Table of Contents

a) Appendix A – Reference Concept.
b) Appendix B – Select Ministry Standard Drawings and Reference Tables.
c) Appendix C – Additional Resources.
d) Appendix D – Guide Signing.
e) Appendix E – Phase One Drawings.
f) Appendix F – Intelligent Transportation Systems (“ITS”) Requirements.
g) Appendix G – Traffic Modeling and Traffic Signal Guidelines (Packages A-J).
h) Appendix H – Right of Way.
i) Appendix I – Global Memoranda of Understanding.
j) Appendix J – Hydrotechnical Sketches

200. DESIGN

200.1 INTRODUCTION

This Section covers the design requirements applicable to the New Bypass Infrastructure and Existing Infrastructure.

200.2 REFERENCE CONCEPT

The Ministry has developed following a public consultation process the Reference Concept. The information provided in this section summarizes the major road and structure features of the Bypass as further detailed in the Reference Concept**.** Any dimensions or lengths stated in this Section 200.2 are estimates only. Project Co is responsible to undertake all design and construction necessary as shown in the Reference Concept and as otherwise required to remove / construct / reconstruct all Infrastructure necessary to build a safe, functional Bypass in accordance with the Technical Requirements.

200.2.1 Highway 46 / Highway 1 Interchange Near Balgonie

The Reference Concept interchange for this location is a Diamond Interchange, with Highway 46 overpassing Highway 1. All ramps are single lane. The existing Highway 46 is a 2-lane highway. Through the interchange 1 lane in each direction is planned on Highway 46 with channelization at the north intersection. The south intersection is a 1-lane roundabout. Channelization with traffic signals is also planned at the Highway 46/ Highway 364, as well as a NB auxiliary lane between the north intersection and Highway 364.

The existing Highway 364 is relocated to intersect Highway 46 north of the diamond intersection, located beyond the ramp terminal ends. Likewise on the south side the existing service road shall be relocated to intersect Highway 46 south of the proposed roundabout. Existing paved service roads are reconstructed on both sides of Highway 1.

The existing at-grade intersection at Main Street east of the interchange is removed and the median closed. The existing at grade intersection at Highway 46 and Highway 1 is removed and the median closed.

An emergency lockable gate access is to be provided at the existing Main Street intersection with Highway 1. Locks and keys to be provided to the Ministry. No acceleration or deceleration ramps are required to be constructed at this location.

200.2.2 Existing Eastbound Exit Ramp on Highway 1, West of Highway 46

The existing at grade right out shall remain.

200.2.3 Highway 48 / Highway 1 Interchange at White City

The Reference Concept interchange for this location is a Diamond Interchange, with Highway 48 overpassing Highway 1. All ramps are single lane. The existing Highway 48 is a 2-lane highway. A 4-lane divided cross-section is planned on Highway 48 through the interchange area. The Highway 48 alignment is shifted slightly to the west to minimize traffic disruption during construction. Highway 48 is terminated at the new service road on the north side.

On the north side, the existing service road is relocated north of the north diamond intersection. On the south side, Highway 48 intersects with Gregory Avenue south of the south diamond intersection. In the southwest quadrant, Ramm Avenue is extended from White City Drive east and south to a T intersection on Gregory Avenue. A combination of reconstructed paved service roads and new paved service roads are planned in the other quadrants.

A section of existing Highway 48 including existing on / off ramps on the south side and a section of the existing service road on the north side are removed. The existing intersection at Highway 1 and Highway 48 is closed.

200.2.4 Emerald Park Road RIRO on Highway 1

In the Reference Concept a RIRO is planned on the eastbound lanes of Highway 1 at Emerald Park Road, a 2-lane road. The planned exit and entrance ramps are designed to freeway standards, tapered design. The design vehicle for the turning movements is the WB-20.

The existing exit ramp east of Emerald Park Road including a section of the westbound service road at this location is removed and the associated braided intersection is replaced with a continuous paved service road Existing paved service roads in all quadrants are reconstructed.

200.2.5 Great Plains Industrial Drive RIRO on Highway 1

In the Reference Concept a RIRO is planned on the eastbound lanes of Highway 1 at Great Plains Industrial Drive, a 2-lane road. The planned exit and entrance ramps are designed to freeway standards, tapered design. The design vehicle for the turning movements is the WB-20. Intersection improvements in the southeast and northwest quadrants are planned at the intersection of Great Plains Industrial Drive and South Plains Road.

The existing entrance and exit ramps are removed as well as the existing median crossing. In the southeast quadrant Great Plains Road is relocated to intersect with South Plains Road. The existing connection to Great Plains Industrial Drive is removed. Existing paved service roads on the north and south sides of Highway 1 are reconstructed.

200.2.6 Pilot Butte Access / Highway 1 Interchange

The Reference Concept interchange for this location is a Diverging Diamond Interchange (DDI), with Pilot Butte Access Road overpassing Highway 1. The eastbound to northbound ramp and the northbound to westbound ramp require 2 lanes; all other ramps are single lane.

The existing Pilot Butte Access Road is a 2-lane highway and it is planned to transition to a five-lane divided cross-section through the interchange area, 3 lanes northbound and 2 lanes southbound. The DDI requires traffic signals at the 2 crossover intersections. Traffic signals shall be provided at the end of the Highway 1 exit ramps at the intersections with the overpassing roadway.

The existing intersection at Pilot Butte Access Road and Highway 1 is removed. The existing service roads adjacent to Highway 1 on both sides are removed. New paved service roads are planned on both sides of Highway 1. The north service road intersects Pilot Butte Access Road north of the north DDI intersection. The west leg of the north service road, which connects Pilot Butte Access Road to Gravel Pit Road will be constructed as a two-lane paved service road in Stage 1 but provide for 'Future Works' to upgrade to a four-lane paved service road with a 5m painted median. The south service road intersects Pilot Butte Access Road south of the south DDI intersection.

200.2.7 Gravel Pit Road RIRO on Highway 1

In the Reference Concept a RIRO is planned on the eastbound and westbound lanes of Highway 1 at Gravel Pit Road, a 2-lane road. The exit and entrance ramps are to be designed to freeway standards, tapered design. The design vehicle for the turning movements is the WB-20.

The existing service road adjacent to Highway 1 on the north side is removed and a new paved service road is planned and offset of Highway 1. The east leg of the north service road, which connects Gravel Pit Road to Pilot Butte Access Road will be constructed as a two-lane paved service road in Stage 1 but provide for 'Future Works' to upgrade to a four-lane paved service road with a 5m painted median (this is the same Service Road as described in 200.2.6). A new paved south service road is planned and is offset of Highway 1. Both service roads intersect with Gravel Pit Road. The existing at-grade intersection on Highway 1 is to be closed.

200.2.8 Tower Road / Highway 1 Interchange

The Reference Concept details a complex interchange planned at this location. The new construction of the 4-lane divided New Bypass Infrastructure begins here, turning south off Highway 1 east of Tower Road then running parallel to Tower Road. The New Bypass Infrastructure curves are designed for a 130 km/h design speed. The New Bypass Infrastructure overpasses existing Highway 1 and the CP Tyvan Subdivision.

In the westbound direction on Highway 1 approaching the New Bypass Infrastructure, a major fork design is planned for the 2 southbound lanes and the continuance of the 2 Highway 1 westbound lanes to Regina. To accomplish this, a third westbound lane is introduced on Highway 1 before the exit and 2 lanes carry onto the New Bypass Infrastructure and 2 lanes carry on to the existing Highway 1 to Regina.

The existing westbound exit ramp from Highway 1 to the north service road is to be removed.
For the eastbound direction, from existing Highway 1 (Victoria Avenue) to Highway 1 eastbound, a 2-lane ramp is planned and starts just east of the existing Highway 1 bridges over the CP and underpasses the mainline lanes. A 2-lane entrance ramp terminal to Highway 1 eastbound is planned.

The connection to Tower Road at existing Highway 1 from the New Bypass Infrastructure and vice-versa is accomplished with high-speed single lane directional ramps. The northbound ramp overpasses the mainline lanes. The intersection at Tower Road and existing Highway 1 is upgraded to accommodate this connection including signalization.

A combination of new and reconstructed paved service roads is planned on the north side of Highway 1. The existing at-grade railway crossing on the north service road at the CP is upgraded. A new service road is constructed on the south side of Highway 1 and the east side of the mainline lanes. The existing service road on the south side between Tower Road and the New Bypass Infrastructure is removed.

200.2.9 Highway 33 Interchange

The Reference Concept interchange at this location is a Diamond Interchange. All ramps are single lane. The existing Highway 33 is a 4-lane divided highway. The New Bypass Infrastructure is overpassing Highway 33.

The existing Tower Road is terminated on either side of the New Bypass Infrastructure with cul-de-sacs. An existing median opening just northwest of the northwest diamond intersection shall remain open. At the northwest diamond intersection, the acceleration lane is not provided for north bound traffic and a right turn bay is provided for southbound traffic. Both interchange ramp intersections, as well as the southeast Service Road intersection shall be designed to accommodate traffic signals as Future Works. A new gravel Service Road is planned in the southeast quadrant adjacent to the New Bypass Infrastructure and ties into Pearl Street on the southerly side of Highway 33. In the northeast quadrant, a new paved service road is planned adjacent to Highway 33. It connects Tower Road and a new paved service road that connects from the north and ends at an intersection with Highway 33. Pearl Street is also connected at this intersection.

200.2.10 Fleet Street RIRO

In the Reference Concept a RIRO is planned on the eastbound and westbound lanes of the New Bypass Infrastructure. Fleet Street is a 2-lane road and is relocated to intersect the New Bypass Infrastructure at right angles. The exit and entrance ramps are designed to freeway standards, tapered design. The design vehicles are the WB-20 for the westbound lanes and the SU9 for the eastbound lanes. An at-grade railway crossing is planned on Fleet Street south at the CN Lewvan railway. The turning radii to/from the mainline lanes on Fleet Street shall not encroach the railway crossing.

A new service road is planned adjacent to the westbound lanes of the New Bypass Infrastructure tying into Fleet Street just north of the mainline. A driveway access off of Fleet Street is provided on the south side of the mainline and CN. Approximately 1.2 km of existing Fleet Street is removed.

200.2.11 Highway 6 Interchange and Highway 6 Twinning

The Reference Concept interchange at this location is a modified Parclo A interchange. All ramps and loops are single lane. The low-volume southbound to westbound movement is provided through a left turn off of Highway 6 and onto the northbound to westbound loop. This configuration avoids the radio towers (Rawlco property) in the northwest quadrant. Highway 6 overpasses the New Bypass Infrastructure.

The existing Highway 6 is a 2-lane highway from just south of existing Highway 1 to the south across the New Bypass Infrastructure and beyond. To the north at Highway 1 it is a 4-lane divided highway into Regina with a 12 m median. Highway 6 is to be twinned from the existing 4-lane cross-section, south across the New Bypass Infrastructure and transitions back to 2 lanes at Township Road 162 near Rowatt. In the first 1 km (+/-) of twinning at the north end, the new lanes are constructed on the east side of the existing Highway 6 lanes, with a 12 m median, to avoid the Enbridge pipeline. It is then widened on the west side with the median transitioning to an 18 m median.

In the northwest quadrant, guiderail is installed on the Highway 6 southbound lanes to protect the existing Rawlco building, and the sideslope ratio behind the guiderail is reduced to 3:1 to maintain adequate clearance from toe of fill to the building. An all directional at grade intersection with access roads is planned to provide access to the Rawlco property on the west side and farmland on the east side. The intersection is located beyond the ends of the interchange ramp tapers.

In the southeast quadrant, a new gravel service road is planned that ties into the existing road into Rowatt. The CN Lewvan Subdivision spur is to be shortened at the end of the spur to avoid the service road crossing the existing spur. A full intersection is planned on Highway 6 south of the New Bypass Infrastructure, located just beyond the interchange ramp tapers, to provide access to properties on the east and west sides of Highway 6.

200.2.12 Courtney Street At-Grade Intersection

In the Reference Concept a full at-grade intersection is planned at Courtney Street and the New Bypass Infrastructure. Courtney Street is a 2-lane road and is realigned to provide a 90° crossing with the New Bypass Infrastructure. The design vehicle for turning movements is the WB-20. The exit and entrance ramp terminals are designed to freeway standards, tapered design.

A new east-west gravel service road is planned on the south side of the New Bypass Infrastructure and west of Courtney Street. It intersects with Courtney Street south of the centerline of the New Bypass Infrastructure. A portion of existing Courtney Street is removed.

200.2.13 Existing Highway 1 West Interchange

The Existing Bypass Infrastructure at this location consists of a first stage modified Diamond Interchange, with a loop ramp provided for the southbound to eastbound movement. The existing bridge that overpasses Highway 1 has three lanes, 1 in each direction for the New Bypass Infrastructure and a parallel exit lane for the loop ramp. North of the interchange a 4-lane divided highway has been constructed north of the CP Indian Head Subdivision, including the railway overpass.

The Reference Concept details a systems level interchange for this location which consists of constructing a new 4-lane divided roadway and 2 new bridges over Highway 1 east of the existing bridge with a reduced 18 m median width (standard is 32 m). The outer separation between the existing bridge and the new southbound lanes is 17 m. The existing bridge and road becomes a collector-distributor (C-D) road, the southbound to eastbound loop is retained as is and another loop is added for the westbound to southbound movement, with weaving occurring on the C-D Road. At the north and south limits of the interchange the median is transitioned back to the standard 32 m width. The main alignment requires shifting to the east at each end to accommodate the C-D Road and is accomplished using smooth horizontal curvature to avoid any "kink" appearance.

An exit design is planned under the existing bridge for the westbound to southbound loop and includes any modifications that may be necessary to the existing bridge.

Route continuity for the New Bypass Infrastructure-Highway 1 West connection is provided with high-speed directional ramps (120 km/h design speed, superelevation rate of .06 m/m). An elevated semi-directional ramp is planned for the eastbound to northbound movement. Lower speed directional ramps are provided for all remaining movements.

A new gravel service road is planned in the southwest quadrant from Fleming Road at Highway 1 West to Pinkie Road. The Condie Road median crossing shall be removed.

All other existing interchange infrastructure constructed previously that is not salvaged for the new interchange is removed.

200.2.14 Hill Avenue Interchange

The existing configuration is an all movement at-grade intersection. The Reference Concept at this location is a Diamond Interchange. All on and off ramps are single lane with Hill Avenue passing over the Bypass mainline as a divided two lane highway. West of the Bypass mainline, Hill Avenue connects to Centre Road. East of the Bypass mainline, Hill Avenue ties into Pinkie Road. Between the east interchange ramp intersection and Pinkie Road, an at-grade "T" intersection will be provided for access to Hill Avenue. The existing Hill Avenue is terminated at a cul-de-sac east of the mainline and the existing roadway is removed. On the west side a paved Service Road is provided to connect Centre Road to an existing Service Road to the west of southbound mainline. The design vehicle for this interchange is the WB-20. Future Works will require the addition of two lanes to Hill Avenue. Channelization is planned at the ramp terminal intersections and the Hill Avenue/Pinkie Road intersection.

200.2.15 Rotary Avenue Interchange

Rotary Avenue is the main entrance to the Global Transportation Hub (GTH) west of Regina, and truck traffic will be predominant. The Reference Concept interchange at this location is a Trumpet B. All movements are free flow.

All interchange ramps are single lane. The interchange to the west terminates and ties into the existing 4-lane undivided Rotary Avenue cross-section constructed previously. The construction of the New Bypass Infrastructure resumes north of the CP Indian Head Subdivision overpass previously constructed.

A design exception for the decision sight distance (DSD) to the exit terminal for the northbound to westbound movement is incorporated here; stopping sight distance (SSD) is used instead. This is due to constraints of the CP Indian Head Subdivision overpass profile.

200.2.16 Dewdney Avenue Interchange

The Reference Concept interchange at this location is a half diamond. The single lane ramps proposed provide access to and from the north. In the Works, Dewdney Avenue is planned as a first stage 2-lane road in this project, with the eastbound lanes constructed first. Future Works will require the addition of 2 lanes. Channelization is planned at the ramp terminal intersections on Dewdney Avenue.

Dewdney Avenue overpasses the New Bypass Infrastructure as well as the CP Spectra Energy Spur east of the mainline lanes. The overpass shall not encroach onto the property located on the south side of Dewdney Avenue and east of the CP Spur.

West of the west ramp intersection is a new "T" intersection and Service Road on the north side of Dewdney Avenue that connects to the existing Condie Road.

200.2.17 Overpass of CN Central Butte Subdivision Rail Line

The New Bypass Infrastructure overpasses the CN Central Butte Subdivision rail line between Dewdney Avenue interchange and 9th Avenue Interchange.

200.2.18 9th Avenue Interchange

The Reference Concept interchange at this location is a modified Parclo A/Diamond Interchange. In the Works, 9th Avenue is planned as a first stage 2-lane road in this project, with the central lanes constructed first. Future Works will require the addition of 2 lanes, 1 each side. Channelization is planned at the ramp terminal intersections on 9th Avenue.

9th Avenue alignment is shifted to the northwest of Pinkie Road to avoid the City of Regina waterlines on the south side of 9th Avenue. It is aligned with the existing east-west Township Road intersection on Condie Road located north of 9th Avenue.

A diamond configuration is proposed on the east side and a one-quadrant Parclo A2 in the northwest quadrant. The low-volume eastbound to southbound movement is provided through a left turn off of 9th Avenue onto the proposed westbound to southbound loop ramp. This is to minimize bridge-crossing requirements on Wascana Creek located south of 9th Avenue.

The loop ramp will ultimately include 2 lanes based on projected traffic volumes. In this project only 1 lane is planned, however the grading is to be done for the ultimate 2-lane cross-section in this project. The northbound to eastbound exit ramp will ultimately include 2 lanes based on projected traffic volumes. In this project only 1 lane is planned, however the grading is to be done for the ultimate 2-lane cross-section in this project.

200.2.19 Armour Road At-Grade Intersection

In the Reference Concept a full at-grade intersection is planned at Armour Road. Armour Road is a 2-lane road. The design vehicle for turning movements is the WB-20. The exit and entrance ramp terminals are designed to freeway standards, tapered design.

200.2.20 Last Mountain Railway Grade Separated Rail Crossing

The New Bypass Infrastructure overpasses the Last Mountain rail line between Armour Road At-Grade Intersection and Highway 11 Interchange.

200.2.21 Highway 11 Interchange

The New Bypass Infrastructure terminates at Highway 11. The Future Works envisaged at this location will ultimately require a 4-legged systems level interchange to be constructed. In this Project only the Works are required to be designed and constructed. The Reference Concept interchange is a Trumpet B. The Parclo A 2-lane cross-section and bridge overpassing Highway 11 are designed and constructed as the future C-D Road. Future Works shall require that the northeast to southeast ramps be constructed on a larger radius. The southeast to southwest ramp is built to its ultimate location.

Highway 11 is a 4-lane divided highway with a 25 m median. The exit and entrance ramps are tied into this highway. The existing exit terminal in the northwest direction on Highway 11 located southeast of the mainline crossing is removed. The existing service road along the northeast side of Highway 11 is removed, including the existing bridge over Boggy Creek. The existing "T" intersection on Highway 11 located southeast of the mainline crossing is removed as well as local roads connecting to it. The existing underpass at Courtney Street and Highway 11 located just southeast of the proposed mainline crossing is removed, which includes removal of 2 bridges and road reconstruction of Highway 11, as well as the removal of a portion of Courtney Street.

The Township Road located southwest of Highway 11 is removed through the New Bypass Infrastructure right-of-way. New gravel service roads are planned on the northwest and southeast sides of the New Bypass Infrastructure.

200.3 PHASE ONE

The Works comprised in Phase One consist of the Infrastructure shown on drawing 15-E-1-01 in Appendix E to Schedule 15-2 – Design and Construction.

200.4 PROJECT LIMITS

The Project Limits are shown on the Reference Concept, limited by the Right of Way.

200.5 DESIGN - GENERAL

200.5.1 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 15 (Technical Requirements). If a performance requirement is not specified in this Schedule 15 (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 Saskatchewan National Highway System. All designs

shall incorporate the appropriate selection of design concepts, design details, specifications, materials and construction methods and techniques.

Bridge structures shall 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.

For bridges that are to be widened in the Future Works, piers shall be proportioned so that the spacing and proportioning of shafts in the Future Works are reasonably close match to the spacing and proportioning of shafts in the Works so that the architectural integrity of the Works design is maintained in the Future Works design. Some asymmetry of pier cap cantilevers is acceptable in the Works, but pier cap cantilevers shall be reasonably symmetrical in the Future Works. Where the Works pier cap cantilevers are designed to be extended in the Future Works, the Works pier and foundation shall be designed for Future Works loading, and construction details shall be included in the Works design to facilitate reinforcement of the Future Works cantilevers, either through embedded couplers or provision for future post-tensioning.

200.5.2 Responsibility for Design

Project Co is responsible for the design in accordance with Section 20.3 of the Project Agreement.

200.5.3 Soils

Project Co shall undertake the design with due consideration for the soil types encountered. Project Co shall carry out a detailed geotechnical investigation in sufficient detail to allow for the identification of all soils issues.

Bridge structure foundations shall be designed in accordance with the Bridge Design Code and the Canadian Foundation Engineering Manual, 4th Edition. 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 Ministry on request) and shall represent Project Co'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, Section 8.5.

Silt material specified as "**ML**" or "**MH**" material (in accordance with the Ministry's Standard Test Procedures) shall not be used in the design and construction of the bridge headslopes and approach fills. For roadway embankments soils classified as "ML" or "MH" shall be considered as "unsuitable materials" with respect to Standard Plan Nos 22020 and 22022. 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 Ministry 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.

200.5.4 Aesthetics

Project Co is advised that the Ministry supports and encourages the inclusion of cost effective features to improve the overall roadway and bridge structure aesthetics.

Project Co shall develop and incorporate in its design a unified aesthetic theme throughout the New Bypass Infrastructure that complements the surrounding environment and the Province of Saskatchewan.

Aesthetics shall be considered in the layout and design of all roadway elements, and the aesthetic principles outlined in the Alberta Transportation'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.

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

- 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 head slope 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 watercourse 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 Bypass Infrastructure shall be underground.
- A discrete graphic, approved by the Ministry (wheat sheaf, lily, etc.) shall be placed on abutment wing walls facing traffic. On twin bridge structures, the graphic is not required on the downstream structure. Project Co shall consult with the Ministry's Communications Branch to finalize the design of the graphic.
- Exposed concrete surfaces shall have pigmented sealers.
- 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.
- Grade separation structures shall have aesthetic treatment of bridge piers. Circular or square column cross-sections shall not be used. 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.

200.5.5 Airport Compatibility

200.5.5.1 Overview Airport Requirements

There are a number of development restrictions associated with the Regina International Airport (CYQR) and its surroundings, which are designed to protect the integrity of the airspace and electronic systems. The aviation-related development restrictions for New Bypass Infrastructure generally relate to land uses or developments where:

- New obstacle heights may pose a hazard to aviation.
- New developments that would cause electronic interference with aviation navigation or communication systems.
- New land uses that may attract birds or wildlife, which would pose a hazard to aviation.
- Transport Canada determines the required lighting and marking for new or temporary obstructions.
- Interference with VHF/UHF Radio Communication Systems.
- Use of cranes during construction.
- Blasting.
- Restrictions to visibility.

200.5.5.2 Project Co's Responsibilities

Project Co's responsibilities shall include but are not limited to:

- All New Bypass Infrastructure shall comply with all airport compatibility standards, guidelines and requirements for development adjacent to the Regina International Airport as determined by NavCanada and Transport Canada.
- All NavCanada and Transport Canada requirements shall be incorporated into the design. These requirements apply to temporary works as well as the New Bypass Infrastructure.
- Project Co shall obtain written confirmation that the review has been undertaken and the design conforms to NavCanada requirements.
- Project Co shall be responsible for all on-going consultation with NavCanada and Transport Canada during the design development and construction phases of the Project to ensure the New Bypass Infrastructure meets all airport compatibility requirements.
- Project Co shall be responsible to make design development submissions in a timely manner with the full information required for NavCanada and Transport Canada to undertake their reviews.

200.5.5.3 NavCanada Land Use Proposal Submission

The process by which NavCanada reviews land use development proposals is known as the "Land Use Proposal Submission Process". During the design development process, Project Co shall prepare and submit Land Use Proposal Submissions to NavCanada in a timely manner to facilitate NavCanada review of the Project. The submissions shall include the Land Use Proposal Submission form and any project information as necessary for the review.

200.5.5.4 Transport Canada Aeronautical Obstruction Clearance Form

Transport Canada is required to perform an assessment on the requirement for obstruction marking and lighting of man-made structures in accordance with the Canadian Aviation Regulations ("**CAR**"). Obstructions are assessed by Transport Canada through the "Aeronautical Obstruction Clearance Form Process". Project Co shall prepare and submit an Aeronautical Obstruction Clearance Form for all permanent and temporary structures within 6 km of the Aerodrome Reference Point of the Regina International Airport, as well as for the following interchange/intersection locations:

- Ninth Avenue North Interchange
- CN Rail Overpass

- Dewdney Avenue Interchange
- Rotary Avenue Interchange
- CP Rail Overpass
- Hill Avenue Interchange
- Tower Road Intersection
- Interchange East of Tower Road.

The coordinates for the Aerodrome Reference Point are N 50-25-56, W 104-39-58. Project Co shall be responsible for any aviation safety marking or lighting requirements identified by Transport Canada in its review.

200.5.5.5 Obstacle Limitation Surfaces

Obstacle Limitation Surfaces ("**OLS**") are height restrictions, established around an airport, to ensure a satisfactory level of safety. The OLS for the Regina International Airport is a federal Airport Zoning Regulation ("**AZR**") which was originally enacted in 1979 and amended in 1986. The OLS restrictions have been annotated on the land title for each parcel of land affected by the height restrictions. The AZR is therefore a mandatory restriction that has been registered against the affected property land titles and takes precedence over any provincial or municipal regulations.

200.5.5.6 Electronic Facilities Zoning

The purpose of the Electronic Facilities Zoning is to protect the airport navigational aids and other telecommunications systems from electronic interference. The affected facilities to be covered in the NavCanada Land Use Proposal are:

- Runway 13 Instrument Landing System Glide Scope.
- Runway 13 Instrument Landing System Localizer.
- The NavCanada Control Tower and Flight Service Station.
- The NavCanada Primary Surveillance Radar site.
- The communication receivers/transmitters.
- 4 non-directional beacons located off-airport in the vicinity of the proposed highway construction.

200.5.5.7 Bird Hazards

Transport Canada (TP1247 E Sec. 3.2) defines the Primary Bird Hazard Zone as the area where aircraft are normally below 1,500 feet (457.2 m) Above Ground Level ("**AGL**"). This area extends a distance of approximately 9 km from the Aerodrome Reference Point, and no land uses which would attract birds or wildlife are permitted. In the Primary Hazard Zone, the following permanent and temporary land uses are not permitted:

- Stormwater management ponds.
- Marshes, swamps and mudflats.
- Plowing/cultivating/haying.

200.5.5.8 VHF/UHF Radio Communications Systems

Metallic structures may cause reflection of communication signals. In cases where such structures are proposed to be constructed within 300 m of a VHF/UHF transmitter/receiver installation, Project Co shall consult with the owner of the communications systems.

200.5.6 Provisions for Future Works

During design of the Roadway elements, Project Co shall be cognizant of the requirement for future expansion through the addition of lanes or other elements of the Future Works as shown in the Reference Concept. The Works shall be designed and constructed such that the New Bypass Infrastructure will accommodate the Future Works as anticipated in the Reference Concept.

During design of the bridge structures, Project Co shall be cognizant of the potential requirement for future widening and/or lengthening of the bridge structures. When required, the Works shall be designed and constructed such that their opening will accommodate the Future Works on the bridge structures as anticipated in the Reference Concept.

Vertical grade lines and horizontal alignments shall be set so that all vertical and horizontal clearance requirements are met after any anticipated bridge structure widening and/or lengthening, or roadway rehabilitation has occurred.

200.5.7 Roadway Safety Audits

200.5.7.1 Road Safety Audit Team

The Road Safety Audit Team shall consist of auditors that shall meet the following minimum criteria:

- 5 years relevant experience in road safety, traffic engineering, or geometric design;
- Participated in at least 5 road safety audits with criteria similar to the Road Safety Audits; and
- Completed at least 1 such road safety audit per year in the last 2 years.

200.5.7.2 Project Co's Responsibility

Project Co shall be responsible for:

- Scheduling, initiating, allowing access to the applicable Site and managing the Road Safety Audit process at the appropriate times during the course of the Project;
- Providing all necessary Design Data for the Road Safety Audit Team to conduct the Road Safety Audit;
- Ensuring that the Road Safety Audit is conducted in accordance with Good Industry Practice;
- Receiving and reviewing the Road Safety Audit Team's report with the Ministry;
- Responding to the Road Safety Audit report including presenting alternatives to address deficiencies and recommendations;
- Implementing required re-design as a result of the corrective suggestions described in the above-noted report;
- Updating changes on the required Design Data; and
- Providing all draft and final documentation related to the Road Safety Audit to the Ministry.

All costs associated with the Road Safety Audit, including any re-design and increased costs to the Works that result from the Road Safety Audit, shall be borne by Project Co.

After each Road Safety Audit, except as otherwise expressly agreed in writing by the Ministry, Project Co shall address all deficiencies and recommendations made by the Road Safety Audit Team.

200.5.7.3 Road Safety Audit Process

The Road Safety Audit process shall be carried out in accordance with the work scope detailed in the Canadian Road Safety Audit Guide (RSA) published by Transportation Association of Canada (TAC). References to "review" or "response" from the owner agency, or other qualifying phrase with similar connotation, shall be construed as the responsibility of Project Co in accordance with the requirements in this section.

The Road Safety Audit Team shall prepare a report to document the audit findings. Road Safety Audit reports shall be submitted to Project Co for the stages identified below. The Road Safety Audit reports shall clearly identify safety hazards that need to be addressed by Project Co along

with recommendations for remediation. Project Co shall respond to the identified hazards and recommendations with remediation counter-measures.

Project Co shall give the Ministry 5 Business Days' notice of any Road Safety Audit taking place. The Ministry may at its discretion attend any Road Safety Audit and may attend any meeting between the Road Safety Audit Team and Project Co. The Road Safety Audit reports shall be provided to the Ministry in accordance with the Schedule 9 - Review Procedure for review at 4 stages as follows:

200.5.7.3.1 Pre-Final Design Road Safety Audit

A Pre-Final Design Road Safety Audit shall be conducted immediately before submission of the Pre-final Design Development Submittals in accordance with Section 20.3 of the Project Agreement. The audit shall undertake a detailed review of the Pre-final Design Development Submittals to identify any potential safety-related enhancements that might have an impact on the Bypass. Issues considered shall include but not be limited to:

- Design consistency;
- Human factors;
- Horizontal and vertical alignment;
- Cross-section design;
- Interchange/intersection configuration;
- Access location;
- Sight distance including, but not limited to, stopping sight distance and turning sight distance, sight distances to traffic control devices, bullnoses, etc;
- Operation of public transit;
- Operational and maintenance safety;
- Traffic operations;
- Environmental factors;
- Clearances to roadside objects;
- Safety assessment of at-grade railway crossings;
- Safety barriers; and
- Provision for vulnerable road and right-of-way users.

200.5.7.3.2 Final Design Road Safety Audit

A Final Design Road Safety Audit shall be conducted immediately before submission of the Final Design Development Submittals in accordance with Section 20.3 of the Project Agreement. The audit shall undertake a detailed review of the completed Final Design Development Submittals to identify any potential safety-related enhancements that might have an impact on the operational safety of the Bypass. Issues considered shall include, but not be limited to:

- Signing and pavement markings;
- Traffic signal configuration;
- Intersection details;
- At-grade railway crossings;
- Drainage;
- Lighting;
- Fencing;
- Clearances to roadside objects;
- Safety barriers;
- Surface standards including treatments and structures;
- Traffic control devices;
- Landscaping;
- Provision for vulnerable road and right-of-way users;
- Accommodation of design vehicles; and
- Any other Pre-Final Design Road Safety Audit results affected by the final design.

200.5.7.3.3 Temporary Traffic Accommodation On-Site Road Safety Audit

A Temporary Traffic Accommodation On-Site Road Safety Audit shall be conducted on the applicable Site before implementation of temporary traffic accommodation set-ups that meet either of the following criteria:

- 2 or more individual work areas (as defined in the Ministry's Traffic Control Devices Manual for Work Zones) within 2.0 kms of each other such that one might influence the traffic operation of the other; and/or
- The duration of temporary traffic accommodation set-ups is 5 days or more. The set-up does not necessarily have to be in place for the entire time but can be one of a number of repeating set-ups that are active at different times.
- Issues considered shall include, but not be limited to:
  - Signing and pavement markings;
  - Traffic signal configuration;
  - Intersection details;
  - At-grade railway crossings;
  - Drainage;
  - Lighting;
  - Clearances to roadside objects;
  - Safety barriers;
  - Traffic control devices;

- Provision for vulnerable road user;
- Accommodation of design vehicles;
- Sight lines.

200.5.7.3.4 Post Construction Road Safety Audit

A Post Construction Road Safety Audit shall be carried out on each section prior to opening the respective section for traffic operation. The Post Construction Road Safety Audit shall be conducted after the roadway is paved and all signage and pavement markings are complete. The audit shall review and identify potential safety enhancements that may reduce the frequency and/or the severity of collisions. The Road Safety Audit Team shall also check for safety deficiencies that result from using particular combinations of design elements not previously detected.

Post Construction Road Safety Audits shall take place prior to Phase One Substantial Completion and Substantial Completion.

For the purposes of completing a Post Construction Road Safety Audit, the Road Safety Audit Team shall fully examine the Works associated with the respective section, including:

- Meeting with Project Co to review any issues relating to the Works, in particular design changes that may affect the safety of the Works;
- Checking to ensure that safety issues identified in the Final Design Road Safety Audit are addressed and the resulting design changes do not create further safety issues;
- Reviewing any design changes that occurred during the relevant Works to ensure they do not create safety issues; and
- Conducting field reviews of such Works, under both daytime and night time conditions.

200.5.7.4 Certification

Project Co shall submit to the Ministry a certificate (a "**Road Safety Audit Certificate**") in the form given in Schedule 9 – Review Procedure in respect of the Pre-Final Design, Final Design, and Post Construction Road Safety Audits, respectively. Each Road Safety Audit Certificate shall be signed by the Design Manager, the Road Safety Audit Team, the Construction Contractor, and Project Co Representative.

Each Road Safety Audit Certificate shall be provided to the Independent Certifier and the Phase One Substantial Completion Certificate and Substantial Completion Certificate for each section shall not be issued unless a Post Construction Road Safety Audit Certificate has been submitted and signed by the Design Manager, the Road Safety Audit Team and the Construction Contractor and Project Co Representative in respect of the relevant section.

Road Safety Audits, including detailed crossing safety assessments of at grade railway crossings, shall be performed pursuant to the Project Agreement and the Management Plans. Road Safety Audits shall be undertaken for both design (including all detour and traffic accommodation designs) and pre-opening stages. The pre-opening safety audit shall be conducted after the roadway is paved and all signage and pavement markings are complete. Road Safety Audits shall be an integral part of the IMS Manual.

200.5.8 Hierarchy of Standards

All design and construction shall meet the requirements stated in this Schedule 15-2 Design and Construction.

In the development of the various designs and plans Project Co shall be guided by the policy, standards, process, guidance, etc. contained in the Ministry's manuals, and other manuals and documents listed hierarchically below.

For all design elements not covered below, appropriate Ministry Manuals and procedures listed or referred to (or other agency Manuals and procedures listed or referred to therein) on the "Doing Business with the Ministry" website (http://www.highways.gov.sk.ca/business) shall apply.

Standard Plans (20000 - 29999) can be found in DM1 starting from the "Abbreviations - Symbols" section.

200.5.8.1 Geometric Design Criteria

a) Reference Concept for connectivity
b) Saskatchewan Supplement (SKS) to TAC *Geometric Design Guide for Canadian Roads* (TAC-GDG) and Standard Plans (Drawings) 20000 to 29999 contained in the Ministry Design Manual Part 1 (DM1).
c) Ministry Design Manual Part 2 (DM2).
d) Ministry Roadside Management Manual as supplemented by SKS.
e) TAC-*Geometric Design Guide* (TAC-GDG) when material is not addressed in SKS, DM1 or DM2, TAC-GDG may be used for design related criteria.
f) City of Regina Development Standards Manual (2010).
g) Alberta Transportation Design Bulletin 68, Roundabout Design Guidelines on Provincial Highways.
h) Project Co Proposal Extracts.

Saskatchewan Supplement to TAC-GDG Disclaimer: The disclaimer is directed at those who may wish to use the Ministry policies and standards contained in the design supplement, SKS, to establish design for entities other than the Ministry. The use of SKS on projects within the Ministry, completed by others, is sanctioned by the current statement. There is no additional

adverse risk assigned or apportioned to the professionals outside the Ministry who under contract with the Ministry are carrying out project designs.

200.5.8.2 Railways

It is the responsibility of Project Co to adhere to all Applicable Law including all provincial or federal acts, regulations, rules, standards and guidelines. It is Project Co's responsibility to obtain the latest versions of any applicable railway design standards that are to be followed during design, construction and operation of any railway crossing. If there is a discrepancy between documents with respect to technical standards, the most stringent of the applicable standards listed below shall apply.

In general the following document hierarchy is to be used:

a) Federal or Provincial Acts
b) Federal or Provincial Regulations
c) Federal or Provincial Rules
d) Federal or Provincial Standards
e) Federal or Provincial Guidelines
f) Railway Crossing Agreement including Work Permit (if required)
g) Railway Standards or Requirements Written Documents
h) Railway Standard Plans
i) AREMA *Manual for Railway Engineering*

Comprised of the following documents:

Transport Canada / Canadian Transportation Agency (Federally Regulated Railways)
Canada Transportation Act, Section 101, S.C. 1996, c.10
Railway Safety Act, R.S.C. 1985, c.32 (4th Supp.)
Grade Crossing Regulations
Notice of Railway Works Regulations, SOR/91-103
Canadian Rail Operating Rules (CROR) with Rules for the Protection of Track Units and Track Work, TC-O-0-93
Rules Respecting Track Safety, TC E-54
Grade Crossing Standards
Standard Respecting Railway Clearance, TC E-05
Standards Respecting Pipeline Crossings Under Railways, TC E-10
Transport Canada Standard for LED Signal Modules at Highway/Railway Grade Crossings, TC E-14
Engineering Standards for "Walk Light" Grade Crossing Warning Systems, TC E-39
Minimum Railway/Road Crossing Sightline Requirements For All Grade Crossings Without Automatic Warning Devices, G4-A
Guideline: Engineering Work Relating to Railway Works, Section 11 of the RSA, TP 13626

Guideline for Inspecting and Testing Preemption Of Interconnected Traffic Control Signals & Railway Warning Systems, TP 13755
Guideline on Requesting Approval to Undertake Certain Railway Works
Pedestrian Safety at Grade Crossing Guide (Final Draft),

Province of Saskatchewan (Provincially Regulated Railways)
The Railway Act, Saskatchewan
Saskatchewan Track Safety Standards, RRD 1000
Saskatchewan Rules for Protection of Track Work and Track Forces, RRD 3000
Public Grade Crossing Standards, RTS 2001
CN
CN Standard Clearance Diagram For All New Railway Bridges, Drawing KIU-10.1M
Protection and Minimum Clearance for Overhead Bridges, Drawing KIU-10.2m
Protection Wall Requirements for Reinforced Earth (Or Equiv.) Walls for Overhead Bridges, Drawing KIU-10.3m
CNR Work Permit, 2014
Regulatory Requirements For Roadway/Railway Crossing Projects
Standard E-4 Sample Drawing
CP
Clearance Diagram, Structure Over or Beside Railway Tracks, Drawing 2008SD-01
Protection of Structures Adjacent to Railroad Tracks
AREMA
AREMA Manual For Railway Engineering, 2014

200.5.8.3 Geotechnical

a) Ministry *Foundation Investigation Manual*
b) *Canadian Foundation Engineering Manual*
c) Project Co Proposal Extracts

200.5.8.4 Roadways Drainage

a) Ministry Hydraulic Manual (Apr 2014)
b) Saskatchewan Supplement (SKS) to TAC *Geometric Design Guide for Canadian Roads* and Standard Plans (Drawings) 20000 to 29999 contained in the Ministry Design Manual Part 1 (DM1)
c) Fisheries and Oceans (DFO) Canada Land Development *Guidelines for the Protection of Aquatic Habitat (Sep 1993)*

d) US Federal Highway Administration (FHWA) *Hydraulic Design of Highway Culverts, Third Edition* (FHWA-HIF-12-026)
e) US Federal Highway Administration (FHWA) *Hydraulic Engineering Circular No. 14, Third Edition, "Hydraulic Design of Energy Dissipators for Culverts and Channels"* (FHWA-NHI-06-086)
f) Ministry *Environmental Best Practices: Sediment and Erosion Control* (Feb 2012)
g) Project Co Proposal Extracts

200.5.8.5 Surfacing

a) Ministry *Surfacing Manual*
b) Project Co Proposal Extracts

200.5.8.6 Roadway Lighting Design

a) Ministry *Design Manual Part 2* (DM2) will be the main reference for the following roadway lighting warrants and design criteria:
   i. Delineation lighting
   ii. Area lighting
b) Transportation Association of Canada (TAC) *Guide for the Design of Roadway Lighting (2006)* shall be used for the determination of interchange and full roadway lighting designs, as well as lighting of the underpasses
c) All lighting structures shall be designed in accordance with CAN/CSA-S6-06, *Canadian Highway Bridge Design Code* including latest supplements or AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition* with interim revisions, whichever governs
d) Railway Crossing Lighting will conform to the latest version of Transport Canada's RTD-10, *Road/Railway Grade Crossings - Technical Standards and Inspection, Testing and Maintenance Requirements*
e) Canadian Electrical Code and the regulations of the electrical inspection department having jurisdiction
f) Project Co Proposal Extracts

200.5.8.7 Traffic Signalization

a) Transportation Association of Canada (TAC) *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC)
b) Canadian Institute of Transportation Engineers (CITE) *Canadian Capacity Guide for Signalized Intersections, Third Edition* (Feb 2008)
c) Saskatchewan Motor Vehicle Act
d) CAN/CSA-S6-06, *Canadian Highway Bridge Design Code* including latest supplements

e) AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition* with interim revisions
f) Transport Canada - *Canadian Railway-Roadway Grade Crossings Standards* (CRRGCS)
g) Project Co Proposal Extracts

200.5.8.8 Signing and Guide Signing

a) Ministry Saskatchewan Traffic Control Devices Manual
   i. Ministry *Roadside Management Manual - Part 2* (RSMM2) will be used for signs the Ministry installs on behalf of others or permits to be installed by others within the right-of-way
b) Transportation Association of Canada (TAC) *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC)
c) Alberta Transportation *Highway Guide and Information Sign Manual* (Oct 2006), and any applicable Design Bulletins, shall be used for Guide Signing
d) TRB *Highway Capacity Manual 2010*
e) Project Co Proposal Extracts

200.5.8.9 Pavement Marking

a) Ministry *Design Manual Part 2* (DM2)
b) Saskatchewan *Maintenance Policies and Standards Manual* (MPSM)
c) Transportation Association of Canada (TAC) *Manual of Uniform Traffic Control Devices for Canada* (MUTCDC)
d) The Ministry's *Specifications for Manufactured Materials*
e) Project Co Proposal Extracts

200.5.8.10 Traffic Barriers

a) Saskatchewan Supplement (SKS) to TAC *Geometric Design Guide for Canadian Roads*.
b) AASHTO *Roadside Design Guide, 4th Edition*
c) Project Co Proposal Extracts

200.5.8.11 Control of Access

a) Ministry *Roadside Management Manual - Part 1* (RSSM1) shall be used to:
   i. establish Control of Access plan or regime
b) Project Co Proposal Extracts

200.5.8.12 Landscaping, Topsoiling, and Seeding

a) Saskatchewan Supplement (SKS) to TAC *Geometric Design Guide for Canadian Roads*
b) Project Co Proposal Extracts

200.5.8.13 Structures Design Criteria

a) Reference Concept for laning
b) Structures Design Criteria as detailed in Section 200.7
c) Ministry Bridge Design Criteria, BD-100 (Oct 2013)
d) CSA W59-13, *Welded Steel Construction (Metal Arc Welding)*
e) AASHTO/AWS D1.5M/D1.5-2010, *Bridge Welding Code*
f) CAN/CSA-S6-06, *Canadian Highway Bridge Design Code* including latest supplements.
g) Ministry *Standard Design Build Specifications*
h) AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition* with interim revisions
i) AASHTO LRFD *Bridge Design Specifications, 7th Edition* with interim revisions
j) AASHTO LRFD *Bridge Construction Specifications, 3rd Edition* with interim revisions
k) Ministry *Design Manuals* Part 1 (DM1) and Part 2 (DM2)
l) Ministry *Drafting Standards Manual*
m) Ministry *Traffic Control Devices Manual for Work Zones*
n) Ministry *Standard Test Procedures Manual*
o) Alberta Transportation *Bridge Structures Design Criteria,* Appendix A - Integral Abutment Design Guidelines (May 2012)
p) Alberta Transportation *Design Guidelines for Bridge Size Culverts* (Jan 2014)
q) Alberta Transportation *Roadside Design Guide* (Aug 2013)
r) Alberta Transportation *Bridge Best Practice Guidelines*
s) Alberta Transportation Design Bulletin #45/2007, "*Use of Retaining Wall Structures for Bridges and Roadways in Active Watercourse Environments*"
t) Alberta Transportation *Bridge Aesthetics Study* (Apr 2005)
u) US Federal Highway Administration (FHWA) Geotechnical Engineering Circular No. 11, "*Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Slopes, Volumes I and II*" (FHWA-NHI-10-024 and FHWA-NHI-10-025)
v) Project Co Proposal Extracts

200.5.8.14 Bridge Hydraulic Design

a) Ministry *Bridge Design Criteria*, BD-100 (Oct 2013)
b) CAN/CSA-S6-06, *Canadian Highway Bridge Design Code* including latest supplements

c) Fisheries and Oceans (DFO) *Canada Land Development Guidelines for the Protection of Aquatic Habitat* (Sep 1993)
d) Ministry *Environmental Best Practices: Sediment and Erosion Control* (Feb 2012)
e) Proposal Co Proposal Extracts

200.5.8.15 Airport Compatibility

The standards for airport compatibility requirements include but are not limited to:

a) Transport Canada; TP312 *Aerodrome Standards and Recommended Practices; 4th edition,* March 1993
b) Transport Canada; Draft TP312 *Aerodrome Standards and Recommended Practices; 5th edition*, December 2012 (draft currently out for review)
c) International Civil Aviation Organization; Annex 14, Volume 1 - Aerodrome Design and Operations
d) International Civil Aviation Organization; European Building Guidance Material on Managing Building Restricted Areas; ICAO Eur Doc 015, September 2009
e) Transport Canada; *Instrument Procedure and Minima Authorized Versus Aerodrome Status*; TP 308 / GPH 209, Advisory Circular 3/02
f) Government of Canada; *Regina Airport Zoning Regulations*; C.R.C., C. 105

The Transport Canada guidelines for land use adjacent to aerodromes is:

a) Transport Canada; *Land Use in the Vicinity of Aerodromes*; TP1247E, 9th edition, 2013/14

200.5.9 Local Authority / Project Co Responsibilities for Conveyed Infrastructure

Project Co shall be responsible for the design and construction of the Conveyed Infrastructure.

Similarly, Project Co shall be responsible for the design and construction of, as well as the coordination with the Local Authority of, closures and removal of all roads and related Infrastructure as indicated on the drawings in Appendix A to Schedule 15-2 – Design and Construction. Where this work results in a dead end road, Project Co shall provide an appropriate cul-de-sac or turn around.

Any Conveyed Infrastructure will be subject to joint deficiency inspections involving the Ministry and Local Authority, at Phase One Substantial Completion or the Substantial Completion as the case may be.

Upon completion of all deficiencies by Project Co, to the satisfaction of the Ministry and the Local Authority, the Conveyed Infrastructure, as shown in the Appendix A drawings and

described in the following table, shall except in respect of the warranties pursuant to Section 38.3 of the Project Agreement become the responsibility of the Ministry or the Local Authority.

Project Co shall warrant the Conveyed Infrastructure to be free from any construction defect (including failure to withstand climatic conditions, maintenance and normal operating conditions) in accordance with Section 38.3 of the Project Agreement.

Conveyed Infrastructure includes:

Description	**Boundary**	**Surface**
Any cul-de-sac or turnarounds	N/A	Match existing
Highway 364 east of Highway 46	10 m back from the approach to the first inductive loop (from Cross Road limit as shown on Schedule 15-3, Appendix A – Balgonie Interchange OMR Limits)	Paved
Highway 46 north of the Highway 364	Extension of Highway 364 ROW (from Cross Road Limit shown on Schedule 15-3, Appendix A – Balgonie Interchange OMR Limits)	Paved
North Service Road off Highway 364, east of Highway 46	Extension of Service Road ROW	Gravel
South Service Road off Highway 364, east of Highway 46	Extension of Service Road ROW	Gravel
Highway 1 South Service Road east of the Municipal road extending south of Highway 46	Municipal road extension of Highway 46 ROW	Gravel
Gregory Ave. east of Highway 48	Extension of Highway 48 ROW	Paved
Gregory Ave. west of Highway 48	Extension of Highway 48 ROW	Paved
Ramm Avenue	From Gregory Street to White City Drive	Paved
Highway 48 south of Gregory Ave.	Extension of Gregory Ave. ROW	Paved
Gravel Pit Road north of Highway 1	North of Road ROW	Gravel
Gravel Pit Road south of Highway 1	South of Road ROW	Gravel
Tower Road north of Victoria Ave.	Extension of the north Service Road ROW	Paved
Victoria Ave. west of Tower Rd	Extension of Tower Rd. ROW	Paved
Service Roads in the south east quadrant of Highway 33 Interchange (north of Highway 33) west of the east Service Rd.	Extension of the East Service Road ROW	Paved
East Service Road between Highway 33 and Pearl St.	Between Highway 33 and Pearl Street	Gravel
Pearl Street Extension	From Pearl Street and turn round	Gravel
Highway 33	Highway 33 mainline excluding ramp lanes and tapers	Paved
Description	**Boundary**	**Surface**
North Service Roads west of Fleet St.	Extension of Fleet St. ROW	Gravel
Fleet St. north of Bypass Mainline	Extension of the north Service Road ROW	Gravel

Fleet St. south of the railway	The north railway ROW	Gravel
Service Roads at the Highway 6 Interchange	The full length of all of the service roads to be Conveyed Infrastructure	Gravel
Highway 6	Highway 6 mainline excluding ramp lanes and tapers	Paved
Courtney St. south of Bypass mainline	Extension of south Bypass ROW	Gravel
Courtney St. north of Bypass mainline	Extension of the widened Courtney St. ROW	Gravel
South Service Roads west of Courtney St.	Extension of Courtney St. ROW	Gravel
Service Roads at the Highway 1 West Interchange	the full length of all of the service roads to be Conveyed Infrastructure	Gravel
Highway 1 West	Highway 1 mainline excluding ramp lanes and tapers	Paved
Centre Rd west of the west Service Road	Extension of the west Service Road ROW	Gravel
West Service Roads south of Centre Rd.	Extension of Centre Rd. ROW	Gravel
Pinkie Road north of Hill Ave.	Extension of Hill Ave. ROW	Paved
Hill Ave.	Extension of Hill Avenue at tie-in to Centre Road on west through to east tie-in to Pinkie Road north and tie-in to Pinkie Road south.	Paved
Pinkie Road	Pinkie Road from the existing West Regina Bypass to Dewdney Avenue	Paved
Dewdney Ave.	Dewdney Ave. excluding ramp lanes and tapers	Paved
9th Ave. North	9th Ave. North excluding ramp lanes and tapers	Paved
Armour Road east of Bypass mainline	Extension of the widened Bypass mainline ROW	Gravel
Armour Road west of Bypass mainline	Extension of the widened Bypass mainline ROW	Gravel
Service Road at SE ¼ 30-17-20-2	Condie Road to Dewdney Ave	Gravel
Isolated Service Road at NE ¼ 28-16-20-2	From Courtney Street to approximately 800 m west of Courtney Street	Gravel
Service Road on east side of the Bypass mainline between Hwy 11 and Last Mountain Rail	Service Road connecting TWP RD 184 to property boundary	Gravel
Service Road on west side of the Bypass mainline between Hwy 11 and Last Mountain Rail	Service Road connecting TWP RD 184 to property boundary	Gravel

Nearby Local Authorities and relevant contact information are listed/shown in the following table.

Municipality	Contact	Address	Telephone	Fax	Email
Cities					
City of Regina		2410 Victoria Ave, Regina SK, S4M 0A1	(306) 777-7487	(306) 546-6023	
Towns					
Town of Balgonie		Box 310, 129 South Railway St E, Balgonie,	(306) 771-2284	(306) 771-2899	townofbalgonie@sasktel.net

Municipality	Contact	Address	Telephone	Fax	Email
		SK, S0G 0E0			
Town of Pilot Butte		Box 253, Pilot Butte Recreation Complex, 222 Diamond Place, Pilot Butte, SK, S0G 3Z0	(306) 781-4547		townofpilotbutte@sasktel.net
Town of White City		Box 220 Station Main, White City, SK, S4L 5B1	(306) 781-2355	(306) 781-2194	townofficea@whitecity.ca
Rural Municipalities					
RM of Edenwold No. 158		Box 10, 100 Queen Street, Balgonie, SK, S0G 0E0	(306) 771-2522	(306) 771-2631	rm158@sasktel.net
RM of Sherwood No. 159		1840 Cornwall Street, Regina, SK, S4P 2K2	(306) 525-5237	(306) 352-1760	info@rmofsherwood.ca
First Nations					
Ochapawace First Nation		Box 550, Whitewood, SK, S0G 5C0	(306) 696-2637		
Cowessess TLE Holdings		Box 139, Cowessess, SK, S0G 5L0	(306) 522-5558		
Sakamay First Nation		1500-1874 Scarth St, Regina, SK, S4P 4E9	(306) 780-9485		
Muskowekwan First Nation		Box 249, Lestock, SK, S0A 2G0	(306) 274-2061	(306) 274-2110	
Crown Corporations					
Global Transportation Hub Authority		350-1777 Victoria Ave, Regina, SK, S4P 4K5	(306) 798-4605	(306) 798-4600	

200.6 ROADWAYS DESIGN

200.6.1 Geometric Design Criteria

200.6.1.1 General Geometric Design Criteria

200.6.1.1.1 Geometric Design Requirements

a) The mainline shall be designed as a rural, high speed, free-flow, 4-lane divided, access controlled facility;
b) All interchange ramp exits and entrances shall be located on the right-hand side, and no left-hand exit or entrance ramps will be permitted;
c) Only 1 exit ramp per direction shall be provided at all interchanges; that is, consecutive exits for 2 different directions are to be combined into a single exit or from a C-D road;
d) Transition from rural freeway standards to arterial standards (curb and gutter), where applicable, shall occur at the arterial end of interchange ramps connecting the Crossroads;
e) Lane balance shall be provided;
f) Route continuity shall be provided throughout the corridor and from Highway 1 east to Highway 1 west via the mainline;
g) The use of combinations of inter-related minimum design criteria is not permitted;
h) Transition lanes and lane-drops shall be provided by dropping the outer lane;
i) Maintenance crossovers in the median of the mainline or between the mainline, C-D roads or ramps are not permitted; and
j) A gated median crossing shall be provided on the mainline between Emerald Park Road and Highway 48 White City Interchange.

Exception to Geometric Design Requirements

a) Transition required from 4-lane divided cross-section on the mainline to 2-lane highway at Highway 11 Interchange.
b) Geometric design of the mainline and Crossroads shall accommodate over dimension vehicles up to 6.4 m wide, 5.3 m high at bridges and 6.0 m high at overhead sign structures and traffic signals, and 42 m in length.
c) Left-hand exit may be used to exit for EB-SB 2-lane directional ramp at Highway 1 West Systems level Interchange to access EB-NB single lane directional ramp.

200.6.1.1.2 Mainline Roadway Classification

a) D130-7430 (As per Standard Plan 21010) and as modified herein.

200.6.1.1.3 Design Vehicle

a) Mainline: At-grade and RIRO intersections: WB-20

Exceptions to Design Vehicle

a) Fleet Street mainline eastbound RIRO: Single Unit (SU)

200.6.1.1.4 Design Speed

a) Mainline ..... 130 km/h
b) Crossroads ..... (See Section 200.6.1.3)
c) Alignments of Crossroads, ramps and Service Roads on approach/departure to controlled at-grade intersections RIRO's or ramp terminals, horizontal radii may be reduced to match radii shown in the Reference Concept.
d) The following sections of Service Road may have horizontal radii reduced to match the radii shown in the Reference Concept:
   i. NW2-17-19-2, north side of Highway 33, east of the Bypass;
   ii. NW2-17-19-2, south side of Highway 33, east of the Bypass;
   iii. NW35-16-19-2, east side of the Bypass, tie-in to Township Road 170; and
   iv. NW18-16-19-2, SE quadrant of Highway 6 Interchange.
e) Consecutive exit ramps are permitted at the Highway 1 West interchange for the westbound to northbound exit ramp followed by the westbound to southbound exit ramp as shown on the Reference Concept. Successive exit ramp separation must be provided to meet TAC figure 2.4.6.5.
f) C-D Roads ..... 80 km/h
g) Service Roads (rural) ..... 80 km/h
h) Service Roads (urban/developed areas) ..... 60 km/h
i) Directional ramp - freeway to freeway (main level) ..... 80 km/h
j) Elevated directional ramp - freeway to freeway, with the exception of lateral stopping sight distance ..... 80 km/h
k) Directional ramp entering Crossroad ..... match design speed of Crossroad
l) Directional ramps entering freeway (at gore) ..... 90 km/h
m) Directional ramps exiting freeway (at gore) ..... 90 km/h
n) All other ramps (at gore) ..... 80% of mainline/Crossroads design speed
o) Loop ramp off mainline ..... 50 km/h
p) Loop ramp off Crossroads and C-D Roads ..... 50 km/h

Exceptions to Design Speed

a) Realignment ramp eastbound to eastbound on Highway 1 east of Tower Road shall be designed to a gradually increasing design speed from 75 km/h to 105 km/h as shown in the Reference Concept.
b) Directional ramps mainline at Highway 1 West Interchange: NB to WB and EB to SB: Design speed shall be 120 km/h.
c) Mainline at Highway 11: Transition from 130 km/h 4-lane divided to 50 km/h 2-lane highway at Interchange.
d) Condie Road/Dewdney Avenue Service Road connection : the 250 m radius shall be designed for 60 km/h design speed to reduce the super-elevation requirements.

Posted Speed

a) The posted speed shall be 20 km/h less than the design speed for new mainline, Highway 1 and Highway 11, with the exception of directional ramps at the Highway 1 West interchange, which shall be posted at 10 km/h less than the design speed. All other posted speeds shall be 10 km/h less than the design speed.

200.6.1.1.5 Crossroads Design Criteria

Crossroad	Number of Lanes	Design Speed	Max. Grade	Lane Width	Median Width	Shoulder Width		Ditch Width Min.
						Left	Right	
		km/h	%	m	m	m	m	m
Highway 46	2	110 (1)	3	3.7	6 (2)(6)	N/A	3	8
Highway 48	4 (8)	110 (1)	3	3.7	6 (2)(6)	N/A	3	8
Emerald Park Road	2	60	4	3.7	N/A	N/A	2	3
Great Plains Road	2	60	4	3.7	N/A	N/A	2	3
Pilot Butte	5 (3)	110 (4)	4	3.7	6 (2)(6)	1	2	4
Gravel Pit Road	2	60	4	3.7	N/A	N/A	2	3
Tower Road	2	100	3	3.7	6 (2)(6)	N/A	2	8
Highway 33 N. of Chuka Creek	4	80	3	3.7	18	1	3	8
Highway 33 S. of Chuka Creek to CN Lewvan	4	100	3	3.7	18	1	3	8
Highway 33 S. of CN Lewvan	4	130	3	3.7	18	1	3	8
Fleet Street	2	90	4	3.7	N/A	N/A	1	3
Highway 6 N. of	4	110	3	3.7	12-18 (5)	1	3	8

Crossroad	Number of Lanes	Design Speed	Max. Grade	Lane Width	Median Width	Shoulder Width		Ditch Width Min.
						Left	Right	
		km/h	%	m	m	m	m	m
TWP Road 162								
Courtney Street	2	90	4	3.7	N/A	N/A	1	3
Highway 1 W (W & E of Mainline)	4	130	3	3.7	24.6	1	3	8
Hill Avenue	2	90(1)	4	3.7	6 (2)(6)	N/A	2	3
Rotary Avenue	4	100(1)	3	3.7	3(7)	N/A	3	8
Dewdney Avenue	2	80	4	3.7	6 (6)	N/A	2	3
9th Avenue	2	90(1)	4	3.7	6 (6)	N/A	2	3
Armour Road	2	90	4	3.7	N/A	N/A	1	3
Highway 11	4	130	3	3.7	24.6	1	3	8

Notes to Table 200.6.1.1.5

(1) Design speed shown is outside of interchange area. Design speed through interchange area shall be 80 km/h.
(2) 6 m median includes 5 m raised and 0.5 m offsets to lane line each side.
(3) 3 lanes NB and 2 lanes SB. Transition to 2 lanes outside of interchange area.
(4) Design speed shown is outside of interchange area. Design speed through interchange area shall be 80 km/h except at crossover intersections where the horizontal curvature is designed to 30 km/h.
(5) Match existing median width of 12 m at north limit for approximately 1 km south. Transition to 18 m median as provided in the Reference Concept.
(6) Median required for channelization at intersections.
(7) 3 m median includes 2 m raised and 0.5 m offsets to lane line each side.
(8) 2 lanes NB and 2 lanes SB. Transition to 2 lanes outside of interchange area.

200.6.1.1.6 Horizontal Radii

a) As per Standard Plans 20200 and 20210. For design speed of 130 km/h use TAC-GDG Table 2.1.2.6 (e max 0.06 m/m).

Exceptions to Horizontal Radii

a) Existing horizontal curves on Highway 1 East, between Tower Road and Balgonie are to remain as existing radii shown in the Reference Concept;

b) Minimum distance between horizontal curves on the NB-WB and SB-WB ramps at Highway 1 West interchange may be reduced to match the Reference Concept; and

c) Spiral lengths for the NB-WB and EB-SB ramps at the Highway 1 West interchange may use TAC- *Canadian Design Guide*, Table 2.1.2.6 for 120 design speed (eMax 0.06).

200.6.1.1.7 Vertical Grades

a) Mainline
   - Downgrade .....5.0% Max.
   - Upgrade.....3.0% Max.

b) Directional ramps, C-D roads, and service roads..... 4.0% Max.
c) Ramps
   - Downgrade .....6.0% Max.
   - Upgrade.....4.0% Max.

d) Crossroads
   - Max Grade..... See Table 200.6.1.1.5
   - Urban cross-sections (curb and gutter) ..... 0.6% Min.

e) Bridge Deck
   - Longitudinal grade..... 2.0% Max., 0.5% Min.

200.6.1.1.8 Vertical Curves

a) K Values: As per Standard Plans 20250 and 20255.
b) Minimum length of crest and sag vertical curves as per Standard Plans 20250 and 20255.
c) Distance between vertical Points of Intersection ("PI") as per SKS 2.1.3-D.

200.6.1.1.9 Superelevation

a) All roads and bridges (e_{max}).....0.06 m/m
b) Interchange loop ramps (e_{max}) .....0.06 m/m
c) No bridges shall be on spiral curves or superelevation transitions.

200.6.1.1.10 Ramp Terminals Along Mainline, Freeways, C-D Lanes and RIRO

a) Direct taper design as per TAC-GDG Figures 2.4.8.2 and Figure 2.4.8.7 for both exit and entrance terminals.

Exception to Ramp Terminals along mainline, freeways, C-D lanes and RIRO

a) For eastbound mainline at Fleet Street use parallel lane design adjacent to the mainline outside lane and provide proper deceleration and acceleration lengths to/from stop condition to the mainline design speed.
b) The westbound acceleration distance from Gravel Pit Road may be designed as shown in the Reference Concept.

200.6.1.1.11 Major Fork Along Mainline

a) Major fork design as per TAC-GDG Figures 2.4.8.4.

200.6.1.1.12 Weaving Distance

a) The absolute minimum weaving distance between consecutive system interchange ramps and all other ramps shall be no less than 800 m in all cases.
b) The absolute minimum weaving distance between all other ramps, including interchange ramps and RIRO ramps, shall be no less than 600 m in all cases.
c) Weaving sections are not permitted on systems ramps.
d) Weave distances shall be measured in accordance with TAC-GDG Figure 2.1.7.5

Exceptions to Weaving Distance

a) EB weave from Pilot Butte to Great Plains exit = 402 m
b) Weave between the WB-SB and SB-EB loop ramps at the Highway 1 West interchange may be designed to match the Reference Concept.

200.6.1.1.13 Lane Widths

a) Mainline ..... 3.7 m
b) C-D road
   - 1 lane ..... 4.8 m
   - 2 lanes ..... 3.7 m
c) Ramp
   - 1 lane ..... 4.8 m
   - 2 lanes ..... 3.7 m
d) Crossroads ..... (See Table 200.6.1.1.5)
e) Directional ramps
   - 1 lane ..... 4.8 m
   - 2 lanes ..... 3.7 m
f) Gravel Service Roads ..... 3.0 m

g) Paved Service Roads.....3.5 m
h) Auxiliary Lanes .....3.7 m

Exceptions to Lane Widths

a) The Condie Road/Dewdney Avenue gravel Service Road connection lane width shall be 4.0 m.

200.6.1.1.14 Shoulder Widths

a) Mainline
   - Left (Inside)[1].....1.0 m
   - Right (Outside)[1].....3.0 m

a) Crossroads.....(See Table 200.6.1.1.5)
b) Directional ramps
   - Inside (1 and 2 lane).....0.6 m
   - Outside (1 and 2 lane).....2.5 m

c) C-D road
   - Inside (1 and 2 lane).....0.6 m
   - Outside (1 and 2 lane).....2.5 m

d) Ramp
   - Inside (1 and 2 Lane) .....0.6 m
   - Outside (1 and 2 Lane).....2.5 m

e) Paved Service Roads.....1.0 m
f) Auxiliary Lanes .....3.0 m

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. On divided roadways, shoulder widths may be a minimum 0.8 m (inside) and 2.5 m (outside) at the Expiry Date (reduced widths due to rehabilitation overlays).

Note

1. Shoulders on existing Highway 1 East do not have to be grade widened, however, in the situation where additional existing road is being trimmed or removed, the remaining shoulder width should as much as is practicable meet the Technical Requirements, and in any case be no less than 0.8m wide (inside) and 2.5 m wide (outside) at the Expiry Date.

200.6.1.1.15 Median Width

a) Mainline (New) .....32.0 m
b) Crossroads..... (See Section 200.6.1.3)

Exception to Mainline Median Width

a) The median width on the mainline through the interchange area at Highway 1 West is reduced to 18 m as shown in the Reference Concept.

200.6.1.1.16 Outer Separation for C-D Roads

a) Outer separation in a multiple interchange configuration shall be as follows:
   - 17.0 m minimum single interchange, no transfer lane. (Outer separation is measured from outer edge of travel lane on the mainline to inner edge of travel lane on the C-D road).

200.6.1.1.17 Highway and Frontage Road Separations

a) SKS 2.2.5-C

200.6.1.1.18 Pedestrian Walk and Multi-Use Trails

a) Width of multi-use trail
   - On grade ..... 3.0 m

b) Width of pedestrian walk
   - On grade ..... 1.5 m
   - On bridges and along retaining structures ..... 2.7 m

   (The 2.7 m width of Pedestrian Walk allows for 0.6 m shy distance to the barrier and/or railing on each side.)

c) Height of bridge barrier and/or railing on bridge and downslope retaining structures outside of:
   - Multi-use trail and/or bikeways ..... 1.37 m
   - Pedestrian walk ..... 1.05 m

200.6.1.1.19 Bridge Approach Widths

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.

200.6.1.1.20 Slopes

All slope ratios are expressed in horizontal: vertical. All references to slope requirements mean that no earth slopes shall be steeper than those listed below and subject to slope stability analysis.

a) Pavement structure sideslopes:
   - Mainline, Highway 1, Highway 11, directional ramps 6:1
   - C-D Roads, ramps/loops, all other Crossroads 5:1
   - Service Roads 4:1

b) Subgrade sideslopes
   - Mainline, Crossroads, directional ramps: Standard Plan 21010, except as noted below:
     - Fills 0-4 m 6:1
     - Fills 4-6 m ..... Slope variable, toe fixed at 24 m
     - Fills Over 6 m .... 4:1, widen subgrade 0.9 m each side for guardrail where required

   Subgrade sideslopes for mainline, crossroads and directional ramps will be amended to state that localized side slope steepening to a minimum of 4:1 will be permitted over lengths not exceeding 120 m and not to exceed in aggregate of 600 m over the length of the New Bypass Infrastructure.

   - Undivided roads, C-D roads, ramps/loops: Standard Plan 21020, except as noted below:
     - Fills 0-4 m 5:1
     - Fills 4-5 m ..... Slope variable, toe fixed at 20 m
     - Fills Over 5 m..... 4:1, widen subgrade 0.9 m each side for guardrail where required
   - Paved Service Roads: Standard Plan 21030, except all fill height sideslopes . 4:1
   - Gravel Service Roads 3:1
   - Sideslopes at bridge locations with guardrail 4:1

c) Bridge headslopes ..... No steeper than 3:1
d) Ditch backslopes ..... 4:1 (No steeper than 3:1)
e) Ditch depth ..... 1.0 m – 1.2 m*
f) Cut section ..... 4:1 (No steeper than 3:1)

* Project Co may raise the ditch bottom up to 0.8 m depth for the following cases:
  i. Where the application of the specified criteria would result in insufficient cover over an existing underground Utility; and
  ii. To provide drainage for the eastbound entrance ramp from Tower Road to the mainline.

200.6.1.1.21 Ditches

a) As per Standard Plan 21010
   - Depth of median ditch ..... 0.5 – 1.5 m
   - Width of mainline side ditches ..... 8.0 m
   - Width of Crossroad ditches ..... See Table 200.6.1.1.5

- Width of Paved Service Road ditches.....5.0 m
- Width of Gravel Service Road Ditches.....4.0 m
- Roundings to be provided at toe of sideslope, toe of backslope, top of backslope.

Exceptions to Ditches

a) No ditching required along the City of Regina waterline right of way at 9th Avenue.

200.6.1.1.22 Vertical Clearances

a) Roadway - underside of railway or roadway superstructure to top of roadway, all bridge clearances shall be a minimum of 5.3m to achieve Substantial Completion and throughout the Operational Term and at the Expiry Date.
b) Sign structures - roadway surface to underside of sign panel.....…….6.0 m Min.
c) Roadway over railway - underside of superstructure to top of rail .....7.01 m Min.
d) Roadway to high voltage power lines:
   - 0 -750 V.....6.35 m Min.
   - 750 – 25,000 V.....6.68 m Min.
   - 72,000 V .....7.13 m Min.
   - 138,000 V .....8.10 m Min.
   - 230,000 V .....8.60 m Min.

200.6.1.1.23 Horizontal Clearances

a) Clear zone and barriers ..... SKS 3.1.1.A and TAC-GDG Table 3.1.3.1
b) Edge of shoulder to toe of bridge headslope.....3.0 m min.
c) Edge of travel lane to 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 SKS Section 3.1.1A and TAC-GDG Section 3.1.3.4. Use of guardrail at bridge substructure elements and retaining walls is permitted.
d) Edge of travel lane to face of bridge barrier or guardrail shall not exceed 3.5 m.
e) Back of guardrail to solid object distance to meet manufacturer's recommendation for design deflection at each design speed.
f) Clear zone calculations for Parclo entrance ramps adjacent to bridges shall be based on the directional ramp standard of 80 km/h.
g) 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.
h) 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.
i) For loop ramps with a curve radius of less than 90 m, the curve modification factor shall be 1.5.

200.6.1.1.24 Stopping Sight Distance ("SSD")

a) As per SKS 1.2.5-A
b) Horizontal – In the case of curves at bridge and/or guardrail locations, meet or exceed the SKS for lateral clearance on horizontal curves for SSD with shoulder width not to exceed 3.5 m.

200.6.1.1.25 Departure Sight Distance

a) As per SKS 2.4.1-B Table SKS 2.4.1-B.3

200.6.1.1.26 Decision Sight Distance

a) Decision sight distance shall be provided at all systems level interchanges on all legs, and at all other interchange exits from the mainline, using TAC-GDG Table 1.2.5.7.
b) Decision sight distance on the mainline to at-grade intersections and RIRO intersections shall be 370 m.
c) Object height shall be 0.0 m for all cases. Height of driver's eye shall be 1.05 m in all cases.

Exception to Decision Sight Distance

a) The decision sight distance for the mainline northbound exit to Rotary Avenue is waived. SSD shall be required as a minimum.

200.6.1.1.27 Horizontal and Vertical Alignments – Mainline

a) The mainline horizontal and vertical alignment is to be designed to avoid any perceived roller coaster or kinked curve appearance, and shall ensure that the alignment compliments the existing topography.

200.6.1.1.28 Horizontal and Vertical Alignments – Crossroads

a) Vertical alignment – K values as per SKS Standard Plans 20250 and 20255.
b) Horizontal alignment at intersection shall follow TAC-GDG section 2.3.
c) Transition between 2-lane/4-lane roadways at intersections as per TAC-GDG. Curves shall be introduced at all through-lane deflections in the vicinity of ramp intersections along Crossroads (deflections exceeding 0° 30 min.). Curves shall be long enough to avoid the appearance of a kink and that they do not require superelevation.

200.6.1.1.29 Medians

a) Except in locations where exceptions to median width have been identified, Project Co shall design the roadway to ensure median barriers are not required on the mainline. Medians on urban Crossroads shall be the raised type.

200.6.1.1.30 Intersections

a) Intersection design shall use SKS desirable standards as an absolute minimum. At intersections where dual left-turn movements are required, the Heavy Single Unit (HSU) design vehicle shall be accommodated on the outside lane and the WB-20 design vehicle shall be accommodated on the inside lane.

200.6.1.1.31 Subgrade Crossfall

a) Subgrade crossfall to be designed as per MHI Standard plan 21010.

Exception to subgrade crossfall

a) Exit and entrance ramps may be reduced to 2% in non-superelevated areas. With this exception, the crossfall on the road surface shall match the subgrade crossfall, including across the shoulders.

200.6.1.2 Interchanges and Intersections

Interchanges shall be designed to the configurations established in the Reference Concept or to equivalent alternative configurations meeting the Technical Requirements. Project Co's design shall achieve the equivalent or better level of service as achieved in the Reference Concept. The traffic volumes stated in Appendix G shall be used for the purpose of traffic analysis using traffic simulation as outlined in Appendix G.

The following interchange types will not be permitted:

- Single Point Diamond Interchange (SPI)
- Elevated "Rotary" Interchange
- Diverging Diamond Interchange (DDI), except at the Pilot Butte Interchange
- Multi-lane roundabouts

The design of at-grade intersections shall be in accordance with the design requirements and design traffic volumes outlined in Appendix G. Specific instructions associated with at-grade intersection assessments and design changes are provided in Appendix G.

A roundabout is not permitted at the Highway 46/Highway 364 intersection.

200.6.1.3 Crossroads

Crossroads shall include all roads that connect to the mainline either at at-grade intersections, RIRO intersections, or at interchanges, as indicated in the Reference Concept. At transition locations for roadway connections at the Project Limits, these roadways shall meet the current standards of the Local Authority, and/or match existing conditions as appropriate.

Gravel Crossroads or Service Roads that intersect with the mainline or other Provincial Highway, shall be paved to either: the near edge of a parallel gravel Service Road; or the further of intersection limits, or right-of-way limits. All other Crossroads shall be paved throughout.

Project Co shall consult with and coordinate its work with each relevant Local Authority, as appropriate, regarding timing and tie-ins of the crossroads at the Project Limits. Crossroads shall have design cross-section and surfacing structure to the interchange or intersection limits as appropriate, and then transition to match the crossroad cross-section and surfacing structure that are in place.

All existing roadway lighting on Crossroads to be reconstructed shall be replaced with new as part of the Works. Project Co shall verify that design and construction of the Works will not compromise the integrity of the operation of the existing roadway lighting and traffic signals infrastructure outside the Project Limits. Project Co shall ensure that areas within the Project Limits, including detours that operate with roadway lighting, will continue to have equivalent lighting during the Works. Worksite floodlights are not considered equivalent.

Para-curb ramps shall be constructed at all pedestrian crossings. These ramps shall be in accordance with City of Regina guidelines.

Approach nose treatments for islands and medians shall be in accordance with City of Regina guidelines.

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

200.6.1.4 Service Roads

Project Co shall design and construct the service roads as detailed in the Reference Concept. Service Roads to be reconstructed prior to Substantial Completion are identified in the Reference Concept. Service Roads are generally described as those roads that do not connect directly to the

mainline. Project Co is responsible for the design and construction of all surfacing, permanent signage, pavement markings, lighting and signalization of the Service Roads.

200.6.1.5 Bridge Sections

The Reference Concept identifies deck cross-section, shoulder and sidewalk configurations, and key plan for all Works bridge structures.

Multi use trails and pedestrian walks requirements shall be in accordance with the relevant Local Authority specifications unless otherwise shown in the Reference Concept. This only applies to Highway 48 (White City) and the Wascana Creek crossings. Multi use trails and pedestrian walks off bridge structures shall extend to the Project Limits and shall transition to the dimensions and material of multi-use trails and pedestrian walks at the Project Limits. Generally, the alignment of multi-use trails and pedestrian walks off structures shall be parallel to and offset from the centreline of the crossroad in accordance with City of Regina guidelines. Wascana Creek Trails are only to be designed and pre-graded by Project Co, to allow for future surfacing and other items by others.

All bridge structures shall be constructed to enable widening of the structure to accommodate the Future Works laning configuration on the bridge structure. Bridges constructed to span roadways shall be constructed to span the Future Works laning configuration of the underpassing roadway at those locations.

200.6.1.6 Retaining Structures

Project Co is responsible for all retaining structures necessary for grading of all New Bypass Infrastructure within the Project Limits, including those associated with Project Co's bridge design. Embankment retaining structures to contain fills beyond warranted guardrail barriers will be allowed. The minimum distance between the back side of the guardrail barrier and the edge of the retaining structure shall be 4.0 m.

Roadside safety and public safety protection shall be provided for all retaining wall structures. Barrier placement and construction shall be in accordance with safe roadside design practices as established in the SKS, Roadside Design Guide, and Section 200.7 (Structures). Where a special situation is not covered by SKS or the *Roadside Design Guide*, provisions in the TAC *Geometric Design Guide* shall be used.

200.6.1.7 Hazard Protection

Project Co is responsible for the design and construction of all required hazard protection for the roadway and bridge structure elements within the Project Limits.

The use of barriers shall be limited to those areas where it is necessary to protect the travelling public from roadside hazards. All designs shall be such as to minimize the need for barriers.

Project Co shall utilize the appropriate barrier configuration for providing protection for roadside hazards based on safety considerations. In any special circumstance where protection is required, Project Co shall protect the public from the hazard using barriers and end treatments in accordance with Section 200 of this Schedule 15-2 – Design and Construction.

200.6.1.8 Over-Dimension and Over-Weight Loads

Project Co shall design all New Bypass Infrastructure to accommodate over-dimension and over-weight loads in accordance with the dimensions given in the Technical Requirements. Project Co shall prepare a plan for submission with the Pre-final Design Development Submittals and the Final Design Development Submittals showing the actual load dimensions that the Bypass can accommodate

200.6.1.9 Traffic Accommodation and Local Detours

Extensive detours which divert provincial highway traffic to other provincial highways and/or municipal roads will not be allowed. Traffic accommodation and detours shall be designed and work zones protected in accordance with the Ministry's *Traffic Control Devices Manual for Work Zones*. Where roadway detours are required they shall maintain safe passage of traffic, and shall provide for the minimum number of specified lanes open in each direction at all times. All such detours shall 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 the existing roadway.

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 Table 200.6.1.9.

Table 200.6.1.9

Roadway(s)	**Min. # Lanes (Each Direction)**	**Min. Shoulder Width (m)**	**Minimum Design Speed**	**** Minimum Posted Speed**
Highway 1 East, Highway 11, and Existing Highway 1 West	1***	1.5	70	60
Highway 33	1	2.0	70	60
Rotary Ave., Dewdney Ave., and Highway 6	1	2.0	70	60
Highway 48, 46, and Pilot Butte Access Road, Hill	1	1.0	60	50

Roadway(s)	Min. # Lanes (Each Direction)	Min. Shoulder Width (m)	Minimum Design Speed	** Minimum Posted Speed
Avenue, Fleet Street, Courtney St., Hill Ave., 9 Ave. North, and Armour Road				
Service Roads	1*	0.5	60	50

* During daylight hours, Project Co may reduce to 1 lane total for both directions with flag person(s) or traffic light control with a maximum 2 minute delay for stopped traffic.

** The maximum posted speed shall be 60 km/h when work is occurring on the road surface where vehicles normally travel or park and highway workers or flag persons are present, highway equipment occupied by a highway worker are present, and/or highway equipment on a highway has its warning lights in operation. Project Co's attention is drawn to Section 203 of the Traffic Safety Act and the Highway Worker Identification Regulation.

*** Two lanes are required during peak times as follows:

- Peak times along the Bypass at Highway 1 East (between Tower Road and the Project Limits to the east of Balgonie Interchange): Monday through Friday from 6 AM to 9 AM for the WB lanes and Monday through Friday from 4 PM to 6 PM for the EB lanes.
- Peak times along the Bypass between Rotary Avenue and 9th Avenue North: Monday through Friday from 6 AM to 9 AM and 4 PM to 6 PM in both directions.

Any cross-overs shall be constructed in accordance with the *Traffic Control Devices Manual for Work Zones for Saskatchewan* and the *Saskatchewan Traffic Control Devices Manual*. (http://www.highways.gov.sk.ca/business). Cross-overs in place for more than one day shall be designed with a design speed of 80 km/h and only be permitted between May 1 and October 31.

Notwithstanding the minimum lane requirements in the preceding table, Project Co shall maintain existing traffic movements throughout construction 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 Ministry will permit short term detours to reroute traffic at crossroads or interchanges to accommodate short term construction operations such as girder erection, subject to Schedule 9 - Review Procedure. Prior to the implementation of short term detours Project Co shall submit to the Ministry for review under Schedule 9 - Review Procedure, a detailed detour plan and an updated Traffic Management Plan pursuant to Schedule 15-1 - General, 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. Short term detours will not be permitted between 6:00 a.m. and 8:00 p.m. where traffic delays are projected to exceed 2 minutes per vehicle. A single lane detour may be used for short term, local detours whenever the traffic can be safely accommodated on a single lane. Project Co shall ensure that multiple site short term detours are not used for adjacent routes serving the same communities. Project Co shall notify the relevant Local Authority and emergency service

providers, with a copy of all such notices provided concurrently to the Ministry, a minimum of seven calendar days prior to the planned implementation of all proposed short term detours.

200.6.2 Utilities

200.6.2.1 Project Co Responsibilities

Standards of practice for the installation of utility infrastructure crossing and/or within the Ministry's ROW, either for the realignment of existing utility infrastructure or for the installation of new Utility Infrastructure, shall follow the standards included within the Ministry's Saskatchewan Supplement to the Transportation Association of Canada's *Geometric Design Guide for Canadian Roads*, SKS 2.1.3 – F, Vertical Alignment, Utility Placement, dated August 7, 2009 or, subject to Section 18 of the Project Agreement any subsequent revisions thereto. Project Co shall be responsible for compliance with the applicable Utility Company standards.

If required, Project Co will solely be responsible for obtaining crossing agreements for haul roads, traffic detours or other temporary works required to complete the Works.

200.6.2.2 Not Used

200.6.2.3 General Provisions for Utility Work

Project Co shall comply with the general provisions for Utility Work as follows:

- in coordination with the Utility Companies, Project Co shall establish the locations within the Lands to allow relocation of all Utility Infrastructure located within the Lands at Commercial Close that cannot be removed from, abandoned within, or relocated outside the Lands;
- Utility Infrastructure shall be relocated such as to provide access, acceptable to the Utility Company, for maintenance and repairs. Sufficient width shall be provided to accommodate all required Utilities and provide the necessary clearances as determined by the Utility Companies;
- all Utility Infrastructure relocations shall be located so as to stay within the limits established by any applicable Permits, Licenses, and Approvals;
- if relocation of Utility Infrastructure is required for the Works, the Utility Infrastructure shall be relocated such that it protects for future widening as shown in the Reference Concept;
- All watermains that are located within the Lands shall be protected from freezing in a manner to be approved by the Utility Company that owns the watermain;
- Utility Infrastructure relocations on the Crossroads shall conform to the standard Utility cross-sections for the appropriate Local Authority;
- All Utility Infrastructure located along a road or road allowance existing at Commercial

Close that will be closed shall be removed or relocated so that access, acceptable to the Utility Company, for maintenance and repairs is maintained;

- All Utility Work agreed upon or undertaken by the Ministry and/or the Utility Companies in between the issuance of the Request for Proposals and Commercial Close shall not be reconstructed or relocated unless otherwise approved by the Ministry;
- Project Co shall provide, at all times, continuity of Utility service to properties adjoining the Lands. Where Utility Work affects service to adjacent property owners, Project Co shall coordinate and/or perform such Utility Work so as to minimize interference to those affected.
- Duct bank access manholes may be maintained within the roadway sideslope provided that the exposed height of manhole does not exceed 100 mm in the uphill direction. Protection barriers will be required if relocation or adjustment of the manhole is not technically feasible.

200.6.2.4 SaskPower and SaskTel Global Memoranda of Understanding

The Ministry has entered into agreements for utilization of Ministry ROW (hereinafter called "**Global Memoranda of Understanding**") with the Saskatchewan Power Corporation ("**SaskPower**") and Saskatchewan Telecommunications ("**SaskTel**"). Project Co shall be bound by the terms and conditions included within the Global Memoranda of Understanding and shall follow the process and be subject to the cost sharing provisions included herein and shall otherwise comply with the provisions of the Project Agreement.

Copies of the Global Memoranda of Understanding with SaskPower and SaskTel are included in Appendix I.

200.6.2.5 CJME-AM Radio Transmitter

Adjacent to the proposed Highway 6 interchange is an existing AM radio transmission site (CJME-AM), owned by Rawlco Radio Inc. Project Co shall design and/or adequately protect all above ground metallic structures located within the vicinity of the CJME AM transmitter to prevent interference with the broadcast signal, in compliance with Industry Canada requirements. Project Co shall coordinate the design of any above ground metallic structures and/or interference protection systems with CJME-AM/Rawlco Radio Inc. through the following representative:

Tom Newton
General Manager
Rawlco Radio Regina
#210 – 2401 Saskatchewan Drive
Regina, SK S4P 4H8
Phone: (306) 525-0000

Email: tnewton@rawlco.com

200.6.3 Railways

200.6.3.1 General

200.6.3.1.1 Scope of Work

Project Co shall design and construct grade-separated and design and upgrade at-grade railway crossings at locations shown in the Reference Concept.

Railway Company Responsibility:

- Provide detailed design of a crossing warning system based on crossing plans provided by Project Co;
- Construct the grade crossing surface as defined in the *Grade Crossing Regulations*;
- Design and construct the warning system defined in the *Grade Crossing Regulations*;
- Construct railway crossing signs, number of tracks signs, an emergency notification sign, and a stop sign installed on the same post as a railway crossing sign; and
- Design, construct or relocate any existing railway traffic signalling, communication or wayside equipment.

Project Co Responsibility:

- Design and construct grade separated crossings;
- Design and construct certain aspects of at-grade crossings:
  - Design and construct the road approach for at grade crossings as defined in the *Grade Crossing Regulations;*
  - Design and construct interconnected traffic control equipment which may include traffic signals or "Prepare to Stop at Railway Crossing" signs; and
  - Design and construct all other aspects of the crossing, not provided by the railway, to provide an in-service road crossing;
  - Design of the grade crossing surface as defined in the *Grade Crossing Regulations;*
- Pay all costs related to the design and construction of at-grade or grade separated crossings, including costs related to obtaining all certificates, Permits, Licenses and Approvals and authorizations required; and
- If costs related to railway crossings are invoiced directly to the Ministry as stated in the railway agreement(s), Permits, Licences and Approvals, the Ministry may pay such costs and Project Co, upon demand, shall reimburse the Ministry for any amount paid.

200.6.3.1.2 Not Used

200.6.3.1.3 Not Used

200.6.3.2 Design

200.6.3.2.1 Background Information

The railways have provided the following current information regarding existing operating conditions (to be confirmed by Project Co):

Railway & Subdivision	Approximate Rail Traffic Density (Trains Per Day)	Track Operating Speed (mph)
LMR Craik Sub.	1	25 mph
CN Central Butte Sub.	2	25 mph
CP Spectra Energy Spur	1	10 mph
CN Lewvan Sub.	2	25 mph
CP Tyvan Sub.	4	30 mph

200.6.3.2.2 Crossing Surfaces

Crossing surfaces shall be selected to provide a high level of ride quality, shall be skid resistant, and resistant to degradation from salt or chemicals. Minimum surfacing requirements at the at-grade railway crossings shall comply with the options outlined in the following table and selection is subject to the Railway Company's approval:

Roadway	Railway	Surface Type
Fleet Street	CN Lewvan Sub.	• Full depth timber • Sectional treated timber • Full depth bituminous (asphalt) with rubber flangeways
Highway 1, North Service Road	CP Tyvan Sub.	• Full depth timber • Sectional treated timber • Full depth bituminous (asphalt) with rubber flangeways
Highway 1, South Service Road	CP Tyvan Sub.	• Full depth timber • Sectional treated timber • Full depth bituminous (asphalt) with rubber flangeways

Mud rail shall not be used to create flangeways on any crossing.

200.6.3.2.3 LMR Design Standards

LMR is required to submit all design and construction drawings, and agreements to CN for review.

200.6.3.2.4 Pier Protection

Pier protection is required if a bridge element or other obstruction is within 7.620 m from the centreline of the railway track, or as otherwise required by the Railway Company.

200.6.3.2.5 Design By Railways

The railways will provide the detailed design of any warning system (as defined in the *Grade Crossing Regulations*), not including design of interconnection to a traffic control device (as defined in the *Grade Crossing Regulations*)

200.6.3.2.6 Utilities

During construction, Project Co shall be responsible for and coordinate all signal locates within the railway right of way.

200.6.3.2.7 Drainage

As part of the design, there shall be no net increase in the drainage along the railway right of way. Project Co shall ensure that no increase of snow drifting, communications impedance or splashing shall occur on railway right-of-way.

200.6.3.2.8 Design Drawings

At-grade crossing drawings shall contain, at a minimum, the following information for review by the Railway Company:

- A plan view of the crossing, drawn to a scale of not less than 1:2000, showing all pertinent information including:
  - The location of all tracks and the right-of-way of the Railway Company for at least 400 m in each direction from the crossing;
  - The location of the travelled portion of the highway and of the Road Right-Of-Way for at least 100 m in each direction from the crossing;

- The width of the railway right-of-way;
- The width of the Road Right-Of-Way;
- The width of the travelled portion of the highway;
- The width of the highway shoulders;
- The angle of the crossing;
- The location of all railway crossing signs and warning devices pertaining to the crossing;
- Sight lines and all obstructions to view within the location of all tracks and highways illustrated on the drawing; and
- Drainage and Utilities relating to the crossing and other information relevant to the construction of the crossing.

- A profile of the railway, drawn to a scale of not less than 1:5000 horizontally and of not less than 1:250 vertically, for at least 400 m in each direction from the crossing, showing:
  - The elevation of the top of the lowest rail, and
  - The elevation of the original ground at the centre line of the track.
- A profile of the highway, drawn to a scale of not less than 1:2000 horizontally and of not less than 1:200 vertically, for at least 100 m in each direction from the crossing, showing:
  - The elevation of the highway surface and details of gradients, and
  - The elevation of the original ground at the centre line of the highway.
- A typical cross-section of the Road Right-Of-Way in the vicinity of the crossing, drawn to a scale of not less than 1:200, showing the travelled portion of the highway, the shoulders, drainage, utilities and other information relevant to the construction of the crossing.
- The following additional information:
  - Identification of the responsible road authority;
  - Identification of the design vehicle;
  - Roadway classification;
  - The current average annual daily traffic (AADT) and the 5-year forecast;
  - Highway/road name and number;
  - Railway mile point and sub-division;
  - Roadway design speed & posted speed;
  - Railway operating speed;
  - Road surface type;
  - Crossing surface type;
  - Design vehicle used in design of the grade crossing;
  - Stopping sight distance;
  - Average road approach gradient;
  - Departure time referred to in the Grade Crossing Standards;
  - Advance activation time referred to in the Grade Crossing Standards;

- Pre-emption time referred to in the Grade Crossing Standards; and
- Whether a sidewalk, path or trail is present, and whether the sidewalk, path or trail has been designated for persons using assistive devices.

200.6.3.2.9 Detailed Safety Assessment

Detailed safety assessment of at-grade railway crossings shall be included as part of the roadway safety audits. The safety assessments shall follow the "Canadian Road/Railway Grade Crossing Detailed Safety Assessment Field Guide" and updated to reflect the Grade Crossing Standards (2014).

200.6.3.2.10 Design Acceptance

Designs related to railway crossings shall be subject to acceptance by the Railway Company.

200.6.3.2.11 Existing CN Rowatt Property South East Of Highway 6 Interchange

Project Co is to remove and dispose of the portion of the existing stub ended pull back track located within the Road Right of Way. The existing wheel stops are to be relocated and re-installed at least 15ft. from the new end of track location. The remaining track, immediately adjacent to the removal, is to be left in a condition that is operable, and in accordance with CN industrial track standards, but not improved from its current condition. Upon completion of the track removal, Project Co is to leave the surrounding area in a neat and tidy condition free of large mounds or depressions that may impede or collect surficial drainage. As the wheel stops will be relocated on active CN yard track, Project Co is to coordinate any flagging protection or work permit requirements with CN.

200.6.4 Earthworks

Project Co shall refer to DM1 Standard Plans 22010 to 22030. These Standard Plans shall be considered minimum requirements for earthworks construction. The mainline shall be considered "System 1" for interpreting these Standard Plans.

All non-hard surfaced areas within the Road Right of Way and other disturbed areas within the Project Limits shall be topsoiled and seeded to grass in accordance with Section 300.3.2 of Schedule 15-2 - Design and Construction.

Topsoil shall consist of a natural, friable surface soil of organic character, suitable for agricultural purposes.

All borrow material shall be clean suitable materials with no contaminants, or hazardous materials.

Deep borrow pit setback distances shall be in accordance with the Ministry Roadside Management Manual as supplemented by SKS.

Prior to Substantial Completion Project Co shall remove in their entirety the Additional Resources identified in the following locations:

Stockpile Locations	**Appendix A Drawing Reference (Schedule 15-2 - Design and Construction)**
Stockpile #1	15-A-2-16 & 15-A-2-17
Stockpile #2	15-A-2-16 & 15-A-2-17
Stockpile #3	15-A-2-17
Stockpile #4	15-A-2-17
Stockpile #5	15-A-2-17
Stockpile #6	15-A-2-14

Particular care shall be taken in removing the Additional Resources so as to cause a minimum of damage and inconvenience to the landowner. On completion of the removal works the ground profile shall be free draining matching the surrounding ground profile and unless otherwise agreed in writing shall be topsoiled and seeded with a grass mix compliant with Section 300.3.2 of Schedule 15-2 – Design and Construction.

Project Co may also obtain for sole incorporation into the Works, earth materials royalty free from the Additional Resources borrow pits identified in Appendix C to Schedule 15-2 – Technical Requirements – Design. Unless otherwise noted Project Co shall have exclusive use of the borrow pits identified in Appendix C to Schedule 15-2 – Technical Requirements – Design from Financial Close to Substantial Completion.

Should they choose to use the Additional Resources listed in Schedule 15-2 Appendix C, Project Co is responsible for the reclamation and management of these resources in accordance with the Ministry policy as outlined therein.

Where Project Co proposes to obtain material from a borrow area that is not Ministry owned, Project Co shall provide to the Ministry prior to commencing operations proof of landowner consent and its right to enter.

Additional Resources identified in this Section may be incorporated into the Works with the consent of the Design Team.

200.6.5 Drainage

200.6.5.1 General

The drainage system for the Bypass shall be designed to protect public safety and, to the extent practicable, prevent economic and environmental damage caused by flooding or drainage issues that could be attributable to or exacerbated by the Bypass. The drainage system shall be designed to minimize the disturbance to the natural hydrology within and surrounding the Project Limits.

Project Co shall be responsible for obtaining all necessary permits, licenses and approvals from, but not limited to, Saskatchewan Ministry of Environment, Water Security Agency, Department of Fisheries and Oceans, City of Regina, and other authorities and requirements as applicable.

The drainage infrastructure for the Project is to be constructed according to the design references, recognized engineering practices, and analysis methods presented in this Section 200.6.5 of Schedule 15-2 – Design and Construction.

200.6.5.2 Culverts and Ditches

The following additional specifications are required in the design of culvert and ditch drainage infrastructure:

- All culverts within the Project Limits shall be considered to be part of the National Highway System.
- Where multiple culverts are required the culverts should be the same diameter.
- The distance between culverts along the Bypass mainline and its Service Roads shall not exceed 800 m, to equalize potentially ponded water on both sides of roadways.
- All stranded catchment areas along the Bypass ROW, including interchange loops, shall have a minimum of 1 culvert extending to an external ditch.
- All culverts shall be designed for a minimum 75-year service life.
- An existing culvert with a diameter less than the minimum specified in Section 606-00 of the Ministry's Hydraulic Manual can be retained if it meets the design specifications established in this section for a culvert belonging to the road classification "All other Provincial Roads", as defined in Table 502-1 in the Ministry's Hydraulic Manual. Any retained culverts within the project area shall be maintained by Project Co in accordance with the OM&R Requirements and is subject to the Handback Requirements. Improvements including extensions and/or lining are considered major upgrades and shall be designed in accordance with the current Ministry Hydraulic Manual.
- At inlets to culverts that cross through the mainline, the hydraulic grade line shall remain a minimum of 300 mm below the top of the sub-grade.
- Ditches shall be graded to provide continuous positive gravity drainage to an

appropriate Point Of Discharge. In areas that naturally drain towards trapped low areas, the longitudinal ditch profile may be less than 0.05% grade. Ditches may terminate below the normal water surface elevation in trapped low areas..

- Ditch blocks and ditch blocks with hydraulic controls allowing the gradual release of water are permitted. Permanently ponded water in ditches is not permitted.
- Hydraulic calculations shall be performed on ditch segments to confirm that flow velocities in the ditches do not exceed a maximum velocity of 1.0 m/s, to prevent erosion of the cross-sections, unless adequate erosion protection is provided. If required, ditch cross-sections may be widened from the standard ditch section so that this criterion is achieved.
- The sections of Wascana Creek, Chuka Creek, and Boggy Creek crossed by the mainline ROW are fish bearing.
- In Townships 16-19-W2 and 16-20-W2 there are engineered drainage works that are designed to alleviate flooding in the region as part of the Rowatt Water Management Project. Any crossing of the mainline or Service Roads over any section of these works shall require consultation with the Saskatchewan Water Security Agency to obtain the proper conditions for sizing drainage structures. In no circumstances shall the new drainage structures have less hydraulic capacity than the existing hydraulic structures located immediately downstream.
- Permanent drainage systems and facilities shall be designed for gravity flow.

200.6.5.3 Bridges

Changes in channel flow velocity, flow direction, and water level that result from the installation of a bridge or a bridge-size culvert shall cause no negative hydraulic impacts upstream or downstream of the bridge crossing. Bridge structure openings on watercourses shall be sized and protected so that over the Design Life of the structure they do not:

- Cause any flooding on neighbouring flood sensitive lands and developments.
- Cause any flooding of the highway road surface.
- Cause a negative impact on local channel stability.
- Cause erosion affecting the stability of the bridge structure or roadway fills.

200.6.5.4 Additional Design and Operational Considerations

The following are required in the design and operation of the drainage infrastructure:

- Manholes shall not be located within the paved area of the roadway, except for catch basin/manholes in the urban section of Crossroads.
- Project Co shall not provide or sell drainage capacity to any third party.

200.6.6 Surfacing Structure

All roads shall be paved, except roads designated for gravel surfacing. Notwithstanding the provisions of this section 200.6.6 the only permitted paved options are:

- For the New Bypass Infrastructure and Conveyed Infrastructure roadways - asphalt concrete pavement ("**ACP**"); or
- For the New Bypass Infrastructure other than the Conveyed Infrastructure roadways - Portland cement concrete pavement ("**PCC**").

No cementitious materials stabilization will be allowed in subgrade soils. Lime may be added to subgrade for drying purposes only. Subgrade shall not incorporate chemical additives. Lime shall be added to ACP mixes placed on Conveyed Infrastructure roadways at 1% by weight of dry aggregate. Open graded ACP mixes will not be allowed on Conveyed Infrastructure roadways. SuperPave is not permitted for use on the Conveyed Infrastructure roadways. The use of recycled asphalt pavement (RAP) is permitted.

Project Co shall design the surfacing structures in accordance with standard design procedures and terminology used by the Ministry as described in the Ministry's Surfacing Manual, on the basis of actual soil parameters determined from sampling and testing the roadway subgrade. Other than Conveyed Infrastructure roadways surfacing structure designs may utilize industry accepted design methods other than the Ministry's Surfacing Manual; however, if alternate design methods are used the pavement design report must provide detailed design information, information on applicable standards, quality control requirements and performance monitoring plans.

The pavement structures for all roadways within the New Bypass Infrastructure shall be designed to primary weights. Project Co's design shall identify assumed traffic splits if designing different structure thicknesses in adjacent lanes. All pavements contained within the Conveyed Infrastructure shall have a 15 year design life, calculated in accordance with the methods in the Ministry's Surfacing Manual, except pavements adjacent to curb and gutter or raised medians (see below). All main line pavements (including all ramps and acceleration and deceleration land pavements) shall have a minimum initial ACP thickness of 80 mm at Substantial Completion. If a concrete pavement is utilized, the structure must be equivalent or better.

All gravel surfaced roadways shall have a minimum 100 mm compacted gravel surfacing placed prior to Substantial Completion. This surfacing shall be placed in 2 lifts with sufficient time between lifts to allow traffic and maintenance grading to work the first lift of gravel into the top layer of subgrade, prior to placing the final lift.

All travelled lanes and shoulder widths shall be paved except for Service Roads where shoulders may be gravelled. The inside 1.0 m of paved shoulders adjacent to the travelled lanes shall have the same pavement structure as the travelled lanes. Shoulder and lane material thicknesses do not have to be the same for the remainder of the shoulder width; however the potential for future widening shall 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 Bypass Infrastructure shall be introduced beyond the tie-in point to preserve subgrade drainage and structural integrity of existing roads. At tie-ins to existing pavement, the existing pavement shall be milled to allow staggering of each lift of new pavement, resulting in a smooth butt joint on each lift of pavement. Pavement longitudinal joints for top lift (including rehabilitation overlays) shall be along paint lines. Underlying lifts, and subsequent pavement rehabilitation overlays, shall have longitudinal joints staggered 100mm.

Pavements to be placed adjacent to curb and gutter or raised medians shall be designed and constructed 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 pavement structure design shall account for future widening to accommodate the Future Works. 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.

Concrete pavements may be constructed, except for pavements contained within Conveyed Infrastructure. If Project Co proposes concrete pavements, details of the design method, applicable standards and specifications, quality control requirements and performance monitoring plans must be provided.

All travelled lanes and shoulders that are paved with PCC shall follow the AASHTO 93 guidelines with a minimum 30 year design.

Jointed Plain Concrete Pavement (JPCP) is acceptable. All concrete shall be made with HS or HSb cement (sulfate resistant) and in accordance with CAN/CSA A23.1-4.

Drainage systems for rigid pavements must consider both infiltration of surface water and ground water. The base must be permeable to provide adequate drainage and be of sufficient thickness to provide a buffer for the shrinking and swelling associated with the subgrade soils in the Regina region.

Project Co shall provide details of crack control and join sealing measures for rigid pavements in accordance with industry accepted design standards. All joints must be dowelled with tie bars between adjacent lanes.

200.6.7 Roadway Lighting

Project Co is responsible for design and installation of all required roadway lighting for the Project. For Roadway lighting on sections of the Conveyed Infrastructure Project Co shall engage and pay SaskPower to do all design and installation of roadway illumination. Remaining sections of the Project are to be designed, constructed, and maintained by Project Co until the Expiry Date. Project Co shall coordinate with SaskPower to provide power feeds and transformers.

Project Co shall engage and pay SaskPower to design and construct the power feeds to provide separate circuits to the street lights that are on Conveyed Lands and those that are not in order to clearly demarcate areas of responsibility between the Local Authority and/or the Ministry as applicable and Project Co.

All existing roadway lighting at the proposed interchanges in the Works construction shall be replaced or relocated as part of the New Bypass Infrastructure. Project Co shall be responsible for disposal of remaining components. Project Co shall contact SaskPower to determine whether they wish to salvage materials owned by them.

As a minimum, Project Co shall provide roadway illumination at all at-grade railway crossings and *continuous interchange* lighting as described in DM2 at all interchanges and *partial or area* lighting as described in DM2 at all intersections including without limitation and in their entirety, all right-in, right-out intersections, all entry and exit ramps and all acceleration and deceleration lanes. Project Co will be required to provide *intersection delineation lighting* as described in the *DM2* at all Service Road intersections.

All designed systems shall be in accordance with the Canadian Electrical Code and the regulations of the electrical inspection department having jurisdiction. Screw-in bases are not permitted.

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. Alternatives to galvanized steel will be considered based upon the application for their usage. Where 2 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).

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

The roadway lighting system shall seamlessly tie into other adjacent Provincial or Local Authority systems. Transitions shall be gradual, in both color and intensity and shall be complementary to the existing roadway lighting infrastructure.

- Median lighting poles will not be allowed.
- For lighting design purposes, the mainline shall be considered an urban freeway.
- All lighting calculations shall be performed using the initial rated lumens of the selected lamp and the total light loss factor. Lamp lumen values for high intensity discharge lamps may be found in the appropriate lamp manufacturer's catalogue.
- The cast-in-place concrete base has historically been a more stable base in withstanding pole leaning over time. 3.1 m and 6.1 m cast-in-place pole bases are recommended to be used. The top of the cast-in-place base shall be no more than 100 mm but no less than 50 mm higher in elevation than the compacted grade after landscaping surrounding the base. On a slope, this refers to the highest grade in the uphill direction. The top section of concrete tubing surrounding the base should be removed to below grade (out of sight). The viewable top portion of the base should be well finished aesthetically and with a 2% slope to allow drainage of water away from the anchor bolts.
- All luminaires shall be IP66 or higher rated. All luminaires shall be full cut off with zero uplight.
- When designing and constructing Roadway lighting that will be on the Conveyed Lands, all roadway lighting and all pedestrian area lighting shall be supplied from high pressure sodium lamps in compliance with SaskPower standards. The color temperature of the lamp shall be 2100K, and the wattages shall be 250, 400 and 600W. High pressure sodium lamps may also be used at other locations.
- LED lighting will be allowed on sections to be operated and maintained by Project Co after Substantial Completion Date. Wattages may vary from 180W to 416W, but shall be readily available in the Canadian market to allow efficient maintenance at the Expiry Date. The color temperature of the roadway lighting shall be 4100K if LED lighting is employed.
- All luminaires used for roadway lighting are to be rated for 347V.
- All luminaires used for roadway lighting are to be controlled by a photoelectric sensor or equivalent automatic controller.
- All luminaires used for roadway lighting shall be connected by underground wiring or wiring in conduits buried within structures.
- The design of high mast light poles shall include a complete design of the foundation, pole and luminaire raising mechanism and shall be signed off by a Structural Engineer with input from a Geotechnical Engineer, and be subject of review and signing off by the Coordinating Professional Engineer.
- A pole and luminaire identification system shall be used to assist in the management and maintenance of the roadway lighting assets. The lighting designer shall determine the pole identification number for each lighting pole in the design. This identification shall appear next to the pole on the lighting design drawings. Each pole shall have a code on a metal plate that is to be field installed. The code shall be based upon the legal land description system of the area in which the asset is located.

200.6.8 Traffic Signals

Project Co is responsible for design and installation of all traffic signals as listed in Appendix G.

Project Co shall engage SaskPower to design and construct the power feeds to provide separate circuits for the traffic signals that are on Conveyed Lands, and those that are not, in order to clearly demarcate areas of responsibility between the Local Authority and/or the Ministry as applicable and Project Co.

Power for the signals may come from a common source with the roadway lighting. Only 120/240 V electrical services shall be used for traffic signals. Service panels for roadway lighting systems where located adjacent to intersections where signalization is not presently warranted shall have the capacity to have a traffic signal system added to the panel loading without requiring the upgrading of the service from the Utility company.

The traffic signal design shall be as per the design traffic volumes identified in Packages A through F of Appendix G, and Packages G to J of Appendix G which define requirements for design, installation, timing plan preparation, signal acceptance, and operation and maintenance requirements.

The traffic signals shall be designed and constructed prior to the Substantial Completion Date at the DDI at Pilot Butte Access Road. The traffic signals shall be designed and constructed prior to the Phase One Substantial Completion Date at the Highway 46/Highway 364 intersection. Project Co shall identify as part of Project Co's Design Data any planned staging of other signal installations (the "**Planned Future Signal Installations**") based on traffic volumes at other locations on the New Bypass Infrastructure. Traffic signals will not be permitted on the mainline.

Project Co shall supply and install, prior to Phase One Substantial Completion the necessary conduits in accordance with the City of Regina traffic signal design and specification at the following locations:

a) the southerly Service Road intersection at the Highway 33 interchange;
b) the south east terminal at Highway 33 interchange;
c) the north west terminal at Highway 33 interchange;
d) Tower Road/Victoria Avenue (Highway 1 East) intersection.

Approved traffic signal control equipment is as described in the recognized product lists of the BC Ministry of Transportation (http://www.th.gov.bc.ca/publications/eng_publications/geotech/rpl.htm) or Alberta Transportation (http://www.transportation.alberta.ca/689.htm), with the exception of the following:

- The Precast Concrete Electric Service Box (CB6 2.7.M3) from the Alberta Transportation list is not allowed; and

- Traffic Controllers and Video Detection equipment shall only be Econolite Cobalt and Encore Equipment.

200.6.9 Signing

Project Co is responsible for the design, supply, and installation of all signs for the Project. Sign classifications are as defined in the Ministry's Roadside Management Manual – Part 2, which include:

1. Guide Signs
2. Regulatory Signs
3. Permitted Signs
4. Warning Signs

All signing and sign structures for the Bypass shall be designed, installed and maintained by Project Co. The guide signing for the Project, including all mainline, interchanges and Crossroad components, is identified in the Reference Concept. The guide sign structures shall be designed to accommodate the loadings imposed by the addition of the Future Works guide sign panels at a future time. The guide sign structures shall be designed to span and handle future sign requirements for the Future Works roadway in accordance with the Reference Concept.

All guide signs for the Project shall include drawings of mainline signs at a level of detail and to the standards that are compatible with the Reference Concept. Exit number tabs shall not be installed at this time, but guide signs shall be designed and constructed to allow for installation in the future.

The details regarding the location and messaging of all overhead, cantilever and ground-mounted guide signs are shown in the Reference Concept. Project Co shall design and install all overhead and cantilever signs and ground mounted guide signs required for the Bypass, including without limitation, those signs set out in the Reference Concept. Project Co acknowledges that certain overhead, cantilever, and ground-mounted signs shown in the Reference Concept are located outside the Project Limits. For the signs outside the Project Limits, Project Co shall obtain all the necessary permits, licenses and approvals from the relevant Local Authority in order to design and install the signs outside the Project Limits.

Project Co shall remove and dispose of all existing signs that contain messaging inconsistent with the new signing design submitted in accordance with Schedule 9 - Review Procedure. In this regard, Project Co shall provide advance notification to, and liaise/coordinate with, the Local Authority accordingly. In all cases, the timing of such sign removals shall be coordinated with Project Co's schedule for Substantial Completion.

The Clearview Highway font shall be used on all guide signs. Interchange sequence signs shall be designed in accordance with Alberta Transportation Design Bulletin #58.

Overhead directional signs shall have reflective sheeting as specified in Section 300.3.1.6.1 of Schedule 15-2 Design and Construction.

Project Co shall submit shop drawings using the "**GuidSIGN**" software package or compatible with GuidSIGN, for the message content and layout on the major guide signs to the Ministry, prior to manufacturing.

Project Co signs, indicating who is maintaining the Bypass Infrastructure during the Operational Term with associated contact information, shall be placed on the mainline downstream of major access points as follows:

- Southbound mainline south of Highway 11 interchange (1 sign);
- Northbound and southbound mainline, north and south, respectively, of Highway 1 West interchange (2 signs);
- Eastbound and westbound mainline, east and west, respectively, of Highway 6 interchange (2 signs);
- Eastbound and southbound mainline, east and south, respectively, of Highway 1 East interchange near Tower Road (2 signs); and
- Westbound Highway 1 East, west of Highway 46 interchange at Balgonie (1 sign).

200.6.10 Pavement Marking

Project Co is responsible for design and construction of all required pavement markings for the Bypass.

200.6.11 Fencing

New fencing is not required for this Project except as noted herein**,**

All deep borrow pits shall be fenced by Project Co as per Ministry Standard Plan 26520 – Standard Woven Wire Fence Type A of the Ministry Construction Manual Volume 1 – 400 Grading – CM483-04. Deep borrow pits are any borrow pits excavated below natural grade line, with side slopes steeper than natural slopes in the immediate vicinity.

Median fencing shall be provided between Pilot Butte Interchange and White City Interchange as indicated on the Reference Concept. Median fencing shall be designed and provided in accordance with the Ministry's Standard Plan 26550.

200.6.12 Intelligent Transportation Systems (ITS)

Project Co shall design and install, as a minimum, the following ITS facilities as part of the Works (Appendix F provides details of current Ministry requirements and specifications):

- Traffic data counter (TDC) stations;
- CCTV cameras;
- Variable Message Signs (VMS);
- Road-Weather Information System (RWIS) station;
- Commercial Vehicle Enforcement (CVE) pre-screening sites including weigh in motion scales, CCTV cameras and Licence Plate Readers, detailed in Appendix F;
- Provision of Data Management Centre (Data Hub) as detailed in Appendix F located at 1 Research Drive, in the Government Research Centre, Regina;

- Provision of Data Management Centre (Traffic Operations Hub) including the control room and the operator work stations, supervisor station, and video wall-display which will be located at 1855 Victoria Ave in Regina as detailed in Appendix F; and
- Wireless network to transmit the data between the devices and the data management centre. The wireless network shall transmit data to a local receiver which will be fed into a Sasktel fiber optic network and to the Data Management Centre.

Traffic signals controllers at the Pilot Butte Interchange and Highway 46/Highway 364 intersection shall transmit data to the Data Management Centre.

The City of Regina shall connect the traffic signal controllers at Tower Road/Victoria Avenue (Highway 1 East) intersection into their systems to enable them to manage the intersection.

The ITS devices will support Project Co and the Ministry in monitoring the real time traffic conditions on the corridor, as part of incident management and traveller information services. In addition, the data will be archived in a web-accessible administrative portal for review of performance and to support future development of systems. The portal shall be accessible by Ministry staff and Project Co. The Ministry shall administer the portal with its database and provide system support and maintenance. The CVE related data will not be made available to Project Co.

Each device shall have a wireless modem that will transmit the data between the device and the Ministry's Data Management Centre. The data shall be transmitted over the wireless network, through Sasktel's fiber network and their data centre to the Data Management Centre which will be implemented as part of the Works.

Project Co shall use the following documents as a guide for the design and deployment of the ITS infrastructure:

- Regina Bypass ITS Design Criteria (Attachment 1 of Appendix F)

Project Co shall submit to the Ministry, in accordance with Schedule 9 - Review Procedure, a detailed technology assessment of current state-of-the-art for each ITS device type in the Project. Project Co shall also submit detailed specifications for the device technologies in accordance with Schedule 9 - Review Procedure.

As part of the design of the ITS infrastructure, Project Co shall submit a comprehensive test plan for each device type during detailed design. The test plan shall include all performance criteria for system acceptance testing (SAT) and field acceptance testing (FAT) environments. For each field device, the hardware test plan for SAT and FAT shall specify, as a minimum, the data set to be tested, duration, and parameters being measured including but not limited to accuracy, latency, speed, bandwidth requirements, and signal strength. Details of the hardware testing requirements are provided in Appendix F. The framework and process of developing this test plan shall be part

of Project Co's submission. Project Co shall submit test plans for review in accordance with Schedule 9 - Review Procedure.

For customized application software, Project Co shall provide a formal test plan including performance evaluation criteria. Project Co shall undertake system performance testing and user acceptance testing of the customized software. For commercial off-the-shelf ("**COTS**") software, Project Co shall include any and all software licenses for all software packages, as well as any licences for devices, wireless network and the Data Management Centre, including central operating system, as part of Project Co's submission. All software licenses are to be assigned to the Ministry or its designate. Details of the software testing requirements are in Appendix F.

200.6.13 Environmental

Project Co shall refer to the following environmental assessment (EA) and related reports for the purposes of carrying out its environmental obligations under the Project Agreement:

- West Bypass (Stage 2), Environmental Assessment Screening, Final Report - AECOM, July 2011.
- West Bypass (Interim Road and Stages 2-3), Vegetation Baseline Report - AECOM, March 2010.
- West Bypass (Interim Road and Stages 2-3), Wildlife Baseline Report - AECOM, March 2010.
- West Bypass (Interim Road and Stages 2-3), Fish and Fish Habitat Baseline Report - AECOM, March 2010.
- Technical Project Proposal, West Bypass Project – Stages 3 and 4 - MMM Group Limited, February 2013.
- Technical Proposal, Bypass Project - AMEC Environment & Infrastructure, March 2014.
- All of the obligations set out in the Saskatchewan Ministry of Environment, Environmental Assessment Branch, letter dated June 11, 2014 (EAB File # 2014-10, Transaction # 10001995).
- Discussion Paper – Condie Aquifer Risk Assessment Review – Summit Environmental, July 4, 2014, including Discussion Paper 01 – Addendum to the Condie Aquifer Risk Assessment Review Updated Water Quality Sampling, Oct 3, 2014.
- Final Report: Phase I Environmental Site Assessment at Western Limited SW 29-17-20 W2M, ext. 16, near Regina, Saskatchewan, September 2014, Golder Associates.
- Regina Bypass 2014 Fall Rare Plant Survey, November 2014, Summit Environmental Consultants.
- Phase I Environmental Site Assessment Overview – Proposed Regina Bypass Route, October 2014, Summit Environmental Consultants.

For purposes of clarity references to the Ministry or MHI shall be deemed to be references to Project Co.

200.6.14 Noise Attenuation

Project Co is responsible for all road traffic noise attenuation for the New Bypass Infrastructure.

Project Co shall ensure that the maximum noise level of 65 dBA Leq_{24} (A-weighted 24 hour equivalent sound level) measured 2 m inside the affected residential property line is adhered to. If the threshold is exceeded, Project Co 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 400.3 (Road Traffic Noise Mitigation (New Bypass 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 the Regina Bypass location was approved) adjacent to the New Bypass Infrastructure, the new residential subdivision development proponent will be responsible for noise attenuation in respect to that new residential subdivision.

Project Co's responsibility for noise mitigation applies up to and including mainline AADT volumes of 75,000 vehicles per day as measured at the Traffic Data Counter Station located at the location identified in Section 2.1.11.4 of Appendix F to Schedule 15-2.

200.6.15 Legal and Other Surveys

The Ministry will conduct legal surveys, and prepare and register legal plans in accordance with design drawings referenced herein. Any additional legal surveys required due to Project Co's designs will be Project Co responsibility. Any additional surveys, plan preparation, and registration and costs, due to Project Co initiated changes, will be the responsibility of Project Co.

200.6.16 High Tensioned Cable Barrier

Project Co shall design and install High Tension Cable (HTC) Barriers at locations shown in the Reference Concept.

200.7 STRUCTURES DESIGN

200.7.1 Design Codes

Project Co shall complete all bridge structure design in accordance with *CAN/CSA-S6* (*Canadian Highway Bridge Design Code*) (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 Ministry. Exceptions to the Bridge Design Code requirements are noted in this Section 200.7 of Schedule 15-2 - Design and Construction.

Live load distribution factors used for girder design shall not be less than the empirical factors specified in the Bridge Design Code unless specifically agreed to in writing by the Ministry. If a bridge does not satisfy the criteria that allow the empirical factors to be used, the live load distribution factors used for girder design shall not be less than the empirical factors that would have been used if the bridge had met these criteria. The distribution factors used shall be shown on the drawings.

Notwithstanding section 1.4.2.5 of the Bridge Design Code, the use of single load path structures will not be permitted. Exceptions to this are piers with 2 columns or less and straddle bents providing the requirements of Section 200.7.9 of Schedule 15-2 - Design and Construction are met. Slab and girder bridge structures with spans less than or equal to 50 m shall have a minimum of 4 girder lines. Slab and girder bridge structures with minimum span lengths greater than 50 m shall have a minimum of three girder lines.

The following products and systems are not allowed for use:

- Stay-in-place deck soffit formwork other than precast concrete panels in accordance with Sections 300.4.13 and 200.7.20 of Schedule 15-2 – Design and Construction
- Steel grid decking
- Induced current cathodic protection system
- Modular deck joints
- Bearings with internal provision for uplift
- Bridge deck heating systems
- Bridge deck automated de-icing systems
- Timber piles or components
- Proprietary composite steel/concrete girders
- Continuous precast deck panels
- Full depth precast deck panels
- MSE abutment and associated wing walls with polymeric reinforcement
- MSE walls shall not be used for retaining walls at stream crossings
- Walls with wire facings
- MSE walls with dry cast concrete block facings
- Epoxy coated reinforcement
- Dynamically cast-in place piles (Compacto piles)
- Slip formed bridge barrier and curbs
- “Half Joint” structures
- Gravity wall structure composed of prefabricated modular block units, keyed/interlocking precast concrete modular block units, with our without MSE reinforcement as retaining structures at bridge locations

- Gravity wall structure composed of prefabricated modular block units keyed/interlocking precast concrete modular block units for general retaining wall applications are limited to a maximum height above grade of 1.5m

For any proprietary systems/structures, Project Co shall submit to the Ministry a letter which states that the proprietary system/structure supplier has monitored the installation of the proprietary system/structure and which certifies that the in-situ system/structure is in accordance with the proprietary system/structure requirements. The letter shall be on the letterhead of the proprietary system/structure supplier and shall be sealed by the Professional Engineer who sealed the proprietary system/structure design drawings.

200.7.2 Design Load

200.7.2.1 Highway Bridges

The minimum highway bridge live load shall be the Bridge Design Code CL-750 plus dynamic load allowance as defined in the Bridge Design Code. Truck axle and wheel loads shall be proportioned from the CL-W truck. No adjustments are required for the 9 kN/m uniformly distributed load for lane load.

The strength of new designs and modified existing structures shall be evaluated at the ultimate limit state in accordance with the Bridge Design Code Clause 14 and shall be capable of carrying the vehicle configurations shown in the Appendix of the Ministry Bridge Design Criteria as follows:

- Normal non permit configurations shown in Figure BE-1 "*Typical Non Permit Vehicle Configurations for Primary Highways*" evaluated using the live load factors for normal traffic (NP) category provided in Table BE-1 "Summary of Rating Factors to be used for Saskatchewan Highways and Infrastructure".
- Multiple bulk haul permit configurations shown in Figure BE-3A "Multiple Trip Permit Configurations for Evaluation of New Designs" evaluated using the live load factors for bulk haul traffic (PB) category provided in Table BE-1 "Summary of Rating Factors to be used for Saskatchewan Highways and Infrastructure".

The strength of deficient elements as determined in the evaluation of either traffic category (live load capacity factor, $F < 1.00$) shall be redesigned in accordance with the Bridge Design Code to eliminate the deficiency.

Single trip overweight limits shall be determined using a sophisticated method as defined by the Bridge Design Code and provided to the Ministry for the vehicle configurations shown in the Bridge Design Criteria Figure BE-2 "Typical Single Trip Vehicle Configuration" and evaluated under the PS traffic category factors as per the Bridge Design Code, Clause 14. For multi-lane loading when a permit vehicle is traveling with normal traffic, the loading to be applied to other

lanes shall be as per the Bridge Design Code, Table 14.4.

Multiple bulk haul permit limits shall be determined using a sophisticated method as defined by the Bridge Design Code and provided to the Ministry for vehicles with axle spacings and inter-axle spacings as shown in Figure BE-1 and in addition for a 9 axle NP truck that has that has dimensions similar to the 8 Axle NP truck with the exception the rear tandem is replaced with a tridem axle, Limits shall be determined using the live load factors for bulk haul traffic (PB) category provided in Table BE-1 "Summary of Rating Factors to be used for Saskatchewan Highways and Infrastructure".

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".

200.7.2.2 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.

200.7.2.3 Vehicle Collision Force on Bridge Piers

Bridge structural supports located ≤ 10 m from the edge of the Future Works 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.

200.7.2.4 Straddle Bents

Straddle bents are substructures defined as a pair of vertical supports connected with a horizontal girder that spans a roadway or other structure. Straddle bents shall include both conventional and integral straddle bent girders, and all associated bearings, columns, footings and piles.

Straddle bent girders shall be designed to have zero tension in top and bottom flanges over their design life under SLS Combination 1 loading.

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:

1. A static force of 1250 kN applied anywhere in a plane parallel to the underpassing roadway; and

2. A static force of 625 kN applied anywhere in a plane normal to the underpassing roadway.

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.

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.

All elements of straddle bents shall be designed with adequate post-collision capacity to carry CL-750 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:

- Straddle bents pushed off their bearings
- Punching failure through girder webs at point of impact
- Bending failure in webs just below top flange due to transverse load applied to bottom flange
- Loss of prestressing strands in area of impact
- Local loss of web or flange section near the point of impact

200.7.3 Hydrotechnical

Structures over watercourses, except bridge size culverts (3.0 m diameter or larger), shall be designed in accordance with the hydraulic requirements in the Ministry Bridge Design Criteria and the following specifications:

- Flow velocities within the bridge cross-section shall not exceed a maximum velocity of 1.2 m/s to prevent scouring, unless adequate erosion protection is provided.
- The high water level within the bridge cross-section for a100-year mean daily return period shall provide a vertical clearance of at least 1 m below the bridge girder soffit.
- The hydraulic capacity shall be increased to the 1:500 year mean daily return period if developments exist that may be impacted.
- Bridge abutments shall be located no closer to the watercourse than as defined by the intersection of a line projecting at 3H:1V from the toe of natural channel and the 10-year return period hydraulic grade line as shown in Case 1 in the sketches provided in Appendix J. Under no circumstances shall fill be placed between the tops of bank with the exception of Case 2 in the sketches provided in Appendix J. Pathways beneath bridge structures shall be designed so that the top of the pathway is at or above the minimum 1:10 year flood level.

- Design shall include buoyancy forces corresponding to a 200-year flood event.

Piers shall not be located within the central 9 m of a channel. Piers and pile groups shall be aligned parallel to channel flow.

200.7.4 Geotechnical

The following specifications are required in the geotechnical investigation and design of bridge infrastructure:

- Bridge structure foundations shall be designed in accordance with the Bridge Design Code and the Canadian Foundation Engineering Manual, 4th Edition.
- Geotechnical boreholes shall extend a minimum of 3 m below the estimated pile tip elevations.

200.7.5 Geometrics

Where practical, bridges shall be located on tangent horizontal alignments.

For deck drainage purposes, a minimum longitudinal grade of 0.5% shall be provided on bridge decks that are not on vertical curves. Wherever possible, the tops of crest curves shall be located beyond the length of the superstructure and approach slabs.

Bridge deck widths shall as a minimum have the same width as the clear roadway on the bridge approaches, and shall be widened where required to meet shy distances, minimum sight lines or drainage requirements. 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 preferably be not less than 3 m. For gaps up to 3 m between adjacent structures, positive fall prevention provision shall be provided.

Corner transitions between headslope and sideslope shall use a smooth curve at the toe of the slope.

Bridge structure supports including piers, retaining walls and sign structure columns shall not be located within 6 m of the underpassing roadway traffic lane outside edge at the Future Works and abutment wall and abutment retaining walls shall not be located within 9 m of the underpassing roadway traffic lane outside edge at the Future Works. All required Future Works sight distances shall be met.

The vertical clearance design for all grade separation bridge structures shall be a minimum of

5.3 m for both the Works and the Future Works geometry.

The Ministry'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 (e.g. 5.31 m);
- Round down to the nearest decimetre (e.g. 5.3 m); then
- Subtract 1 decimetre for tolerance (e.g. Post vertical clearance as 5.2 m)

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.

200.7.6 Durability

200.7.6.1 Design Life

Minimum Design Life of structures shall be:

- Bridges and bridge-size culverts ..... 75 years
- MSE walls ..... 100 years
- Retaining walls other than MSE wall ..... 75 years
- Overhead sign structures ..... 50 years
- Time dependant calculations (corrosion, fatigue and creep)..... 100 years

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.

200.7.6.2 Bridge Deck Protection

The deck protection system shall consist of:

- Type DC concrete; and
- The Ministry standard deck waterproofing system.

The Ministry standard deck protection and wearing surface system has a total thickness of 90 mm consisting of nominal 5 mm thick rubberized asphalt waterproofing membrane, plus 3 mm protective board, plus 2 40 mm lifts of asphaltic concrete pavement. The rubberized asphalt

waterproofing membrane shall be used on all bridge decks. 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. The asphalt mix design shall meet the following requirements:

- Type 150-200A asphalt cement shall be used as bituminous binder.
- Marshall stability shall not be less than 10000 N for all bridges.
- Stripping potential shall not exceed 5%.
- Reclaimed asphalt concrete mix will not be allowed in the production of the asphalt concrete.
- Vibratory compaction is not allowed. First pass by static roller, subsequent rolling by rubber tired roller.

200.7.6.3 Protection from Bridge Deck Drainage

Bridge deck drainage shall not be allowed to discharge onto any exposed substructure 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 buried elements that may potentially be exposed to leakage of salt contaminated moisture shall be protected by an approved impervious waterproofing membrane.

200.7.6.4 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.

200.7.6.5 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 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.

200.7.6.6 Concrete Slope Protection

All concrete slope protection shall be done in accordance with Alberta Transportation Standard Drawing S-1409-99 (Concrete Slope Protection).

200.7.6.7 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 300.4.2.17 of Schedule 15-2 Design and Construction, and Drawing SK-1.

200.7.6.8 Concrete Classification Types

Types of concrete shall be as detailed in Section 300.4.2.5 (Type and Composition of Concrete). The following gives minimum concrete types that shall be used in the specified locations on bridges.

Type DC Concrete

- Cast-in-place decks, curbs, barriers, sidewalks, and medians
- Abutment, pier and intermediate diaphragms
- Deck joint blockouts
- Tops of abutment backwalls and wingwalls (300 mm minimum below road top surface)
- The entire 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
- All concrete within a depth of 300 mm of Splash Zone Surfaces

Type C Concrete

- Pile caps
- 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)
- MSE wall levelling pads
- Cast-in place retaining walls

Type C1 Concrete

- Concrete slope protection
- Concrete drain troughs

Type P1

- Pipe pile infill concrete

Type P2

- Drilled caissons

Type G

- Precast bridge girder concrete shall conform to Section 300.4.4 of Schedule 15-2 - Design and Construction.

Type G1

- Keyways between box stringers

Concrete for underground components that are exposed to chemicals shall also meet the requirements of CSA Standard A23.1.

200.7.6.9 Clear Concrete Cover

The following minimum clear covers for reinforcing steel shall be specified in the Design Data, unless noted otherwise in Ministry 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 cast against earth ..... 100 mm
- Concrete cast against earth (headslope protection) ..... 70 mm
- Cast in place concrete exposed to earth ..... 70 mm
- Cast in place piling ..... 75 mm
- Approach slab concrete on clean granular fill and polyethylene sheeting ..... 40 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 ..... 70 mm

- Traffic and top face of curbs, traffic barriers (parapets), and end posts ..... 70 mm
- Parapet back surface ..... 50 mm
- Top surface of cast-in-place decks protected with waterproofing membrane and ACP wearing surface ..... 60 mm
- Underside of deck slab cantilever ..... 50 mm
- Underside of deck slab interior panels ..... 40 mm
- Cast in place abutment walls ..... 60 mm
- Abutment T-beams ..... 60 mm
- Cast in place substructure in Splash Zone ..... 70 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
- Precast NU, I girder, all faces for reinforcing steel ..... 30 mm
- Precast NU, I girder, all faces for pretension strand ..... 45 mm
- Precast box girder, top surface ..... 65 mm
- Precast box girder, soffit ..... 30 mm
- Precast box girder, exterior surface ..... 35 mm
- Precast box girder, interior surface ..... 35 mm
- MSE precast concrete panel front face ..... 55 mm
- MSE precast concrete panel back face ..... 40 mm
- Other ..... 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

200.7.6.10 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 of Schedule 15-2 - Design and Construction. Epoxy coated reinforcing steel is not permitted in any element. Unless otherwise specified, the requirement is for all reinforcement in the member:

Stainless Steel Reinforcing Steel or Low Carbon/Chromium Reinforcing Steel

- MSE wall panels
- MSE wall copings
- Concrete within 300 mm of Splash Zone Surfaces, unless otherwise specified
- All reinforcing in a pier cap where any portion of the component is a Splash Zone Surface

Stainless Steel Reinforcing Steel

- Curbs and barriers above the deck/wingwall construction joint, including dowels projecting through the construction joint
- Exposed sidewalks and medians
- Concrete for abutment backwalls, abutment diaphragms and wingwalls within 300 mm of road surface top
- Deck joint blockouts
- Corbels and dowels connecting approach slabs to abutment corbel

Carbon Steel Reinforcing Steel or Stainless Steel Reinforcing Steel or Low Carbon/Chromium Reinforcing Steel

Reinforcing mats for cast-in-place decks and approach slabs shall be composed of only one type of reinforcing steel.

- Full depth cast-in-place decks and partial depth cast-in-place decks over precast panels protected with waterproofing system
- Reinforcing bars projecting from partial depth precast concrete deck panels
- Approach slabs and sleeper slabs that are Type DC concrete protected with waterproofing system

Carbon Steel Reinforcing Steel

- All locations not otherwise specified
- Precast girders

200.7.7 Materials

200.7.7.1 Concrete

Materials for concrete shall be as detailed in Section 300.4.2 of Schedule 15-2 - Design and Construction.

200.7.7.2 Reinforcing Steel

Minimum size of reinforcing bars in all cast-in-place bridge elements shall be 15M.

Welding of structural reinforcing steel shall be prohibited for cast-in-place and precast elements.

Carbon steel reinforcing steel shall conform to CSA Standard G30.18.

Deformed welded wire mesh shall conform to ASTM Specification A1064/A1064M, minimum yield 480 MPa.

Stainless steel reinforcing steel shall conform to the requirements of ASTM Specification A276 and ASTM Specification A955/A955M – UNS designations S24100, S31653, S31603, S31803, S30400, or S32304. After rolling, the bars shall be pickled to remove mill scale and surface oxidation. The minimum yield strength shall be 420 MPa. The design of the stainless steel reinforcing steel, including hooks, development lengths and bar splices shall be based on a yield strength of 400 MPa.

Low carbon/chromium reinforcing steel shall conform to ASTM Specification A1035/A1035M with minimum yield strength of 690 MPa. The design of the low carbon/chromium reinforcing steel, including hooks, development lengths and bar splices shall be based on a yield strength of 400 MPa.

200.7.7.3 Prestressing Steel

Prestressing strand shall conform to the requirements of ASTM Specification A416/A416M for low relaxation strand (f_{pu} = 1860 MPa).

Prestressing rods shall conform to the requirements of ASTM Specification A722/A722M (f_{pu} = 1030 MPa).

200.7.7.4 Structural Steel

Girders and all plate materials welded to steel girders shall conform to the requirements of CSA Standard G40.21, Grade 350AT steel, Category 3.

Non-galvanized bearing and bracing materials bolted to girders shall conform to CSA Standard G40.21, Grade 350A steel.

Galvanized bearing materials not welded to girders shall conform to CSA Standard G40.21, Grade 300W steel, galvanized after fabrication in accordance with ASTM Specification A123/A123M.

Stud shear connectors shall be 22 mm diameter and shall conform to ASTM Specification A108, Grades 1015, 1018 or 1020.

HSS sections shall conform to CSA Standard G40.21, Grade 350WT steel, Category 3, Class H with silicon content less than 0.03%, galvanized after fabrication in accordance with ASTM Specification A123/A123M. Factors contributing to galvanization-induced cracking shall be minimized.

Miscellaneous steel including deck joints shall conform to CSA Standard G40.21, Grade 300W steel, galvanized after fabrication in accordance with ASTM Specification A123/A123M.

Structural bolts, nuts and washers shall conform to ASTM Specifications A325/A325M, A563/A563M, and F436/F436M, respectively. Bolts, nuts, and washers for use with corrosion-resistant steel shall be Type 3. Bolts, nuts, and washers for connecting galvanized components shall be Type 1 and shall be galvanized.

Pipe piles shall conform to ASTM Specification A252 Grade 2 steel, or better.

H-piles shall conform to CSA Standard G40.21.

The chemical composition of base metal and welding consumable that is to be galvanized shall be as follows:

- Carbon less than 0.25%
- Phosphorous less than 0.05%
- Manganese less than 1.35%
- Silicon less than 0.03% or between 0.15% and 0.25%.

200.7.7.5 Anchor Rods

Anchor rods for bearings in contact with black steel shall be stainless steel conforming to AISI Standard Type 316 with minimum yield (0.2%) = 290MPa.

Anchor rods for bearings in contact with galvanized steel shall be carbon steel anchor bolts conforming to CSA Standard G40.21, Grade 300W or ASTM Specification A307, galvanized in accordance with ASTM Specification A123/A123M.

Anchor rods for bridgerail post anchors and other high tension applications shall conform to ASTM Specification A193, Grade B7 steel (F_y – 725 MPa, F_u = 860 MPa), galvanized in accordance with ASTM Specification A123/A123M.

200.7.8 Overhead Sign Structures and High-Level Lighting Support Structures

Overhead sign structures and high-level lighting support structures with a height greater than 16 m 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 the Bridge Design Code, Table A3.1.7 for a return period of 50 years
- The design ice thickness for ice accretion shall be the value given in the Bridge Design Code, 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 Ministry will not approve the use of vibration mitigation devices in lieu of designing to resist periodic galloping forces. Furthermore, the Ministry 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 Specification 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:
  - Works sign panels
  - Future Works sign panels (Future Works shall consider any potential changes due to safety audits, which changes and audits are Project Co's responsibility)
  - 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 300 mm to 600 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.

200.7.9 Substructure/Foundations

200.7.9.1 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 in the Design Data. These welds shall be tested using non-destructive testing techniques.

For substructure elements founded on driven steel H-Piles, HP 310 or larger piles shall be used. For substructure elements founded on driven steel Pipe piles, 324x7.35 mm or larger piles shall be used.

All exposed steel piles shall be galvanized to a minimum depth of 2.0 m below stream bed elevation. Corrosion rates below ground shall be in accordance with AASHTO.

Steel pile bents shall not be used adjacent to roadways.

200.7.9.2 Bridge Piers

Piers for 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.

Piers for overpasses may be founded on piles or spread footings, but spread footings shall not be used unless founded directly on competent hard/stiff glacial clay till.

Piers with three columns or less shall have a minimum cross-section area of 2.8 m^2 for each column. Piers with 4 or more columns shall have a minimum cross-section area of 1.8 m^2 for each column.

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.

200.7.9.3 Bridge Abutments

200.7.9.3.1 General

Bridge ends shall be supported on piles. Bridge ends shall have cast-in-place wing walls oriented parallel to the overpassing roadway. 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. Unless approved otherwise, all bridge structures shall be of an "Open" style employing headslopes in front of abutments in accordance with the Ministry Standard Plan 20154 "Lateral Clearances at Underpasses".

For conventional headslopes, provide minimum 0.6 m wide bench in front of abutment seat for bearing inspection access, and provide a minimum abutment seat embedment of 0.5 m below top of bench. Abutments shall be designed such that bearings can be viewed by an inspector standing directly on the bench, and with maximum abutment seat height of 1.8 m above the bench. For vertical abutments, provide a minimum of 0.5 m wide concrete walkway in front of abutment seat for inspection access. The inspection walkway shall be a concrete slab, monolithic with any abutment retaining wall coping, with a 3% wash slope towards the vertical face. The inspection walkway shall be protected with continuous safety railing, designed as a "guard" having a minimum height of 1070 mm. Proportion the abutments such that bearings can be viewed by an inspector standing directly on the walkway, and with maximum abutment seat height of 1.8 m above the walkway. The inspection walkway shall be accessible from the side without need of any equipment. Locked gates shall be provided to limit access to these walkways by the general public.

For abutment seats behind independent retaining walls, the design shall provide a minimum abutment seat embedment of 0.6 m below top of walkway. For all abutments, wingwalls parallel to the over-passing roadway shall extend a minimum distance of 0.6 m beyond top of fill line, and shall have a minimum embedment of 0.6 m below top of grade at all locations.

Good 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 Drawing SK-4 (Deck Water Proofing System with 80 mm 2 Course Hot Mix ACP) and Drawing SK-3 (Standard Concrete Joints)).
- 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 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 200.7.17 of Schedule 15-2 - Design and Construction.
- For MSE wall abutments see Sections 200.7.19 and 300.4.7 of Schedule 15-2 - Design and Construction for additional details.

200.7.9.3.2 Layout of Retaining Walls at Abutments

This section applies to the layout of walls at abutments adjacent to roadways and railways. Wall geometry shall satisfy the following requirements:

- Wingwalls may be set parallel to the underpassing Roadway but wingwalls on the approaching traffic side for the underpassing roadway, shall be flared away from traffic at a minimum flare rate of 20:1 and the end of the wingwall shall be buried into the ground;
- Walls parallel to underpassing railways, the wingwalls shall be flared away from the track at both sides of the abutments at a flare rate of 20:1;
- In no case shall the enclosed angle between the front abutment wall and a wingwall be less than 70°.
- The height of the turned-back wingwall shall not exceed 12 m, and the barrier may be integral with the approach slab over the turned back wingwall;
- If a roof slab is required, both wingwalls shall be cast-in-place concrete and cantilevered off the grade beam; and
- Where the length of 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.

A suitably flat area shall be provided at the base of any wall over 2 m in exposed height, to enable ladder access to the wall at any location along the wall to be done in a safe manner.

200.7.9.3.3 Approach Slabs

Approach slabs shall be in accordance with the provisions of section 1.7.2 of the Bridge Design Code except as noted:

- Concrete for approach slab shall be Type DC.
- Approach slabs shall have sufficient length to limit their rotation due to settlement to 0.5%, and shall have a minimum length of 4800 mm (measured parallel to centreline of roadway).
- Approach slabs shall have Deck Water Proofing System with 2 Course Hot Mix ACP
- Approach slabs shall not be constructed with integral barriers or curbs;

- Approach slab thickness shall be as required by the designer but shall have a minimum thickness of 300 mm;
- Approach slab should be designed assuming a void has developed underneath a minimum of one-half the span length of the slab adjacent to the abutment support (i.e. one-half of span unsupported in a longitudinal direction), approach slabs supported upon a sleeper slab shall be designed for its full span unsupported;
- 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.

200.7.9.3.4 Integral Substructures

Integral substructures for a single bridge shall not include both fully integral and semi-integral abutments. Semi-integral abutment bridges are single or multiple span structures with rigid foundations where the concrete deck is continuous with the approach slabs but is not continuous with the abutments. Integral abutments shall not be used for bridge spans greater than specified in "Table - Maximum Thermal Spans" below. Steel girder bridges less than 60 m and concrete girder bridges less than 80 m, measured end to end including length of approach slabs, should desirably be designed using integral abutments with no deck joints. In addition to the general requirements for abutments, integral abutments shall also be designed to meet the following requirements:

- For fully/semi integral bridge decks the maximum skew shall not exceed 20°.
- Discussion of analysis and constrained force effects shall be included in the design report.
- For fully integral abutments the abutment foundation shall be a single row of piles. The piles should be 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 0.9 pounds per cubic foot filler bead nominal diameter of 5 mm or approved equal. 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 piles shall be embedded a minimum of 600 mm into the abutment seat.
- Cycle control joint types C1 and C2 shall be located 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.
- The installation of expansion foam material behind integral abutments for the purpose of relieving earth pressures shall not be permitted.
- Fully integral abutment approach slabs shall not be designed to move longitudinally in

and out between stationary and parallel non-integral wingwalls.

- 2 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.
- 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.

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

(1) Joint Types C1and C2 shall be designed as shown in Drawing SK-2.
(2) Joint Type C1 - The pavement shall be saw-cut at the end of the approach slab for crack control.
(3) 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.

200.7.10 Retaining Walls

Limits on retaining wall height are given in Section 200.5.4 of Schedule 15-2 - Design and Construction.

Long term lateral displacements of tall retaining walls after completion of construction shall not result in the top of the wall moving in excess of 1 horizontal to 500 vertical relative to the bottom of the wall or 10 mm, whichever is smaller. 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.

Retaining walls with traffic running parallel to the top of the wall shall have rigid bridge barriers meeting 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.

Safety railing shall be mounted on the top concrete surface of all retaining walls that are not otherwise protected by a traffic barrier, pedestrian rail or bicycle barrier. Safety railing shall have a minimum height of 1070 mm. 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 200.6.1 (Geometric Design Criteria) 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 Sections 200.7.19 and 300.4.7 of Schedule 15-2 - Design and Construction.

Dry cast concrete block walls are not permitted.

200.7.11 Ducts and Conduit Systems

200.7.11.1 Ducts or Conduits in Curbs and Barriers

No utility ducts or conduits are required to accommodate future utilities. The attachment or the installation of conduits and ducts within or on bridge structures shall not be allowed, except that a minimum of 1-53 rigid PVC conduit for traffic signal interconnection will be required on all grade separation structures where a traffic signal is warranted presently, or warranted by the end of the Project Term.

All conduits 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 conduits cast into curbs/barriers shall be rigid PVC, meeting the requirements of CSA Standard C22.2 No. 211.2 and in accordance with the rules of the Canadian Electrical Code ("**CEC**"), Part 1. Coupling shall be solvent bell ends. Rigid conduit shall be bent only with a standard conduit bender.

200.7.11.2 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 Ministry.

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:

- 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 requirements. The PVC junction box is to be set flush with the surface of the pier shaft and shall be fitted with a gasketed weatherproof cover.
- 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 maybe 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.
- 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.
- 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.
- 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.

- 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.
- Luminaires conduits and/or conduit support equipment that are supported on the superstructure shall be located within interior girder bays.
- Luminaire conduits and/or conduit support equipment shall be attached to the bridge structure with anchors cast into the haunch concrete at appropriate locations.
- 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.
- 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.
- Prior to the wiring being installed, all conduits shall be proven to be free and clear of obstructions.

200.7.12 Deck, Curbs, Medians, Concrete Barriers, Sidewalks

Deck slabs for beam and slab bridges designed with the empirical method in accordance with section 8.18.4 of the Bridge Design Code shall have a minimum slab thickness equal to the greater of the girder c/c 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.

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:

- Notwithstanding the Bridge Design Code clause 5.7.1.6.1.1:
  - For the design moment intensity due to the vertical axle loads of the CL-750 Truck, the effects of individual loads shall be obtained and superimposed or, alternatively, the design moment intensity due to the CL-750 Truck may be obtained directly by multiplying the maximum cantilever moments in Table 5.10 by a factor of 1.20, 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 105 kN.

Clause 5.7.1.7.1 of the Bridge Design Code presents design guidelines for transverse bending moments in concrete decks supported on longitudinal girders. For the Project this clause of the Bridge Design Code shall be amended as follows:

- The second paragraph shall be amended to read:
  - "Concrete deck slabs that are proportioned in accordance with the empirical design method of clause 8.18.4 for the CL-750 Truck need not be analyzed for transverse bending moments due to live load, except for the cantilever portions."
- In the third paragraph, sub clause (a)(i), the number '87.5' shall be replaced with the number '105', and the Truck type shall be revised from 'CL-625' to 'CL-750'.

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.

Cast-in-place deck slabs designed to be composite with supporting precast box beams shall be a minimum of 225 mm thick and have 2 mats of deck reinforcement.

Deck systems using precast concrete partial depth panels shall meet the requirements of Sections 200.7.20 and 300.4.13 of Schedule 15-2 - Design and Construction.

Vehicular traffic concrete barriers required to meet the Performance Level 2 shall be Ministry standard Type 1 Bridge Barriers. If Performance Level 3 is required by the Bridge Design Code, the overall height of the Ministry standard Type 1 Bridge Barrier shall be increased to 1370 mm by increasing the width of the concrete base and maintaining the front face geometric shape below the slope break point and extending the sloped portion of the barrier above the slope break point. Concrete curbs and barriers shall have crack control joints above the deck level at a maximum spacing of 2.5 m (centred between bridgerail posts where bridgerail posts are used). Longitudinal reinforcing in the curbs and barriers above the top of deck shall be continuous at the control joints. Control joints shall extend down to the top of the concrete deck and shall be caulked prior to application of deck waterproofing membrane.

Concrete paving lips along the edge of ACP are not permitted.

The sidewalk shall have a curb projecting 150 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. 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.

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 Alberta Transportation Roadside Design Guide. Required median width (lip of gutter to lip of gutter) transition from roadway to bridge shall be maintained with lane markings.

The following set-back requirements or protective measures shall be followed when attachments, such as signs, lamp posts, sign structure support columns, piers of adjacent bridges, etc. are on top of or close behind bridge barriers:

Applicable roadside barrier standard	**Set-back from top traffic face of barrier or other treatment**
TL 2	305 mm minimum
TL 3	610 mm minimum
TL 4	For lamp posts and sign structure columns, provide PL2 combination barrier with a height of 1400 mm and a minimum set-back 610 mm. 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.

A minimum of 2 electrical connections are required on bridge decks to accommodate the copper sulphate electrode ("**CSE**") or half-cell testing as identified in Section 402.3.2 of Schedule 15-3-OM&R and Handback 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. 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.

200.7.13 Bearings

Bearing types for beam and slab bridges shall be:

- Steel reinforced elastomeric bearing pads with or without stainless steel and polytetrafluoroethylene polymer (PTFE) sliding surfaces;
- Fixed steel plate rocker bearings;
- Proprietary pot bearings; and
- Proprietary spherical bearings.

Steel reinforced elastomeric bearings with or without stainless steel and PTFE sliding surfaces shall incorporate the following standard features:

- Steel sole plates and base plates shall be provided.
- Field welding adjacent to elastomeric pad shall be done with care. The temperature of the steel shall not exceed 120° Celsius. Distance between the weld and the elastomer shall not be less than 40 mm.
- 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 extra construction tolerance 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 a tolerance of 0.005 radians at SLS.
- For bearings with a sliding surface, an unfilled 3 mm thick PTFE sheet shall be recessed 2.5 mm into and 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 304, No. 8 finish and shall be welded to the bottom of the sole plate.
- Un-lubricated PTFE shall be specified.
- 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.

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 pintels.
- 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.
- 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.

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 ULS.

- Notwithstanding section 11.6.5.4 of the Bridge Design Code, the average stress in the pot bearing elastomer at serviceability limit states loads shall not exceed 30 MPa.

Proprietary spherical bearings shall incorporate the following features:

- Notwithstanding clause 11.6.1.1 of the Bridge Design Code, spherical 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.
- The attachment of the stainless steel plate to the upper plate shall be accomplished by a continuous machine weld (semi-automatic process). The weld shall be clean, sound, and smooth, without overlaps and properly fused to each component so as to prevent ingress of moisture. Bearing components shall remain undistorted and undamaged as a result of the welding process.

Elastomer shall be polyisoprene (natural rubber) and meet the requirements of the Bridge Design Code table 11.5.

Notwithstanding section 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:

Limit State	Permanent Load (MPa)	All Loads (MPa)
SLS	25	35
ULS	40	55

Notwithstanding section 11.6.3.6 of the Bridge Design Code, the average contact pressure for PTFE elements filled with up to 15% by mass of glass fibres used for face mating surfaces of guides for lateral restraint, shall not exceed 55 MPa for all loads at the ultimate limit state.

Bearings shall be set level by using tapered sole plates to correct for effects of roadway grade and final girder camber. For long bridges, the sliding plane of abutment expansion bearings shall be set parallel to the grade slope for proper functioning of the expansion joints. Effects of longitudinal forces generated by the inclined sliding bearings shall be investigated.

When finger plate expansion joints and 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.

Bearing finishing and attachments shall meet the following requirements:

- Base plates shall be zinc hot-dip galvanized or zinc metallized.
- 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 300.4.3 of Schedule 15-2 - Design and Construction. 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 plate can be attached to shoe plates by field welding or bolting. 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 by painting 2 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.

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. Where required, machining shall be performed prior to hot-dip galvanizing. Where the galvanizing process may cause distortion, metalizing shall be used instead.

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 conditions. The stainless steel plate shall be wider than the elastomeric pad by at least 10 mm on each side.

Shim plates used for shim stacks shall be hot-dip galvanized.

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. For pier girders, jacks shall be placed front and back of bearings and bearings removed sideways. At abutments, jacks shall be placed in front of the bearing and the bearings pulled out sideways. 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.

Wherever practical, reinforced concrete shear blocks or steel restraint brackets independent of bearings shall be used to transfer lateral loads between the superstructure and substructure.

200.7.14 Girders

200.7.14.1 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 fully integral and semi-integral abutment designs, abutment diaphragms shall 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.

200.7.14.2 Precast-Prestressed Concrete Girder Bridges

For NU girders, typical girder details shall be in accordance with the Alberta Transportation's Standard Drawings S-1757-08 and S1758-08 (NU Girder Bridges-Typical Details Sheet 1 and 2).

Pier diaphragms shall be continuous cast-in-place concrete. Positive moment connections at piers shall be developed by bent-up strands and projected hooked rebar. Minimum separation between girder ends shall be 300 mm. For pier diaphragms with a pinned or expansion connection to the pier, the 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 erection loads only.

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. Composite

girder design strength shall be based on a section that includes a haunch height of not more than 13 mm at mid-span.

Appropriate allowance for prestress (pre-tension and post-tension) shortening, shrinkage and creep shall be included in the fabricated length of the girders.

Stirrup projections from the top of the precast girder into the deck shall meet all code requirements for developing full composite action. All stirrups shall have 135º hooks (or single closed loop) 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.

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.

For “NU” girders and other “I” shaped girders, 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.

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 2 pieces with full tension lap splices. The top of the ties can be left open in the midspan region where there is conflict with post-tensioning cables.

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 > 250% of the strand area.

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.

For NU Girders a minimum of 4 bonded pretensioning strands shall be incorporated in the top flange to assist in controlling stresses due to transportation and deck construction.

For connecting diaphragms in exterior girders, no connection components shall be visible on the exterior surface of the girders.

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 4 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.

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.

200.7.14.3 Steel Girder Bridges

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.

Intermediate transverse stiffeners and girder ends at splice locations shall normally be square to the girder flanges. Abutment detailing dimensions shall account for the effects of girder end tilt. Girder ends and bearing stiffeners shall be vertical in the erected position.

All welded steel girders, regardless of span, shall be cambered for roadway gradeline profile and 110% of total dead load deflection.

All bearing and jacking stiffeners shall be "finished to bear bottom" and "snug fit only top", and then fillet welded to both top and bottom flanges and to the web.

For long bridges with large expansion movements, the use of multiple bearing stiffeners shall be considered.

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.

Diaphragm connector plates shall be welded to both top and bottom flanges. 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 Section 10.10.6.4 of the Bridge Design Code. Intermediate stiffeners in regions of stress reversal shall be snug fit to both flanges. Corner cope of intermediate stiffeners and connector plates shall normally be 80 mm vertical x 35 mm horizontal for web thicknesses of 14 to 20 mm.

Corners of stiffener plates projecting past the outside edge of flange plates shall be coped 45º.

No intersecting welds are allowed.

All weld ends for stiffeners, gussets, and other attachments to girders shall terminate 10 mm from the edge or end of plates.

Material properties for steel girders and attachments, bracing and bolts shall be as per Section 300.4.3 of Schedule 15-2 - Design and Construction.

Changes in girder flange widths and thicknesses at welded splices shall be tapered at 2.5 (longitudinal):1.

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 25 mm, 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.

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 or steel lateral restraints.

The following features shall be used to prevent staining of sub-structure concrete:

- The end of the girders within 3 m of an expansion joint shall be coated with an approved coating system.
- The exterior face of steel girders on overpass structures shall be coated with an approved coating system.

200.7.14.4 Intermediate Diaphragms

Intermediate diaphragms are required in bridge structures with girder and slab superstructures. Intermediate diaphragms in bridge structures with steel beam and slab superstructures shall have a maximum spacing of 8.0 m. Intermediate diaphragms in bridge structures with precast concrete beam and slab superstructures shall have a maximum spacing of 13.0 m. Additional bracing may be required to satisfy erection stability and geometry control during construction.

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 temporary walkways outside the edge of the deck slab. Loads assumed for such design shall be based on realistic estimates for each bridge and shall be shown in the Design Data. Diaphragms provided shall become part of the permanent structure and be left in place for possible future maintenance, i.e. widening, rehabilitation, etc.

200.7.15 Deck Joints

New structures shall be fully continuous from end to end. Deck joints shall only be permitted at abutments.

The following standard deck joints shall be used: (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”. Only 1 manufacturer per joint type project wide shall be accepted.

Alberta Transportation 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	Finger plate joint	n/a	n/a

Alberta Transportation Standard Drawing	**Joint Type**	**Maximum Permissible Normal Movement**	**Maximum Permissible Shear Movement[1]**
Deck Joint Assembly)			
S-1800 to S-1802 (Cover Plated V-Seal Deck Joint)(3)	Cover-plated V-seal (102 mm V-seal)	100 – 60 = 40 mm	20 mm (2)
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 mm2

(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% 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 Alberta Transportation's deck joint Standard Drawings with natural rubber seals shall be used. Multi-cell strip seal deck joints are the Ministry's preferred deck joint system where their use is not limited by the movement capacity of the seal perpendicular and parallel to the joint.

Deck joints shall incorporate stop movement bars to maintain a minimum joint gap of 60 mm to facilitate seal replacement. Designers shall note that this is often larger than the minimum gap indicated on manufacturer's brochures, which provide gap widths suitable for first installation only.

Finger plates and cover plates shall be fixed to the deck side to allow jacking and raising of the superstructure. The top of the expansion joint or cover plate shall be recessed 3 mm to avoid damage from snow plows. Neoprene drip sheets and stainless steel or galvanized collector drains are to be provided with finger plate type joints to intercept water passing through the joint and to direct flow to the collection system for treatment where required.

Modular seal deck joint systems are not permitted.

The free ends of any cover plates at deck joints shall be pointed towards the bridge abutments.

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.

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.

Water ingress into or onto the substructure or abutment wall backfill from the superstructure above shall be prevented.

Joints between the superstructure end diaphragm and the substructure shall be waterproofed.

200.7.16 Bridgerails

200.7.16.1 General

Project Co shall use Ministry standard bridgerails and approach end transitions. Refer to Ministry Bridge Design Criteria for additional requirements.

When a vehicular bridge includes a sidewalk, a traffic separation barrier shall be provided between the sidewalk and the roadway. The barrier shall have a smooth surface with no snag points and a minimum height of 0.6 m measured from the surface of the sidewalk, and be designed to avoid vehicle encroachment.

Design of barriers shall facilitate snow removal operations.

200.7.16.2 Pedestrian/Cyclist Railing

Railings for pedestrian and cyclist safety shall be provided wherever a vertical drop of more than 500 mm occurs between the level of the pedestrian surface and the adjacent surface. Typically raised sidewalks and curbs shall only be used at locations where posted speed is 60 km/hr or less. If curbs or raised sidewalks are used to separate traffic, the curb or sidewalk height shall not exceed 200 mm.

For pedestrian/cyclist railing designed for use at the outside of sidewalks with a traffic separation barrier on the road, the pedestrian/cyclist railing shall be mounted on a concrete curb projecting 150 mm above the sidewalk. Minimum height of pedestrian railings and bicycle railings shall be 1.05 m and 1.37 m respectively. Sidewalks on highway overpass locations shall incorporate a 1.9 m high curved anti-vandal fence mounted upon a 600 mm high curb to prevent climbing.

200.7.16.3 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.

The selection of the bridgerail expansion joint gap shall ensure that the bridge deck expansion joint gap closes before the bridgerail expansion gap.

Steel bridge railing for bridges with curve radii of 600 m or less shall be fabricated curved.

200.7.16.4 Miscellaneous

Exterior bridge barriers adjacent to 4.2 m wide traffic lanes shall be combination traffic/cyclist railings with a minimum height of 1400 mm.

Concrete barriers shall have crack control joints above the deck level at a maximum spacing of 2.5 m (centered between bridgerail posts where applicable).

Longitudinal reinforcing in barriers shall be continuous at the control joints.

Control joints shall be caulked prior to application of deck waterproofing membrane.

200.7.17 Bridge Drainage

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” or “Scourstop” ditch or equivalent. Drain troughs may be eliminated if the roadway drainage at the bridge transitions is being controlled by curbs/concrete barriers and catch basins. 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.

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 Ministry and that causes them to blend into the surrounding structure.

Deck drainage adjacent to barriers, curbs or medians shall not exceed 1.8 m in width and in no case shall the flow encroach more than 0.5 m onto the adjacent lane during the design event. 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).

Drains on overpasses shall not be placed above the traveled lanes of the roadway below.

Bridge decks with waterproofing membranes are to have provisions to allow for the drainage of water that penetrates the asphalt wearing surface along the gutter lines. Drains shall not be permitted on overpass structures overtop of traveled lanes below. Ministry's typical detail for seepage drains are installed at 1.2 m spacing. Seepage drains are to be avoided in locations above traffic. In these locations wick drains shall be used between adjacent seepage drains.

Salt contaminated surface drainage shall be contained and not be allowed to come into contact with bridge components other than intended drainage features.

200.7.18 Engineering Drafting Requirements

200.7.18.1 General

Drafting standards and standard details shall be in accordance with "*Saskatchewan Ministry of Highways and Infrastructure Drafting Standards Manual*", 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 the following additional requirements:

- Screened-back lines or screened-back patterns shall not be used. Greyscales are not acceptable.
- Bench mark locations shall be shown on drawings in coordinates and not as stations and offsets.
- All lettering shall be done in capitals except metric SI units symbols which are to follow CSA Standard Z234.1 Metric Practice Guide (e.g. mm, m, km, kN, MPa). Minimum text size shall be 3 mm on a 24 x 36 plot.
- When associated with a number, symbols shall always be used (e.g. 16 m, not 16 metres). However, in text the unit shall be spelled out in full.
- When a decimal fraction is used, a leading zero shall be placed in front of the decimal point.
- Abbreviations shall not be used unless required to save space. Abbreviations shall not be used in notes.

- When abbreviating, use only the standard abbreviations provided, and use without periods.
- Annotations shall be placed as close as possible to the relevant item to eliminate or reduce the length of leaders.
- Where possible, annotations shall be in full and positioned to be readable from the bottom of the plan.
- Standard Ministry symbols shall be used when available.
- River and stream names shall follow the shape of the feature.
- A space shall be included between numbers and units (e.g. 100 mm).
- Cross references to other drawings in notes shall refer to the other drawing number (e.g. for details see dwg 12756).
- Electronic CAD files shall be submitted in AutoCAD format, and shall be submitted as "flat" files without entire models attached to each sheet or referenced details.
- All AutoCAD files shall be configured so that when plotted on the Ministry's plotters the plots replicate the signed Mylar originals. The Ministry will supply the pen tables and font libraries for their plotters on request.
- Drawings submitted on Mylar shall be wet plotted on 3 mil double matte finish Mylar film. Electrostatic plots are not acceptable.
- Professional stamps shall be signed in permanent black ink. Smeared signatures will not be accepted.
- All dimensions shall be ground dimensions. Stations may be given in either grid or ground coordinates. Chosen system shall be specified in the general notes and used uniformly across all drawings sets.
- Skew angles shall be given to the nearest minute.
- All drawing sets shall have consistent presentation, and shall be modelled on Ministry practice. Design teams shall be coordinated so that all like drawings are presented in a uniform manner.
- Design Data drawings shall illustrate what is to be constructed, and shall not show multiple options.
- The general principle to be used is that general arrangement drawings shall show everything that will exist at the end of construction. Because of this, future girder and substructure layouts shall not to be shown on the general arrangement drawing. Instead this information shall be included on one of the information sheets.

200.7.18.2 Design Information

200.7.18.2.1 Reinforcing Steel

Reinforcing steel design information and details shall be shown in the Design Data drawings in accordance with the Ministry's Drafting Standards Manual and the following requirements:

- Bar marks shall not be duplicated on any bridge unless the bars are identical.
- Incremented bars shall each have their own bar mark.
- Bar mark suffixes on bar lists for bars other than carbon steel reinforcing steel shall be as follows:
  - Low carbon/chromium ASTM Specification 1035 ..... MX
  - Galvanized bars.....G
  - Solid stainless steel bars (UNS S24100, S31653, S31603, S31803, S30400 or S32304) .....SS
- The type of stainless steel bar shall be updated to actual bar type used for construction on the drawings.
- The minimum size of reinforcing bars shall be 15M with the following exceptions:
  - Welded wire mesh in concrete slope protection;
  - Reinforcing bars in precast concrete girders;
  - Reinforcing bars in precast deck panels; and
  - Reinforcing bars in drain troughs.
- Complete detailed reinforcing steel bar lists (reinforcing schedules), including mass of reinforcing steel for each component (i.e. deck, abutment, pier, etc.) shall be provided in the plans.
- In the quantity summary on the information sheet drawing, totals for each bar type shall be shown separately for substructure and superstructure.

200.7.18.2.2 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. Minimum depth of penetration, splice detail and tip detail shall be shown on the Design Data drawings.
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 in the Design Data. 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.

200.7.18.2.3 Bearings

The following information shall be shown on the Design Data drawings:

- Bearing layout
- Bearing types and required number for each type
- Bearing replacement jacking locations and loads
- Bearing schedule showing design loads, translation and rotation requirements
- Temperature setting graphs for construction and for long term account for elastic, shrinkage and creep shortening of prestressed girders
- Sole plate, tapered dimensions and connection to girder details
- Base plate, anchor rods, and grout pad details
- Lateral restraint details
- Bearing Setting Elevation Table showing top of sole plate elevations and 2 empty rows, for bearing heights and top of grout pad elevations, to be filled in after bearing heights are obtained from Project Co.

200.7.18.2.4 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. PROJECT CO SHALL DETERMINE THE ADJUSTMENTS AND MAKE THE APPROPRIATE CORRECTIONS."

Steel Girder Superstructures

The span lengths shown on the general layout drawings shall be measured at a fabrication temperature of 0° 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 0° 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.
- 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 0˚ C, 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 0° CELSIUS. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT 0° CELSIUS".

Welded steel girders shall be cambered for 110% 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 and bracing dead load, deck dead load, super-imposed dead load (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.

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

0^{o} 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 0° 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.
- 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 +0° CELSIUS. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT 0° 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 in the Design Data. Camber data shall be provided at various construction stages, such as at transfer, erection, deck pour, post-tensioning, super-imposed dead load, gradeline profile, etc.

Consideration shall be given for the forms for all prestressed girders to be adjusted to allow for sag to be built into the girder to account for the camber resulting from the prestressing.

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"

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 0° CELSIUS. ABUTMENT AND PIER STATIONINGS ARE LOCATED SUCH THAT BEARINGS ARE CENTRED AT 0° 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"

200.7.18.3 Bridgerail

All dimensions for bridgerail layouts are to be given on centreline of bridgerail anchor bolts.

200.7.18.3.1 Benchmark Tablets

Benchmark tablet numbers can be obtained from the Ministry. Once the benchmarks have been installed and surveyed, report the elevations of the benchmarks back to the Ministry.

200.7.18.4 Design Drawings

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.

Other types of structures (i.e. bridge sized culverts, etc.) should follow the same basic order with drawings added and/or deleted as necessary.

Design Data 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.

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.

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 Highway XX, Centreline N-W RAMP, Centreline RDWY, Centreline CROWN, Centreline BRG ABUT #X, Centreline ABUT #X (for integral abutments), Centreline PIER #X, Centreline median Highway 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 (the "**Top of Centreline Finished Crown**") is defined as the point where the headslope line intersects the finished centreline roadway profile. Top of Centreline Finished Crown stations and elevations are to be shown for each end of the structure. Station is given to the nearest decimetre and elevation to the nearest centimetre. These points are to be shown on all 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.

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.

Design Data drawings shall, at a minimum, include the following items. Note that in the following requirements for the Design Data drawings the term "stream" is used also to designate a road or railway track in the case of a grade separation or railway crossing.

General Layout

- Clear zone requirements, calculated critical vertical clearances with their critical locations for current construction as well as the Future Works construction shall be shown 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 for all stream crossing structures.

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, 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;
  - Design HGL and freeboard;
  - Historical high flood;
  - Velocity for design discharge through the proposed bridge opening;
  - Critical ice condition with situation and 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.

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 bridges.
- 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, beginning of vertical curves ("**BVC**"), end of vertical curves ("**EVC**") and points of intersection ("**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 and 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 upstream and downstream of the proposed crossing, with any beaver dams and irregularities in the streambed identified.
- Top of water/ice elevations for critical ice conditions.

200.7.18.5 Record Drawings

The record drawings shall show all relevant as-built details of the New Bypass 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 200.7.12 of Schedule 15-2 - Design and Construction, shall be recorded on the drawings.

For sign structures, the general layout drawings shall be updated to match the actual sign structures as fabricated.

200.7.19 Mechanically Stabilized Earth (MSE) Walls

200.7.19.1 Design Standards

MSE walls shall meet the requirements of Section 200.7.10 of Schedule 15-2 - Design and Construction.

The design 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. Final design calculations shall bear the seal of a Professional Engineer registered in the Province of Saskatchewan.

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;
- Alberta Transportation 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.

Polymeric or geotextile are not permitted as reinforcement for MSE abutment or associated wing walls.

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. Passive pressure in front of the wall mass shall be assumed to be zero for design purposes.

The design life for all MSE wall components shall be as defined in Section 200.7.6 of Schedule 15-2 - Design and Construction.

200.7.19.2 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.

200.7.19.3 Facing

All MSE walls shall be faced with precast concrete wall panels. Wire faced walls are not permitted. The non-exposed side of MSE wall panels shall be in full contact with compacted backfill. 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.

200.7.19.4 Coping Cap

A cast-in-place or precast 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 concrete wall coping shall be smooth and have no steps or abrupt changes in height.

200.7.19.5 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.

200.7.19.6 Geometric Requirements

MSE wall backfill shall extend a minimum of 0.5 m beyond the end of the soil reinforcement. The minimum length of the soil reinforcement shall be 2.5 m or 0.7H but for walls supporting bridges, the minimum reinforcement length shall be 60% of the distance from the top of the levelling pad to the road surface plus 2 m, or the minimum length required by AASHTO. The mechanical height, H, shall be the vertical difference between the levelling pad and the elevation at which the failure surface intercepts the ground surface supported by the wall.

For stepped levelling pads, the maximum elevation difference between adjacent steps shall not exceed 750 mm. The minimum length of each stepped section shall be 2250 mm.

Acute corners less than 70° inside panels shall not be allowed.

200.7.19.7 Surface Drainage

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 200.5.4 of Schedule 15-2 - Design and Construction.

200.7.19.8 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.

200.7.19.9 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 F-shaped barriers in accordance with Ministry standard drawing 28810 (Bridge Barrier Type 1) 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.

200.7.19.10 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.

200.7.19.11 Panels

Minimum precast concrete panel thickness shall be 140 mm, excluding any additional thickness required for aesthetic surface treatment. Maximum height of any precast concrete panel shall be 2500 mm. Panel reinforcing steel 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 m 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 Project Co 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.

200.7.20 Deck Systems Using Precast Concrete Partial Depth Deck Panels

200.7.20.1 General

This section is for the design of deck systems using precast concrete partial depth deck panels.

Unless otherwise noted in this section, all other requirements of Section 200.7 of Schedule 15-2 - Design and Construction shall apply to the design of deck systems using precast concrete partial depth deck panels.

200.7.20.2 Design

Deck slabs using precast concrete partial depth deck panels shall be permitted with the following design requirements:

- 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).
- The cast-in-place concrete deck slab shall be designed to be fully composite with the precast panels.
- The minimum composite deck slab system thickness shall be the greater of the girder c/c spacing divided by 15.0 or 225 mm. In addition, the following shall be satisfied:
  - The precast deck panel shall have a minimum thickness of 90 mm;

- The cast-in-place concrete portion of the composite deck slab system shall have a minimum thickness of 135 mm;

- The precast panels shall be fully prestressed and the stresses in the precast panel shall not exceed the following:
  - From transfer until the 28 day strength is attained:
    i. Compression: 0.6 $f`_{ci}$
    ii. Tension: 0.5 f'_{cri}
  - After the 28 day strength is attained and at serviceability limit states:
    i. Tension: f'_{cr}
  - The average compressive stress in the precast panel at prestress strand release shall be <= 7.0 MPa.
- 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.
- The composite deck slab system shall be designed using flexural design methods based on elastic moments:
  - 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 105 kN to correspond with the CL-750 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.
  - For curved or skewed bridges, all moments shall be determined by elastic analysis.
  - For all bridges the following minimum transverse positive moment reinforcing shall be provided over supporting girder lines.
    i. Transverse prestressing strand, with a minimum reinforcement ratio, ρ, of 0.003, shall be provided 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 prestressing strand shall not exceed 300 mm.

ii. At interior girder lines, the transverse prestressing strand shall project out of the precast panel edges and over the girder flanges as required to provide a lap splice with the strand projecting from opposing precast panels supported on the same girder. At exterior girder lines, the transverse prestressing strand shall be extended at least 1 full development length beyond the exterior girder centreline.

- The minimum design compressive strength for the precast panels shall be as specified in Section 200.7.6 of Schedule 15-2 - Design and Construction.
- The composite deck slab system shall conform to the following:
  - The precast panels shall have a minimum age of 45 days when the cast-in-place portion of the deck is cast.
  - The cast-in-place concrete portion shall have 15M continuous bottom longitudinal reinforcing bars (parallel to girder lines) spaced at 300 mm on centre placed directly on top of the precast panels. Where conflict with the transverse positive moment prestressing strand exists, these longitudinal reinforcing bars shall be placed directly on top of the transverse prestressing strand.
- Prestressing strands shall be 9.5 mm diameter.
- Prestressing strand cast into the panels shall not be coated steel.
- With a steel girder superstructure, the following additional provisions shall apply:
  - 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.
  - The girder top flange shall have a minimum width of 450 mm.
  - 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 prestressing strand projecting out of the precast panels.
- With precast concrete girder superstructures, the following additional provisions shall apply:
  - 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.
  - 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 prestressing strand projecting out of the precast panels.

- 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.
- No portion of any hardware associated with the deck formwork, including deck overhang formwork, shall be visible after removal of all formwork.

200.7.21 Design Report Requirements

200.7.21.1 Not Used

200.7.21.2 Design Drawing Submission Specifics

Project Co shall supply the following for the Ministry's record purposes:

- 1 full- sized 24"x36" stamped and signed set of construction drawings on Mylar film;
- 2 sets of 11x17 stamped and signed construction drawings, organized by bridge structure and submitted in binders, and for all sign structures submitted in a single binder, sequenced from 1 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;
- 1 set of the electronic version of the stamped and signed construction drawings in AutoCAD format; and
- 1 set of the electronic version of the stamped and signed construction drawings in .pdf format.

Drawings shall be submitted as a standalone set for each bridge, and shall be submitted with Ministry plan numbers and bridge file numbers. These will be issued by the Ministry on request. It is acceptable for Project Co to use an alternate numbering system but the title block shall also incorporate the Ministry's drawing number and file number system.

Each structure shall have its own complete stand-alone set of drawings, and any drawings that are common to a number of structures shall be included in each set and allocated a different Ministry number in each set. Electrical drawings pertaining to each structure shall be included in the drawing set.

Keep Ministry drawing numbers as 1 sequential set through each bridge 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 Ministry standard drawings used with the Ministry standard drawing numbers.

Any Project Co assigned drawing numbers shall remain on the drawings, and be located immediately above the drawing numbers.

All sign structures shall have their own general layout drawing that includes site plan, structure elevation view, general notes pertaining to design, materials, foundation construction, fabrication and installation.

Sign structure drawings are considered to be bridge drawings, so the same guidelines shall be followed.

200.7.22 Checking Requirements

200.7.22.1 Checking of Structural Design

Project Co shall engage an independent Checking Team, the qualifications of which are described in Section 20.7 of the Project Agreement, to perform design checks of structures.

The Checking Team shall be responsible for:

a) Carrying out a complete review of the Design Data relating to structures including re-analysis of the original design including hydrotechnical, geotechnical, geometric and operational safety components;
b) Carrying out a 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;
c) Ensuring that the engineering drawings and construction specifications accurately convey the requirements of the original design;
d) Ensuring the completeness, integrity and accuracy of all aspects of the engineering drawings and construction specifications;
e) Conducting a review to ascertain that the design of structures meets performance expectations outlined in the Project Agreement including without limitation the Technical Requirements and that such design is carried out according to accepted industry standards; and
f) Identifying deficiencies in the design and analyses, and notifying Project Co and the Ministry of unresolved deficiencies.

The Checking Team shall provide independent design check notes and shall report that the design checks have been completed based on the information provided by the Engineer of Record and Coordinating Professional Engineer.

Project Co shall at the same time submit a Design Certificate (Structures) and an Independent Structural Design Check Certificate in accordance with the Schedule 9 - Review Procedure for all Structures Final Design Development Submittals and all revisions thereto.