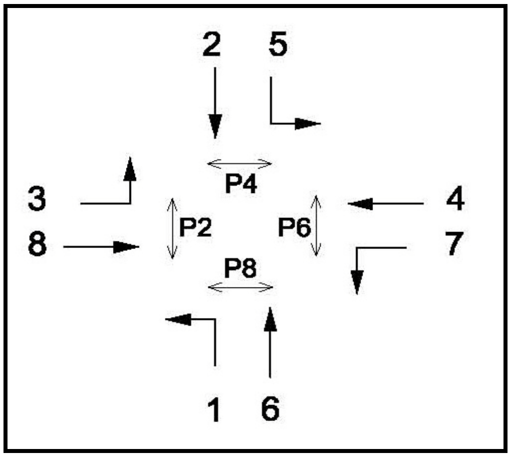


Figure 1 - Signal Phasing Convention

2. Protected-Prohibited (Protected-Only) Left Turn Phasing

Protected-prohibited left turn phasing shall be used where two or more of the following criteria are met:

- The speed of oncoming traffic is sufficiently high to make the judgment of gaps difficult for drivers (70 km/h or higher);
- The opposing through movement has five or more lanes (3 through lanes and 2 turn lanes);
- The left turn movement has two or more lanes and there is an opposing through movement;
- There is restricted sight distance of opposing through movement and the restriction cannot be resolved with geometric improvements;
- Where there are heavy pedestrian movements that conflict with the left turning movement;
- There is a history of left turn across path type collisions.

3. Left Turn Phase Determination

The following general considerations may indicate that a left turn phase shall be used:

- left turns are permitted from two lanes on one approach with an opposing through movement;
- the left turn queue frequently extends beyond the left turn lane, blocking the through movement;
- intersection geometry creates a visibility problem which may be alleviated by a left turn phase; or
- the speed of approaching traffic is sufficiently high to make driver judgment of gaps difficult.

Under the following special conditions, left turn phasing shall be used, regardless of whether or not any other criteria are satisfied:

- Railway or public transit vehicles operate in an exclusive right-of-way in the median which is parallel to the left turn lane;
- Dual left turns are permitted AND there is a significant (>250 vph) opposing through movement.
- The average left turn demand > 2 per cycle in the study hour, AND the speed limit is ≥ 80 Km/h.

Under the following special conditions, left turn phasing shall not be used, regardless of whether or not any other criteria are satisfied:

- The average left turn demand ≤ 2 per cycle in the study hour.
- There is no exclusive left turn bay, or opportunity for one.
- There is insufficient green time within the current cycle length to accommodate the proposed left turn phase. This is based on an operational analysis that quantifies the effect of the new phase, and demonstrates that, if implemented, significant undesirable effects in terms of the overall intersection stops, delays or increased fuel consumption will result.
- The resulting longer cycle length would impact the overall network system efficiency, or it would negatively affect the progression of vehicles along a corridor; or

3.1 Left turn Phase Warrant Criteria

Where neither of the above conditions applies, the following criteria need to be considered in combination. If both condition 1 and condition 2 are met, AND one of the remaining five conditions is met, then a left turn phase is warranted.

Condition 1 – Left Turn Traffic Demand

- A minimum **left turn demand** (average over the study hour) must be present prior to further consideration.
  - $V_{LT} > 2$ per cycle

  where:

  V_{LT} = left turn traffic (veh/hr)

Condition 2 – Gaps in Opposing Traffic

- Sufficient **gaps in the opposing traffic** flow are not available for the left turn demand. The cross product of left turn traffic and opposing through traffic (taking into account the number of opposing through lanes) will provide a measure for this.
  - $V_{LT} \times f(V_{OP}) > 50{,}000$

  where:

  V_{OP} = opposing traffic (veh/hr)

  f = volume adjustment factor based on number of lanes (**f** = 1.0 for 1 lane; 0.625 for 2 lanes; 0.51 for 3 lanes; 0.44 for 4 lanes)

Condition 3 – Left Turn Collision History

- The **left turn collision history** indicates a problem. The number of left turn collisions > 20 in 5 years; or >5 in 1 year; or > 6 in 5 years during study period; or >2 in 1 year during study period. However, if the left turn phase cannot be justified by any other criteria, then other measures should be fully explored prior to installing the left turn phase.

Condition 4 – Left Turn Delay

- The average **delay to the left turn vehicles** is unacceptable. A field survey, or a simulation of the existing phase scenario in SimTraffic, demonstrates that the left turn traffic is experiencing significant delay (>55 sec/veh).

Condition 5 – Queue Length

- The **left turn queue lengths** are frequently longer than the storage bay. A field survey, or a simulation of the existing phase scenario in SimTraffic, demonstrates that the maximum left turn queues are longer than the storage capacity.

Condition 6 – Public Transit

- Drivers of **public transit** buses or school buses have difficulties finding adequate gaps in the opposing traffic during a permissive phase. The left turn transit demand >3 in-service vehicles per hour.

Condition 7 – Gaps in Opposing Pedestrian Traffic

- Left turn traffic has difficulties finding adequate **gaps in the opposing pedestrian traffic** during a permissive phase.
  - $V_{LT} \times V_{Ped} > 10{,}000$

  where:
  V_{LT} = left turn traffic (veh/hr)
  V_{Ped} = opposing ped traffic (ped/hr)

4. Signal Timing Intervals

4.1 Vehicle Clearance for Through Movements

The clearance distance considered for through movements is illustrated in **Figure 2**.

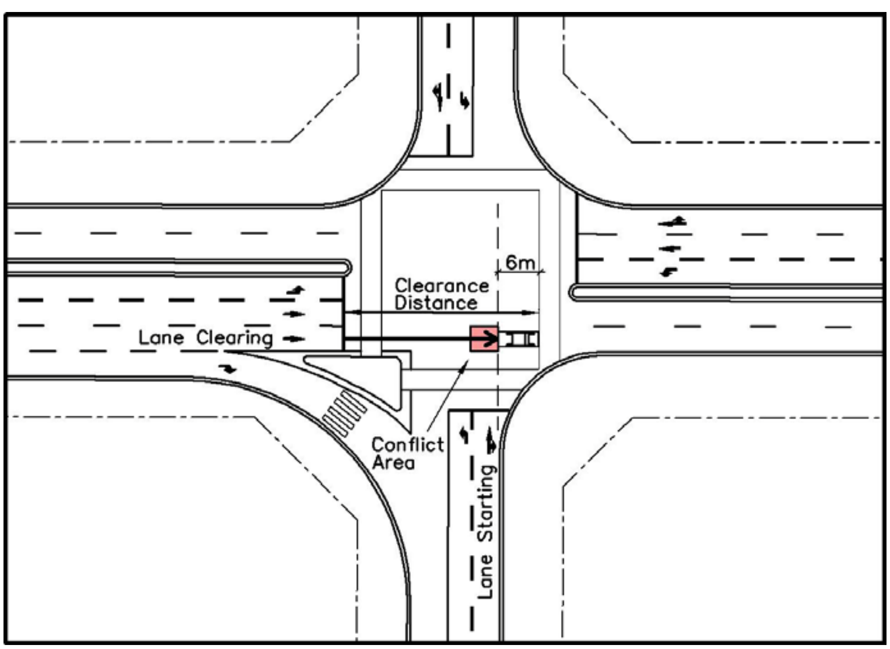


Figure 2 Clearance Distance for Through Movements

The intergreen period usually consists of an amber interval and an all red interval, and is calculated using the following formula:

$$I = t_{pr} + [(v) / (2*a + 2*g*G)] + [(W_c+L_{veh}) / v_c]$$

Variable	Value	Units	Description
t_{pr}	1.00	sec	*Perception / reaction time – based on a quick response to the amber signal*
a	3.00	m/s^2	*Average deceleration rate, assuming smooth tires and wet pavement (f = 0.31)*
g	9.81	m/s^2	*Gravitational constant*
G	G	%	*Average grade of approach within 50m of the stop line*
v	v	m/s	*Operating speed for through traffic (Speed Limit or 85th percentile speed)*
v_C	v	m/s	*Clearing speed for through traffic (equal to v)*
s	6.94	m/s	*Startup speed of a vehicle on the side street (assume 25km/h at start of all-red)*
W_c	w	m	*Distance to clear, measured from the stop line to the far end of the potential conflict zone for the most critical combination of lanes for which the green interval terminates and lanes for which the green interval is about to start*
L_{veh}	6.00	m	*Length of the clearing vehicle*

4.1.1 Amber Clearance

The amber interval is the first part of the equation, and provides the warning to drivers that the signal is changing from green to red. It is based upon the operating speed and grade of the approaches. The amber interval is the time needed for the driver to bring the vehicle to a stop, and includes two components:

- Distance travelled during the perception-reaction time of the driver
- Distance travelled to bring the vehicle from the operating speed to a stop.

$$A = t_{pr} + [(v) / (2*a+2*g*G)]$$

Minimum Amber time (thru) = 3.0 seconds
Maximum Amber time (thru) = 6.0 seconds

Table 1 summarizes the recommended amber intervals for through movements:

Table 1 Recommended Amber Intervals for Through Movements

Grade	50 km/h	60 km/h	70 km/h	80 km/h
-4%	3.7	4.2	4.7	5.3
-3%	3.6	4.1	4.6	5.1
-2%	3.5	4.0	4.5	5.0
-1%	3.4	3.9	4.3	4.8
0%	**3.3**	**3.8**	**4.2**	**4.7**
1%	3.2	3.7	4.1	4.6
2%	3.2	3.6	4.0	4.5
3%	3.1	3.5	3.9	4.4
4%	3.0	3.5	3.9	4.3

4.1.2 All-Red Clearance

The All-Red clearance interval is the second part of the equation, and is used to ensure the intersection is clear of traffic before the next conflicting phase begins (provides a measure of safety between conflicting phases). The All-Red interval provides a short period of time where all traffic movements have the red indication. It is calculated by the time needed for a vehicle to clear the conflict zone inside an intersection at the posted speed, assuming that the vehicle enters the intersection just when the signal display turns red. It also accounts for the startup time for a driver on the side street to approach the conflict zone. The All-Red Clearance is calculated using:

$$(W_c+L_{veh})/v_c$$

Minimum All Red time (thru) = 1.0 seconds
Maximum All Red time (thru) = 4.0 seconds

Table 2 summarizes the recommended all red intervals for through movements:

Table 2 Recommended All-Red Intervals for Through Movements

Grade	50 km/h	60 km/h	70 km/h	80 km/h
20 m	1.9	1.6	1.3	1.2
25 m	2.2	1.9	1.6	1.4
30 m	2.6	2.2	1.9	1.6
35 m	3.0	2.5	2.1	1.8
40 m	3.3	2.8	2.4	2.1
45 m	3.7	3.1	2.6	2.3
50 m	4.0	3.4	2.9	2.5
55 m	4.0	3.7	3.1	2.7
60 m	4.0	4.0	3.4	3.0

4.2 Vehicle Clearance for Left Turn Movements

Intergreen interval requirements for leading left turns are different from the intergreen interval requirements for lagging left turns.

4.2.1 Clearance Intervals for Leading Left Turns

The clearance interval for protected-permissive left turn phases is displayed with an amber arrow, followed by a potential hidden-red.

The clearance interval for protected-prohibited left turn phases is displayed with a solid amber ball, followed by a solid red ball.

The duration of the amber interval with both leading protected-permissive and leading protected-prohibited left turns are calculated in the same manner as for the through movements, except that the speed at which they are going through the intersection is slower. A left turn vehicle speed of between 25 and 35 km/h are often selected for use in the calculation of amber interval for typical left turns movements.

For leading left turn signals, the left turning vehicles can come to a stop at the middle of an intersection area (but outside the conflict zone) and wait for their turns to clear the intersection during the clearance intervals of the left turn signal phase, as illustrated on Figure 3.

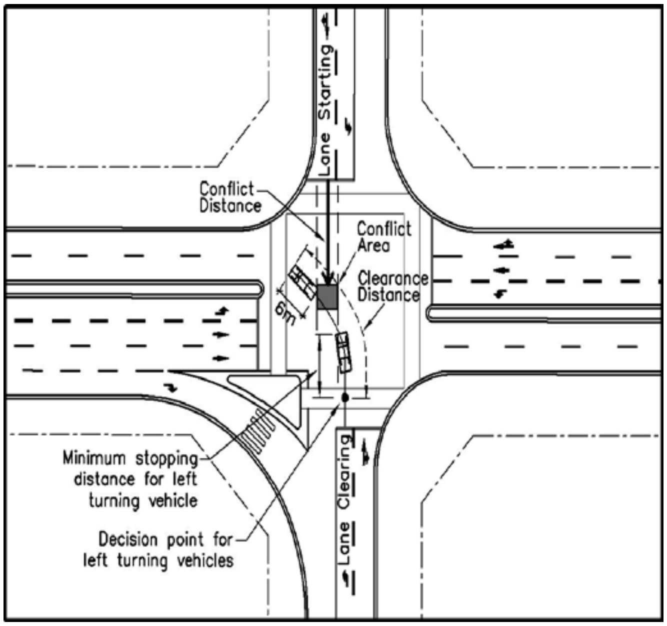


Figure 3 Clearance Distance for Left Turn Movements Facing a Leading Left Turn Signal

The left turning drivers at the "Decision Point" are confronted with 2 choices – (i) brake and come to a stop in the middle of the intersection, in front of the conflict zone, as shown in Figure 3; or (ii) carry on with the turning maneuver and clear the conflict zone (left turn clearing path is labeled "clearance distance"). The location of the "Decision Point" can be determined by measuring from the safe stopped location in the middle of the intersection, to a distance upstream which is the minimum stopping distance for the left turning vehicle (traveling at the assumed left turning speed).

The following factors are needed in determining the clearance times for left turn signals:

- Clearing speed of left turning vehicles
- Left turn clearance distance
- Distance into the intersection that a left-turning vehicle can stop and still stay clear of the travel paths of opposing through traffic
- Approach distance for opposing conflicting through traffic
- Approach speed for opposing conflicting through traffic
- Grade at the intersection

Tables 3 summarizes the calculated clearance times for leading protected-permissive left turn signals and leading protected-prohibited left turn signals with left turn clearing speeds of 25 km/h, 30 km/h and 35 km/h. In carrying out the calculation, it was assumed that the approaching conflicting traffic is traveling at close to posted speeds. For opposing approaches with posted speeds of 50 km/h or lower, it is assumed that the approach speed is 50 km/h. For opposing approaches with posted speeds of 60 km/h or higher, it is assumed that the approach speed is 60 km/h.

Table 3 Clearance Times for Leading Left Turn Signal

Opposing Traffic Posted Speed		50 km/h or lower				60 km/h or higher			
Cross Street Traffic Approach Distance		**5 m**	**10 m**	**15 m**	**20 m**	**5 m**	**10 m**	**15 m**	**20 m**
Left Turn Clearance Distance at 25 km/h Clearing Speed	**20 m**	3.0 s	2.4 s	1.8 s	1.2 s	3.1 s	2.7 s	2.2 s	1.8 s
	25 m	3.0 s	2.4 s	1.8 s	1.2 s	3.1 s	2.7 s	2.2 s	1.8 s
	30 m	3.0 s	2.4 s	1.8 s	1.2 s	3.1 s	2.7 s	2.2 s	1.8 s
	35 m	3.6 s	3.0 s	2.4 s	1.8 s	3.7 s	3.3 s	2.8 s	2.4 s
	40 m	3.6 s	3.0 s	2.4 s	1.8 s	3.7 s	3.3 s	2.8 s	2.4 s
	45 m	3.6 s	3.0 s	2.4 s	1.8 s	3.7 s	3.3 s	2.8 s	2.4 s
	50 m	4.1 s	3.5 s	2.9 s	2.2 s	4.3 s	3.8 s	3.4 s	2.9 s
Left Turn Clearance Distance at 30 km/h Clearing Speed	**20 m**	3.0 s	2.4 s	1.8 s	1.2 s	3.1 s	2.7 s	2.2 s	1.8 s
	25 m	3.0 s	2.4 s	1.8 s	1.2 s	3.1 s	2.7 s	2.2 s	1.8 s
	30 m	3.0 s	2.4 s	1.8 s	1.2 s	3.1 s	2.7 s	2.2 s	1.8 s
	35 m	3.5 s	2.9 s	2.3 s	1.7 s	3.6 s	3.2 s	2.7 s	2.3 s
	40 m	3.5 s	2.9 s	2.3 s	1.7 s	3.6 s	3.2 s	2.7 s	2.3 s
	45 m	3.5 s	2.9 s	2.3 s	1.7 s	3.6 s	3.2 s	2.7 s	2.3 s
	50 m	3.9 s	3.3 s	2.7 s	2.1 s	4.1 s	3.6 s	3.2 s	2.7 s
Left Turn Clearance Distance at 35 km/h Clearing Speed	**20 m**	3.0 s	2.4 s	1.8 s	1.2 s	3.2 s	2.7 s	2.2 s	1.8 s
	25 m	3.0 s	2.4 s	1.8 s	1.2 s	3.2 s	2.7 s	2.2 s	1.8 s
	30 m	3.0 s	2.4 s	1.8 s	1.2 s	3.2 s	2.7 s	2.2 s	1.8 s
	35 m	3.4 s	2.8 s	2.2 s	1.8 s	3.6 s	3.3 s	2.8 s	2.4 s
	40 m	3.4 s	2.8 s	2.2 s	1.8 s	3.6 s	3.3 s	2.8 s	2.4 s
	45 m	3.4 s	2.8 s	2.2 s	1.8 s	3.6 s	3.3 s	2.8 s	2.4 s
	50 m	3.9 s	3.3 s	2.7 s	2.1 s	4.0 s	3.8 s	3.4 s	2.9 s

4.2.1.1 Amber and Red Intervals for Leading Left Turns

The left turn clearance times in **Tables 3** can be allocated into amber and red intervals using **Table 4** below:

Table 4 Recommended Amber and Red Intervals for Leading Left Turn Signals

Left Turn Clearance Times (from Table 5.4.3)	**Amber Interval**	**Red Interval ***
0.0 to 3.0 s	3.0 s	0.0 s
3.1 to 3.5 s	3.0 s	0.5 s
3.6 to 4.0 s	3.5 s	0.5 s
4.1 to 4.5 s	3.5 s	1.0 s
4.6 to 5.0 s	4.0 s	1.0 s
5.1 to 5.5 s	4.0 s	1.5 s
5.6 to 6.0 s	4.5 s	1.5 s
6.1 to 6.5 s	4.5 s	2.0 s
6.5 to 7.0 s	5.0 s	2.0 s

Note: The Red Interval will be a “hidden red” interval for protected-permissive left turn signals.

4.2.2 Clearance Intervals for Lagging Left Turns

The duration of the amber and all-red intervals for a lagging left turn shall be equal to the amber and all-red intervals of the concurrent through phases.

4.3 Pedestrian Timing

Pedestrian crossing time is the time needed for pedestrians to safety cross the street before the start of a conflicting phase.

4.3.1 Minimum Walk

The minimum walk times are typically set as:

- 7 seconds: lightly used intersections
- 10 seconds: heavily used intersections
- 5 seconds: very light pedestrian traffic and wide highway

4.3.2 Flashing Don't Walk

Pedestrian clearance times are based on walking speed and the width of the intersection. Pedestrian walking speed can vary based on the population demographic of the adjacent land-use (children / seniors). Normal walking speeds are assumed to be 1.2 m/s, however in areas where a high number of children or seniors is expected, the walking speeds are reduced. In typical urban situations, the crossing distance is taken as the total length of the crosswalk.

For crosswalks on wide rural highways, the measurement of the walk clearance distance may be taken from the point where the pedestrian steps on the road to the point where the pedestrian clears the potential conflict zone. The above two walk clearance situations are illustrated in **Figure** 4.

Walking Speed:

- 1.2 m/s - typical pedestrian population
- 1.0 m/s - children expected, near playgrounds and schools
- 0.9 m/s – seniors/visually impaired expected

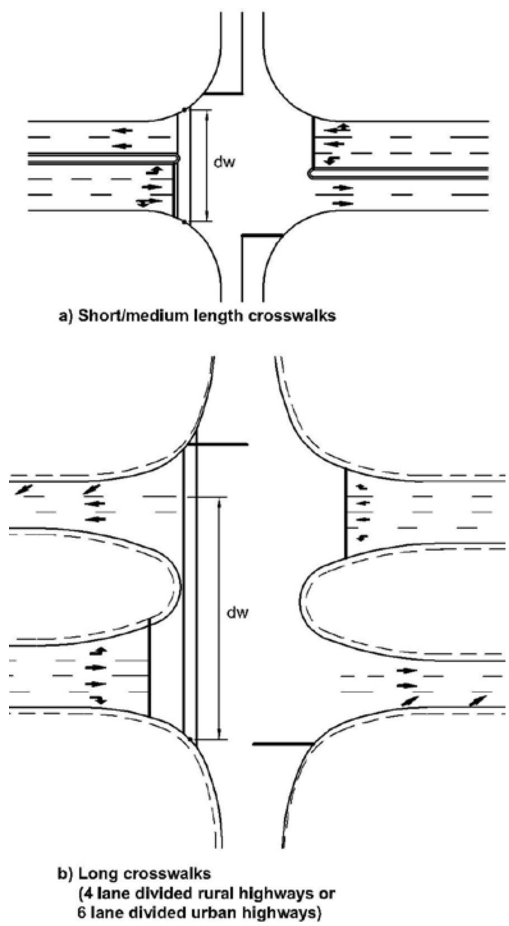


Figure 4 Pedestrian Clearances

Table 5 summarizes the calculated pedestrian clearance time for various types of pedestrians.

Table 5 Recommended Pedestrian Clearance Time

Crossing Distance	Typical Usage	Children Expected	Seniors* Expected
15 m	13 s	15 s	17 s
20 m	17 s	20 s	23 s
25 m	21 s	25 s	28 s
30 m	25 s	30 s	34 s
35 m	30 s	35 s	39 s
40 m	34 s	40 s	45 s
45 m	38 s	45 s	50 s
50 m	42 s	50 s	56 s

* Includes persons with disabilities

The calculated walk clearance time is normally used to time for the Flashing Don't Walk interval of a pedestrian signal. Typically, amber clearance time is included in pedestrian clearance calculations. However, this practice of including the amber interval as part of the pedestrian clearance interval may place pedestrians at risk if a concurrent permissive left turn movement is receiving an amber signal and the left turning vehicles are expected to clear the intersection during the amber interval. Therefore, at intersections where there are both heavy left turning vehicular traffic and heavy pedestrian traffic, and that there have been known pedestrian safety concerns, it may be desirable to exclude the amber clearance time in the pedestrian clearance calculations.

4.4 Minimum Green

Minimum green times are based on the road classification and the appropriate movement of the traffic. These times are always in full second intervals. For TRANS, they are:

- 30 seconds – major road through movements
- 7 seconds - left turns
- 10 seconds – minor road through movements or interchange ramps

4.5 Extension Time

Active optimization of the signal timings can occur with the inclusion of actuated extension of a phase. Extending the green time for an approach that is experiencing a continuing demands provides more efficient use of the entire cycle. Extension time is typically 3 - 5 seconds per actuation, but may be longer if there is a higher volume of heavy vehicles, or when the clearing distance is very long. Normally, extension time for left turn phases is kept low (maximum of 3 - 4 seconds) to increase intersection operation efficiency.

4.6 Maximum Green

The maximum green time is the upper limit to which a green interval can be extended. The controller will default to this value in the absence of vehicle detection inputs (failed detectors), therefore the maximum green times should be based on the volume to capacity calculations for an appropriate cycle length. Normally, maximum green time of 30 – 60 seconds are used for highway through phases, 25 – 40 seconds are used for cross-streets through phases, and 15 – 30 seconds for left turn signal phases.

For congested intersections, it is essential that Synchro is used to determine the optimal signal cycle length, and that the maximum phase timing for each key traffic movements are achieved by programming the MAX timing of the individual phases.

For isolated, actuated intersections, an additional parameter, MAX 2, can provide additional flexibility to signal operation.

MAX 2 provides an alternative maximum green time that can be programmed to be selected for special times such as peak hours. Therefore, the intersection can operate under the normal maximum green time and change to a longer MAX2 time during peak hours when traffic demands are expected to be much higher.

5. Flashing Considerations

5.1 Start-Up Flash / Pre-Commissioning Flash

The traffic signals shall not be placed in to a flash mode before commissioning. When the signal poles and the signal heads are installed, all signal displays shall be bagged for a minimum of 7 days. When the traffic signal is ready for full operation, the signal display shall be unbagged at such time just before the traffic signal is turned on for full operation.

5.2 Emergency Flash

Emergency flash occurs either when a fault has been detected by the MMU (Malfunction Management Unit) within the traffic controller cabinet assembly, or when the controller is manually put in flash by a police officer or a signal technician.

The considerations for choosing between flashing amber/flashing red or all-way flashing-red for emergency flash are similar to that for start-up flash. An additional consideration for emergency flash is the response time for the contractor to mobilize on site.

For traffic signals located within or near to an urban centre where the response time for repair maintenance is relatively short, it is more desirable to have the traffic signal programmed in all-way flashing red mode for emergency flash. However, if the traffic signals are located away from an urban centre and the response time for repair is expected to be long, the same issues should be considered as for start-up flash.

Emergency flash for traffic signals located at interchange ramp intersections shall be all-way flashing-red. The all-way flashing-red flashing mode minimizes the potential back up of ramp traffic into the freeway.

5.3 Programmed Flash

Programmed flash is not permitted in the NE AHD DBFO Project.

6 Operational Modes

6.1 Coordinated vs Free Operations

Interchange ramp intersection traffic signals shall operate in a semi-actuated coordination mode during the daytime, and in a fully-actuated coordination mode during the nighttime if the nighttime traffic volumes are low. Signal operations among coordinated traffic signals shall be synchronized through the use of a GPS time clock to be installed in the traffic control (TC) cabinets.

Isolated signalized intersection shall operate in a fully-actuated, free operation mode. An intersection is considered an isolated intersection if the closest signalized intersection is located more than 800m away.

If the traffic signal is located within the traffic signal network of the Local Authority, and the Local Authority requests that the traffic signal be coordinated with the rest of the traffic signals in their network, the Contractor shall utilize the GPS time clock in the TC Cabinet for synchronization purposes, even though the traffic signal may be more than 800m away from the next traffic signal.

6.2 Locking vs Non-Locking Mode of Operation

The selection of locking or non-locking modes shall be programmed in the controller for the applicable signal phases, and <u>not</u> in the traffic cameras or on the detector amplifiers (where loops are used).

Use non-locking mode for:

- main road operations
- left turn lane with a prohibited-permissive signal phase

Use locking mode for:

- minor road operations
- left turn lane with a prohibited-prohibited signal phase

6.3 Delay Setting (Detection Zone programming in the Traffic Controller)

The use of delay setting shall be programmed in the controller in the applicable detector menu only, and not on the controller phase setting in the traffic cameras. This allows the flexibility for individual detection zones to be programmed independently of the other detection zones.

For a side street right-hand lane application, apply a 5 sec to 7 sec delay to the detection zone in the right hand lane.

For detections in the left hand lane of a minor road where the cross street left turning vehicles may potentially encroach into the left turn lane detection zone, apply a delay of 1 sec to 2 sec to the affected side street detection zones.

For detections in the left turn lane for a protected-prohibited left turn signal phase, to minimize false calls from the adjacent through lanes, apply a 1 sec to 2 sec delay to the detection zones in the left turn bay.

7 Time-Of-Day Programs

Time-of-day programs shall be implemented at signal locations at interchange ramp intersections as well as locations where it is required to coordinate with adjacent traffic signals of the Local Authority, and the Local Authority traffic signals are operating under multiple time-of-day programs.

Typically, 2 sets of time-of-day programs are used – one for weekdays and one for weekends. The selection of the use of the 2 programs shall be programmed in the day-of-week program menu of the controller. It is expected that the following time-of-day and day-of-week programs are needed.

Weekday Time-Of-Day Programs (5 Plans)	Weekend Time-Of-Day Programs (3 Plans)
AM Peak	
Midday	Midday
Noon Peak	Weekend Peak
Midday	Weekend Peak
PM Peak	Weekend Peak
Evening / Night Time	Evening / Night Time

At locations where drastically different characteristics are expected on any particular day of the week, a special day-of-week program with its own set of time-of-day programs are needed.

At isolated locations where the traffic signal is operating under a fully-actuated, free mode, time-of-day programs are not required unless the lack of it result in unnecessary delays and inefficient operations.

Traffic signals near major commercial sites may require separate evening and night time plan due to outbound traffic when the stores close. As well, a weekend peak period timing plan may also be needed to accommodate the weekend shopping traffic.

In all locations where time-of-day programs are needed, a GPS time clock shall be installed in the TC cabinet.

8 Progression / Signal Coordination

Coordination of a network of traffic signals is required where two or more signalized intersections are in close proximity to each other.

The Contractor shall utilize the Synchro 7 modeling software as a tool to generate preliminary timing settings and then improve the timings with manual enhancements. The procedures for such an approach are as follows:

1) Assign a higher growth factor for the through traffic along the highway corridor to arbitrarily increase the MOE's values for the traffic flow along the highway. The resulting corridor signal timings would be biased towards arterial traffic flow
2) For corridors with very light pedestrian traffic, turn off the pedestrian signal requirements in the Phasing Window. This will have the effect of "freeing" up the model to focus on vehicular operation optimization and avoid overly constraining the operation by trying to meet pedestrian timing requirements. (suggested for intersections with hourly pedestrian volumes of 10 ped or less)
3) Revisit the individual intersection split timings. Evaluate the v/c ratios of the side street approaches

and see if the side street split time can be further reduced while achieving a still acceptable level of service on the side street

4) Manually adjust the intersection offsets in the time-space diagram to see if the traffic progression objective can be improved
5) Determine if any main street left turn phases that are against the desired peak traffic flow direction can be turned off while still providing a reasonable level of service
6) Determine if any phasing changes can be implemented to improve operation at the critical bottleneck intersections (use of double left turns, change in lane configuration, etc)
7) Determine if lead-lag left turn phasing will benefit traffic progression
8) Determine if consecutive stops can be avoided for any major traffic movement through the traffic signals within the coordinated traffic signal system. This includes heavy left turns from interchange ramps.
9) Test effects of fluctuating side street traffic demand on main street signal coordination (due to early return of the main street green phase). This can be achieved by checking the green band / through band performance of the Synchro time-space diagram while varying the percentage profile to display from 30 percent to 90 percent.

8.1 Directional Optimization

Directional progression provides for excellent traffic flow in a single direction at the expense of all other flows. Directional progression should be considered when:

- Peak hour flows have a directional split of 65/35 or greater;
- The highway is part of a one-way couplet;
- The impact of the progression strategy will not significantly degrade movement in the lesser direction.

8.2 Balanced Optimization

Equitable progression through a corridor provides vehicles with improved flow in both directions of a highway. Balanced progression should be used in situations when directional splits are more or less equal and do not experience peak hour directional surges.

8.3 Signal Coordination Design Considerations

Figure 5 illustrates the various checks that may be necessary along coordinated roadway corridor(s). Each consideration is labeled with the corresponding lettering in the figure.

A. Primary Major Corridor Traffic Progression – high priority especially along peak travel directions. Highly desirable to achieve two-way coordination

B. Secondary Major Corridor Traffic Progression – also high priority depending on the relative level of traffic flow as compared to the Primary Major Corridor. If needed, coordination needs for the Primary Major Corridor will be considered ahead of the Secondary Major Corridor

C. Traffic Progression between Adjacent Intersections – Important to achieve to avoid driver frustration

D. Minor Corridor Traffic Progression – Often acceptable to provide traffic progression along the minor corridor and come to a stop at the Major Corridor

E. Traffic Progression between Closely Spaced Intersections – Very important to achieve to avoid driver frustration. Often difficult to achieve.

F. Coordination for Major Left Turn Movements – Need to accommodate peak period sharp turning traffic flow to avoid driver frustration. May result in gridlock situation or major congestion if not timed properly.

G. Coordination for Major Left Turns between Two Major Corridors – Special considerations needed if there is a very heavy traffic flow between the two Major Corridors. In this case, often lead-lag left turn phasing may need to be considered to achieve better signal progression. Note: It is difficult to achieve results that will benefit multiple traffic movements.

H. Coordination for Left Turns from Minor Corridors – Desirable, but only if it does not affect traffic progression along the major corridor.

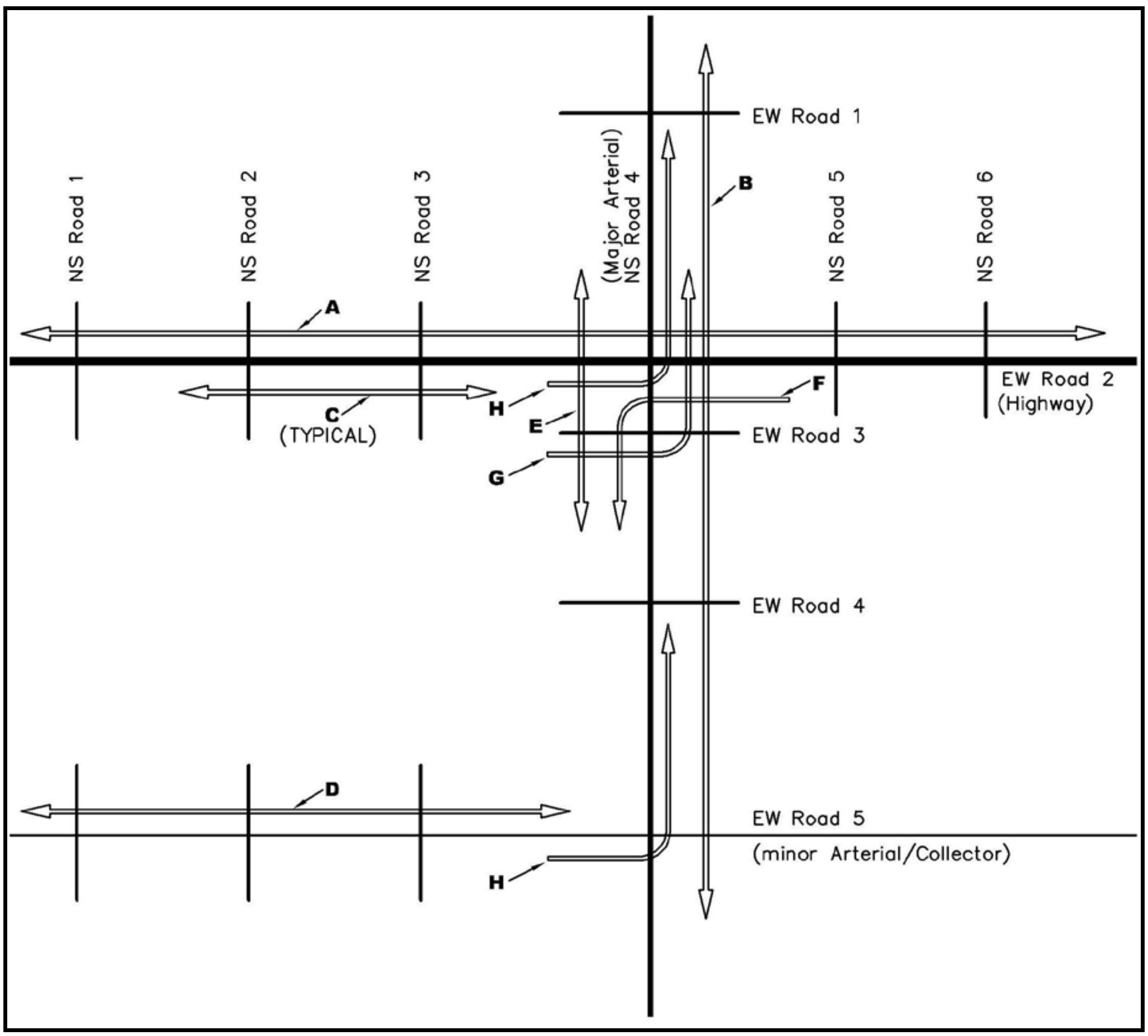


Figure 5 Signal Coordination Design Considerations

8.4 Signal Coordination Check under Fluctuating Traffic Demand

The effectiveness of all corridor signal coordination schemes shall be checked under varying levels of side street traffic demands to ensure that the degree of signal coordination will be satisfactory under all traffic conditions. Time-space diagrams shall be used in carrying out this signal coordination check, by utilizing the following checking techniques:

1. Basic Synchro file settings prior to checking effectiveness of signal coordination:
   - Timing Setting (F5):
     - Control Type: Actuated-Coordinated
     - Recall Mode: Main Street through phase – C-Max; all others – None
   - Phasing Setting (F6):
     - Ped Phase: Turn off all ped phase unless heavy pedestrian traffic is expected
2. Check for signal coordination
   - Time-Space Diagram (F7):
     - Flow / Band: Select Flow display option
     - Traffic Display: check time-space diagram coordination results by using the following
       - Displaying 90^{th} Traffic Percentile
       - Displaying 70^{th} Traffic Percentile
       - Displaying 50^{th} Traffic Percentile
       - Displaying 30^{th} Traffic Percentile
       - Displaying 10^{th} Traffic Percentile
     - By carrying out the above check, the impacts of low side street traffic demands on potential early return to green on the main road (and potentially its impacts on signal coordination along the corridor) can be assessed.

Package H outlines the Project Acceptance Requirements for traffic signal installations in the NE AHD DBFO Project. The requirements cover areas in Testing, Inspection, Documentation, Commissioning, and Project Acceptance following completion of the traffic signal installations.

1. Tests

The following tests shall be carried out during the traffic signal installation, prior to the commissioning of the traffic signal:

a. Pole Base Concrete Test – Slump & Air Test during concrete placement, and compressive strength test to the concrete cylinders before poles can be mounted on the bases
b. Traffic Cabinet Bench Test (to be done by the Contractor)
c. Grounding Test (to be done by the Contractor)
d. Megger Test (to be done by the Contractor)

Records of the above tests shall be submitted to the Department for review and approval. Such records shall be included in the final documentation at the completion of the traffic signal installations.

2. TC Cabinet Bench Testing and Signal Timings Implementation

Bench testing of the new TC Cabinet is required. Bench testing shall be for a minimum of 48 hours. It is the responsibility of the Contractor to prepare and enter detailed signal timings and settings for the traffic signal controller. This includes the settings for the basic timings, detector settings, coordination settings, and time-of-day programs.

After the controller timings have been entered, the Contractor shall submit the controller database to the Department for review and approval prior to implementing them for bench testing purposes. Following successful bench testing of the TC Cabinet, the Contractor shall submit to the Department a bench test result report for review and approval before the TC Cabinet can be transported to the site for field installation.

3. Timing for Field Installation of TC Cabinet

The TC Cabinet shall be stored in a protected environment from the time it is bench tested to the time it is installed in the field so that potential condensation inside the TC Cabinet can be minimized.

The TC Cabinet shall be installed in the field only after the AC power feed for the TC Cabinet is ready.

4. Inspections

The Contractor shall appoint an inspector to carry out the inspections at various stages of the traffic signal installation. The inspector shall be someone not involved in the actual traffic signal installation process, and shall possess the following qualifications:

- Traffic Technician with 5 year experience with traffic signal installation, maintenance and troubleshooting, and 3 year experience in traffic controller and video camera programming
- Completed the following IMSA Courses: Traffic Signal Level 1 & 2, Traffic Signal Inspector Course, and Work Zone Safety Course

4.1 Below Ground Installation Inspection

4.1	Below Ground Installation Inspection
When?	After all below ground installations are completed
Who?	Contractor's designated inspector
Safety Check at Start of Inspection:	
	Check if the site is safe for construction workers, the general public (vehicles and pedestrians), and the personnel involved in the inspection
Pre-Inspection Requirements:	
	Complete all below ground installations
	Complete a red-line plan recording "as-built" below ground installations (using the Below Ground Installations Drawing).
	Complete **Field Wiring** – all cables are pulled
	Backfill all trenches and excavate areas and **level** the surrounding ground
	Leave open all junction box lids to allow for inspection
	Complete the installation of the **PD Cabinet** and place the **electrical permit** inside the cabinet
Inspector's Tasks:	
	Review completeness of the below ground installation design and confirm specifications are met
	Check that the PD Cabinet installation is completed, with the electrical permit placed inside.
	Complete Below Ground Inspection Checklist
	Take record photos

4.2 Above Ground Installation Inspection / Pre-Commissioning Inspection

4.2	Above Ground Installation Inspection / Pre-Commissioning Inspection
When?	After all above ground installations are completed and the traffic signal is ready for full operation
Who?	Contractor's designated inspector – with a bucket truck with its operator to standby in case it is necessary to adjust signal head and camera alignment and mounting positions
Safety Check at Start of Inspection:	
	Check if the site is safe for construction workers, the general public (vehicles and pedestrians), and the personnel involved in the inspection
Pre-Inspection Requirements:	
	Complete all above ground installations including all poles, cabinets, traffic control devices and detection devices
	Cover all new signal indications to avoid confusion to motorists. This includes the advance warning flashers.
	Complete a red-line plan recording "as-built" information on the Above Ground Installation and the Pole Elevation Drawings.
	Complete bench testing of the TC Cabinet
	Place a **logbook** and all traffic signal construction drawings inside the TC Cabinet. The log book shall contain pertinent information such as contact information (name, phone number) of the contractor, as well as, if available, the Contractor's 24-hour emergency phone number.
	Complete all wiring terminations
	Complete all megger test and grounding test
	Test the operation of all **traffic control devices**
	Test and program all **detection devices**
	Program the controller with the timings, time-of-day programming, coordination timings (if needed) provided on the Construction Drawings
	Have a **bucket truck standby** during the inspection.
	Open all **handhole covers** and pull out the cable splice bundle inside the handhole (for inspection on

	wiring, splices, cable labeling / tape marking)
	Measure vertical clearance measurements of the lowest mounted signal heads, signs or traffic control devices on the mast arms of the signal poles. The measurements shall be marked on the Pole Elevation Drawing
Inspector's Tasks:	
	Verify that the intended **detector functions** are achieved (i.e. successful installation, wiring , setup and configuration of the detection devices and camera / controller database programming)
	Check for **completeness of the above ground installations**. This includes signs and pavement markings.
	Check for **readiness** of the traffic signal **for full operation**
	Check if the **controller timings** are in place and would operate as per design
	Check if **documentation** and **controller database** are in place / received, and a **log book** is placed in the cabinet
	Complete the **Pre-Commissioning Inspection Checklist**
	Take **record photos** and **Upload the final controller database**

4.3 Construction Completion Inspection

4.3	Construction Completion Inspection
When?	After successful completion of the Pre-Commissioning Inspection.
Who?	Owner's representative
	Contractor (should have at least 2 workers assisting in the construction completion inspection / signal start-up process)
Safety Check at Start of Inspection:	
	Check if the site is safe for construction workers, the general public (vehicles and pedestrians), and the personnel involved in the inspection
Pre-Inspection Requirements to be fulfilled by the Contractor:	
	Successful Pre-Commissioning Inspection
	Controller programmed with the timings provided on the Construction Drawings
	A **bucket truck** with its operator to standby in case it is necessary to adjust signal head alignment and mounting positions
	Contractor shall be prepared to have **traffic accommodation signage** available for the signal start-up process
	Submit required **documentation** to the Owner
	Check if **regulatory signs and warning signs** (including the "NEW" "TRAFFIC SIGNAL" signs) are in place
Contractor's Tasks during Inspection:	
	Carry out necessary precautions and tasks (such as removal of barricades, site clean-up) are done before it is safe to open up the intersection or start-up the traffic signal for vehicular and pedestrian traffic
	Provide traffic control during signal start-up
	Start-up traffic signal for full operation
	Demonstrate to the Owner that the intended **detector functions** are achieved
	Demonstrate to the Owner that the intended **signal operation functions** are achieved
	Site cleanup, remove signs, un-bag signals / signs
	Complete the **Construction Completion Inspection Checklist**
	Take **record photos**
Owner\`s Representative\`s Task:	

	Check for **readiness** of the traffic signal **for full operation**
	Check if **necessary precautions and tasks** (such as removal of barricades, site clean-up) are done before it is safe to be opened up the intersection or start-up the traffic signal for vehicular and pedestrian traffic
	Give **permission to the Contractor to start-up traffic signal** for full operation
	Prepare a **deficiency list** based on deficiencies identified in the Construction Completion Inspection. The list shall provide the **dates** when the deficiencies are expected to be rectified (as agreed to by the Contractor)
	Complete the **Construction Completion Inspection Checklist**
	Take **record photos**

5. Documentation

The following general documentation shall be submitted by the Contractor to the Owner prior to the commissioning of the traffic signal:

1) Drawings
   a) Complete set of as-built red line mark-up plans (quality of mark-up shall be legible and to scale)
   b) Record drawings for traffic signal installations in both hardcopy and digital pdf format (stamps and signed)
   c) Clearance measurements (mark on pole elevation drawing the distance from the bottom of fixtures on the mast arm to the pavement surface)
   d) Cabinet schematic (in cabinet and in digital format)
2) Serial Numbers
   a) TC Cabinet
   b) PD Cabinet
   c) Controller
   d) MMU
   e) Detector
3) Tests and Permits
   a) Cable megger test report
   b) Electrical safety codes inspection permit
   c) Equipment grounding test report
   d) Concrete test results (for pole bases) – both field slump and air test, and cylinder compressive strength tests
4) Equipment and Settings
   a) Controller database printout and digital file (in both raw controller database format and in pdf format)
   b) MMU programming chart
   c) MMU manufacturer's certification
   d) Cabinet bench test report and record

e) Cabinet field test record and report

5) Operations and Maintenance Manuals
   a) Log book (in cabinet)
   b) Controller operations manual (in digital format)
   c) Controller maintenance manual (in digital format)
   d) Malfunction management manual (in hardcopy, place in cabinet, also in digital format)

6. Commissioning

1) Commissioning of the traffic signal shall be carried out in the presence of the representatives of the Department
2) When the signal pole and the signal heads are installed, all signal displays shall be bagged for a minimum of 7 days
3) The traffic signals shall not be placed into a flash mode before commissioning. Instead, when the traffic signal is ready for full operation, the Department shall give permission to the Contractor to start up the signal. The signal display shall be unbagged at such time.
4) Commissioning or start-up of the traffic signal shall be scheduled between 9 AM and 3 PM.
5) The following requirements shall be met before the start-up of the traffic signal
   a) Backfilling completed along all trenched areas and around pole bases, cabinets and junction boxes
   b) All signal related traffic control signs are installed
   c) All detection devices are installed and in operation
   d) All signal timings are programmed
   e) Documentation provided

7. Traffic Signal Project Acceptance

1) The traffic signal installation is considered accepted by the Department if all the above requirements are met, and
2) The traffic signal has been in operation for 28 days without any operational or equipment problems. The 28 day period is called the **"burn in period"** for the traffic signal.
3) The Contractor shall rectify any traffic signal equipment or operations problems reported within 28 days after the traffic signal is commissioned, and then notify the Department so the correction can be verified through a field visit.
4) The same 28 day burn in period will then apply. If no traffic signal equipment or operation problems are reported in the following 28 days, the traffic signal installation is then considered accepted by the Department.

8. Traffic Signal Inspection Forms

The following inspection forms shall be completed by the Contractor's designated inspector and submitted to the Owner as part of the Project Completion Documentation:

- Traffic Signal Below Ground Installation Inspection Form
- Traffic Signal Above Ground Installation Inspection / Pre-Commissioning Inspection Form
- Traffic Signal Construction Completion Inspection Form

Project:		Project No:
Site (NS/EW):		
Inspected by:	Signature:	Date:

Below Ground Installations Inspection

1. Pole Base Inspection

	Category	Item No	Location	Response	Corner Poles				Median Poles				AWF Poles			
			Location		SWC	NWC	NEC	SEC	SM	WM	NM	EM	N Leg	E Leg	S Leg	W Leg
			Pole		A	B	C	D	E	F	G	H	I	J	K	L
Concrete Base	1	1	Location correct?	Y/N												
		2	Size (dia) correct?	Y/N												
		3	Shape (round)	M/Y												
		4	Height above ground	M												
		5	Concrete Condition	Y/N												
		6	Edge Chamfered?	Y/N												
		7	Sonar Tube Removed?	Y/N												
Anchor Rods	2	1	Anchor Rod dia	M												
		2	Anchor Rod Ht (above base)	M												
		3	Anchor Rod BCD	M												
		4	Anchor Rod Orientation	M/Y												
		5	Anchor Rod Conditions	Y/N												
Conduits	3	1	Conduit Type	Y/N												
		2	No of Conduits	M												
		3	Conduit Elev (above base)	M/Y												
		4	Edge rounded?	Y/N												
Backfill	4	1	Backfilled with granular?	Y/N												
		2	Reinstatement / Grading	Y/N												
		3	Cleanup of area	Y/N												
Additional Comments	5	1	Additional Comments													

2.3 Anchor Bolt BCD Measurements
400 BCD or 283 SQ; 280 BCD or 198 SQ

M - Measurement needed

Project:		Project No:	
Site (NS/EW):	0		
Inspected by:	Firm:	Signature:	Date:

Below Ground Installations Inspection

2. Junction Box / Cabinet Base Inspection

	Category	Item No	Location	Response	Corner JB								Median JB				AWF JB				Cabinet	
					SWC		NWC		NEC		SEC		SM	WM	NM	EM	N Leg	E Leg	S Leg	W Leg	NEC	NEC
			JB		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TC	PD
Junction Box	1	1	Location correct?	Y/N																		
		2	Size (S/M/L/O, W,L,D) correct?	Y/N																		
		3	Type correct?	Y/N																		
		4	Level? (Cabinet - Ht above ground)	Y/N																		
		5	JB Lid Bolts?	Y/N																		
		6	Condition?	Y/N																		
		7	Granular fill inside JB?	Y/N																		
Ground	2	1	Ground rod installed?	Y/N																		
		2	Ground rod connected?	Y/N																		
		3	Metal cover grounded?	Y/N																		
Conduits	3	1	Conduit type	Y/N																		
		2	Conduit size	Y/N																		
		3	No of conduits	M																		
		4	Elevation (15cm above base)	M																		
		5	Edge rounded?	Y/N																		
		6	Pull ropes?	Y/N																		
		7	Taped / Labelled / Numbered	Y/N																		
Backfill	4	1	Backfilled with granular?	Y/N																		
		2	Topsoiled?	Y/N																		
		3	Grassed / Seeded?	Y/N																		
		4	Reinstatement / Grading	Y/N																		
		5	Cleanup of area	Y/N																		
Cables	5	1	Signal Cable Count	M																		
		2	Camera Cable Count	M																		
		3	SL Cable Count	M																		
		4	AWF Cable Count	M																		
		5	Radio Cable Count	M																		
		6	EVP Cable Count	M																		
		7	Sum		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		8	Label (L)?	Y/N																		
		9	Sufficient slack (S)?	Y/N																		
Additional Comments	6	1	Additonal Comments																			

Project:		**Project No:**	
Site (NS/EW):			
Inspected by:		Signature:	Date:

Above Ground Installations Inspection

1. Drive-by Inspection - One run per approach. Additional runs needed for slotted turn bays, wide approaches, etc.

	Category	Item No	Location	Response	Corner Poles				Median Poles				AWF Poles			
					SWC	NWC	NEC	SEC	SM	WM	NM	EM	N Leg	E Leg	S Leg	W Leg
			Pole		A	B	C	D	E	F	G	H	I	J	K	L
Poles	1	1	Correct type, height, arm span?	Y/N												
		2	Correct location, offset from road?	Y/N												
		3	Barricaded, guardrail?	Y/N												
		4	Rotatable base?	Y/N												
Signs	2	1	Correct sign type, size?	Y/N												
		2	Correct location / position of signs?	Y/N												
		3	Correct mounting height of signs?	Y/N												
Heads	3	1	Correct head type, color, size?	Y/N												
		2	Correct location / position of signal heads?	Y/N												
		3	Correct mounting height of heads?	Y/N												
		4	Correct alignment of signal heads?	Y/N												
		5	Correct backboards, color?	Y/N												
		6	Head alignment visibilty check?[Note 1]	Y/N												
		7	Any obstructions to signal display?	Y/N												

[Note 1] Head Alignment Visibility Check:
50 km/h posted speed - 70m
60 km/h posted speed - 90m
70 km/h posted speed - 110m
80 km/h posted speed - 140m
90 km/h posted speed - 200m

Project:		**Project No:**	
Site (NS/EW):			
Inspected by:	Signature:	Date:	

Above Ground Installations Inspection

2. At Intersection Inspection - One corner at a time, additional stops for AWF poles, median signals, etc.

	Category	Item No		Response	Corner Poles				Median Poles				AWF Poles			
			Location		SWC	NWC	NEC	SEC	SM	WM	NM	EM	N Leg	E Leg	S Leg	W Leg
			Pole		A	B	C	D	E	F	G	H	I	J	K	L
General	1	1	Work area safe?	Y/N												
		2	Construction materials cleaned up?	Y/N												
		3	Backfill & Grading completed?	Y/N												
Poles	2	1	Are poles plumb?	Y/N												
		2	Pole lateral clearance sufficient?	Y/N												
		3	Pole vertical clearance sufficient?	Y/N												
		4	Poles damaged?	Y/N												
		5	Poles galvanized?	Y/N												
		6	Bolts tight?	Y/N												
		7	Poles shimmed / base grouted?	Y/N												
		8	Hand hole in proper location?	Y/N												
		9	Hand hole covers present?	Y/N												
		10	Pole caps / Mast-arm end caps?	Y/N												
		11	Pole bonded?	Y/N												
Hand hole wiring	3	1	Wiring bundle tidy?	Y/N												
		2	Wiring bundle forms drip loop?	Y/N												
		3	Cable labeling?	Y/N												
		4	Correct number of conductors?	Y/N												
Signs	4	1	Correct number of signs?	Y/N												
		2	Signs appropriate for geometry?	Y/N												
		3	Signs correct size?	Y/N												
		4	Signs correct type?	Y/N												
		5	Signs mounted correctly	Y/N												
Heads (Both Veh & Ped)	5	1	Correct head type, color, size?	Y/N												
		2	Correct location / position of signal heads?	Y/N												
		3	Correct mounting height of heads?	Y/N												
		4	Correct alignment of signal heads?	Y/N												
		5	Damaged?	Y/N												
		6	LED cleanless check?	Y/N												
PB	6	1	Pushbuttons installed at the correct locations and heights?	Y/N												
		2	Pushbuttons correct type, size, shape and colour?	Y/N												
		3	Are pushbutton signs present?	Y/N												
		4	Are pushbuttons weather-proof?	Y/N												
		5	Do the pushbuttons work?	Y/N												
Rotatable	7	1	Rotatable base correct type?	Y/N												
		2	Rotatable base correct orientation?	Y/N												
		3	Pipe sleeve in correct location?	Y/N												
		4	Safety hardware (lock/retaining pin) in place?	Y/N												
Detection	8	1	Camera mounted correct location?	Y/N												
		2	Camera mount hardware correct?	Y/N												
		3	Preemption device mounting correct?	Y/N												
		4	Wireless Antenna mounting correct?	Y/N												
		5	Microwave detetctor mounting correct?	Y/N												

Project:		Project No:
Site (NS/EW):		
Inspected by:	Signature:	Date:

Above Ground Installations Inspection

3. Cabinet Inspection

	Category	Item No	Location	Response	TC Cabinet	PD Cabinet
					SWC	SWC
General	1	1	Work area safe?	Y/N		
		2	Construction materials cleaned up?	Y/N		
		3	Backfill & Grading completed?	Y/N		
Controller and Cabinets	2	1	Are the cabinets properly centered and installed on the base?	Y/N		
		2	Bench testing of the TC Cabinet completed?	Y/N		
		3	Are the following equipment properly installed - controller, conflict monitor / mmu, flasher, load switches, detector amplifiers?	Y/N		
		4	Are the connection of the signal wire, home run detector wire, and communication wire connected to the cabinet terminal correctly?	Y/N		
		5	Test controller operation by visually verifying operation and check timings, offsets, and delay timers.			
		6	Check for anti-backup programming or back-up protection programming			
		7	Check for advance warning flasher programming (overlap programming)			
		8	Check for timing programming such as dual entry, locking, delay, intergreen, recalls, coordination settings, time-of-day programs.			
		9	Ensure that timing information, log book, signal drawings, relevant standard drawings, and the equipment installation print have been placed in a waterproof pouch in the cabinet.			
		10	Are the communication equipment properly installed?	Y/N		
		11	Are heater, fan, air filter, thermostat properly placed?	Y/N		
		12	Test the operation of the communication equipment.			
		13	Is the electrical permit in place?	Y/N		
		14	Are all wiring terminations completed?	Y/N		
		15	Megger test & grounding test completed?	Y/N		

Project:		Project No:
Site (NS/EW):		Date:

Construction Completion Inspection Checklist

	Category	Item No	Description	Contractor	Owner's Representative
Safety Check	1	1	Site is safe for construction workers and general public?		
		2	Cleanup of area completed?		
Pre-Inspection Requirements	2	1	BG Inspection & AG Inspection completed?		
		2	Controller programmed as per design?		
		3	Traffic accommodation signage available?		
		4	Documentation submitted to the Owner?		
		5	Regulatory signs and warning signs in place?		
During Inspection	3	1	Detector functions are achieved as per design?		
		2	Signal operation functions are achieved as per deisgn?		
		3	Signals are ready for full operation?		

	Deficiency List:	Shall be completed by:
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Print Name & Signature (Contractor)

Print Name & Signature (Owner's Representative)

The Contractor shall refer to the requirements outlined in **Package I** for operation and maintenance requirements for the traffic signals in the NE AHD DBFO Project throughout the duration of the 30 years DBFO period.

1. Operations

1.1 Opening Day Operations

The Contractor shall prepare Opening Day Operations traffic signal timings which shall include all basic timing programming, time-of-day programs and day-of-week programs ready for safe and efficient traffic signal operation starting from the day the traffic signal is ready for switched on for full operations.

If there is already an existing traffic signal at the traffic signal location, the existing traffic count data shall be used to determine the Opening Day Operations traffic signal timings. If the turning movement volume (TMV) traffic count data is not available on the Alberta Transportation website, the Contractor shall collect AM and PM peak hour turning movement volumes at the existing traffic signal. Traffic volumes for the midday or non-peak period timing plans can be estimated based on adjustment factors derived by examining AT's TMV data in adjacent locations or by ATR data nearby.

If the traffic signal is a new signal, traffic counts will not be available. In that case, the Contractor may estimate the Opening Day traffic volumes by applying a scale factor of 0.7 to the 2041 Traffic Volumes in the Functional Plan. Traffic volumes for the midday or non-peak period timing plans can be estimated based on adjustment factors derived by examining AT's TMV data in adjacent locations or by ATR data nearby. Signal timings derived in this fashion are acceptable as interim signal timings only.

Monitoring of the traffic operation immediately following start-up of the traffic signal shall be done by the Contractor during the AM and PM peak periods as well as the Midday and Evening / Night Time periods, and make necessary timing adjustments to ensure that:

- the operations at the traffic signal are acceptable with no signal cycle failures (require multiple signal cycle to go through the signalized intersection),
- the traffic signals in a coordinated corridor are indeed coordinated, and
- there are no traffic queue backups that may affect the freeway operations.

1.2 Traffic Signal Timing Adjustments Following Burn-In Period

Allowing 3 weeks for the traffic patterns to settle down following the start-up of the traffic signal, <u>the Contractor shall collect detailed 24-hour turning movement volumes</u> with vehicle classification information (as a minimum, vehicles shall be classified as passenger cars and heavy vehicles) within 2 weeks after the 28-day burn-in period is over.

The TMV data shall be collected in 15 minute increments to provide detailed traffic flow information such as peak hour factor and heavy vehicle percentage for the traffic periods representative of the time-of-day plans to be developed by the Contractor.

For locations where a distinctively different weekend traffic pattern is anticipated with heavy weekend peak period traffic flows, 24-hour turning movement volumes shall also be collected for a typical weekend day so that the weekend traffic patterns are captured in traffic count data.

Monitoring of the traffic operation following each traffic signal re-time shall be done by the Contractor during the AM and PM peak periods as well as the Midday and Evening / Night Time periods, and make necessary timing adjustments to ensure that:

- the operations at the traffic signal are acceptable with no signal cycle failures,
- the traffic signals in a coordinated corridor are indeed coordinated, and
- there are no traffic queue backups that may affect the freeway operations.

1.3 Synchro Modeling for Signal Timing Preparations

The Contractor shall prepare Synchro files for all traffic signal timings implemented. Such Synchro files shall be submitted to the Department for review, approval, and file. One Synchro file is needed for each time-of-day plan.

1.4 Annual Traffic Signal Timing Adjustments

TMV Traffic data at each signalized intersection shall be collected (can potentially be collected using the camera system if traffic cameras capable of collecting TMV data are installed and programmed / configured to collect TMV count data) at the intersection every year in October so that the Contractor can check if the key traffic movements at the intersection have experienced growth exceeding 20 percent.

If the year-to-year traffic growth exceeds 20 percent, the Contractor shall revise their Synchro models to develop new signal timings. The new signal timings shall be implemented before November 1 of each year.

If the year-to-year traffic growth is less than 20 percent, the Contractor shall revise their Synchro models when the cumulated traffic growth since last signal re-time has reached 20 percent.

In any case, new traffic signal timings must be re-timed by the Contractor every 4 years. The Contractor shall collect detailed TMV data at each signalized intersection in preparation of the new traffic signal timings.

1.5 When if Actual Traffic Flows Exceed Functional Plan Traffic Volumes

If the traffic data collected by the Contractor exceed the traffic volume level in the 2041 Functional Planning Study Report, the Contractor shall report this situation to the Department. The Department will then determine the correct course of action after it has a chance to review the traffic data.

Comparison of traffic volume level can be carried out based on the sum of the critical lane volumes method. Procedures for calculating the critical lane volumes can be found in the Functional Planning Study Report.

2. Maintenance

2.1 External Preventive Maintenance

External preventive maintenance refers to the general up-keeping of the traffic signal components and it includes the following tasks:

a. Re-Lamping of Signals

The lamps for LED installations have a longer duty cycle and therefore will only be replaced upon failure or once every 10 years.

b. Cleaning of Signals

Each spring the entire traffic signal system is cleaned using a power washer to remove the dirt and grime that has built up over the winter. This work should be scheduled to be late enough in the spring so that the other road cleanup will not be affected.

This includes all signals, poles, and cabinets as a minimum. The Contractor shall inspect the work when completed to ensure that there has been no damage, moisture leaking in, loose parts or misalignment of the signals by the power washing. All moving parts such as pedestrian pushbuttons, door hinges and handles as an example must be tested and lubricated after the washing is completed.

c. Verification of Detection Devices

The operation of the traffic and pedestrian detection devices shall be verified on a regular basis. This is done through the regular summer and winter cabinet maintenance program by the Contractor, as well as regular field checking by Department staff. Any failure of these devices should be noted and corrective action taken.

d. External Maintenance Reports

External maintenance reports should be produced after each scheduled maintenance activity is performed. A separate report should be produced for each location. The information on the report will identify all of the work that has been completed. Each report should be signed by the technician doing the work, reviewed and initialed by his immediate supervisor, and finally by the Contractor's project manager for the traffic signal maintenance work.

2.2 Internal (Cabinet) Preventive Maintenance

The cabinet and the controls within the cabinet are the heart of the traffic signal operation regardless of the complexity. As such it is important that the tests performed address not only the functional operation but also the safety and fail safe features of the system. Internal cabinet maintenance shall be carried out by a qualified signal technician. The qualified signal technician shall possess the following qualifications:

- Traffic Signal Technician with 3 year experience with traffic signal installation and maintenance
- Completed the following IMSA Courses: Traffic Signal Level 1 and Work Zone Safety

The controls at each traffic signal location should be checked twice annually at intervals not to exceed six months (generally in the spring and fall). At these checks specific items are tested and recorded on the inspection form provided. In addition to this the Contractor should check the operation of all environment equipment such as heaters and exhaust fans for proper operation. This should be done in the late fall and early spring.

The current status, on site activities and recommendations for further action should be fully documented using the detailed data forms provided.

When the maintenance is completed, the controls and cabinet should be left neat, clean, and in a safe operating mode. Any deficiencies, which result in a degraded signal operation should be repaired immediately to restore proper operation. All remedial changes to existing wiring and controller functions to affect repairs or to keep the system operational must be documented and the Department notified of all actions. The system should never be left in an unsafe mode.

a. Internal Maintenance – Winterizing Cabinet

- Clean interior of cabinet by wiping down any dust and vacuuming
- Wash exterior of cabinet and wipe dry
- Check main door locks and police door lock
- Check terminations of all wires and re-tighten as necessary
- Close lower vent in door by inserting winter guard behind filter
- Check operation of the cabinet heater and thermostat, and adjust thermostat
- Ground connections should be tested by means of a ground-rod tester to make sure that the ground resistance meets Canadian Electrical Code specifications – the test measurement should be recorded.
- All light relays are checked for leakage using a suitable digital voltmeter. The levels noted are recorded. Turned on voltage is recorded to check that it is within the allowable standards
- Solid-state flasher is tested for operation
- Flash transfer relays are tested for operation and any visible wear
- Intersection is completely tested for flash operation

b. Internal Maintenance – Summerizing Cabinet

- Clean interior of cabinet by wiping down any dust and vacuuming
- Wash exterior of cabinet and wipe dry
- Check main door locks and police door lock
- Check terminations of all wires and re-tighten as necessary
- Remove winter guard from behind filter. Clean or replace filter as required.
- Check operation of the cabinet fan and thermostat, and adjust thermostat
- All electrical connections should be checked to verify that they are secure and tight
- Care should be taken not to over-tighten or damage wire ends and terminal lugs
- Ground connections should be tested if then meet Canadian Electrical Code specifications – the test measurement should be recorded.
- All light relays should be checked for leakage using a suitable digital voltmeter. The levels noted are recorded. Turned on voltage is recorded to check that it is within the allowable standards
- Solid-state flasher should be tested for operation
- Test flash transfer relays for operation and any visible wear

c. Terminal Facility Pluggables

- All indicators should be tested for proper operation and accuracy

- All devices and connectors should be mechanically and electrically sound
- Applicable ground and line voltages should be checked and recorded
- Applicable controller inputs, as they relate to specific locations, should be tested and should operate accurately, e.g. vehicle and pedestrian detectors, preempt, coordination and communication, etc
- Proper controller outputs should be tested for accurate and reliable operation (e.g. light relays coordination commands, conflict monitor inputs,, etc)

d. Malfunction Management Unit (MMU)

The following tests as a minimum are performed on the MMU in the terminal facility to ensure that the device meet current NEMA standards for this type of device. If the device fails to pass the tests, the unit should be replaced with a spare which will be tested the same prior to being put in service.

- Trip at no more than 28 volts + 10%
- Trip on low 24 volt DC
- Fail on low voltage AC
- Voltage monitor is accurately checked
- Red fail or absence of signal is detected and causes the monitor to fail
- Green, yellow and red inputs all cause conflict properly
- Trip properly when AC signals are placed on the cabinet field terminals

e. Conflict Monitor Bench Test

In addition to testing the conflict monitor in its environment, the terminal facility, it is important to bench test the monitor to manufacturer and NEMA standards. To do this, each unit should be removed and tested using a certified automatic conflict monitor tester. This test is performed once annually after the initial cabinet test is performed. If the unit fails to pass the test, the unit should be changed and a new unit installed until the original unit can be repaired. Repaired or new units should be bench tested as above prior to being installed for operation, and the certified test results provided to the Department. Monitors failing to meet or pass the tests, should be repaired or replaced.

f. Internal Maintenance Reports

The internal maintenance reports as provided should be filled in as specified, signed by the technicians performing the work, reviewed and initialed by his immediate supervisor, and finally by the Contractor's project manager for the traffic signal maintenance work to verify the work is complete. Included as part of the report, is the hard copy report of the MMU bench test, as well as any repair reports supplied by the manufacturer for any repairs to the MMU.

A preventive maintenance checklist is shown in Tables 1a and 1b to show the checks needed in the Spring and Fall Maintenance Schedules.

Table 1.a Preventive Maintenance Checklist (page 1 of 2)

Tasks	Spring	Fall	As Required
1/ CABINETS			
1.1 Lubricate hinges and locks	X		
1.2 Clean filters	X	X	
1.3 Vacuum cabinet	X	X	
1.4 Check weatherproof seals		X	
1.5 Check anchor bolts	X		
1.6 Check for water accumulation and check duct sealant	X		
1.7 Check ground rod clamp and wire	X	X	
1.8 Check wiring schematics and records	X	X	
1.9 Check operation of fan and heater	X	X	
1.10 Check radio interference filter and lightning arrester	X	X	
1.11 Check circuit breaker and fuses	X	X	
1.12 Check ground fault receptacle	X	X	
1.13 Remove any snow or brush			X
2/ SIGNAL HEADS			
2.1 Clean lenses, signs, and reflectors	X		
2.2 Replace lamps	X		
2.3 Check gasket for water infiltration and deterioration	X	X	
2.4 Check alignment	X		
2.5 Check for mast arms, free-swing signals, check clevis and chain	X	X	
2.6 Check for cracks or rust in the hardware	X	X	
2.7 Check hoods, wing nuts, and hinges	X	X	
2.8 Replace substandard hardware	As req'd	As req'd	
2.9 Replace defective lenses and reflectors	As req'd	As req'd	
2.10 Check locking rings; install proper locking devices as required	X		
2.11 Check condition of back plates	X		
2.12 Perform a nighttime check for visibility from each approach			X
3/ MAST ARMS AND POLES			
3.1 Check alignment of mast arms	X		
3.2 Inspect poles, arms for damages caused by impact with vehicles	X		
3.3 Inspect for rust, spot paint as required	X		
3.4 Inspect joint for rust and cracks at arms / upright location and at base plate	X		
3.5 Inspect anchor bolts for rust and tightness	X		
3.6 Inspect horizontal and vertical angles of arms	X		
3.7 Repaint exterior (if originally painted)			X
4/ PUSHBUTTONS			
4.1 Check pushbuttons	X	X	
4.2 Check pushbutton indicator lamp (if used)	X	X	
4.3 Check pushbutton signs, clean or replace if necessary	X	X	
4.4 Check push button sign alignment	X	X	
5/ DETECTORS			
5.1 Visually inspect along loop detector saw cut for exposed wires, cracks, potholes	X	X	
5.2 Check alignment for traffic cameras; verify call inputs to controller phases	X	X	
5.3 Check whether the detector is detecting vehicles within the detection zone	X	X	
5.4 Tune the detector amplifier if necessary	X	X	
5.5 Check whether the connectors are tight and secure	X	X	

Table 1.b Preventive Maintenance Checklist (page 2 of 2)

Tasks	Spring	Fall	As Required
6/ JUNCTION BOXES AND HANDHOLES			
6.1 Check integrity of the splices	X	X	
6.2 Check the ground rod, clamp connection, and bonding of conduits	X	X	
6.3 Check the insulation	X		
6.4 Check for abnormal amount of water	X		
6.5 Check lid for abnormal condition and fit	X		
7/ CONTROL EQUIPMENT			
7.1 Check whether the time setting matches the master time sheet	X	X	
7.2 Check whether indicator lamps on the modules are working; replace failed lamps		X	
7.3 Check for extension by detector actuation		X	
7.4 Check whether modules fit tightly and securely into the frame		X	
7.5 Check whether connectors are tight and secure		X	
7.6 Wipe dust off controller, detectors, and auxiliary equipment		X	
7.7 Conflict monitor testing		X	
7.8 Check whether load switch packs fit tightly and securely into their sockets		X	
7.9 Check operation of auxiliary logic		X	
7.10 Check mercury relays (if used) for excessive splash		X	
7.11 Check whether flashers are firm in socket; check on/off ratio and flash rate		X	
7.12 Check terminal connections for discolouration and tightness		X	
7.13 Check internal time clock of the controller	X	X	
8/ INTERCONNECTED EQUIPMENT			
8.1 Check whether controller operates in the mode selected by the supervisory master	X	X	
8.2 Disconnect from the master supervisory system and check for "free" or backup operation	X	X	
8.3 Check any special equipment per manufacturer's recommendation	X	X	
9/ MISCELLANEOUS			
9.1 Record all changes in timing, wiring or any function	X	X	

2.3 Response (Reactive) Maintenance

Response maintenance is defined as the initial response by the Department to any reported equipment or system malfunction. Response maintenance includes both field procedures used to restore operations and shop procedures followed to repair and test the malfunctioning equipment. Proper procedures and assignment of responsibilities for the operations and maintenance team in dealing with response maintenance is paramount to ensuring public safety and maintaining the efficient operation of the system.

A contact list should be made available to all parties that are involved in the operations and maintenance of the traffic signal. A copy of the list should also be placed inside the traffic controller cabinet as well as inside the police panel of the traffic controller cabinet.

a. Receive Notification

The Contractor can receive notification of equipment malfunction from a number of sources:

- Through public call-ins or complaint calls
- Through regular drive by checks by the Contractor

- Through drive by checks by the Department's field staff
- Through calls by the R.C.M.P. or the Local Police when they drive by and noticed the problem

The Contractor shall prepare documentation recording the reported problem in a permanent log file, capturing the following information:

- Date and time of initial report
- Location
- Initial description of the problem
- Data and time of initial response
- Crew / contractor assigned to initial response

b. Response Time

A response plan describing acceptable response times for every conceivable, reportable problem is critical to the success of a response maintenance strategy. The initial response time to arrive at a reported problem intersection and verify and identify the problem can be established based on the guidelines outlined below in **Table 2.**

Table 2 Recommended Response Time (for Response Maintenance Contractor) Note 1

Type of Trouble Call	Response Time
Imminent Danger (interim measures may be needed by RCMP or by placing the signal in flash or via 4-way stop)	2 hr
Knockdowns	
Damaged Signal Pole – Imminent Danger	2 hr
Damaged Pole / Cabinet / signal heads– No Impending Safety Problem	2 days
Damaged Visor / Backboard	1 week
Equipment Failure	
Lamp Burnout – Red or AAWF	3 hr
Lamp Burnout – Green/Amber (with Secondary Display)	1 day
Lamp Burnout – Pedestrian Signals	3 days
Detection Failure – Cross Street, Left Turns	2 days
Detection Failure – Highway, Pushbuttons	3 days
Signal in Flash – With Major Operational Problems	2 hr
Signal in Flash – No Major Operational Problems	4 hr

Note 1 – these are the response time requirements for a qualified traffic signal technician to be on site for traffic signal related incidents.

c. Response Maintenance Activities

i. Secure the Site

When the traffic signal maintenance contractor arrives at the site of the reported problem, the first responsibility is to ensure the safety of the response crew and the traveling public. In extreme cases (e.g. signal knockdowns), a police unit or flag personnel will be required to handle traffic until an interim device can be installed. The order of priority is:

- Make sure the area is safe to work in and free of electrical hazards
- Make sure that the site is safe for the traveling public
- Identify the problem and make repairs

The first priority is a concern any time electrical circuits have been damaged and a potential shock hazard exists. The only acceptable initial action is to cut the electrical power at the source. Once the electrical hazard has been removed, then traffic control is the primary concern. At minor intersections, portable stop signs may be sufficient. At intersections with high demand, a police officer or flag personnel may be required to handle the traffic. Only after traffic control has been stabilized can the actual maintenance troubleshooting and repairing begin.

ii. Diagnose the Problem

With the location secure and traffic stabilized, the technician can concentrate on the primary problem. The objective is to isolate the fault so that replacements or repairs can be made. With many types of electrical components, the most efficient means of isolating the problem is to replace various components with spares until the fault is identified (trial and success vs. trial and failure).

At this initial diagnostic level it is important that the primary objective is to return the site to normal service as quickly as possible. There is always a great temptation to diagnose and repair the problem in the field. This temptation should be avoided for several reasons: speed, repair quality, and documentation are several of the most important.

In most cases, the quickest way to return a site to full service is to replace faulty items like controllers, detectors, and conflict monitors with spare units. These electronic devices should be carefully diagnosed, repaired, and tested in the shop before being returned to field service. Finally, it is likely that repairs performed in the shop under controlled conditions will be more accurately logged than repairs made in the field.

Very often, a fault is intermittent. There is no easy solution to electrical and electronic problems that appear and disappear, only to reappear again. The only solution is careful and tedious identification and elimination of all potential sources of the malfunction until the actual culprit is identified.

iii. Signal Shutdown

Selective shutdown shall be avoided, and at no time shall all indications to one approach be turned off while other approaches remain under signal control. However, it is possible to disconnect individual signal heads, if multiple indications are provided.

If signals are turned off completely, for however short a time period, alternate traffic control methods must be employed. Depending on the duration of the signal shutdown, alternative control measures such as flag person control, or control with STOP signs and advance warning signs. Extra caution should be exercised to avoid having both flag persons and sign control competing for the motorists' attention and likely ending up confusing them.

The decision on whether flag person control or stop sign control is to be used in cases of signal shutdown, or whether the stop signs are to be two- or –four-way, is critical to the flow of traffic. Unless otherwise instructed by the Regional Office, all stop sign control should normally be for the minor crossroad, leaving the primary highway free-flow. If a two way stop control results in excessive operation problems and there is a concern that it may affect traffic safety, it may be necessary to notify the R.C.M.P. for assistance in directing traffic (especially during the heaviest peak traffic periods).

iv. Perform Interim Repairs

As previously noted, it is advisable to identify the faulty device, replace it with a spare and correct the problem in the shop. This advice is valid for discrete components: controllers, detector amplifiers, and conflict monitors. Some problems are related to the controller cabinet and/or the field wiring and cannot be simply replaced. These repairs must be made in the field. For traffic signals located far from the shop of the response technician, it may be impracticable to bring the malfunctioned units back to the shop for repair.

In making the field repairs, the technician generally has three choices:

1. Degrade mode
2. Temporary repair
3. Permanent repair

These are not mutually exclusive; many temporary repairs result in degraded operation. Detector-related faults often lead to degraded operations. If the problem is isolated to the amplifier, then replacement will restore the intersection to full service operation. It is common, however, for the fault to be with the loop in the roadway or with the lead-in cable.

A quick remedial action for this problem is to place the phase associated with that detector on recall. This will ensure that the phase will be serviced even though the detector is broken. When a phase is placed on recall, however, it is important to recognize the mode of operation of that phase has changed from actuated to fixed time. It will be necessary, therefore, to change the signal setting. Typically, the maximum time setting should be shortened to reduce overall intersection delay.

v. Log the Activity

The final action associated with any maintenance actions is to log the activity. The log book inside the cabinet should be updated whenever there are maintenance / repair activities at the cabinet or for all traffic signal timing changes. Reporting can become a tedious, onerous, and wasteful exercise unless it is carefully designed and maintained. One way to drastically reduce the amount of time and cost required to maintain the system is to computerize it. The Department is currently developing a TSSA database which can be used to assist in this documentation process. Once completed, it will be used to log all maintenance activities occurring at each signal system.

When setting up a maintenance record system, the temptation is to assign the data input task to a clerk who has little knowledge of the data being captured and little or no stake in the quality of the information. A much better approach is to design a system in which the people who will use the information are the ones who will be responsible for entering the data. Another key to success is to have the people who will be using the system become actively involved in the design of the system. A final key is to install a flexible system that can be changed.

Following verification, either a final repair or emergency repair should be performed as follows:

- Final repair entails complete repair or replacement of failed equipment to restore the intersection to proper and safe operation in accordance with permit specifications within a 24 hour period.
- Emergency repair temporarily restore safe operation within a 24 hour period. Final repair to bring the equipment into conformance with the permit specifications should be completed within 30 days unless prohibited by weather conditions or unavailability of equipment.

Table 3 presents a recommended list of initial versus emergency repairs for common major problems for traffic signals.

Table 3 Initial vs Emergency Repairs for Traffic Signal Problems

Knockdowns	Recommended Type of Repair
Cantilever Pole	Emergency or Final
Pedestal Pole	Emergency or Final
Traffic Cabinet	Emergency or Final
Signal Heads	Final Only
Equipment Failure	Recommended Type of Repair
Lamp burnout	Final Only
Traffic Controller	Final Only
Master Controller	Final Only
Detector Loop	Emergency or Final
Traffic Camera	Emergency or Final
Pushbutton	Final Only
Detector Amplifier	Final Only
Conflict Monitor / MMU	Final Only
Flasher	Final Only
Time Switch	Emergency or Final
Load Switch / Relay	Emergency or Final
Coordination Unit	Emergency or Final
Communication	Emergency or Final
Signal Cable	Final Only