Environmental Impact Assessment Pursuant to Bylaw 7188

Horsehills Road Over Horsehills Creek (B130) Bridge Replacement

Final Report

Prepared for:
City of Edmonton
Edmonton, Alberta

Under Contract to:
MPA Engineering Ltd.
Sherwood Park, Alberta

Project Number EP-882
February 2021

Prepared by:
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19 February 2021
EP882

Dear Ms. Johnson,

Re: Environmental Impact Assessment Pursuant to Bylaw 7188 for Horsehills Road over Horsehills Creek (B130) Bridge Replacement - FINAL REPORT

As requested, please find enclosed a pdf copy of the above-mentioned final Environmental Impact Assessment for submission to City Planning for their files and sign-off pursuant to Bylaw 7188. As requested by City Planning, a copy of the concordance table documenting reviewer comments and the project team's response is included in the EIA in Appendix I. In addition, text throughout the report was updated accordingly related to wildlife passage, slope stability, reclamation, etc. In addition, the wetland mapping was refined on Figure 7 to match submissions prepared for Alberta Environment and Parks pursuant to the Code of Practice for Watercourse Crossings. *Fisheries Act* and *Historic Resources Act* approvals have been added to the appendices.

Please note that City Planning determined that a Site Location Study (SLS) is not required for this project because the new bridge (B481) will occupy the same footprint as the existing bridge (B130).

Please contact either of the undersigned if you require additional information.

Sincerely,

Spencer Environmental
Management Services Ltd.

Stephanie Jean, M.Sc., P.Biol.
Environmental Scientist

Andra Bismanis, M.Sc., P.Biol.
Vice-President, Science Practice

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1.0 INTRODUCTION

The Horsehills Road over Horsehills Creek Bridge (B130) (the bridge) is located in the northeast corner of Edmonton, north of Manning Drive (SW 17-54-23-W4M) (Figure 1, Appendix A). Built in 1971, the existing bridge is an 8.5 m long single span girder bridge supported by treated, vertical wooden pile abutments (Plate 1.1). It supports two lanes of traffic and has a posted speed limit of 50 km/h. Due to the poor condition of the existing structure, the City of Edmonton (the City) is proposing to replace the bridge in the same footprint (Figure 2, Appendix A). The City has retained MPA Engineering Ltd. (MPA) to provide engineering services for replacement of Horsehills Road bridge and the adjacent roadway approaches.

Plate 1.1. Horsehills Road over Horsehills Creek (B130) with single span girder supported by wooden pile abutments (27 October 2020).

Horsehills Creek is a tributary to the North Saskatchewan River; therefore, the bridge and adjacent roadway approaches on Horsehills Road are located within the boundaries of the City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan (NSRV ARP) (Bylaw 7188) (Figure 1, Appendix A). The project triggers the need for an environmental review pursuant to that Bylaw. A scoping meeting with City ecological planners to discuss environmental review requirements determined that the appropriate level of review for replacement of this major facility, as defined by the NSRV ARP, is an Environmental Impact Assessment (EIA) subject to approval by the City's Urban Planning Committee. An accompanying Site Location Study (SLS) is not required because the bridge will be replaced in its existing footprint. To that end, MPA retained Spencer Environmental Management Services Ltd. (Spencer Environmental) as environmental consultant to complete the EIA.

This report comprises the Bylaw 7188 EIA prepared for the replacement of Horsehills Road Bridge over Horsehills Creek and adjacent Horsehills Road roadway approaches within the Bylaw 7188 boundary. It should be noted that the City is proposing a separate Horsehills Road upgrading project that may be tendered at the same as the bridge replacement project and be constructed by the same contractor. While that roadway upgrading project will

extend into the Bylaw 7188 boundary to connect to the north bridge roadway approach, impacts are expected to be confined to the existing roadway and is, therefore, not considered in this document. The EIA content follows a project-specific Terms of Reference developed through scoping discussions held between Spencer Environmental, MPA and the City. This EIA addresses all components of the bridge replacement project having potential to affect lands within the NSRV ARP. A concordance table documenting City Bylaw 7188 EIA reviewer comments and the proponent's responses is provided in Appendix I.

2.0 THE PROPERTY

2.1 Project Area Location, Disposition, Zoning

Horsehills Road Bridge over Horsehills Creek is located immediately north of Manning Drive, east of 18 Street and west of the Nanaksar Gurdwara Gursikh Temple within the City's northeast corner. Figure 1 (Appendix A) illustrates the bridge's location in relation to Bylaw 7188 and adjacent lands, including two, 2100 mm culverts approximately 28 m downstream and crossing under Manning Drive. The bridge is located on City-owned lands in the NSR ravine system within the Edmonton Energy and Technology Park Neighborhood and is zoned as Agriculture (AG). Figure 3 (Appendix A) illustrates land use zones adjacent to the bridge site. The bridge is not located in the City's Flood Protection Overlay area or the provincial flood hazard area.

2.2 Historic Conditions

Historical aerial photograph review was limited to available imagery on Google Earth (2020) that spans the period 2002 to 2018. That series shows very little change in the area surrounding the bridge during this period. In 2002, the Nanaksar Gurdwara Gursikh Temple was already present on the landscape and a beaver dam was present on Horsehills Creek approximately 40 m north of the bridge. The development of a farmyard approximately 450 m northwest of the bridge can first be seen in 2008 where a portion of a forest stand was cleared, and some small buildings are present. At some point between 2002 and 2008, a new beaver dam was constructed in the creek approximately 15 m north of the bridge and the previous dam was mostly removed. This newly constructed beaver dam appears to have caused higher water levels around the bridge compared to the previous dam placement. In 2011, a larger building is present in the cleared area. Other than this development the remaining landscape remained the same throughout this time period. Most of the area is crop land with scattered residences. There was no change in roadways over this period.

2.3 Summary of Environmental Regulatory Approvals

All typically relevant federal, provincial and municipal environmental legislation, bylaws and policies were reviewed for their application to this project (Appendix B). Because the project is taking place over a watercourse, construction of this project will require federal and provincial approvals. As is often the case, several provincial and federal statutes prohibiting harm to select resources are relevant to project construction; however, Bylaw 7188 is the only trigger for an environmental assessment. Table 2.1 presents a summary of environmental legislation and bylaws identified as applicable to this project. Additional legislation/bylaw detail is provided in Appendix B.

Several other municipal permits, such as OSCAM, may be required, depending on proponent activity.

Table 2.1. Summary of Applicable Legislation and Bylaws (details in Appendix B)

Legislation or Policy	Regulatory Agency	Authorization/ Approval/Permit Required	Approval Timeline or Potential Schedule Impact
Bylaws Requiring Approvals - Municipal			
***North Saskatchewan River Valley Area Redevelopment Plan* (Bylaw 7188)**	City Planning	EIA required. Must be approved by the Urban Planning Committee	Committee date for approval of the EIA anticipated in winter 2021.
***Corporate Tree Management Policy* (C456C)**	City Forestry	Proponent to collaborate with City Forestry regarding City owned trees and shrubs in the project area	Proponent responsibility
City of Edmonton (Bylaw 18100) - EPCOR Drainage Services Bylaw	EPCOR	Permit to discharge into storm sewer system may be required	Proponent responsibility
***City of Edmonton Parkland* (Bylaw 2202)**	City of Edmonton	Permit required to stage for construction	Proponent responsibility
Acts Influencing Construction Methods - Provincial			
Public Lands Act	Alberta Environment and Parks (Land Management Branch)	Any work within the bed and shore of a crown claimed body of water will require a *Public Lands Act* disposition	AEP determined that the bridge crossing falls within the boundary of registered road plan 3344PX and is, therefore, outside the jurisdiction of AEP and does not require a *Public Lands Act* disposition.
Water Act* and *Wetland Policy	Alberta Environment and Parks (Water Approvals Branch)	An approval is required for all activities that may impact water and the aquatic environment, including taking water from a watercourse, realigning a watercourse and constructing within a watercourse. Temporary and permanent impacts to a wetland will require the submission and approval of a Wetland Assessment and Impact Form (WAIF).	CoP Notification submission at least 14 days prior to construction commencement. WAIF to be submitted with CoP.
Wildlife Act	Alberta Environment and Parks	No permit required; however, the act prohibits disturbing prescribed breeding wildlife.	Proponent responsibility. Vegetation clearing and/or bridge demolition between 20 April and 20 August may result in nest sweep findings that delay clearing and/or bridge demolition.

Legislation or Policy	Regulatory Agency	Authorization/ Approval/Permit Required	Approval Timeline or Potential Schedule Impact
Historical Resources Act	Alberta Culture, Multiculturalism and Status of Women (ACMSW)	All projects with potential to disturb historical, archaeological and paleontological resources will require Approval.	None. ACMSW granted approval on 04 December 2020 (see Appendix J).
Acts Influencing Construction Methods - Federal			
Fisheries Act	Fisheries and Oceans Canada (DFO)	Review and/or authorization is required if a project in or near water has potential to cause death of fish and the harmful alteration, disruption or destruction (HADD) of fish habitat. Permits may be sought for aquatic species at risk.	None. Letter of Advice received by MPA from DFO on 16 November 2020 (see Appendix K).
Migratory Birds Convention Act	Environment and Climate Change Canada	No permit required; however, violation of the act may result in penalties	Proponent responsibility. Vegetation clearing between 20 April and 20 August may result in nest sweep findings that delay clearing.
Species At Risk Act	Environment and Climate Change Canada	No permits required; however, violation of the act may result in penalties	Proponent responsibility. Schedule potentially impacted if species at risk found in the area.

2.4 Environmental Site Assessments

Parkland Geo-Environmental Ltd. (ParklandGEO) conducted a Limited Phase II Environmental Site Assessment (ESA) in the bridge project area to assess the environmental condition of the soil under the bridge and surrounding area based on the assumption that the existing bridge timber piles had been treated with creosote (ParklandGEO 2020a). ParklandGEO's complete Limited Phase II ESA report may be found in Appendix C. A summary of their scope of work and findings is provided below.

ParklandGEO's scope of work included:

- advancement of two boreholes (one on each side of Horsehills Creek) on 16 July 2020. Borehole 20-01 (west side of creek) was drilled to a depth of 25.3 m below grade and borehole 20-02 (east side of creek) was drilled to a depth of 19.5 m below grade.
- collection of soil samples at various depths. All samples were analyzed for vapours and kept in an ice-filled cooler to moderate temperature fluctuations.
- submission of samples to AGAT Laboratories Inc. for benzene, toluene, ethylbenzene, xylenes (BTEX), petroleum hydrocarbon, metals and salinity analysis.

Overall, based on analytical results and field observations, salinity, metal and hydrocarbon impacts were not identified at the bridge location. Selenium concentrations were found to be above the Tier 1 Guidelines; however, this is common for these types of soils in the Edmonton area and the high concentrations are expected to be naturally occurring (ParklandGEO 2020a; Appendix C).

3.0 ENVIRONMENTAL CONTEXT

3.1 Overview of Study Area and Adjacent Lands

Horsehills Road Bridge is located in northeast Edmonton (SW-17-54-23-4) and crosses over Horsehills Creek, a tributary to the North Saskatchewan River (NSR), which is located approximately 3.8 km (straight-line distance) southeast of the bridge (Figure 1, Appendix A). Manning Drive is located approximately 35 m south of the bridge, 18 Street NW lies approximately 170 m west of the bridge and the Nanaksar Gurdwara Gursikh Temple is approximately 170 m east of the bridge. Agriculture is the primary land use in the area, with many woodlands and wetlands scattered across the landscape. Natural riparian vegetation can be found along Horsehills Creek throughout most of the region.

The EIA study area was defined at two scales: local and expanded. The local study area comprised the lands within and adjacent to the bridge that have potential to be directly affected by the proposed bridge replacement, permanently or temporarily (Figure 1, Appendix A). The expanded study area, framed by the mapped extent on Figure 1 in Appendix A, includes adjacent lands to the north and south which Horsehills Creek flows through that are structurally connected. The expanded study area was relevant to some resources such as wildlife movement.

3.2 Environmental Sensitivities

3.2.1 Original (2016) Mapping

Figure 4 (Appendix A) shows the results of the City of Edmonton environmental sensitivities analysis and classification mapping (Solstice 2016) in the project vicinity. In the local study area, Horsehills Creek is mapped as high value to the City. The ditch along Horsehills Road is mapped as high value on the north side of the road and moderate value on the south side of the road. The City considers high, very high and extremely high value as lands suitable for protection or conservation. Areas mapped as low and moderate value to the City are considered as good candidates for restoration.

3.2.2 Refined Mapping

Methods

Using the 2020 site-specific vegetation data and mapping, we re-analyzed the City of Edmonton's Environmental Sensitivities (2016) GIS layer for the local study area. In particular, we updated the input Ecological Asset scores for the Natural Vegetation ('AVegNat2' attribute), and for the Non-Native Vegetation ('A VegNoNat1' attribute). We reviewed wildlife data and found it to be similar to that used in the 2016 analysis. No other new data were available. Contours are from City of Edmonton open data. Overlay analysis (union function) was used to intersect the 2020 vegetation polygons with the 2016 Environmental Sensitivities polygons. This not only allowed us to update the relevant scores, but it also allowed us to break up larger 2016 mapped polygons to reflect finer scale 2020 mapped polygons. Scores were updated as shown in Table 3.1.

Table 3.1. Sensitivity Analysis Refinement

Where 2019 Vegetation were observed to be…	…the respective Environmental Sensitivities attribute was updated to:
Non-Forested Reed Canary Grass (NF.13)	Natural Vegetation ('AVegNat2' attribute) = 2 score
Seasonal Graminoid Marsh (M-G-III)	Natural Vegetation ('AVegNat2' attribute) = 2 score
Non-Forested Smooth Brome (NF.7)	Non-Native Vegetation ('AVegNoNat1' attribute = 1 score

With the scores updated, the Environmental Sensitivities analysis - whereby Assets, Threats and Constraints were summed - was re-run using the model formula as per originally prescribed by Solstice Canada (2016) to produce the new cumulative Environmental Sensitivities layer for the study site. The original final score categorical classes were used to bin the new scores.

Description

The revised Environmental Sensitivities map (Figure 5, Appendix A) shows some changes in mapping within the local study area. Lands adjacent to Horsehills Creek and in the ditch north of Horsehills Road, formally mapped as high value, are now mapped as very high value. The majority of the ditch south of Horsehills Road was originally mapped as moderate value and is now partially mapped as high value to the City. The portion of the south ditch that is still mapped as moderate value is located adjacent to the roadway. It should be noted that Horsehills Road and the bridge are not mapped because they are developed areas.

3.3 Surface Water, Groundwater and Fish Habitat

3.3.1 Methods

Surface Water

Surface water flows in the proposed project area were described based on examination of topographic maps and field observations. Available literature, environmental assessments and overviews prepared by Spencer Environmental and others were reviewed for additional information.

Groundwater

ParklandGEO installed nested piezometers within two boreholes on 16 July 2020 (ParklandGEO 2020b, Appendix D). Boreholes were drilled on either side of the bridge and creek through the road surface. Groundwater conditions were noted during borehole drilling, upon completion of piezometer installation and on 06 August 2020. ParklandGEO's full report is provided in Appendix D.

Fish Habitat

A Qualified Aquatic Environmental Specialist (QAES) from MPA undertook a fisheries field investigation of the bridge site in March 2020 (MPA 2020a, Appendix E). To gain an

understanding of the potential fish habitat up and downstream of the bridge crossing the watercourse was visually observed and photographed upstream and downstream of the crossing location and any observed obstacles or barriers to fish movement were recorded. MPA's full QAES report can be found in Appendix E.

3.3.2 Description

Surface Water

Horsehills Creek is the most significant feature in the project area and generally meanders southeast towards the North Saskatchewan River. The Horsehills Creek basin drains low-relief uplands presently dominated by agricultural land use through a relatively steep valley to the North Saskatchewan River. The first order tributaries are dominantly intermittent, vegetated swales (GeoMorphix 2015), and perennial flow is restricted to the lowest portion of the channel network. There are many localized impoundments throughout the upper portion of the drainage network due to beaver and agricultural activity. The average channel width is 2.0 m, with the streambed width in the vicinity of the existing bridge approximately 3.5 m wide (MPA 2020b). The channel capacity flow obtained using this channel geometry, the HIS channel slope and the Channel Capacity Calculator developed by Alberta Transportation is 13.5 m^3/s (MPA 2020a).

Plate 3.1. View of Horsehills Creek upstream (left) and downstream (right) of the bridge crossing (19 June 2020).

Horsehills Creek is an unmapped Class C water body with a fisheries Restricted Activity Period (RAP) from 16 April to 30 June (AESRD 2012).

A formal wetland assessment was not undertaken for this EIA. However, through desktop review of aerial imagery, a fringe wetland can be seen along Horsehills Creek just north of the bridge (Figure 2, Appendix A). The wetland is approximately 4.3 ha in size and encompasses most of the floodplain along the section of Horsehills Creek from 18 Street to Horsehills Road. Only a small portion of the wetland is located in the local study area. According to the Alberta Wetland Classification System (AESRD 2015) this wetland would be classified as a seasonal graminoid marsh. It is possible that this wetland was

created due to a beaver dam located north of the bridge; however, considering that beaver dams have been present in this area for many years this wetland would likely be considered naturally occurring by Alberta Environment and Parks (AEP).

Groundwater

Groundwater infiltration and sloughing were observed in both boreholes during drilling, generally within the sand lenses and just below rafted clay shale (ParklandGEO 2020b, Appendix B). Groundwater levels were measured at 2.2 m below ground in borehole one and 4.0 m below ground in borehole two on 16 July 2020, and at 6.36 m and 1.17 m below ground at borehole one and 1.12 m and 1.15 m below ground at borehole two on 06 August 2020 (ParklandGEO 2020b).

Groundwater elevations are expected to fluctuate on a seasonal basis and will be highest after periods of heavy precipitation and snowmelt (ParklandGEO 2020b).

Fish Habitat

At the bridge crossing location Horsehills Creek is slow flowing (MPA 2020a). Riparian vegetation was intact and consisted of mainly grasses, sedges and sparse willows. The substrate consisted of mainly fine silty material (MPA 2020a).

No gravel substrate was noted during the March 2020 field investigation; therefore, no habitat was present for gravel spawning fish species (MPA 2020a). Spawning habitat for vegetation spawning species was ranked as low due to small amounts of in-stream vegetation (MPA 2020a). Minimal amounts of suitable rearing habitat were observed up and downstream of the bridge crossing and habitat would only be suitable for hardy, non-sport species (MPA 2020a). Satellite imagery shows many beaver dams downstream of the bridge crossing. It is very likely that some of these dams are impassable to fish, and fish in the NSR that wish to migrate into Horsehills Creek would not be able to access the majority of the habitat provided by the creek (MPA 2020a). Since the majority of Horsehills Creek is anticipated to freeze to the bottom during winter, the overwintering potential was ranked as low (MPA 2020a).

3.4 Geology/Geomorphology

3.4.1 Methods

ParklandGEO (2020b) (Appendix D) undertook field investigations on 16 July 2020. Two boreholes were drilled, one to a depth of 25.3 m below ground and another to 19.5 m below ground. Soil was examined and classified during drilling using the Modified Unified Soil Classification System; soil samples were taken from 0.75 m for the first 7 m followed by 1 m intervals to determine the soil moisture profile and vapour readings. Standard Penetration Tests (SPTs) were performed at depth intervals of 1.5 m. Soil samples were tested for moisture content, Atterberg Limits, water soluble sulphate concentrations, grain size distribution, pH and resistivity testing.

ParklandGEO (2020b) determined slope stability by conducting limit equilibrium analysis using the Slope/W software program to evaluate the factor of safety (FS) for representative slope profiles. The FS was calculated using the Morgenstern-Price Method and a variety of parameters to assess the model sensitivity.

A summary of ParklandGEO's (2020b) findings is provided below. ParklandGEO's full report can be found in Appendix D.

3.4.2 Description

The site is located within the Upper Cretaceous Edmonton Bedrock Formation (ParklandGEO 2020b). The Edmonton bedrock formation primarily consists of sandstone, siltstone and clay shale containing coal and bentonite seams (ParklandGEO 2020b). The general soil profile encountered was asphalt road surface, underlain by gravel/clay fill, which was underlain by lacustrine clay, rafted clay shale and clay. The clay shale had a resistivity of 166 ohm/cm and a pH of 8.24. The lacustrine clay had a resistivity of 210 ohm/cm and a pH of 7.47 (ParklandGEO 2020b). Water soluble sulfate concentration tests indicated a moderate to very severe potential for sulphate attack on subsurface concrete in contact with native soils (ParklandGEO 2020b).

Based on an embankment height of 2 m that consisted entirely of clay fill and groundwater 1 m below the road surface, the steepest embankment side slopes for this site are 3.5H:1V to achieve an FS of 1.5 for long term slope stability (ParklandGEO 2020b).

3.5 Vegetation

3.5.1 Methods

Vegetation in the local study area and immediately adjacent lands was characterized by undertaking the following tasks:

- Desktop preliminary plant community delineations using high resolution remote imagery.
- Plant communities were classified following the Urban Ecological Field Guide for the City of Edmonton, Alberta, Canada (City of Edmonton 2015). Manicured lands present were classified as such. Wetland plant communities were classified using the Alberta Wetland Classification System (AESRD 2015).
- The Alberta Conservation Information Management System (ACIMS) (AEP 2020) was searched for all records of special status plant species within the project area. Site accessed on 03 March 2020. The area searched consisted of legal section 17-54-23-W4M.
- Plant community inventory and rare plant survey conducted on 16 July 2020 to characterize communities and identify occurrences of rare plants. A complete species list is available in Appendix F. Scientific and common names follow ACIMS (2019) nomenclature.

3.5.2 Description

The following plant communities were mapped in the study area (Figure 6, Appendix A):

- Non-Forested Smooth Brome - Level Slopes (NF.7)
- Non-Forested Reed Canary Grass (NF.13)
- Seasonal Graminoid Marsh (M-G-III)

3.5.2.1 Non-Forested Smooth Brome - Level Slopes (NF.7)

This community is characterized in City of Edmonton (2015) as being anthropogenic in origin and dominated by species of grasses, particularly the exotic species, smooth brome (*Bromus inermis*). This community tends to occur on nutrient rich soils.

In the local study area, the non-forested smooth brome community was located along the roadsides, ranging in width from approximately 1 m to 3 m (Figure 6; Plate 3.2). This community generally conformed to the description provided above and was characterized in the local study area as being dominated by grass species, such as quackgrass (*Elymus repens*), slender wheatgrass (*Elymus trachycaulus*) and foxtail barely (*Hordeum jubatum*), with smooth brome being the dominant species. Frequent and occasional forbs included alsike clover (*Trifolium hybridum*), meadow horsetail (*Equisetum pratens*), tufted vetch (*Vicia cracca*), black medick (*Medicago lupulina*), common plantain (*Plantago major*) and common dandelion (*Taraxacum officinale*). Two shrub species, buckbrush (*Symphoricarpos occidentalis*) and red-osier dogwood (*Cornus stolonifera*), were also found in small patches throughout this community, with buckbrush being more common. Several noxious weed species were also found occasionally in this community including creeping thistle (*Cirsium arvense*), common tansy (*Tanacetum vulgare*), scentless chamomile (*Tripleurospermum inodorum*), white cockle (*Silene latifolia*) and perennial sow-thistle (*Sonchus arvensis*).

Plate 3.2. View to southwest of non-forested smooth brome - level slopes community adjacent the south side of Horsehills Road (16 July 2020).

3.5.2.2 Non-Forested Reed Canary Grass (NF.13)

City of Edmonton (2015) characterizes this community as being dominated by reed canary grass (*Phalaris arundinacea*), with low shrub cover. This community commonly occurs on moist, rich soils.

The non-forested reed canary grass community occupied the majority of the local study area, with the exception of the roadsides and wetland (Figure 6; Plate 3.3). This community generally conformed to the above description and was characterized in the field as being dominated by reed canary grass with a low shrub cover of basket willow (*Salix petiolaris*) and beaked willow (*Salix bebbiana*). Other frequently or occasionally occurring graminoids within this community included beaked sedge (*Carex atheroides*), fowl bluegrass (*Poa palustris*), wire rush (*Juncus balticus*), common tall mana grass (*Glyceria grandis*), slough grass (*Beckmannia syzigachne*), sweet grass (*Anthoxanthum hirtum*) and rough hair grass (*Agrostis scabra*). Occasionally occurring forbs within this community included water parsnip (*Sium suave*), common nettle (*Urtica dioica*), marsh hedge-nettle (*Stachys pilosa*), wild mint (*Mentha arvensis*), water smartweed (*Persicaria amphibia*), silverweed (*Potentilla anserina*) and purple stemmed aster (*Symphyotrichum puniceum*). Water sedge (*Carex aquatalis*) was the dominant species present within wet patches of this community. Wet areas occurred in low spots within this community, mainly within the ditch adjacent to Horsehills Road. Common cattail (*Typha latifolia*) also frequently occurred within these wet areas, as well as in patches adjacent to Horsehills Creek. Two noxious weed species, creeping thistle and perineal sow-thistle, were found scattered throughout this community.

Plate 3.3. View to northeast of the non-forested reed canary grass community adjacent to Horsehills Creek and upstream of the bridge; it was observed throughout most of the project area (16 July 2020).

3.5.2.3 Seasonal Graminoid Marsh (M-G-III)

The seasonal graminoid marsh wetland was analogous to the non-forested reed canary grass plant community; however, it was delineated as a wetland community due to frequent

inundation seen in historical aerial photographs (Plate 3.4). It was dominated by reed canary grass in moist areas, while water sedge dominated wet areas. Other frequently occurring graminoid species included beaked sedge, common cattail, common tall manna grass and slough grass. Forbs found within this community include mint, water smartweed and silverweed. Small numbers of basket willow and beaked willow were also scattered throughout the graminoid marsh community. The noxious weeds, creeping thistle and perineal sow thistle, were also observed scattered throughout the seasonal graminoid marsh plant community.

Plate 3.4. View to the northeast of the seasonal graminoid marsh plant community on the east side of Horsehills Creek (16 July 2020).

3.5.2.4 Special Status Species

In the City of Edmonton, rare plant species are considered those having an ACIMS conservation rank of S1, S2 or S3. S1 species are known from five or fewer locations in the province. S2 are species are known from 6-20 occurrences, and S3 species are known from 21-100 occurrences in the province. A search of ACIMS data conducted on 03 March 2020 returned no records of special status vascular plant species in the project area. A rare plant survey required by City Planning was undertaken on 16 July 2020; one special status species, false dragonhead (*Physostegia ledinghamii*; S3), was found within the seasonal graminoid marsh plant community. A description of this species and its occurrences is provided in the following section.

False Dragonhead (Physostegia ledinghamii)

False dragonhead is a forb in the mint family (Lamiaceae). It is characterized by a square stem, opposite lance-shaped leaves with serrate edges and pink flowers in a terminal spike with smaller spikes originating from the leaf axils (Plate 3.5) (Saskatchewan Wildflowers 2020). False dragonhead is typically found along stream banks and in moist woods (Saskatchewan Wildflowers 2020). It occurred as approximately 10 individuals in a single location (approximately 2 m^2) within the seasonal graminoid marsh plant community in

the local study area (Figure 6, Appendix A). No individuals were observed immediately adjacent to the bridge.

Plate 3.5. False Dragonhead (*Physostegia ledinghamii*), showing square stem, opposite lance-shaped leaves with serrate edges and a terminal flower spike (16 July 2020).

3.5.2.5 Weeds

The Alberta *Weed Control Act* defines two categories of weeds: noxious and prohibited noxious. Noxious weeds are generally those that are currently widespread in the province and are considered difficult to eradicate. Provincial legislation requires these species be controlled. Prohibited noxious weeds are those that are currently uncommon or absent in the province but have been identified as noxious due to their potential to invade and damage natural and cultivated systems. Alberta law requires that prohibited noxious weeds be destroyed where they are found.

Prohibited Noxious Species

No prohibited noxious species were observed during the 16 July 2020 rare plant survey.

Noxious Species

Noxious weeds found in the study area included creeping thistle, scentless chamomile, white cockle, perennial sow-thistle, and common tansy. All of these species are common on disturbed lands in the Edmonton area. Creeping thistle was the most widespread noxious species in the local study area, scattered throughout both identified plant communities.

3.6 Wildlife

3.6.1 Methods

Wildlife resources in the study area were characterized by undertaking the following tasks:

- One breeding bird survey in the local study area, as required by City Planning, was conducted on 19 June 2020, at 0719 hours, by a professional biologist experienced in breeding bird surveys. The survey comprised one, 80 m wide and 200 m long fixed-width transect (Figure 6, Appendix A). The transect was walked slowly at a rate of 15 to 20 m per minute and all birds detected within a distance of 40 m on either side of the transect were recorded.
- The study area was visually surveyed on 19 June 2020 for the presence of wildlife trees.
- Available habitat type, condition and quality was assessed through field observations and examination of study area vegetation data and maps.
- A search of FWMIS for all wildlife records for lands within a one kilometer radius of the local study area centre. FWMIS was accessed on 03 March 2020.
- A search of the eBird database on 18 June 2020 for records of special status bird species in the project area.
- A site visit to inspect the bridge for the presence of bird nests was conducted on 27 October 2020.
- A list of potential special status species was generated by considering all of the above and our knowledge of Edmonton wildlife communities and occurrences (Appendix G).
- All incidental wildlife and wildlife sign observations during all site visits were recorded.

3.6.2 Description

3.6.2.1 Available Habitat/Connectivity

The local study area was dominated by anthropogenic (roadway ditches) and natural habitat types comprising dense, tall grasses and sedges with pockets of low shrubs that were strongly influenced by ongoing American beaver (*Castor canadensis*) activity and the resulting wetland and riparian habitat (Plate 3.6). Beaver dams were present upstream of the bridge as well as downstream of the bridge inside the north and south ends of the 2100 mm culverts crossing under Manning Drive. No trees, including wildlife trees (i.e., trees with visible nests or large trees with cavities), were observed in the local study area. Overall, the structural and spatial diversity of the habitat in the local study area, particularly north of the roadway, provided high quality wetland and riparian habitat for a wide range of avian and mammal species.

Plate 3.6. View to north of Horsehills Creek, beaver dam and dense natural vegetation from bridge B130 (19 June 2020).

The Horsehills Creek corridor is regionally considered a natural linkage in the City of Edmonton's Ribbon of Green and ecological network in northeast Edmonton (City of Edmonton 1990, 1992 and O2 2020, and Spencer Environmental 2006). Large, medium- and small-sized urban-adapted wildlife use the matrix of habitat patches associated with Horsehills Creek and its tributaries to move across an agricultural landscape bisected by transportation infrastructure (arterial, collector and local roadways and railways), including on the level tablelands in the project area. Manning Drive (Highway 15), a four-lane, divided highway located approximately 30 m south of the Horsehills Road bridge, poses the most significant barrier to wildlife movement in the regional and project area and effectively creates a dead end for wildlife movement along the Horsehills Creek corridor at this location. Large and medium-sized animal species (e.g. deer, moose and coyote) may be able to cross the four-lane highway with some success, particularly at night during lower traffic volumes, however crossing locations are abundant in the level landscape and there are no pinch points where they would be forced to cross at a specific location. At a local level, two relatively large culverts (2100 mm) convey Horsehills Creek under Manning Drive immediately downstream of the bridge and may allow some smaller-bodied animal species to cross under Manning Drive as an alternate to crossing over the highway when the culverts are not inundated with water. Beaver tracks and beaver dams were observed inside the ends of one of the culverts during the October 2020 site visit. Coyote tracks were also observed at the entrance of one of the culverts during that site visit, suggesting they may use the culvert for passage underneath the roadway and/or for hunting (e.g., American beaver).

During bridge preliminary design, the AADT for Horsehills Road was estimated to be between 200-400 vehicles per day (MPA 2020). According to the City of Edmonton's Wildlife Passage Engineering Design Guidelines (WPEDG)(City of Edmonton 2010), Horsehills Road is, therefore, considered a local road (<1000) with the main function of providing access to properties. Local roads may be considered barriers to movement by slow moving members of the amphibian (AMP) and small terrestrial (ST) ecological design groups (EDG's), however, they are not considered a barrier to birds, bats and medium or

large terrestrial (MT and LT, respectively) EDG's. In this case, the existing bridge is somewhat permeable to local movements of AMP and ST EDG's, particularly under low water conditions, despite the presence of vertical abutment walls and wooden struts spanning the width of the creek under the bridge. Beaver (MT EDG) are also able to pass under the bridge under current conditions.

The existing bridge does have a relatively low clearance with a calculated openness ratio of 1.37, however, movement under the bridge by large-sized animals is impeded by the presence of several wooden struts across the width of the bridge and creek channel and high water levels at some times of the year (Plate 3.7). The Horsehills Creek corridor is relatively wide and level and permeable to wildlife movement in the local study area and so it is likely that most large-, medium- and small-sized animals cross over the surface of the two-lane, local Horsehills Road when travelling through the area north of Manning Drive.

Plate 3.7. View to south under existing bridge with wooden struts (27 October 2020).

3.6.2.2 Documented and Potential Wildlife

Avifauna

Breeding Bird Survey

The EIA's breeding bird survey provides a snapshot of avian use in the project area. The survey recorded 21 individuals across 10 species (Table 3.2; Figure 6; Appendix A). This resulted in a relatively high density of birds of 13.13 birds/ha, which was a reflection of the high quality and diversity of habitat present in the local study area, particularly in the wetland to the north of the bridge where most individuals were heard and/or observed. Most passerines were singing territorially, indicating breeding behaviour and a clay-colored sparrow was observed carrying nesting material near a willow shrub. A female bufflehead was with eight (8) newly hatched ducklings, providing evidence of successful

breeding. An additional four (4) species were incidentally observed outside the transect survey area in the habitat north of the bridge including house sparrow, house wren, song sparrow and sora. All species observed are known to commonly breed in suitable habitat in the Edmonton area except for the barn swallow, a federal and provincial special status species. While this species may be observed in the Edmonton area it is not common (see Special Status Species section below for further discussion of this species).

Table 3.2. Birds detected during fixed-width transect survey, inside and outside survey area (19 June 2020)

Species Common Name	Scientific Name	Total Birds Detected Inside Transect Area (1.6 ha)	Total Birds Detected Outside Transect Area (Incidental)
Barn swallow*	*Hirundo rustica*	2	
Bufflehead	*Bucephala albeola*	1	
Blue-winged teal	*Spatula discors*	1	
Clay-colored sparrow	*Spizella pallida*	3	2
House sparrow			1
House wren	*Troglodytes aedon*		1
Le Conte's sparrow	*Ammodramus leconteii*	3	
Northern Shoveler	*Spatula clypeata*	1	
Red-winged blackbird	*Agelaius phoeniceus*	4	1
Savannah sparrow	*Passerculus sandwichensis*	3	1
Sedge wren	*Cistothorus platensis*	1	
Song sparrow	*Melospiza melodia*		1
Wilson's snipe	*Gallinago delicata*	2	
Sora**	*Porzana carolina*		1
Total Birds Detected		**21**	**8**
Species Richness		**10**	
Bird density (birds/ha)		**13.13**	

*Special status species (federal *Species At Risk Act – Threatened* (Schedule 1), provincial status (2015) - *Sensitive*)
**also identified in FWMIS database search

Barn swallow, sora and red-winged blackbird were also incidentally observed during the rare plant survey on 16 July 2020.

Although no evidence of nesting under the bridge was observed in October 2020, bridges may be used by passerines such as some species of swallows as nesting structures.

Mammals

Incidental mammal observations recorded during all site visits included the presence of a beaver dam across Horsehills Creek north of the bridge. Beaver chewed shrub stems were observed under the bridge during the October 2020 site visit as well as extensive beaver tracks and a trail in the sediment leading to a mud and stick dam in the north end of one of the culverts immediately downstream of the bridge. Coyote tracks were also observed near the same culvert in October.

3.6.2.3 Special Status Species

Based on species habitat requirements, an understanding of the available habitat, provincial species distributions, species records in the FWMIS database and field data from this study, two special status species were identified as having at least some potential to occur in the local study area. The following section discusses the potential occurrence of species that are ranked by the Province as *At Risk* or *May be At Risk*, or, have been federally assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as either *Endangered, Threatened,* or *Special Concern,* and were rated by this study as having at least a moderate likelihood of occurrence within the local study area (Table 3.3). In addition, all species on Schedule 1 of the *Species at Risk Act* (SARA) with ranges that include Edmonton and for which suitable habitat is available in the project area are included for discussion. Species having a provincial status of *Sensitive*, but no federal status, hold no potential to trigger project considerations beyond those applicable to wildlife in general, and, thus, are not discussed, even if their potential for occurrence was considered moderate or high.

The FWMIS search returned records of four special status species observed within 1 km of the project area: fisher (*Pekania pennanti*), great blue heron (*Ardea herodias*), least flycatcher (*Empidonax minimus*) and sora (as noted above, sora was detected at the bridge site). All species are provincially ranked as *Sensitive* with no federal ranking and will not be discussed further here.

FWMIS sensitive species range records indicate that the study area falls within the province's sharp-tailed grouse (*Tympanuchus phasianellus*) survey area and the bald eagle (*Haliaeetus leucocephalus*) range (AEP 2020). Sharp-tailed grouse are not expected to occur within the local study area because suitable grassland/shrubland habitat is not present. No suitable bald eagle perching or nesting sites are present in the local or expanded study areas.

A search of the eBird database returned no additional records of special status bird species for the local study area.

Table 3.3. Special Status Wildlife Species with Potential to Occur in the Study Area

Common Name	Scientific Name	Provincial Status (General Status of AB Wild Species 2015)	Wildlife Act Designation *	COSEWIC Designation	SARA Designation (Schedule 1)	Observed /Previous Record**	Likelihood of Occurrence	Potential Habitat Use
Western toad	*Anaxyrus boreas*	Sensitive	None given	Special Concern	Special Concern		Moderate	Breeding /Foraging
Barn Swallow**	*Hirundo rustica*	Sensitive	None given	Threatened	Threatened	BBS, FWMIS	High	Breeding /Foraging

* Under the *Wildlife Act,* select species carry a designation of Threatened or Endangered; additional species assessed by the Endangered Species Conservation Committee (ESCC) also have these designations
**BBS = observation recorded on 19 June 2020 during breeding bird survey

Western toad

Western toads use a wide variety of aquatic habitats for breeding including shallow (< 1m) water bodies such as lakes, ponds, streams and ditches with emergent and flooded shoreline vegetation (COSEWIC 2012). Adult toads may remain and forage in adjacent marshes or riparian edges of breeding sites or they may travel up to several kilometers to other wetlands, riparian areas along streams or upland sites such as forests, meadows and shrub lands. In Alberta, hibernation sites are generally located in natural habitats, especially in coniferous forest stands, as opposed to human-modified or open habitats. While no amphibian surveys were conducted in support of the bridge replacement project, suitable breeding and foraging habitat is available in the local study area for this species. Wintering habitat may be less available. In the greater Edmonton region, we have observed that this species range is more restricted than the commonly occurring boreal chorus and wood frog. The likelihood of occurrence in the project area is therefore rated as moderate.

Barn swallow

Two barn swallows were observed flying around north of the bridge in the local study area during the 19 June 2020 breeding survey and then again during the rare plant survey in July 2020. This species often nests on bridges and buildings by constructing nests from mud and then fastening them to a vertical wall or on a horizontal ledge underneath an overhang (Brown and Brown 2019). While they could potentially build and use a nest under the subject bridge, the behaviour of these birds suggested foraging rather than breeding/nesting in the local study area as they were not observed approaching the bridge. Water levels were too high to inspect under the bridge in June and July 2020, however, we did inspect the bridge on 27 October 2020 and did not observe any evidence of bird nests under the bridge. It could be that these birds are using other nearby bridges or buildings for nesting and using the habitat in the local study area for foraging only. The likelihood of occurrence in the project area is thus rated as high for foraging based on current conditions.

3.7 Historical Resources

3.7.1 Methods

Circle CRM Group Inc. (2020) prepared an application pursuant to the *Historical Resources Act* (HRA) in support of the proposed project. They undertook a desktop review of the provincial Listing of Historic Resources (2020), project design drawings and aerial photographs with an overlay of the project footprint. The application was submitted to Alberta Culture, Multiculturalism and Status of Women (ACMSW) on 12 November 2020 for the department's review and comment regarding possible requirements pursuant to the HRA.

3.7.2 Description

Circle CRM Group Inc. (Circle CRM) determined that Horsehills bridge is located on lands designated with a Historic Resource Value (HRV) of 5 (high potential to contain a historic resource) for archaeology and is located within a High Archaeological Resource Zone. No known historic resource sites are located within one kilometer of the proposed project and the majority of the project footprint occurs in previously disturbed lands in the roadway right-of-way. Based on this information, Circle CRM determined there is limited potential to have significant impact to significant historical resources and recommended that *Historical Resource Act* Approval be granted for the project. ACMSW agreed with this recommendation and granted approval for the project on 04 December 2020 (Appendix J).

4.0 THE PROJECT

4.1 Project Description

During preliminary design, MPA (2020b) considered all feasible replacement alternatives for replacement of the existing B130 bridge. Due to the poor condition of the existing structure, no maintenance alternatives were considered, and four replacement structure alternatives were reviewed. Based on life cycle costing and other considerations, MPA's recommended alternative (Alternative #2) comprised replacing the existing bridge with a new 10 m SLW bridge including gradeline revisions to raise the elevation of the bridge by approximately 450 mm (MPA 2020b). The City accepted this recommendation and consequently MPA proceeded with detailed design for bridge replacement Alternative #2 and the associated Horsehills Road approaches. That detailed design is the subject of this EIA.

The proposed new SLW-510 girder bridge (new bridge number B481) will be a single span, 10.16 m wide and 10 m long bridge constructed in the same footprint as the existing bridge (Appendix H) (MPA 2020b). The width of the new bridge will be an improvement over the existing 8.2 m bridge width with respect to roadway safety. The 10 m span over the creek will allow for a more conservative hydraulic opening compared to existing conditions, will not require instream piers and will avoid pile conflicts with the existing bridge. The new bridge substructure will comprise concrete abutments on steel H-piles. Concrete abutments will provide better resistance to corrosive road salts from nearby Manning Drive to the east (MPA 2020b). The bridge will be raised by 0.45 m to an elevation of 652.03 m, providing 0.01 m of freeboard at the design 1:50 year flood event, an improvement over the existing structure. The higher bridge elevation will require raising the grade of Horsehills Road by approximately 450 mm over a distance of 240 m adjacent the bridge (MPA 2020b). Owing to the roadway grade raise, sideslopes and ditches will be reconstructed/modified and there will be some disturbance of the creek channel in the vicinity of the bridge. Based on survey information, the ditch slopes are considered mild in the vicinity of the bridge and no significant drainage is anticipated from the new bridge (MPA 2020b). Class 1 heavy riprap will be placed over non-woven geotextile on the abutment slopes and keyed into the creek bed to maintain slope stability. An approximately 1.5 m wide section of smooth creek bed will remain down the centerline of the channel to facilitate small and medium-sized wildlife movement under the new bridge. All disturbed sideslopes and ditches will be topsoiled and seeded at the end of the construction. Guardrails and bridge rails have been included in the proposed bridge design to meet roadway safety requirements (MPA 2020b).

The existing bridge comprising concrete girders and treated timber substructure will be removed and disposed of appropriately. This will include removal and disposal of existing bridge girders, abutments, wing wall piling and bridge appurtenances (MPA 2020b).

Demolition of the existing bridge and construction of the new bridge is expected to require instream work in Horsehills Creek. It will also require a temporary local road closure of Horsehills Road and a detour via Manning Drive (Plate 4.1).

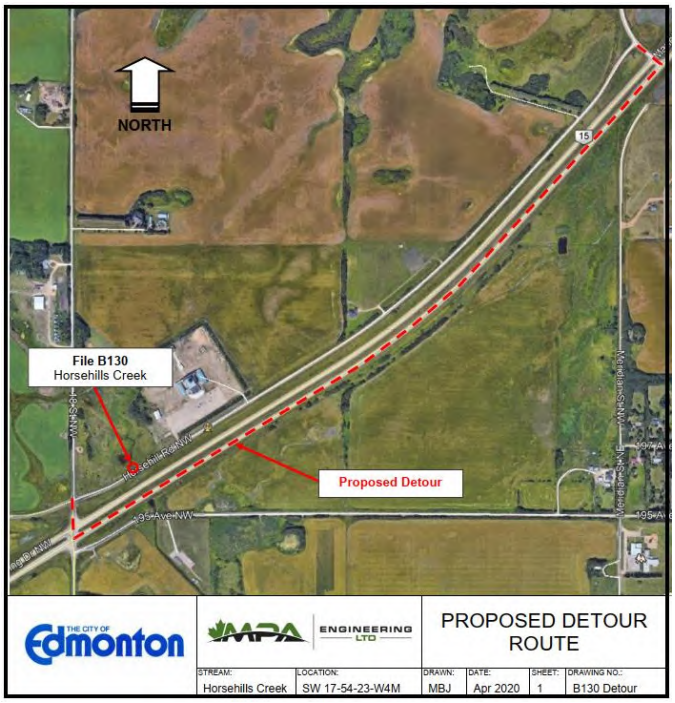

Plate 4.1. Proposed detour route during the local road closure of Horsehills Road (MPA 2020b).

4.2 Construction Schedule

Bridge replacement and adjacent roadway upgrading construction is tentatively scheduled to occur 01 May – 31 October 2021. No instream work will be permitted during the fisheries Restricted Activity Period (RAP) 16 April 16 – 30 June without QAES recommendations and notification to AEP.

4.3 Construction Laydown Area and Access

Construction storage areas and access will be located on asphalt within the existing Horsehills Road ROW and away from Horsehills Creek. Specific laydown locations will be identified by the project proponent and the successful contractor prior to the initiation of construction. The successful contractor will prepare a project-specific ECO Plan in accordance with the *Environmental Construction Operations (ECO) Plan Framework: Municipal Version (2020 Edition)*and will be reviewed by the City's consultant to ensure it meets all environmental regulations prior to commencement of construction.

4.4 Project Phases and Associated Key Activities

The expected general scope of construction methodology will be as follows (M. Johnson, *pers. comm.*):

4.4.1 Site Preparation

- Notification of local residents, businesses and institutions of the proposed construction schedule, temporary road closure and detour.

- Coordinate access for project equipment and site security.
- Closure of the local section of Horsehills Road to public traffic and install appropriate warning and detour signage.
- Establishment of construction staging areas.
- Removal of existing vegetation within the established disturbance boundaries.
- Remove and stockpile all wetland soils and topsoil prior to any disturbance for reuse.
- Install temporary silt fencing as required around any stockpiles or exposed soil to prevent siltation of the watercourse.
- Isolate in-stream work and conduct fish capture and release as required.

4.4.2 Bridge Demolition

- Remove and dispose of the existing bridge rail and guardrail.
- Remove and dispose of all concrete girders.
- Remove all treated timber backwall planks and cut off treated timber piles at least 300 mm below streambed.
- All existing bridge material will be disposed of at an appropriate disposal site.

4.4.3 Bridge and Roadway Approach Construction

- Drive the piles for each abutment.
- Form the concrete abutments, install reinforced steel and pour concrete.
- Backfill behind the backwalls and for the headslopes.
- Install Class 1 rock riprap on the headslopes.
- Erect precast concrete girders on the abutments.
- Cast the approach slabs.
- Complete road grading.
- Install and compact the basecourse.
- Install the bridge deck waterproofing.
- Place and compact ACP on the bridge and road approaches.
- Install the new bridge rail and guardrail.

4.4.4 Reclamation/Landscaping

- No formal restoration plan will be prepared for this local road bridge replacement project.
- All disturbed areas will be recontoured, topsoiled and seeded with a City of Edmonton approved naturalization seed mix.
- Reclamation of the disturbed seasonal graminoid marsh plant community will require placement of wetland soils and/or topsoil seeded with a wet meadow seed mix (see Section 5.2.5).
- A small amount of erosion control matting will be installed in disturbed areas at all four corners of the bridge where the ditch transitions to the creek.

5.0 PROJECT IMPACTS AND MITIGATION MEASURES

5.1 Assessing Impacts

5.1.1 Potential Impact Identification and Analysis

Based on the environmental context described in Section 3, the following Valued Ecosystem Components (VECs) were identified for impact assessment: surface water quality, temporary wetland impacts, channel hydraulics, fish and fish habitat, creek bank slope stability, vegetation and wildlife. For each VEC, potential impacts to be examined were identified by overlaying the project drawings on mapped resources, reviewing project activities, conferring with multidisciplinary project team members, reviewing project reports and applying our professional experience with impact assessment and construction performance auditing in other, similar, projects. This process resulted in identification of specific potential impacts that warranted assessment.

In addition, we separately examined the potential for the following select project incidents to occur and impact natural resources:

- Release of hazardous/deleterious substances on or off-site
- Release of sediment or other debris on or off-site

5.1.2 Impact Characterization

Identified impacts were characterized according to guidance received from the EIA Terms of Reference (Table 5.1). Potential impacts were characterized with respect to nature (positive or negative, direct or indirect), magnitude (negligible, minor, or major), duration and timing (temporary, permanent or seasonal), geographic extent and likelihood. These criteria were defined as shown in Table 5.1:

Table 5.1: Impact Descriptor Definitions.

Nature of Impact	
Positive Impact	An interaction that enhances the quality or abundance of physical features, natural or historical resources.
Negative Impact	An interaction that diminishes the abundance or quality of physical features, natural resources or historical resources.
Direct	An interaction that results in the loss or reduction of a resource/feature.
Indirect	An interaction that results in off-site impacts, such as sedimentation off-site.
Magnitude	
Negligible Impact	An interaction that is determined to have essentially no effect on the resource. (Such impacts are not characterized with respect to direction duration or confidence.)

Minor Impact	An interaction that has a noticeable effect but does not eliminate a local or regional population, physical feature or affect it beyond a defined critical threshold (where that exists).
Major Impact	An interaction that affects a local or regional population, resource, or physical features beyond a defined critical threshold (where that exists) or beyond the normal limits of natural perturbation.
Duration and Timing	
Temporary Impact	A change that does not persist indefinitely.
Permanent Impact	A change that persists indefinitely.
Seasonal Impact	A change that will terminate or diminish significantly after one season.
Geographic Extent	Extent of area affected. Quantify where feasible.
Likelihood	What is the probability that the impact will occur? Is it likely or unlikely?

When applying these descriptors, we considered the project described in Section 4. No additional mitigation measures were applied at the time of potential impact characterization.

5.1.3 Mitigation Development and Residual Impact Assessment

Mitigation measures were developed for all identified negative impacts. Any impact anticipated to remain following mitigation implementation was termed a residual impact. As with potential impacts, residual impacts were characterized with respect to: nature, magnitude, duration and timing, geographic extent and likelihood.

5.2 Impact Assessment Results and Mitigation Measures

5.2.1 Surface Water Quality

Instream and near stream works associated with demolition of the existing bridge and construction of the new bridge and associated disturbances to the adjacent riparian areas have potential to create sediments that could enter Horsehills Creek and travel downstream. There is also potential for accidental releases into the creek. Any spills or mobilized sediment on site could enter Horsehills Creek and travel downstream. These types of impacts are assessed below in Section 5.2.8.

5.2.2 Improved Channel Hydraulics

Impacts

The proposed design of the new bridge will comprise a longer single span truss (10 m), creating a wider channel opening compared to current conditions (8.2 m). In addition, the existing timber struts under the current bridge will be removed with the new design, further improving flow through the hydraulic opening. The underside of the new bridge will also be higher than the existing bridge, providing an extra 0.01 m of freeboard at the design 1:50 year event. Based on this information, the new bridge is expected to result in improved creek hydraulics at the bridge crossing location compared to existing conditions and is, therefore, rated as a positive, direct, minor, permanent and likely impact to creek hydraulics.

Mitigation and Residual Impacts

No mitigation measures required. Residual impacts will remain positive, direct, minor, permanent and likely.

5.2.3 Fish and Fish Habitat

Impacts

Instream works associated with demolition of the old bridge and construction of the new bridge have potential to cause death of fish or harmful alteration, disruption or destruction (HADD) of fish habitat, which is prohibited under the federal *Fisheries Act*. If appropriate measures are not taken to avoid harming fish or fish habitat, impacts to fish and fish habitat are anticipated to be a negative, direct, major, permanent, local, likely impact. It is rated as major because it represents contravention of the law.

Mitigation and Residual Impacts

MPA's (2020a; Appendix E) fisheries assessment recommends several mitigation measures and best management practices to ensure neither HADD nor death of fish will occur during bridge construction activities. These measures include:

- No instream construction activity should take place during the designated RAP extending from 16 April to 30 June.
- Site isolation measures (e.g., silt boom or floating silt curtain) should be utilized for containing suspended sediment where in-water work is required (e.g., pile driving to minimize sediment in the water course.
- All instream activities will be isolated from open or flowing water and constructed in a way to maintain the natural flow of water downstream and to avoid introducing sediment into the watercourse.
- Earthen material should not be used to isolate the work site.
- Sediment and erosion control measures must be implemented prior to start of work and maintained until works are completed. Sediment generation and disturbance to the banks should be minimized as much as possible. The sediment and erosion control measures will be inspected regularly.

- If flowing water is present at the time of construction the watercourse should be visually monitored and the contractor shall be responsible for controlling the release of sediment when completing instream works.
- All reasonable efforts should be made to minimize the duration of construction. Construction crews should have all necessary materials and equipment prepared on site before beginning. Ensure maintenance of downstream flow (in terms of quality and quantity) at all times when constructing the isolated crossing. If a dam and pump isolation method is used to maintain downstream flow, backup pumping capacity must be on site and ready to take over pumping immediately if operating pumps fail. Pumps are to be continuously monitored to ensure downstream flow is maintained at all times until the dam materials are removed and normal flows restored to the channel. Alternatively, if a clean flow bypass method is used, the diversion methods must be designed to accommodate potential high flow events (i.e., secured in place and the receiving channel must be of sufficient capacity.
- Pumps used at fish-bearing waterbodies should be screened with a maximum mesh size of 2.54 mm and a maximum screen approach velocity of 0.038 m/s. The maximum screen velocity can be achieved by placing pump intakes in a metal cage with a mesh size of less than 2.54 mm.
- Screens should be located in areas and depths of water with low concentrations of fish throughout the year and away from natural or artificial structures that may attract fish that are migrating, spawning or in rearing habitat. The screen face should be orientated in the same direction as the flow.
- Ensure that openings in the guides and seals are less than the opening criteria to make “fish tight”.
- Screens should be located a minimum of 300 mm above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
- Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.
- Large cylindrical and box-type screens should have a manifold installed in them to ensure even water velocity distribution across the screen surface. The ends of the structure should be made from solid materials and the end of the manifold should be capped.
- Provision should be made for the removal, inspection and cleaning of screens.
- Ensure regular maintenance and repair of cleaning apparatus, seals and screens is carried out to prevent debris-fouling and impingement of fish.
- Pumps should be shut down when fish screens are removed for inspection and cleaning.
- The contractor will minimize any disturbance to aquatic resources during construction.
- Disturbance of riparian vegetation will be kept to a minimum. Disturbed areas will be stabilized, vegetated and/or seeded as soon as possible after construction.
- Equipment will be refueled and serviced to ensure that deleterious substances do not enter any watercourse. Equipment operating near any watercourse will be clean and free of external oil, grease, mud or fluid leaks. Consideration should be given to the use of non-petroleum based oils for machinery.

- Clean all equipment entering the project location prior to arrival. Equipment should also be cleaned before being moved to different sub-basins after construction to avoid transfer of mud, debris or aquatic pests (e.g., *Myxobolus cerebralis*, the parasite that causes whirling disease in fish).
- Any rock rip rap to be used should be clean, free of fine materials, and of sufficient size to resist displacement during peak flood events.
- A fuel/deleterious substance spill response plan should be in place and an emergency spill response kit should be kept on site during construction.

MPA submitted a Request for Review to Fisheries and Oceans Canada (DFO) for their review. DFO has determined there will be no contravention of the *Fisheries Act* resulting from the proposed project and has issued a Letter of Advice (Appendix K). With these mitigation measures in place residual impacts to fish and fish habitat are expected to be negligible.

5.2.4 Slope Stability

Impacts

Removal of the existing bridge and construction of the new bridge could affect slope stability of the creek banks. ParklandGEO (2020b; Appendix D) observed no recent signs of instability at either the east or west roadway embankments at the existing bridge site. If appropriate measures are not taken to avoid slope destabilization, impacts to slope stability are anticipated to be negative, direct, minor, permanent, local and likely.

Mitigation and Residual Impacts

MPA prepared detailed design drawings based on the recommendations provided by ParklandGEO's report and will be onsite fulltime during pile driving to ensure bearing capacities are achieved. MPA is experienced with monitoring bearing pile installations and typically do not have a geotechnical subconsultant involved during construction supervision unless geotechnical issues arise, which require further input beyond the information provided in the geotechnical report and beyond their expertise. With these measures in place, residual impacts to slope stability are reduced to negligible.

5.2.5 Vegetation

The following potential impacts to vegetation were identified as needing examination:

- Loss or alteration to native upland and wetland plant communities
- Loss of special status plant species
- Establishment of invasive or weedy species

5.2.5.1 Loss or Alteration to Native Upland and Wetland Plant Communities

Impacts

Temporary and permanent direct loss of upland and wetland plant communities will result from demolition of the old bridge and construction of the new bridge and associated roadway approaches. When considering the total anticipated construction disturbance area

polygon representing 0.52 ha (Figure 7, Appendix A), approximately 0.40 ha (77%) of native upland and wetland vegetation will be cleared within the Bylaw 7188 boundary from a combination of the bridge replacement project and the City's separate roadway upgrade project (to be completed by others) (Table 5.2). Specific to the bridge replacement project, approximately 0.17 ha (including a 5 m buffer to account for contractor access) of native upland and wetland plant communities will be directly impacted within the Bylaw 7188 boundary by bridge construction activities (Table 5.2).

Project related construction activities will require the removal of small areas of wetland vegetation. Vegetation removal is required to accommodate construction access, install a Type C erosion control soil covering and for installation of Class 1 heavy riprap around the bridge abutments. Installation of riprap will result in a permanent wetland impact of 0.0031 ha (Figure 7, Appendix A). Vegetation removal required for construction access and installation of a Type C erosion control soil covering are considered to be temporary impacts because it is anticipated that, post-construction, wetland vegetation will re-establish in all temporarily impacted areas. During construction, impacts to wetland vegetation will be minimized to the extent possible.

While there are no trees in the project area, there are some shrubs that fall under the purview of the City's *Corporate Tree Management Policy* that could potentially be impacted by construction activities. Impacts to native upland and wetland vegetation are rated as negative, direct, minor, temporary to permanent, local and likely.

Table 5.2. Anticipated Impact Areas to Native Plant and Wetland Communities.

Plant or Wetland Community		**New Bridge Footprint Impact Area Only *within and outside* Bylaw 7188 Boundary (buffered by 5 m) (ha)**	**Total Anticipated Construction Disturbance Area Impact Area *within* Bylaw 7188 Boundary (ha)**
Native non-forested reed canary grass	Within Bylaw 7188 boundary	0.08	0.21
Seasonal graminoid marsh	Within Bylaw 7188 boundary	0.05	0.14
	Outside Bylaw 7188 boundary	0.01	N/A
Non-forested smooth brome	Within Bylaw 7188 boundary	0.03	0.05
Total (*within* Bylaw 7188 boundary)		**0.17**	**0.40**

Mitigation and Residual Impacts

To lessen the potential impact on native upland and wetland plant communities during proposed bridge construction, equipment storage, maintenance and refueling in areas that support native plant communities will be prohibited. Prior to bridge construction, marking the project clearing limits with highly-visible flagging will help minimize the extent of vegetation and wetland loss. Efforts will be made to minimize vegetation removal as much as possible. There are no trees in the project area but any shrubs that are damaged or removed must be replaced pursuant to the City's *Corporate Tree Management Policy*. A pre-site inspection with City Natural Areas will be scheduled a minimum of four weeks prior to construction commencement to review construction plans. No formal restoration plan will be prepared for this typical local road related bridge replacement project, however reclamation will comprise recontouring all disturbed areas on the bridge and approach roadway embankments and ditches and topsoiling and seeding with a City of Edmonton approved naturalization seed mix. Replacement plantings will occur on site as required.

Minimization of potential wetland impacts is encouraged by limiting the extent of construction activities within the wetland. Bridge construction access through the floodplain area is also discouraged. During bridge construction, wetland soils will be salvaged, stockpiled and used for reclamation. If wetland soils cannot be salvaged, reclamation of temporarily impacted areas in the seasonal graminoid marsh will comprise soil decompaction, replacing topsoil to match pre-existing grades and application of an appropriate wet meadow seed mix. Wetland temporary and permanent impacts related to the bridge project are anticipated to be small in nature and a Wetland Assessment and Impact Form (WAIF) will be prepared and submitted to AEP along with the Code of Practice for Watercourse Crossings at least 14 days prior to the start of construction, pursuant to the *Water Act*. With these measures in place, impacts to the wetland from the bridge replacement project should be reduced to negligible.

5.2.5.2 Loss of Special Status Plant Species

Impacts

During the 16 July 2020 rare plant survey one special status plant species, false dragonhead, was observed in the local study area (Figure 6, Appendix A). False dragonhead is ranked as S3 (20-100 occurrences within Alberta), which are not tracked or considered rare by the Province; however, the City of Edmonton does consider S3 species as rare. This species occurred as approximately 10 individuals in a single location (approximately 2 m^2) within the seasonal graminoid marsh plant community on the north side of Horsehills Road and east of the bridge. No individuals were observed adjacent the bridge; however, the location of false dragonhead does fall within the anticipated construction disturbance limits. Impacts to these plants would be negative, minor, temporary, local, direct and likely.

Mitigation and Residual Impacts

Mitigation measures are not typically implemented for loss of S3 plant species. However, since the City considers S3 species rare, it is recommended as a best management practice to have a rare plant specialist fence off the area, so impacts to the plants are avoided. With this mitigation measure in place, the residual impact to special status plant species is rated as negligible.

5.2.5.3 Establishment of Invasive or Weedy Species

Impacts

Surface disturbance from construction could create ideal conditions for the establishment and spread of noxious weed species. Weeds could become established following construction through the movement of seeds and rhizomes carried on equipment as well as by colonization by seeds transported naturally from adjacent weed populations. Weed establishment in the project area is undesirable, as weeds may then spread to surrounding native plant communities along Horsehills Creek. Preventing weed establishment in the first place may be the best and most economical opportunity for weed management. In the absence of mitigation, the spread of weedy species within reclaimed areas will likely occur and will have a negative, direct, minor, local, permanent and likely impact.

Mitigation and Residual Impacts

Precautions such as cleaning equipment before moving into the project area will help reduce the potential transfer and spread of weedy species. Cleared areas will be revegetated with topsoil and an appropriate seed mix approved by the City as soon as possible following construction. Some level of weed control will likely be required until desired vegetation becomes established, but the need for such measures can be assessed through monitoring. All short-term weed control measures will be outlined in the contractor's Environmental Construction Operations (ECO) Plan. With proper implementation of these measures, the residual impact will be reduced to negligible.

5.2.6 Wildlife and Wildlife Habitat

The following potential impacts to wildlife were identified as needing examination:

- Loss of terrestrial habitat due to clearing activities
- Habitat alienation during construction
- Breeding wildlife mortality
- Mortality or disturbance of special status wildlife species

5.2.6.1 Loss of Terrestrial Habitat Due to Clearing Activities

Impacts

Any loss of natural vegetation in the project area represents an associated loss of natural habitat. It is expected that relatively small, localized areas of natural habitat will be cleared adjacent the existing bridge prior to demolition. The habitat value of areas to be cleared adjacent the bridge and roadway are considered moderate, however, as noted in the vegetation discussion, the majority of habitat loss will be temporary. As a result, the anticipated temporary habitat loss from bridge replacement is rated as a negative, direct, minor, local in scale, and likely impact.

Mitigation and Residual Impacts

Applying all mitigation measures outlined in the vegetation section will result in establishment of areas of native grasses and sedges, with a reduced exotic/weedy

component. This is considered to fully mitigate for the loss, over time. The residual impact is rated as negligible.

5.2.6.2 Habitat Alienation During Construction

Impacts

Activities and noise associated with construction have potential to disrupt wildlife species using adjacent habitat, leading to habitat alienation in those areas. This effectively reduces the amount of usable habitat available to individuals. However, in this case, this potential impact is rated as minor for the following reasons:

- Most wildlife species in the area are likely already adapted to human disturbance.
- Construction disturbance will be periodic over the construction period, and location specific within the project area.
- Construction will typically occur during daylight or early evening hours, leaving adjacent areas relatively undisturbed for nocturnal species.

Considering all the above, the impact of habitat alienation during construction activities is rated as negative, indirect, minor, temporary, local and likely.

Mitigation and Residual Impacts

Few mitigation measures are available. Work crews will be instructed not to harass wildlife and the contractor's ECO plan will include worker/wildlife encounter protocols. The residual impact of habitat alienation during construction activities is, therefore, also rated as negative, indirect, minor, long-term, temporary, local and likely.

5.2.6.3 Breeding Wildlife Mortality

Impacts

Clearing of vegetation can cause wildlife mortality, particularly during the spring and summer breeding season when the mobility of many species is restricted. During those times, adults remain close to nest sites, and young are restricted to nests or not yet able to move long distances. To protect wildlife, and particularly nesting birds protected by the *Migratory Birds Conservation Act* (MBCA) and *Wildlife Act*, current best management practices provided by Environment and Climate Change Canada (ECCC) recommends avoiding vegetation clearing during the period when there is a high probability of nesting activity (i.e., high risk period). This extends to the removal of weedy, grassy areas because commonly occurring species such as the clay-colored sparrow and savannah sparrow may use those areas for nesting and are covered by the legislation. When this practice is not adopted and in the absence of other mitigation measures (e.g., nest sweep), there can be high potential for nest disturbance. There is some potential for birds to nest on the existing bridge and within the wetland and riparian vegetation adjacent the bridge and in nearby shrubs. Destruction of active nests could be in conflict with legislation. Should clearing due diligence not be employed, wildlife mortality resulting from clearing could occur. This would be a negative, direct, major, permanent, local, likely impact. It is rated as major because it represents contravention of the law.

Mitigation and Residual Impacts

In this region, wildlife mortality from vegetation clearing (including brush piles and tall grass) is best avoided by scheduling clearing outside the period 20 April to 20 August. If clearing/removal must occur during this time period, nest sweeps by a qualified biologist will be required to identify active nests and appropriately buffer them until the nest is no longer active. With these measures in place, wildlife mortality should be avoided, and the residual impact would be negligible.

5.2.6.4 Mortality or Disturbance to Special Status Wildlife Species

Impacts

Two special status wildlife species have the potential to occur in suitable habitat in the project area including western toad and barn swallow. Based on the presence of potentially suitable wetland habitat in the project area, there is a moderate to low chance that western toads breed and forage in the study area. The bridge replacement project, however, will take place along the southern fringe of the wetland in the roadway right-of-way and will not result in draining the wetland. As noted in Section 5.2.5, a relatively small area of wetland vegetation will be temporarily removed to accommodate bridge replacement activities. Based on this information, and the fact that western toads are not commonly observed in the Edmonton area, potential impacts to western toad from the bridge project are rated as negative, minor, permanent, local and unlikely.

While barn swallows were observed flying around foraging in the local study area, no evidence of breeding behaviour or bird nests on the underside of the bridge were observed. It is likely these individuals were nesting elsewhere and using the project area for foraging. Based on this information, removal of the existing bridge is not expected to impact this species and impacts are rated negligible.

Mitigation and Residual Impacts

Mitigation measures described above in Section 5.2.5 apply to minimizing impacts to wetland habitat during bridge replacement construction activities. The underside of the bridge should be inspected for active bird nests prior to demolition. With these measures in place, residual impacts to special status wildlife species are rated as negligible.

5.2.7 Ecological Connectivity/Wildlife Movement

The potential for the project to change ecological connectivity/wildlife movement patterns was examined.

Impacts

A separate wildlife passage assessment report was not completed for this bridge replacement project, however, the City's Wildlife Passage Engineering Design Guidelines (WPEDG) (City of Edmonton 2010) were considered in support of bridge replacement alternative selection, preliminary and detailed design of the bridge and development of mitigation measures and BMP's during construction, maintenance and operation of the

bridge and roadway approaches. As noted above in Section 4.1, four crossing alternatives were considered during preliminary design comprising culverts or a new bridge. Wildlife passage for EDG's small terrestrial (ST) and medium terrestrial (MT) were a key consideration in comparing alternatives and ultimately factored in the choice of a bridge over a culvert arrangement. Large terrestrial (LT) such as deer and moose were not considered as it was not appropriate for this local road context at this location.

The new bridge will be an improvement over the existing bridge as it will be 0.45 m higher and approximately 2 m wider than the existing bridge with abutment slopes rather than vertical abutment walls. The openness ratio will increase from 1.37 to 1.87 and the wooden struts spanning the creek will be removed during demolition of the old bridge. Preliminary design originally called for riprap armouring of the entire extent of the abutment slopes and the creek channel under the bridge. After review and consideration of amphibian, ST and MT wildlife movement requirements, the riprap design was revised during detailed design so that the creek channel bottom will remain a natural substrate to permit wildlife passage under low water conditions. The bridge abutments were designed to preserve the integrity of the road and to withstand creek high flows, however, the extension of a small area of riprap upstream and downstream of the bridge will likely act as a natural funnel to AMP, ST and MT animals that wish to pass under the bridge along the creek channel.

Sightlines for drivers will not change at the bridge crossing compared to existing conditions. As described in Section 5.2.5.1, and as is typical for local road related bridge construction, all disturbed areas at the bridge and approach roadway embankments and ditches will be recontoured, topsoiled and seeded with a City of Edmonton approved naturalization seed mix. Reclamation of a small area of the seasonal graminoid marsh plant community will require placement of wetland soils and/or topsoil seeded with a wet meadow seed mix. The landscape, therefore, will remain level, with open unobstructed views of the adjacent wetlands and Manning Drive freeway embankment and ditch. MT or LT animals wishing to cross the local road should be easily visible to drivers.

Impacts to ecological connectivity/wildlife movement as a result of bridge replacement are rated as positive, direct, minor, permanent, local and likely. This applies to AMP, ST and MT animals including amphibians, coyote, American beaver, muskrat, porcupine, snowshoe hare, white-tailed jack rabbit, fox, weasels, waterfowl, voles and mice.

Mitigation and Residual Impacts

No additional mitigation measures are required for this local road at this location and residual impacts remain positive, direct, minor, permanent, local and likely.

5.2.8 Project Incidents

5.2.8.1 Release of Hazardous/Deleterious Substances On or Off-Site

Impacts

Fuels, lubricants and other hazardous materials are anticipated on-site hazardous materials. Spills or releases can occur during refueling, as a result of equipment failure (e.g., leaking hose), accidents, or improper storage/containment at sites. Spills can cause localized

contamination of Horsehills Creek, soils, wetland and plant communities, wildlife habitat on and off site and if they enter catch basins, they could travel to Horsehills Creek and ultimately to the North Saskatchewan River. Most spills would likely be small in nature, but if uncontrolled, spills could spread over large areas. Small spills are anticipated at most construction sites. Large spills are more preventable. Spill migration is particularly likely on the relatively steep Horsehills Road embankments. Unprotected catch basins in the project area that lead into the City's storm sewer system have the potential to capture unmitigated releases of deleterious materials and transmit them to downstream water bodies. Catch basins are especially vulnerable where they are situated at the foot of unprotected slopes where long slopes produce higher flow velocities and can capture higher flow volumes that could overwhelm insufficient protective measures

If appropriate plans and practices are not put into place, the impact of a hazardous or deleterious substance spill could be negative, direct, minor to major, permanent, local and likely.

Mitigation and Residual Impacts

The contractor will be required to comply with City of Edmonton's Enviso system. In addition, for the construction period, the contractor will be required to provide a spill prevention and emergency response plan and a hazardous waste management plan. Those plans will include specific measures related to securely protect the creek in the project area. The plans must also include construction monitoring protocols and frequency. With these in place the residual impact should be negligible.

5.2.8.1 Release of Sediment or Other Debris On or Off-site

Impacts

Site preparation during bridge demolition and construction activities will result in the removal of vegetation and exposure of bare soil surfaces, likely for extended periods of time. Demolition and construction activities on exposed soils can result in erosion and loss of top-soils and sub-soils, degradation of top-soil quality, weakened slope stability, or introduce sediments directly into Horsehills Creek and ultimately into the NSR. In areas where existing vegetation cover is cleared, exposed soils are susceptible to fluvial (surface water) erosion in wet conditions, and, to a lesser extent, aeolian (wind) erosion in dry conditions. The clearing of vegetation on steep slopes will expose soils that are especially susceptible to erosion resulting from surface runoff given high slope gradients. Eroded soils can accumulate in downslope undisturbed vegetated areas and in the creek channel. If mitigation measures (controls and clean-up measures) are not put into practice, the impact on vegetation, habitat and Horsehills Creek would be negative, direct, minor to major, permanent, local and likely.

Mitigation and Residual Impacts

The contractor will be required to comply with City of Edmonton's Enviso system. In addition, for the construction period, the contractor will be required to prepare a site-specific temporary ESC plan, to City of Edmonton specifications, and a site-specific water management plan. These plans will also include monitoring protocols and frequency. With

these plans in place the residual impact of sediment or other debris release off site or to the creek should be negligible.

5.3 Cumulative Effects

The cumulative effects assessment study area was defined as Horsehills Creek Ravine extending 300 m up and downstream of the existing bridge. The assessment considered past projects, known projects and publicly announced future projects.

5.3.1 Past Projects

Based on a review of aerial photography, the developed footprint in the cumulative effects study area has remained essentially the same since 2002.

5.3.2 Present Projects

There are no known current projects taking place in this area.

5.3.3 Future Planned Projects

Other than the already mentioned planned adjacent roadway upgrades to Horsehills Road, there are no known specific future projects planned for this area. At a regional level, the EETP ASP area north of Manning Drive is expected to ultimately become developed with various industrial development ranging from large petro-chemical plants to various supporting businesses and research and development initiatives (A. Forrest, *pers.comm*.). In anticipation of future development in the area and associated drainage requirements, the Horsehills Creek drainage area, particularly south of Manning Drive, has been studied relative to identification of priority bank stabilization areas to minimize erosion (L. Maslen, *pers. comm.*). As well, the Ribbon of Green SW + NE Plan speaks to restoration of the wildlife movement corridor along Horsehills Creek south of Manning Drive and connecting to the northern reaches of the North Saskatchewan River (O2 2020).

5.3.4 Conclusion

Since the proposed bridge replacement project is a stand-alone project and is a replacement of existing infrastructure, it will not act as a catalyst for additional future development in this area. The proposed project, therefore, has no potential to add to the cumulative impact of past projects, however, it may contribute to the long-term management of the Horsehills Creek watershed and improvement of the wildlife corridor along Horsehills Creek in the regional area.

6.0 ENVIRONMENTAL MONITORING

This EIA identifies three monitoring commitments for the City:

- Pursuant to the City of Edmonton's Enviso program, Environmental Construction Operations (ECO) Plan monitoring during site preparation and construction phases of the project must be completed weekly.
- Monitoring is required by the Erosion and Sediment Control Plan, to be undertaken by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent.
- MPA will oversee the contractor's construction activities, including monitoring bearing pile installations.

7.0 PUBLIC CONSULTATION

Two private residences, Mscape Landscape Products Ltd., Kinder Kollege Daycare and the Nanaksar Gurudwara Gursikh Temple are located along the section of Horsehills Road that will be impacted by a temporary road closure during construction. Temporary impacts to these stakeholders are expected to be minor due to the relatively short duration of bridge construction and the provision of an alternate and short detour route. Stakeholders directly impacted by the project will be informed by a City representative (MPA 2020b). Public communication regarding the project and construction timing will include a mail-out to the residences and businesses in the area and regular updates on the City's website (MPA 2020b). Appropriate project information signage will be posted on site. The need for a public information session is not anticipated (MPA 2020b).

8.0 CONCLUSIONS

8.1 Impact and Sensitivities

This EIA has shown that with the described mitigation measures applied, all but one impact related to the construction phase of the bridge replacement project can be mitigated such that adverse residual impacts are reduced to negligible. The key sensitivity identified for the proposed project, therefore, is:

- habitat alienation during construction.

The project is anticipated to result in one temporary negative residual impact related to wildlife during construction. Construction activities and related noise have the potential to result in wildlife habitat alienation in adjacent areas. Activities and noise associated with construction phases have potential to disrupt wildlife species using adjacent habitat, leading to habitat alienation in those areas. This effectively reduces the amount of usable habitat available to individuals. Few mitigation measures are available, however, work crews will be instructed not to harass wildlife and the contractor's ECO plan will include worker/wildlife encounter protocols.

Considering the above, and that communication with City stakeholders remains open during project development, we are of the opinion that the proposed project does not require additional modifications to proceed responsibly.

8.2 EIA Limitations

This EIA was founded on preliminary and detailed design drawings and reports and limited construction methodology information. The EIA was predicated on the knowledge that the City's construction contractor will develop environmental controls intended to induce excellent environmental performance during construction.

8.3 Summary of Key Mitigation Measures – Construction Phase

The following represents a list of key mitigation measures selected to itemize important action items for the construction phase of the project for the City and the contractor. All mitigation measures should be included in the Contractor's ECO Plan.

8.3.1 Surface Water and Fish and Fish Habitat

- The City must ensure that the construction contractor adheres to all the mitigation measures listed in Section 5.2.1 and 5.2.3 and distilled here to mitigate potential impacts to surface water and fish and fish habitat and ensure compliance with Provincial and Federal Acts pertaining to water and fish.
    - Prepare a detailed ESC Plan
    - Follow instream construction BMPs
    - Construction is to take place outside the RAP
    - Follow decontamination protocols for whirling disease
    - See DFO Letter of Advice in Appendix K

8.3.2 Vegetation (including trees and shrubs)

- The City project manager will arrange for a pre-site inspection with Natural Areas at least four weeks prior to construction start to review construction plans and tree and shrub protection pursuant to the *Corporate Tree Management Policy.*

- The City must ensure that the construction contractor adheres to all the mitigation measures listed in Section 5.2.5 and distilled here to address native upland wetland plant community losses:
    - Reclaim disturbed wetland areas with placement of wetland soils and/or topsoil seeded with a wet meadow seed mix
    - Revegetate exposed soils promptly
    - Discourage weed establishment
    - Implement weed control and monitoring

8.3.3 Wildlife

- The City must ensure that the construction contractor adheres to all mitigation measures listed in Section 5.2.6 to mitigate potential wildlife impacts and ensure compliance with all Provincial and Federal Acts pertaining to wildlife.
- Note that vegetation clearing and bridge demolition timing are critical issues related to nesting birds.
- The City will arrange for the underside of the bridge to be inspected for active bird nests prior to demolition. Prior to April 20th a bird sweep will be conducted to look for nests and review possible mitigation measures to prevent nesting under the bridge prior to construction.

8.3.4 Project Incidents

- The City must ensure that the construction contractor adheres to all mitigation measures listed in Section 5.2.8 and distilled here to mitigate impacts to project incidents.
    - Prepare a detailed spill prevention and emergency response plan
    - Water management plan

9.0 REFERENCES

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9.1 Personal Communications

A. Forrest, P.Biol., Environmental Scientist, Spencer Environmental Management Services Ltd.

M. Johnson, P.Eng., Bridge Engineer, MPA Engineering Ltd., Sherwood Park, Alberta.

L. Maslen, P.Biol., President, Spencer Environmental Management Services Ltd.

Appendix A: Figures

Figure 1. Project Location Site Overview
Figure 2. Site Overview and Wetland Extent
Figure 3. Land Use and Zoning
Figure 4. City of Edmonton Environmental Sensitivities - Original (2016)
Figure 5. City of Edmonton Environmental Sensitivities - Updated (2020)
Figure 6. Upland Plant Communities, Wetlands, Rare Plant Occurrences and Breeding Bird Survey Transect Location
Figure 7. Proposed Plant Community and Wetland Impact Areas

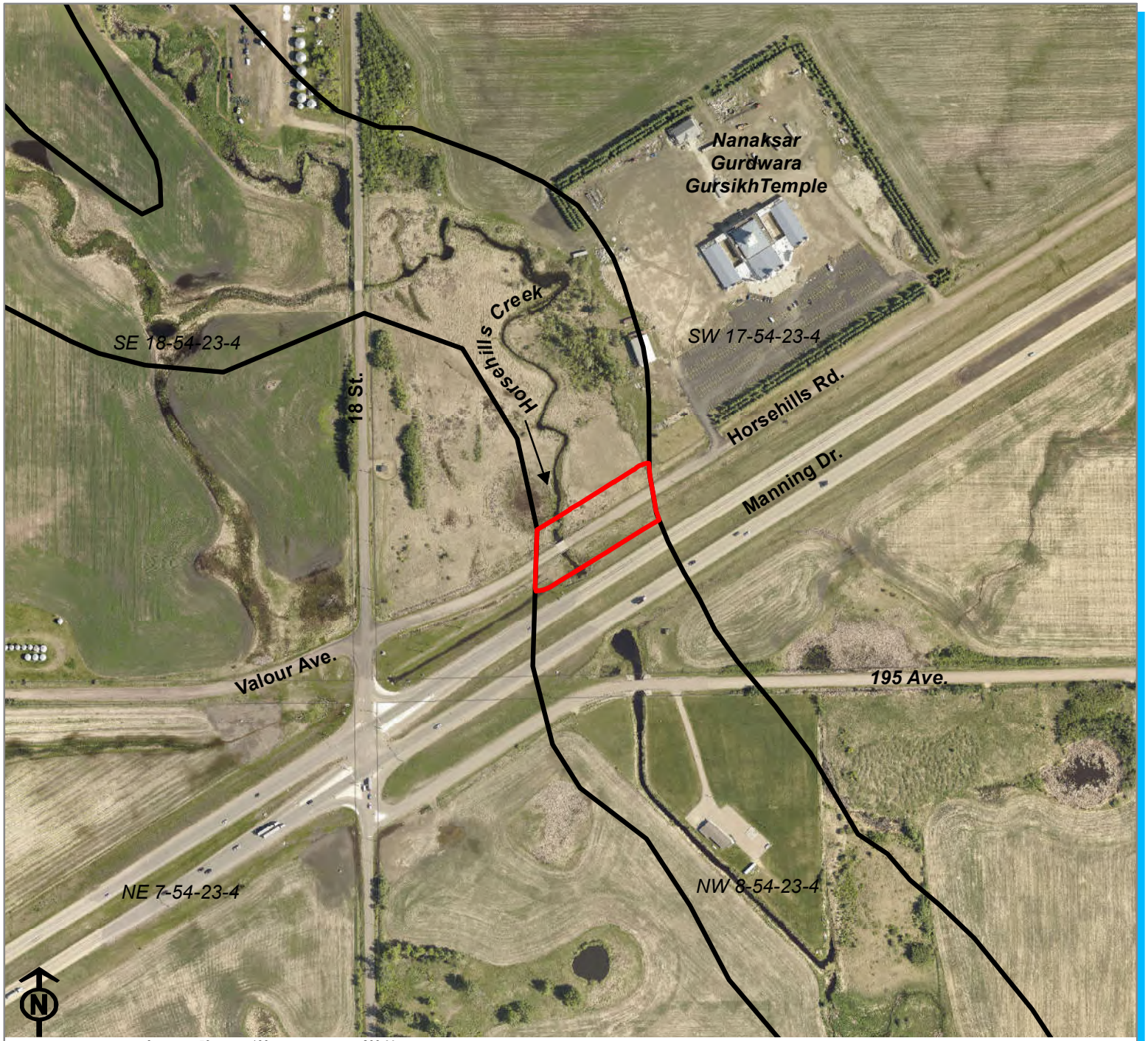
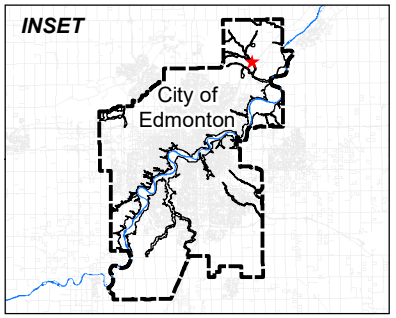


Figure 1.
Project Location
Site Overview
Horsehills Rd
over Horsehills Creek
Bridge (B130)
Replacement
SW 17-54-23-W4M

Legend

- Local Study Area
- Bylaw 7188 Boundary (COE, 2008)

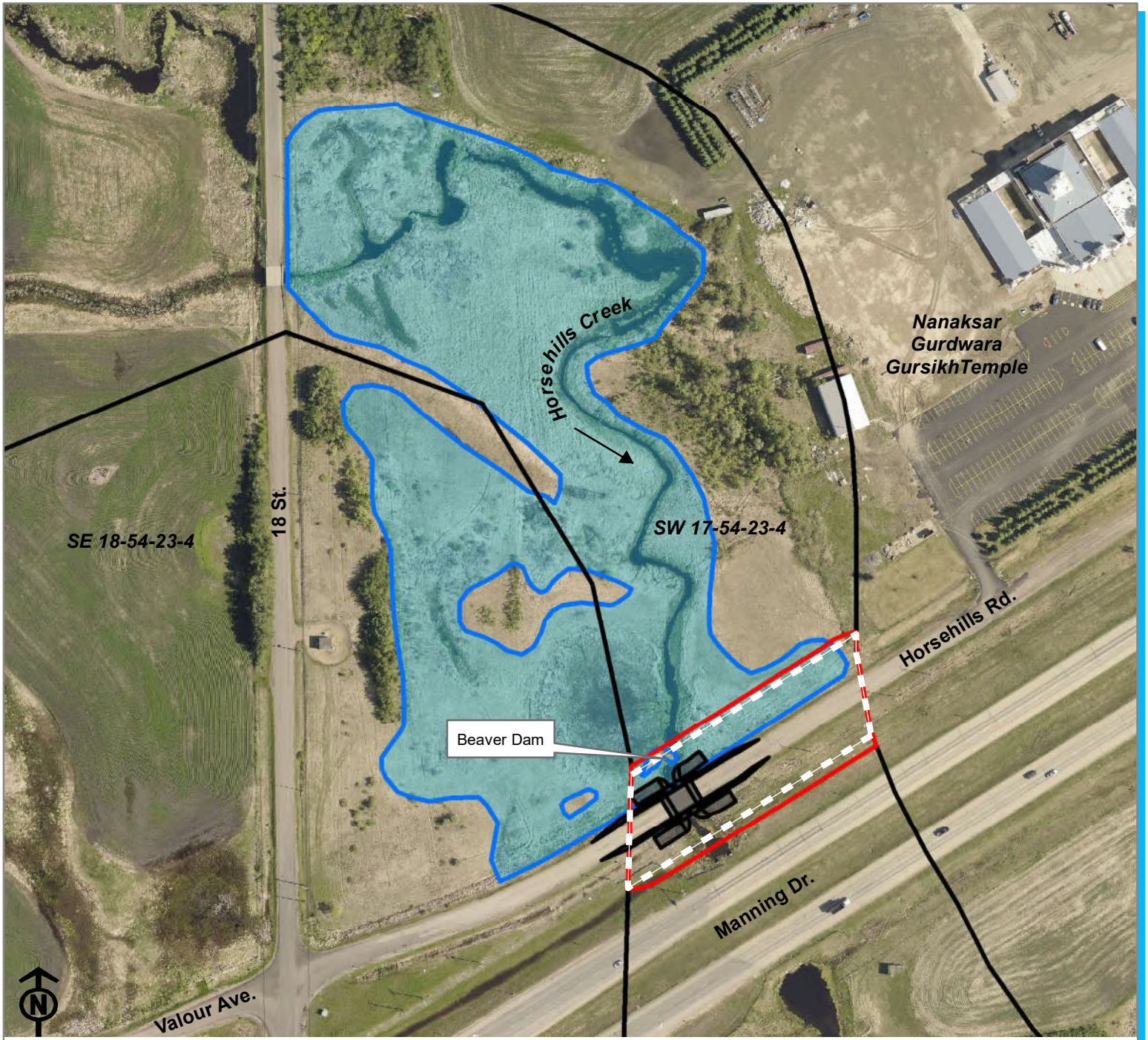
**Map extent reflects the Expanded Study Area*



Map Date: 12 November 2020
Imagery Mosaic: May-July 2019 (COE)

SPENCER ENVIRONMENTAL
MANAGEMENT SERVICES LTD.

Figure 2.
Site Overview and Wetland Extent
Horsehills Rd over Horsehills Creek Bridge (B130) Replacement
SW 17-54-23-W4M

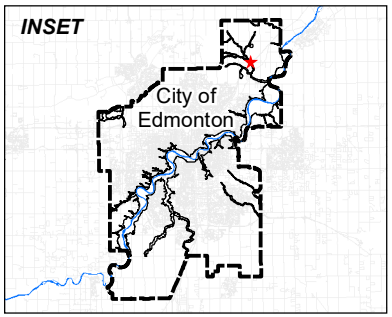


Legend

- Local Study Area
- Anticipated Construction Disturbance*
- Proposed New Bridge and Roadway Approaches*
- Bylaw 7188 Boundary (COE, 2008)

Wetland Class**

- Seasonal Graminoid Marsh (M-G-III)

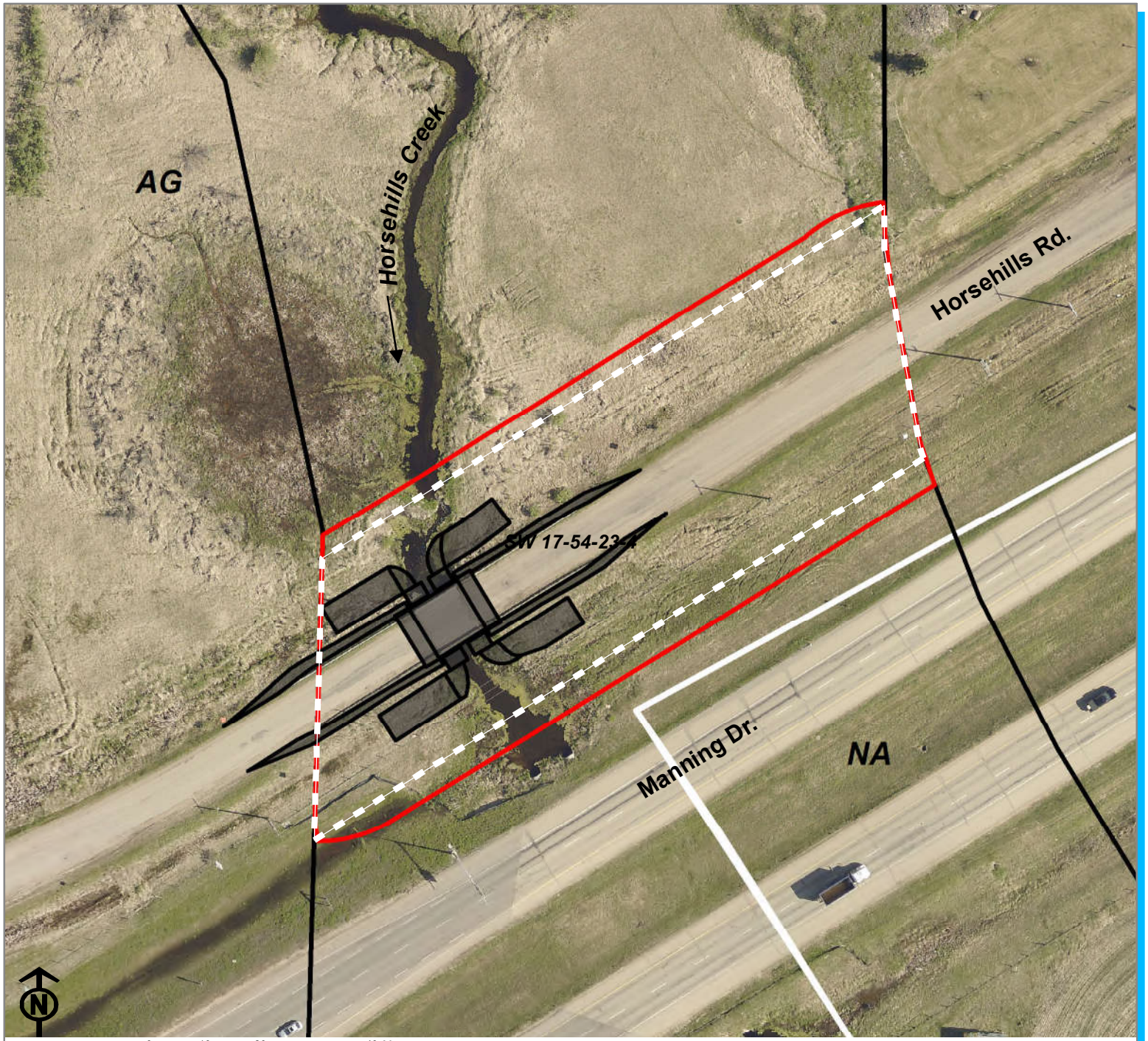


Map Date: 17 February 2021
Imagery Mosaic: May-July 2019 (COE)

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

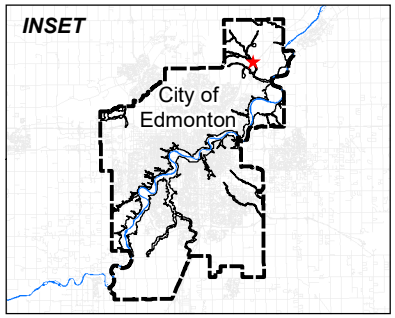
*Detailed design provided by MPA Engineering Ltd. (2020).
**Wetland classification follows the Alberta Wetland Classification System (ESRD, 2015).

Figure 3.
Land Use and Zoning
Horsehills Rd
over Horsehills Creek
Bridge (B130)
Replacement
SW 17-54-23-W4M



Legend

- Local Study Area
- Anticipated Construction Disturbance*
- Proposed New Bridge and Roadway Approaches*
- Bylaw 7188 Boundary (COE, 2008)
- A Zoning (COE, 2020)



Map Date: 12 November 2020
Imagery Mosaic: May-July 2019 (COE)

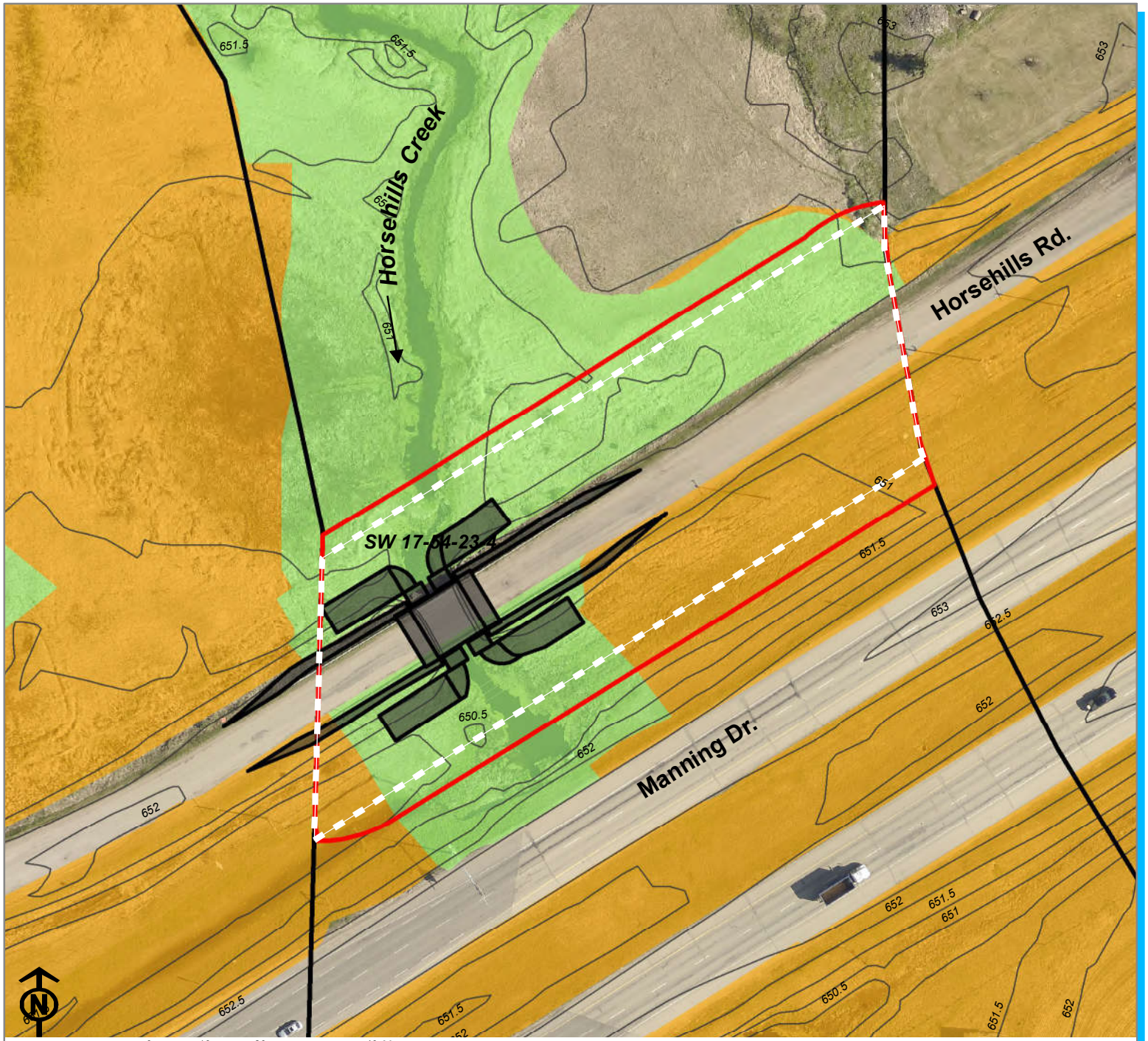
SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Detailed design provided by MPA Engineering Ltd. (2020).

Figure 4.
City of Edmonton Environmental Sensitivities - Original (2016)

Horsehills Rd over Horsehills Creek Bridge (B130) Replacement

SW 17-54-23-W4M

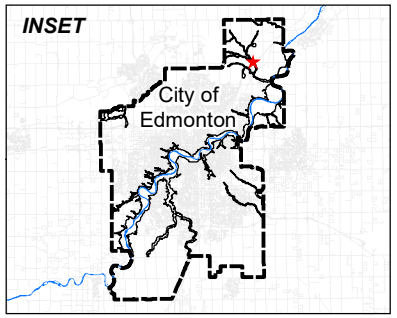


Legend

- Local Study Area
- Anticipated Construction Disturbance*
- Proposed New Bridge and Roadway Approaches*
- Bylaw 7188 Boundary (COE, 2008)
- Contours (COE, 2018)

Environmental Sensitivity**

- High Value
- Moderate Value



Map Date: 12 November 2020
Imagery Mosaic: May-July 2019 (COE)

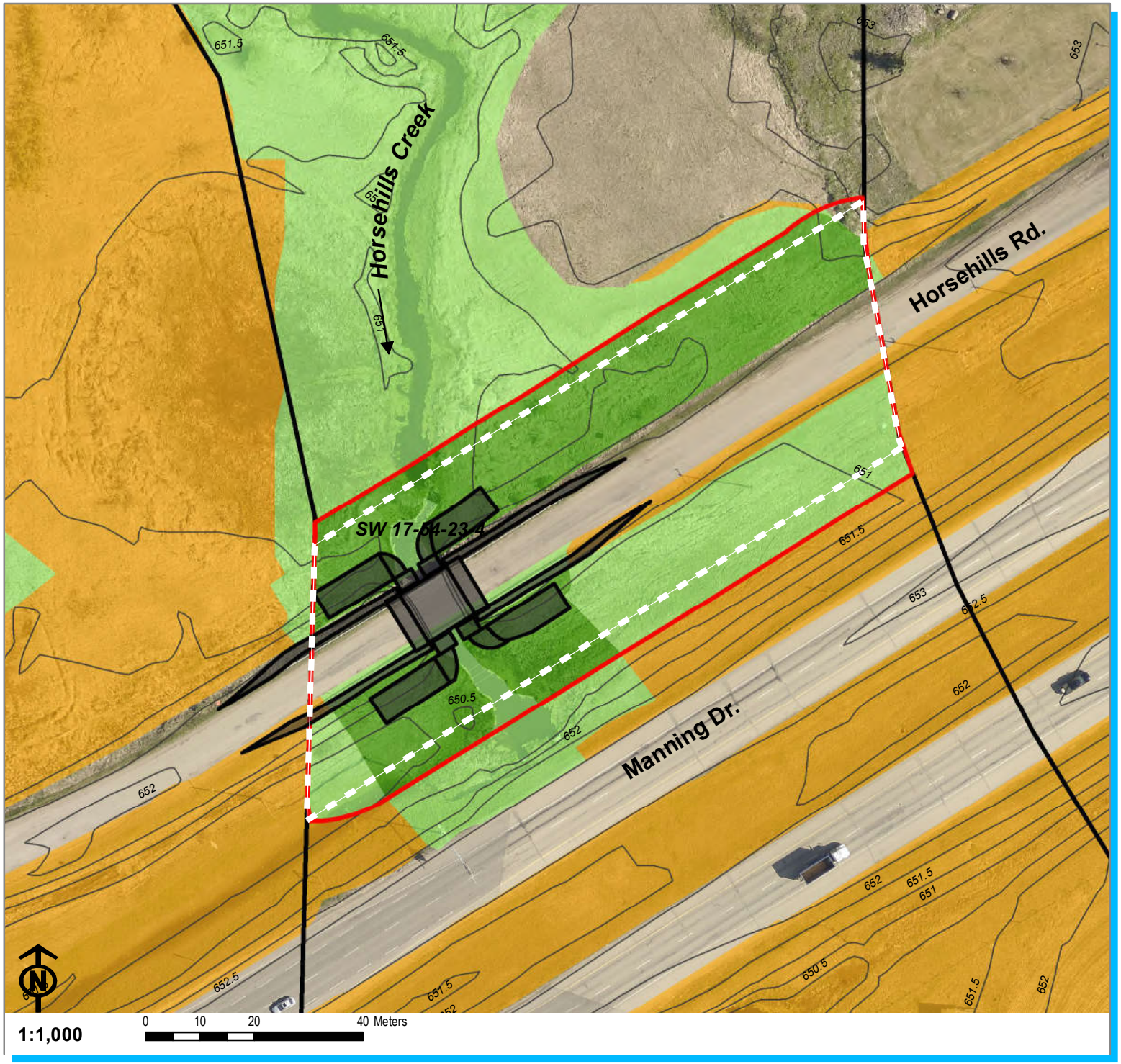
SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Detailed design provided by MPA Engineering Ltd. (2020).
**City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2016).

Figure 5.
City of Edmonton Environmental Sensitivities - Updated (2020)

Horsehills Rd over Horsehills Creek Bridge (B130) Replacement

SW 17-54-23-W4M

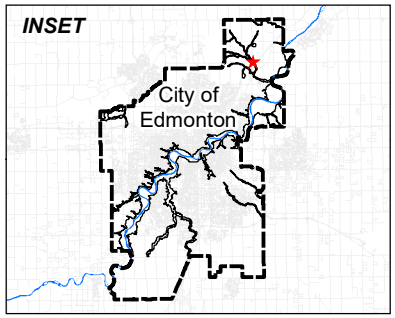


Legend

- Local Study Area
- Anticipated Construction Disturbance*
- Proposed New Bridge and Roadway Approaches*
- Bylaw 7188 Boundary (COE, 2008)
- Contours (COE, 2018)

Environmental Sensitivity**

- Very High Value
- High Value
- Moderate Value



Map Date: 12 November 2020
Imagery Mosaic: May-July 2019 (COE)

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Detailed design provided by MPA Engineering Ltd. (2020).
**Update of City of Edmonton Environmental Sensitivity Project (Solstice Canada, 2016) data based on site-specific survey data conducted by Spencer Environmental (2020).

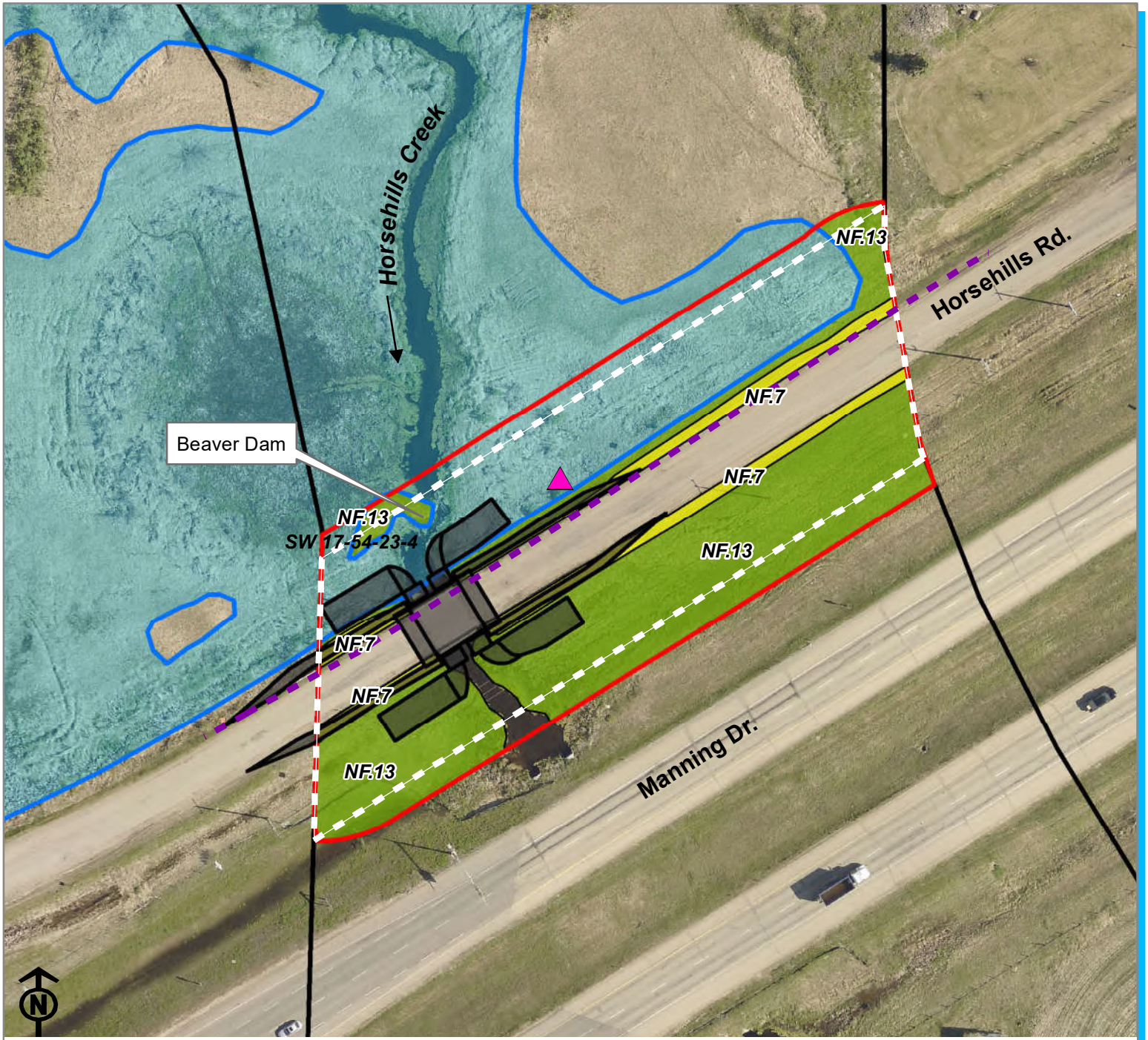


Figure 6.
Upland Plant Communities, Wetlands, Rare Plant Occurrences and Breeding Bird Survey Transect Location
Horsehills Rd over Horsehills Creek Bridge (B130) Replacement
SW 17-54-23-W4M

Legend

- Local Study Area
- Anticipated Construction Disturbance*
- Proposed New Bridge and Roadway Approaches*
- Bylaw 7188 Boundary (COE, 2008)

Upland Plant Communities**

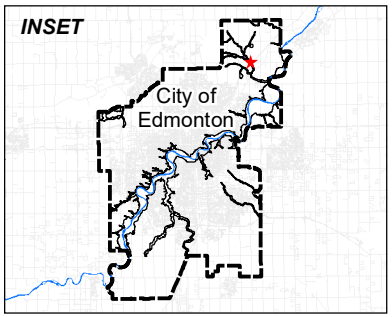
- Non-Forested Reed Canary-Grass (NF.13)
- Non-Forested Smooth Brome (NF.7)

Wetland Class***

- Seasonal Graminoid Marsh (M-G-III)

Special Status Species

- False Dragonhead (S3) Location (approx.)
- Breeding Bird Survey Transect



Map Date: 17 February 2021
Imagery Mosaic: May-July 2019 (COE)

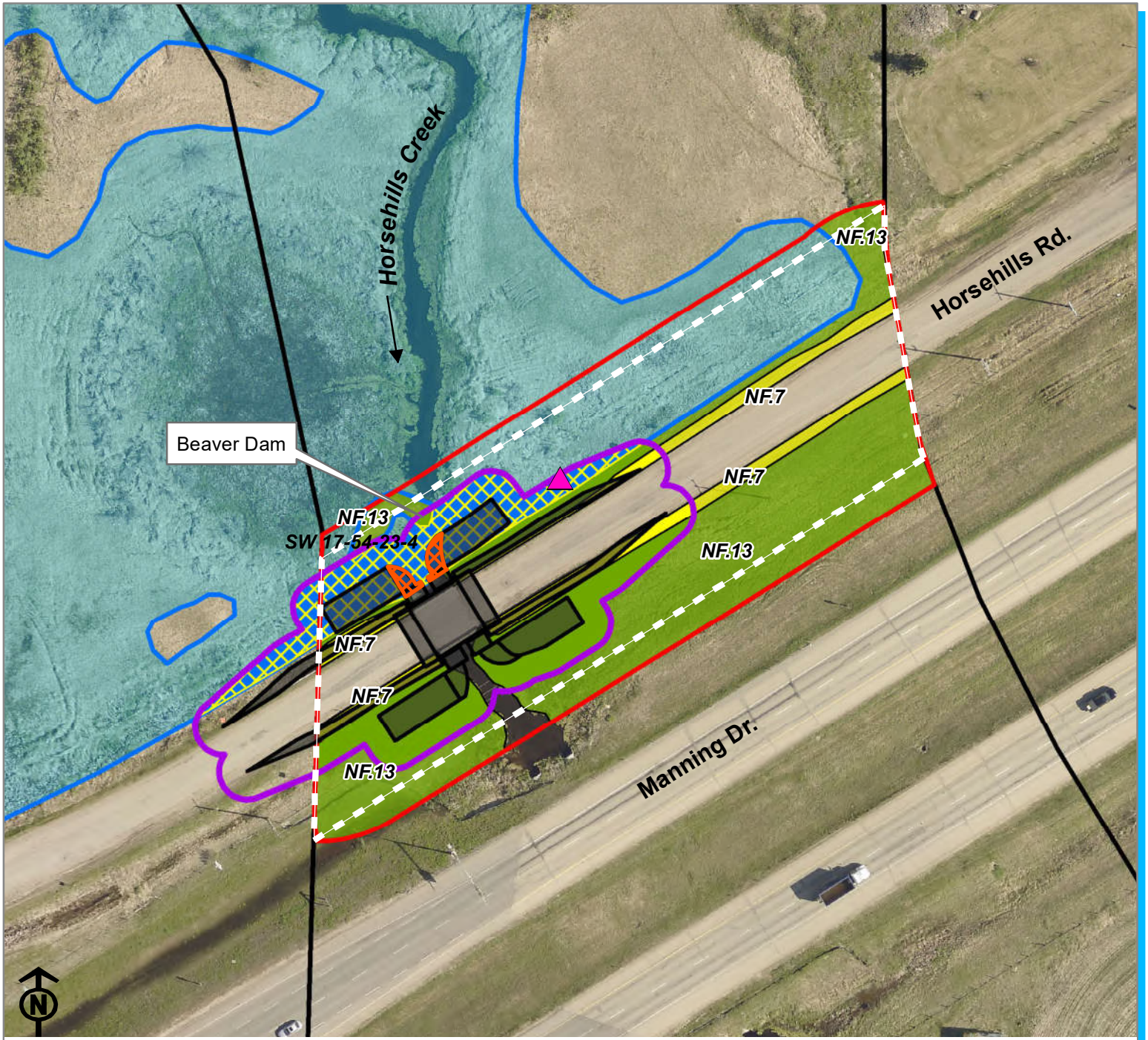
SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Detailed design provided by MPA Engineering Ltd. (2020).
**Upland plant community classification follows the Urban Ecological Field Guide for the City of Edmonton, Alberta, Canada (City of Edmonton, 2015).
***Wetland classification follows the Alberta Wetland Classification System (ESRD, 2015).

Figure 7. Proposed Plant Community and Wetland Impact Areas

Horsehills Rd over Horsehills Creek Bridge (B130) Replacement

SW 17-54-23-W4M



Legend

- Local Study Area
- Anticipated Construction Disturbance*
- Permanent Wetland Impact Area
- Potential Temporary Wetland Impact Area
- Proposed Bridge Construction Buffer (5m)
- Proposed New Bridge and Roadway Approaches*
- Bylaw 7188 Boundary (COE, 2008)

Upland Plant Communities**

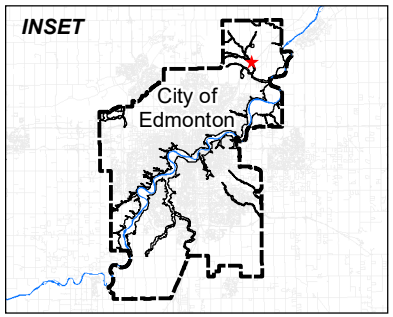
- Non-Forested Reed Canary-Grass (NF.13)
- Non-Forested Smooth Brome (NF.7)

Wetland Class***

- Seasonal Graminoid Marsh (M-G-III)

Special Status Species

- False Dragonhead (S3) Location (approx.)



Map Date: 17 February 2021
Imagery Mosaic: May-July 2019 (COE)

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

*Detailed design provided by MPA Engineering Ltd. (2020).
**Upland plant community classification follows the Urban Ecological Field Guide for the City of Edmonton, Alberta, Canada (City of Edmonton, 2015).
***Wetland classification follows the Alberta Wetland Classification System (ESRD, 2015).

Appendix B. Environmental Approvals Table

Summary of Potential Environmental Approvals for Replacement of the Horsehills Road Bridge over Horsehills Creek

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
Municipal					
North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188)	City Planning	Bylaw regulates all activities on City lands in the North Saskatchewan River Valley. Horsehills Road bridge replacement requires an Environmental Impact Assessment (EIA)	EIA must be approved by Urban Planning Committee	EIA to be submitted to the Urban Planning Committee for approval	Committee date for approval of the EIA anticipated in winter 2021
Corporate Tree Management Policy (C456C)	City Forestry	Policy provides protection for the City's Urban Forest (boulevard and open space trees/shrubs and natural stands) inventory and a mechanism for monetary compensation for lost canopy. Prior to removal, trees/shrubs are assessed by City's Urban Forestry Department	None, but compensation for lost canopy must be arranged with CoE	Meet with City forester to assess project area regarding shrubs.	Meet with City Natural Areas at least four weeks prior to construction commencement to assess the project area.
City of Edmonton (Bylaw 18100) - EPCOR Drainage Services Bylaw	EPCOR	Bylaw regulates the use of the sewer and contractor must consult with EPCOR regarding use of sewer to dewater site. Application for a permit of payment of fees	No prohibited, restricted or hazardous waste may be released into the sewage system without written consent from EPCOR	Application for a permit to discharge into the sewer system may be required	Proponent responsibility
City of Edmonton Parkland (Bylaw 2202)	City of Edmonton	Bylaw to protect and preserve natural ecosystems for the benefit of all citizens of the City	Approval required to stage construction equipment or other use in park space	Application for a permit to stage for construction	Proponent responsibility
ENVISO, City Policy C505, City Policy C512	City of Edmonton	Based on the ISO 14001 Standard, ENVISO provides a framework for a strong environmental management system aimed at legal/regulatory compliance, pollution prevention and continual improvement	• Proponent must be compliant with all aspects of ENVISO. An Enviso Design Environmental Permit Approval checklist must be completed for all City projects prior to tender. • Review of the Enviso Proponent's Environmental	• Process must be implemented as project is underway • checklist must be completed prior to tender	Proponent responsibility

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
			Responsibility Package and City Policy C512. • Signing Proponent's Environmental Acknowledgement Form		
Provincial					
Public Lands Act	Alberta Environment and Parks (Land Management Branch)	Use of crown lands, including the bed and shore of all bodies of water, are regulated under this Act. Act requires proponents wishing to work on, alter or occupy Crown land to obtain a disposition or amend existing dispositions.	AEP determined that the bridge crossing falls within the boundary of registered road plan 3344PX and is, therefore, outside the jurisdiction of AEP and does not require a *Public Lands Act* disposition.	None	N/A
Water Act and *Wetland Policy*	Alberta Environment and Parks (Water Approvals Branch)	An approval is required for all activities that may impact water and the aquatic environment, including taking water from a watercourse, realigning a watercourse, constructing within a watercourse, and draining filling or altering any permanent or temporary wetland. Temporary wetland impacts will require the submission and approval of a Wetland Assessment and Impact Form (WAIF).	Code of Practice Notification and WAIF	Submit Code of Practice Notification and WAIF To comply with CoP, a project may also require the specifications and recommendations of a Qualified Aquatic Environmental Specialist (QAES).	CoP Notification submission with WAIF at least 14 days prior to bridge construction commencement
Wildlife Act	Alberta Environment and Parks	This Act applies to most species of wildlife. The willful molestation, disruption, or destruction of a wildlife nest or den is prohibited by this Act. Special provisions provide for the protection of raptors and their nests/habitats. Project requires clearing of vegetation that may support nesting/denning wildlife. Wildlife may also use the old bridge as a nest site.	Although permitting for clearing is not required under the Act, violations of the Act may result in fines	Avoid vegetation clearing and/or bridge demolition during the period 20 April to 20 August. Contingent approach is to have a qualified biologist undertake a nest sweep of project area to avoid disturbance of active nests and dens. Abide by findings to ensure compliance.	Not applicable if vegetation clearing and/or bridge demolition is completed before the start of the nesting season (20 April). Nests sweeps undertaken between 20 April and 20 August have potential to result in findings that delay clearing.

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
Historical Resources Act	Alberta Culture, Multiculturalism and Status of Women (ACMSW)	All projects with potential to disturb historical, archaeological and paleontological resources are regulated under this Act and require approval from ACMSW	Approval required	Submit Historical Resources Act application to ACMSW. ACMSW will determine if an Historical Resources Impact Assessment (HRIA) is required	None. ACMSW granted approval on 04 December 2020 (see Appendix J).
Federal					
Fisheries Act	Fisheries and Oceans Canada (DFO)	Review and/or authorization is required if a project in or near water has potential to cause death of fish and the harmful alteration, disruption or destruction (HADD) of fish habitat. Permits may be sought for aquatic species at risk.	Request for review	Submit request for review to DFO	None. Letter of Advice received by MPA from DFO on 16 November 2020 (see Appendix K).
Canadian Navigable Waters Act	Transport Canada	Not relevant to this project, as Horsehills Creek is not navigable.	Horsehills Creek is not navigable	None	Not applicable
Migratory Birds Convention Act	Environment and Climate Change Canada	This Act prohibits the disturbance of nests and individuals of most migratory bird species and prohibits the release of deleterious substances into waters or areas frequented by migratory birds. Project requires clearing of migratory bird nesting habitat.	The Act provides guidelines for enforcement only; it is not linked to formal approvals required for construction. Violation of the Act may, however, result in penalties	Avoid vegetation clearing during the period 20 April to 20 August. Contingent approach is to have a qualified biologist undertake a nest sweep of project area and to then avoid disturbance of any noted nesting birds (see related notes for *Wildlife Act*)	Nests sweeps undertaken between 20 April and 20 August have potential to result in findings that delay clearing and/or bridge demolition.
Species At Risk Act	Environment and Climate Change Canada	This Act prohibits disturbance to species listed on Schedule 1 of the SARA as endangered, threatened or extirpated and, in some instances, listed species' habitat, on federal lands. On non-federal lands, the Act applies only to disturbance of aquatic species and migratory birds that are listed on Schedule 1 as endangered, threatened or extirpated.	Although no approvals or permits are required, violation of the *SARA* may result in penalties	If any federally listed species are identified as present within or adjacent to the project area, best practice is to consider the impact of the project on that species in consultation with Environment and Climate Change Canada	Schedule impacted only if SARA species are found in the area

Appendix C. Limited Phase I ESA (ParklandGEO 2020a)

Parkland Geo-Environmental Ltd.
189 Pembina Road
Sherwood Park, AB, T8H 2W8
www.parklandgeo.com
T: 780 416 1755
F: 780 416 1752

October 28, 2020
Project No. ED2251

Via e-mail: melanie.johnson@mpaeng.ca
Original will remain on file

MPA Engineering Ltd.
 # 304 - 85 Cranford Way
Sherwood Park, Alberta
T8H 0H9

ATTN Ms. Melanie Johnson, P.Eng.
Bridge Engineer

RE: Limited Phase 2 ESA
Bridge B130, Horsehills Creek and Horsehill Road, Edmonton, Alberta
Summary of Work and Findings

Dear Ms. Johnson:

1.0 INTRODUCTION

Parkland Geo-Environmental Ltd. (ParklandGEO) was retained by MPA Engineering Ltd. (MPA) to complete a Limited Phase 2 Environmental Site Assessment (ESA) at a bridge intended for replacement located along Horsehill Road in Edmonton, Alberta (Figure 1). The investigation was completed concurrently with a geotechnical investigation, presented in:

> *Geotechnical Investigation Report Proposed B130 Bridge Replacement, Bridge B130, Horsehill Road Over Horsehill Creek, Edmonton, Alberta. Prepared for MAP Engineering Ltd. Prepared by Parkland Geo-Environmental Ltd. File ED2251. August 2020.*

This letter provides a summary of the limited Phase 2 ESA completed during the geotechnical investigation.

2.0 FIELD INVESTIGATION PROGRAM

On July 16, 2020, two boreholes were drilled using a truck-mounted, continuous flight, 150 mm diameter solid stem auger operated by Drilling Solutions Inc. of Sherwood Park, Alberta. One borehole (20-01) was drilled to 25.3 meters below grade (mbg) and the other borehole (20-02) was drilled to 19.5 mbg as shown on Figure 2. Supervision of the drilling, soil sampling, and logging of the various soil strata was performed by Ms. Nicole Prince, P.Eng. of ParklandGEO. The detailed borehole logs are attached to this letter report.

The soil sampling method included collecting soil at various drilling depths and placing them in large plastic bags, 125 mL glass jars and 40 mL glass vials containing 10 mL of methanol. All samples were analyzed for vapours used a RKI Eagle Hydrocarbon Surveyor and then kept in an ice-filled cooler to moderate temperature fluctuations prior to delivery. The samples were submitted to AGAT Laboratories Inc. for benzene, toluene, ethylbenzene, and xylenes (BTEX) and petroleum hydrocarbons (PHC) fractions F1-F4 analysis, as well as metals and salinity analysis.

3.0 ASSESSMENT CRITERIA

The applicable regulatory guidelines applied to this site are:

- Alberta Tier 1 Soil and Groundwater Remediation Guidelines (January 2019). Alberta Environment.

Selection of the applicable guidelines is governed by the land use, soil grain size, and exposure pathways applicability. The pathway assessments for this site is presented on Table 1. The soils were generally fine grained clay with some small sand layers, thus the laboratory results were compared to the best represented grain size for the depth collected and material observed. Natural and agricultural land use guidelines were used based on the current and surrounding land use.

4.0 SOIL DESCRIPTION

The soil profile encountered at this site was the asphalt road surface, underlain by gravel and/or clay fill, which was underlain by clay that extended beyond the depths of drilling. The clay varied in consistency and plasticity and contained occasional sand layers.

Detailed descriptions of the soil conditions encountered are provided on the borehole logs attached. Definitions of the terminology and symbols used on the logs are provided on the accompanying explanation sheets also attached to this report.

5.0 ANALYTICAL RESULTS

5.1 Soil Vapour Screening

A total of eighteen soil samples were collected for field hydrocarbon vapour screening from the site. The field hydrocarbon concentrations ranged from non-detect (ND) to 490 ppmv (parts per million by volume) with the RKI Eagle. The highest reading of 490 ppmv was measured in Borehole (BH) 20-02 at 5.25 m and was submitted for laboratory analysis of hydrocarbons. The next highest reading of 320 ppmv was also measured in BH 20-02 at 1.5 m. The highest concentration measured from BH 20-01 was 210 ppmv, which was collected at a depth of 0.75 m and also submitted for laboratory analysis of hydrocarbons. All other soil vapour concentrations were less than 150 ppmv.

Field screening results are presented in Table 2.

5.2 Soil Hydrocarbons

One surficial soil sample and one subsurface soil sample were collected and submitted for BTEX F1 to F4 analysis. Detectable concentrations of PHC Fraction F 3 and F4 were measured in the samples collected, however were significantly below the Alberta Guidelines. All other parameters from the soil samples were below laboratory detection limits, thus below Guidelines.

The soil hydrocarbon analytical results are presented in Tables 3 and 4.

5.3 Soil Metals

One soil sample from BH 20-01 at 3.75 m and one from BH20-02 at 1.5 m were collected and submitted for metals analysis. The sample collected from BH 20-01 contained a selenium concentration in excess of the Alberta Guidelines. All other parameters from the soil samples submitted were below laboratory detection limits and/or below Guidelines.

Analytical results are presented in Table 5 attached.

5.4 Soil Salinity

One soil sample was collected and submitted from each borehole at depths of 2.25 m (BH 20-01) and 6.0 m (BH 20-02) for salinity analysis. Both samples submitted were classified with a fair rating for electrical conductivity parameters and unsuitable for sodium adsorption ratio (SAR) parameters. The pH vales ranged from 7.46 (Borehole 20-02) to 8.14 (Borehole 20-01).

The soil salinity analytical results are presented in Table 6.

6.0 CONCLUSION

Based on the analytical results and the field observations, salinity, metal and hydrocarbon impacts were not identified at the B130 Bridge location. The selenium concentration above the Tier 1 Guideline is very common for these types of soils in the Edmonton area and are expected to be naturally occurring.

7.0 CLOSURE

The American Society for Testing and Materials Standard of Practice notes that no environmental site assessment can wholly eliminate uncertainty regarding the potential for recognized environmental conditions in connection with a property. Performance of a standardized environmental site assessment protocol is intended to reduce, but not eliminate, uncertainty regarding the potential for recognized environmental conditions in connection with the subject property, given reasonable limits of time and cost.

This report has been prepared for the exclusive use of **MPA ENGINEERING LTD.** Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **PARKLAND GEO-ENVIRONMENTAL LTD.**, and The ParklandGEO Consulting Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. No other warranty, expressed or implied, is made.

We trust that this report meets with your current requirements. If there are any questions, please contact the undersigned at 780.416.1755.

Respectfully Submitted,
PARKLAND GEO-ENVIRONMENTAL LTD.

Nicole Prince, P.Eng.
Geo-Environmental Engineer

APEGA Permit to Practice No. P - 8867

Daniel Yost, P.Eng.
Principal, Geo-Environmental Engineering Manager
Reviewer/Responsible Member

Attached: Figures 1 and 2
Tables 1 to 6
Site Photographs
Borehole Logs
Laboratory Results
Report Limitations and Usage

FIGURES

FIGURE 1: AREA PLAN

FIGURE 2: SITE PLAN

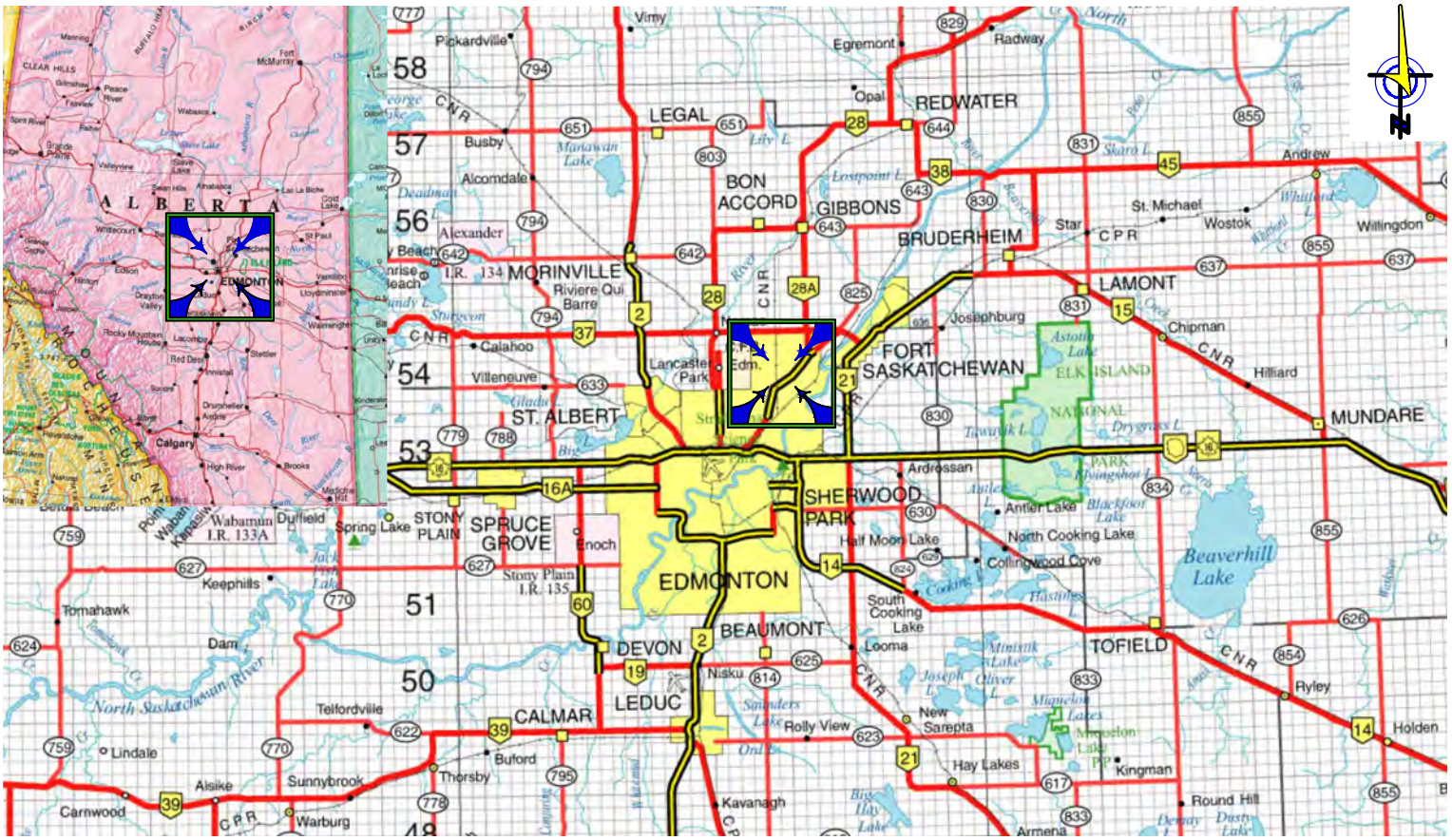


IMAGE FROM GOOGLE EARTH 2019

ParklandGEO

CLIENT:

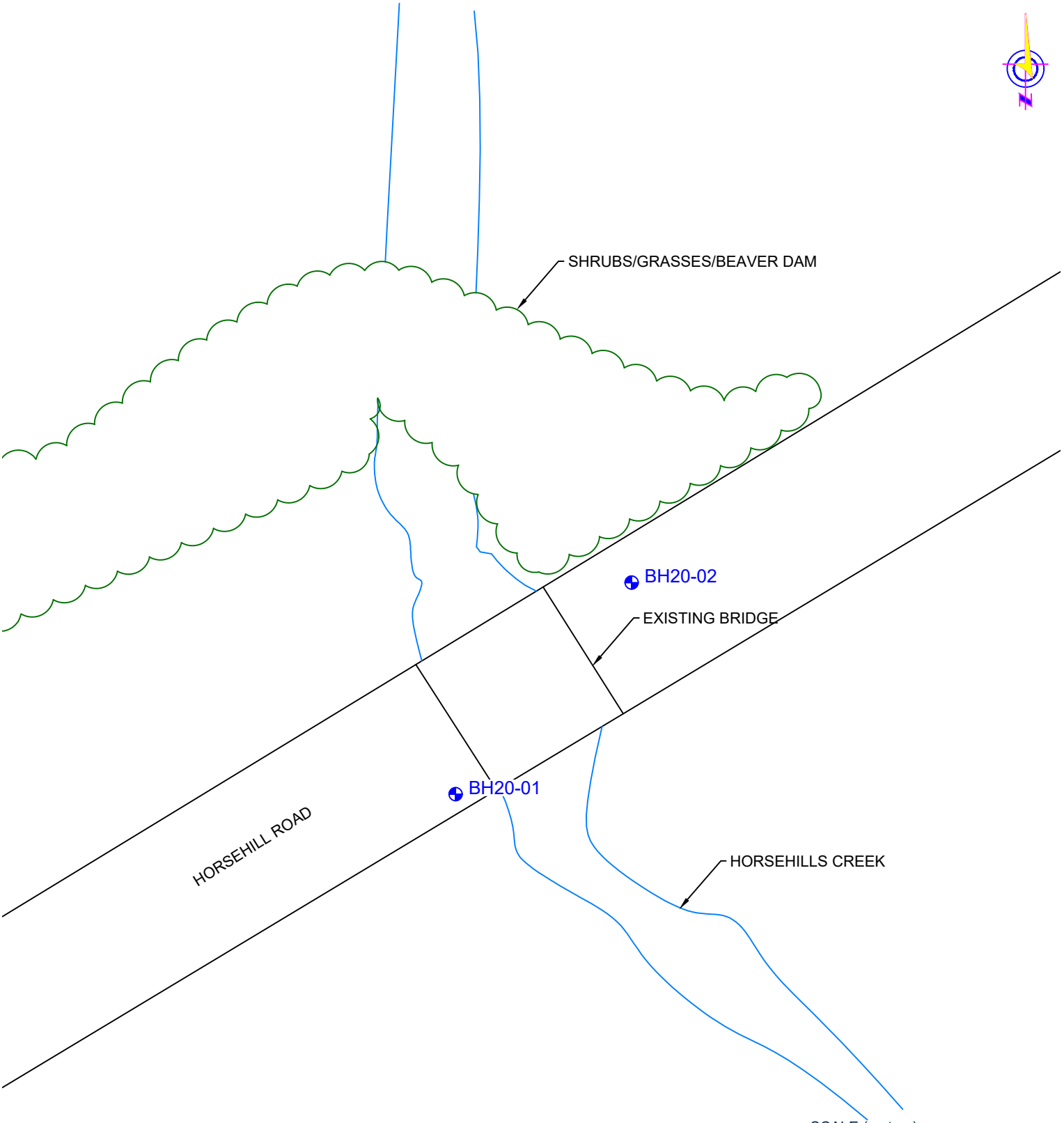
MPA ENGINEERING LTD

AREA PLAN

PROPOSED B130 BRIDGE REPLACEMENT
HORSEHILL ROAD, EDMONTON, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
GM	BG	0	JUNE, 2020

SCALE:	JOB NO.	DRAWING NO.
NTS	ED2251	FIGURE 1



NOTE: THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. NOT ALL STRUCTURES OR FEATURES MAY BE SHOWN. BASE DRAWINGS PROVIDED BY MORRISON HERSHFIELD.

LEGEND:

PARKLANDGEO BOREHOLE

SCALE (metres)

-10 -5 0 5 10

ParklandGEO

CLIENT:

MPA ENGINEERING LTD

SITE PLAN

PROPOSED B130 BRIDGE REPLACEMENT
HORSEHILL ROAD, EDMONTON, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
GM	BG	0	AUGUST, 2020

SCALE:	JOB NO.	DRAWING NO.
1:3000	ED2251	FIGURE 2

TABLES

TABLE 1: LAND-USE AND PATHWAY ASSESSMENT
TABLE 2: SOIL ANALYSES - FIELD HYDROCARBON VAPOURS
TABLE 3: SOIL ANALYSIS - BTEX AND PHC; SURFACE
TABLE 4: SOIL ANALYSIS - BTEX AND PHC; SUBSOIL
TABLE 5: SOIL ANALYSIS - METALS AND INORGANICS
TABLE 6: SOIL ANALYSIS - SALINITY

TABLE: 1
TITLE: LAND-USE AND PATHWAY ASSESSMENT

PROJECT#: ED2251
CLIENT: MPS Engineering Ltd.
PROJECT: Proposed B130 Bridge Replacement
SITE: Horesehill Road, Edmonton, Alberta
LOCATION: Horsehills Creek

1. Tier 1/2 Applicability

Condition	Applicable	Comments
Source of volatile contaminants present within 30 cm of a building foundation	NO	
Land/water use not captured by Generic Tier 1 land uses	NO	
Exposure Pathway is present that is not considered at Tier 1 for the land use	NO	
Human receptors spend more time at site than average or receiver higher levels of exposure	NO	
Ecological receptors with high sensitivity	NO	
Unusual structural features (ie. earthen floor, unusually low air exchange rates)	NO	
Groundwater flow to stagnant waterbodies	NO	
Groundwater within 10 m of a surface water body	NO	
Very coarse textured materials enhancing groundwater or vapour transport	NO	
Fractured bedrock	NO	
Source length of groundwater contamination greater than 10 m	NO	
Inorganic contaminants in organic soil	NO	

Note: If any of the above conditions are applicable, Tier 1 Guidelines cannot be used; a Tier 2 approach must be used. If none of the above conditions are applicable, a Tier 1 or Tier 2 approach may be used.

2. Applicable Land Use

Land Use	Applicable	Comments
Natural Area (away from human habitation; primary concern is the protection of ecological receptors)	YES	
Agricultural (primary land use is growing crops or tending livestock)	YES	
Residential (primary activity is residential or residential activity, includes urban parks, campgrounds)	NO	
Commercial (primary activity is commercial, and there is free access to all members of the public)	NO	
Industrial (primary activity is production / manufacturing - public access is restricted)	NO	

3. Applicable Soil Type

Soil Type	Applicable	Comments
Fine-Grained	YES	
Coarse-Grained	YES	

4. Applicable Surface Water Use

Water Use	Applicable	Comments
Drinking Water	YES	
Aquatic Life	YES	
Irrigation	YES	
Livestock Water	YES	
Wildlife Water	YES	

5. Pathway Exclusion

Pathway	Applicable	Comments
Human Exposure Pathways		
Direct Soil Contact	YES	
Vapour Inhalation (basement)	YES	
Vapour Inhalation (slab-on-grade)	YES	
Protection of Domestic Use Aquifer*	YES	
Off-Site Migration by Wind or Water Erosion	YES	
Ecological Exposure Pathways		
Direct Soil Contact	YES	
Nutrient/Energy Cycling	YES	
Livestock Ingestion	YES	
Wildlife Ingestion	YES	
Freshwater Aquatic Life*	YES	
Livestock Watering*	YES	
Wildlife Watering*	YES	
Irrigation Watering*	YES	
Off-Site Migration by Wind or Water Erosion	YES	
Other Pathways		
Management Limit	YES	

* Pathway can be excluded at Tier 2 approach.

Refer to Each Table for the Most Stringent Guideline for the Applicable Legislation, Land-Use and Soil Type

TABLE: 2
TITLE: SOIL ANALYSES - FIELD HYDROCARBON VAPOURS

PROJECT#: ED2251
CLIENT: MPS Engineering Ltd.
PROJECT: Proposed B130 Bridge Replacement
SITE: Horesehill Road, Edmonton, Alberta
LOCATION: Horsehills Creek

All concentrations in parts per million by volume (ppmv)
ND = Non-detectable (< 5 ppmv)
= Submitted for Laboratory Analysis for Hydrocarbons
= Submitted for Laboratory Analysis for Metals
= Submitted for Laboratory Analysis for Salinity

Depth (m)	BOREHOLE	
	20-01	20-02
0.75	210	55
1.50	10	320
2.25	10	60
3.00	15	ND
3.75	ND	ND
4.50	95	35
5.25	10	490
6.00	140	100
6.75	25	ND

Sample Dates			
16-Jul-20	20-01	to	20-02

TABLE: 3
TITLE: SOIL ANALYSES - BTEX AND PETROLEUM HYDROCARBON (PHC) FRACTIONS; SURFACE

PROJECT#: ED2251
CLIENT: MPS Engineering Ltd.
PROJECT: Proposed B130 Bridge Replacement
SITE: Horsehill Road, Edmonton, Alberta
LOCATION: Horsehills Creek

CRITERIA: ALBERTA TIER 1/2 SOIL AND GROUNDWATER REMEDIATION GUIDELINES, JANUARY 2019
TABLES A-1 TO A-5 SURFACE SOIL REMEDIATION GUIDELINE VALUES FOR ALL LAND USES AND EXPOSURE PATHWAYS

Surface Guidelines for BTEX and F1-F4 must be applied to a depth of 1.5 m within 5 m setback from a wellhead OR to a depth of 3 m at any other site.

LAND USE	
Natural Area	YES
Agricultural	YES
Residential	NO
Commercial	NO
Industrial	NO

SOIL TYPE	
Fine	YES
Coarse	YES

NGR = No Guideline Required
BDL = Below Detection Limit
HVC = Hydrocarbon Vapour Concentration (in parts per million per volume (ppmv))
PHC = Petroleum Hydrocarbon Fraction; F1 = C6-C10 (minus BTEX); F2 = C10-C16; F3 = C16-C34; F4 = C34-C50

All concentrations in mg/kg unless otherwise noted
Bold = Exceeds Criteria
NO = Does not meet QA/QC for Laboratory

PATHWAY	APPLICABLE	MOST STRINGENT CRITERIA FOR LAND USE AND SOIL TYPE							
		Benzene	Toluene	Ethylbenzene	Xylenes	PHC F1	PHC F2	PHC F3	PHC F4
Human Exposure Pathways									
Direct Soil Contact	YES	78	640	1700	480	12000	6800	15000	21000
Vapour Inhalation (basement)	YES	0.1	130	60	16	30	160	-	-
Vapour Inhalation (slab-on-grade)	YES	0.073	95	44	12	24	130	-	-
Protection of Domestic Use Aquifer*	YES	0.046	0.52	0.073	0.99	1100	1500	-	-
Off-Site Migration by Wind or Water Erosion	YES	-	-	-	-	-	-	-	-
Ecological Exposure Pathways									
Direct Soil Contact	YES	31	75	55	65	210	150	300	2800
Nutrient/Energy Cycling	YES	-	-	-	-	-	-	-	-
Livestock Ingestion	YES	44	2500	1600	6600	27000	25000	30000	21000
Wildlife Ingestion	YES	18	980	640	2600	11000	9800	16000	8400
Freshwater Aquatic Life*	YES	0.17	0.12	540	41	1300	520	-	-
Livestock Watering*	YES	0.2	26	36	160	6600	16000	-	-
Wildlife Watering*	YES	0.33	1000	17000	16000	30000	30000	-	-
Irrigation Watering*	YES	-	-	-	-	-	-	-	-
Off-Site Migration by Wind or Water Erosion	YES	-	-	-	-	-	-	-	-
Other Pathways									
Management Limit	YES	-	-	-	-	700	1000	2500	10000

SAMPLE				MOST STRINGENT CRITERIA FOR APPLICABLE PATHWAY(S)								QA/QC		
				Benzene	Toluene	Ethylbenzene	Xylenes	PHC F1	PHC F2	PHC F3	PHC F4	Hold Times Met	Acceptable Limits Met	Notes
Sample ID	**Depth (m)**	**Sample Date**	**Lab ID**	**0.046**	**0.12**	**0.073**	**0.99**	**24**	**130**	**300**	**2800**			
1G1	0.75	16-Jul-20	1290509	<0.005	<0.05	<0.01	<0.05	<10	<10	40	30	YES	YES	

TABLE: 4
TITLE: SOIL ANALYSES - BTEX AND PETROLEUM HYDROCARBON (PHC) FRACTIONS; SUBSOIL

PROJECT#: ED2251
CLIENT: MPS Engineering Ltd.
PROJECT: Proposed B130 Bridge Replacement
SITE: Horesehill Road, Edmonton, Alberta
LOCATION: Horsehills Creek

CRITERIA: ALBERTA TIER 1/2 SOIL AND GROUNDWATER REMEDIATION GUIDELINES, JANUARY 2019
TABLES A-6 TO A-10 SUBSOIL REMEDIATION GUIDELINE VALUES FOR ALL LAND USES AND EXPOSURE PATHWAYS

Subsurface Guidelines may be used as follows:
(a) Below 1.5 m in depth within a 5 m setback from an oilfield wellhead
(b) Below 3 m in depth at any site; or
(c) Below 1.5 m at remoted forested sites in Green Zone with fine-texture soil regardless of distance to wellhead
Exclusion of the ecological direct soil contact pathway is permissible for petroleum hydrocarbon fractions F1 to F4 only.

LAND USE	
Natural Area	YES
Agricultural	YES
Residential	NO
Commercial	NO
Industrial	NO

SOIL TYPE	
Fine	YES
Coarse	YES

NGR = No Guideline Required
BDL = Below Detection Limit
HVC = Hydrocarbon Vapour Concentration (in parts per million per volume (ppmv))
PHC = Petroleum Hydrocarbon Fraction; F1 = C6-C10 (minus BTEX); F2 = C10-C16; F3 = C16-C34; F4 = C34-C50

All concentrations in mg/kg unless otherwise noted
Bold = Exceeds Criteria
NO = Does not meet QA/QC for Laboratory

PATHWAY	APPLICABLE	MOST STRINGENT CRITERIA FOR LAND USE AND SOIL TYPE							
		Benzene	Toluene	Ethylbenzene	Xylenes	PHC F1	PHC F2	PHC F3	PHC F4
Human Exposure Pathways									
Direct Soil Contact	YES	78	640	1700	480	12000	6800	15000	21000
Vapour Inhalation (basement)	YES	0.1	130	60	16	30	160	-	-
Vapour Inhalation (slab-on-grade)	YES	0.14	180	86	23	55	290	-	-
Protection of Domestic Use Aquifer*	YES	0.046	0.52	0.073	0.99	1100	1500	-	-
Off-Site Migration by Wind or Water Erosion	YES	-	-	-	-	-	-	-	-
Ecological Exposure Pathways									
Direct Soil Contact	YES	62	150	110	130	-	-	-	-
Nutrient/Energy Cycling	YES	-	-	-	-	-	-	-	-
Livestock Ingestion	YES	-	-	-	-	-	-	-	-
Wildlife Ingestion	YES	-	-	-	-	-	-	-	-
Freshwater Aquatic Life*	YES	0.17	0.12	540	41	1300	520	-	-
Livestock Watering*	YES	0.2	26	36	160	6600	16000	-	-
Wildlife Watering*	YES	0.33	1000	17000	16000	30000	30000	-	-
Irrigation Watering*	YES	-	-	-	-	-	-	-	-
Off-Site Migration by Wind or Water Erosion	YES	-	-	-	-	-	-	-	-
Other Pathways									
Management Limit	YES	-	-	-	-	700	1000	2500	10000

SAMPLE				MOST STRINGENT CRITERIA FOR APPLICABLE PATHWAY(S)								QA/QC		
				Benzene	Toluene	Ethylbenzene	Xylenes	PHC F1	PHC F2	PHC F3	PHC F4	Hold Times Met	Acceptable Limits Met	Notes
Sample ID	**Depth (m)**	**Sample Date**	**Lab ID**	**0.046**	**0.12**	**0.073**	**0.99**	**30**	**160**	**2500**	**10000**			
2G7	5.25	16-Jul-20	1290519	<0.005	<0.05	<0.01	<0.05	<10	<10	60	30	YES	YES	

TABLE: 5
TITLE: SOIL ANALYSES - METALS AND INORGANICS

PROJECT#: ED2251
CLIENT: MPS Engineering Ltd.
PROJECT: Proposed B130 Bridge Replacement
SITE: Horsehill Road, Edmonton, Alberta
LOCATION: Horsehills Creek

CRITERIA: ALBERTA TIER 1/2 SOIL AND GROUNDWATER REMEDIATION GUIDELINES, JANUARY 2019
TABLES A-1 TO A-5 SURFACE SOIL REMEDIATION GUIDELINE VALUES FOR ALL LAND USES AND EXPOSURE PATHWAYS

LAND USE	CURRENT
Natural Area	YES
Agricultural	YES
Residential	NO
Commercial	NO
Industrial	NO

SOIL TYPE	
Fine	YES
Coarse	YES

NGR
Guideline values based on total metals

All concentrations in mg/kg unless otherwise noted
Bold = Exceeds Criteria
NO = Does not meet QA/QC for Laboratory

PATHWAY	APPLICABLE	MOST STRINGENT CRITERIA FOR LAND USE AND SOIL TYPE																		
		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium (hex)	Chromium (total)	Cobalt	Copper	Lead	Magnesium	Molybdenum	Nickel	Selenium	Silver	Thallium	Tin	Uranium	Vanadium	Zinc
Human Exposure Pathways																					
Direct Soil Contact	YES	-	21	-	-	1.4	-	220	-	1100	140	-	-	200	80	-	1	-	23	-	10000
Vapour Inhalation (basement)	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vapour Inhalation (slab-on-grade)	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Protection of Domestic Use Aquifer*	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Off-Site Migration by Wind or Water Erosion	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ecological Exposure Pathways									-	-						-					
Direct Soil Contact	YES	20	17	750	5	10	0.4	64	20	63	300	-	4	45	1	20	1.4	5	500	130	250
Nutrient/Energy Cycling	YES	-	-	-	-	54	-	-	-	350	723	-	-	171	-	-	-	-	-	255	280
Livestock Ingestion	YES	-	380	-	-	3.8	-	-	-	300	70	-	-	528	4.5	-	1	-	33	-	980
Wildlife Ingestion	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Freshwater Aquatic Life*	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Livestock Watering*	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wildlife Watering*	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Irrigation Watering*	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Off-Site Migration by Wind or Water Erosion	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Pathways									-	-						-					
Management Limit	YES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SAMPLE				MOST STRINGENT CRITERIA FOR APPLICABLE PATHWAY(S)																			QA/QC		
				Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium (hex)	Chromium (total)	Cobalt	Copper	Lead	Magnesium	Molybdenum	Nickel	Selenium	Silver	Thallium	Tin	Uranium	Vanadium	Zinc	Hold Times Met	Acceptable Limits Met	Notes
Sample ID	**Depth (m)**	**Sample Date**	**Lab ID**	**20**	**17**	**750**	**5**	**1.4**	**0.4**	**64**	**20**	**63**	**70**	**-**	**4**	**45**	**1**	**20**	**1**	**5**	**23**	**130**	**250**			
1G5	3.75	16-Jul-20	1290513	0.7	9.1	250	1	<0.5	<0.3	30.4	12.8	29.4	15.4	31	1.7	32.2	**2.5**	<0.5	<0.5	0.9	2.7	50	89	YES	YES	
2G2	1.50	16-Jul-20	1290514	<0.5	6.6	316	1	<0.5	<0.3	29.8	11.2	24.7	11.7	41	<0.4	32.4	0.6	<0.5	<0.5	0.8	1.9	55.3	86	YES	YES	

TABLE: 6
TITLE: SOIL ANALYSES - SALINITY

PROJECT#: ED2251
CLIENT: MPS Engineering Ltd.
PROJECT: Proposed B130 Bridge Replacement
SITE: Horesehill Road, Edmonton, Alberta
LOCATION: Horsehills Creek

CRITERIA: ALBERTA TIER 1/2 SOIL AND GROUNDWATER REMEDIATION GUIDELINES, JANUARY 2019
TABLE 4, ALBERTA TIER 1 SALT REMEDIATION GUIDELINES

Topsoil Guidelines apply to surface A, L, F, H and O horizons or the equivalent surface soil where these horizons are not present.
Subsoil Guidelines apply to B and C horizons and the upper portion of the parent material.
For Commercial/Industrial Sites, Topsoil EC = 4 dS/m, Topsoil SAR = 12, Subsoil EC = 4 dS/m, Subsoil SAR = 12
Material characterized by SAR of 12 to 20 may be rated as "Poor" if the the texture is sandy loam or coarser and saturation % is less than 100.

SAR and pH are unitless. All other concentrations in mg/kg unless otherwise noted.
NO = Does not meet QA/QC

EC = Electrical Conductivity
SAR = Sodium Adsorption Ratio
TGR = Total Gypsum Ratio

SUBSOIL	EC	Rating	SAR	pH	Calcium	Chloride	Magnesium	Potassium	Sodium	Sulphate	Sat. %	TGR (t/ha)
	<3	Good	<4									
	3-5	Fair	4-8									
	5-10	Poor	8-12	6-8.5	No Guidline							
	>10	Unsuitable	>12									

Sample ID	Depth (m)	Sample Date	EC (mS/cm)	Rating	SAR	Rating	pH	Ca	Cl^-	Mg	K	Na	SO_4^{2-}	Sat. %	TGR (t/ha)	QA/QC: Hold Times Met	QA/QC: Laboratory Detection Limits Met	Notes
1G3	2.25	16-Jul-20	3.35	Fair	14.3	Unsuitable	8.14	42	62	31	3	405	957	66	2.44	YES	YES	
2G8	6.00	16-Jul-20	3.01	Fair	14.9	Unsuitable	7.46	63	44	41	26	718	1880	136	3.82	YES	YES	

ATTACHMENTS

SITE PHOTOGRAPHS

BOREHOLE LOGS

EXPLANATION SHEETS

LABORATORY RESULTS

Photograph 1: Facing west from the bridge location. Drilling rig can be seen set up at Borehole 20-01.

Photograph 2: Facing north from the bridge location, looking along Horsehill Creek.

Photograph 3: Facing south from the bridge location, along Horsehill Creek. The creek can be seen entering 2 culverts to allow drainage below Highway 15.

Photograph 4: Completed borehole with flush mounted well protector installed at the surface.

BOREHOLE NO.: 20-01

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: SW of Existing Bridge

PROJECT NO.: ED2251

SUBSURFACE PROFILE

Depth (m)	Description	Elev.
	GROUND SURFACE	0.0
0	***Asphalt***	
	Sand and Gravel Fill Loose, damp, brown	
1	***Silty Clay Fill*** Some sand, low plastic,firm, damp, brown	-1.8
2	Grey with black organic staining and odour at 0.5 m	-2.3
	Sand And clay, little rust inclusions, moist, brown and grey	
3		
	Clay And silt, trace sand, high plastic, firm, trace rust and coal inclusions, occasional sand pockets and white mineral includsions, damp, mottled grey and brown	-4.5
4		
5		-5.5
	Rafted Weathered Clay Shale Some silt, trace sand, stiff, high plastic, damp, crumbly, grey	-6.3
6		
	Sand Little clay, wet, brown	
7	***Clay*** Some silt, some sand, trace gravel, medium plastic, occasional sand pockets and white mineral inclusions, damp, grey	
8		
9		
10		
11		
12		
13		
14		
15		

SAMPLE

Sample No.	Type	SPT (N)
1D1		5
1D2		6
1U1		6
1D4		17
1D5		5
1D6		8
1D7		22
1D8		19
1D9		13
1D10		8

Atterberg Limits Moisture Content (%)

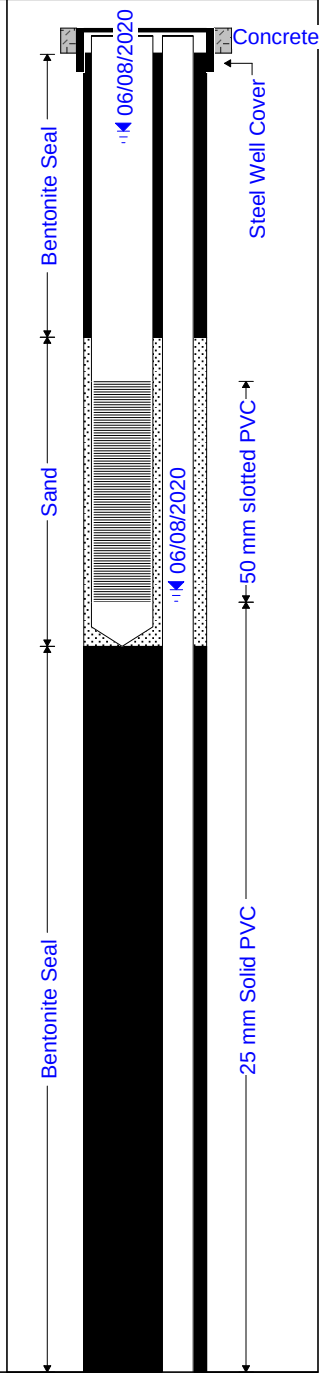
(Wp |-----x-----| Wl)

25 50 75

22 26 23 29 38 22 22 24 27 30 20 18 27 25 21 26 21 19

Comments
Vapours = 210 ppmv
Vapours = 10 ppmv
Vapours = 10 ppmv
Vapours = 15 ppmv
Vapours = Non-Detectable
Vapours = 95 ppmv
Vapours = 10 ppmv
Vapours = 140 ppmv
Vapours = 25 ppmv
Grain Size Analysis at 9.0 m: Clay = 30.3% Silt = 32.1% Sand = 37.6% Gravel = 0.0%

Well Completion Details



LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

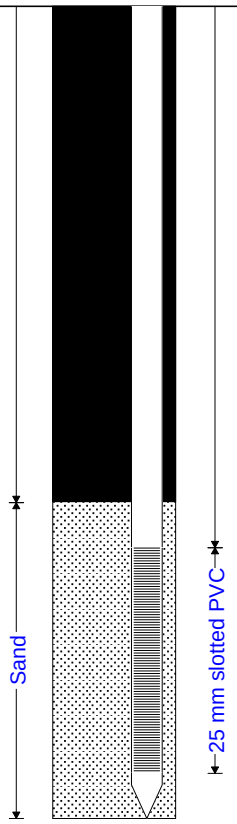
GROUND ELEVATION:
NORTHING: 5948163
EASTING: 0343635

BOREHOLE NO.: 20-01

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: SW of Existing Bridge

PROJECT NO.: ED2251

SUBSURFACE PROFILE				SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)	(Wp |-----x-----| Wl) 25 50 75		
			-15.3				19		
		Sand Coarse grained, moist							
16		***Clay*** Some sand, trace gravel, medium plastic, moist to wet, grey		1D11		15	21		
17							21		
				1D12		11			
18							27		
19		- And sand, soft, wet, grey at 19 m		1D13		15			
20									
		- Trace silt and gravel, occasional sand pockets, high plastic, damp, grey at 20.25 m		1D14		17			
21							25		
22				1D15		19			
23							17		
				1D16		19			
24							17		
25			-25.3	1D17		26			
26		END OF BOREHOLE WATER AND SLOUGH TO 2.2 m UPON COMPLETION							
27									
28									
29									
30									



LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

GROUND ELEVATION:
NORTHING: 5948163
EASTING: 0343635

BOREHOLE NO.: 20-02

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: NE of Existing Bridge

PROJECT NO.: ED2251

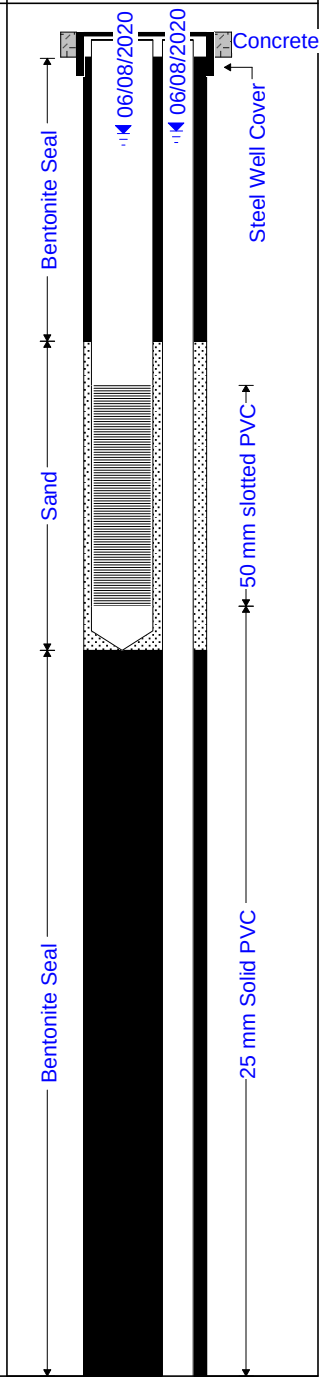
SUBSURFACE PROFILE

Depth (m)	Description	Elev.
	GROUND SURFACE	0.0
0	***Asphalt***	
	Clay Fill Some silt, little sand, trace gravel, firm, medium plastic,occasional rust, damp brown	-1.5
1		-1.8
	Organic Soil	
2	***Clay*** Some silt, little sand, firm, high plastic, occasional rust, damp, mottled grey/brown	
3		
4		-4.5
	Rafted Weathered Clay Shale Some silt, trace sand, stiff, high plastic, damp, crumbly, grey	-5.5
5	***Clay*** Some sand and silt, little gravel, trace rust, wet, brown	
6		-6.8
7	***Clay*** Some silt, little sand, trace gravel, firm to stiff, medium to high plastic, damp to moist, grey	
8		
9		
10		
11		
12	- trace coal inclusions and medium plastic at 12.75 m to 14.0m	
13		
14		
15		

SAMPLE

Sample No.	Type	SPT (N)	Atterberg Limits Moisture Content (%) (Wp |-----x-----| Wl) 25 50 75	Comments
2D1		7	18	Vapours = 55 ppmv
			25	Vapours = 320 ppmv
2D2		5	32	Vapours = 60 ppmv
2U1		-	38	Vapours = 0 ppmv
			40	Vapours = 0 ppm
2D3		8	20	Vapours = 35 ppmv
2D4		13	23	Vapours = 490 ppmv
			26	Vapours = 100 ppmv
			24	Vapours = 0 ppmv
2D5		4	27	Atterberg Limit at 2.25 m: PL = 22.0% LL = 62.0% PI = 40.0%
			27	
			26	
2D6		9	31	
			22	
			20	
2D7		7	23	
			27	
			19	

Well Completion Details



LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

GROUND ELEVATION:
NORTHING: 5948175
EASTING: 0343645

BOREHOLE NO.: 20-02

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: NE of Existing Bridge

PROJECT NO.: ED2251

SUBSURFACE PROFILE				SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)	(Wp |-----x-----| Wl) 25 50 75		
16				2D8		27	19 21 21 27		Sand
17									
18									
19			-19.5	2D9		18			25 mm slotted PVC
20		END OF BOREHOLE WATER TO 4 MBG AND SLOUGH TO 11 MBG UPON COMPLETION							
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

GROUND ELEVATION:
NORTHING: 5948175
EASTING: 0343645

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following two pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The materials, boundaries, and conditions have been established only at the borehole location at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile usually have gradual rather than distinct unit boundaries as shown on the borehole logs.

1. PRINCIPAL SOIL TYPE – The major soil type by weight of material or by behaviour.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt & Clay	Smaller than 0.075 mm

2. DESCRIPTION OF MINOR SOIL TYPE – Minor soil types are identified by weight of minor component.

Percent	Descriptor
35 to 50	and
20 to 35	some
10 to 20	little
1 to 10	trace

3. RELATIVE STRENGTH OF COARSE GRAINED SOIL – The following terms are used relative to Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm.

Description	N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

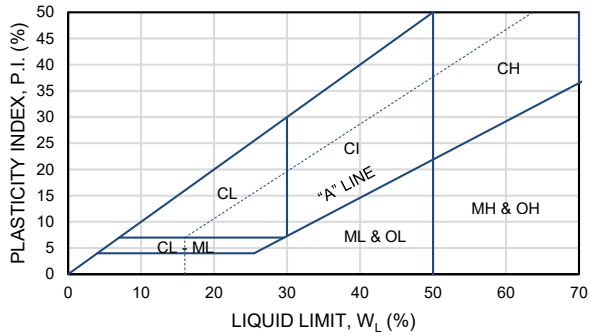
4. CONSISTENCY OF FINE GRAINED SOILS – The following terms are used relative to undrained shear strength and Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm. It is noted that this correlation needs to be used with caution as the correlation is only very approximate.

Description	Undrained Shear Strength, C_u (kPa)	N Value
Very Soft	Less than 12	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 150	15 to 30
Hard	Over 150	Over 30

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

MODIFIED UNIFIED CLASSIFCATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. LESS THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. LESS THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range by eight of minor components.

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CLIENT NAME: PARKLAND GEO
189 PEMBINA ROAD
SHERWOOD PARK, AB T8H2W8
(780) 416-1755
ATTENTION TO: Nicole Prince
PROJECT: ED2251
AGAT WORK ORDER: 20E628520
SOIL ANALYSIS REVIEWED BY: Melinda Guay, Technical Reviewer
TRACE ORGANICS REVIEWED BY: Melinda Guay, Technical Reviewer
DATE REPORTED: Jul 27, 2020
PAGES (INCLUDING COVER): 14
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (780) 395-2525

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days following analysis, unless expressly agreed otherwise in writing. Please contact your Client Project Manager if you require additional sample storage time.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
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- *The test results reported herewith relate only to the samples as received by the laboratory.*
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- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

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Certificate of Analysis

AGAT WORK ORDER: 20E628520

PROJECT: ED2251

CLIENT NAME: PARKLAND GEO

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

CCME / Tier 1 Metals + Cr6 (soil)

DATE RECEIVED: 2020-07-20

DATE REPORTED: 2020-07-26

		SAMPLE DESCRIPTION:		1G5 3.75	2G2 1.5
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2020-07-16	2020-07-16
Parameter	Unit	G / S	RDL	1290513	1290514
Antimony	mg/kg	20	0.5	0.7	<0.5
Arsenic	mg/kg	17	0.5	9.1	6.6
Barium	mg/kg	750	0.5	250	316
Beryllium	mg/kg	5	0.5	1.0	1.0
Cadmium	mg/kg	1.4	0.5	<0.5	<0.5
Chromium	mg/kg	64	0.5	30.4	29.8
Chromium, Hexavalent	mg/kg	0.4	0.3	<0.3	<0.3
Cobalt	mg/kg	20	0.5	12.8	11.2
Copper	mg/kg	63	0.5	29.4	24.7
Lead	mg/kg	70	0.5	15.4	11.7
Molybdenum	mg/kg	4	0.5	1.7	<0.5
Nickel	mg/kg	45	0.5	32.2	32.4
Selenium	mg/kg	1	0.5	**2.5**	0.6
Silver	mg/kg	20	0.5	<0.5	<0.5
Thallium	mg/kg	1	0.5	<0.5	<0.5
Tin	mg/kg	5	0.5	0.9	0.8
Uranium	mg/kg	23	0.5	2.7	1.9
Vanadium	mg/kg	130	0.5	50.0	55.3
Zinc	mg/kg	250	1	89	86

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Alberta Tier 1 - Soil - Agricultural - Fine
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

1290513 Results are based on the dry weight of the sample.
*Values verified by repeat analysis.

1290514 Results are based on the dry weight of the sample.

Analysis performed at AGAT Edmonton (unless marked by *)

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AGAT WORK ORDER: 20E628520

PROJECT: ED2251

CLIENT NAME: PARKLAND GEO

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Soil Analysis - Salinity (pH Calcium Chloride)

DATE RECEIVED: 2020-07-20

DATE REPORTED: 2020-07-26

		SAMPLE DESCRIPTION:		1G3 2.25	2G8 6.0
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2020-07-16	2020-07-16
Parameter	Unit	G / S	RDL	1290512	1290522
pH (CaCl2 Extraction)	pH Units		N/A	7.46	8.14
Electrical Conductivity (Sat. Paste)	dS/m		0.05	3.35	3.01
Sodium Adsorption Ratio	N/A		0.34	14.3	14.9
Saturation Percentage	%		1	66	136
Chloride, Soluble	mg/L		5	94	32
Calcium, Soluble	mg/L		1	63	46
Potassium, Soluble	mg/L		2	4	19
Magnesium, Soluble	mg/L		1	47	30
Sodium, Soluble	mg/L		2	614	528
Sulfate, Soluble	mg/L		6	1450	1380
Theoretical Gypsum Requirement	tonnes/ha		0.01	2.44	3.82
Calcium, Soluble (meq/L)	meq/L		0.05	3.14	2.30
Calcium, Soluble (mg/kg)	mg/kg		1	42	63
Chloride, Soluble (meq/L)	meq/L		0.06	2.65	0.90
Chloride, Soluble (mg/kg)	mg/kg		2	62	44
Magnesium, Soluble (meq/L)	meq/L		0.08	3.87	2.47
Magnesium, Soluble (mg/kg)	mg/kg		1	31	41
Potassium, Soluble (meq/L)	meq/L		0.05	0.10	0.49
Potassium, Soluble (mg/kg)	mg/kg		2	3	26
Sodium, Soluble (meq/L)	meq/L		0.09	26.7	23.0
Sodium, Soluble (mg/kg)	mg/kg		2	405	718
Sulfur (as Sulfate), Soluble (meq/L)	meq/L		0.04	30.2	28.7
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg		2	957	1880

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

1290512-1290522 If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.
Sodium Adsorption Ratio is a calculated parameter. The calculated value is the ratio of the sodium concentration in mmol/L over the square rooted sum of the calcium and magnesium concentrations in mmol/L.
Theoretical Gypsum Requirement is a calculated parameter. The calculation is from “A Comparison of Methods for Gypsum Requirement of Brine-Contaminated Soils”, Canadian Journal of Soil Science, 1998.

Analysis performed at AGAT Edmonton (unless marked by *)

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Certificate of Analysis

AGAT WORK ORDER: 20E628520

PROJECT: ED2251

CLIENT NAME: PARKLAND GEO

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2020-07-20

DATE REPORTED: 2020-07-25

		SAMPLE DESCRIPTION:		1G1 0.75	2G7 5.25
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2020-07-16	2020-07-16
Parameter	**Unit**	**G / S**	**RDL**	**1290509**	**1290519**
Benzene	mg/kg		0.005	<0.005	<0.005
Toluene	mg/kg		0.05	<0.05	<0.05
Ethylbenzene	mg/kg		0.01	<0.01	<0.01
Xylenes	mg/kg		0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg		10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg		10	<10	<10
C10 - C16 (F2)	mg/kg		10	<10	<10
C16 - C34 (F3)	mg/kg		10	40	60
C34 - C50 (F4)	mg/kg		10	30	30
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A
Moisture Content	%		1	17	17
Surrogate	**Unit**	**Acceptable Limits**			
Toluene-d8 (BTEX)	%	60-140		92	94
Ethylbenzene-d10 (BTEX)	%	60-140		66	60
o-Terphenyl (F2-F4)	%	60-140		92	99

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AGAT WORK ORDER: 20E628520

PROJECT: ED2251

CLIENT NAME: PARKLAND GEO

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2020-07-20

DATE REPORTED: 2020-07-25

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

1290509-1290519 Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.
C6 –C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.
Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylenes + o-Xylene.

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AGAT WORK ORDER: 20E628520

PROJECT: ED2251

CLIENT NAME: PARKLAND GEO

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Polyaromatic Hydrocarbon Analysis in Soil

DATE RECEIVED: 2020-07-20

DATE REPORTED: 2020-07-24

		SAMPLE DESCRIPTION:		1G3 2.25	2G7 5.25
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2020-07-16	2020-07-16
Parameter	Unit	G / S	RDL	1290512	1290519
Naphthalene	mg/kg		0.005	<0.005	<0.005
2-Methylnaphthalene	mg/kg		0.005	<0.005	<0.005
Quinoline	mg/kg		0.05	<0.05	<0.05
Acenaphthylene	mg/kg		0.005	<0.005	<0.005
Acenaphthene	mg/kg		0.005	<0.005	<0.005
Fluorene	mg/kg		0.02	<0.02	<0.02
Phenanthrene	mg/kg		0.02	<0.02	<0.02
Anthracene	mg/kg		0.004	<0.004	<0.004
Fluoranthene	mg/kg		0.01	<0.01	0.01
Pyrene	mg/kg		0.01	<0.01	0.02
Acridine	mg/kg		0.05	<0.05	<0.05
Benzo[a]anthracene	mg/kg		0.02	<0.02	<0.02
Chrysene	mg/kg		0.05	<0.05	<0.05
Benzo[b+j]fluoranthene	mg/kg		0.03	<0.03	<0.03
Benzo[k]fluoranthene	mg/kg		0.02	<0.02	<0.02
Benzo[a]pyrene	mg/kg		0.03	<0.03	<0.03
Indeno[1,2,3-cd]pyrene	mg/kg		0.02	<0.02	<0.02
Dibenzo[ah]anthracene	mg/kg		0.005	<0.005	<0.005
Benzo[ghi]perylene	mg/kg		0.05	<0.05	<0.05
B[a]P TPE	mg/kg		0.023	0.023	0.023
IACR (Fine Soil)			0.026	0.026	0.026
IACR (Coarse Soil)			0.014	0.014	0.014
Surrogate	**Unit**	**Acceptable Limits**			
Naphthalene-d8	%	50-140		101	104
p-Terphenyl-d14 (PAH)	%	50-140		83	85
Pyrene-d10	%	50-140		99	104

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Certificate of Analysis

AGAT WORK ORDER: 20E628520

PROJECT: ED2251

CLIENT NAME: PARKLAND GEO

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Polyaromatic Hydrocarbon Analysis in Soil

DATE RECEIVED: 2020-07-20

DATE REPORTED: 2020-07-24

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

1290512-1290519 Results are based on the dry weight of the sample.
Based on GC/MS target ion analysis.
Isomers Benzo(b)fluoranthene and Benzo(j)fluoranthene have the same GC retention time and are reported as the sum based on the Benzo(b)fluoranthene response.
B[a]P TPE, IACR (Coarse) and IACR (Fine) are calculated parameters. They are calculated according to the Alberta Tier 1 Soil and Groundwater Remediation Guidelines, January 10, 2019. Note that if the analysis returns non-detects for a parameter, ½ the detection limit is entered into the formulas. As per the Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment Volume 4 Analytical Methods (2016).

Analysis performed at AGAT Edmonton (unless marked by *)

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Quality Assurance

CLIENT NAME: PARKLAND GEO

AGAT WORK ORDER: 20E628520

PROJECT: ED2251

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Soil Analysis - Salinity (pH Calcium Chloride)															
pH (CaCl2 Extraction)	208	1277904	5.52	5.30	4.1%	N/A	99%	90%	110%						
Electrical Conductivity (Sat. Paste)	208	1277904	4.84	4.41	9.3%	< 0.05	95%	80%	120%						
Saturation Percentage	208	1277904	64	64	0.0%	< 1	101%	80%	120%						
Chloride, Soluble	59	1277904	1590	1600	0.3%	< 5	87%	70%	130%	97%	80%	120%	109%	70%	130%
Calcium, Soluble	208	1277904	462	466	0.9%	< 1	100%	70%	130%	103%	80%	120%	101%	70%	130%
Potassium, Soluble	208	1277904	8	7	NA	< 2	95%	70%	130%	94%	80%	120%	96%	70%	130%
Magnesium, Soluble	208	1277904	104	105	0.8%	< 1	96%	70%	130%	87%	80%	120%	96%	70%	130%
Sodium, Soluble	208	1277904	189	191	0.8%	< 2	97%	70%	130%	95%	80%	120%	101%	70%	130%
Sulfate, Soluble	208	1277904	<10	<10	NA	< 2	97%	70%	130%	83%	80%	120%	97%	70%	130%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated
If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.

CCME / Tier 1 Metals + Cr6 (soil)															
Antimony	208	1299289	<0.5	<0.5	NA	< 0.5	88%	70%	130%	100%	80%	120%	93%	70%	130%
Arsenic	208	1299289	7.8	8.0	1.8%	< 0.5	96%	80%	120%	104%	80%	120%	82%	80%	120%
Barium	208	1299289	104	97.7	6.7%	< 0.5	100%	70%	130%	101%	80%	120%	86%	70%	130%
Beryllium	208	1299289	0.8	0.7	NA	< 0.5	87%	70%	130%	107%	80%	120%	108%	70%	130%
Cadmium	208	1299289	<0.5	<0.5	NA	< 0.5	96%	70%	130%	105%	80%	120%	99%	70%	130%
Chromium	208	1299289	21.8	20.9	4.4%	< 0.5	95%	70%	130%	103%	80%	120%	92%	70%	130%
Chromium, Hexavalent	207	1299289	<0.3	<0.3	NA	< 0.3	80%	70%	130%	105%	80%	120%	93%	70%	130%
Cobalt	208	1299289	7.3	7.0	3.6%	< 0.5	89%	70%	130%	105%	80%	120%	93%	70%	130%
Copper	208	1299289	10.8	10.3	4.3%	< 0.5	96%	70%	130%	109%	80%	120%	94%	70%	130%
Lead	208	1299289	12.4	11.8	5.2%	< 0.5	102%	70%	130%	108%	80%	120%	99%	70%	130%
Molybdenum	208	1299289	<0.5	<0.5	NA	< 0.5	98%	70%	130%	99%	80%	120%	105%	70%	130%
Nickel	208	1299289	21.0	19.8	6.0%	< 0.5	79%	70%	130%	104%	80%	120%	95%	70%	130%
Selenium	208	1299289	0.6	<0.5	NA	< 0.5	93%	70%	130%	95%	80%	120%	90%	70%	130%
Silver	208	1299289	<0.5	<0.5	NA	< 0.5	98%	70%	130%	99%	80%	120%	102%	70%	130%
Thallium	208	1299289	<0.5	<0.5	NA	< 0.5	100%	70%	130%	104%	80%	120%	110%	70%	130%
Tin	208	1299289	2.8	1.4	NA	< 0.5	96%	70%	130%	107%	80%	120%	77%	70%	130%
Uranium	208	1299289	0.7	0.7	NA	< 0.5	101%	70%	130%	106%	80%	120%	105%	70%	130%
Vanadium	208	1299289	36.6	35.4	3.4%	< 0.5	100%	70%	130%	107%	80%	120%	94%	70%	130%
Zinc	208	1299289	41	42	3.9%	< 1	93%	70%	130%	114%	80%	120%	86%	70%	130%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.
If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.
With multi element runs, a maximum of 10% for each QC parameter may fail to an absolute maximum of 10%

Certified By:

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Quality Assurance

CLIENT NAME: PARKLAND GEO

AGAT WORK ORDER: 20E628520

PROJECT: ED2251

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Soil Analysis (Continued)

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

AGAT Laboratories

6310 ROPER ROAD
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CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: PARKLAND GEO

AGAT WORK ORDER: 20E628520

PROJECT: ED2251

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)															
Benzene	2191	1290519	<0.005	<0.005	NA	< 0.005	108%	60%	140%	95%	60%	140%	81%	60%	140%
Toluene	2191	1290519	<0.05	<0.05	NA	< 0.05	104%	60%	140%	91%	60%	140%	77%	60%	140%
Ethylbenzene	2191	1290519	<0.01	<0.01	NA	< 0.01	87%	60%	140%	88%	60%	140%	67%	60%	140%
Xylenes	2191	1290519	<0.05	<0.05	NA	< 0.05	106%	60%	140%	80%	60%	140%	76%	60%	140%
C6 - C10 (F1)	2191	1290519	<10	<10	NA	< 10	103%	60%	140%	98%	60%	140%	68%	60%	140%
C10 - C16 (F2)	1222	1290519	<10	<10	NA	< 10	106%	60%	140%	118%	60%	140%	117%	60%	140%
C16 - C34 (F3)	1222	1290519	60	70	15.4%	< 10	111%	60%	140%	124%	60%	140%	127%	60%	140%
C34 - C50 (F4)	1222	1290519	30	30	NA	< 10	113%	60%	140%	128%	60%	140%	133%	60%	140%
Moisture Content	1222	1290519	17	17	0.0%	< 1									

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.
The sample spikes and dups are not from the same sample ID.

Polyaromatic Hydrocarbon Analysis in Soil															
Naphthalene	702	1290519	<0.005	<0.005	NA	< 0.005	133%	50%	140%	110%	50%	140%	105%	50%	140%
2-Methylnaphthalene	702	1290519	<0.005	<0.005	NA	< 0.005	110%	50%	140%	96%	50%	140%	89%	50%	140%
Quinoline	702	1290519	<0.05	<0.05	NA	< 0.05	98%	50%	140%	92%	50%	140%	91%	50%	140%
Acenaphthylene	702	1290519	<0.005	<0.005	NA	< 0.005	116%	50%	140%	92%	50%	140%	85%	50%	140%
Acenaphthene	702	1290519	<0.005	<0.005	NA	< 0.005	113%	50%	140%	95%	50%	140%	88%	50%	140%
Fluorene	702	1290519	<0.02	<0.02	NA	< 0.02	109%	50%	140%	89%	50%	140%	81%	50%	140%
Phenanthrene	702	1290519	<0.02	<0.02	NA	< 0.02	114%	50%	140%	95%	50%	140%	88%	50%	140%
Anthracene	702	1290519	<0.004	<0.004	NA	< 0.004	107%	50%	140%	95%	50%	140%	79%	50%	140%
Fluoranthene	702	1290519	0.01	<0.01	NA	< 0.01	109%	50%	140%	91%	50%	140%	84%	50%	140%
Pyrene	702	1290519	0.02	0.02	NA	< 0.01	110%	50%	140%	94%	50%	140%	85%	50%	140%
Acridine	702	1290519	<0.05	<0.05	NA	< 0.05	104%	50%	140%	118%	50%	140%	90%	50%	140%
Benzo[a]anthracene	702	1290519	<0.02	<0.02	NA	< 0.02	110%	50%	140%	89%	50%	140%	84%	50%	140%
Chrysene	702	1290519	<0.05	<0.05	NA	< 0.05	89%	50%	140%	87%	50%	140%	81%	50%	140%
Benzo[b+j]fluoranthene	702	1290519	<0.03	<0.03	NA	< 0.03	104%	50%	140%	85%	50%	140%	80%	50%	140%
Benzo[k]fluoranthene	702	1290519	<0.02	<0.02	NA	< 0.02	106%	50%	140%	84%	50%	140%	81%	50%	140%
Benzo[a]pyrene	702	1290519	<0.03	<0.03	NA	< 0.03	109%	50%	140%	87%	50%	140%	82%	50%	140%
Indeno[1,2,3-cd]pyrene	702	1290519	<0.02	<0.02	NA	< 0.02	108%	50%	140%	87%	50%	140%	85%	50%	140%
Dibenzo[ah]anthracene	702	1290519	<0.005	<0.005	NA	< 0.005	91%	50%	140%	86%	50%	140%	83%	50%	140%
Benzo[ghi]perylene	702	1290519	<0.05	<0.05	NA	< 0.05	116%	50%	140%	92%	50%	140%	89%	50%	140%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.
The sample spikes and dups are not from the same sample ID.

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: PARKLAND GEO

AGAT WORK ORDER: 20E628520

PROJECT: ED2251

ATTENTION TO: Nicole Prince

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Arsenic	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Barium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Beryllium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Cadmium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Chromium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP/MS
Chromium, Hexavalent	INOR-171-6215	ASA 20-4.3; REISENAUER 1982	SPECTROPHOTOMETER
Cobalt	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Copper	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Lead	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Molybdenum	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Nickel	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Selenium	INORG-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Silver	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Thallium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Tin	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Uranium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Vanadium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Zinc	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
pH (CaCl2 Extraction)	INOR-171-6207	SHEPPARD 2007; HENDERSHOT 2008	PH METER
Electrical Conductivity (Sat. Paste)	INOR-171-6208	SHEPPARD 2007; MILLER 2007	CONDUCTIVITY METER
Sodium Adsorption Ratio	INOR-171-6201 & INOR-171-6002	McKeague 3.26	CALCULATION
Saturation Percentage	INOR-171-6002	MILLER 2007; SHEPPARD 2007	GRAVIMETRIC
Chloride, Soluble	INOR-171-6212	CARTER & GREGORICH 2007, SM 3120B	COLORIMETER
Calcium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Potassium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Magnesium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sodium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sulfate, Soluble	SOIL 0110; SOIL 0120; INST 0140	SHEPPARD 2007; EATON 2005	ICP/OES

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Method Summary

CLIENT NAME: PARKLAND GEO

AGAT WORK ORDER: 20E628520

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SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Theoretical Gypsum Requirement	INOR-171-6201 & INOR-171-6002	USDA HDBK 60, 22D	CALCULATION
Trace Organics Analysis			
Benzene	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
Toluene	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
Ethylbenzene	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
Xylenes	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
C6 - C10 (F1)	ORG-170-5110/5140/5430/5440	CCME Tier 1 Method	GC/FID
C6 - C10 (F1 minus BTEX)	ORG-170-5110/5140/5430/5440	CCME Tier 1 Method	GC/FID
C10 - C16 (F2)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
C16 - C34 (F3)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
C34 - C50 (F4)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	ORG-170-5120/5300	CCME Tier 1 Method-S H	GC/FID
Moisture Content	LAB-175-4002	CCME Tier 1 Method-S %	GRAVIMETRIC
Toluene-d8 (BTEX)	ORG-170-5110/5140/5430/5440	EPA SW-846 8260-S	GC/MS
Ethylbenzene-d10 (BTEX)	ORG-170-5110/5140/5430/5440	EPA SW-846 8260-S	GC/MS
o-Terphenyl (F2-F4)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
Naphthalene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
2-Methylnaphthalene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Quinoline	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Acenaphthylene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Acenaphthene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Fluorene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Phenanthrene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Anthracene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Fluoranthene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Pyrene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Acridine	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Benzo[a]anthracene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Chrysene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Benzo[b+j]fluoranthene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Benzo[k]fluoranthene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Benzo[a]pyrene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Indeno[1,2,3-cd]pyrene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Dibenzo[ah]anthracene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Benzo[ghi]perylene	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Naphthalene-d8	ORG-170-5421	EPA SW-846 3510 & 8270	GC/MS
p-Terphenyl-d14 (PAH)	ORG-170-5420	EPA SW846 8270 D/3540 C/3570	GC/MS
Pyrene-d10	ORG-170-5421	EPA SW-846 3510 & 8270	GC/MS
B[a]P TPE	ORG-170-5420	CCME	CALCULATION
IACR (Fine Soil)		CCME	CALCULATION
IACR (Coarse Soil)		CCME	CALCULATION

AGAT Laboratories
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Calgary, Alberta T2E 7P7
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webearth.agatlabs.com

Laboratory Use Only
Arrival Temperature: 2.2 °C
AGAT Job Number: 20E628520
Date and Time: '20 JUL 20 16:48

Chain of Custody Record

Emergency Support Services Hotline 1-855-AGAT 245 (1-855-242-8245)

Report Information

Company: Parkland GEO
Contact: Nicole Prince
Address: 189 Pembina Rd
Sherwood Park, AB
Phone: (780) 9161755 Fax:
LSD:
Client Project #: ED2251
Sampled By: NP

Report Information

1. Name: Nicole Prince
Email: nicole.prince@parklandgeo.ca
2. Name: Daniel Yost
Email: daniel.yost@parklandgeo.ca
3. Name:
Email:

Turnaround Time Required (TAT)

Regular TAT ☐ 5 to 7 Business Days
Rush TAT ☐ <24 Hours (200%) ☐ Two Day / Next Day (100%) ☐ Three Day (50%) ☐ Four Day (25%)
Date Required:

SEE BACK FOR SURCHARGE BREAKDOWN. CONTACT YOUR CPM FOR ADDITIONAL INFORMATION

Invoice To

Same Yes ☐ / No ☐
Company:
Contact:
Address:
Phone: Fax:
PO/AFE#:
Standing Offer #:

Requirements (Selection may impact detection limits)

☐ CCME
☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ FWAL
☐ Drinking Water
☐ Other:

☐ AB Tier 1
☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ Natural Area
☐ Alberta Surface Water
☐ Chronic ☐ Acute

Report Format

☐ Single Sample Per Page
☐ Multiple Samples Per Page
☐ Export

LABORATORY USE (LAB ID #)	SAMPLE IDENTIFICATION	DEPTH	DATE/TIME SAMPLED	SAMPLE MATRIX	COMMENTS (FILTERED, PRESERVED, HAZARDOUS*) *ADDITIONAL FEE	# OF CONTAINERS VIALS / JARS	BAGS	BOTTLES	Detailed Salinity: ☐ AB ☐ SK ☐ BC ☐ D50	☐ CCME/AB : BTEX/F1-F4 ☑ CCME/AB : BTEX/F1-F2	☐ BC: BTEXS/VPH/EPH ☐ BC: LEPH/HEPH	SK: BTEX/TVH/C11-C22, C23-C60	Soil Metals: ☐ HWS-B ☐ SP-B ☐ Hg ☑ Cr^{6+}	Water Metals: ☐ Dissolved ☐ Total ☐ Hg ☐ Cr^{6+}	Routine Water Chemistry	Landfill: ☐ AB Class 2 ☐ BC ☐ SK	Coliforms: ☐ Total ☐ Fecal ☐ E.coli	Particle Size: ☐ Sieve (75µm) ☐ Texture	PAH	HOLD FOR 30 DAYS NO ANALYSIS (Additional Fee)	HOLD FOR 30 DAYS AFTER ANALYSIS (Additional Fee)
1	1290509 IG1	0.75	July 16/2020	Soil		3				✓											
2	512 IG3	2.25	↓	↓		2			✓										✓		
3	513 IG5	3.75				1							✓								
4	514 2G-2	1.5				1							✓								
5	519 2G7	5.25				4				✓									✓		
6	522 2G8	6.0				1			✓												
7																					
8																					
9																					
10																					

Samples Relinquished By (Print Name and Sign)	Date/Time	Samples Received By (Print Name and Sign)	Date/Time
Nicole Prince	July 20/2020		7/20/2020

Pink Copy - Client
Yellow Copy - AGAT
White Copy - AGAT

Page 1 of 1

N°: AB 090047

Document ID: DIV 50-1507.005

Date Revised: May 10, 2018

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM

RECEIVING BASICS - Shipping

Company/Consultant: Parkland GEO

Courier: Drop off Prepaid Collect

Waybill#: /

Branch: [EDM] GP FN FM RD VAN LYD FSJ EST SASK Other:___

If multiple sites were submitted at once: Yes (No)

Custody Seal Intact: Yes No (NA)

TAT: <24hr 24-48hr 48-72hr (Reg) Other_____

Cooler Quantity: 1

TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes (No)

Inorganic Tests (Please Circle): Mibi , BOD , Nitrate/Nitrite , Turbidity , Color , Microtox , Ortho PO4 , Tedlar Bag , Residual Chlorine , Chlorophyll* , Chloroamines*

Earliest Expiry: /

Hydrocarbons: Earliest Expiry /

SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES (NO) Precaution Taken:_____

Legal Samples: Yes (No)

International Samples: Yes (No)

Tape Sealed: Yes (No)

Coolant Used: Icepack Bagged Ice (Free Ice) Free Water None

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

FROZEN (Please Circle if samples received Frozen)

1 (Bottle/Jar) 2.1 + 2.1 + 2.5 = 2.2 °C 2(Bottle/Jar)___+___+___=____°C

3 (Bottle/Jar)___+___+___=____°C 4 (Bottle/Jar)___+___+___=____°C

5 (Bottle/Jar)___+___+___=____°C 6 (Bottle/Jar)___+___+___=____°C

7 (Bottle/Jar)___+___+___=____°C 8 (Bottle/Jar)___+___+___=____°C

9 (Bottle/Jar)___+___+___=____°C 10 (Bottle/Jar)___+___+___=____°C

(If more than 10 coolers are received use another sheet of paper and attach)

LOGISTICS USE ONLY

Workorder No: 20E628520

Samples Damaged: Yes (No) If YES why?

No Bubble Wrap Frozen Courier

Other: _____

Account Project Manager: _____ have they been notified of the above issues: Yes No

Whom spoken to: _____ Date/Time: _____

CPM Initial_____

General Comments: _____

* Subcontracted Analysis (See CPM)

Date issued: March 11, 2020

LIMITATIONS

GENERAL TERMS, CONDITIONS
AND LIMITATIONS

The use of this attached report is subject to the following general terms and conditions.

1. STANDARD OF CARE - In the performance of professional services, ParklandGEO used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty expressed or implied is made in any manner.

2. INTERPRETATION OF THE REPORT - The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations and recommendation of ParklandGEO are based solely on the information available to him. Classification and identification of soils, rocks, geological units, contaminated materials and contaminant quantities will be based on commonly accepted practices in geotechnical or environmental consulting practice in this area. ParklandGEO will not be responsible for the interpretation by others of the information developed.

3. SITE INFORMATION - The CLIENT has agreed to provide all information with respect to the past, present and proposed conditions and use of the Site, whether specifically requested or not. The CLIENT acknowledged that in order for ParklandGEO to properly advise and assist the CLIENT, ParklandGEO has relied on full disclosure by the CLIENT of all matters pertinent to the Site investigation.

4. COMPLETE REPORT - The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to ParklandGEO by the CLIENT, communications between ParklandGEO and the CLIENT, and to any other reports, writings or documents prepared by ParklandGEO for the CLIENT relative to the specific Site, all of which constitute the Report. The word "Report" shall refer to any and all of the documents referred to herein. In order to properly understand the suggestions, recommendations and opinions expressed by ParklandGEO, reference must be made to the whole of the Report. ParklandGEO cannot be responsible for use of any part or portions of the report without reference to the whole report. The CLIENT has agreed that "This report has been prepared for the exclusive use of the named CLIENT. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."

   The CLIENT has agreed that in the event that any such report is released to a third party, the above disclaimer shall not be obliterated or altered in any manner. The CLIENT further agrees that all such reports shall be used solely for the purposes of the CLIENT and shall not be released or used by others without the prior written permission of ParklandGEO.

5. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY DISCLAIMER
   There is no warranty, expressed or implied, by ParklandGEO that:
   a) the investigation uncovered all potential geo-hazards, contaminants or environmental liabilities on the Site; or
   b) the Site is entirely free of all geo-hazards or contaminants as a result of any investigation or cleanup work undertaken on the Site, since it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

   The CLIENT acknowledged that:
   a) the investigation findings are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
   b) unless specifically stated in the agreed Scope of Work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
   c) any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
   d) any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
   e) any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted; and
   f) the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
   g) there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently discovered as part of the investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials and in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.

6. COST ESTIMATES - Estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT. Accordingly, estimated costs for construction or remediation are based on the known site conditions, which can vary as new information is discovered during construction. As some construction activities are an iterative exercise, ParklandGEO shall therefore not be liable for the accuracy of any estimates of remediation or construction costs provided.

7. LIMITATION OF LIABILITY - The CLIENT has agreed that to the fullest extent permitted by the law ParklandGEO's total liability to CLIENT for any and all injuries, claims, losses, expenses or damages whatsoever arising out of or in anyway relating to the Project is contractually limited, as outlined in ParklandGEO's standard Consulting Services Agreement. Further, the CLIENT has agreed that to the fullest extent permitted by law ParklandGEO is not liable to the CLIENT for any special, indirect or consequential damages whatsoever, regardless of cause.

8. INDEMNIFICATION - To the fullest extent permitted by law, the CLIENT has agreed to defend, indemnify and hold ParklandGEO, its directors, officers, employees, agents and subcontractors, harmless from and against any and all claims, defence costs, including legal fees on a full indemnity basis, damages, and other liabilities arising out of or in any way related to ParklandGEO's work, reports or recommendations.

Appendix D. Geotechnical Investigation (ParklandGEO 2020b)

Geotechnical, Environmental and Materials Engineering

Red Deer · Sherwood Park · Grande Prairie · Calgary · Fort McMurray
Peace River · Medicine Hat · Lethbridge · Estevan

GEOTECHNICAL INVESTIGATION REPORT
PROPOSED B130 BRIDGE REPLACEMENT

BRIDGE B130
HORSEHILL ROAD OVER HORSEHILL CREEK
EDMONTON, ALBERTA

PREPARED FOR

MPA ENGINEERING LTD.

SHERWOOD PARK, ALBERTA

PREPARED BY

PARKLAND GEO-ENVIRONMENTAL LTD.

SHERWOOD PARK, ALBERTA

PROJECT No.: ED2251

DATE: AUGUST 26, 2020

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1.0 INTRODUCTION

Parkland Geo-Environmental Ltd. (ParklandGEO) was retained by MPA Engineering Ltd. (MPA) to assess the in-situ soil conditions and provide design recommendations for the replacement of a single span bridge along Horsehill Road within Edmonton, Alberta, as shown on the Area Plan, Figure 1. The scope of the study was outlined in ParklandGEO's proposal PRO-ED19-295R1 dated October 2, 2019. Authorization to proceed with the investigation was given by Ms. Melanie Johnson, P.Eng. of MPA on June 12, 2020 via email.

This report summarizes results of the field and laboratory testing program and presents general geotechnical recommendations for site preparation, design and construction of the proposed bridge structure. A limited Phase II Environmental Site Assessment (ESA) was also conducted as part of the investigation. The results of the Phase II ESA will be summarized in a separate report.

2.0 SITE & PROJECT DESCRIPTION

The site was located along Horsehill road, approximately 240 m northeast of the intersection of Highway 15 and 18 Street, within Edmonton, Alberta. The road was used for access to a temple and nearby residences. The existing structure was a single span bridge supported on timber piles with an asphalt paved surface. The purpose of the investigation was to assess the subsurface conditions and provide recommendations for the replacement of the existing bridge structure.

At the time of the investigation, the site consisted of Horsehill road, which ran southwest to northeast and crossed Horsehill Creek approximately 185 m east of 18 Street. The area surrounding the site was generally undeveloped land containing long grasses, short shrubs and the creek bed which ran north to south. The pavement adjacent to the bridge structure was in poor condition with potholes and alligator cracking in many locations.

2.1 GEOLOGICAL HISTORY

The site is located within the Upper Cretaceous Edmonton Bedrock Formation. The Edmonton bedrock formation primarily consists of sandstone, siltstone and clay shale containing coal and bentonite seams. During the last glaciation, the Edmonton area was covered in glaciers which deposited sediment during their retreat. These sediments included glacial till and glacio-lacustrine clays and silts.

3.0 FIELD AND LABORATORY PROGRAMS

On July 16, 2020, one borehole was drilled to 25.3 meters below grade (mbg) and one borehole was drilled to 19.5 mbg as shown on the Site Plan, Figure 2. The boreholes were drilled using a truck-mounted, continuous flight, 150 mm diameter solid stem auger operated by Drilling Solutions Inc. of Sherwood Park, Alberta. Supervision of the drilling, soil sampling, and logging of the various soil strata was performed by Ms. Nicole Prince, P.Eng. of ParklandGEO. The detailed borehole logs are provided in Appendix A.

During drilling the following sampling and testing procedures were used:

- The soil was examined in the field and classified using the Modified Unified Soil Classification System. The borehole logs and the explanation sheets of the terms and symbols used on the borehole logs are provided in Appendix A.

- Disturbed soil samples were obtained at 0.75 m intervals for the first 7 m for Phase II ESA testing and then at 1.0 m intervals to determine the soil moisture profile and vapour readings.

- Standard Penetration Tests (SPTs) were performed at depth intervals of 1.5 m in all boreholes. The number of blows required to drive the SPT split-spoon sampler 300 mm into the soil was noted and plotted on the borehole logs as SPT "N" values.

- Nested piezometers consisting of hand slotted, 25 and 50 mm diameter PVC pipe were installed in both boreholes to monitor groundwater elevations.

- The groundwater conditions were noted during, on completion and approximately three weeks following drilling.

- Borehole locations were obtained using a hand-held Garmin GPS.

- All soil samples were returned to ParklandGEO's laboratory for select testing to determine soil properties. The laboratory program consisted of obtaining moisture contents, Atterberg Limits, water soluble sulphate concentrations and grain size distribution. Select samples were sent to AGAT Laboratories for pH and resistivity testing. The results of all laboratory testing are shown on the borehole logs (Appendix A) and are included in Appendix A.

4.0 SUBSURFACE CONDITIONS

The general soil profile encountered at this site was the asphalt road surface, underlain by gravel and/or clay fill, which was underlain by clay that extended beyond the depths of drilling. The clay varied in consistency and plasticity and contained occasional sand layers.

Detailed descriptions of the soil conditions encountered are provided on the borehole logs in Appendix A. Definitions of the terminology and symbols used on the logs are provided on the accompanying explanation sheets in Appendix A.

4.1 ASPHALT

Approximately 75 mm of asphalt was encountered at the surface of both boreholes.

4.2 GRAVEL FILL

A 125 mm layer of gravel fill was encountered beneath the asphalt in Borehole 20-01. The gravel fill contained some sand, was damp and brown.

4.3 CLAY FILL

Clay fill was encountered beneath the gravel fill in Borehole 20-01 and beneath the asphalt in Borehole 20-02 and extended to depths ranging from 1.5 to 1.7 mbg. The clay fill contained some silt, little to some sand, occasional rust staining, was medium plastic, damp and brown. SPT 'N' values ranged from 5 to 7 blows, indicating a firm consistency. Moisture contents ranged from 18 to 26 percent, which is likely near to above the optimum moisture content (OMC).

An approximately 250 mm thick layer of organic stained clay containing occasional topsoil and organic inclusions was encountered at depths ranging from 0.5 to 1.5 mbg in both boreholes.

4.4 LACUSTRINE CLAY

Lacustrine clay was encountered beneath the fill in both boreholes and extended to depths ranging from 5.0 to 5.3 mbg. The clay contained some silt, little to trace sand, was damp and mottled brown/grey. Atterberg Plastic and Liquid Limits of 22 and 62 percent, respectively, were found in Borehole 20-02 at 2.25 mbg, indicating a high plasticity. SPT 'N' values ranged from 5 to 8 blows, indicating a firm to stiff consistency. Moisture contents ranged from 25 to 40 percent, which is likely above the OMC.

4.5 RAFTED CLAY SHALE

Rafted weathered clay shale was encountered beneath the upper clay in both boreholes and extended to a depth of about 5.5 mbg. The clay shale contained some silt, trace sand, was damp, crumbly and grey. SPT 'N' values ranged from 13 to 17 indicating a stiff to very stiff consistency. Moisture contents ranged from 20 to 23 percent.

4.6 CLAY

Clay was encountered beneath the upper clay in both boreholes and extended beyond the depths of drilling. The clay contained some silt, some to little sand, trace to no gravel, was medium to high plastic, damp to moist and grey. Grain size analysis at 9.0 m in Borehole 20-01 found 30 percent clay, 32 percent silt, 38 percent sand and no gravel. SPT 'N' values ranged from 4 to 27 blows, indicating a soft to very stiff consistency. Moisture contents ranged from 18 to 31 percent, with an average of 23 percent.

4.7 SAND

Layers of sand were encountered at various depths within the clay layer in Borehole 20-01. The sand generally contained little to some clay, was moist to wet and brown.

4.8 SOIL CHEMISTRY TESTING

Soil samples at 5.25 mbg in Borehole 20-01 and 3.00 mbg in Borehole 20-02 were sent to AGAT Laboratories Ltd. for resistivity and pH analysis (Appendix A). The results are presented in Table 1.

TABLE 1: RESISTIVITY AND pH TEST RESULTS

Borehole	Depth (m)	Soil Type	Resistivity (ohm-cm)	pH
20-01	5.25	Clay Shale	166	8.24
20-02	3.00	Lacustrine Clay	210	7.47

Soil samples at 0.75 m in Borehole 20-01 and 2.25 m in Borehole 20-02 were tested for water soluble sulphate concentrations. The water soluble sulphate concentration tests indicated a moderate to very severe potential for sulphate attack of subsurface concrete in contact with native soils. The results are summarized in Table 2.

TABLE 2: CHEMICAL TEST RESULTS

Borehole	Depth (m)	Soil Type	Water Soluble SO_4 (%)	Potential for Sulphate Attack
20-01	0.75	Clay Fill	0.143	Moderate
20-02	2.25	Lacustrine Clay	2.063	Very Severe

4.6 GROUNDWATER

Groundwater infiltration and sloughing were observed in both boreholes during drilling generally within the sand lenses and just below the rafted clay shale. Groundwater conditions were observed by ParklandGEO upon completion and three weeks following drilling (August 6, 2020), and are summarized below in Table 3.

Groundwater elevations are expected to fluctuate on a seasonal basis and will be highest after periods of heavy precipitation and snowmelt. The seasonally high groundwater levels will decrease during dry periods as the groundwater recedes.

The actual groundwater conditions at the time of construction could vary from those recorded during this investigation. Groundwater conditions should be monitored prior to the start of construction.

TABLE 3: GROUNDWATER LEVELS

Borehole	Depth of Standpipe (mbg)	Depth of Groundwater (mbg)	
		On Completion[1]	August 6, 2020
20-01	24.0	2.20	6.36
	7.00		1.17
20-02	19.5	4.00	1.12
	6.17		1.15

[1] Depth to saturated slough at completion of drilling.

5.0 STABILITY ANALYSES

It is understood that the preferred creek crossing structure is a single span bridge. A slope stability analysis was completed to assess the stability of the proposed embankment side-slopes at the bridge replacement location.

Slope stability is described in terms of a factor of safety (FS) against slope failure, which is the ratio of total forces resisting failure divided by the sum of forces promoting failure. In general, a FS of less than 1.0 indicates that failure is expected and a FS of more than 1.0 indicates that the slope is stable. A steepened slope will slump back over time to establish a stable profile for the existing soil and groundwater conditions. The FS of a slope will increase slightly as vegetation is established on the face to protect the subgrade soil from weathering. Given the possibility of variation, groundwater fluctuation, erosion and other factors, slopes with a FS ranging between 1.0 and 1.3 are considered marginally stable and a “short term” stable slope is considered to have a FS greater than 1.3. As per the Canadian Geotechnical Society publication “Canadian Foundation Engineering Manual 4th Edition”, a minimum FS of 1.5 is required for long term slope stability.

Limit equilibrium analysis was carried out using the Slope/W software program to evaluate the FS for representative slope profiles. The FS was calculated using the Morgenstern-Price Method and a variety of parameters to assess the model sensitivity.

5.1 SOIL STRENGTH PARAMETERS

Based on local experience and the results of the field and laboratory testing programs, the following soil parameters were estimated for the embankment side-slope stability models.

TABLE 4: ESTIMATED SOIL STRENGTH PARAMETERS FOR STABILITY ANALYSIS

Soil	Unit Weight - γ (kN/m^3)	Cohesion - c’ (kPa)	Phi’ - φ’ (degrees)
Clay Fill	18.5	2	25
Lacustrine Clay	17.5	1	23
Clay	18.0	4	25

5.2 SIDE SLOPE ANALYSIS

To assess the stability of the embankment side slopes a global stability analysis was conducted to determine the required sideslope angle to achieve a FS of 1.5 for the found soil and groundwater conditions. As no details of the embankment were known at the time of this report, certain assumptions were made. The embankment was modeled with a height of 2.0 m and consisted entirely of clay fill. The groundwater table was modeled at 1.0 m below the road surface, which assumes the proposed road would be constructed to the same elevation as the existing ground surface. A surcharge load of 10 kPa was placed 2 m from the crest of the embankment in order to simulate traffic loading. The analysis is considered applicable for both abutments as the soil conditions were similar within both boreholes. Based on these assumptions and the soil properties listed in Table 4, a 3.2H:1V embankment was found to achieve a FS of 1.5. Therefore, the steepest embankment sideslopes for this site are 3.5H:1V. Detailed analysis outputs can be found in Appendix B.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 GEOTECHNICAL EVALUATION

It is understood that the preferred foundation type for the single span bridge replacement is driven steel H-piles. Exact dimensions and type of replacement structure were not known at the time of the investigation; therefore, assumptions have been made for preliminary design purposes. Overall, the site conditions are considered suitable for the proposed development with a moderate level of subgrade preparation as outlined in Section 6.2. The existing fill material is low to medium plastic clay, which may be re-used as engineered fill if free of organics or other deleterious materials.

The most important geotechnical issues with the proposed bridge structure are as follows:

- **Organic Soil.** Organic soil was encountered within the clay fill in Borehole 20-01 and beneath the clay fill in Borehole 20-02. It is recommended to remove all organic soil prior to the placement of any fill for the road embankment or bridge abutments. Soil to be re-used as engineered fill must also be free of organic deposits.

- **Road Fill and High Plastic Soils.** The upper clay encountered in both boreholes was found to be high plastic. High plastic soils are not well suited for road fill material. However, if the proper preparation methods (Section 6.4) are followed, complete removal of the lacustrine clay may not be necessary.

- **Embankment Side Slopes**. The side slope was found to have a factor of safety greater than 1.5 for a 2.0 m high embankment with 3.5H:1V side slopes, under the existing soil conditions.

- **Headslopes**. At the time of this report details regarding the proposed headslope were not known. It is recommended to review the stability of the proposed headslope once the preliminary design is established.

- **Rafted Bedrock.** Rafted bedrock has the potential to cause early refusal or damage to the pile tips during installation of the steel driven piles. The bedrock at this site was extremely weathered clay shale with a stiff consistency and is not expected to be a concern for the installation of the piles. ParklandGEO should be notified if hard, thick layers of rafted bedrock are encountered during construction.

- **Surface Drainage in Approach Ditches.** The site grading should promote positive surface water drainage into the creek bed and assess erosion prevention measures near the road ditches as they approach the head slope of the bridge abutments. Any other areas of high surface water drainage should be protected against erosion as well.

- **Corrosion.** Resistivity and pH tests showed extremely high corrosion potential at this location in the native clay (Section 6.15). Additional preparation may be necessary to protect the steel piles against corrosion before installation.

It should be recognized that this project has several variables which may be impacted by construction methodology, schedule and weather conditions. Is recommended that the work plan proposed by the contractor be reviewed with respect to potential impact on the geotechnical issues and recommendations discussed in the following sections.

6.2 SITE PREPARATION

Site preparation for the proposed roads and creek crossing should consist of the removal of all topsoil, organic soil, excessively soft and deleterious materials (i.e., concrete, wood, etc.). Exposed soil surfaces should be scarified and uniformly re-compacted to a minimum of 98 percent of Standard Proctor Maximum Dry Density (SPMDD) in pavement areas.

Fill required to bring the site up to road grade should be a low to medium plastic inorganic clay, well graded sand, or select coarse graded gravel. Granular fill may be required if soft, wet areas are encountered. Fill placed for the access roads or behind the bridge abutments should be compacted to a minimum of 98 percent of SPMDD. The existing clay fill may be re-used as engineered fill subject to additional testing and removal of organic deposits. The native high plastic clay should not be re-used as engineered fill. It is recommended the maximum thickness of any lift after compaction should not exceed 150 mm for fine grained material and 200 mm for granular fill (sand and gravel).

Water should not be allowed to pond on the proposed roadways. A minimum grade of 2 percent is recommended to promote surface runoff and minimize the potential saturation and degradation of the roadways.

6.3 EXCAVATIONS

Excavation and construction of temporary cut-slopes may be required to install the proposed bridge. All excavation work must comply with the requirements of the Alberta Occupational Health and Safety Act (OHS Act, 2018), OHS Regulation (2018) and OHS Code (2019). The OHS Code contains the technical requirements that support the Act and Regulation.

The excavation will be conducted mostly through existing clay fill and native clay. During the excavation, isolated wet sand seams and pockets are likely to be encountered. Where either poor/sloughing soils or these wet sloughing soils are encountered and causing instability of the cut-slopes, flattening of the temporary slopes to 2H:1V would likely be necessary. It is recommended

to make pumps available once the excavation begins and to construct temporary sumps as necessary to sufficiently dewater the base of the open cut excavation. Dewatering prior to excavation may be necessary.

Surface grading should be undertaken so that surface water is not allowed to pond adjacent to cut-slopes. Surcharge loads, including excavation spoils, should be kept back from the crest of excavated slopes a minimum distance equal to the height of excavation. Inspection is recommended to assess the in-situ soil strength and behavior.

Monitoring and maintenance of cut-slopes should be carried out on a regular basis. Excavations for this project will require an observational approach combining past local experience, contractor experience and geotechnical input.

6.4 SWELLING CLAY

High plastic, swelling clays are present at this site. High plastic soils will exhibit volume changes such as swelling and shrinkage with changes in soil moisture content. Swelling potential decreases at higher soil moisture contents in the order of 35 percent or greater. The high plastic soils observed at this site have soil moisture levels ranging between 29 and 40 percent. The typical problem with swelling soils is that the soils are exposed to wet and dry conditions during construction. When a shallow footing or pavement is placed over the soil the evapo-transpiration conditions change and the soil gains moisture. Since structural features are placed after shrinkage, the effects of swelling are magnified when the soil re-establishes a new soil moisture equilibrium. The swelling problems are magnified by the variation of plasticity in the subgrade, which might lead to non-uniform swelling and potentially destructive differential heave.

The following construction practices can be used to try and reduce possible problems with heaving/shrinking:

1. Higher plastic clays could be removed and replaced or mixed with a suitable low to medium plastic backfill material. Given the thick deposits of high plastic clay at this site, complete removal may not be practical.

2. Swelling pressures and heave potential are reduced when soil moisture contents approach 35 percent. Soils drier than this will be subject to higher swelling. It is crucial not to allow exposed subgrade soils to dry during construction through the use of protective layer such as mud slabs. If subgrade conditions are uniform, heave may still occur, but the potential for differential heave will be reduced. Measures should be taken to reduce the potential for heave below the abutment seat pile caps.

6.5 HIGHWAY BRIDGE CODE REQUIREMENTS FOR FOUNDATIONS

6.5.1 Limit States Design

In accordance with the 2014 Canadian Highway Bridge Design Code (CHBDC), and by the Canadian Standards Association (CSA), the use of Limit States Design (LSD) is required for the design of bridges and their structural components including foundations. The limit states of LSD design are the Ultimate Limit States (ULS) and the Serviceability States (SLS).

The ULS case is primarily concerned with safety and the static equilibrium of the structure and resistance at the point of collapse or structural failure. The geotechnical value for this case is the ultimate resistance. For foundation design this ultimate resistance calue is reduced using a Geotechincal Resistance Factor (GRF) which is based on the application of the resistance factor and related analysis completed on site. As per the CHBDC the following GRF values should be used for foundation design:

TABLE 5: LSD* GEOTECHNICAL RESISTANCE FACTORS FOR DEEP FOUNDATIONS

GEOTECHNICAL CASE	Resistance Factors
Static analysis - Compression	0.4
Static analysis - Tension	0.3
Static test - Compression	0.6
Static test - Tension	0.4
Dynamic analysis - Compression	0.4
Dynamic test - Compression (field measurement and analysis)	0.5

* CHBDC - Section 6 - Foundations - Table 6.1 - Geotechnical resistance factors

6.5.2 Serviceability Limit State

The Serviceability Limit State (SLS) occurs when the foundation is considered to be unserviceable due to foundation deformations that exceeds SLS limitations, deformations that are detrimental to the bridge superstructure, and deformations that cause misalignments, distortion or tilting. The SLS case is addressed by determining the maximum available unfactored resistance to keep the foundation deformation within tolerable limits under services loads (ie. settlement, lateral deflection, etc.). Typically, the foundation loads, configuration and serviceability tolerances must be known to properly determine geotechnical SLS resistance values.

6.5.3 Seismic Considerations

The NBCC requires structures to be designed to resist a minimum earthquake force. The formula for obtaining minimum earthquake force is dependant on several factors including the Foundation Factor (F) which should be determined using a Site Class of D for this site (Table 4.1.8.4.A, NBCC).

6.6 DRIVEN STEEL PILES

A foundation configuration utilizing a system of open or closed-end pipe piles or H-piles was considered suitable for this site. Closed-end pipe piles have the advantage of allowing a light to be dropped down the centre of the pile to check vertical alignment and to check against damage. Concrete filling of the pipe pile will add strength to the section, reduce the corrosion potential inside the pipe and help facilitate the pile cap connection. Corrosion of the pipe in a partially saturated medium must be considered in selecting pipe wall thickness and has been discussed in Section 6.15.

Driven steel piles may be designed for ultimate limit states using the values for shaft friction and end bearing provided in Table 6.

TABLE 6: ULTIMATE DRIVEN PILE RESISTANCE

Soil Type	Average Depth (m)[1]	Ultimate Resistance (kPa)	
		Skin Friction	End Bearing
Frost Zone	0.0 - 2.0	0	-
Upper Clay	2.0 - 13.0	50	-
Lower Clay	below 13.0	85	1000

[1] From existing grade and approximate only; To be verified in field.

The ultimate resistance values in this table are based on semi-empirical data, therefore the "factored" resistance should be calculated by multiplying the unfactored values above by a **geotechnical resistance factor of 0.4**, in accordance with the highway bridge code (Table 5 in Section 6.5.1). The GRF for resistance to axial compression may be increased to 0.5 if the pile capacities are verified by a dynamic monitoring method; or the GRF may be further increased to 0.6 if the pile capacities are verified by a static load test.

The ULS capacity of driven steel piles is determined by multiplying the factored ULS skin friction resistance by the exterior surface area of the pipe pile or the surface area of the web and outside face of the flanges for H-piles. The upper 2.0 m of pile shaft, or the length of the pile shaft in fill, whichever is greater, should be assumed to carry no load. The minimum depth of steel driven piles

to resist uplift forces created by frost action should be calculated in accordance with Section 6.7.2. The dead weight and skin friction should be considered when determining the minimum depth of embedment. It should be noted that these recommendations are within the limitations of frost action only. Total dimensions of pile foundations should be designed by an experienced structural engineer.

The resistance to structural uplift loads may be calculated using the ultimate ULS skin friction values in the table above. The factored resistance should be calculated by multiplying the ultimate values by a geotechnical resistance factor of 0.3, in accordance with the building code. Pile foundations which are required to resist uplift forces should be designed for both resistance to pullout and their structural ability to carry tensile stresses. Uplift from structural loads and frost action should be analysed separately. These two uplift loads are not additive, since the load mechanisms are vastly different.

- Preliminary hammer sizing may be assessed by using a maximum hammer energy of 6.0 x 10^6 J (Newton metre) times the cross sectional area of the pile. The minimum recommended pipe diameter is 300 mm with wall thickness between 7 to 12.5 mm. If smaller diameter piles are to be used, re-assessment of this design will be required. For pipe piles greater than 500 mm in diameter the minimum pipe wall thickness should be increased to 12.5 mm, and the end bearing values in Table 6 should be revised.

- Steel piles should not be driven beyond practical refusal. For preliminary purposes, the practical refusal criteria may be taken as 8 blows per each 25 mm interval for the last 300 mm of pile penetration. The actual refusal criteria should be verified once the hammer energies and pile details are known.

- The minimum allowable pile spacing should be taken as three pile diameters. Where groups of piles are to be installed, the piles should be installed starting at the centre with outer piles installed last. The elevations of the tops of piles already installed should be monitored as adjacent piles are driven in order to determine if heaving of the piles has occurred. Piles that have heaved must be re-driven. If groups of piles are installed at a pile spacing less than the minimum, a group reduction factor must be applied to the bearing capacity of each pile.

- If steel pipe piles are used, it is suggested to fill the piles with concrete after installation. Concrete filling of the open pipe will add strength to the section, reduce the corrosion potential inside the pipe and help facilitate pile cap connections. The native soil has an extremely high corrosion potential. Corrosion of the pipe in a partially saturated medium must be considered in selecting pipe wall thickness.

- The steel piles should be inspected prior to installation to confirm that the appropriate material specifications are satisfied; and to check that there are no protrusions on the shaft or at the tip which could result in voids along the shaft as the pile is driven.

- Monitoring of the pile installation by experienced geotechnical personnel is recommended to confirm that the piles are installed in accordance with design assumptions and that the driving criteria are satisfied. A complete driving record of blows per 300 mm of penetration for each pile should be obtained and reviewed by the pile designer. The hammer information, stroke height, splice locations, tip elevations and ground elevations should also be recorded. If a diesel hammer is used, the blows per minute should be recorded.

- A Pile Driving Analyzer (PDA) test program may be considered to verify the ultimate pile resistance for this site, however, may not be economical due to the relatively small number of piles expected to be required. For resistance values verified by this dynamic monitoring method the GRF used to calculate the factored resistance may be increased to 0.5, resulting in a 25 percent increase in pile capacity for the ultimate limit states. A static load test program could also be considered to further increase the factored resistance.

6.7 ADDITIONAL PILE CONSIDERATIONS

6.7.1 Abutments

Provisions to minimize the potential of heaving on the undersides of the abutments due to frost penetration or swelling of the underlying medium to high plastic soil should be implemented. Due to the presence of high plastic clay, a crushable non-degradable void filler should be used under the base of the abutments. A product such as Voidform (or equivalent) is recommended. The minimum thickness of the void should be 100 mm. Should a compressible material be used as an alternative to the Voidform, the uplift pressure acting on the underside of the abutments or grade beams may be taken as the crushing strength of the compressible medium.

The finished grade adjacent to each abutment should be capped with clay and sloped away so that surface runoff is not allowed to infiltrate and collect in the void space or in the compressible medium. If water is allowed to accumulate in the void space or the compressible medium becomes saturated, the beneficial effect will be negated and frost heaving pressures will occur on the undersides of the abutment or grade beam.

6.7.2 Frost Design Considerations

Pile shafts will be subject to adfreezing stresses within the depth of frost. Adfreezing pressures causing pile jacking should be assumed to average 65 kPa for concrete and 100 kPa for steel, over the estimated depth of frost penetration, which is 2.75 m for this site. The adfreeze force is an ultimate load. In the case of cast-in-place piles, resistance to adfreeze uplift forces will be provided

by the dead load acting on the pile, the weight of the pile and the frictional resistance of the shaft below the frost zone. The upper length of the pile shaft embedded in fill, if greater than the frost depth, should be assumed to provide no resistance against frost forces. The resisting forces should be 150 percent of the calculated adfreeze forces.

6.7.3 Downdrag Force Considerations

Piles installed through cohesive fills greater than 1.0 m but less than 3.0 m in thickness should be assumed to have a downdrag, or negative skin friction, the minimum downdrag should be 25 kPa over the length of the pile within the fill.

If fill thicknesses exceed 3.0 m, the downdrag loading should be reviewed and revised. If new fill is placed on site the downdrag should be applied over the combined thickness of both the new and any existing fill layers. When considering downdrag, there are increases in both the structural loads on the pile and pile settlement. Therefore, downdrag must be accounted for in both the structural ultimate capacity and serviceability limits state evaluations. The downdrag does not affect the geotechnical capacity of the pile. Downdrag loads can be minimized by providing a casing or sleeve around the pile or can be reduced to 50 percent using a coating on the pile shaft.

6.8 LATERAL EARTH PRESSURES

Lateral pressures exerted on bridge abutments and retaining walls are generally due to earth pressure of backfill, residual horizontal stresses induced by compaction and pressures due to external surcharge loads at surface. The following relationship makes no allowance for additional horizontal forces due to frost or hydrostatic pressures to build up behind the wall on the assumption that frost protection and a weeping drain system will be utilized. The earth pressure relationship given below assumes nominal compaction of the backfill to a maximum of 98 percent SPMDD. The three following earth pressure cases exist in retaining wall design and analysis.

1. Active Case. Active earth pressures (K_A) should be used behind retaining walls which are unrestrained at the top. Active earth pressure produce a horizontal driving force and an overturning moment.

2. "At Rest" Case. "At rest" pressures (K_O) should be used behind retaining walls which are restrained at the top and would include typical basement walls, and would apply at this site.

3. Passive Case. Passive earth pressures (K_P) act on the front of the wall when soil is placed up against the base of the wall. Stresses on the wall push against the soil creating a much larger resisting force than is produced by the active or at rest conditions. The passive case is not recommended for use in the general design of short retaining walls (height < 1.5 m).

A triangular earth pressure may be used for the design of short retaining walls where the maximum horizontal earth pressure acting on the wall is calculated using the following equation:

$$P = K Q + K \gamma H$$

Where:
- P = lateral earth pressure at depth H below ground level (kPa)
- Q = surcharge loading at the top of the wall (kPa)
- K = coefficient of lateral earth pressure (as per Table 7)
- γ = total unit weight of backfill compacted to 98 percent SPMDD (kN/m^3)
- H = height of fill behind the retaining wall (m) - typically the height of wall

Recommended design values for these parameters depend on the type of backfill used. Design values for anticipated materials are given in the following table:

TABLE 7: LATERAL EARTH PRESSURE PARAMETERS

Type of Backfill	Total Unit Weight (kN/m^3)	Friction Angle, ϕ (degrees)	Coefficient of Lateral Earth Pressure		
			K_A	K_O	K_P
Crushed Granular Material	20	35	0.271	0.426	3.69
General Engineered Clay Fill	18.5	25	0.406	0.577	2.463

These parameters assume that a granular envelope is placed behind the abutment and a sub-drain and weep holes are installed such that there is no hydrostatic water pressure behind the abutment. The parameters also assume a flat backslope at the top of the wall.

Only light, hand operated equipment should be operated within 1.5 m of walls and walls should be braced prior to backfilling. If no frost protection is provided, the active or at rest lateral earth pressures pushing on the wall should be increased by a factor of 2.

6.9 SETTLEMENT

Fill soils compacted near OMC to a density in the order of 95 percent of SPMDD will undergo settlement due to self-weight of the fill, in the range of 3 to 5 percent of the fill height. Fill soils compacted to higher densities will undergo smaller settlements. Settlement of select granular fill soils will be almost instantaneous under the proposed loading conditions. For medium plastic clay backfill, most of the settlement is expected to occur after construction.

6.10 BACKFILL PLACEMENT

Clay and gravel fill used to bring the site up to the final grade should be thoroughly mixed, moisture adjusted and placed to a density of at least 98 percent of SPMDD. All local or imported clay fill soils should be placed 0 to 2 percent higher then the OMC. Clay fill with moisture contents in excess of 3 percent above OMC should not be placed without approval of the geotechnical engineer. Material and compaction uniformity is most important. Compaction uniformity, fill quality and soil moisture content should be closely monitored by a field density testing program.

6.11 PAVEMENTS

6.11.1 Road Design

The proposed pavement design sections are based on the assumption that the roadway will be constructed on a stable, prepared subgrade with a minimum soaked California Bearing Ratio (CBR) of 2.0. This is indicative of a low level of subgrade support as expected during spring thaw when the subgrade soils will exist in a weakened condition. A non-woven geotextile separation layer must be placed between the subgrade and the gravel base layer to minimize the ingress of clay and silt into the gravel. Subgrade problems may be encountered depending on local weather and groundwater conditions at the time of construction. If soft subgrade conditions are encountered, it is assumed that the subgrade will be improved with coarse gravel to support construction traffic and paving activities.

The gravel road design proposed for the road are for standard duty traffic. The road section is based on Alberta Transportation standards. One design is proposed for the site access, with an Equivalent Single Axle Load (ESAL) of 1.9×10^4 (based on an estimated 50 average annual daily traffic with 5 percent single unit trucks and 1 percent tractor trailer combinations). If it is anticipated that traffic will exceed these levels, the design sections provided below should be reviewed. The recommended pavement structure provided in Table 8 is based on a reliability of 75% and a standard deviation of 0.45.

TABLE 8: RECOMMENDED ROAD STRUCTURE

Material	Standard Duty	Compaction % SPMDD
Asphaltic Concrete Type M1* (Asphalt Binder PG 46-34	75 mm	98 %
Designation 2, Class 20 Crushed Granular Base Course	220 mm	98 %
Non-woven Geotextile	Yes	-
Scarify and Recompacted Exposed Subgrade	150 mm	100 %

*As per Alberta Transportation Specification Standard

Local asphalt pavement construction is often dictated by construction traffic and weather conditions at the time of construction. The thickness of the base layer provided above is considered to be the minimum requirement for the assumed ESAL's, assuming no subgrade improvement is required.

6.11.2 Suggested Pavement Materials

The performance of the proposed pavement design sections will be, in part, dependent on achieving an adequate level of compaction in subgrade and pavement materials. Aggregate materials for base and subbase gravel should be composed of sound, hard, durable particles free from organics and other foreign material.

Any new fill material required to bring the road areas up to design grade, should be placed uniformly to at least 98 percent of SPMDD (Section 6.2). The recommended levels of compaction for the granular materials in the pavement section should also be a minimum of 98 percent of SPMDD. Aggregate materials for base gravel should be composed of sound, hard, durable particles free from organics and other foreign material. It is recommended to use aggregates conforming to the following Alberta Transportation specifications.

TABLE 9: RECOMMENDED GRAVEL GRADATION

Sieve Size (mm)	Percent Passing by Weight
	Designation 2, Granular Base Class 20*
80	-
50	-
20	100
16	84 - 94
10	63 - 86
5	40 - 67
1.25	20 - 43
0.63	14 - 34
0.315	9 - 26
0.16	5 - 18
0.08	2 - 10

* Crushed Gravel

Material shall be sound, hard, durable particles free from elongated particles, organics or other foreign matter. Lightweight particles shall not exceed 2percent when tested in heavy liquid with relative density of 2.0. Alternative gravel material may be used, subject to review of the geotechnical engineer.

The road should be sloped and graded to effectively remove all surface water as rapidly as possible. To minimize the occurrence of surface water ponding, surface grades of at least 2 percent are recommended. Allowing water to pond on the road surface will lead to infiltration of the water into the subgrade which could result in weakening of the subgrade soils.

6.12 GEOSYNTHETICS

A geotextile filter fabric is recommended as a separation barrier for all transitions between gravel and fine grained soils. Filter fabric is not required between layers or zones of select gravel. The filter fabric should be laid continuously below any transitions between coarse grained backfill and

the fine grained subgrade, and should be provided with overlaps in conformance with the manufacturer's recommendations or at least 300 mm, whichever is greater.

6.13 SITE DRAINAGE

Site grading during and after construction is an important consideration. The road fill slopes should be sloped and graded to effectively and rapidly remove all surface water during and after construction. Water should not be allowed to pond on any exposed subgrade surfaces.

6.14 ROADSIDE DITCHES

Roadside ditches will direct surface run-off into the creek at both ends of the proposed embankment. Any exposed fine grained materials along the bridge headslope extending into the ditches will be susceptible to erosion from fast moving surface water expected during peak precipitation events. Design grading and erosion control measures such as vegetating the surface of all exposed soils and placing rip-rap should be applied where necessary.

It is expected that surface water from road-side ditches will enter the creek bed near the east and west ends of the bridge. These transition areas often are subject to significant erosion. Therefore, surface drainage from the ditches into the creek bed may need to be controlled and provided with energy dissipation measures, as well as erosion control measures.

6.15 CORROSION POTENTIAL

Soil resistivity and pH indicate that the corrosion potential of steel piles is extremely high. Samples were tested within the native clay. A protective coating is recommended as an options to reduce long term corrosion of the piles.

TABLE 10: SOIL CORROSION POTENTIAL

Soil Resisitivity (ohm cm)	Potential Degree of Corrosion
<1000	Extremely High
1000 - 3000	Highly
3000 - 5000	Corrosive
5000 - 10000	Moderately
10000 - 20000	Mildly
>20000	Extremely non-corrosive

6.16 INSPECTION

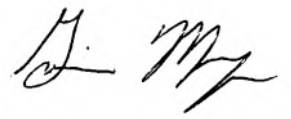
It is recommended that on-site inspection and testing be performed to verify that actual site conditions are consistent with assumed conditions which meet or exceed design criteria. Minimum inspection by qualified personnel should include monitoring pile driving and compaction testing of backfill.

7.0 LIMITATIONS AND CLOSURE

This report has been prepared for the exclusive use of **MPA ENGINEERING LTD.** and their approved agents for specific application to the project and site described in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **PARKLAND GEO-ENVIRONMENTAL LTD.**, and The ParklandGEO Consulting Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. No other warranty, expressed or implied, is made. The General Terms and Conditions of this report are attached and should be considered part of this report.

We trust that this report meets with your current requirements. If there are any questions, please contact the undersigned at 780 / 416 - 1755.

Respectfully Submitted,
PARKLAND GEO-ENVIRONMENTAL LTD.



Gavin Mayer, E.I.T.
Geotechnical Engineer

Brad Gavronsky, P.Eng.
Geotechnical Engineer

APEGA Permit to Practice No. P - 8867

Ramon Facundo, P.Eng.
Responsible Member/Reviewer

FIGURES

FIGURE 1: AREA PLAN

FIGURE 2: SITE PLAN

SITE PHOTOGRAPHS

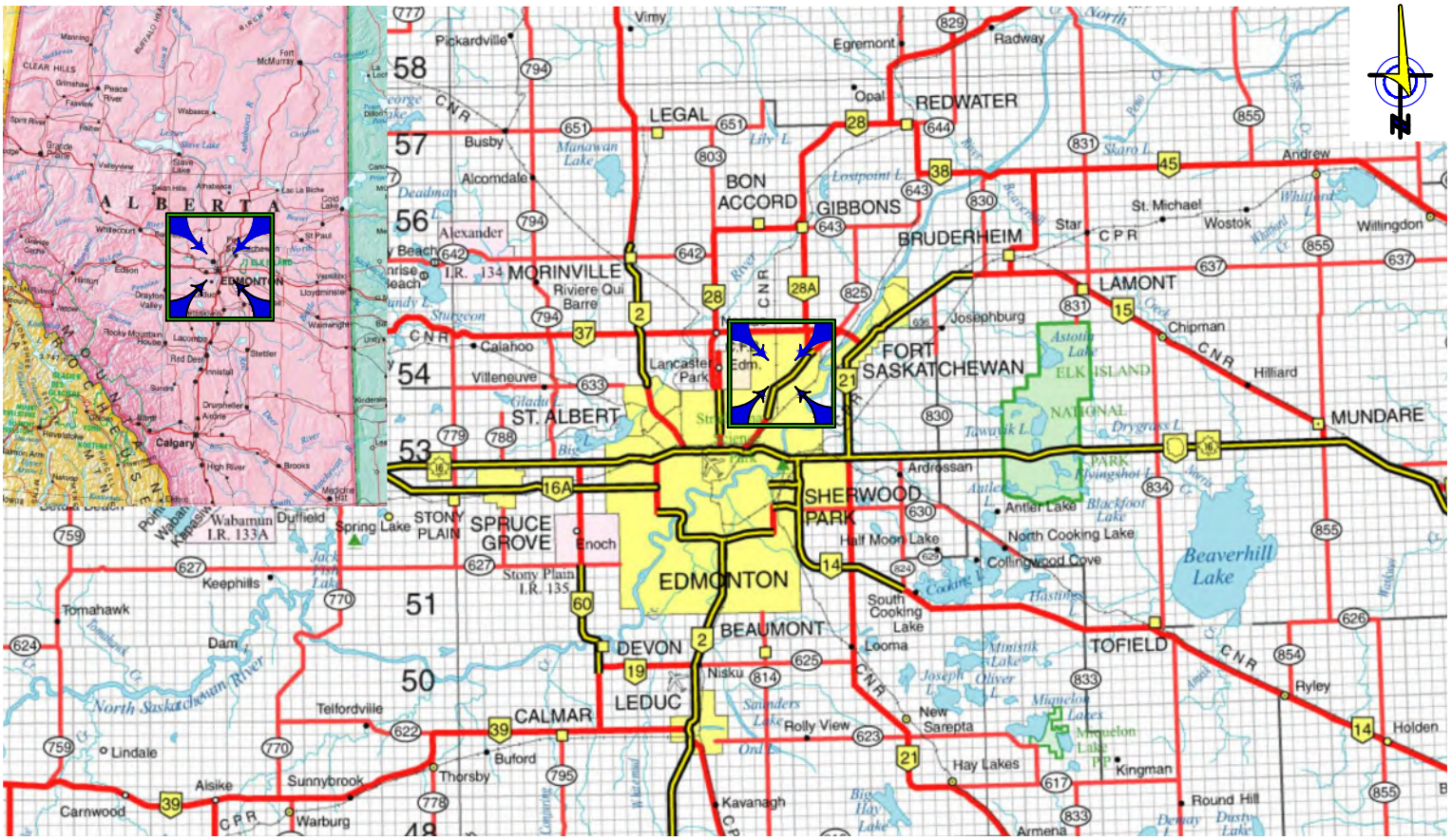


IMAGE FROM GOOGLE EARTH 2019

Parkland GEO

CLIENT:

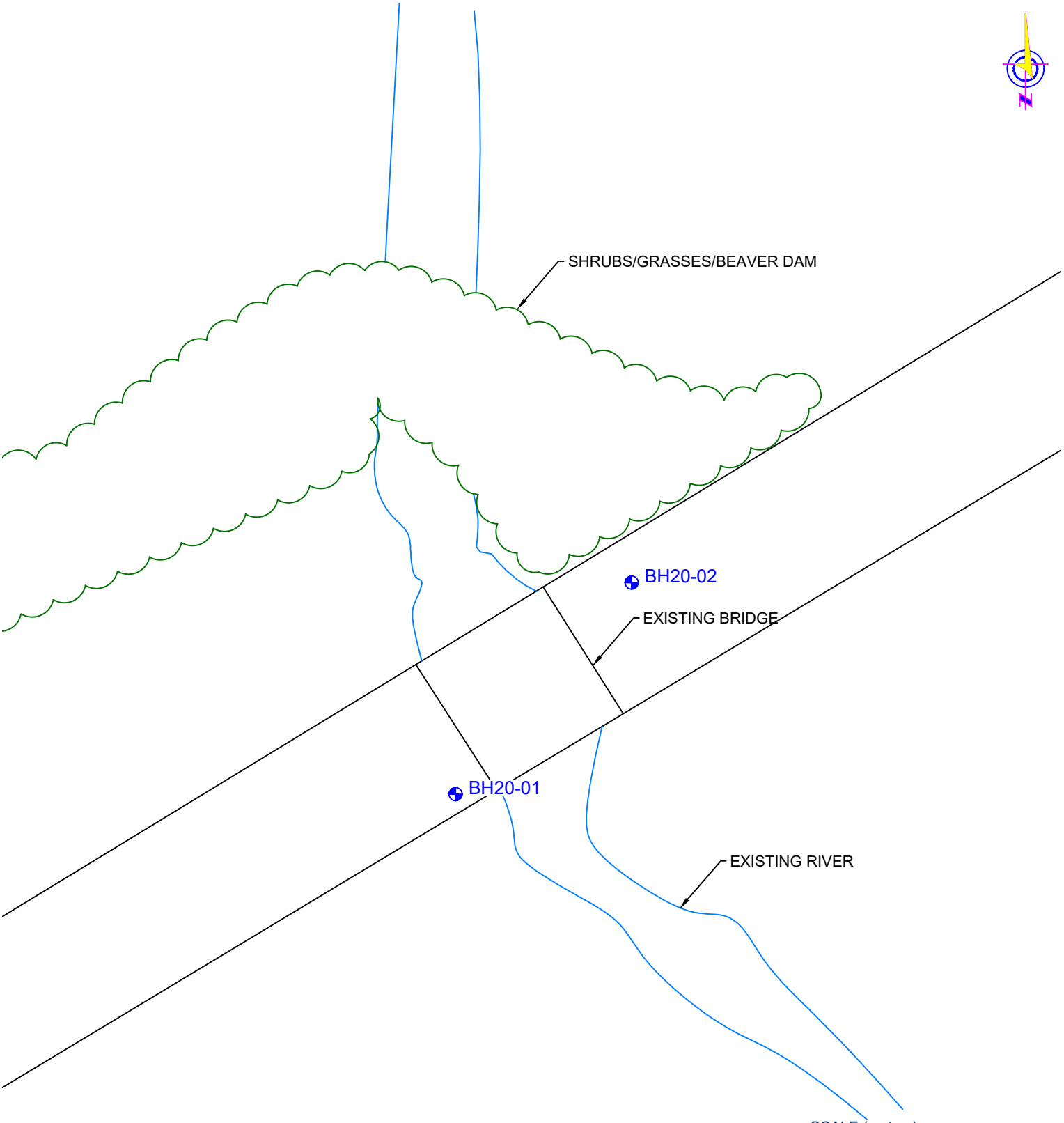
MPA ENGINEERING LTD

AREA PLAN

PROPOSED B130 BRIDGE REPLACEMENT
HORSEHILL ROAD, EDMONTON, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
GM	BG	0	AUGUST, 2020

SCALE:	JOB NO.	DRAWING NO.
NTS	ED2251	FIGURE 1



NOTE: THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. NOT ALL STRUCTURES OR FEATURES MAY BE SHOWN. BASE DRAWINGS PROVIDED BY MORRISON HERSHFIELD.

LEGEND:

PARKLANDGEO BOREHOLE

SCALE (metres)

-10 -5 0 5 10

ParklandGEO

CLIENT:

AMEC ENGINEERING LTD

SITE PLAN

PROPOSED B130 BRIDGE REPLACEMENT
HORSEHILL ROAD, EDMONTON, ALBERTA

DRAWN:	CHK'D.:	REV #:	DATE:
GM	BG	0	AUGUST, 2020

SCALE:	JOB NO.	DRAWING NO.
NTS	ED2251	FIGURE 2

Photograph 1: Facing west from the bridge location. Drilling rig can be seen set up at Borehole 20-01.

Photograph 2: Facing north from the bridge location, looking along Horsehill Creek.

Photograph 3: Facing south from the bridge location, along Horsehill Creek. The river can be seen entering 2 culverts to allow drainage below Highway 15.

Photograph 4: Completed borehole with flush mounted well protector installed at the surface.

APPENDIX A

BOREHOLE LOGS

EXPLANATION SHEETS

LABORATORY RESULTS

BOREHOLE NO.: 20-01

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: SW of Existing Bridge

PROJECT NO.: ED2251

SUBSURFACE PROFILE

Depth (m)	Description	Elev.
0	GROUND SURFACE	0.0
0	***Asphalt***	
0	***Sand and Gravel Fill*** Loose, damp, brown	
1	***Silty Clay Fill*** Some sand, low plastic,firm, damp, brown	-1.8
2	Grey with black organic staining and odour at 0.5 m	-2.3
3	***Sand*** And clay, little rust inclusions, moist, brown and grey	
4	***Clay*** And silt, trace sand, high plastic, firm, trace rust and coal inclusions, occasional sand pockets and white mineral includsions, damp, mottled grey and brown	-4.5
5		-5.5
6	***Rafted Weathered Clay Shale*** Some silt, trace sand, stiff, high plastic, damp, crumbly, grey	-6.3
7	***Sand*** Little clay, wet, brown	
7	***Clay*** Some silt, some sand, trace gravel, medium plastic, occasional sand pockets and white mineral inclusions, damp, grey	
8		
9		
10		
11		
12		
13		
14		
15		

SAMPLE

Sample No.	Type	SPT (N)
1D1		5
1D2		6
1U1		6
1D4		17
1D5		5
1D6		8
1D7		22
1D8		19
1D9		13
1D10		8

Atterberg Limits Moisture Content (%)

(Wp |-----x-----| Wl)

25 50 75

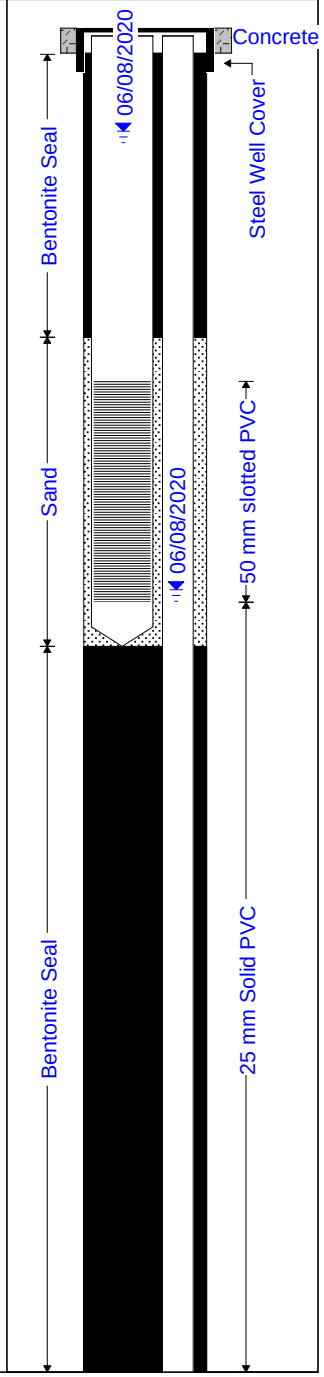
22 26 23 29 38 22 22 24 27 30 20 18 27 25 21 26 21 19

Comments

Vapours = 210 ppmv
Vapours = 10 ppmv
Vapours = 10 ppmv
Vapours = 15 ppmv
Vapours = Non-Detectable
Vapours = 95 ppmv
Vapours = 10 ppmv
Vapours = 140 ppmv
Vapours = 25 ppmv

Grain Size Analysis at 9.0 m:
Clay = 30.3%
Silt = 32.1%
Sand = 37.6%
Gravel = 0.0%

Well Completion Details



LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

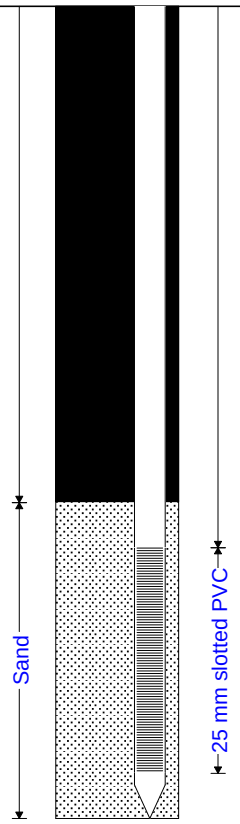
GROUND ELEVATION:
NORTHING: 5948163
EASTING: 0343635

BOREHOLE NO.: 20-01

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: SW of Existing Bridge

PROJECT NO.: ED2251

SUBSURFACE PROFILE				SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)	(Wp |-----x-----| Wl) 25 50 75		
			-15.3				19		
		Sand Coarse grained, moist							
16		***Clay*** Some sand, trace gravel, medium plastic, moist to wet, grey		1D11		15	21		
17							21		
				1D12		11			
18							27		
19		- And sand, soft, wet, grey at 19 m		1D13		15			
20									
		- Trace silt and gravel, occasional sand pockets, high plastic, damp, grey at 20.25 m		1D14		17			
21							25		
22				1D15		19			
23							17		
				1D16		19			
24							17		
25			-25.3	1D17		26			
26		END OF BOREHOLE WATER AND SLOUGH TO 2.2 m UPON COMPLETION							
27									
28									
29									
30									



LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

GROUND ELEVATION:
NORTHING: 5948163
EASTING: 0343635

BOREHOLE NO.: 20-02

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: NE of Existing Bridge

PROJECT NO.: ED2251

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Elev.
0		GROUND SURFACE	0.0
		Asphalt	
		Clay Fill Some silt, little sand, trace gravel, firm, medium plastic,occasional rust, damp brown	-1.5
			-1.8
2		***Organic Soil***	
		Clay Some silt, little sand, firm, high plastic, occasional rust, damp, mottled grey/brown	
4			-4.5
		Rafted Weathered Clay Shale Some silt, trace sand, stiff, high plastic, damp, crumbly, grey	-5.5
6		***Clay*** Some sand and silt, little gravel, trace rust, wet, brown	-6.8
		Clay Some silt, little sand, trace gravel, firm to stiff, medium to high plastic, damp to moist, grey	
		- trace coal inclusions and medium plastic at 12.75 m to 14.0m	

SAMPLE

Sample No.	Type	SPT (N)
2D1		7
2D2		5
2U1		-
2D3		8
2D4		13
2D5		4
2D6		9
2D7		7

Atterberg Limits Moisture Content (%)

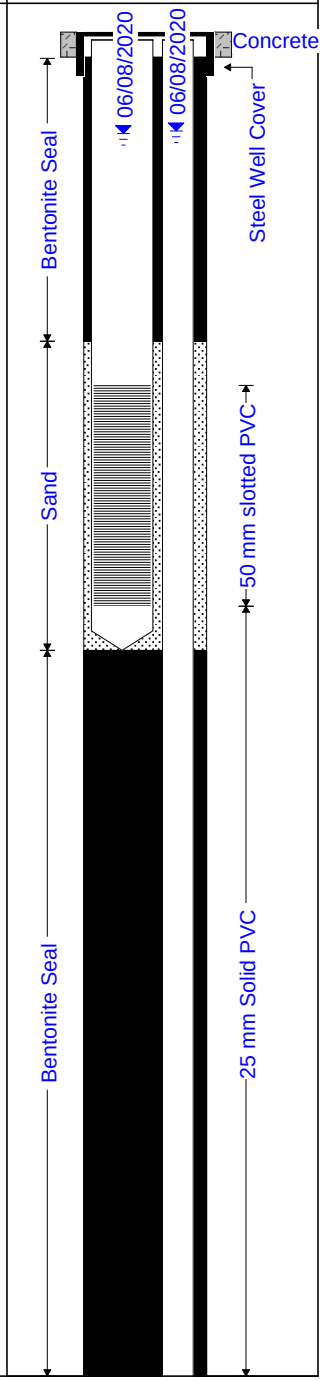
(Wp |-----x-----| Wl)

25 50 75

18 25 32 38 40 20 23 26 24 27 27 26 31 22 20 23 27 19

Comments
Vapours = 55 ppmv
Vapours = 320 ppmv
Vapours = 60 ppmv
Vapours = 0 ppmv
Vapours = 0 ppm
Vapours = 35 ppmv
Vapours = 490 ppmv
Vapours = 100 ppmv
Vapours = 0 ppmv
Atterberg Limit at 2.25 m: PL = 22.0% LL = 62.0% PI = 40.0%

Well Completion Details



LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

GROUND ELEVATION:
NORTHING: 5948175
EASTING: 0343645

BOREHOLE NO.: 20-02

CLIENT: MPA Engineering Ltd.
SITE: Horsehills Road, Edmonton, AB
BH LOCATION: NE of Existing Bridge

PROJECT NO.: ED2251

SUBSURFACE PROFILE				SAMPLE			Atterberg Limits Moisture Content (%)	Comments	Well Completion Details
Depth (m)	Symbol	Description	Elev.	Sample No.	Type	SPT (N)	(Wp |-----x-----| Wl) 25 50 75		
16				2D8		27	19, 21, 21, 27		Sand; 25 mm slotted PVC
17									
18									
19			-19.5	2D9		18			
20		END OF BOREHOLE WATER TO 4 MBG AND SLOUGH TO 11 MBG UPON COMPLETION							
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

LOGGED BY: NP
CONTRACTOR: Drilling Solutions Inc.
RIG/METHOD: Truck Mounted Solid Stem Auger
DATE: July 16, 2020

GROUND ELEVATION:
NORTHING: 5948175
EASTING: 0343645

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The materials, boundaries, and conditions have been established only at the borehole location at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile can have gradual rather than distinct boundaries.

1. **PRINCIPAL SOIL TYPE** – The major soil type by weight of material or by behaviour.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt	0.020 to 0.075 mm
Clay	Smaller than 0.020 mm

2. **DESCRIPTION OF MINOR SOIL TYPE** – Minor soil types are identified by weight of minor component.

Descriptor	Percent
and	35 to 50
some	20 to 35
little	10 to 20
trace	1 to 10

3. **CONSISTENCY OF FINE GRAINED SOILS** – The following terms are used relative to undrained shear strength and Standard Penetration Test (SPT), , N value, for blows per 300 mm penetration (ASTM D1586).

Description	Undrained Shear Strength, C_u (kPa)	SPT N Value
Very Soft	Less than 12	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 150	15 to 30
Hard	Over 150	Over 30

4. **RELATIVE DENSITY OF COARSE GRAINED SOIL** – The following terms are used relative to Standard Penetration Test (SPT),, N value for blows per 300 mm penetration (ASTM D1586).

Description	SPT N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

5. **TYPICAL SEDIMENTARY BEDROCK TYPES AND CLASSIFICATION** – The following terms are based on visual inspection and field/laboratory identification tests.

Characteristic	Sandstone	Mudrocks			
		Siltstone	Mudstone	Clayshale	Claystone
Composition	>50% Sand $CaCO_3$ or silica binder. Use weak acid to test for $CaCO_3$.	>50% Silt	33% to 66% Silt & 33% to 66% Clay	>50% Clay & <33% Silt	
Bedding	Banding possible Non- Fissile Wackes – dirty sandstone matrix (>15% clay)	Non-Fissile & Non-laminated	Non-Fissile & Non-laminated	Fissile	Non-Fissile

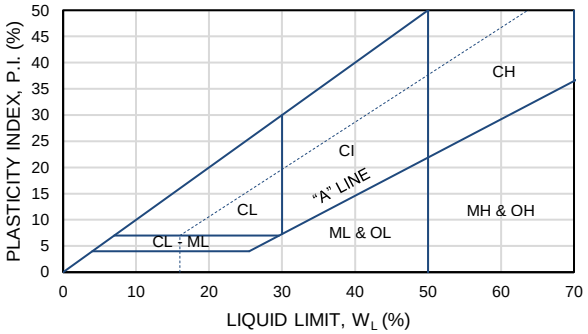
Definitions

Fissile Breaks apart on bedding planes, not fractures.
Shale Only used to describe a fissile clay mudrock.
Slate Hard Mudstone exposed to high pressure and temperature.
Limestone Sedimentary rock (i.e. particles) formed from calcium carbonate minerals from skeletal fragments of marine organisms such as coral. Particles generally too small to see with eye.

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 4$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 4$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

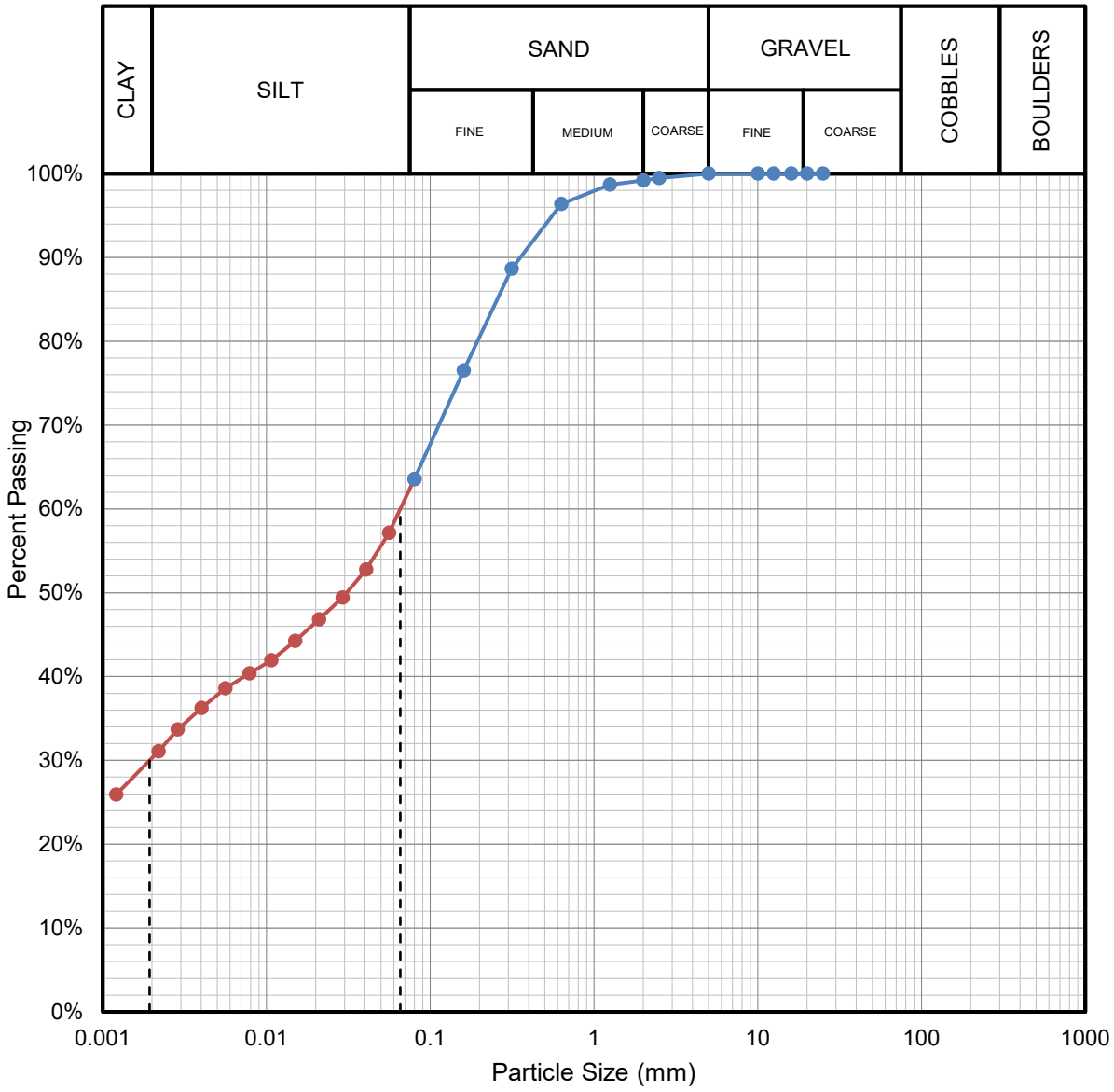
1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range of minor components.

PARTICLE-SIZE ANALYSIS

ASTM D422

PROJECT: B130 Bridge Replacement
PROJECT#: ED2251
CLIENT: MPA
SOIL DESCRIPTION: sand, some silt, some clay

SAMPLE DATE: July 16, 2020
TEST DATE: August 4, 2020
SAMPLE ID: 1G12
DEPTH: 9.0 m



SUMMARY OF RESULTS		
	Gravel	0.0%
	Sand	37.6%
	Silt	32.1%
	Clay	30.3%

GRAIN SIZE		
	D_{10}	0.0002 mm
	D_{30}	0.0019 mm
	D_{60}	0.0657 mm

COEFFICIENTS		
	Coefficient of Uniformity, C_U	340.4
	Coefficient of Curvature, C_C	0.3

TECH: OH
CHECKED: MEA

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY

ASTM D4318 - Method A: Multi-Point

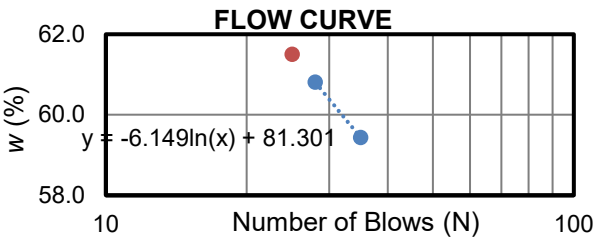
PROJECT: B130 Bridge Replacement
PROJECT#: ED2251
CLIENT: MPA
SOIL DESCRIPTION: 0

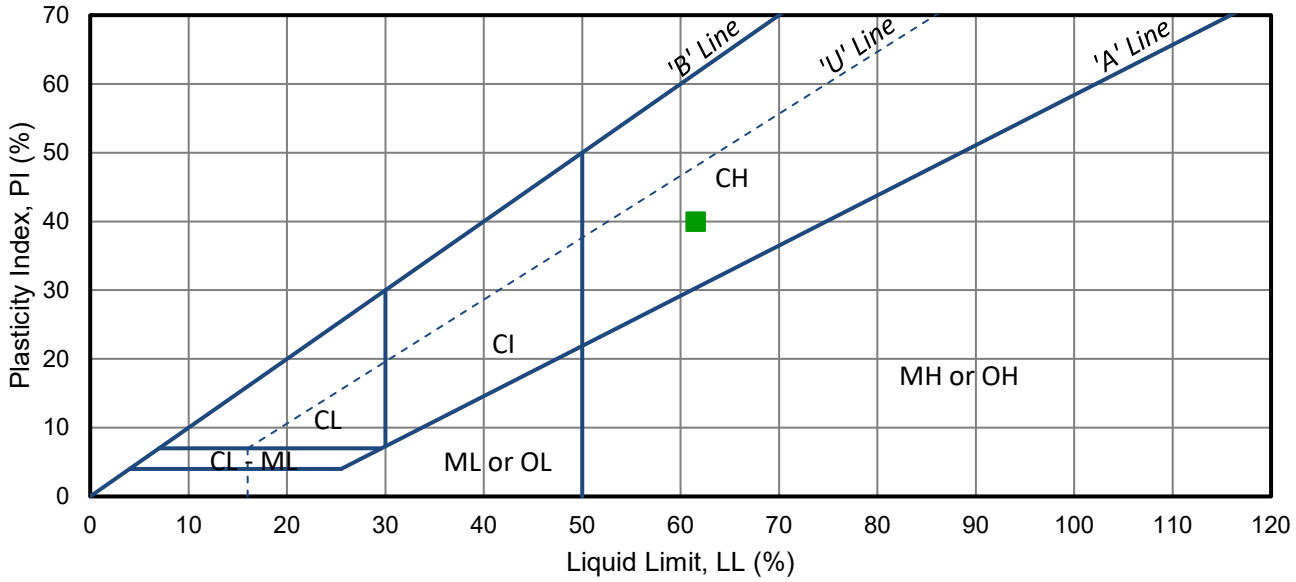
SAMPLE DATE: July 16, 2020
TEST DATE: August 5, 2020
SAMPLE ID: 20-02
DEPTH: 2.25 m

PROCEDURE USED: Wet Preparation - Method A: Mult-Point

	AS RECEIVED	PLASTIC LIMIT				LIQUID LIMIT			
		1	2	3	4	1	2	3	4
Number of blows, N						35	28		
Container Number		1	4	92		40	48		
Tare Container, M_C (g)		11.114	11.042	11.034		29.253	29.319		
Wet Sample + Tare, M_{CMS} (g)		16.926	14.768	16.450		74.921	81.999		
Dry Sample + Tare, M_{CDS} (g)		15.886	14.108	15.488		57.896	62.078		
Dry Sample, M_S (g)		4.772	3.066	4.454		28.643	32.759		
Water, M_W (g)		1.040	0.660	0.962		17.025	19.921		
Moisture Content, w (%)		21.8	21.5	21.6		59.4	60.8		

Plastic Limit, PL or w_P (%)	22
Liquid Limit, LL or w_L (%)	62
Plasticity Index, PI (%)	40
Modified USCS Classification	#REF!





WATER SOLUBLE SULPHATE IN SOIL

ASTM C1580

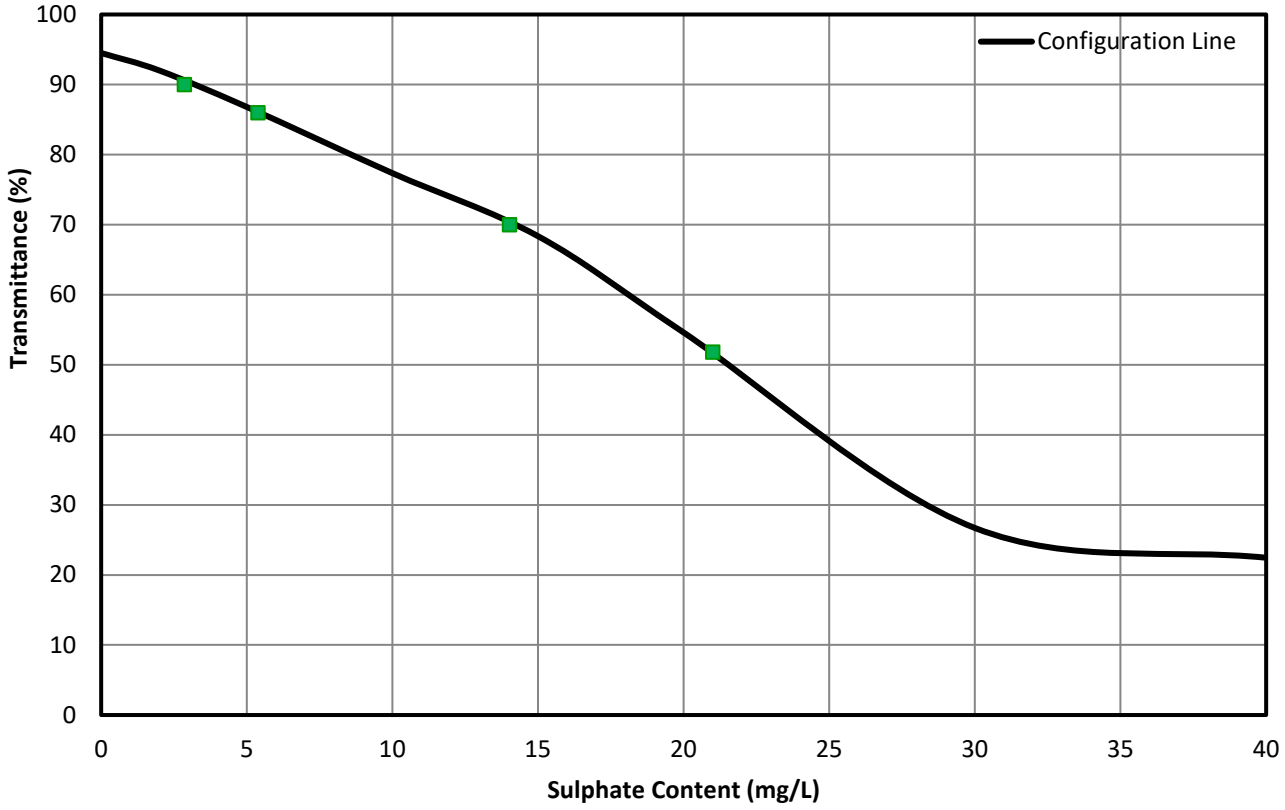
PROJECT: B130 Bridge Replacement
PROJECT#: ED2251
CLIENT: MPA
SOIL DESCRIPTION:

SAMPLE DATE: July 16, 2020
TEST DATE: August 10, 2020
SAMPLE ID: BH20-01
DEPTH: 0.75 m

Sample Name	Soil Weight (g)	Transmittance (%)
A1	30.000	51.8
A2	30.000	70.0
B1	3.000	86.0
B2	3.000	90.0

Sulphate Content (%)	0.143
Degree of Exposure*	**MODERATE**

Beer's Law Plot



*REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A23.1-14)					
EXPOSURE CLASSIFICATION	**DEGREE OF EXPOSURE**	**WATER-SOLUBLE SULPHATE(SO4) IN SOIL SAMPLE, %**	**CEMENT TO BE USED**	**MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, Mpa**	**MAXIMUM WATER/ CEMENTING MATERIALS RATIO**
S-1	Very Severe	over 2.0	HS	35	0.4
S-2	Severe	0.20 to 2.0	HS	32	0.45
S-3	Moderate	0.10 to 0.20	MS or HS	30	0.5

TECH: OH
CHECKED: KS

WATER SOLUBLE SULPHATE IN SOIL

ASTM C1580

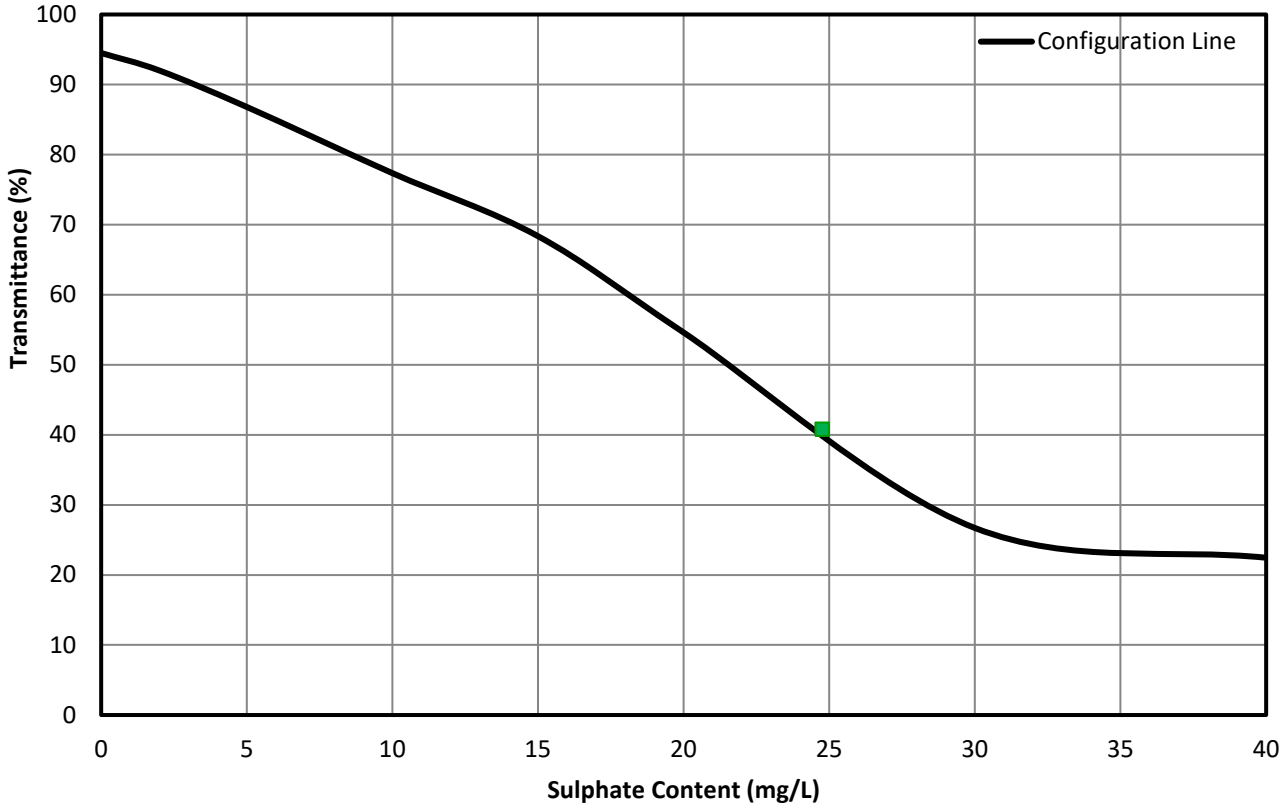
PROJECT: B130 Bridge Replacement
PROJECT#: ED2251
CLIENT: MPA
SOIL DESCRIPTION:

SAMPLE DATE: July 16, 2020
TEST DATE: August 10, 2020
SAMPLE ID: BH20-02
DEPTH: 2.25 m

Sample Name	Soil Weight (g)	Transmittance (%)
A1	30.000	0.0
A2	30.000	0.1
B1	3.000	19.6
B2	3.000	40.8

Sulphate Content (%)	2.063
Degree of Exposure*	VERY SEVERE

Beer's Law Plot



*REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A23.1-14)					
EXPOSURE CLASSIFICATION	DEGREE OF EXPOSURE	WATER-SOLUBLE SULPHATE(SO4) IN SOIL SAMPLE, %	CEMENT TO BE USED	MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, Mpa	MAXIMUM WATER/ CEMENTING MATERIALS RATIO
S-1	Very Severe	over 2.0	HS	35	0.4
S-2	Severe	0.20 to 2.0	HS	32	0.45
S-3	Moderate	0.10 to 0.20	MS or HS	30	0.5

TECH: OH
CHECKED: KS

AGAT Laboratories

6310 ROPER ROAD
EDMONTON, ALBERTA
CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 20E631444

PROJECT: ED2251

CLIENT NAME: PARKLAND GEO

ATTENTION TO: Accounts Payable

SAMPLING SITE:

SAMPLED BY:

Soil Analysis - pH CaCl2 and Resistivity

DATE RECEIVED: 2020-07-29

DATE REPORTED: 2020-08-02

		SAMPLE DESCRIPTION:		2G4 3.0m	1G7 5.25m
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2020-07-16	2020-07-16
Parameter	Unit	G / S	RDL	1310009	1310010
pH (CaCl2 Extraction)	pH Units		N/A	7.47	8.24
Resistivity	ohm.cm		1	210	166

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

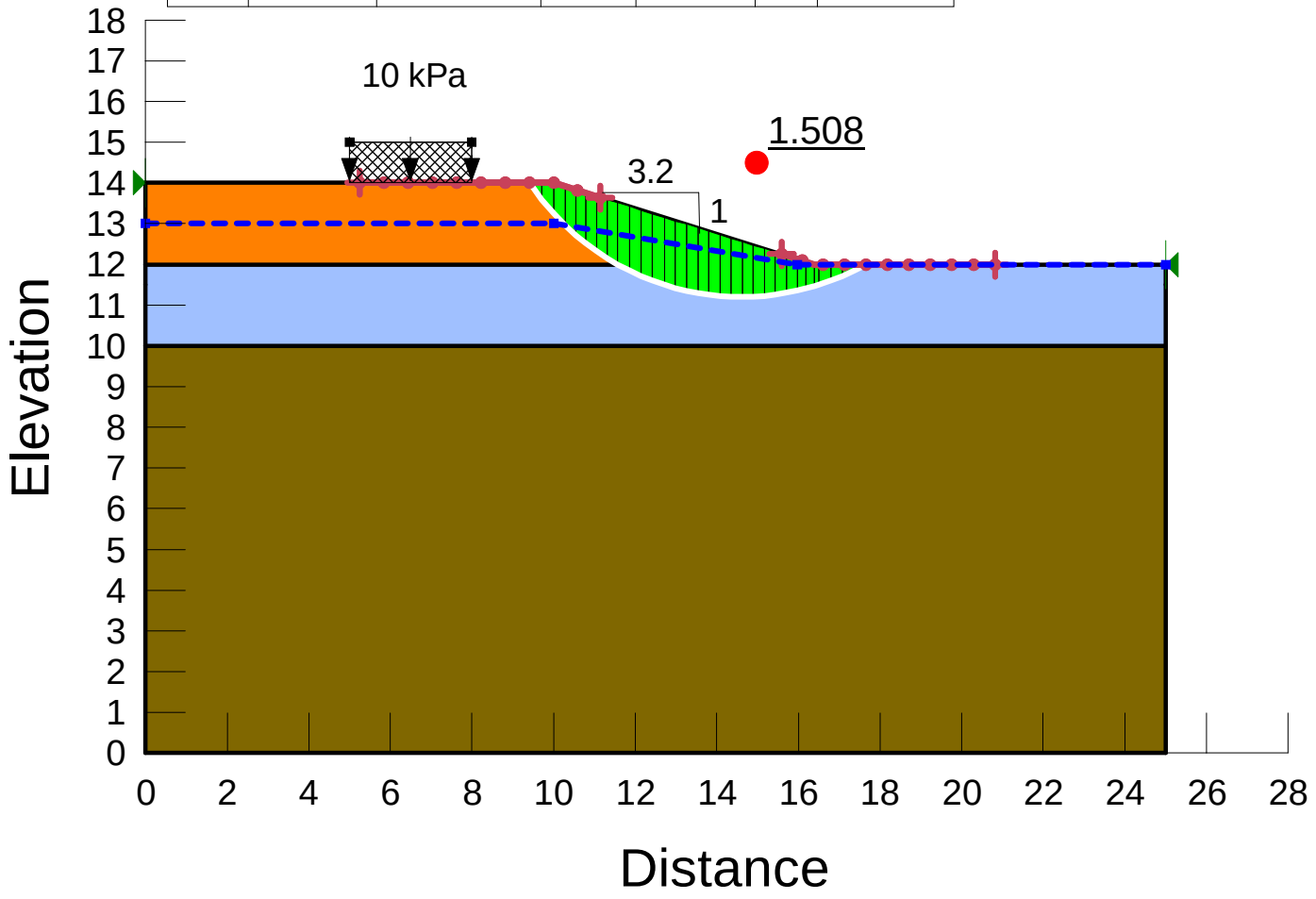
Analysis performed at AGAT Edmonton (unless marked by *)

Certified By:

APPENDIX B

B1 - SIDE SLOPE ANALYSIS - 3.2H:1V

Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
	Clay Fill	Mohr-Coulomb	18.5	2	25	1
	Lower Clay	Mohr-Coulomb	18	4	25	1
	Upper Clay	Mohr-Coulomb	17.5	1	23	1



Parkland GEO

Sideslope Analysis 3.2H:1V

B130 Bridge Replacement

DATE: 08/19/2020

JOB NO.: ED2251

Figure B1

LIMITATIONS

GENERAL TERMS, CONDITIONS
AND LIMITATIONS

The use of this attached report is subject to the following general terms and conditions.

1. STANDARD OF CARE - In the performance of professional services, ParklandGEO used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty expressed or implied is made in any manner.

2. INTERPRETATION OF THE REPORT - The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations and recommendation of ParklandGEO are based solely on the information available to him. Classification and identification of soils, rocks, geological units, contaminated materials and contaminant quantities will be based on commonly accepted practices in geotechnical or environmental consulting practice in this area. ParklandGEO will not be responsible for the interpretation by others of the information developed.

3. SITE INFORMATION - The CLIENT has agreed to provide all information with respect to the past, present and proposed conditions and use of the Site, whether specifically requested or not. The CLIENT acknowledged that in order for ParklandGEO to properly advise and assist the CLIENT, ParklandGEO has relied on full disclosure by the CLIENT of all matters pertinent to the Site investigation.

4. COMPLETE REPORT - The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to ParklandGEO by the CLIENT, communications between ParklandGEO and the CLIENT, and to any other reports, writings or documents prepared by ParklandGEO for the CLIENT relative to the specific Site, all of which constitute the Report. The word "Report" shall refer to any and all of the documents referred to herein. In order to properly understand the suggestions, recommendations and opinions expressed by ParklandGEO, reference must be made to the whole of the Report. ParklandGEO cannot be responsible for use of any part or portions of the report without reference to the whole report. The CLIENT has agreed that "This report has been prepared for the exclusive use of the named CLIENT. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."

   The CLIENT has agreed that in the event that any such report is released to a third party, the above disclaimer shall not be obliterated or altered in any manner. The CLIENT further agrees that all such reports shall be used solely for the purposes of the CLIENT and shall not be released or used by others without the prior written permission of ParklandGEO.

5. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY DISCLAIMER
   There is no warranty, expressed or implied, by ParklandGEO that:
   a) the investigation uncovered all potential geo-hazards, contaminants or environmental liabilities on the Site; or
   b) the Site is entirely free of all geo-hazards or contaminants as a result of any investigation or cleanup work undertaken on the Site, since it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

   The CLIENT acknowledged that:
   a) the investigation findings are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
   b) unless specifically stated in the agreed Scope of Work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
   c) any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
   d) any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
   e) any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted; and
   f) the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
   g) there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently discovered as part of the investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials and in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.

6. COST ESTIMATES - Estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT. Accordingly, estimated costs for construction or remediation are based on the known site conditions, which can vary as new information is discovered during construction. As some construction activities are an iterative exercise, ParklandGEO shall therefore not be liable for the accuracy of any estimates of remediation or construction costs provided.

7. LIMITATION OF LIABILITY - The CLIENT has agreed that to the fullest extent permitted by the law ParklandGEO's total liability to CLIENT for any and all injuries, claims, losses, expenses or damages whatsoever arising out of or in anyway relating to the Project is contractually limited, as outlined in ParklandGEO's standard Consulting Services Agreement. Further, the CLIENT has agreed that to the fullest extent permitted by law ParklandGEO is not liable to the CLIENT for any special, indirect or consequential damages whatsoever, regardless of cause.

8. INDEMNIFICATION - To the fullest extent permitted by law, the CLIENT has agreed to defend, indemnify and hold ParklandGEO, its directors, officers, employees, agents and subcontractors, harmless from and against any and all claims, defence costs, including legal fees on a full indemnity basis, damages, and other liabilities arising out of or in any way related to ParklandGEO's work, reports or recommendations.

Appendix E. Fisheries Assessment (MPA 2020a)

QAES Fisheries Assessment and Recommendations

Horsehills Road over Horsehills Creek (B130) SW 17-54-23-W4M

THE CITY OF Edmonton

June 2020

MPA ENGINEERING LTD

FISHERIES ASSESSMENT

June 17, 2020

File: **B130**

City of Edmonton
Transportation Planning & Design Integrated Infrastructure Services
12th Floor Edmonton Tower
10111 104 Avenue NW
Edmonton, AB T5J 0J4

Attention: John Phong, P.Eng., Project Engineer

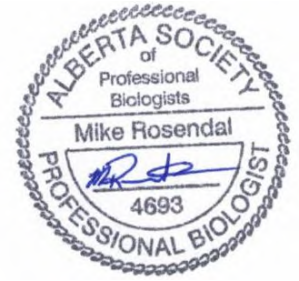
Dear John:

RE: QAES Report and Recommendations,
Horsehills Road over Horsehills Creek (B130), SW 17-54-23-W4M

MPA Engineering Ltd has completed a Qualified Aquatic Environmental Specialist (QAES) assessment report for the existing bridge crossing carrying Horsehills Road over Horsehills Creek located in SW 17-54-23-W4M within the city of Edmonton, Alberta. Attached is a copy of the assessment report including QAES recommendations for the protection of fish and fish habitat.

If you have any questions in relation to the QAES assessment, please contact Mike Rosendal at 780-624-8151 or via email at Mike.Rosendal@mpaeng.ca.

Sincerely,
MPA Engineering Ltd.
per:



Mike Rosendal, B.Sc., QAES, P.Biol, EP

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MPA Engineering Ltd. – Third Party Disclaimer

MPA Engineering Ltd. ("MPA") has prepared this report for the benefit of the client to whom it is addressed. This report and its contents represent MPA's best professional judgment in light of the knowledge and information available to MPA at the time of preparation. MPA makes no representation or warranty, and expressly disclaims any liability with respect to the content of this report to any Third Party, including but not limited to errors or omissions contained therein.

ABSTRACT / SYNOPSIS

- Code of Practice Details
  - The Water Act Code of Practice (CoP) classification for this location is class “C”.
  - The designated Restricted Activity Period (RAP) extends from April 16th to June 30th of any given year.
  - All conditions outlined in Schedule 2, Part 1 (a) of the Code of Practice will be met.
- Overall Fish Habitat Value
  - Previous fish assessments have been conducted at this location, but none have resulted in the capture or observation of any fish species.
  - Spawning potential is ranked as “low” for gravel spawners and “low” for vegetation spawners.
  - Rearing potential is ranked as “low”.
  - Migration potential is ranked as “low”.
  - Overwintering potential is ranked as “nil-low”.
  - Overall fish habitat ranking would be “low”.
- Proposed Works
  - The City of Edmonton is planning on replacing the existing bridge structure at this location. The proposed new structure will be a 10 m SLW bridge with a 450 mm grade raise.
- Impacts to Fish and Fish Habitat
  - Provided that any in-stream construction activity takes place outside of the recommended Restricted Activity Period and that all the recommendations outlined in this report are implemented, any impacts to fish and/or fish habitat are expected to be low. As the project does entail placing rock riprap within the channel a Request for Review application should be submitted to the Department of Fisheries and Oceans (DFO) to ensure compliance with the Federal *Fisheries Act.*

1.0 INTRODUCTION

MPA Engineering Ltd (MPA) was retained by the City of Edmonton to complete a QAES assessment for a bridge replacement project on Bridge B130, located on Horsehills Road within the City of Edmonton, Alberta in SW 17-54-23-W4M. The existing structure at this site consists of an 8.5 m HC concrete girder bridge on a treated timber substructure. The bridge was originally constructed in 1971. A site plan showing the location of the bridge is contained in the Appendix.

2.0 SITE BACKGROUND

2.1 Location

The crossing is located within the city limits of Edmonton, Alberta. It is located on Horsehills Road, east of 18th Street. From the crossing location, the watercourse flows southeast for approximately 8 km before eventually entering the North Saskatchewan River. Photos of the site are included in the Appendix.

2.2 Alberta Natural Regions

Horsehills Creek is located primarily within the Central Parkland Natural Subregion of Alberta. Approximately 2 percent of this Subregion is covered by small waterbodies and approximately 10 percent of this Subregion is covered in wetlands. (Downing and Pettapiece 2006).

2.3 Watershed Overview and Historical Fisheries Background

2.3.1 Horsehill Creek

A query of the Alberta Government Fish and Wildlife Internet Mapping Tool (FWIMT 2020) shows previous fisheries assessments having been conducted in the past including in 2011, 2012 and 2015 at this crossing location. No fish were captured or observed during these previous assessments. FWIMT does contain further records showing that Brook Stickleback (*Culaea inconstans*), Fathead Minnow (*Phoxinus neogaeus*), Pearl Dace (*Margariscus margarita*), White Sucker (*Catostomus commersoni*), and Northern Pike

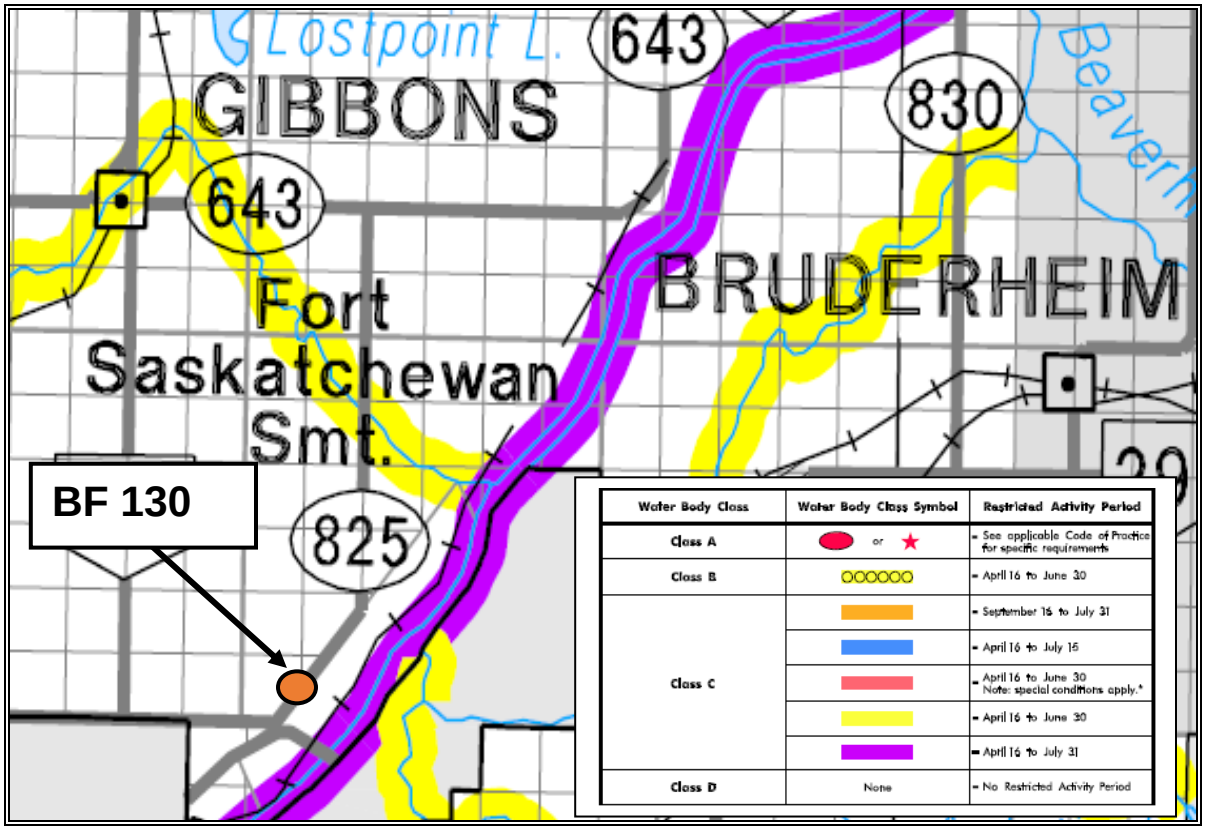
(*Esox Lucius)* have been captured in Horsehills Creek but only closer to the confluence with the North Saskatchewan River.

2.3.2 Stream Class

Under the Alberta Water Act Code of Practice (COP), maps and class of water bodies are detailed under section 8. Horsehills Creek is a designated Class “C” waterbody.

2.3.3 Restricted Activity Period

The designated Restricted Activity Period (RAP) of Horsehills extends from April 16th to June 30th of any given year. See excerpt from the St. Paul Code of Practice map below.



3.0 SITE ASSESSMENT

A field investigation was carried out in March 2020 by MPA Engineering Ltd. The watercourse was visually observed and photographed upstream and downstream of the crossing location. Any noted obstacles or barriers to fish movement were recorded. The

field work along with the photos taken were used to gain an understanding of the potential fish habitat located both upstream and downstream of the bridge crossing.

3.1 Creek Channel

Horsehills Creek at this location is a slow flowing waterbody. Much of the channel has been impacted by city development. Riparian vegetation was largely intact and consisted of mainly sedges, grasses and sparse willows. The substrate consisted of mainly fine silty material. Due to the timing of the field investigation the channel was completely frozen to bottom. Photos of the upstream and downstream areas can be found in the Appendix.

3.2 Fish Habitat

3.2.1.1 Spawning

There was no gravel substrate noted during the investigation. Spawning habitat for gravel spawning species would be ranked as “nil”. The channel contained little to no amounts of in-stream vegetation. Spawning habitat for vegetation spawning species would be ranked as “low”.

3.2.1.2 Rearing

Throughout the upstream and downstream channel there were minimal amounts of suitable rearing habitat. The overall ranking of rearing habitat in this watercourse would be ranked as “low” and would only be suitable for hardy non-sport fish species.

3.2.1.3 Migration

Although no beaver dams were noted during the investigation, satellite imagery shows the presence of many beaver dams downstream of the study section. It is very likely that some of these beaver dams are impassable to fish and that any fish within the North Saskatchewan River that wish to migrate into Horsehills Creek would not be able to access the majority of the habitat in Horsehills Creek. The overall ranking for migration potential in this watercourse would be ranked as “low”.

3.2.1.4 Overwintering

The majority of the channel would be expected to freeze completely to bottom during winter conditions. The overall overwintering potential in this watercourse would be ranked as “low”.

4.0 DISCUSSION

4.1.1 Fisheries Resource

4.1.1.1 Habitat Value and Utilization by CoP (sport) fish

The Alberta Code of Practice (CoP) defines “fish” as any species used for domestic, sport or commercial purposes. It also refers to fish of special concern and/or any rare, endangered, threatened or vulnerable species. These are commonly referred as “sport” fish and include species of the *Percidae* (perch, walleye), *Esocidae* (pike), and *Salmonidae* (salmon, trout, grayling, whitefish) families and others.

The FWIMT database contains no records of sport fish species utilizing Horsehills Creek near this particular bridge crossing. The area holds little to no spawning, rearing, migrating or overwintering habitat for sport fish species. The overall utilization of the crossing location by sport fish is expected to be “nil-low”.

4.1.1.2 Habitat Value and Utilization by Non-CoP (forage) fish

Non-sport fish are generally all other fish that don’t fit the description of fish under the CoP for Watercourse Crossings (GoA 2013). These are generally classified as forage fish and include species of the *Catastomidae* (suckers), *Gasterosteidae* (stickleback) and *Cyprinidae* (minnow) families. These species have a high tolerance to low oxygen concentrations and can often occur in areas where other fish cannot survive (Nelson and Paetz 1992). Most forage fish tend to generally spawn during the spring and summer months. (Nelson and Paetz 1992).

The FWIMT database also contains records of non-sport fish species utilizing Horsehills Creek at this particular bridge crossing. The area contains little to minor amounts of suitable spawning, rearing, migrating and overwintering habitat for non-sport fish species. The overall utilization of the crossing location by non-sport fish species would be classified as “low”.

5.0 PROPOSED WORKS

The City of Edmonton is planning on replacing the existing culvert structure at this location. MPA Engineering is recommending that the replacement structure be a 10 m SLW bridge with a 450 mm grade raise.

The upstream channel bed width is approximately 2 m, the banks are in the order of 1.2 m in height and the top width is about 8 m. After the water overtops the banks it would flood the wetland/farmland areas adjacent to the channel upstream of the crossing.

The channel capacity flow obtained using this channel geometry, the HIS channel slope and the Channel Capacity Calculator developed by Alberta Transportation is 13.5 m3/s (0.27 m3/s/km2).

It should be noted that the downstream channel appears to have been channelized and as such channel capacity method utilizing the downstream channel parameters would not be representative of the anticipated flows.

The hydraulic reaction shown below are estimated for the existing bridge:

Flow (m^3/sec)	Flood	Deck Elevation	Bridge Headwater*			Downstream Channel Tailwater	
			Freeboard (m)	Elev.	Velocity (m/sec)	Elev.	Velocity (m/sec)
8.5 m 'HC' Girders on TT					Channel Elevation:		649.60 m
9	1:25	651.58	-0.15	651.22	0.76	651.21	0.98
12	1:50	651.58	-0.34	651.41	0.80	651.40	1.10
15	1:100	651.58	-0.51	651.58	0.91	651.56	1.21

*Bottom of Girder Elevation = 651.07 m

The existing bridge would flow with 0.34 m of negative freeboard during the design 1 in 50 year event, and the water would be approximately 0.17 m below deck elevation. The existing bridge does not provide the desired minimum freeboard of 0.3 m during the design or check flows. The bridge would need to be raised by approximately 0.64 m to provide 0.3 m of freeboard during the design event.

The hydraulics for the replacement structure are shown in the following table

Flow (m^3/sec)	Flood	Deck Elevation	Bridge Headwater*			Downstream Channel Tailwater	
			Freeboard (m)	Elev.	Velocity (m/sec)	Elev.	Velocity (m/sec)
10 m SLW-510 Girder Bridge					Channel Elevation		649.60 m
9	1:25	652.03	0.20	651.23	1.12	651.21	0.98
12	1:50	652.03	0.01	651.42	1.25	651.40	1.10
15	1:100	652.03	-0.15	651.58	1.35	651.56	1.21

*Bottom of girder elevation is 651.43 m

It should be noted that this proposed structure would be installed approximately 450 mm higher than the existing bridge and provides a larger opening and as such will increase the hydraulic capacity of the crossing when compared to the existing bridge.

6.0 RECOMMENDATIONS FOR THE PROTECTION OF FISH AND FISH HABITAT

Under the new provisions of the *Fisheries Act*, proponents are required to comply with the fish and fish habitat protection provisions of the *Fisheries Act* by incorporating measures to avoid causing the death of fish or the harmful alteration, disruption or destruction of fish habitat (DFO 2019). These measures can be found at the following link; http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html. The following mitigation measures and best management practices are provided as recommendations to the contractor to ensure that no HADD occurs and that death of fish will not occur as a result of the construction activity.

- No instream construction activity should take place during the designated Restricted Activity Period extending from April 16th to June 30th of any given year.
- Site isolation measures (e.g., silt boom or floating silt curtain) should be utilized for containing suspended sediment where in-water work is required (e.g., pile driving) to minimize sedimentation in the watercourse.
- All instream activities will be isolated from open or flowing water and constructed in way to maintain the natural flow of water downstream and to avoid introducing sediment into the watercourse.
- Earthen material should not be used to isolate the work site.

- Sediment and erosion control measures must be implemented prior to the start of work and maintained until all works are completed. Sediment generation and disturbance to the banks should be minimized as much as possible. The sediment and erosion control measures will be inspected regularly.
- If flowing water is present at the time of construction the watercourse should be visually monitored and the Contractor shall be responsible for controlling the release of sediment when completing instream works.
- All reasonable efforts should be made to minimize the duration of construction. Construction crews should have all necessary materials and equipment prepared on-site before beginning. Ensure maintenance of downstream flow (in terms of quantity and quality) at all times when constructing the isolated crossing. If a dam and pump isolation method is used to maintain downstream flow, backup pumping capacity must be on-site and ready to take over pumping immediately if operating pumps fail. Pumps are to be continuously monitored to ensure downstream flow is maintained at all times until the dam materials are removed and normal flows restored to the channel. Alternatively, if a clean flow bypass method is used, the diversion methods must be designed to accommodate potential high flow events (i.e., be secured in place and the receiving channel must be of sufficient capacity).
- Pumps used at fish-bearing waterbodies should be screened with a maximum mesh size of 2.54 mm and a maximum screen approach velocity of 0.038 m/s. The maximum screen velocity can be achieved by placing pump intakes in a metal cage with a mesh size of less than 2.54 mm.
- Screens should be located in areas and depths of water with low concentrations of fish throughout the year and away from natural or artificial structures that may attract fish that are migrating, spawning or in rearing habitat. The screen face should be oriented in the same direction as the flow.
- Ensure that openings in the guides and seals are less than the opening criteria to make “fish tight”.
- Screens should be located a minimum of 300 mm (12 inches) above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
- Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.

- Large cylindrical and box-type screens should have a manifold installed in them to ensure even water velocity distribution across the screen surface. The ends of the structure should be made out of solid materials and the end of the manifold should be capped.
- Provision should be made for the removal, inspection and cleaning of screens.
- Ensure regular maintenance and repair of cleaning apparatus, seals and screens is carried out to prevent debris-fouling and impingement of fish.
- Pumps should be shut down when fish screens are removed for inspection and cleaning.
- The contractor will minimize any disturbance to aquatic resources during construction.
- Disturbance of riparian vegetation will be kept to a minimum. Disturbed areas will be stabilized, vegetated and/or seeded as soon as possible after construction.
- Equipment will be refueled and serviced to ensure that deleterious substances do not enter any watercourse. Equipment operating near any watercourse will be clean and free of external oil, grease, mud, or fluid leaks. Consideration should be given to the use of non-petroleum based oils for machinery (e.g., vegetable oil).
- Clean all equipment and heavy machinery entering the Project location prior to arrival. Equipment and heavy machinery should also be cleaned before being moved to different sub-basins after construction to avoid the transfer of mud, debris or aquatic pests (e.g., *Myxobolus cerebralis*, the parasite that causes whirling disease in fish).
- Any rock rip rap to be used should be clean, free of fine materials, and of sufficient size to resist displacement during peak flood events.
- A fuel/deleterious substance spill response plan should be in place and an emergency spill response kit should be kept on-site during construction.

The replacement of the existing bridge with another bridge will ultimately result in an overall benefit to fish and/or fish habitat. Removal of the older creosote pier piles will also benefit fish and fish habitat as it will eliminate the potential of introducing a deleterious substance into the waterbody. The work entailed to replace the bridge will include some head slope reconstruction along with rip rap armouring of the head slopes and the water channel to protect the integrity of the structure and to prevent erosion. Provided that mitigation measures are implemented as described above, any harmful alteration, disruption or destruction of fish habitat is expected to be minimal and the project should not result in the death of any fish. As the project does entail placing rock riprap in the water channel, a

Request for Review application should be submitted to DFO to ensure compliance with the Federal *Fisheries Act*.

7.0 CONCLUSION

The City of Edmonton is planning on replacing the existing bridge structure at this location. This document has outlined the observations, findings and recommendations of a QAES regarding the fish habitat and fish utilization potential of Horsehills Creek at the proposed crossing location. It is the professional opinion of the QAES that the watercourse at this location has “nil-low” value for sport fish species and “low” value for non-sport fish species.

Provided that any in-stream construction activity takes place outside of the RAP and that all of the mitigation measures as outlined in this report are implemented, it is the opinion of the QAES that the proposed works are not likely to have serious adverse effects on the productive capacity of fish and/or fish habitat at this location. It is anticipated that any harmful alteration, disruption or destruction of fish habitat will be minimal, and that the project should not result in the death of any fish. A Request for Review should be submitted to the Department of Fisheries and Oceans Canada (DFO) for this project to ensure compliance with the Federal *Fisheries Act*. A Code of Practice notification should be submitted to Alberta Environment and Parks to ensure all conditions outlined in Schedule 2, Part 1 (a) of the Code of Practice will be met.

8.0 REFERENCES

Alberta Environment and Parks. 2020. Fish and Wildlife Internet Mapping Tool Public Site (FWIMT). Retrieved from https://maps.srd.alberta.ca/FWIMT_Pub.

Fisheries and Oceans Canada. 2019. Measures to protect fish and fish habitat. Website: http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html

Government of Alberta. 2013. Code of Practice for Watercourse Crossings. Edmonton, AB. 44 pp.

Natural Regions Committee 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta. Pub. No. T/852

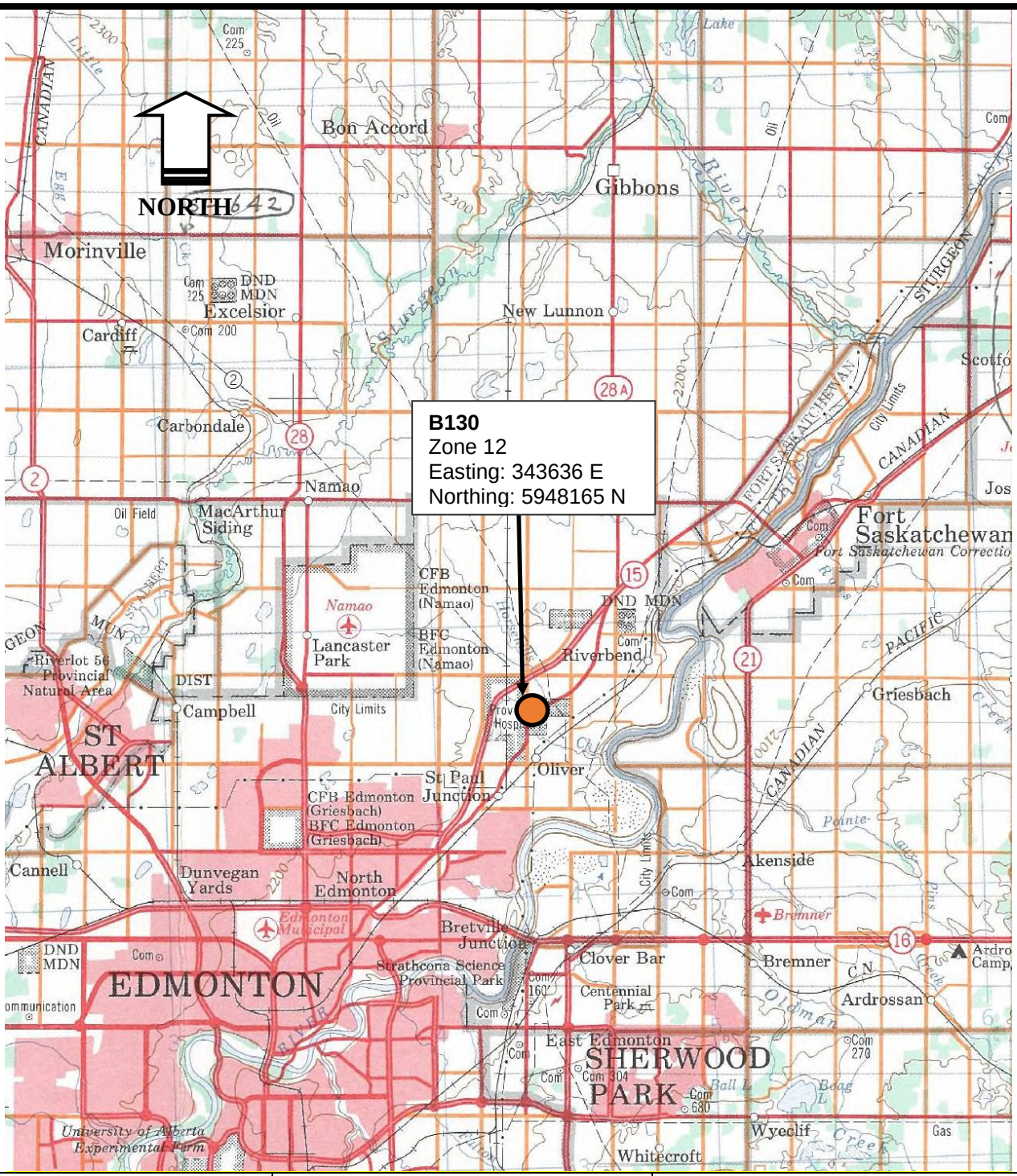
Nelson, J.S. and M.J. Paetz. 1992. The Fishes of Alberta, 2nd Edition. University of Alberta Press and University of Calgary Press, Edmonton, AB. 437 pp.

9.0 APPENDIX

9.1 Location Plan

9.2 Photos

9.3 Draft Design Drawings



THE CITY OF Edmonton	MPA ENGINEERING LTD	LOCATION PLAN				
STREAM: Horsehills Creek	LOCATION: SW 17-54-23-W4M	DRAWN: MR	DATE: June 2020	SHEET: 1	DRAWING NO.: B130 Location	

MPA ENGINEERING LTD		File No.:	**B118**
		Date:	**March 18, 2020**
Stream:	**Horsehill Creek**	By:	**Melanie Johnson**
Highway / Location:	**Horsehills Road NE of 18th Street – SW 17-54-23-W4M**	Page:	**1** of **13**

Looking NE at road alignment bridge bridge

Looking north upstream

Looking south downstream

Looking SE at road alignment from bridge

Looking north upstream from 30 m upstream

Looking upstream from approximately 100 m upstream

Looking downstream at bridge from 100 m upstream

Looking at Bridge elevation from SE corner

Underside of Bridge

Looking NE at road alignment from 18th Street

Looking SE at road alignment from 150 m NE of bridge

Looking at SW ditch 100 m SW of bridge

Looking at NW ditch from 100 m SW of bridge

Looking at NW ditch from bridge

Looking at SW ditch from bridge

Looking at NE ditch 100 m NE of bridge

Looking at SE ditch from 100 m NE of bridge

Looking at SE ditch from bridge

Looking at NE ditch from bridge

Looking downstream from 195 ave bridge

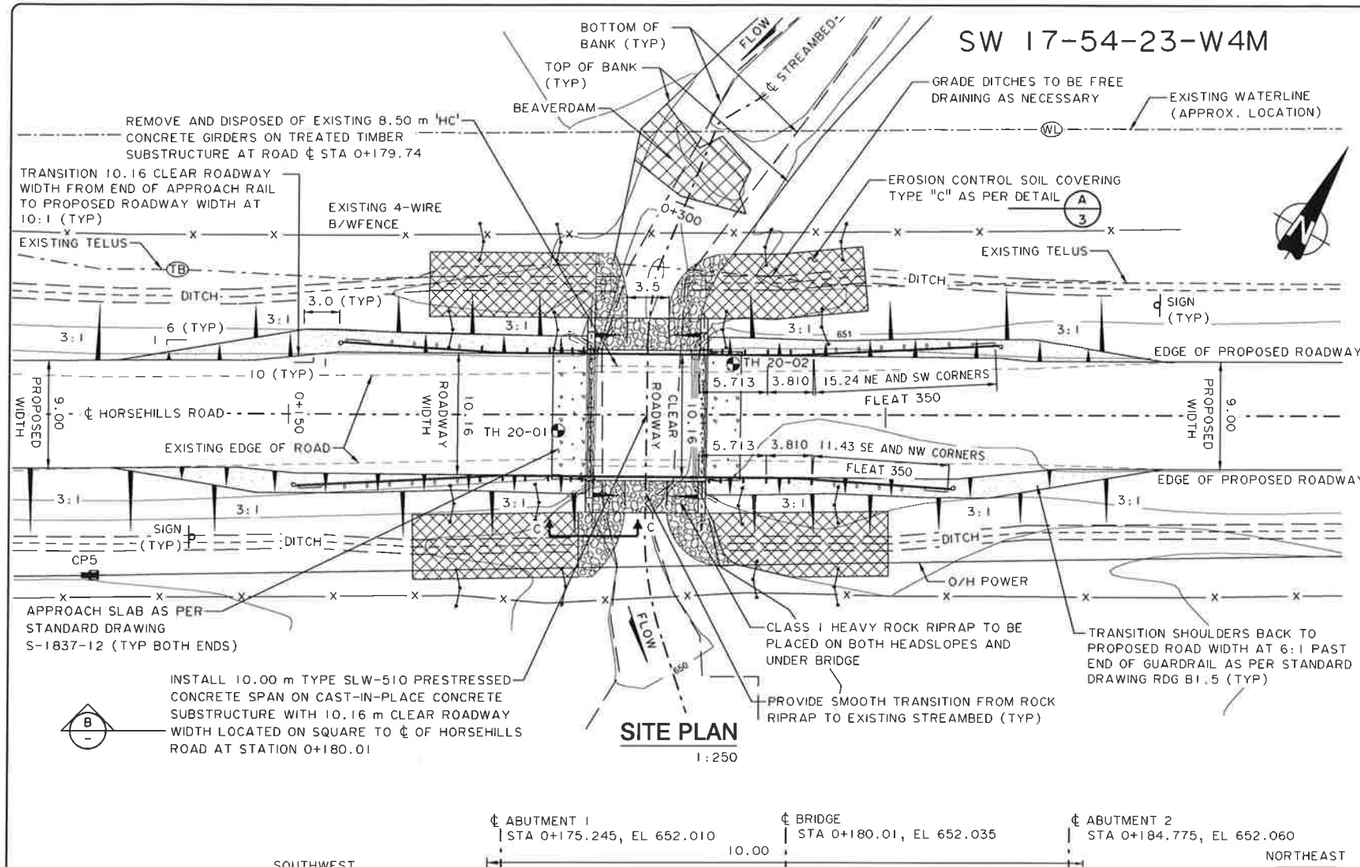
Looking upstream at Manning Road/Culvert from 195 Ave Bridge

Looking north 195 ave bridge elevation

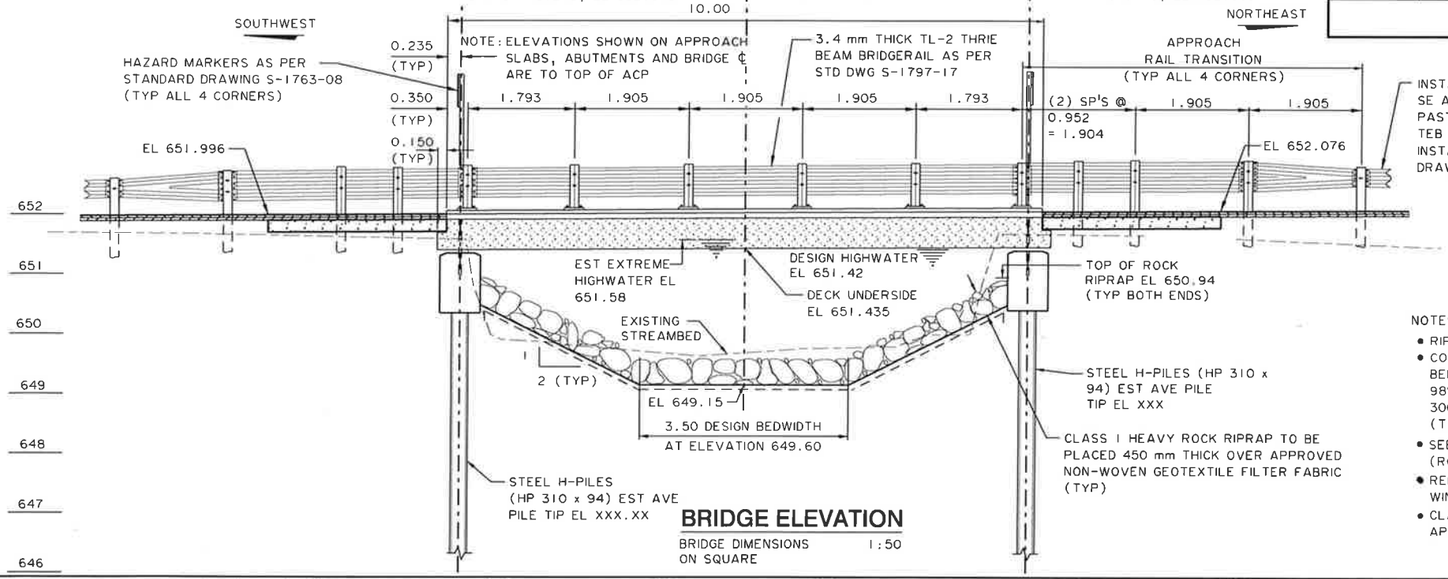
Looking downstream from 80 m downstream of 195 ave bridge

Looking upstream from 80 m downstream of 195 ave bridge

Waterline sign located approximately 55 m SW of existing bridge



SITE PLAN
1:250



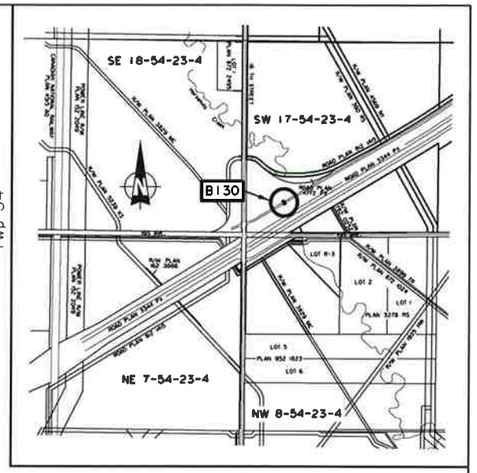
BRIDGE ELEVATION
BRIDGE DIMENSIONS ON SQUARE 1:50

INSTALL 19.05 m AT SW AND NE CORNERS AND 15.24 m AT SE AND NW CORNERS OF STRONG POST APPROACH GUARDRAIL PAST END OF THRIE BEAM TRANSITION AS PER STD DRAWING TEB 3.09 AND TEB 3.16a
INSTALL FLEAT 350 TERMINAL END AS PER STD DRAWING RDG B1.5 (TYP)

NOTES:
- RIPRAP TO BE PLACED PRIOR TO GIRDER ERECTION
- COMPACTED GRANULAR MATERIAL (DES 2 CLASS 40) PLACED BEHIND ABUTMENTS TO BE PLACED IN MAX 150 mm LIFTS TO A MIN 98% OF STANDARD PROCTOR DENSITY AT OPTIMUM MOISTURE. TOP 300 mm TO BE COMPACTED TO 100% STANDARD PROCTOR DENSITY (TYP BOTH ABUTMENTS)
- SEE CONTRACT SPECIAL PROVISIONS FOR ROAD SURFACING DETAILS (ROADWORK)
- REMOVE AND DISPOSE OF EXISTING BRIDGE GIRDERS, ABUTMENTS, WING WALL PILING AND BRIDGE APPURTENANCES
- CLASS 1 HEAVY RIPRAP TO BE PLACED 450 mm THICK OVER APPROVED NON-WOVEN GEOTEXTILE FILTER FABRIC (TYP)

INDEX

SHEET	DESCRIPTION	DRAWING
21	PRESTRESSED CONCRETE SLW-510 DETAIL SHEET 1	S-1836-12
20	PRESTRESSED CONCRETE SLW-510 DETAIL SHEET 2	S-1837-12
19	PRESTRESSED CONCRETE 10 m SLW-510 INTERIOR GIRDER	S-1824-12
18	PRESTRESSED CONCRETE 10 m SLW-510 EXTERIOR GIRDER	S-1825-12
17	PRESTRESSED CONCRETE 10 m SLW-510 INTERIOR AND EXTERIOR GIRDER LAYOUTS	S-1826-12
16	STANDARD WATERPROOFING FOR DECK AND ABUTMENTS - SHEET 3	S-1840-17
15	STANDARD WATERPROOFING FOR DECK AND ABUTMENTS - SHEET 2	S-1839-17
14	STANDARD WATERPROOFING FOR DECK AND ABUTMENTS - SHEET 1	S-1838-17
13	W-BEAM STRONG POST TL-3 FLEAT 350 ENERGY ABSORBING TERMINAL	RDG-B1.5
12	STANDARD IDENTIFICATION PLAQUES AND BENCHMARK TABLETS	S-1847-17
11	TL-2 THRIE BEAM BRIDGERAIL ON 75 mm HIGH CURB	S-1797-17
10	SL PRECAST GIRDER BRIDGES WITH CAST-IN PLACE CONCRETE SUBSTRUCTURES - SHEET 3	S-1764-08
9	SL PRECAST GIRDER BRIDGES WITH CAST-IN PLACE CONCRETE SUBSTRUCTURES - SHEET 2	S-1763-08
8	SL PRECAST GIRDER BRIDGES WITH CAST-IN PLACE CONCRETE SUBSTRUCTURES - SHEET 1	S-1762-08
7	DECK WATER PROOFING SYSTEM WITH 80 mm TWO-COURSE HOT-MIX ASPHALT CONCRETE PAVEMENT	S-1443-98
6	STRONG POST W-BEAM BLOCKED OUT GUARDRAIL	TEB 3.09
5	TYPICAL STRONG POST W-BEAM OF MODIFIED THRIE BEAM GUARDRAIL PLACEMENT AT BRIDGE APPROACHES (TWO LANE HIGHWAY)	TEB 3.16a
4	INFORMATION SHEET 3	XXXXX-P
3	INFORMATION SHEET 2	XXXXX-P
2	INFORMATION SHEET 1	XXXXX-P
1	GENERAL LAYOUT	XXXXX-P



SITE MAP
NTS

BENCH MARK
- CP5, PLACED SPIKE IN POWERPOLE LOCATED 13.48 m SOUTH OF ROAD LOCAL ROAD ℄ STA 0+133.70, NORTHING 5948133.48, EASTING 343607.04, ELEVATION 651.145
- CP10, PLACED REBAR IN GROUND LOCATED 17.23 m SOUTH OF OF LOCAL ROAD ℄ STA 0+097.65, NORTHING 5948112.95, EASTING 343574.52, ELEVATION 651.309
- CP15, PLACED SPIKE IN POWERPOLE LOCATED 11.88 m SOUTH OF LOCAL ROAD ℄ STA 0+240.88, NORTHING 5948186.79, EASTING 343699.19, ELEVATION 650.860

SURVEY BY
- MPA ENGINEERING. JANUARY 7, 2020

HYDROTECHNICAL SUMMARY
- DRAINAGE AREA = 50 km²
- DESIGN DISCHARGE = 12 m³/s (ESTIMATED 1:50 YEAR FLOW)
- EXTREME DISCHARGE = 15 m³/s (ESTIMATED 1:100 YEAR FLOW)
- MEAN VELOCITY THROUGH PROPOSED BRIDGE FOR DESIGN DISCHARGE = 1.25 m/s
- AVERAGE SURVEYED STREAM SLOPE = 0.0022 m/m

STRUCTURAL DESIGN
- DESIGN SPECIFICATION: CAN/CSA S6-06
- DESIGN LIVE LOAD: CL-800-AB
- ABUTMENT PILES: BEARING VALUE = 410 kN
- BEARING VALUES FOR BEARING PILES SHALL BE BASED ON THE BEARING VALUE FORMULA IN ALBERTA TRANSPORTATION BCS 3.4

PROPOSED STRUCTURE
- INSTALL 10.00 m, TYPE SLW-510 PRESTRESSED CONCRETE SPAN ON CAST-IN-PLACE CONCRETE SUBSTRUCTURE (10.16 m CLEAR ROADWAY) LOCATED AT STATION 0+180.01, ON SQUARE TO THE ROADWAY, DECK ELEVATION 652.035 AT CENTER

GENERAL NOTES
- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE
- ROADWAY DESIGN STANDARD: RCU-209-110
- SCALES SHOWN ARE CORRECT FOR 22" x 34" SHEET SIZE

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PROGRAM NO.
CONTRACT NO

CONSTRUCTION RETURN
CONTRACTOR
SURVEYOR
DATE
FILE NUMBER
CONSTRUCTION ENGINEER DATE
GENERAL SUPERVISOR DATE

DESIGNER
PROFESSIONAL ENGINEER ALBERTA W.B. JOHNSON
XXXXXXX
PERMIT NUMBER P6432

MPA ENGINEERING LTD
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Sherwood Park, Alberta
T8H 0H9
APPROVED FOR CONSTRUCTION

CHECKER
PROFESSIONAL ENGINEER ALBERTA SHANE HALL
XXXXXXX
PERMIT NUMBER P6432

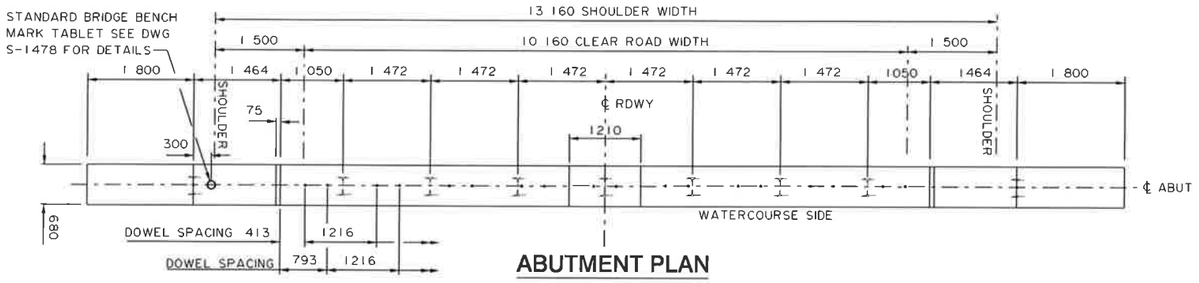
DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE
MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE
SURVEY
JOB NO.
SCALE
HOR.
VER.
DRAWN DATE
DESIGNED DATE
CHECKED DATE

THE CITY OF Edmonton
INTERGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE

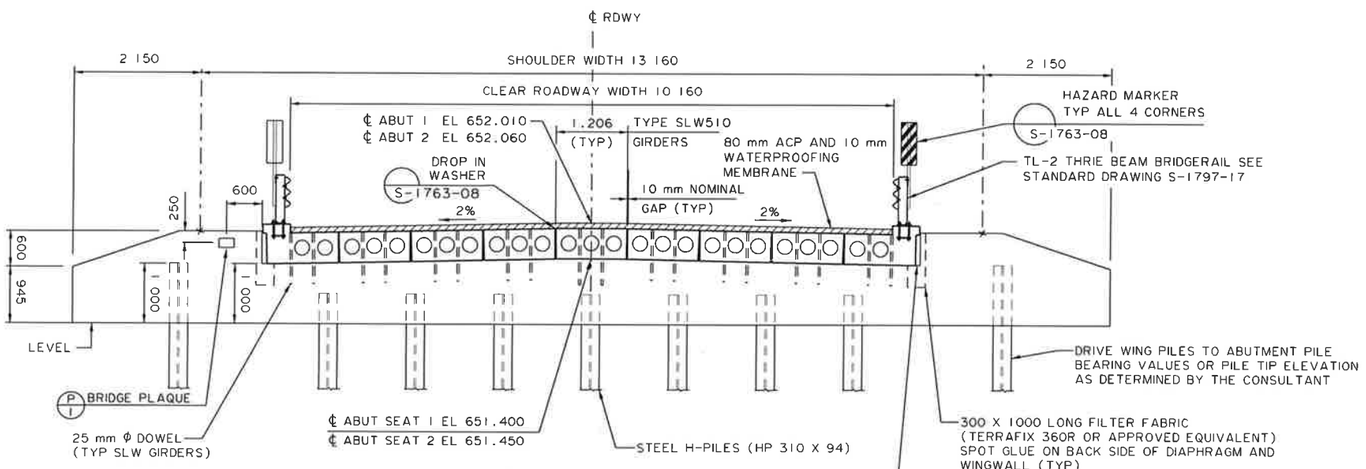
PROJECT
HORSEHILLS CREEK BRIDGE (B130)
HORSEHILLS ROAD EAST OF 18th STREET
GENERAL LAYOUT

DRAWING NUMBER XXXXX



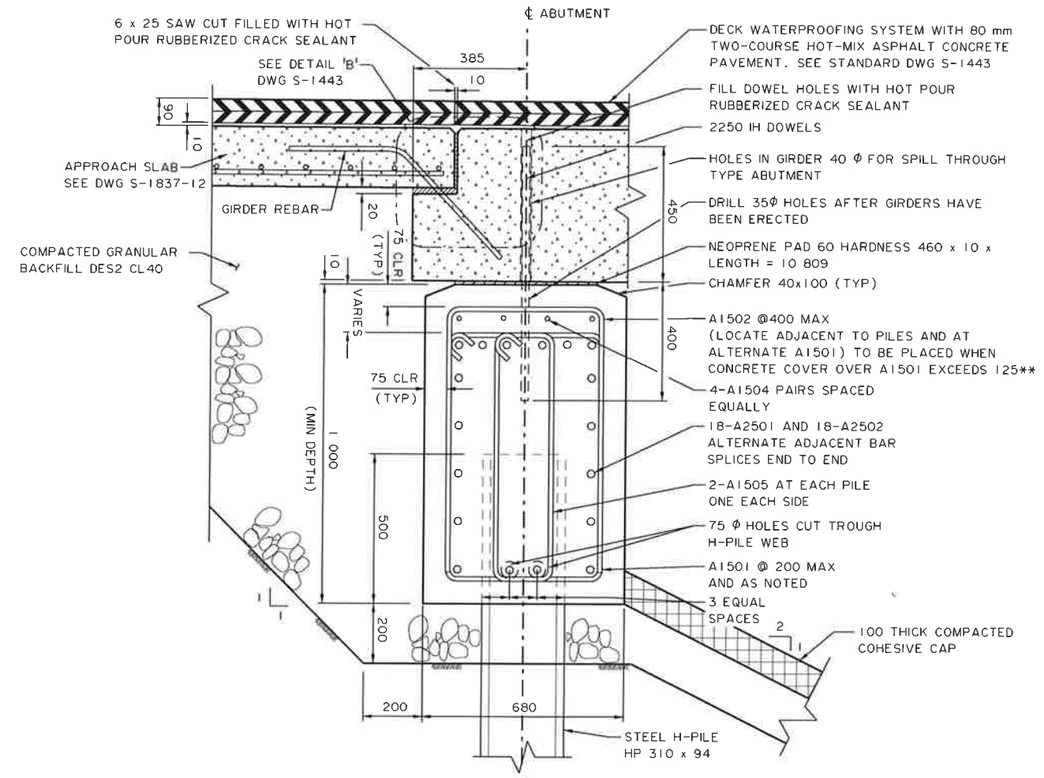
ABUTMENT PLAN

ALL DIMENSIONS IN MILLIMETRES 1:50



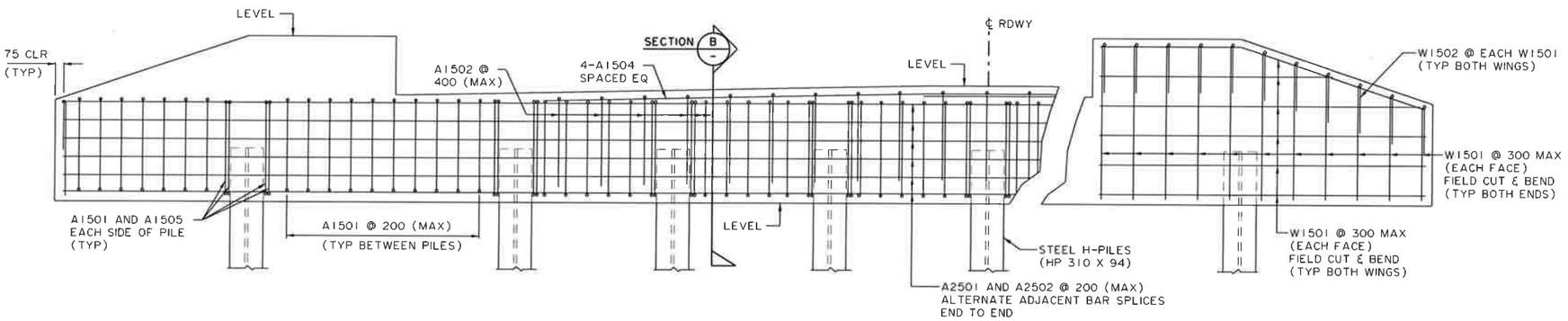
ABUTMENT ELEVATION

ALL DIMENSIONS IN MILLIMETRES (ON SQUARE) LOOKING EAST 1:50



B ABUTMENT SECTION

ALL DIMENSIONS IN MILLIMETRES 1:10



ABUTMENT REBAR ELEVATION

ALL DIMENSIONS IN MILLIMETRES (ON SQUARE) LOOKING EAST 1:25

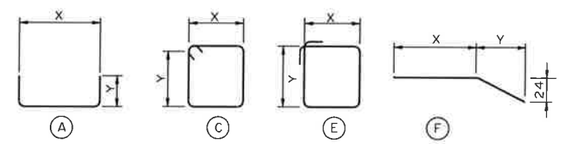
BAR LIST: ABUTMENTS (TOTAL)

MARK	SIZE	NO.	TYPE	X	Y	LENGTH (mm)	MASS (kg)
A1501	15	168	C	530	850	3 040	801
A1502	15	36	A	530	820	2 170	123
A1504	15	16	F	2359	1200	3 559	89
A1505	15	36	E	225	850	2 430	194
A2501	25	36	STR	-	-	12 000	1 696
A2502	25	36	STR	-	-	6 712	948
W1501**	15	26	STR	-	-	12 000	490
W1502	15	48	A	530	450	1 430	108

BAR TYPES (ALL BAR DIMENSIONS ARE OUT TO OUT)

** DENOTES FIELD CUT

PLAIN TOTAL kg: 4 449



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PROGRAM NO.
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GENERAL SUPERVISOR DATE

DESIGNER
PROFESSIONAL ENGINEER M.R. JOHNSON ALBERTA 22321
XXXXXXX
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MPA ENGINEERING LTD
#304, 85 Cranford Way,
Sherwood Park, Alberta
T8H 0H9
APPROVED FOR CONSTRUCTION

CHECKER
PROFESSIONAL ENGINEER SHANE HALL ALBERTA 22321
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PERMIT NUMBER P6432

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DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE
MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

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JOB NO.
SCALE
HOR
VER

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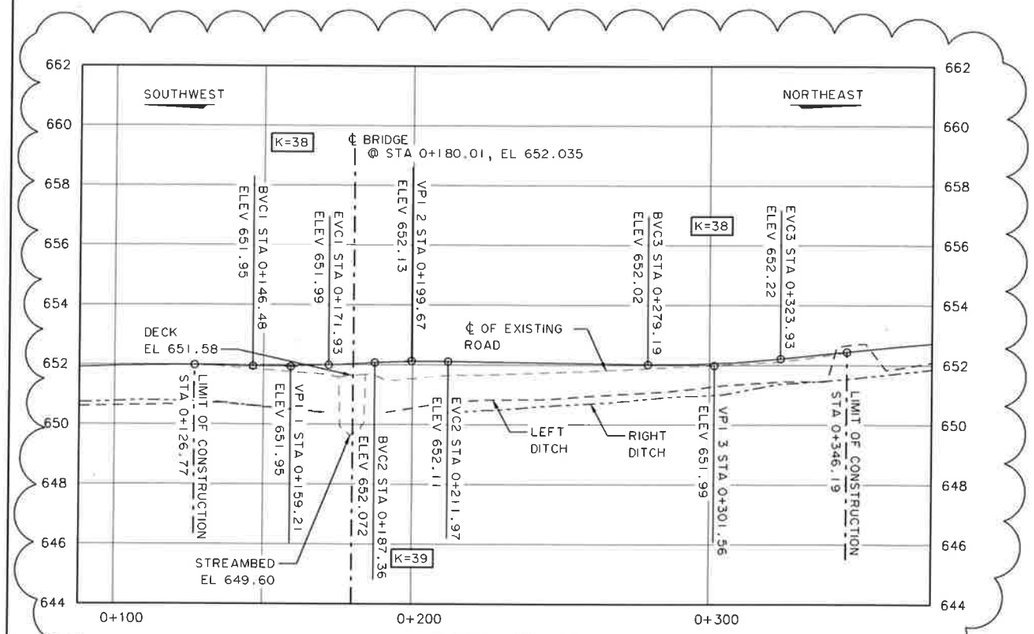
THE CITY OF Edmonton
INTERGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE

PROJECT
HORSEHILLS CREEK BRIDGE (B130)
ON HORSEHILLS ROAD EAST OF 18th STREET
INFORMATION - SHEET 1

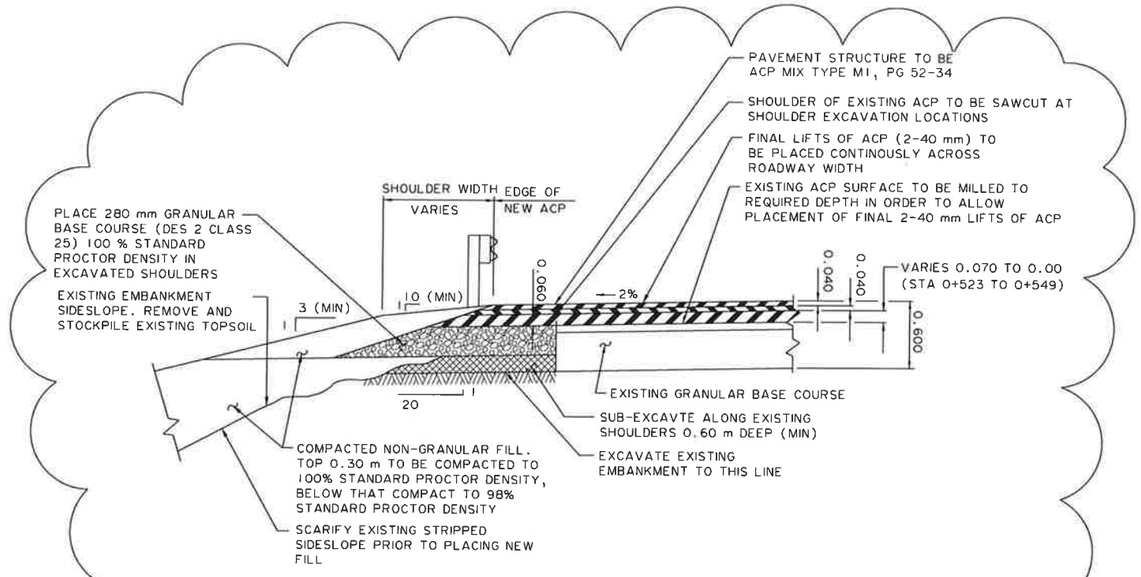
DRAWING NUMBER XXXXX



ROAD PROFILE

(HORIZ 1:1000) (VERT 1:100)

FOR DISCUSSION WITH CITY

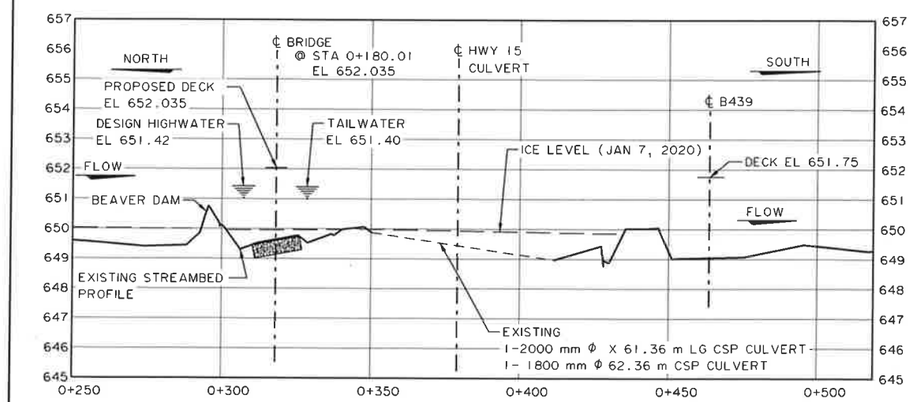


HALF SECTION FOR SHOULDER WIDENING (WITH GRADE RAISE)

ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE
FOR ALL FILLS
WEST SIDE: STA 0+496 TO 0+506
EAST SIDE: STA 0+520 TO 0+580

NTS

FOR DISCUSSION WITH CITY



STREAMBED PROFILE

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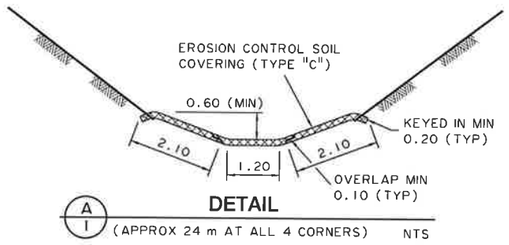
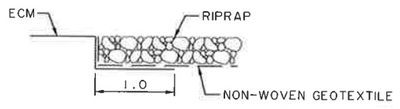


A/1 **DETAIL**

(APPROX 24 m AT ALL 4 CORNERS) NTS



C-C/1 **SECTION**

NTS

BAR LIST: APPROACH SLABS AND TRANSITION CURBS (TOTAL)

MARK	SIZE	NO	TYPE	X	Y	LENGTH	MASS
A1502CR	15	38	STR			10 854	648
A1503CR	15	4	STR			700	4
A2001CR	20	148	STR			2 900	1011

CORROSION RESISTANT REINFORCING TOTAL kg: 1 663

TYPE OF WORK	ESTIMATED QUANTITY
BACKFILL-ABUTMENTS	
GRANULAR BACKFILL (DES 2 CLASS 25)	67 m³
ROADWAY WORK	
* COMMON EXCAVATION	m³
BORROW EXCAVATION	m³
ACP MIX TYPE M1, PG 52-34	m³
GRANULAR BASE COURSE (DES2 CLASS 40)	m³
NON-WOVEN GEOTEXTILE FOR ROCK RIPRAP	155 m²

* SUITABLE MATERIAL EXCAVATED FROM HEADSLOPES AND ABUTMENTS MAY BE RE-USED AS ROADWAY FILL AT THE CONSULTANTS DISCRETION

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DESIGNER
PROFESSIONAL ENGINEER ALBERTA
XXXXXXX
PERMIT NUMBER P6432

MPA ENGINEERING LTD
#204, 85 Cranford Way,
Sherwood Park, Alberta
T8H 0H9
APPROVED FOR CONSTRUCTION

CHECKER
PROFESSIONAL ENGINEER ALBERTA
XXXXXX
PERMIT NUMBER P6432

DEPARTMENT / BRANCH	APPROVAL	DATE

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MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

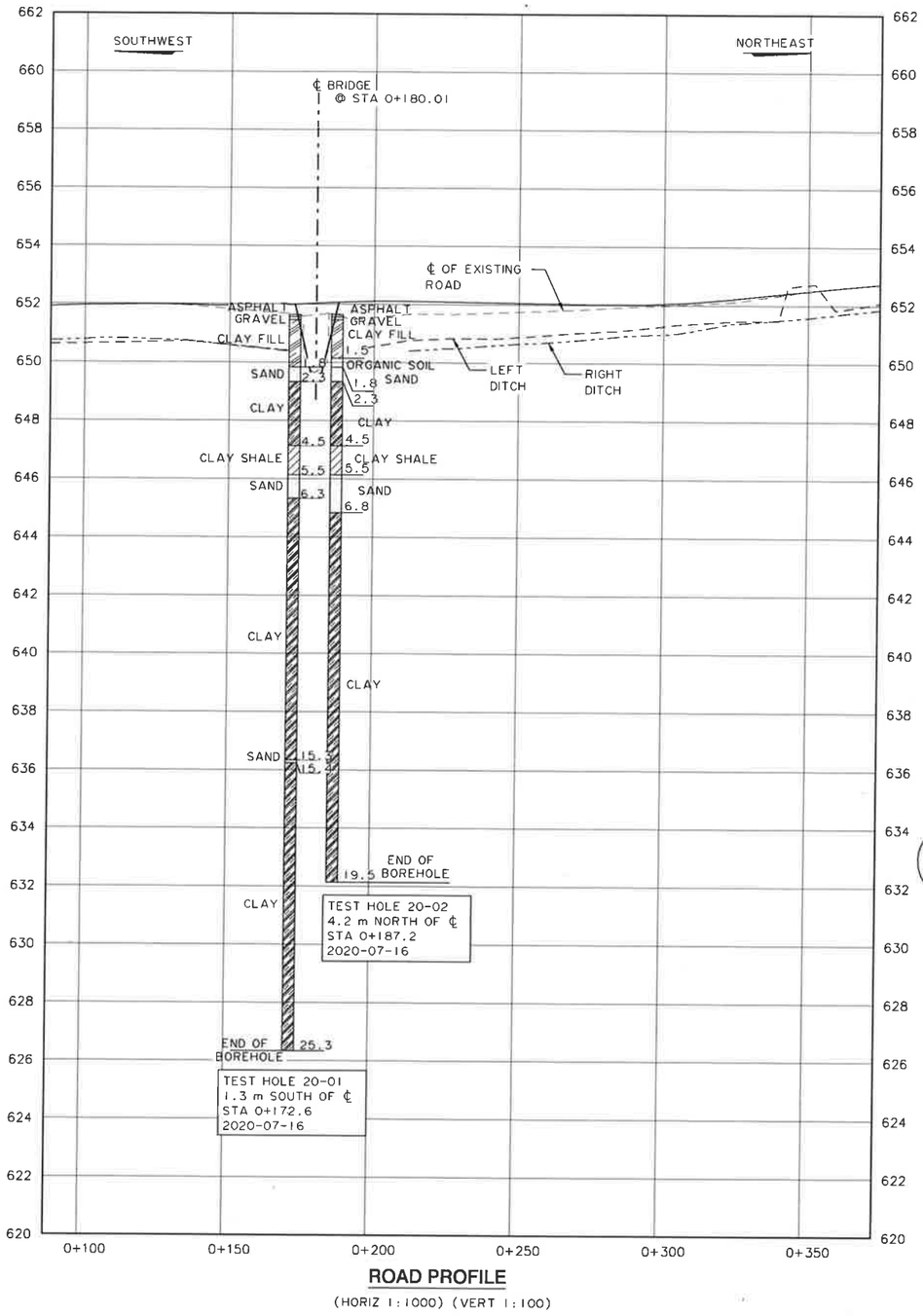
SURVEY
JOB NO
SCALE
HOR
VER

DRAWN WDT DATE 2020-09-23
DESIGNED MBJ DATE 2020-09-23
CHECKED SMH DATE 2020-XX-XX

THE CITY OF Edmonton
INTERGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE

PROJECT **HORSEHILLS CREEK BRIDGE (B130)**
ON HORSEHILLS ROAD EAST OF 18th STREET
INFORMATION - SHEET 2

DRAWING NUMBER **XXXXX**



ROAD PROFILE

(HORIZ 1:1000) (VERT 1:100)

NOTE: SCALE MAY CHANGE

GEOTECHNICAL NOTES

- ALL GEOTECHNICAL INFORMATION PROVIDED FOR THIS PROJECT HAS BEEN COMPILED FOR DESIGN PURPOSES ONLY. WHILE IT IS BELIEVED TO CORRECTLY REPRODUCE OR SUMMARIZE OBSERVATIONS MADE DURING TESTING, IT IS VALID ONLY FOR THE PRECISE LOCATIONS SHOWN, AND IS NOT CONSTRUED AS GUARANTEEING THE ACTUAL MATERIALS AND CONDITONS EXISTING THROUGHOUT THE SITE. THE TESTING METHODS USED MAY NOT HAVE DETERMINED THE PRESENCE, ABSENCE OR EXTENT OF BOULDERS, HARD OR SOFT FORMATIONS, WATER TABLES, ARTESIAN CONDITIONS AND OTHER VARIABLES. IT IS THE RESPONSIBILTY OF OTHERS USING THIS INFORMATION TO ENSURE THAT IT IS ADEQUATE FOR THEIR PURPOSES, OR TO SUPPLEMENT IT WITH ADDITIONAL INFORMATION.
- GEOTECHNICAL LOGS PROVIDE MOST BUT NOT ALL OF THE AVAILABLE INFORMATION RETRIEVED DURING DRILLING. DETAILED LOGS WILL BE PROVIDED UPON REQUEST
- GEOTECHNICAL INVESTIGATION AND REPORT COMPLETED BY PARKLAND GEO, JUL 16, 2020

NO.	REVISIONS	BY	DATE	APP'D
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CONTRACTOR

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DATE

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GENERAL SUPERVISOR DATE

DESIGNER

PROFESSIONAL ENGINEER B.B. JOHNSON ALBERTA

XXXXXXX

PERMIT NUMBER P6432

MPA ENGINEERING LTD

#304, 85 Cranford Way,
Sherwood Park, Alberta
T8H 0H9

APPROVED FOR CONSTRUCTION

CHECKER

PROFESSIONAL ENGINEER DWANE HALL ALBERTA

XXXXXX

PERMIT NUMBER P6432

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO.

SCALE

HOR.

VER.

DRAWN DATE

DESIGNED DATE

CHECKED DATE

THE CITY OF Edmonton

INTERGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE

PROJECT

HORSEHILLS CREEK BRIDGE (B130)

ON HORSEHILLS ROAD EAST OF 18th STREET

INFORMATION - SHEET 3

DRAWING NUMBER

XXXXX

Appendix F. Plant Species Inventory

Horsehills Road Over Horsehills Creek Plant Species Inventory by Plant Community (16 July 2020)

Species*				Community**	
Scientific Name	**Common Name**	**Origin**	**ACIMS Rank**	**Non-Forested Reed Canary-Grass/ Seasonal Graminoid Marsh**	**Non-Forested Smooth Brome**
Shrubs					
Cornus stolonifera	red-osier dogwood	Native	S5		R
Salix bebbiana	beaked willow	Native	S5	R	
Salix petiolaris	basket willow	Native	S5	O	
Symphoricarpos occidentalis	buckbrush	Native	S5		O
Forbs					
Achillea alpina	many-flowered yarrow	Native	S5	R	
Achillea millefolium	common yarrow	Native	S5		R
Brassica napus	canola	Exotic	SNA		R
Chenopodium album	lamb's-quarters	Exotic	SNA	R	
Cirsium arvense	creeping thistle	Noxious	SNA	O	O
Epilobium ciliatum	northern willowherb	Native	S5	R	
Equisetum pratense	meadow horsetail	Native	S5		F
Erigeron philadelphicus	Philadelphia fleabane	Native	S5		R
Galium aparine	cleavers	Exotic	SNA	R	
Galium trifidum	small bedstraw	Native	S5	O	
Geum aleppicum	yellow avens	Native	S5	O	
Medicago lupulina	black medick	Exotic	SNA		O
Medicago sativa	alfalfa	Exotic	SNA		R
Melilotus alba	white sweet-clover	Exotic	SNA		O
Mentha arvensis	wild mint	Native	S5	F	
Persicaria amphibia	water smartweed	Native	S5	F	
Petasites frigidus var. sagittatus	arrow-leaved coltsfoot	Native	S5	R	
Physostegia ledinghamii	false dragonhead	Native	S3	R	
Plantago major	common plantain	Exotic	SNA	O	O
Potentilla anserina	silverweed	Native	S5	F	
Ranunculus cymbalaria	seaside buttercup	Native	S5	R	
Ranunculus macounii	Macoun's buttercup	Native	S5	R	
Rosa woodsii	common wild rose	Native	S5	R	
Rumex fueginus	American Golden Dock	Native	S5	R	

Horsehills Road Over Horsehills Creek Plant Species Inventory by Plant Community (16 July 2020)

Species*				Community**	
Scientific Name	**Common Name**	**Origin**	**ACIMS Rank**	**Non-Forested Reed Canary-Grass/ Seasonal Graminoid Marsh**	**Non-Forested Smooth Brome**
Rumex occidentalis	western dock	Native	S5	O	
Sagittaria cuneata	arum-leaved arrowhead	Native	S5	R	
Schoenoplectus acutus	great bulrush	Native	S5	R	
Scirpus microcarpus	small-fruited bulrush	Native	S5	R	
Scutellaria galericulata	marsh skullcap	Native	S5	O	
Silene latifolia	white cockle	Noxious	SNA		R
Sisyrinchium montanum	common blue-eyed grass	Native	S5	R	
Sium suave	water parsnip	Native	S5	O	
Solidago sp.	goldenrod	Native	S5		R
Sonchus arvensis	perennial sow-thistle	Noxious	SNA	O	O
Sonchus oleraceus	annual sow-thistle	Exotic	SNA		O
Stachys pilosa	marsh hedge-nettle	Native	S5	O	
Symphyotrichum ciliolatum	Lindley's aster	Native	S5	O	
Symphyotrichum puniceum	purple-stemmed aster	Native	S4	O	
Tanacetum vulgare	common tansy	Noxious	SNA		R
Taraxacum officinale	common dandelion	Exotic	SNA	O	O
Thalictrum venulosum	veiny meadow rue	Native	S5	O	
Trifolium hybridum	alsike clover	Exotic	SNA		F
Trifolium pratense	red clover	Exotic	SNA		O
Trifolium repens	white clover	Exotic	SNA		O
Tripleurospermum inodorum	scentless chamomile	Noxious	SNA		O
Typha latifolia	common cattail	Native	S5	F	
Urtica dioica	common nettle	Native	S5	O	
Vicia americana	wild vetch	Native	S5	R	
Vicia cracca	tufted vetch	Exotic	SNA		O
Graminoids					
Agrostis scabra	rough hair grass	Native	S5	O	
Alopecurus aequalis	short-awned foxtail	Native	S5	R	
Anthoxanthum hirtum	sweet grass	Native	S5	O	
Beckmannia syzigachne	slough grass	Native	S5	O	

Horsehills Road Over Horsehills Creek Plant Species Inventory by Plant Community (16 July 2020)

Species*				Community**	
Scientific Name	**Common Name**	**Origin**	**ACIMS Rank**	**Non-Forested Reed Canary-Grass/ Seasonal Graminoid Marsh**	**Non-Forested Smooth Brome**
Bromus inermis	smooth brome	Exotic	SNA		D
Carex aquatilis	water sedge	Native	S5	D	
Carex atherodes	awned sedge	Native	S5	F	
Carex bebbii	Bebb's sedge	Native	S5	R	
Carex canescens	hoary sedge	Native	S5	R	
Carex utriculata	small bottle sedge	Native	S5	R	
Eleocharis palustris	creeping spike-rush	Native	S5	O	
Elymus repens	quackgrass	Exotic	SNA		O
Elymus trachycaulus	slender wheatgrass	Native	S5		O
Glyceria grandis	common tall manna grass	Native	S5	O	
Hordeum jubatum	foxtail barley	Native	S5		O
Juncus balticus	wire rush	Native	S5	F	
Phalaris arundinacea	reed canary grass	Native	S5	D	
Poa palustris	fowl bluegrass	Native	S5	O	
Poa pratensis	Kentucky bluegrass	Native	S5	R	O
Species Richness				**50**	**27**
Native Species Richness				**44**	**12**
Exotic Species Richness				**4**	**10**
Noxious Species Richness				**2**	**5**

*Scientific nomenclature, common names and ranks follow ACIMS (2019), using vascular plant data updated March 2018

**Species abundance abbreviations per community are as follows: D=dominant, A=abundant, F=frequent, O=occasional, R=rare

Appendix G. Wildlife List

Horsehills Road over Horsehills Creek Wildlife List (November 2020)

Common Name	Scientific Name*	Species Group	Provincial Status (General Status of AB Wild Species 2015)	Wildlife Act Designation	COSEWIC Designation	SARA Designation	Observed/ Previous Record**	Likelihood of Occurrence	Potential Habitat Use
Western Toad	*Anaxyrus boreas*	Amphibian	Sensitive		Special Concern	Schedule 1		Moderate	
Wood Frog	*Lithobates sylvaticus*	Amphibian	Secure						
Boreal Chorus Frog	*Pseudacris maculata*	Amphibian	Secure						
Common Garter Snake	*Thamnophis sirtalis*	Reptile	Sensitive					Low	
Gadwall	*Mareca strepera*	Bird	Secure						
Mallard	*Anas platyrhynchos*	Bird	Secure						
Blue-winged Teal	*Spatula discors*	Bird	Secure						
Northern Shoveler	*Spatula clypeata*	Bird	Secure						
Northern Pintail	*Anas acuta*	Bird	Secure						
Green-winged Teal	*Anas crecca carolinensis*	Bird	Secure						
Canvasback	*Aythya valisineria*	Bird	Secure						
Redhead	*Aythya americana*	Bird	Secure						
Bufflehead	*Bucephala albeola*	Bird	Secure						
Common Goldeneye	*Bucephala clangula*	Bird	Secure						
Sora	*Porzana carolina*	Bird	Sensitive				BBS 2020	High	Breeding, Foraging
American Coot	*Fulica americana*	Bird	Secure						
Killdeer	*Charadrius vociferus*	Bird	Secure						
Spotted Sandpiper	*Actitis macularius*	Bird	Secure						
Solitary Sandpiper	*Tringa solitaria*	Bird	Secure						
Wilson's Snipe	*Gallinago delicata*	Bird	Secure						
Great Blue Heron	*Ardea herodias*	Bird	Sensitive				FWMIS	Moderate	Foraging
Northern Harrier	*Circus cyaneus*	Bird	Secure						
Black-billed Magpie	*Pica hudsonia*	Bird	Secure						
American Crow	*Corvus brachyrhynchos*	Bird	Secure						
Common Raven	*Corvus corax*	Bird	Secure						
Barn Swallow	*Hirundo rustica*	Bird	Sensitive		Threatened	Schedule 1 (Threatened)	BBS 2020, veg survey 2020	High	Foraging
Black-capped Chickadee	*Poecile atricapillus*	Bird	Secure						
House Wren	*Troglodytes aedon*	Bird	Secure						
Sedge Wren	*Cistothorus platensis*	Bird	Sensitive				BBS 2020	High	Breeding, Foraging
Marsh Wren	*Cistothorus palustris*	Bird	Secure						
Clay-colored Sparrow	*Spizella pallida*	Bird	Secure						

Horsehills Road over Horsehills Creek Wildlife List (November 2020)

Common Name	Scientific Name*	Species Group	Provincial Status (General Status of AB Wild Species 2015)	Wildlife Act Designation	COSEWIC Designation	SARA Designation	Observed/ Previous Record**	Likelihood of Occurrence	Potential Habitat Use
Savannah Sparrow	*Passerculus sandwichensis*	Bird	Secure						
Le Conte's Sparrow	*Ammodramus leconteii*	Bird	Secure						
Song Sparrow	*Melospiza melodia*	Bird	Secure						
Lincoln's Sparrow	*Melospiza lincolnii*	Bird	Secure						
Red-winged Blackbird	*Agelaius phoeniceus*	Bird	Secure						
American Beaver	*Castor canadensis*	Mammal	Secure						
Deer Mouse	*Peromyscus maniculatus*	Mammal	Secure						
Southern Red-backed Vole	*Myodes gapperi*	Mammal	Secure						
Eastern Heather Vole	*Phenacomys ungava*	Mammal	Secure						
Meadow Vole	*Microtus pennsylvanicus*	Mammal	Secure						
Prairie Vole	*Microtus ochrogaster*	Mammal	Secure						
Muskrat	*Ondatra zibethicus*	Mammal	Secure						
Meadow Jumping Mouse	*Zapus hudsonius*	Mammal	Secure						
Western Jumping Mouse	*Zapus princeps*	Mammal	Secure						
Common Porcupine	*Erethizon dorsatum*	Mammal	Secure						
Masked Shrew	*Sorex cinereus*	Mammal	Secure						
Prarie Shrew	*Sorex haydeni*	Mammal	Secure						
Dusky Shrew	*Sorex monticolus*	Mammal	Secure						
Water Shrew	*Sorex palustris*	Mammal	Secure						
Pygmy Shrew	*Sorex hoyi*	Mammal	Secure						
Coyote	*Canis latrans*	Mammal	Secure						
Fisher	*Pekania pennanti*	Mammal	Sensitive					Low	
Long-tailed Weasel	*Mustela frenata*	Mammal	May Be At Risk					Low	
Ermine	*Mustela erminea*	Mammal	Secure						
Least Weasel	*Mustela nivalis*	Mammal	Secure						
Mink	*Neovison vison*	Mammal	Secure						
Striped Skunk	*Mephitis mephitis*	Mammal	Secure						
Moose	*Alces alces*	Mammal	Secure						
Mule Deer	*Odocoileus hemionus*	Mammal	Secure						
White-tailed Deer	*Odocoileus virginianus*	Mammal	Secure						

* Scientific names are based on the Cornell Lab of Ornithology's 2018 Clements Checklist (birds) and the Government of Alberta's 2015 Wild Species Status List (mammals, amphibians, reptiles)

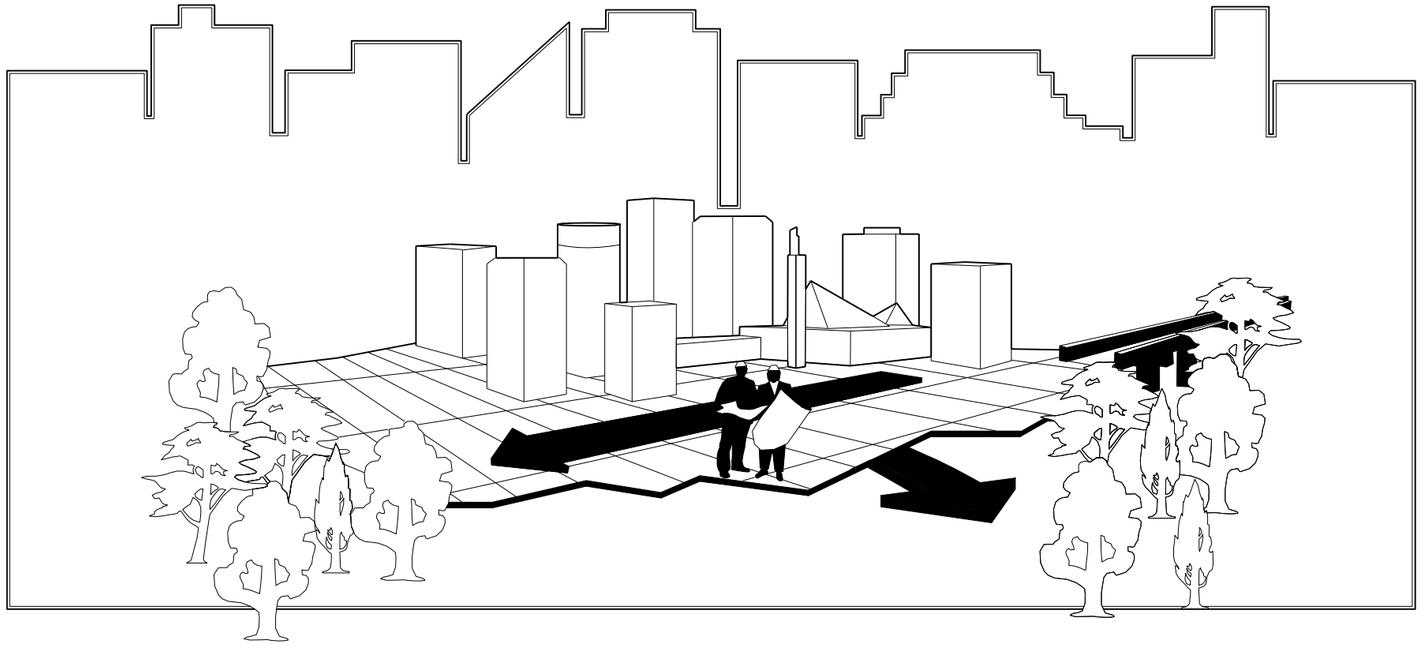
** Sources of species records: BBS = breeding bird survey observation (26 June 2019), FWMIS = Fish and Wildlife Management Information System (Accessed 06 March 2020; observation dates unknown), veg survey 2020 = rare plant survey (16 July 2020)

Appendix H. Design Drawings

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES

TRANSPORTATION INFRASTRUCTURE BRANCH



CONTRACT SET

HORSEHILLS CREEK BRIDGE (B481)

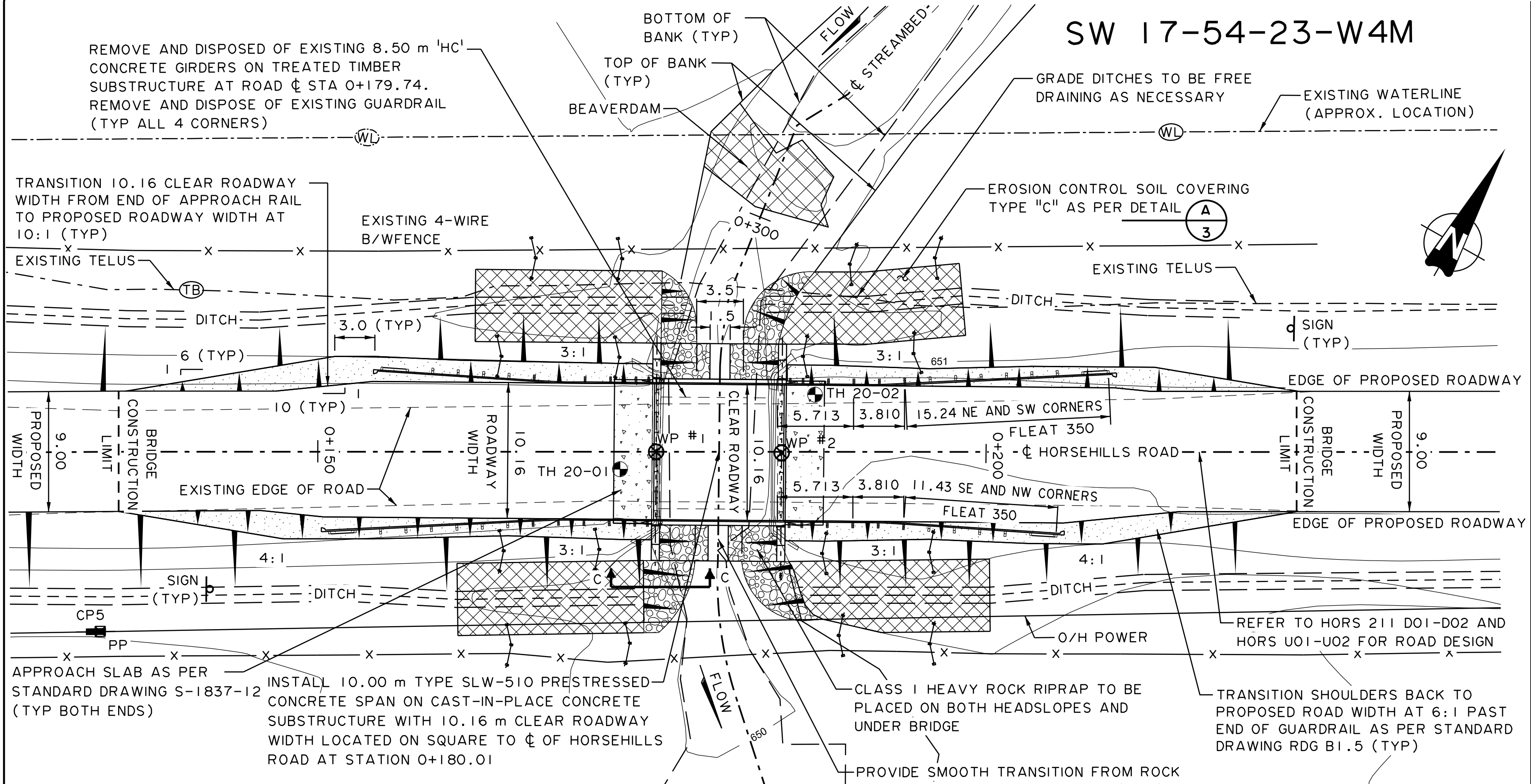
HORSEHILLS ROAD EAST OF 18 STREET

Contract No. 2131

APPROVED FOR CONSTRUCTION
DIRECTOR OF TRANSPORTATION INFRASTRUCTURE — DATE

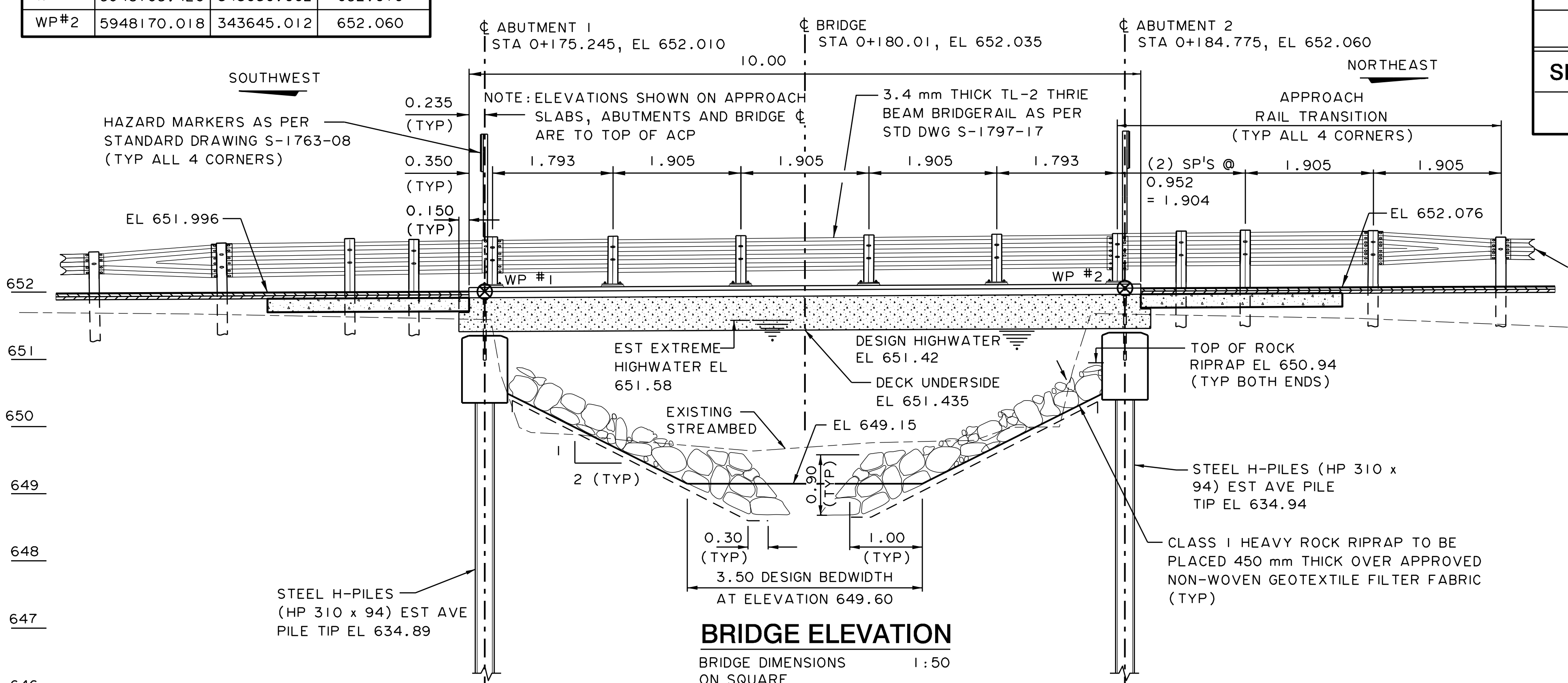
APPROVED FOR CONSTRUCTION
MANAGER OF TRANSPORTATION INFRASTRUCTURE — DATE

DRAWING
HORS 211 S00



SITE PLAN
1:250

WORK POINTS			
NO.	NORTHING	EASTING	ELEVATION
WP#1	5948165.426	343636.662	652.010
WP#2	5948170.018	343645.012	652.060

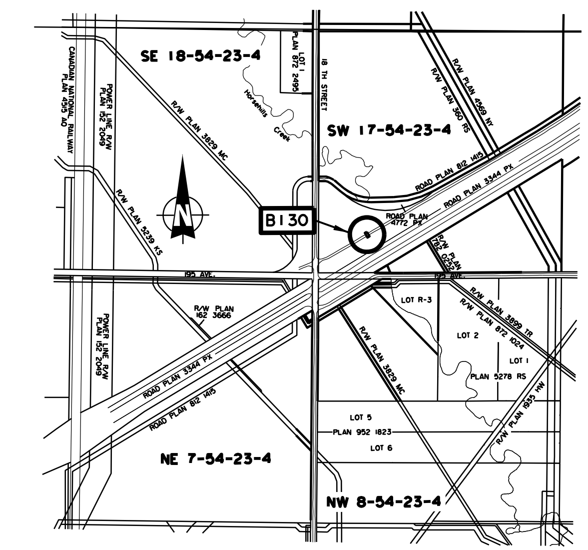


BRIDGE ELEVATION
BRIDGE DIMENSIONS ON SQUARE 1:50

NOTES:
- RIPRAP TO BE PLACED PRIOR TO GIRDER ERECTION
- COMPACTED GRANULAR MATERIAL (DES 2 CLASS 40) PLACED BEHIND ABUTMENTS TO BE PLACED IN MAX 150 mm LIFTS TO A MIN 98% OF STANDARD PROCTOR DENSITY AT OPTIMUM MOISTURE. TOP 300 mm TO BE COMPACTED TO 100% STANDARD PROCTOR DENSITY (TYP BOTH ABUTMENTS)
- SEE CONTRACT SPECIAL PROVISIONS FOR ROAD SURFACING DETAILS (ROADWORK)
- REMOVE AND DISPOSE OF EXISTING BRIDGE GIRDERS, ABUTMENTS, WING WALL PILING AND BRIDGE APPURTENANCES

INDEX

SHEET	DESCRIPTION	DRAWING
22	PRESTRESSED CONCRETE SLW-510 DETAIL SHEET 1	S-1836-12
21	PRESTRESSED CONCRETE SLW-510 DETAIL SHEET 2	S-1837-12
20	PRESTRESSED CONCRETE 10 m SLW-510 INTERIOR GIRDER	S-1824-12
19	PRESTRESSED CONCRETE 10 m SLW-510 EXTERIOR GIRDER	S-1825-12
18	PRESTRESSED CONCRETE 10 m SLW-510 INTERIOR AND EXTERIOR GIRDER LAYOUTS	S-1826-12
17	STANDARD WATERPROOFING FOR DECK AND ABUTMENTS - SHEET 3	S-1840-17
16	STANDARD WATERPROOFING FOR DECK AND ABUTMENTS - SHEET 2	S-1839-17
15	STANDARD WATERPROOFING FOR DECK AND ABUTMENTS - SHEET 1	S-1838-17
14	W-BEAM STRONG POST TL-3 FLEAT 350 ENERGY ABSORBING TERMINAL	RDG-B1.5
13	STANDARD IDENTIFICATION PLAQUES AND BENCHMARK TABLETS	S-1847-17
12	TL-2 THRIE BEAM BRIDGERAIL ON 75 mm HIGH CURB	S-1797-17
11	SL PRECAST GIRDER BRIDGES WITH CAST-IN PLACE CONCRETE SUBSTRUCTURES - SHEET 3	S-1764-08
10	SL PRECAST GIRDER BRIDGES WITH CAST-IN PLACE CONCRETE SUBSTRUCTURES - SHEET 2	S-1763-08
9	SL PRECAST GIRDER BRIDGES WITH CAST-IN PLACE CONCRETE SUBSTRUCTURES - SHEET 1	S-1762-08
8	DECK WATER PROOFING SYSTEM WITH 80 mm TWO-COURSE HOT-MIX ASPHALT CONCRETE PAVEMENT	S-1443-98
7	STRONG POST W-BEAM BLOCKED OUT GUARDRAIL	TEB 3.09
6	TYPICAL STRONG POST W-BEAM OF MODIFIED THRIE BEAM GUARDRAIL PLACEMENT AT BRIDGE APPROACHES (TWO LANE HIGHWAY)	TEB 3.16a
5	BRIDGE/CULVERT STANDARD INDENTIFICATION PLAQUES AND BENCH MARK TABLETS	BSD 1001
4	INFORMATION SHEET 3	HORS 211-S04
3	INFORMATION SHEET 2	HORS 211-S03
2	INFORMATION SHEET 1	HORS 211-S02
1	GENERAL LAYOUT	HORS 211-S01



SITE MAP
NTS

BENCH MARK
- CP5, PLACED SPIKE IN POWERPOLE LOCATED 13.48 m SOUTH OF ROAD LOCAL ROAD ℄ STA 0+133.70, NORTHING 5948133.48, EASTING 343607.04, ELEVATION 651.145
- CP10, PLACED REBAR IN GROUND LOCATED 17.23 m SOUTH OF OF LOCAL ROAD ℄ STA 0+097.65, NORTHING 5948112.95, EASTING 343574.52, ELEVATION 651.309
- CP15, PLACED SPIKE IN POWERPOLE LOCATED 11.88 m SOUTH OF LOCAL ROAD ℄ STA 0+240.88, NORTHING 5948186.79, EASTING 343699.19, ELEVATION 650.860

SURVEY BY
- MPA ENGINEERING. JANUARY 7, 2020
- UTM NAD 83 ZONE 12, COMBINED SCALE FACTOR 0.9996000

HYDROTECHNICAL SUMMARY
- DRAINAGE AREA = 50 km²
- DESIGN DISCHARGE = 12 m³/s (ESTIMATED 1:50 YEAR FLOW)
- EXTREME DISCHARGE = 15 m³/s (ESTIMATED 1:100 YEAR FLOW)
- MEAN VELOCITY THROUGH PROPOSED BRIDGE FOR DESIGN DISCHARGE = 1.25 m/s
- AVERAGE SURVEYED STREAM SLOPE = 0.0022 m/m

STRUCTURAL DESIGN
- DESIGN SPECIFICATION: CAN/CSA S6-06
- DESIGN LIVE LOAD: CL-800-AB
- ABUTMENT PILES: BEARING VALUE = 410 kN (SLS, 630 kN (ULS)
- BEARING VALUES FOR BEARING PILES SHALL BE BASED ON THE BEARING VALUE FORMULA IN ALBERTA TRANSPORTATION BCS 3.3

PROPOSED STRUCTURE
- INSTALL 10.00 m, TYPE SLW-510 PRESTRESSED CONCRETE SPAN ON CAST-IN-PLACE CONCRETE SUBSTRUCTURE (10.16 m CLEAR ROADWAY) LOCATED AT STATION 0+180.01, ON SQUARE TO THE ROADWAY, DECK ELEVATION 652.035 AT CENTER

GENERAL NOTES
- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE
- ROADWAY DESIGN STANDARD: RCU-209-110
- SCALES SHOWN ARE CORRECT FOR 22" x 34" SHEET SIZE
- DESIGN SPEED 70 km/hr
- POSTED SPEED 60 km/hr
- REFER TO HORS 211 D01-D02 AND HORS 211 U01-U02 FOR ROAD DESIGN

NO.	REVISIONS	BY	DATE	APP'D
7				
6				
5				
4				
3				
2	-	-	-	
1	-	-	-	

PROGRAM NO.
CONTRACT NO.

NO.	ISSUE	BY	DATE
4			
3			
2			
1			

CONSTRUCTION RETURN
CONTRACTOR
SURVEYOR
DATE
FILE NUMBER
CONSTRUCTION ENGINEER DATE
GENERAL SUPERVISOR DATE

DESIGNER
PROFESSIONAL ENGINEER M.B. JOHNSON ALBERTA
XXXXXXX
PERMIT NUMBER P6432

MPA ENGINEERING LTD
#304, 85 Cranford Way, Sherwood Park, Alberta T8H 0H9
APPROVED FOR CONSTRUCTION

CHECKER
PROFESSIONAL ENGINEER SHANE HALL ALBERTA
XXXXXX
PERMIT NUMBER P6432

DEPARTMENT / BRANCH | APPROVAL | DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE
MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

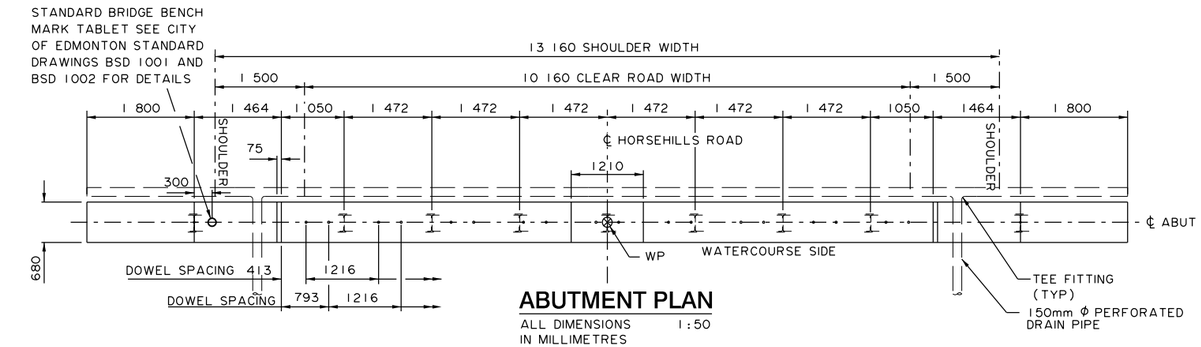
SURVEY B130
JOB NO.
SCALE
HOR
VER

DRAWN WDT DATE 2020-09-23
DESIGNED MBJ DATE 2020-09-23
CHECKED SMH DATE 2020-XX-XX

THE CITY OF Edmonton
INTERGRATED INFRASTRUCTURE SERVICES
INFRASTRUCTURE DELIVERY

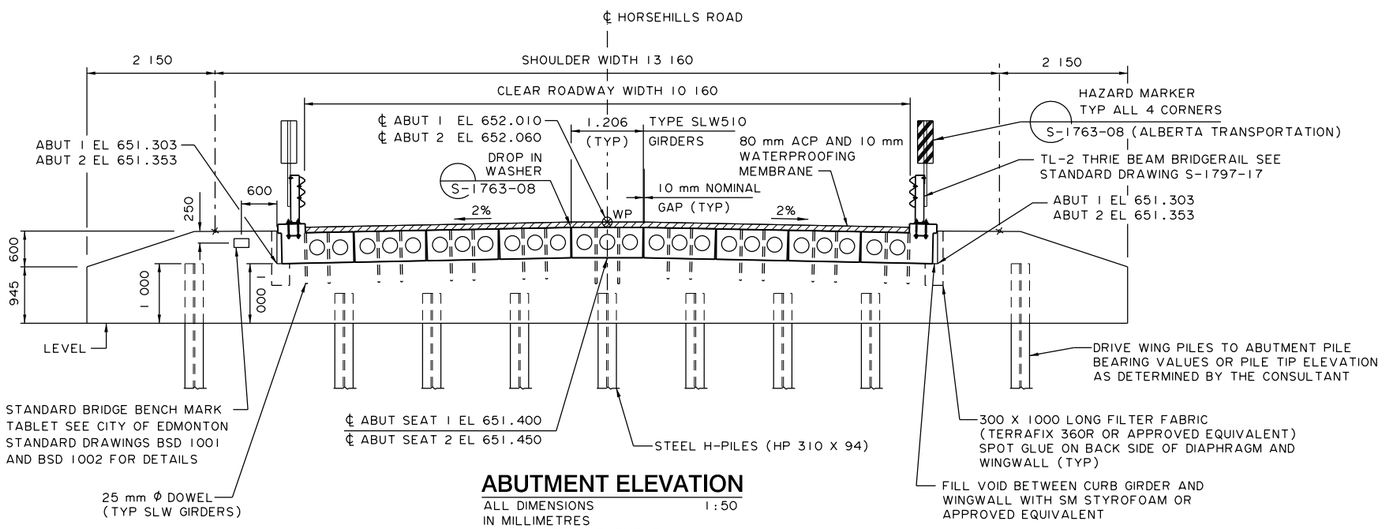
PROJECT **HORSEHILLS CREEK BRIDGE (B481)**
HORSEHILLS ROAD EAST OF 18 STREET
GENERAL LAYOUT

DRAWING NUMBER **HORS 211 S01**



ABUTMENT PLAN

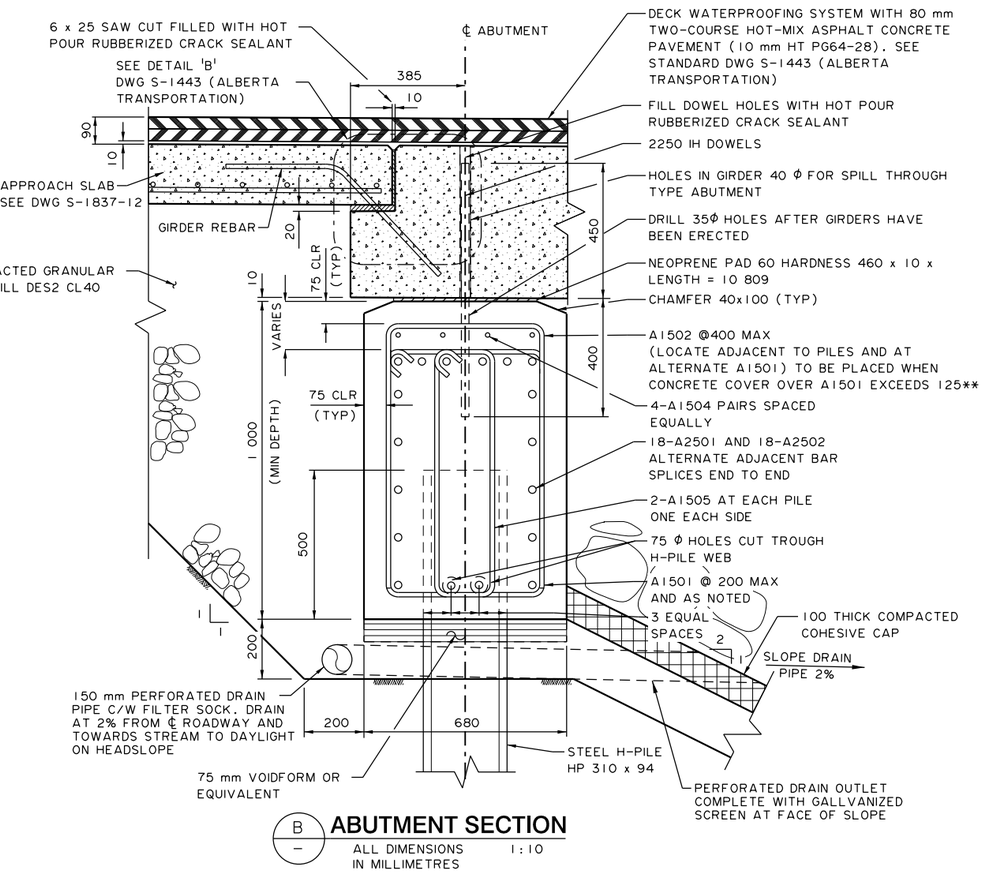
ALL DIMENSIONS IN MILLIMETRES 1:50



ABUTMENT ELEVATION

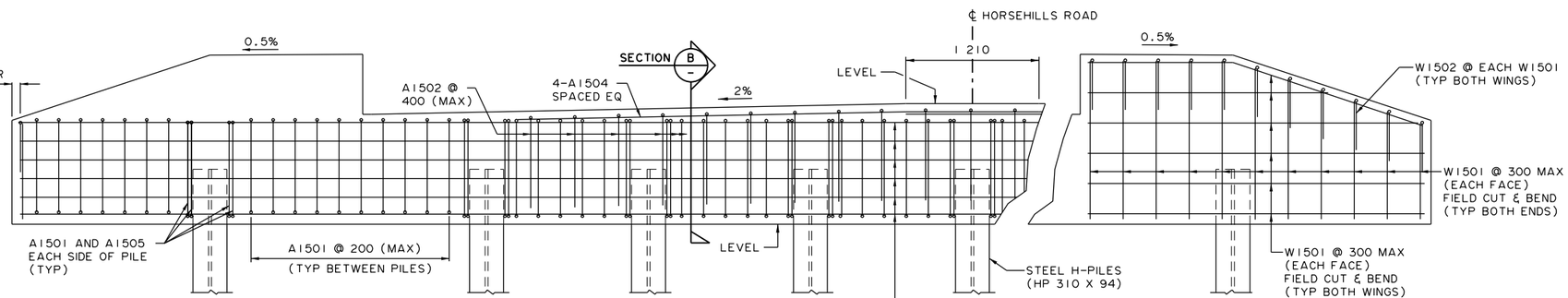
ALL DIMENSIONS IN MILLIMETRES 1:50

(ON SQUARE) ABUTMENT 1 LOOKING WEST ABUTMENT 2 LOOKING EAST



B / – ABUTMENT SECTION

ALL DIMENSIONS IN MILLIMETRES 1:10



ABUTMENT REBAR ELEVATION

ALL DIMENSIONS IN MILLIMETRES 1:25

(ON SQUARE) LOOKING EAST

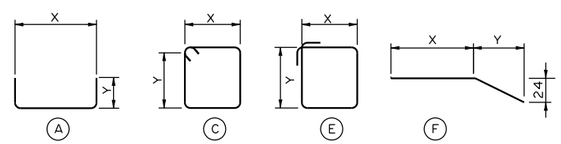
BAR LIST: ABUTMENTS (TOTAL)

MARK	SIZE	NO.	TYPE	X	Y	LENGTH (mm)	MASS (kg)
A1501	15	168	C	530	850	3 040	801
A1502	15	36	A	530	820	2 170	123
A1504	15	16	F	2359	1200	3 559	89
A1505	15	36	E	225	850	2 430	194
A2501	25	36	STR	–	–	12 000	1 696
A2502	25	36	STR	–	–	6 712	948
W1501**	15	26	STR	–	–	12 000	490
W1502	15	48	A	530	450	1 430	108

BAR TYPES (ALL BAR DIMENSIONS ARE OUT TO OUT)

** DENOTES FIELD CUT

PLAIN TOTAL kg: 4 449



NO.	REVISIONS	BY	DATE	APP'D
7				
6				
5				
4				
3				
2	-	-	-	
1	-	-	-	

PROGRAM NO.

CONTRACT NO.

NO.	ISSUE	BY	DATE
4			
3			
2			
1			

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DESIGNER

PROFESSIONAL ENGINEER ALBERTA M.B. JOHNSON

XXXXXXX

PERMIT NUMBER P6432

MPA ENGINEERING LTD

#304, 85 Cranford Way, Sherwood Park, Alberta T8H 0H9

APPROVED FOR CONSTRUCTION

CHECKER

PROFESSIONAL ENGINEER ALBERTA SHANE HALL

XXXXXX

PERMIT NUMBER P6432

TRANSPORTATION PLANNING AND DESIGN SUPERVISOR		
DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO.

SCALE

HOR

VER

DRAWN WDT DATE 2020-09-23

DESIGNED MBJ DATE 2020-09-23

CHECKED SMH DATE 2020-XX-XX

THE CITY OF Edmonton

INTERGRATED INFRASTRUCTURE SERVICES

INFRASTRUCTURE DELIVERY

PROJECT

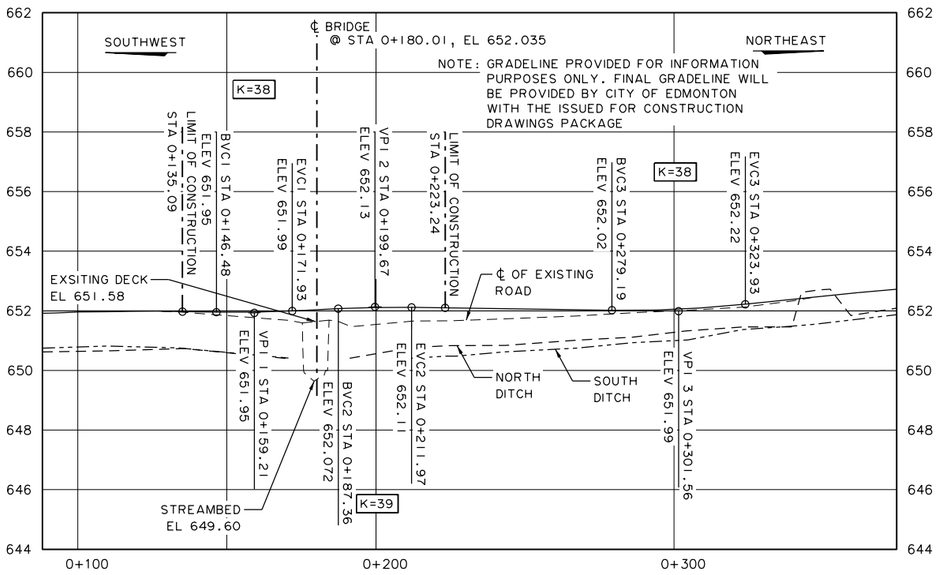
HORSEHILLS CREEK BRIDGE (B481)

HORSEHILLS ROAD EAST OF 18 STREET

INFORMATION - SHEET 1

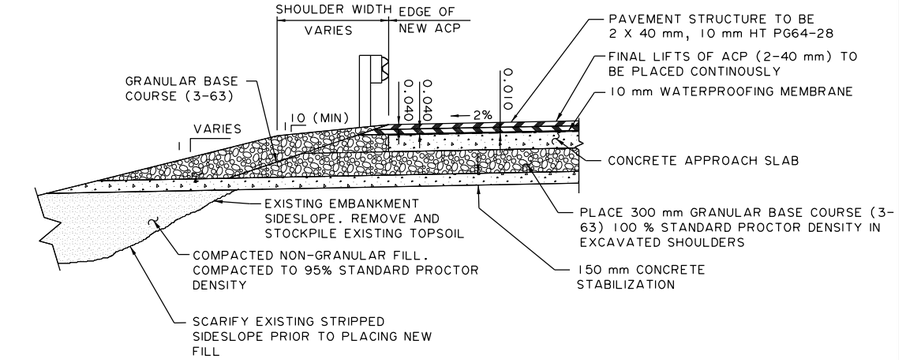
DRAWING NUMBER

HORS 211 S02



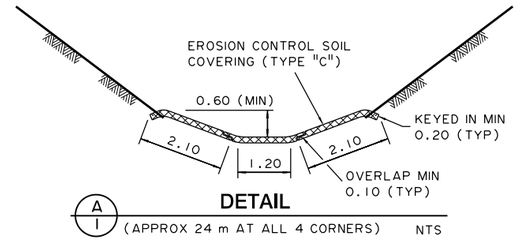
ROAD PROFILE

(HORIZ 1:1000) (VERT 1:100)



HALF SECTION THROUGH CONCRETE APPROACH SLAB

ALL DIMENSIONS IN METRES UNLESS NOTED OTHERWISE NTS

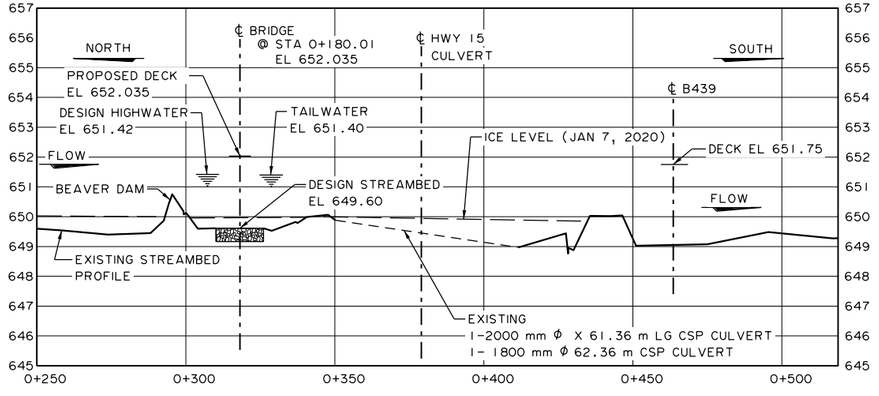


A/1 **DETAIL**

(APPROX 24 m AT ALL 4 CORNERS) NTS

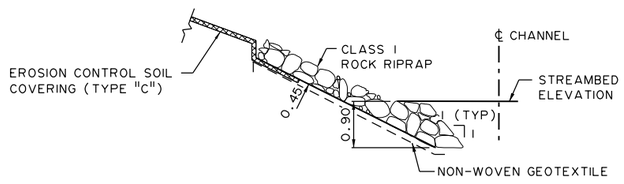
BAR LIST: APPROACH SLABS AND TRANSITION CURBS (TOTAL)							
MARK	SIZE	NO	TYPE	X	Y	LENGTH	MASS
A1502CR	15	38	STR			10 854	648
A1503CR	15	4	STR			700	4
A2001CR	20	148	STR			2 900	1011

CORROSION RESISTANT REINFORCING TOTAL kg: 1 663



STREAMBED PROFILE

(HORZ 1:1000) (VERT 1:100)



C-C/1 **SECTION**

NTS

ESTIMATED QUANTITIES BETWEEN BRIDGE CONSTRUCTION LIMITS STA 0+XXX AND 0+XXX

TYPE OF WORK	ESTIMATED QUANTITY
BACKFILL-ABUTMENTS	
GRANULAR BACKFILL (DES 2 CLASS 25)	34 m^3
ROADWAY WORK - BRIDGE	
EXISTING ACP REMOVE AND DISPOSED	57 m^3
* COMMON EXCAVATION	64 m^3
** SUB-CUT EXCAVATION	97 m^3
BORROW EXCAVATION	170 m^3
ACP (10 mm HT PG 64-28)	101 t
ACP (20 mm-B PG 58-28)	110 t
GRANULAR BASE COURSE (3-63)	325 m^3
CEMENT STABILIZATION	445 m^2
NON-WOVEN GEOTEXTILE FOR ROCK RIPRAP	170 m^2

* SUITABLE MATERIAL EXCAVATED FROM HEADSLOPES AND ABUTMENTS MAY BE RE-USED AS ROADWAY FILL AT THE CONSULTANTS DISCRETION

** ASSUMES ALL CUB-CUT EXCAVATION IS SUITABLE AND CAN BE RE-USED AS ROADWAY FILL

NO.	REVISIONS	BY	DATE	APP'D
7				
6				
5				
4				
3				
2	-	-	-	
1	-	-	-	

NO.	ISSUE	BY	DATE
4			
3			
2			
1			

PROGRAM NO. CM-24-0000
CONTRACT NO. 2131

CONSTRUCTION RETURN
CONTRACTOR
SURVEYOR
DATE
FILE NUMBER
CONSTRUCTION ENGINEER DATE
GENERAL SUPERVISOR DATE

DESIGNER
PROFESSIONAL ENGINEER ALBERTA M.B. JOHNSON
XXXXXXX
PERMIT NUMBER P6432

MPA ENGINEERING LTD
#304, 85 Cranford Way,
Sherwood Park, Alberta
T8H 0H9
APPROVED FOR CONSTRUCTION

CHECKER
PROFESSIONAL ENGINEER ALBERTA SHANE HALL
XXXXXX
PERMIT NUMBER P6432

TRANSPORTATION PLANNING AND DESIGN SUPERVISOR		
DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE
MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

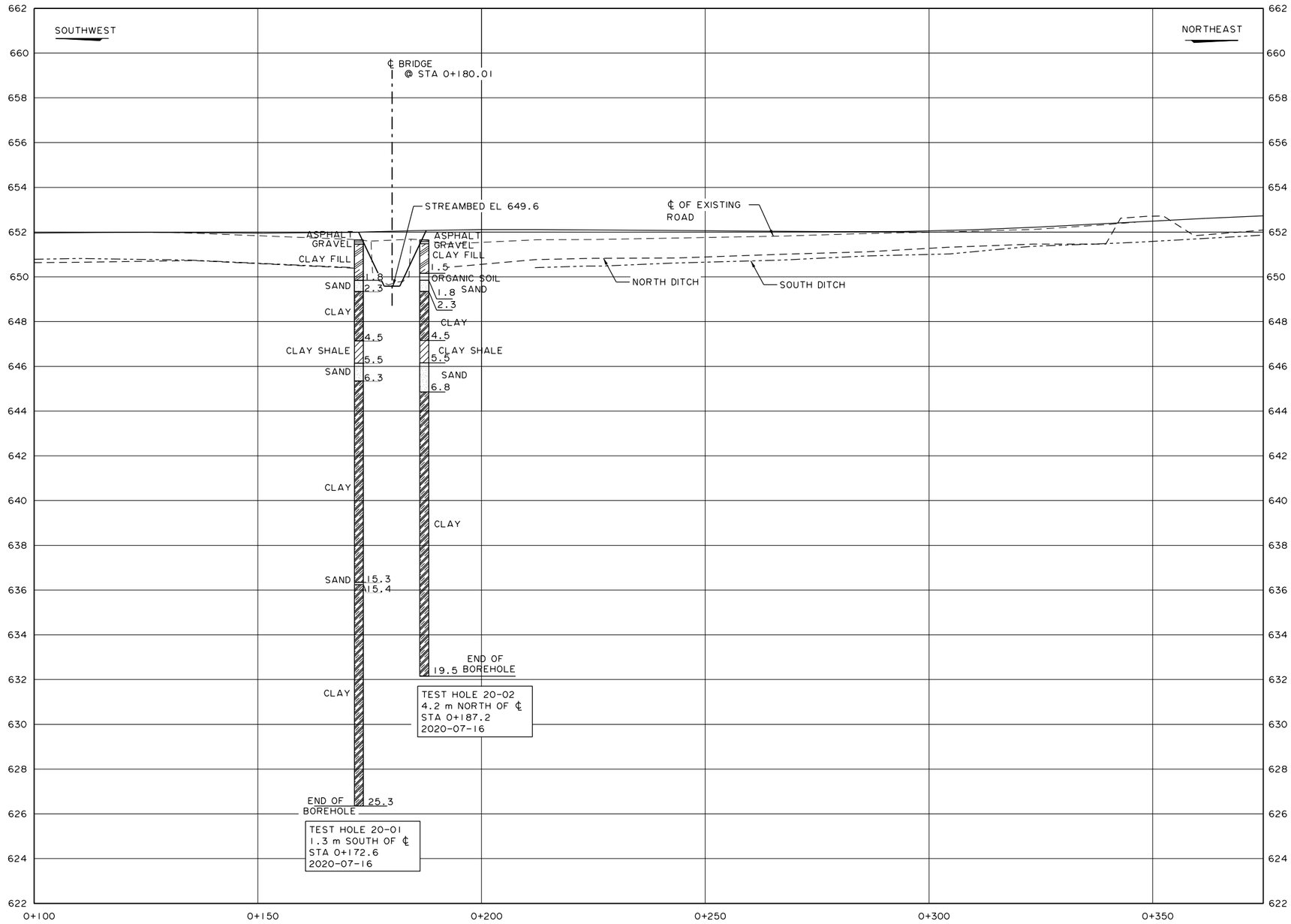
SURVEY
JOB NO.
SCALE
HOR
VER

THE CITY OF Edmonton
INTERGRATED INFRASTRUCTURE SERVICES
INFRASTRUCTURE DELIVERY

DRAWN WDT DATE 2020-09-23
DESIGNED MBJ DATE 2020-09-23
CHECKED SMH DATE 2020-XX-XX

PROJECT
HORSEHILLS CREEK BRIDGE (B481)
HORSEHILLS ROAD EAST OF 18 STREET
INFORMATION - SHEET 2

DRAWING NUMBER
HORS 211 S03



ROAD PROFILE

(HORIZ 1:500) (VERT 1:100)

GEOTECHNICAL NOTES

- ALL GEOTECHNICAL INFORMATION PROVIDED FOR THIS PROJECT HAS BEEN COMPILED FOR DESIGN PURPOSES ONLY. WHILE IT IS BELIEVED TO CORRECTLY REPRODUCE OR SUMMARIZE OBSERVATIONS MADE DURING TESTING, IT IS VALID ONLY FOR THE PRECISE LOCATIONS SHOWN, AND IS NOT CONSTRUED AS GUARANTEEING THE ACTUAL MATERIALS AND CONDITONS EXISTING THROUGHOUT THE SITE. THE TESTING METHODS USED MAY NOT HAVE DETERMINED THE PRESENCE, ABSENCE OR EXTENT OF BOULDERS, HARD OR SOFT FORMATIONS, WATER TABLES, ARTESIAN CONDITIONS AND OTHER VARIABLES. IT IS THE RESPONSIBILTY OF OTHERS USING THIS INFORMATION TO ENSURE THAT IT IS ADEQUATE FOR THEIR PURPOSES, OR TO SUPPLEMENT IT WITH ADDITIONAL INFORMATION.
- GEOTECHNICAL LOGS PROVIDE MOST BUT NOT ALL OF THE AVAILABLE INFORMATION RETRIEVED DURING DRILLING. DETAILED LOGS WILL BE PROVIDED UPON REQUEST
- GEOTECHNICAL INVESTIGATION AND REPORT COMPLETED BY PARKLAND GEO, JUL 16, 2020

NO.	REVISIONS	BY	DATE	APP'D
7				
6				
5				
4				
3				
2	-	-	-	
1	-	-	-	

NO.	ISSUE	BY	DATE
4			
3			
2			
1			

PROGRAM NO. _____

CONTRACT NO. _____

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DESIGNER

PROFESSIONAL ENGINEER ALBERTA M.B. JOHNSON

XXXXXXX

PERMIT NUMBER P6432

MPA ENGINEERING LTD

#304, 85 Cranford Way,
Sherwood Park, Alberta
T8H 0H9

APPROVED FOR CONSTRUCTION

CHECKER

PROFESSIONAL ENGINEER ALBERTA SHANE HALL

XXXXXX

PERMIT NUMBER P6432

TRANSPORTATION PLANNING AND DESIGN SUPERVISOR		
DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO.

SCALE

HOR

VER

THE CITY OF Edmonton

INTERGRATED INFRASTRUCTURE SERVICES

INFRASTRUCTURE DELIVERY

DRAWN WDT DATE 2020-09-23

DESIGNED MBJ DATE 2020-09-23

CHECKED SMH DATE 2020-XX-XX

PROJECT

HORSEHILLS CREEK BRIDGE (B481)

HORSEHILLS ROAD EAST OF 18 STREET

INFORMATION - SHEET 3

DRAWING NUMBER

HORS 211 S04

Appendix I. Bylaw 7188 EIA Review Concordance Table

City of Edmonton Bylaw 7188 Review Comments Summary
AA20-120 Horsehills Road over Horsehills Creek Bridge Replacement Project
Environmental Impact Assessment – FINAL Report
Revised 19 February 2021

City of Edmonton—Initial Circulation Comments (January 2021)

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
EPCOR Drainage Services (Water and Sewer Servicing)		
Environmental Impact Assessment		
Our records indicate that no water and/or sewer services exist within the area of the proposal directly off EPCOR mains. The owner/developer must conform to the requirements of the City of Edmonton Erosion and Sedimentation Control Guidelines and Field Manual.	• Comment noted.	N/A
City Planning (Urban Growth and Open Space Strategy)		
Environmental Impact Assessment		
The EIA should confirm if a separate wildlife passage assessment report is available. Wildlife Passage assessment is usually prepared at the time of project concept stage. If there was no such reporting available, please consider City of Edmonton Wildlife Passage Engineering Design Guidelines for impact assessment to specific Ecological Design Group (EDG) of wildlife to identify proper mitigation measures and best management practices for construction, maintenance and operational purposes.	• A separate wildlife passage assessment report was not completed for this bridge replacement project. • The CoE Wildlife Passage Engineering Design Guidelines (WPEDG) were considered in support of mitigation measures and BMP's during construction, maintenance and operation of the bridge and roadway approaches.	N/A
As of now, the preliminary design of the proposed crossing did not identify specific measures and elements to support specific EDG and their habitat requirements. This report should inform the preliminary design for consideration of specific mitigation measures and identified areas for consideration at the detailed design stage. For e.g. the EIA could inform the preliminary design to incorporate appropriate mitigation measures to reduce the likelihood of at-grade crossing and/or facilitate safe at-grade crossing should wildlife attempt it. Suggested mitigation includes, but is not limited to:	• As requested at the EIA scoping meeting on 05 February 2020, wildlife movement in the area was considered during crossing option analysis in the context of the existing landscape (e.g., adjacent Manning Drive freeway and culverts in embankment = barriers to movement). Also, it was expected that environmental conditions be improved over the current condition at the bridge crossing. These two goals have been achieved with the new bridge design.	Sections 1.0, 5.27

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
• Passive techniques of lowering traffic speeds, including visual traffic calming (e.g., non-palatable trees and perceived roadway width for drivers); non-palatable trees and dense vegetation planted along the median; suggested/recommended (rather than enforced) lowered speed limit at and approaching the crossing location; signage indicating that this is a wildlife crossing location / wildlife may present. • Visual/physical separation of the roadway from the Horsehill Creek corridor if applicable to discourage at-grade crossing, such as vegetated berm. • Low fencing or wing walls near the crossing location to funnel small terrestrial species to the below-grade crossing structures, without creating substantial barriers and fragmenting habitat for larger species Please consider additional requirements at the detailed design drawings stages for the selected crossing design that reflect: • Estimated stream hydraulics (e.g., high water mark, stream velocity, etc.) demonstrating adequate passage during typical conditions as well as during/after storm events • Landscaping, including road right-of-way, in-stream, and riparian channel landscaping, intended to restore natural habitat and encourage use of the crossing by amphibian, small terrestrial, and medium terrestrial EDGs; • Landscaping and design features intended to facilitate safe and effective passage of aerial species (birds and bats) above grade; • Please consider further information to be prepared at the design details of the roadway itself (including median and boulevards) that will minimize the visual and acoustic impacts of the roadway on wildlife, including, but not limited to: Curb improvements; Lighting; Landscaping.	• During bridge preliminary design, the AADT for Horsehills Road was estimated to be between 200-400 vehicles per day (MPA 2020). According to the WPEDG, Horsehills Road is, therefore, considered a local road (<1000) with the main function of providing access to properties. • As noted in the EIA (Section 4.1), four crossing alternatives were considered during preliminary design comprising culverts or a bridge. Wildlife passage for Ecological Design Groups (EDG's) small terrestrial (ST) and medium terrestrial (MT) were a key consideration in comparing alternatives and ultimately factored in the choice of a bridge over a culvert arrangement. Large terrestrial (LT) such as deer and moose were not considered as it was not appropriate for this local road context at this location. • Local roads may be considered barriers to movement by slow moving members of the amphibian (AMP) and small terrestrial (ST) EDG's, however, they are not considered a barrier to medium or large terrestrial (MT and LT, respectively) EDG's. • In this case, the existing bridge is somewhat permeable to local movements of AMP and ST EDG's, particularly under low water conditions, despite the presence of vertical abutment walls and the wooden struts spanning the width of the creek under the bridge. Beaver (MT EDG) are also able to pass under the bridge under current conditions. • The new bridge will be an improvement over the existing bridge as it will be higher and wider than the existing bridge with abutment slopes rather than vertical walls. The wooden struts spanning the creek will be removed with the old bridge.	

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
	• Preliminary design originally called for riprap armouring of the entire extent of the abutment slopes and the creek channel under the bridge. After review and consideration of amphibian, ST and MT wildlife movement requirements, the riprap design was revised so that the creek channel bottom will remain a natural substrate to permit wildlife passage under low water conditions. • The bridge abutments were designed to preserve the integrity of the road and to withstand creek high flows, however, the extension of a small area of riprap upstream and downstream of the bridge will likely act as a natural funnel to AMP, ST and MT animals that wish to pass under the bridge along the creek channel. • As noted in the EIA, and as is typical for local road related bridge construction, all disturbed areas on the bridge and approach roadway embankments and ditches will be recontoured, topsoiled and seeded with a City of Edmonton approved naturalization seed mix. • Reclamation of the small area of the seasonal graminoid marsh plant community will require placement of wetland soils and/or topsoil seeded with a wet meadow seed mix. • A small amount of erosion control matting will be installed in disturbed areas at all four corners of the bridge where the ditch transitions to the creek (as noted on the design drawings in Appendix H of the EIA). • Most birds and bats are not affected by local roads. • The culverts under Manning Drive located 30 m downstream from the proposed bridge and Manning Drive itself, remain barriers to ST, MT, and LT wildlife movement to the south and effectively	

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
	create a dead end for wildlife movement along the Horsehills Creek corridor at this location. • Sightlines for drivers will not change at the bridge crossing compared to existing conditions. The landscape will remain level, with open unobstructed views of the adjacent wetlands and Manning Drive freeway embankment and ditch. MT or LT animals wishing to cross the local road should be easily visible. • No other mitigation measures are required for a local road at this location.	
Engineering Services (Business Planning and Support)		
Environmental Impact Assessment		
It is not clear from the information provided for review whether the geotechnical consultant has conducted a review of the proposed design drawings and specifications. It is therefore recommended that the geotechnical consultant shall review the proposed design drawings and SP's for the project to ensure adherence to their recommendations and their geotechnical suitability.	This is not typically done on small bridge projects. We have a geotechnical report and MPA has prepared the design drawings to follow the recommendations of the report.	Section 5.2.4
Continuous involvement of the geotechnical consultant throughout the construction phase will be imperative to ensure their recommendations are adhered to and to ensure quality of construction. Pile monitoring by qualified geotechnical professionals from ParklandGeo will be required during the foundation construction. Subgrade inspections, site drainage and other geotechnical site related issues will also require geotechnical inspection. Quality assurance testing will be required to ensure geotechnical specifications are met. The geotechnical consultant must be available to provide input should any geotechnical-related issues arise during the final design and construction processes.	MPA will be onsite fulltime during pile driving to ensure bearing capacity are achieved. MPA is experienced with monitoring bearing pile installations and typically do not have a geotechnical sub involved during construction supervision unless geotechnical issues arise which require further input beyond the information provided in the geotechnical report and beyond our expertise.	Section 5.2.4, 6.0
Engineering and Survey Services (Environmental Engineering)		
Environmental Impact Assessment		
It is noted that a Limited Phase II Environmental Site Assessment was completed for the project by Parkland-Geo and is included in	• Comment noted.	N/A

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
the Environmental Impact Assessment authored by Spencer Environmental. The Phase II ESA was initiated to investigate the potential impacts from the bridge's timber foundation. We will review this report in more detail and discuss its findings with the project manager.		
Civic Events and Festivals (Community and Recreation Facilities)		
Environmental Impact Assessment		
Our main concern is timing…please advise when this is available.	• As noted in the EIA, bridge replacement and adjacent roadway upgrading construction is tentatively scheduled to occur 01 May – 31 October 2021	Section 4.2
Natural Area Operations (Parks and Roads Services)		
Environmental Impact Assessment		
Please note the Corporate Tree Management Policy applies to both trees and shrubs. Therefore, this policy should still be a consideration, as it was identified that shrubs species (e.g., Salix) were present.	• Efforts will be made to minimize vegetation removal as much as possible. There are no trees in the project area but any shrubs that are damaged or removed must be replaced pursuant to the City's *Corporate Tree Management Policy*.	Section 5.2.5.1
Weeds will likely be a large concern for this project. Please ensure the recommended mitigation measures are adhered to throughout the duration of the project. Every attempt should be made to minimize disturbance in this area, as restoration may be challenging.	• Weeds will be managed according to the mitigation measures documented in the EIA.	Sections 5.2.5.3, 8.3
A site visit with naturalareaoperations@edmonton.ca will be required to conduct a pre-site inspection.	• A pre-site inspection will be organized as requested Lisa indicated she will organize the inspection.	Section 5.2.5.1, 8.3
A restoration plan will be required for this work. Please circulate a restoration plan for approval, prior to beginning this work.	• As noted in the EIA, and as is typical for local road related bridge construction, all disturbed areas on the bridge and approach roadway embankments and ditches will be recontoured, topsoiled and seeded with a City of Edmonton approved naturalization seed mix. • Reclamation of the small area of the seasonal graminoid marsh plant community will require	Sections 4.4.4, 5.2.5.1, and 8.3, Appendix H

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
	placement of wetland soils and/or topsoil seeded with a wet meadow seed mix. • A small amount of erosion control matting will be installed in disturbed areas at all four corners of the bridge where the ditch transitions to the creek (as noted on the design drawings in Appendix H of the EIA). • No further restoration plan will be prepared	
Urban Forestry (Parks and Roads Services)		
Environmental Impact Assessment		
All construction within 10 meters of a tree must be reviewed with Natural Areas. They will review construction plans and tree protection. This meeting will need to be scheduled a minimum of four weeks in advance of the construction start date.	• As noted above, there are no trees in the project area, but there are a few shrubs.	Sections 3.5.2.1, 5.2.5.1, 8.3
Parkland Management (Right-of-Way and Parkland Management)		
Environmental Impact Assessment		
The contractor that is awarded the tender is required to obtain parkland access permits, application for this permit must come in 6 week prior to access/construction start date. The project manager is responsible for providing the finalized signed agreements that form schedule A of the parkland access permits. If they have questions they can reach out directly to me at prsparklandmanagement@edmonton.ca.	• Comment noted. • Lisa indicated she will reach out to the Parkland Management group for further clarification as this is not in or near a park.	N/A
Resource Planning and Land Development (Parks and Road Services)		
Environmental Impact Assessment		
This project must follow all City Policies and Servicing Agreements.	• Comment noted.	N/A
The site is in compliance with the site's Natural Area Management Plan and reviewed by Natural Areas Operations.	• Comment noted.	N/A
A comprehensive site restoration plan must be developed and reviewed and approved by all necessary stakeholders.	• Please see response above.	N/A
Erosion and Sedimentation Control Measures must be in place prior to any construction activity to prevent any contaminants from entering Infrastructure or water bodies.	• This is required mitigation noted in the EIA. • Temporary measures will be included in the Contractors ECO plan which will be reviewed by	Sections 5.2.3, 5.2.8.2, 8.3

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
	MPA and the City. MPA will be on-site during construction to ensure compliance with the Eco plan and monitoring the site for any deficiencies that would lead to sedimentation or erosion.	
All damages to natural areas must be repaired with approved natural grass seed mixtures and natural plantings/vegetation as per Landscape Construction Standards and the maintenance (watering, weed control, etc.) of restored natural areas will be the responsibility of the proponent until the natural area planting material is established and accepted by PARS. All other damages to parkland inventory (granular or hard surface paths, etc.) must be restored to pre-existing conditions and COE Construction Standards and PARS	• Please see response above.	Sections 4.4.4, 5.2.5.1, and 8.3, Appendix H
Any lay down, staging or haul route area on Parkland must be approved and fenced, with no vehicular or project activity outside of the fenced area. Contact parkslandscapeinventory@edmonton.ca to request inspections. There should be no access to the lay down, staging or haul route area to ensure public safety. The restoration of the entire area must be repaired to the existing turf conditions. Soil compaction protection, aeration and seeding/sodding; including the maintenance (watering, mowing and weed control) of restored areas will be the responsibility of the proponent until the area is established and accepted by PARS.	• As noted in the EIA, construction storage areas and access will be located on asphalt within the existing Horsehills Road ROW and away from Horsehills Creek. • The road will be closed and the construction area and laydown areas on the roadway will be secured to prevent public access. • Construction access to the site will be via existing roadways. • Please see response above regarding restoration/reclamation plans. • Lisa indicated she will organize the inspection.	Sections 4.3, 4.4.1, 5.2.5.1, 8.3
Use of this area must be managed carefully to prevent any spills or release of contaminants.	• Agreed. Mitigation measures are documented in the EIA. And will be addressed in the Contractors ECO plan.	Sections 5.2.8, 8.3
If tree conflicts (work within 5m of a tree) are anticipated, or arise during construction, or a tree is within 3m of the haul route a site meeting with the City of Edmonton Natural Area Forester will be required. Please be advised that all costs associated with the removal, replacement or transplanting of trees shall be covered by the applicant as per the Corporate Tree Management Policy	• Please see response above. • There are no trees in the project area, but there are a few shrubs. • A meeting will be scheduled as required. Lisa indicated she will organize the inspection.	Sections 3.5.2.1, 5.2.5.1, 8.3

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
(C456A). The City of Edmonton will schedule and carry out all required tree work involved with this project.		
The site is left in an intended state that meets the City's satisfaction.	• Comment noted.	N/A
For projects longer than one day, signage must be posted indicating a project contact person and phone number for inquiries.	• Appropriate signage will be posted on-site. • In addition, stakeholders directly impacted by the project will be informed by a City representative. Public communication regarding the project and construction timing will include a mail-out to the residences and businesses in the area and regular updates on the City's website.	Section 7.0
General Conditions Regarding Vegetation Removal		
Environmental Impact Assessment		
Upon approval of the plan, a site meeting with Natural Areas will be required to review construction plans and tree protection. This meeting will need to be scheduled a minimum of four weeks in advance of the construction start date. This is to review access points, placement of all permanent or temporary construction material required for this project, and to determine tree protection requirements for construction within 5 meters of any City tree. For any vegetation removal, please ensure the area has been clearly staked. Note the laydown area fencing must be installed outside the dripline of any adjacent trees.	• Please see response above. • There are no trees in the project area, but there are a few shrubs. • A meeting will be scheduled as required. Lisa indicated she will organize the inspection.	Sections 3.5.2.1, 5.2.5.1, 8.3
Please be advised that all costs associated with pruning, removal, tree damage, or replacement shall be covered by the Proponent as per the Corporate Tree Management Policy. Natural Areas will schedule and carry out all required tree work involved with this project. Please contact naturalareaoperations@edmonton.ca to arrange this meeting.	• Comment noted. • A meeting will be scheduled as required. Lisa indicated she will organize the inspection.	N/A
Any soil damage or compaction compromising the tree's root system within the parkland space shall be corrected by and at a cost to the Proponent. Please be advised that all costs associated with soil remediation, watering, and tree protection shall be covered by the Proponent as per the Corporate Tree Management Policy.	• Comment noted.	N/A

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
Please note that the removal of vegetation has the opportunity to impact birds and bird habitat. Protection of migratory and non-migratory birds is legislated federally and provincially and enforceable regardless of whether or not individual environmental reviews conducted in accordance with the River Valley Bylaw include discussions of these topics. The onus is on the individual or company conducting habitat disturbance or construction activities to ensure that due diligence has been exercised to avoid harm to migratory and non-migratory birds. Individuals or companies that do not avoid harm to most wildlife species risk prosecution under the Wildlife Act and, in some cases, the Species at Risk Act. In the case of migratory birds, prosecution under the Migratory Birds Convention Act is also possible.	• As noted in the EIA, vegetation clearing (including brush piles and tall grass) in the period 20 April – 20 August is best avoided by scheduling clearing outside the period 20 April to 20 August. If clearing/removal must occur during this time period, nest sweeps by a qualified biologist will be required to identify active nests and appropriately buffer them until the nest is no longer active. • As noted in the EIA, the underside of the bridge will be inspected for active bird nests prior to demolition. Prior to April 20th a bird sweep will be conducted to look for nests and review possible mitigation measures to prevent nesting under the bridge prior to construction.	Section 5.2.6.3, 5.2.6.4, 8.3
General Conditions		
Environmental Impact Assessment		
All mitigation measures and commitments outlined by City reviewers must be incorporated into the construction work plan.	• Comment noted.	N/A
The proponent is responsible for seeking approval for any other regulatory permits from provincial and federal agencies.	• Comments noted.	N/A
Please contact the Neighbourhood Resource Coordinator Shannon Murray (780-496-5589) in the area to ensure appropriate community notification.	• Lisa indicated she will contact the neighbourhood resource coordinator.	N/A
For potential impacts to City parks and facilities: • Please ensure restoration of the site occurs and meets existing site conditions. All damages to parkland must be restored to City of Edmonton Construction Standards and City Operations' satisfaction. • Noxious weeds shall be managed and controlled as required within any fenced area and should be the responsibility of the contractor/department during construction. • Signage must be posted indicating a project contact person and phone number for inquiries.	• Please see various responses above.	Sections 4.4.4, 5.2.5.1, 5.2.5.2, Section 7.0 and 8.3, Appendix H

Review Comment	Response and Select Construction Phase Related Commitments	EIA Report Section Reference
All trail closures shall adhere to the City's Trail Closure Procedures. All trail closure activities must be approved through River Valley Operations prior to construction and closure of trails. Please contact Braeden Holmstrom (Team Leader, River Valley & Horticulture) at 587-986-2841 to obtain the necessary trail closure approvals. This shall be done a minimum of two weeks in advance of planned construction.	• Comment noted. • There are no trails in the project area.	N/A
Please attach this letter for any further City of Edmonton approvals.	• Comment noted.	N/A

Appendix J. *Historical Resources Act* Approval

Alberta

HRA Number: 4715-20-0089-001
December 04, 2020

Historical Resources Act Approval

Proponent: City of Edmonton
12th Floor Edmonton Tower, 10111 104 Avenue NW, Edmonton, AB T5J 0J4
Contact: John Phong

Agent: Circle CRM Group Inc.
Contact: Margarita de Guzman

Project Name: **Horsehills Road Over Horsehills Creek (B130) Bridge Replacement**

Project Components: Bridge
Temporary Workspace

Application Purpose: Requesting HRA Approval / Requirements

Historical Resources Act approval is granted for the activities described in this application and its attached plan(s)/sketch(es) subject to Section 31, "a person who discovers an historic resource in the course of making an excavation for a purpose other than for the purpose of seeking historic resources shall forthwith notify the Minister of the discovery." The chance discovery of historical resources is to be reported to the contacts identified within Standard Requirements under the *Historical Resources Act*: Reporting the Discovery of Historic Resources.

Martina Purdon
Manager, Regulatory Approvals
and Information Management
Alberta Culture, Multiculturalism
and Status of Women

Lands Affected: All New Lands

Proposed Development Area:

MER	RGE	TWP	SEC	LSD List
4	23	54	17	4

Documents Attached:

Document Name	Document Type
Project Plan	Illustrative Material

CITY OF EDMONTON

Horsehills Road over Horsehills Creek (B130) Bridge Replacement

LEGEND

- Proposed New Bridge and Roadway Approaches
- Anticipated Construction Disturbance

THE CITY OF Edmonton

SPENCER ENVIRONMENTAL MANAGEMENT SERVICES LTD.

0 1:2,000 80

meters

Projection: NAD83 UTM Zone 12
Basemap: ESRI World Imagery

Horsehills Creek

LSD-04 Sec-17 Twp-054 Rge-23 Mer-4

LSD-13 Sec-08 Twp-054 Rge-23 Mer-4

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STANDARD REQUIREMENTS UNDER THE *HISTORICAL RESOURCES ACT*: REPORTING THE DISCOVERY OF HISTORIC RESOURCES

If development proponents and/or their agents become aware of historic resources during the course of development activities, they are required, under Section 31 of the *Historical Resources Act*, to report these discoveries to the Heritage Division of Alberta Culture, Multiculturalism and Status of Women. This requirement applies to all activities in the Province of Alberta.

1.0 REPORTING THE DISCOVERY OF ARCHAEOLOGICAL RESOURCES

The discovery of archaeological resources is to be reported to Darryl Bereziuk, Director, Archaeological Survey, at 780-431-2316 (toll-free by first dialing 310-0000) or darryl.bereziuk@gov.ab.ca.

2.0 REPORTING THE DISCOVERY OF PALAEONTOLOGICAL RESOURCES

The discovery of palaeontological resources is to be reported to Dan Spivak, Head, Resource Management, Royal Tyrrell Museum of Palaeontology, at 403-820-6210 (toll-free by first dialing 310-0000) or dan.spivak@gov.ab.ca.

3.0 REPORTING THE DISCOVERY OF HISTORIC PERIOD SITES

The discovery of historic structures to be reported to Rebecca Goodenough, Manager, Historic Places Research and Designation Program, at 780-431-2309 (toll-free by first dialing 310-0000) or rebecca.goodenough@gov.ab.ca. Please note that some historic structure sites may also be considered Aboriginal traditional use sites.

4.0 REPORTING THE DISCOVERY OF ABORIGINAL TRADITIONAL USE SITES

The discovery of any Aboriginal traditional use site that is of a type listed below is to be reported to Valerie Knaga, Director, Aboriginal Heritage Section, at 780-431-2371 (toll-free by first dialing 310-0000) or valerie.k.knaga@gov.ab.ca.

Aboriginal Traditional Use sites considered by Alberta Culture, Multiculturalism and Status of Women to be historic resources under the *Historical Resources Act* include:

Historic cabin remains;
Historic cabins (unoccupied);
Cultural or historical community camp sites;

Ceremonial sites/Spiritual sites;
Gravesites;
Historic settlements/Homesteads;
Historic sites;
Oral history sites;
Ceremonial plant or mineral gathering sites;
Historical Trail Features; and,
Sweat/Thirst/Fasting Lodge sites

5.0 FURTHER SALVAGE, PRESERVATIVE OR PROTECTIVE MEASURES

If previously unrecorded historic resources are discovered, proponents may be ordered to undertake further salvage, preservative or protective measures or take any other actions that the Minister of Alberta Culture, Multiculturalism and Status of Women considers necessary.

Appendix K. *Fisheries Act* Letter of Advice

Fisheries and Oceans Canada
Pêches et Océans Canada

Ontario and Prairie Region
Fish and Fish Habitat Protection Program
867 Lakeshore Rd.
Burlington, ON
L7S 1A1

Région de l'Ontario et des Prairies
Programme de protection du poisson et de son habitat
867 chemin Lakeshore
Burlington, ON
L7S 1A1

Your file *Votre référence*

16 November 2020

Our file *Notre référence*
20-HCAA-02271

Lisa Erickson
City of Edmonton
13th Floor Edmonton Tower
10111 104 Avenue NW
Edmonton, ON
T5J 0J4

Subject: Bridge Replacement, North Saskatchewan River, Edmonton (20-HCAA-02271) – Implementation of Measures to Avoid and Mitigate the Potential for Prohibited Effects to Fish and Fish Habitat

Dear Lisa Erickson:

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received your proposal on 9 November 2020; and. We understand that you propose to:

- Replace the existing bridge and install riprap; and
- Work in dry or isolated condition and relocate fish if present.

In addition, the following aquatic species are subject to the *Aquatic Invasive Species Regulations* and may be found in the vicinity of your proposed work, undertaking, or activity:

- Prussian Carp
- Phragmites
- Himalayan Balsam
- Flowering Rush

Our review considered the following information:

- Request for Review form and associated documents submitted on 9 November 2020; and
- Email correspondence with Brendan Spearin (Fisheries and Oceans Canada) on 16 November 2020 regarding Aquatic Invasive Species.

Your proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by means other than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the *Aquatic Invasive Species Regulations*.

The aforementioned impacts are prohibited unless authorized under their respective legislation and regulations.

To avoid and mitigate the potential for prohibited effects to fish and fish habitat (as listed above), we recommend implementing the measures listed below:

- Plan in-water works, undertakings and activities to respect timing windows to protect fish and fish habitat
    - No in-water work between April 16 – June 30
- Capture, relocate and monitor for fish trapped within isolated, enclosed, or dewatered areas
    - Dewater gradually to reduce the potential for stranding fish
- Screen intake pipes to prevent entrainment or impingement of fish
    - Use the code of practice for water intake screens
- Apply the interim code of practice for temporary cofferdams and diversion channels
- Limit impacts on riparian vegetation to those approved for the work, undertaking or activity
- Maintain an appropriate depth and flow (i.e., base flow and seasonal flow of water) for the protection of fish and fish habitat
- Develop and implement an Sediment Control Plan to minimize sedimentation of the waterbody during all phases of the work, undertaking or activity
    - Conduct all in-water works, undertakings or activities in isolation of open or flowing water to reduce the introduction of sediment into the watercourse
    - Schedule work to avoid wet, windy and rainy periods (and heed weather advisories)
    - Inspect and maintain regularly the erosion and sediment control measures and structures during all phases of the project
    - Remove all exposed non-biodegradable sediment control materials once site has been stabilized
    - Operate machinery on land, or from barges or on ice
    - Use methods to prevent substrate compaction (e.g., swamp mats, pads)
    - Monitor the watercourse to observe signs of sedimentation during all phases of the work, undertaking or activity and take corrective action

    - Dispose and stabilize all dredged material above the high water mark of nearby waterbodies to prevent entry in the water
- Avoid obstructing and interfering with the movement and migration of fish
- Do not deposit any deleterious substances in the water course
- Develop and implement a response plan to avoid a spill of deleterious substances

Provided that you incorporate these measures into your plans, the Program is of the view that your proposal is not likely to result in the contravention of the above mentioned prohibitions and requirements.

Should your plans change or if you have omitted some information in your proposal, further review by the Program may be required. Consult our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review may be necessary. It remains your responsibility to remain in compliance with the *Fisheries Act*, the *Species at Risk Act* and the *Aquatic Invasive Species Regulations.*

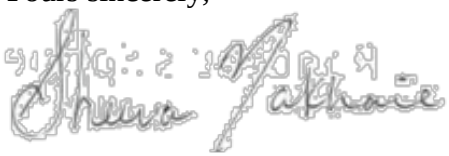
Whirling disease, a disease of finfish, caused by infection with a microscopic parasite called Myxobolus cerebralis, has been identified in Alberta. There may be a requirement for you to apply for a permit from the Canadian Food Inspection Agency to move certain species of finfish, such as rainbow trout, and things, such as sediments, within or out of Alberta. Please visit http://www.inspection.gc.ca/animals/aquatic-animals/domestic-movements/eng/1450122972517/1450122973466 for more information.

It is also your *Duty to Notify* DFO if you have caused, or are about to cause, the death of fish by means other than fishing and/or the harmful alteration, disruption or destruction of fish habitat. Such notifications should be directed to (http://www.dfo-mpo.gc.ca/pnw-ppe/CONTACT-eng.html).

We recommend that you notify this office at least 10 days before starting your project and that a copy of this letter be kept on site while the work is in progress. It remains your responsibility to meet all other federal, territorial, provincial and municipal requirements that apply to your proposal.

If you have any questions with the content of this letter, please contact Sheeva Nakhaie at 905-315-5270, or by email at Sheeva.Nakhaie@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,



Sheeva Nakhaie
Biologist, Triage and Planning