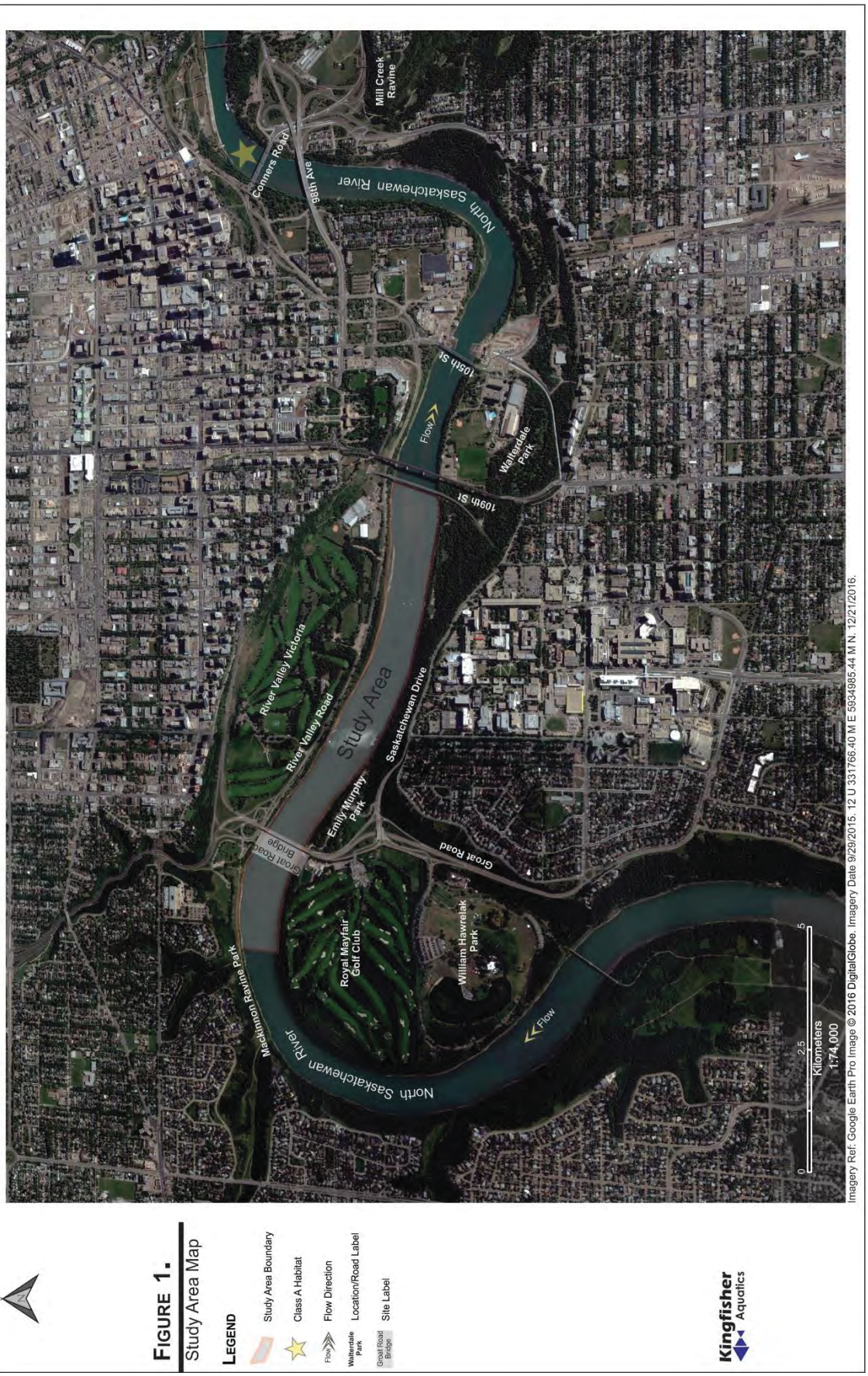

Mill Creek Ravine
Connors Road
99th Ave
North Saskatchewan River
105th St
Flow
Waterdale Park
109th St
River Valley Victoria
River Valley Road
Study Area
Saskatchewan Drive
Emily Murphy Park
Great Road Bridge
Great Road
Royal Mayfair Golf Club
William Hawrelak Park
Mackinnon Ravine Park
North Saskatchewan River
Flow
0
2.5
5
Kilometers
1:74,000
Imagery Ref: Google Earth Pro Image © 2016 DigitalGlobe. Imagery Date 9/29/2015. 12 U 331766.40 M E 5934985.44 M N. 12/21/2016.
FIGURE 1.
Study Area Map
LEGEND
Study Area Boundary
Class A Habitat
Flow Direction
Location/Road Label
Site Label
Kingfisher Aquatics

Table 2. Summary of fish species captured from the North Saskatchewan River in the City of Edmonton[1].

Fish Species			Status			Provincial Management Priority Ranking
Common Name	Scientific Name	Species Code	Federal[2]		Provincial[3]	
			COSEWIC	SARA	Wildlife Act	
Brook Stickleback	*Culaea inconstans*	BRST	No Listing	No Status	Secure	5
Burbot	*Lota lota*	BURB	No Listing	No Status	Secure	3
Emerald Shiner	*Notropis atherinoides*	EMSH	No Listing	No Status	Secure	5
Fathead Minnow	*Pimephales promelas*	FTMN	No Listing	No Status	Secure	5
Flathead Chub	*Platygobio gracilis*	FLCH	No Listing	No Status	Secure	5
Finescale Dace	*Phoxinus neogaeus*	FNDC	No Listing	No Status	Undetermined	5
Goldeye	*Hiodon alosoides*	GOLD	No Listing	No Status	Secure	3
Lake Chub	*Couesius plumbeus*	LKCH	No Listing	No Status	Secure	5
Lake Sturgeon	*Acipenser fulvescens*	LKST	Endangered	Under Consideration	Threatened	1
Longnose Dace	*Rhinichthys cataractae*	LNDC	No Listing	No Status	Secure	5
Longnose Sucker	*Catostomus*	LNSC	No Listing	No Status	Secure	4
Mooneye	*Hiodon tergisus*	MOON	No Listing	No Status	Secure	3
Mountain Whitefish	*Prosopium williamsoni*	MNWH	No Listing	No Status	Secure	5
Northern Pike	*Esox lucius*	NRPK	No Listing	No Status	Secure	2
Pearl Dace	*Margariscus margarita*	PRDC	No Listing	No Status	Secure	5
Quillback	*Carpoides cyprinus*	QUIL	No Listing	No Status	Undetermined	4
River Shiner	*Notropis blennius*	RVSH	No Listing	No Status	Secure	5
Sauger	*Stizostedion canadense*	SAUG	No Listing	No Status	Sensitive	3
Shorthead Redhorse	*Moxostoma macrolepidotum*	SHRD	No Listing	No Status	Secure	4
Silver Redhorse	*Moxostoma anisurum*	SLRD	No Listing	No Status	Undetermined	4
Spoonhead Sculpin	*Cottus ricei*	SPSC	Not At Risk	No Status	May Be At Risk[4]	5
Spottail Shiner	*Notropis hudsonius*	SPSH	No Listing	No Status	Secure	5
Trout-perch	*Percopsis omiscomaycus*	TRPR	No Listing	No Status	Secure	5
Walleye	*Sander vitreus*	WALL	No Listing	No Status	Secure	2
White Sucker	*Catostomus commersoni*	WHSC	No Listing	No Status	Secure	4

1 From FWMIS; does not include species with fewer than 5 individuals captured

2 COSEWIC 2016, SARA Public Registry 2017

3 ASRD 2010, ESRD 2015

4 Ranking is based a single population in the lower Red Deer River and a general lack of data on the species (AEP 2017). As such, this ranking is not considered pertinent to this project.

5.2 FISH HABITAT

In general, the NSR near Edmonton flows through a broad, unobstructed, single channel that is largely devoid of islands and braided channels. The upstream limit of the study area was located at the tail of a large bend in the river. Within the study section, the river channel broadened and the channel was relatively straight with only subtle meanders present. Downstream from the study section the NSR maintained a relatively straight path for approximately 1.2 km, at which point a more consistent meandering flow pattern became apparent.

A summary of streambank and channel characteristics is presented in Table 3. The average width of the river was 209 m based on measurements taken at 12 transects that were established in the vicinity of the bridge (Figure 2). Depth measurements taken along each transect revealed that most of the habitat was 0.5 m to 1.5 m deep. Figures showing depth profiles along each transect are provided in Appendix D. In general, the streambanks were steeply sloped and exhibited some instability. Streambanks along the left-upstream-bank (LUB) were typically taller and more well-vegetated while banks along the right-upstream-bank (RUB) were more exposed and were shorter. A steep slope extending up to a terrace was a common profile throughout the study section. Photographs showing bank conditions at each transect are provided in Appendix E.

Table 3. Summary of streambank and channel characteristics.

Channel Properties	Upstream of Crossing		Downstream of Crossing	
Wetted Width (m)	214		204	
Depths (m)	See Appendix D			
Streambed Substrate	Fines dominant along LUB Gravels and Cobbles dominant mid-channel and along RUB		Gravels dominant along LUB, coarse substrates dominant mid-channel, Cobbles and Fines dominant along RUB	
Instream Cover	Limited, primarily depth cover with some boulders		Limited, primarily depth cover with some boulders	
Bank Properties	**Left Upstream Bank**	**Right Upstream Bank**	**Left Upstream Bank**	**Right Upstream Bank**
Bank Height (m)	4.1	3.2	2.3	2.2
Bank Angle (º)	78	77	73	58
Bank Cover	Generally absent		Minimal boulders present	
Bank Substrate	Fines	Armoured and Fines	Fines	Mostly Fines
Riparian Vegetation	Generally exposed, some shrubs and trees higher on slope	Generally exposed, some armoured and grass areas	Some exposed areas, grasses and shrubs also present	Some armoured areas, grass predominant further downstream

Approximately 2580 m of the NSR in the vicinity of the Groat Road Bridge was inventoried and mapped. Habitat mapping is delineated on Figure 2 and a summary of the habitat inventory is presented in Table 4. The majority (45.5% of the inventory section) of the habitat was identified as erosional with depositional habitat (35.5%) and armoured habitat (19.0%) comprising the remainder. Overall, erosional habitat was more common on the LUB and depositional habitat was more prevalent on the RUB. Habitat classified as armoured was restricted to a single unit located on the RUB immediately upstream and downstream from the bridge. Streambank and shoreline conditions along this armoured section were generally consistent with the classification criteria for A1 habitat. However, the shoreline substrate was varied, consisting of small coarse material as well as artificial riprap material (broken concrete slabs) which is more typical of A4 habitat. Overall, the determination to classify this area as A1 habitat was based on the fact that the majority of shoreline and bank conditions (fish cover, water depth, and water velocity) was more representative of A1 habitat then A4 habitat.

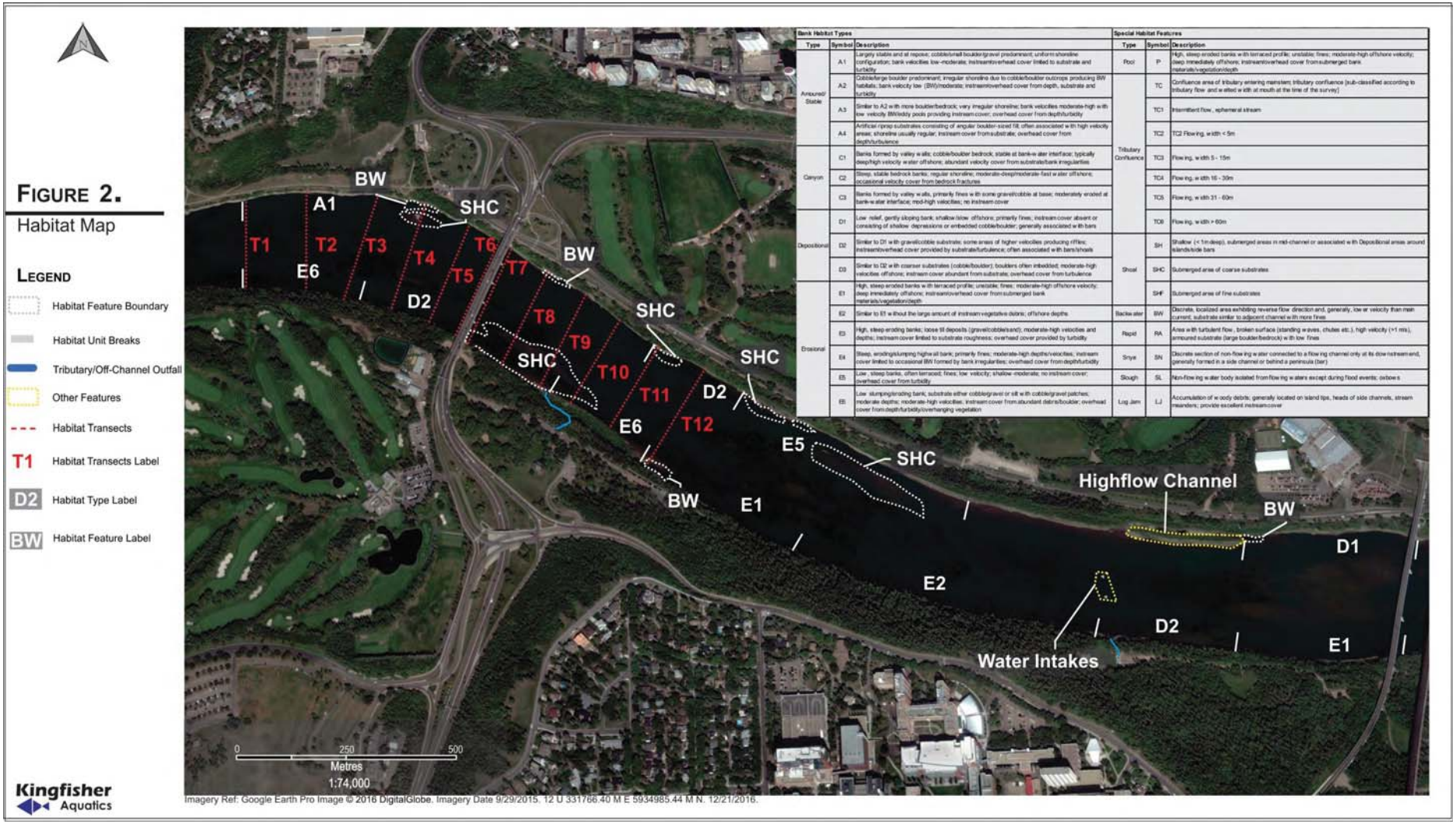
Table 4. Summary of habitat inventory.

Habitat Unit or Feature[1]	Number of Units (#)		Total Combined Length (m)[2]		Percentage of Bank Length (%)	
	RUB	**LUB**	**RUB**	**LUB**	**RUB**	**LUB**
A1	1	0	975	0	38	0
D1	1	0	330	0	13	0
D2	2	2	785	730	30	28
E1	0	3	0	595	0	23
E2	1	0	0	700	0	27
E5	1	0	490	0	19	0
E6	0	2	0	560	0	22
BW	3	1	Not Calculated[3]			
SHC	4	1	Not Calculated[3]			

1 Habitat features are defined on Figure 2

2 Lengths derived from habitat map

3 Habitat Features dimensions were not calculated due to lack of distinct habitat feature boundaries.



Bank Habitat Types

Type	Symbol	Description
Armoured/ Stable	A1	Largely stable and at repose; cobble/small boulder/gravel predominant; uniform shoreline configuration; bank velocities low-moderate; instream/overhead cover limited to substrate and turbidity
	A2	Cobble/large boulder predominant; irregular shoreline due to cobble/boulder outcrops producing BW habitats; bank velocity low (BW)/moderate; instream/overhead cover from depth, substrate and turbidity
	A3	Similar to A2 with more boulder/bedrock; very irregular shoreline; bank velocities moderate-high with low velocity BW/eddy pools providing instream cover; overhead cover from depth/turbidity
	A4	Artificial riprap substrates consisting of angular boulder-sized fill; often associated with high velocity areas; shoreline usually regular; instream cover from substrate; overhead cover from depth/turbulence
Canyon	C1	Banks formed by valley walls; cobble/boulder bedrock; stable at bank-water interface; typically deep/high velocity water off-shore; abundant velocity cover from substrate/bank irregularities
	C2	Steep, stable bedrock banks; regular shoreline; moderate-deep/moderate-fast water off-shore; occasional velocity cover from bedrock fractures
	C3	Banks formed by valley walls, primarily fines with some gravel/cobble at base; moderately eroded at bank-water interface; mod-high velocities; no instream cover
Depositional	D1	Low relief, gently sloping bank; shallow/slow off-shore; primarily fines; instream cover absent or consisting of shallow depressions or embedded cobble/boulder; generally associated with bars
	D2	Similar to D1 with gravel/cobble substrate; some areas of higher velocities producing riffles; instream/overhead cover provided by substrate/turbulence; often associated with bars/shoals
	D3	Similar to D2 with coarser substrates (cobble/boulder); boulders often imbedded; moderate-high velocities off-shore; instream cover abundant from substrate, overhead cover from turbulence
Erosional	E1	High, steep eroded banks with terraced profile; unstable; fines; moderate-high off-shore velocity; deep immediately off-shore; instream/overhead cover from submerged bank materials/vegetation/depth
	E2	Similar to E1 without the large amount of instream vegetative debris; off-shore depths
	E3	High, steep eroding banks; loose till deposits (gravel/cobble/sand); moderate-high velocities and depths; instream cover limited to substrate roughness; overhead cover provided by turbidity
	E4	Steep, eroding/slumping higher till bank; primarily fines; moderate-high depths/velocities; instream cover limited to occasional BW formed by bank irregularities; overhead cover from depth/turbidity
	E5	Low, steep banks, often terraced; fines; low velocity; shallow-moderate; no instream cover; overhead cover from turbidity
	E6	Low slumping/eroding bank; substrate either cobble/gravel or silt with cobble/gravel patches; moderate depths; moderate-high velocities; instream cover from abundant debris/boulder; overhead cover from depth/turbidity/overhanging vegetation

Special Habitat Features

Type	Symbol	Description
Pool	P	High, steep eroded banks with terraced profile; unstable; fines; moderate-high off-shore velocity; deep immediately off-shore; instream/overhead cover from submerged bank materials/vegetation/depth
Tributary Confluence	TC	Confluence area of tributary entering mainstem; tributary confluence [sub-classified according to tributary flow and wetted width at mouth at the time of the survey]
	TC1	Intermittent flow, ephemeral stream
	TC2	TC2 Flowing, width < 5m
	TC3	Flowing, width 5 - 15m
	TC4	Flowing, width 16 - 30m
	TC5	Flowing, width 31 - 60m
	TC6	Flowing, width > 60m
Shoal	SH	Shallow (< 1m deep), submerged areas in mid-channel or associated with Depositional areas around islands/side bars
	SHC	Submerged area of coarse substrates
	SHF	Submerged area of fine substrates
Backwater	BW	Discrete, localized area exhibiting reverse flow direction and, generally, low velocity than main current, substrate similar to adjacent channel with more fines
Rapid	RA	Area with turbulent flow, broken surface (standing waves, chutes etc.), high velocity (>1 m/s), armoured substrate (large boulder/bedrock) with low fines
Snye	SN	Discrete section of non-flowing water connected to a flowing channel only at its downstream end, generally formed in a side channel or behind a peninsula (bar)
Slough	SL	Non-flowing water body isolated from flowing waters except during flood events; oxbows
Log Jam	LJ	Accumulation of woody debris; generally located on island tips, heads of side channels, stream meanders; provide excellent instream cover

The majority of the study area was comprised of moderate depth run habitat with multiple large shoals and small backwaters interspersed throughout the study section (Figure 2). Two small tributary channels that were associated with off-channel outfalls/storm water management systems were located along the left-upstream-bank (LUB) at approximately 200 m and 1400 m downstream of Groat Road Bridge. There was also a dry side channel located on the right-upstream bank and two instream water intakes located near the middle of the channel approximately 1350 m downstream from the bridge (Figure 2). Streambed substrate within the study area varied widely and consisted of a mixture of boulders, cobbles, gravels, and fine materials. Generally, fine substrates were more prevalent in depositional habitats then in erosional habitats and were more common along the margins of the river compared to the centre of the channel.

5.2.1 Water Quality

General water quality parameters were measured a one location within the study section. Results of the analysis are provided in Table 5.

Table 5. Select *in situ* water quality in the North Saskatchewan River near the Groat Road Bridge.

Dissolved Oxygen mg/L	pH	Turbidity (NTU)	Temperature ^{O}C	Specific Conductivity µS/cm
11.87	8.6	4.11	5.0	308.7

5.3 SUMMARY

The reach of the NSR in the vicinity of Edmonton is characterized as rearing and summer feeding habitat and also serves as a migration corridor (ASRD 2008). The shallow to medium depth run habitat that was ubiquitous within the study section, is considered to provide moderate value habitat which is consistent with its Class C designation (AESRD 2012). While lake sturgeon likely move through the area periodically, the habitat assessment did not identify critical habitat for this species within the study area. Many of the sport fish species and larger-bodied non-sport species listed in Table 2 likely utilize the habitat for feeding and as a migratory corridor while forage fish that are common in the NSR likely occupy the study section on a year-round basis. There is some habitat potential for broadcast spawners but no specific attributes were present to suggest that the habitat in the vicinity of the bridge was preferential for spawning. In general, rearing habitat potential was considered to be low in the immediate vicinity of the project since rearing is more likely to occur in suitable microhabitat (i.e. side channels) than in the moderate depth run habitat that was predominant at the bridge site. While some fish may utilize the habitat adjacent to the bridge site during the winter, water depths and velocities were not considered to be optimal for overwintering.

6.0 POTENTIAL IMPACTS AND MITIGATION

6.1 POTENTIAL IMPACTS

The proposed bridge rehabilitation (Alternative 4B) will result in some localized bank disturbances and will require instream construction. As such, the project has potential to affect fisheries resources directly and indirectly. Scoping of potential impacts based on review of proposed plans and consideration of existing conditions and potential fish species utilization resulted in the identification of several main impact pathways that are summarized in Table 6. Analysis of impacts to fish habitat and fish movements associated with the current berm plan are discussed further in Section 6.1.1 and 6.1.2 respectively.

Table 6. Summary of potential impacts to fisheries resources.

Impact Pathway		Potential Impact
Category	**Potential Source**	**Description**
Release of sediment	➢ Clearing of riparian area(s) ➢ Upslope and downslope earthworks ➢ Instream construction	If sediment is not controlled: ➢ Alteration of fish habitat due to fine deposition if sediment ➢ Reduction in food production due to fine deposition ➢ Reduced fish health and/or mortality due to increase in suspended sediments
Release of deleterious substances	➢ Operation of equipment near water ➢ Demolition of existing superstructure ➢ Construction processes (i.e. pouring concrete)	If deleterious substances not contained: ➢ Reduced fish health and/or mortality
Fish entrapment	➢ Creation of isolated pockets of water when installing berms ➢ Impingement of fish in pump intakes	➢ Fish mortality if fish become permanently stranded ➢ Fish mortality if fish are impinged in pumps during dewatering process
Channel constriction	➢ Increased water velocities in river	➢ Impediment to fish movements if water velocities in channel are too swift ➢ Alteration of fish habitat due to scouring
Temporary habitat alteration	➢ Installation of rock berms and access routes	➢ Temporary alteration of habitat ➢ Temporary reduction in habitat availability
Permanent alteration of habitat	➢ Installation of rock berms and access routes	➢ Habitat will be altered if berm material is not completely removed from the channel
Alteration of streambank(s)	➢ Installation of access routes	➢ Temporary alteration of fish habitat

6.1.1 Direct Habitat Disturbance

As identified in Table 6, the berms and access routes that are required to complete the project have potential to result in a direct habitat disturbance (hereafter referred to as a habitat footprint). Information provided in Appendix A outlines the berm sequencing process and provides a figure with the habitat footprint(s) overlain on the project area.

Several instream berms will be constructed to facilitate completion of the project. These access berms will be constructed of rock riprap and will have an instream footprint of approximately 2488 m^2. This footprint will exist in the river for approximately 615 days. As described in the information provided in Appendix A, these berms will be installed and removed in several stages and configurations to facilitate completion of the project while keeping the bridge open to vehicle and pedestrian traffic. In the shorter term, several small cofferdams will be constructed to allow for pier stabilization work to be completed in the dry. Due to local conditions (i.e. steep banks, limited space) in the immediate vicinity of the bridge, a road will need to be constructed along the north side of the river to enable machinery and equipment access to the construction site. Preliminary plans indicate that this access road would be constructed of Class 2 rock riprap and would consist of a 30 m long by 8 m wide access ramp and a 190 m by 6 m wide road. On the south side, a 15 m long by 8 m wide access ramp would be installed to provide access to the construction site. Table 7 provides a breakdown of estimated habitat footprint(s) with associated berm stages and timelines.

Table 7. Summary of potential direct habitat disturbance (habitat footprints).

Project Component	Habitat Footprint	Habitat Description	Duration of Impact (days)
Access Berm Stage 1	2488 m^2 (120 m long by 24 m wide)	Moderate depth run habitat	105
Access Berm Stage 2	2488 m^2 (120 m long by 24 m wide)	Moderate depth run habitat	30
Access Berm Stage 3	2488 m^2 (120 m long by 24 m wide)	Moderate depth run habitat	80
Access Berm Stage 4	1440 m^2 (30 m long by 48 m wide)	Moderate depth run habitat	145
Access Berm Stage 5 Cofferdam	2568 m^2 (120 m long by 24 m wide) (8 m long by 10 m wide)	Moderate depth run habitat	105
Access Berm Stage 6	2488 m^2 (120 m long by 24 m wide)	Moderate depth run habitat	30
Berm Stage 7 Cofferdams	2648 m^2 (120m long by 24 m wide) (8 m long by 10 m wide) (8 m long by 10 m wide)	Moderate depth run habitat	120
South Access Route	120 m^2 (15 m long by 8 m wide)	Shoal habitat, shallow run habitat	615
North Access Route	1380 m^2 (30 m long by 8 m wide) (190 m long by 6 m wide)	Shoal habitat, shallow run habitat	365

6.1.2 Fish Movements

The access berms will constrict the channel which has potential to increase water velocities in the NSR. As described in Table 1 and Appendix A, the berms will only be at full size during the later summer to late winter period and as such water velocities are not expected to be significantly impacted during the spring spawning period.

Fish typically move throughout rivers to complete aspects of their life cycles including spawning, feeding, and to seek refuge from predators or harmful environmental conditions. Fish swimming capabilities differ depending on fish species, developmental stage of the fish, and physical factors such as water temperature. In general, fish swimming performance is assessed based on burst speed (up to 20 seconds), prolonged speed (up to 30 minutes), and sustained speed (prolonged indefinitely) (Kadopodis and Gervais 2016).

Northwest Hydraulic Consultants Ltd. (NHC) assessed hydraulic conditions for the proposed berm arrangement (NHC 2016). Their assessment provided information on predicted water velocities, flow depths and water levels at the bridge site based on a discharge of 343 m^3/s, which corresponds to a 2-year open water flow event. The 1D model predicts that average water velocities at the bridge during the baseline case are approximately 1 m/s and that velocities will increase by approximately 70% when the south berm is in place and will almost double when the north berm is in the river (NHC 2016). However, the 2D modelling

shows that while water velocities will increase within the constricted area, there will be areas of slower velocities (<1m/s) that will persist along the margins of the channel, along the berms, and adjacent to some of the existing piers (NHC 2016). In addition, there will be backwater areas immediately upstream and downstream of the berm(s) (NHC 2016). Kadopodis and Gervais (2016) provide an extensive summary of existing information on fish swimming performance including significant speed-time regression for six fish groups. These fatigue curves show that adult walleye, pike, and sturgeon can all swim for prolonged periods at 1m/s or more (Kadopodis and Gervais 2016). Adult sturgeon have burst speeds approaching 2 m/s while pike and walleye have burst speeds of approximately 3m/s and 5m/s respectively (Kadopodis and Gervais 2016).

Overall, it does not appear that the proposed access berms will impede critical fish movements considering the time of year that the berm(s) will be in place, the life history and swimming capability of the fish species that occupy this section of the NSR, and the 2D hydraulic model that shows how lower velocity pathways will exist through the constricted area. As such, there is no need for mitigation provided that the berm(s) are installed as currently designed and the installation schedule is adhered to.

6.2 MITIGATION

Potential impacts to fisheries resources as a result of the project can be mitigated through implementation of best management practices (BMP's) and specific management/protection plans as described below.

Scheduling of Instream Work

Given the potential for lake sturgeon and other spring spawning species to occupy the NSR in the vicinity of the project, Dialog has developed a construction schedule that avoids completion of any instream work during the spring period (Appendix B).

Instream Access Plan

Dialog has prepared a conceptual access plan to facilitate the remediation work (Appendix A). Recommendations for mitigation actions to be used in conjunction with the access plan include:

- The access berms will be constructed of rock riprap. Loose earthen material such as clay will not be used for the access berm.
- Floating silt curtains or silt booms will be deployed downstream of the berm during installation or removal of berms.
- The berms will be designed to have the smallest feasible footprint while still providing adequate room to complete the work.
- Quantities will be tracked to ensure that all berm material is removed from the channel at the end of the project.
- Placement of the rock material will be conducted in a strategic manner to limit potential mobilization of fine sediments
- The berm will be installed in a manner to minimize the risk of fish becoming entrapped in isolated areas.

Cofferdams

- If possible, the cofferdam will be constructed using sheet pilings.
- If it is determined that sheet pilings are not technically feasible then an earthen cofferdam may need to be used. For an earthen cofferdam:
    - The berm material should have high plasticity.
    - The cofferdam area must be isolated from flowing water in the NSR before placing earthen material. This can be achieved by installing a rock berm around the cofferdam area, by installing floating silt curtains around the cofferdam area, or by other means deemed acceptable by a professional biologist.
    - The earth cofferdam must be armoured with appropriately sized rock riprap.
    - Turbidity monitoring must be conducted during the instream portion of the work.
    - A fish salvage of the isolated area must be completed.
    - Quantities must be tracked to ensure that all earthen material is removed from the NSR.

Erosion and Sediment Control

- Minimize disturbances to streambanks.
- Ensure that an erosion and sediment control plan is developed and implemented for the duration of the project.
- BMP's outlined in the City of Edmonton's Erosion and Sediment Control guidelines (2005) and manual (2005) should be implemented as required based on site conditions.

Containment of Deleterious Substances

- Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds.
- Ensure that equipment used within 100 m of the NSR is equipped with environmentally-sensitive hydraulic fluids that are non-toxic to aquatic life and that are readily or inherently biodegradable;
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.
- Develop a spill response plan.

Turbidity Monitoring

A turbidity monitoring program should be designed and implemented for this project. The details of the monitoring program should be determined prior to initiating work. At a minimum, the monitoring program should incorporate the following:

- A Qualified Aquatic Environment Specialist (QAES) should be retained to develop and implement the program.
- An equation that explains the relationship between turbidity and total suspended solids (TSS) should be developed prior to initiating instream works.
- The program should outline frequency of monitoring during specific phases of the project.
- The program should identify a suitable background sample site located upstream of the project and a minimum of three compliance sample sites located downstream of the project.
- The program should define exceedance criteria.
- The program should define response actions and protocols in the event that an exceedance occurs.

Fish Capture and Release Plan

A Fish Capture and Release (FC&R) plan should be developed so that it can be implemented in the event that fish become entrapped during berm and/or cofferdam construction. If a pump is used to de-water fish bearing areas, then the pump intake should be screened in accordance with DFO End-of-pipe fish screen guidelines (DFO 1995) to avoid fish impingement and/or entrainment.

General Measures to Avoid Harm

Standard BMP's described below should be implemented as deemed necessary depending on project details and local conditions:

- Clearing of riparian vegetation should be kept to a minimum.
- Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark.
- Immediately stabilize shoreline or banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site.
- Restore bed and banks of the waterbody to their original contour and gradient. Where original bank form can not be restored due to instability, establish a new gradient that maintains bank stability and does not encroach on fish habitat.
- If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, then ensure that appropriately-sized, clean rock is used; and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Remove all construction materials from site upon project completion.
- Implementation of practices outlined in DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (2013).

6.3 SUMMARY OF POTENTIAL IMPACTS AND MITIGATION

In general, potential impacts to fisheries resources arising from the Groat Road Bridge Alternative 4B Rehabilitation Option can be mitigated through implementation of established BMP's. Table 8 provides a summary of potential impacts and recommended mitigation. Based on this analysis, and assuming that all mitigation is implemented as described, there is potential for the temporary instream footprint associated with the access berms and access roadway to result in serious harm to fish. Additional analysis of the potential for serious harm to fish is provided in Section 6.4.

Table 8. Summary of potential impacts and mitigation.

Impact Category	Mitigation	Potential for Residual Impact to Result in Serious Harm to Fish
Release of sediment	➢ Instream construction timing to avoid sensitive periods for fish ➢ Site isolation ➢ Use of clean riprap to form berms ➢ Turbidity monitoring ➢ Minimize riparian disturbance ➢ Erosion and sediment control plan ➢ Implement BMP's	Not expected
Release of deleterious substances	➢ Clean equipment, use of spill plans, implement bmp's ➢ Spill response plan	Not expected
Fish entrapment	➢ Instream access plan that avoids entrapment ➢ Fish capture and release plan	Not expected
Channel constriction	➢ Hydrological modelling to assess potential impact on water velocities	Not expected
Alteration of streambank	➢ Minimize temporal and physical impact ➢ Rehabilitate in a timely manner	Not expected
Temporary alteration of habitat and reduction in fish habitat availability	➢ Minimize temporal and physical berm footprint	Possible, additional analysis required

6.4 POTENTIAL SERIOUS HARM TO FISH

Section 35 of the Fisheries Act states that *No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal* [CRA] *fishery, or to fish that support such a fishery*

DFO interprets Serious Harm to Fish as:

- the **death of fish**;
- a **permanent alteration** to fish habitat of a spatial scale, duration or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes;
- the **destruction of fish habitat** of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.

Considering these criteria in conjunction with the results of the impact assessment presented in Table 8; it was determined that the project is unlikely to result in either the death of fish or a permanent alteration of fish habitat assuming that all recommended mitigation measures are strictly adhered to. However, the impact assessment process indicated that additional analysis was necessary to determine whether the temporary loss of fish habitat constituted destruction of fish habitat that would be considered serious harm to fish. Details of this analysis are presented in Table 9.

Table 9. Analysis of potential for serious harm to fish as a result of destruction of fish habitat.

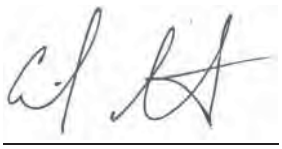
Criteria	Key Indictors	Assessment
Spatial Scale & Duration of Impact	➢ 2488 m^2 berm in place for approximately 470 days ➢ 80 m^2 berm extension in place for approximately 45 days ➢ 160 m^2 berm extension in place for approximately 55 days ➢ 1440 m^2 berm in place for 145 days (stored berm material) ➢ 120 m^2 south access route in place for 615 days ➢ 1380 m^2 north access route in place for 365 days ➢ Maximum instream footprint of <4100 m^2 at any given time. This represents less than 1% of the habitat available within the study section	➢ Small Spatial Scale ➢ Short Duration
Intensity of Impact	➢ Berm provides no potential for habitat utilization	➢ High
Habitat Utility	➢ Habitat is moderately sensitive ➢ Habitat is not rare ➢ Habitat is resilient ➢ Habitat is not unique or critical to fish species	➢ Low to Moderate
Probability of Serious Harm to Fish Key Rationale: ➢ The project footprint is small (<1% of the habitat available in the study area). ➢ The impact is short-term (impact will exist for <3% of the 75-year lifespan of the bridge). ➢ The impacted habitat is: • not unique or in short supply in the NSR; • not considered critical habitat for fish known to occupy the area. ➢ Post-project the habitat utility is expected to quickly return to pre-disturbance condition		**LOW**

Based on the analysis conducted, the project is considered to have a low probability of resulting in serious harm to fish. **However, it is recommended that a Request for Review be submitted to DFO before proceeding with the project.**

7.0 CLOSURE

We trust that the information presented in this report meets your requirements. If you have any questions or comments, please contact the undersigned.

Kingfisher Aquatics Ltd.



Erik Stemo, P.Biol.
Senior Fisheries Biologist
Project Manager

Scott Holroyd, P.Biol
Senior Fisheries Biologist
Project Biologist

8.0 REFERENCE

Alberta Environment and Parks. 2017. Alberta Wild Species Status Search – Common Name "Spoonhead Sculpin". Obtained from http://aep.alberta.ca/fish-wildlife/species-at-risk/wild-species-status-search.aspx. Accessed on February 1, 2017.

Alberta Environment Sustainable Resource Development. 2012. Code of Practice for Watercourse Crossings – St. Paul Management Area Map. Prepared by Resource Information Management Branch, Corporate Services Division. November 2012. Queen's Printer For Alberta. Edmonton, Alberta.

Alberta Environment Sustainable Resource Development. 2013. Code of Practice for Watercourse Crossings (Made under the Water Act and the Water (Ministerial) Regulation. Consolidated to include amendments in force as of June 24, 2013. Queen's Printer For Alberta. Edmonton, Alberta.

Alberta Sustainable Resource Development. 2002. Status of the Lake Sturgeon (Acipenser fulvescens) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 46, Edmonton, AB. 30 pp.

Alberta Sustainable Resource Development. 2008. Fisheries Management Objectives of the North Saskatchewan River. 52pp.

Alberta Transportation (AT). 2009. Fish Habitat Manual – Guidelines & Procedures for Watercourse Crossings in Alberta. Alberta Transportation, Edmonton, Alberta.

Allan, J.H. 1984. The Fish and Fisheries of the North Saskatchewan River Basin; Their Status and Environmental Requirements. Report of Pisces Environmental Consulting Services Ltd. prepared for Alberta Environment. Edmonton, Alberta. 190 pp.

City of Edmonton. 2005. Erosion and Sediment Control Guidelines.

City of Edmonton. 2005. Erosion and Sediment Control Field Manual.

COSEWIC. 2016. Canadian Wildlife Species at Risk, Committee on the Status of Endangered Wildlife in Canada. Website: http://www.registrelep.gc.ca/default.asp?lang=En&n=6A538543-1&offset=1&toc=show. Accessed on February 1, 2017.

Dialog. 2016. Groat Road Bridge over the North Saskatchewan river (B059) Bridge Rehabilitation Preliminary Engineering Report. Prepared for City of Edmonton. 28 pp + App.

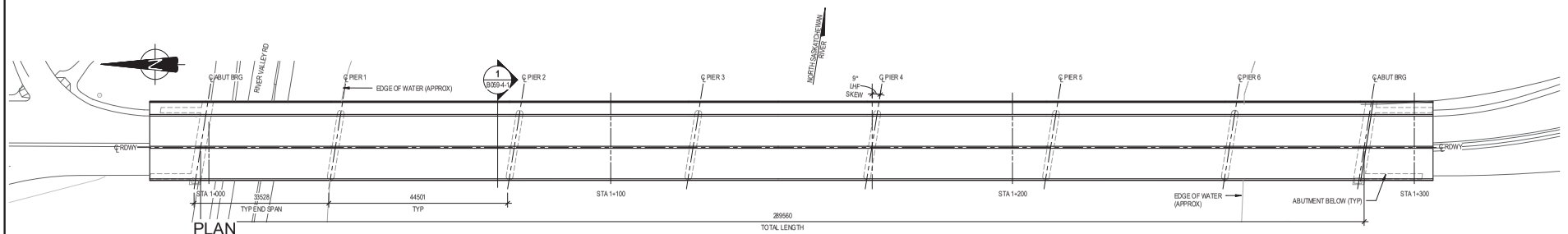
Fisheries and Oceans Canada. 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Ottawa, Ontario. 20p +App.

Northwest Hydraulic Consultants. 2016. Groat Road Bridge Rehabilitation Hydrotechnical Assessment of Berms – 2D Modelling. Prepared for Dialog Design, Edmonton, Alberta. 11pp. + App.

SARA Public Registry. 2017. Species at Risk Public Registry – Species Index. Last Modified 2017-02-08. Website: http://www.registrelep.gc.ca/sar/index/default_e.cfm. Accessed February 9, 2017.

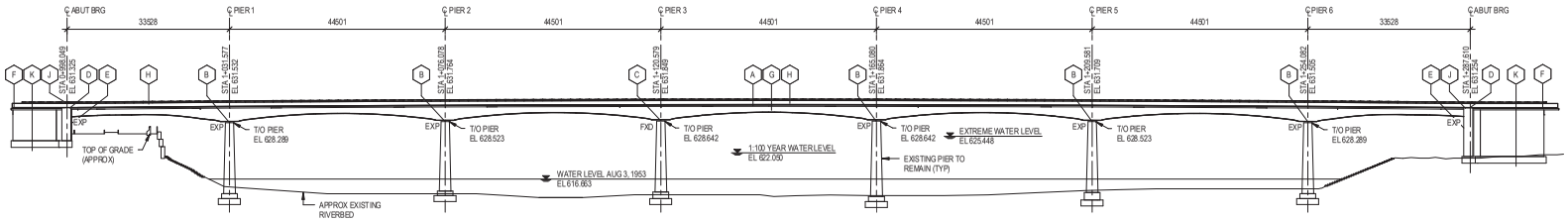
Appendix A

Design and Construction Information



PLAN

SCALE: 1 : 500



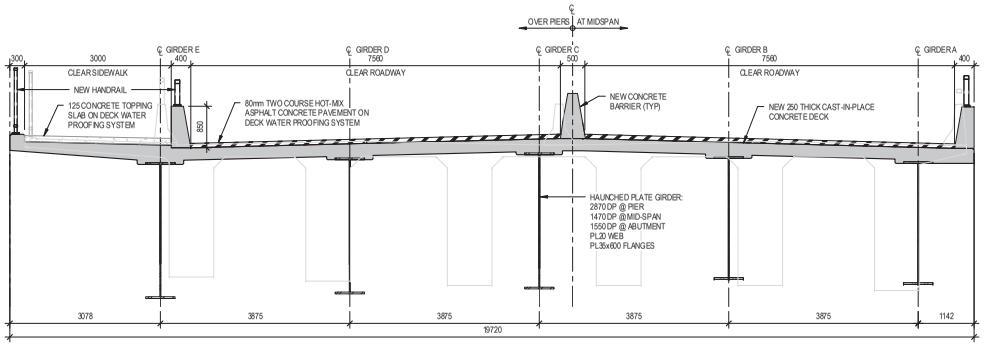
ELEVATION

SCALE: 1 : 500 LOOKING EAST

GENERAL SCOPE OF WORK

(CONSTRUCTION SEQUENCE MAY VARY)

- A — DEMOLISH EXISTING DECK AND GIRDERS.
- B — INSTALL NEW EXPANSION BEARINGS.
- C — INSTALL NEW FIXED BEARINGS.
- D — REMOVE AND REPLACE ABUTMENT SEAT, BEARINGS, ROOF SLAB, AND BEAMS. ADD FOUR NEW ABUTMENT SUPPORT PILES AT SOUTH ABUTMENT ONLY. REFER TO SHEET B059-4-4 AND DETAIL 1/B059-4-5.
- E — REMOVE, REHABILITATE, AND RECONSTRUCT FIELDSTONE FACING SLABS.
- F — REALIGN ROADWAY AT ABUTMENTS.
- G — INSTALL NEW STEEL PLATE GIRDERS.
- H — INSTALL NEW CONCRETE DECK, BARRIERS, RAILINGS, AND DRAINS. INSTALL NEW ASPHALT SURFACE AND WATERPROOFING SYSTEM.
- J — INSTALL NEW ABUTMENT DECK JOINT.
- K — INSTALL UNDERGROUND OIL GRIT SEPARATORS AT EACH ABUTMENT.



1 / B059-4-V

SECTION

SCALE: 1 : 50

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-01-20

DESIGNED SAO DATE 2017-01-20

CHECKED NSR DATE 2017-01-20

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES

TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

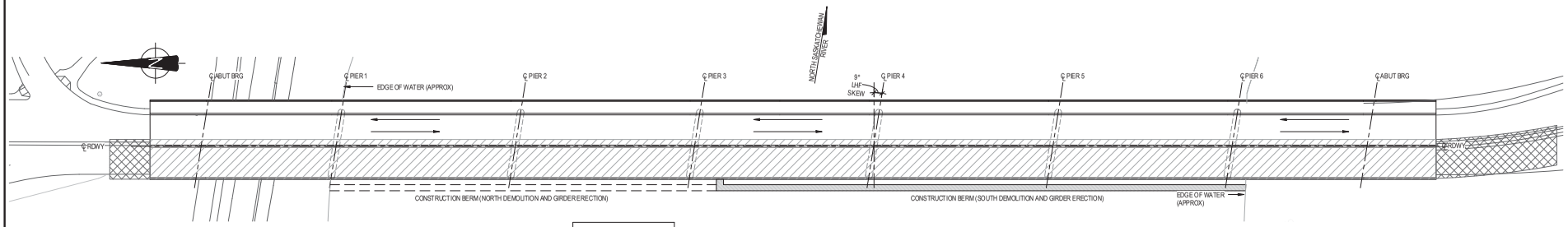
GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION ALTERNATIVE 4

GENERAL ARRANGEMENT

DRAWING

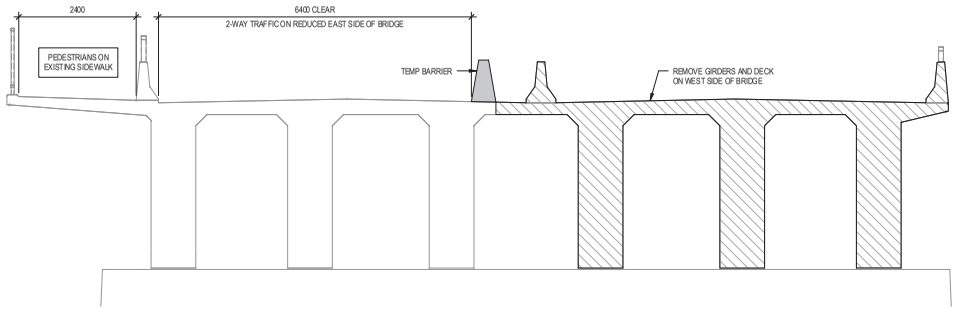
B059-4-1



PLAN

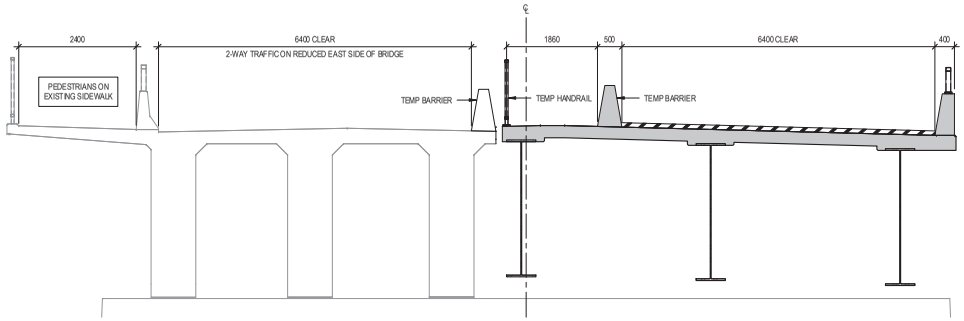
SCALE: 1 : 500

LEGEND
BRIDGE CONSTRUCTION
LAYDOWN AREA



1 (B059-4-2) SECTION - PHASE 1 DEMOLITION

SCALE: 1 : 50



2 (B059-4-2) SECTION - PHASE 1 CONSTRUCTION

SCALE: 1 : 50

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-01-20

DESIGNED SAO DATE 2017-01-20

CHECKED NSR DATE 2017-01-20

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES

TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

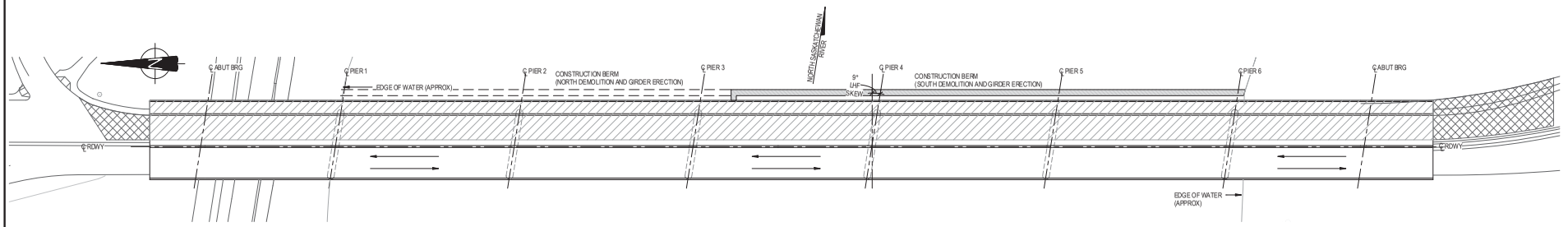
GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION ALTERNATIVE 4

STAGING PLAN - PHASE 1

DRAWING

B059-4-2

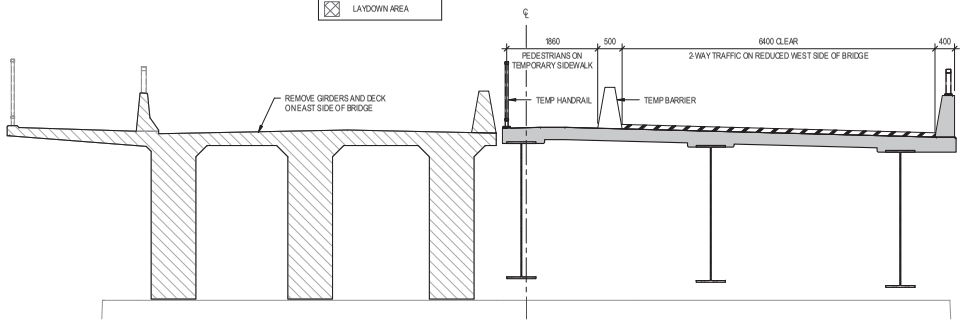


PLAN

SCALE: 1 : 500

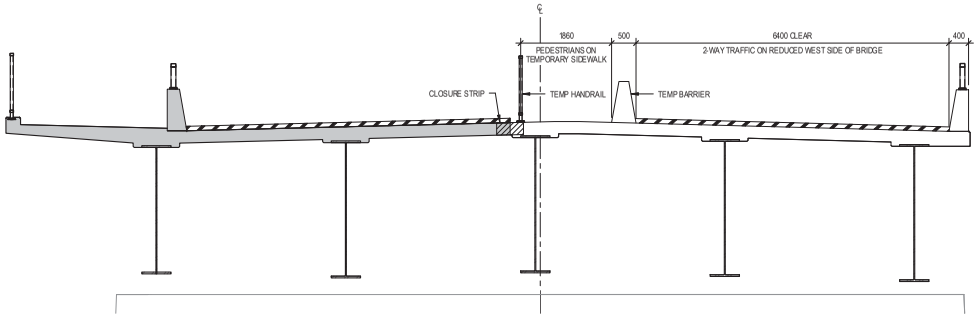
LEGEND

- BRIDGE CONSTRUCTION
- LAYDOWN AREA



1 (B059-4-3) SECTION - PHASE 2 DEMOLITION

SCALE: 1 : 50



NOTE:
AFTER PHASE 2 GIRDERS, DECK, AND ACP ARE CONSTRUCTED, TEMPORARY HANDRAIL AND BARRIER TO BE REMOVED AND CENTRE MEDIAN BARRIER AND PAVING TO BE COMPLETED.

2 (B059-4-3) SECTION - PHASE 2 CONSTRUCTION

SCALE: 1 : 50

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-01-20

DESIGNED SAO DATE 2017-01-20

CHECKED NSR DATE 2017-01-20

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES

TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

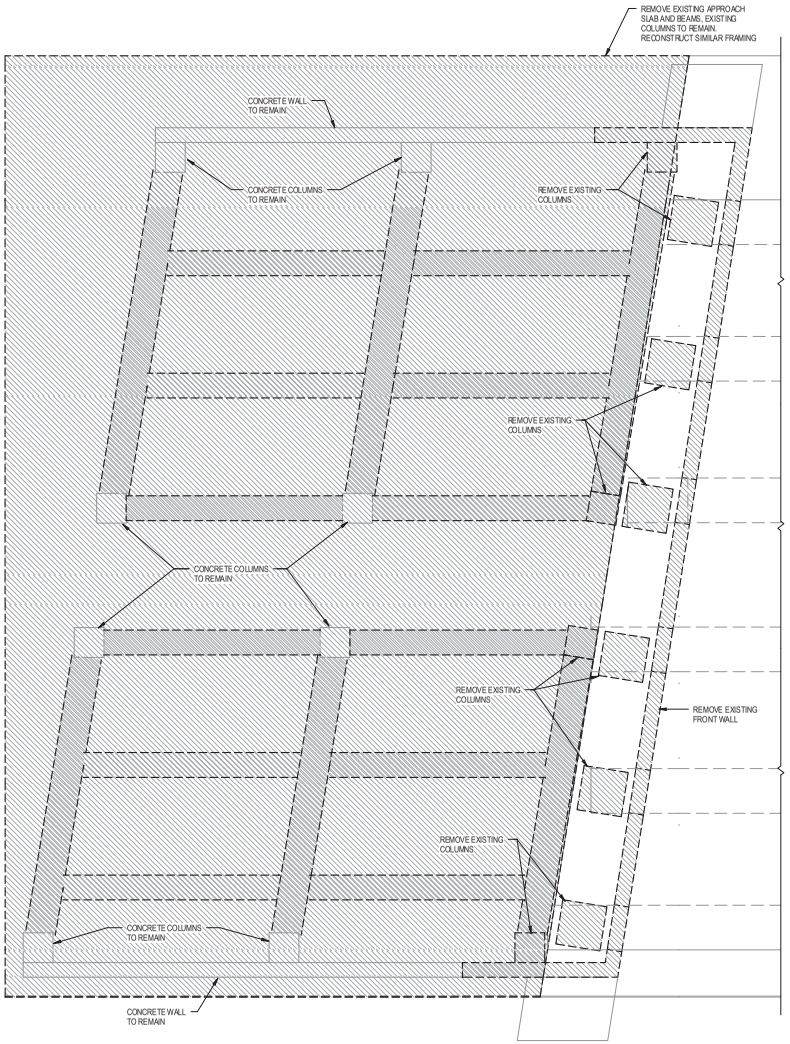
GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION ALTERNATIVE 4

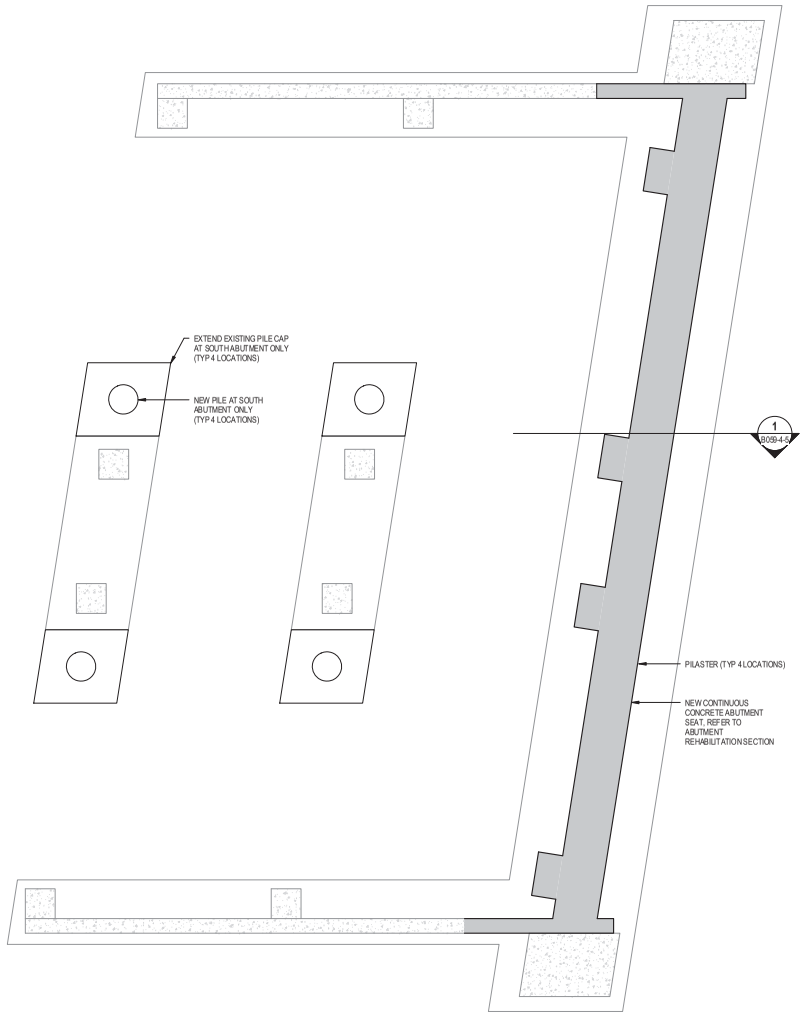
STAGING PLAN - PHASE 2

DRAWING

B059-4-3



1 B059-4-4 DEMOLITION PLAN - APPROACH SLAB
SCALE: 1 : 50



2 B059-4-4 CONSTRUCTION PLAN - APPROACH SLAB
SCALE: 1 : 50

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.
CONTRACT NO.

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

DIALOG

APPROVED FOR CONSTRUCTION
DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE
MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

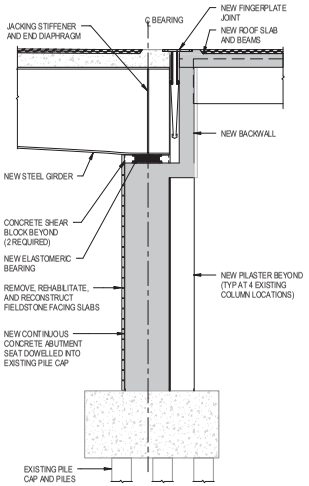
SURVEY
JOB NO
SCALE
HOR
VER

DRAWN MTC DATE 2017-01-20
DESIGNED SAO DATE 2017-01-20
CHECKED NSR DATE 2017-01-20

THE CITY OF Edmonton
INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT
GROAT ROAD OVER N SASKATCHEWAN RIVER
REHABILITATION ALTERNATIVE 4
ABUTMENT REHABILITATION

DRAWING
B059-4-4



1 / B059-4-5 SECTION - ABUTMENT REHABILITATION

SCALE: 1 : 50

NO.	REVISIONS	BY	DATE	APP'D

PROGRAM NO.

CONTRACT NO.

NO.	ISSUE	BY	DATE

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-01-20

DESIGNED SAO DATE 2017-01-20

CHECKED NSR DATE 2017-01-20

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES

TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

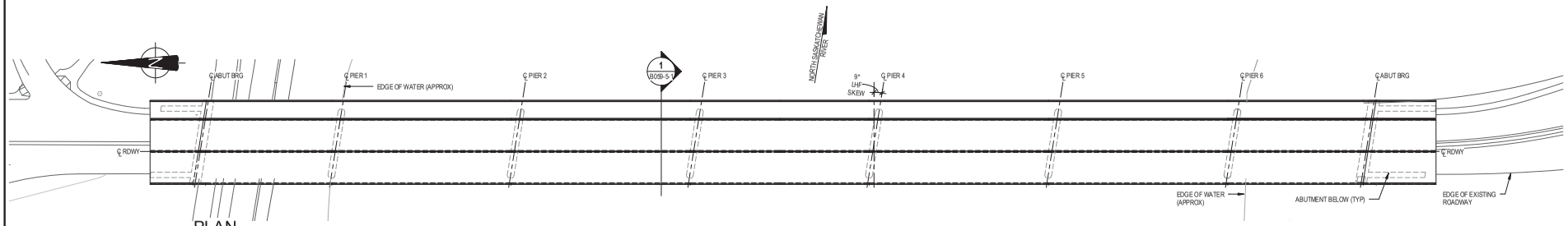
GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION ALTERNATIVE 4

SECTIONS AND DETAILS

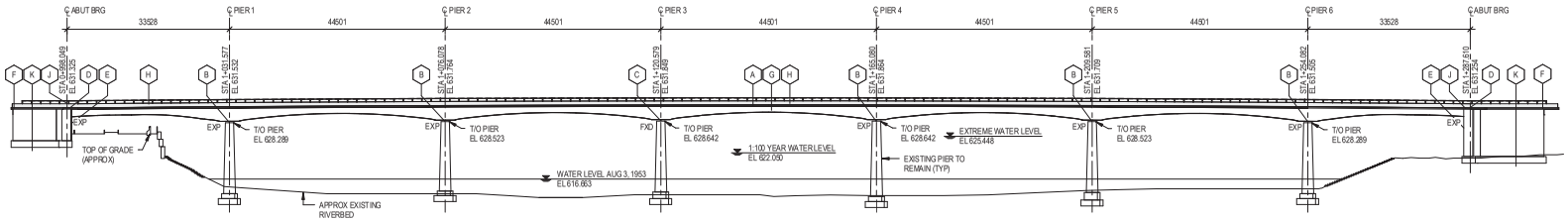
DRAWING

B059-4-5



PLAN

SCALE: 1 : 500



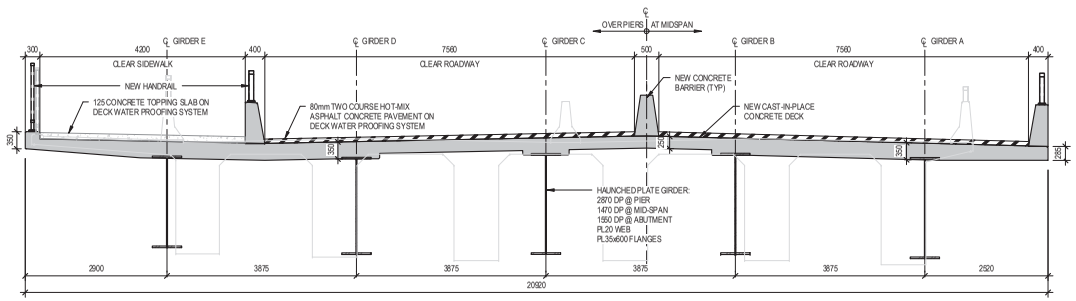
ELEVATION

SCALE: 1 : 500 LOOKING EAST

GENERAL SCOPE OF WORK

(CONSTRUCTION SEQUENCE MAY VARY)

- A — DEMOLISH EXISTING DECK AND GIRDERS.
- B — INSTALL NEW EXPANSION BEARINGS.
- C — INSTALL NEW FIXED BEARINGS.
- D — REMOVE AND REPLACE ABUTMENT SEAT, BEARINGS, ROOF SLAB, AND BEAMS. ADD FOUR NEW ABUTMENT SUPPORT PILES AT SOUTH ABUTMENT ONLY. REFER TO SHEET B059-4-4 AND DETAIL 1/B059-4-5.
- E — REMOVE, REHABILITATE, AND RECONSTRUCT FIELDSTONE FACING SLABS.
- F — REALIGN ROADWAY AT ABUTMENTS.
- G — INSTALL NEW STEEL PLATE GIRDERS.
- H — INSTALL NEW CONCRETE DECK, BARRIERS, RAILINGS, AND DRAINS. INSTALL NEW ASPHALT SURFACE AND WATERPROOFING SYSTEM.
- J — INSTALL NEW ABUTMENT DECK JOINT.
- K — INSTALL UNDERGROUND OIL GRIT SEPARATORS AT EACH ABUTMENT.



1 B059-5-1 SECTION

SCALE: 1 : 50

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-01-20

DESIGNED SAO DATE 2017-01-20

CHECKED NSR DATE 2017-01-20

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES

TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION ALTERNATIVE 4B

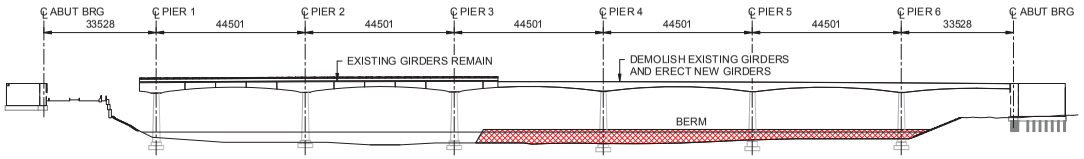
GENERAL ARRANGEMENT

DRAWING

B059-5-1

BERM STAGE 1
(ESTIMATED CONSTRUCTION SCHEDULE)

1. INSTALL BERM FROM SOUTH SIDE - APPROX 60% OF RIVER WIDTH - LATE AUGUST 2018
2. DEMOLISH WEST GIRDERS FROM SOUTH ABUTMENT TO PIER #3 - SEPTEMBER 2018
3. ERECT WEST GIRDERS FROM SOUTH ABUTMENT TO PIER #4 - OCTOBER 2018



ELEVATION

1 : 750

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC 2017-03-16

DESIGNED SAO 2017-03-16

CHECKED NSR 2017-03-16

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION AND SUPERSTRUCTURE REPLACEMENT

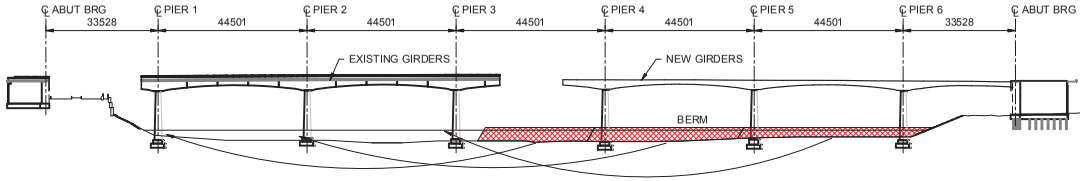
BERM STAGE 1

DRAWING

B059-BERM-1

BERM STAGE 2
(ESTIMATED CONSTRUCTION SCHEDULE)

1. MOVE BERM FROM SOUTH HALF OF THE RIVER TO NORTH HALF OF RIVER INSTREAM - NOVEMBER 2018



ELEVATION

1 : 750

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-03-16

DESIGNED SAO DATE 2017-03-16

CHECKED NSR DATE 2017-03-16

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION AND SUPERSTRUCTURE REPLACEMENT

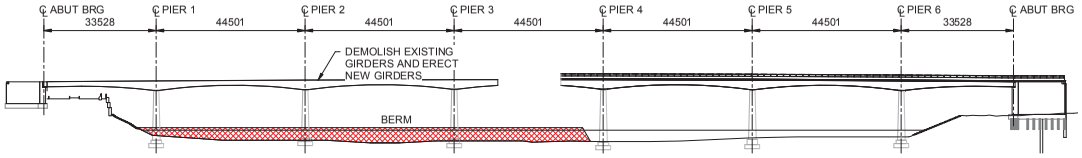
BERM STAGE 2

DRAWING

B059-BERM-2

BERM STAGE 3
(ESTIMATED CONSTRUCTION SCHEDULE)

1. CONSTRUCT NORTH CONSTRUCTION ACCESS ROAD
2. DEMOLISH NORTHWEST GIRDERS - DECEMBER 2018
3. ERECT NORTHWEST STEEL GIRDERS - JANUARY 2019



ELEVATION

1 : 750

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.
CONTRACT NO.

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

DIALOG

APPROVED FOR CONSTRUCTION
DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE
MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY
JOB NO
SCALE
HOR
VER

DRAWN MTC DATE 2017-03-16
DESIGNED SAO DATE 2017-03-16
CHECKED NSR DATE 2017-03-16

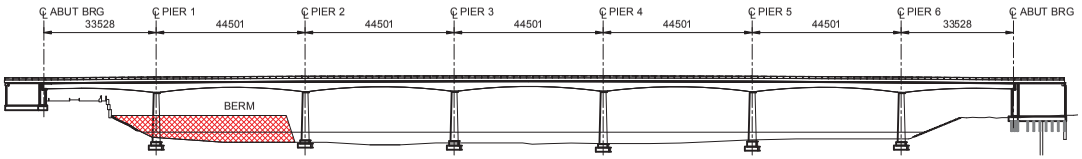
THE CITY OF Edmonton
INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT
GROAT ROAD OVER N SASKATCHEWAN RIVER
REHABILITATION AND SUPERSTRUCTURE REPLACEMENT
BERM STAGE 3

DRAWING
B059-BERM-3

BERM STAGE 4
(ESTIMATED CONSTRUCTION SCHEDULE)

1. SHIFT BERM MATERIAL AGAINST NORTH BANK - FEBRUARY 2019
2. STORE BERM MATERIAL AGAINST NORTH BANK - FEBRUARY TO AUGUST 2019



ELEVATION

1 : 750

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC 2017-03-16

DESIGNED SAO 2017-03-16

CHECKED NSR 2017-03-16

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT

GROAT ROAD OVER N SASKATCHEWAN RIVER

REHABILITATION AND SUPERSTRUCTURE REPLACEMENT

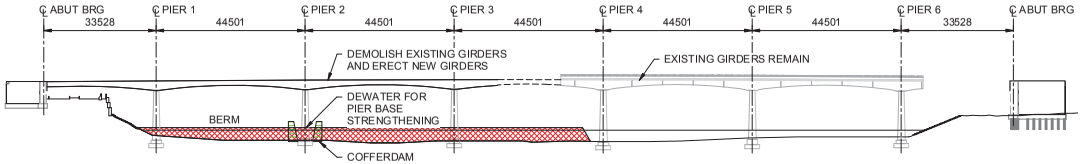
BERM STAGE 4

DRAWING

B059-BERM-4

BERM STAGE 5
(ESTIMATED CONSTRUCTION SCHEDULE)

1. EXTEND BERM BELOW NORTHEAST GIRDERS - LATE AUGUST 2019
2. DEMOLISH EAST GIRDERS FROM NORTH ABUTMENT TO PIER #4 - SEPTEMBER 2019
3. ERECT EAST GIRDERS FROM NORTH ABUTMENT TO PIER #3 - OCTOBER 2019



ELEVATION

1 : 750

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-03-16

DESIGNED SAO DATE 2017-03-16

CHECKED NSR DATE 2017-03-16

THE CITY OF Edmonton

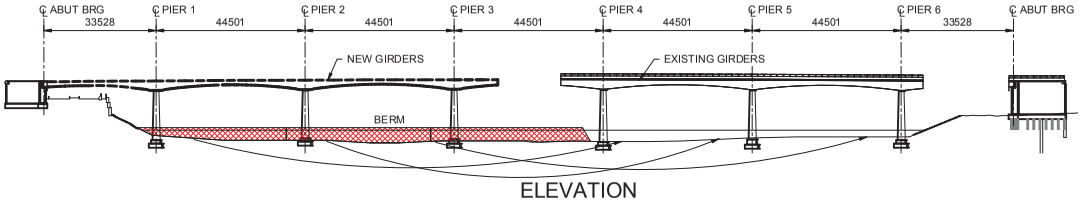
INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT
GROAT ROAD OVER N SASKATCHEWAN RIVER
REHABILITATION AND SUPERSTRUCTURE REPLACEMENT
BERM STAGE 5

DRAWING
B059-BERM-5

BERM STAGE 6
(ESTIMATED CONSTRUCTION SCHEDULE)

1. MOVE BERM FROM NORTH HALF OF THE RIVER TO SOUTH HALF OF RIVER INSTREAM - NOVEMBER 2019
2. REMOVE NORTH CONSTRUCTION ACCESS ROAD AND RAMP - DECEMBER 2019



ELEVATION

1 : 750

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-03-16

DESIGNED SAO DATE 2017-03-16

CHECKED NSR DATE 2017-03-16

THE CITY OF Edmonton

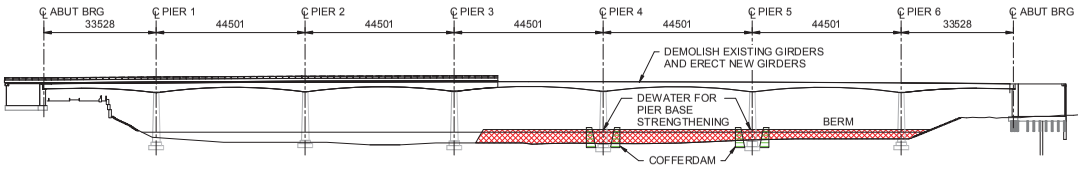
INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT
GROAT ROAD OVER N SASKATCHEWAN RIVER
REHABILITATION AND SUPERSTRUCTURE REPLACEMENT
BERM STAGE 6

DRAWING
B059-BERM-6

BERM STAGE 7
(ESTIMATED CONSTRUCTION SCHEDULE)

1. DEMOLISH BALANCE OF BRIDGE - DECEMBER 2019
2. ERECT REMAINING STEEL GIRDERS - JANUARY 2020
3. REMOVE ALL BERM AND RAMP MATERIAL - FEBRUARY 2020



ELEVATION

1 : 750

NO.	REVISIONS	BY	DATE	APP'D

NO.	ISSUE	BY	DATE

PROGRAM NO.

CONTRACT NO.

CONSTRUCTION RETURN

CONTRACTOR

SURVEYOR

DATE

FILE NUMBER

CONSTRUCTION ENGINEER DATE

GENERAL SUPERVISOR DATE

DIALOG

APPROVED FOR CONSTRUCTION

DATE

DEPARTMENT / BRANCH	APPROVAL	DATE

DIRECTOR OF TRANSPORTATION INFRASTRUCTURE DATE

MANAGER OF TRANSPORTATION INFRASTRUCTURE DATE

SURVEY

JOB NO

SCALE

HOR

VER

DRAWN MTC DATE 2017-03-16

DESIGNED SAO DATE 2017-03-16

CHECKED NSR DATE 2017-03-16

THE CITY OF Edmonton

INTEGRATED INFRASTRUCTURE SERVICES
TRANSPORTATION INFRASTRUCTURE BRANCH

PROJECT
GROAT ROAD OVER N SASKATCHEWAN RIVER
REHABILITATION AND SUPERSTRUCTURE REPLACEMENT
BERM STAGE 7

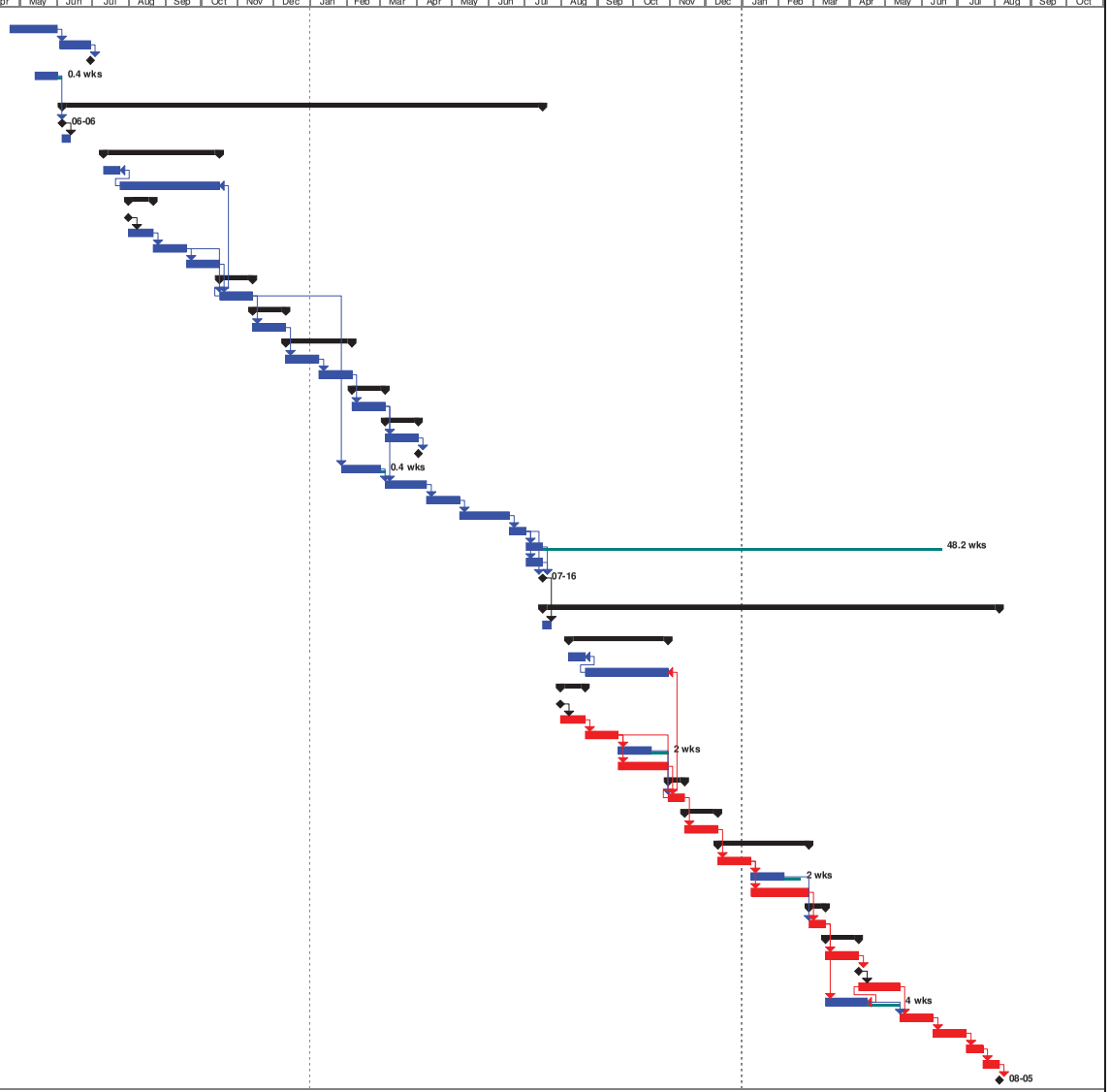
DRAWING
B059-BERM-7

Appendix B

Construction Schedule

Groat Road Bridge - Option 4 - With Pier Modifications - Upper and Lower

ID	Task Name	Duration	Start	Finish
1				
2	Tender Period	6 wks	Mon 18-04-23	Fri 18-06-01
3	Tender Evaluation	4 wks	Mon 18-06-04	Fri 18-06-29
4	Contract Award	0 days	Fri 18-06-29	Fri 18-06-29
5	Move Utilities	3 wks	Mon 18-05-14	Fri 18-06-01
6				
7	**WEST Side Work - 2018 / 2019**	**290 days**	**Wed 18-06-06**	**Tue 19-07-16**
8	Mobilize to site	0 days	Wed 18-06-06	Wed 18-06-06
9	Implement Traffic Control	1 wk	Wed 18-06-06	Tue 18-06-12
10	**Stage 1**	**70 days**	**Wed 18-07-11**	**Wed 18-10-17**
11	Demo End Spans	2 wks	Wed 18-07-11	Wed 18-07-25
12	Abutment Reconstruction	12 wks	Wed 18-07-25	Wed 18-10-17
13	**Stage 2**	**15 days**	**Wed 18-08-01**	**Tue 18-08-21**
14	In Stream Window Open	0 days	Wed 18-08-01	Wed 18-08-01
15	Install Berm	3 wks	Wed 18-08-01	Tue 18-08-21
16	Demo spans 2, 3 and 4	4 wks	Wed 18-08-22	Tue 18-09-18
17	Pier Modifications	4 wks	Wed 18-09-19	Tue 18-10-16
18	**Stage 3**	**20 days**	**Wed 18-10-17**	**Tue 18-11-13**
19	Erect South Girders - 3 spans	4 wks	Wed 18-10-17	Tue 18-11-13
20	**Stage 4**	**20 days**	**Wed 18-11-14**	**Tue 18-12-11**
21	Move berm to north side	4 wks	Wed 18-11-14	Tue 18-12-11
22	**Stage 5**	**40 days**	**Wed 18-12-12**	**Tue 19-02-05**
23	Demo north spans	4 wks	Wed 18-12-12	Tue 19-01-08
24	Pier Modifications	4 wks	Wed 19-01-09	Tue 19-02-05
25	**Stage 6**	**20 days**	**Wed 19-02-06**	**Tue 19-03-05**
26	Erect North Girders	4 wks	Wed 19-02-06	Tue 19-03-05
27	**Stage 7**	**20 days**	**Wed 19-03-06**	**Tue 19-04-02**
28	Move / store berm materials	4 wks	Wed 19-03-06	Tue 19-04-02
29	Instream Work Complete	0 days	Tue 19-04-02	Tue 19-04-02
30	Form south deck	5 wks	Mon 19-01-28	Fri 19-03-01
31	Form north deck	5 wks	Wed 19-03-06	Tue 19-04-09
32	Cast Deck	4 wks	Wed 19-04-10	Tue 19-05-07
33	Form and cast barrier	6 wks	Wed 19-05-08	Tue 19-06-18
34	Waterproof / pave	2 wks	Wed 19-06-19	Tue 19-07-02
35	Complete tie ins	2 wks	Wed 19-07-03	Tue 19-07-16
36	Move utilities	2 wks	Wed 19-07-03	Tue 19-07-16
37	Open for traffic	0 days	Tue 19-07-16	Tue 19-07-16
38				
39	**EAST Side Work - 2019 / 2020**	**276 days**	**Wed 19-07-17**	**Wed 20-08-05**
40	Switch Traffic Control	1 wk	Wed 19-07-17	Tue 19-07-23
41	**Stage 8**	**60 days**	**Thu 19-08-08**	**Thu 19-10-31**
42	Demo End Spans	2 wks	Thu 19-08-08	Thu 19-08-22
43	Abutment Reconstruction	10 wks	Thu 19-08-22	Thu 19-10-31
44	**Stage 9**	**15 days**	**Thu 19-08-01**	**Wed 19-08-21**
45	In Stream Window Open	0 days	Thu 19-08-01	Thu 19-08-01
46	Install Berm	3 wks	Thu 19-08-01	Wed 19-08-21
47	Demo spans 6, 5 and 4	4 wks	Thu 19-08-22	Wed 19-09-18
48	Pier Modifications - Top	4 wks	Thu 19-09-19	Wed 19-10-16
49	Pier Modifications - Hinge (1 of)	6 wks	Thu 19-09-19	Wed 19-10-30
50	**Stage 10**	**10 days**	**Thu 19-10-31**	**Wed 19-11-13**
51	Erect North Girders - 3 spans	2 wks	Thu 19-10-31	Wed 19-11-13
52	**Stage 11**	**20 days**	**Thu 19-11-14**	**Wed 19-12-11**
53	Move berm to south side	4 wks	Thu 19-11-14	Wed 19-12-11
54	**Stage 12**	**55 days**	**Thu 19-12-12**	**Wed 20-02-26**
55	Demo south spans	4 wks	Thu 19-12-12	Wed 20-01-08
56	Pier Modifications - Top	4 wks	Thu 20-01-09	Wed 20-02-05
57	Pier Modifications - Hinge (2 of)	7 wks	Thu 20-01-09	Wed 20-02-26
58	**Stage 13**	**10 days**	**Thu 20-02-27**	**Wed 20-03-11**
59	Erect South Girders	2 wks	Thu 20-02-27	Wed 20-03-11
60	**Stage 14**	**20 days**	**Thu 20-03-12**	**Wed 20-04-08**
61	Remove berm materials	4 wks	Thu 20-03-12	Wed 20-04-08
62	Instream Work Complete	0 days	Wed 20-04-08	Wed 20-04-08
63	Form North Deck	5 wks	Thu 20-04-09	Wed 20-05-13
64	Form South Deck	5 wks	Thu 20-03-12	Wed 20-04-15
65	Cast Deck	4 wks	Thu 20-05-14	Wed 20-06-10
66	Form and cast barrier	4 wks	Thu 20-06-11	Wed 20-07-08
67	Waterproof / pave	2 wks	Thu 20-07-09	Wed 20-07-22
68	Complete tie ins	2 wks	Thu 20-07-23	Wed 20-08-05
69	Open for traffic	0 days	Wed 20-08-05	Wed 20-08-05



Project: Groat Road Bridge - OPTION
Date: Wed 17-03-29

Critical | Task | Progress | Slack | Summary | Rolled Up Critical | External Tasks | Deadline
Critical Split | Split | Milestone | Slippage | Project Summary | Rolled Up Critical | External Milestone

Appendix C

Assessment Methods

Kingfisher Aquatics Ltd (Kingfisher) Alberta Watercourse Crossing Assessment Procedures have been developed to meet the information requirements of provincial and federal regulators for most instream activities associated with watercourse crossing construction. Application of Kingfisher standard procedures can vary; they may be utilized in combination with assessment methods outside of the following standard procedures depending on the assessment requirement and study objectives. Deviations from these standard procedures will be addressed in report text.

The Guide to the Code of Practice for Watercourse Crossings Including Guidelines for Complying with the Code of Practice (the Guide to the Code of Practice), Section B: Aquatic and Biological Site Assessments served as the primary reference and outline for these standard procedures (Alberta Environment 2001).

A) ASSESSMENT PREPARATION

In order to determine assessment requirements, all available project information will be reviewed prior to initiation of the field assessment activities to aid in the determination of:

1) potential streambed, streambank and riparian disturbance;
2) anticipated potential effects on the aquatic environment; and
3) the estimated zone of impact resulting from potential effects.

Background topography and drainage information will be collected through the review of available maps, satellite imagery and air imagery. Historical fisheries information will be collected through:

1) Querying the provincial database known as the Fish and Wildlife Management Information System that is accessed through the Fish and Wildlife Internet Mapping Tool maintained by Alberta Environment and Parks; and
2) Reviewing related fisheries articles, when available, from peer-reviewed, government, private firm, non-government organization, and aboriginal organization sources.

B) FIELD ASSESSMENT

At project locations where the existing fish and/or fish habitat information is insufficient to assess the potential effects of the project on the aquatic environment, a field assessment is required to collect site-specific information and to address identified data gaps.

1) Study Area

Field assessments conducted for watercourse crossings require at a minimum:

- one 100 m or longer study section established upstream of the watercourse crossing or proposed watercourse crossing right of way; and
- one 300 m or larger study section located downstream of the watercourse crossing or proposed watercourse crossing right of way. The downstream study section must encompass the entire zone of impact. Additional study sections may be required to determine potential fish species that could be affected by the project.

2) Determining the Zone of Impact

The Guide to the Code of Practice (Alberta Environment 2001) defines the zone of impact as the area of streambed and streambanks of the water body that will be altered or disrupted as a result of the works and where 90% of the sediment discharged as a result of the works will be deposited.

C) FISH COLLECTION

When there is insufficient fisheries information available to evaluate potential project effects on the aquatic environment Kingfisher will conduct fish sampling to the extent required to meet the specific information requirements of the project.

1) Permitting

All fish sampling conducted by Kingfisher will be done so under licence from the Province of Alberta and, when applicable, the Government of Canada. The follow permits may be required to conduct fish sampling depending on the method used, the location waterbody being sampled, and the potential fish species present:

- Alberta Environment and Parks issued Research Licence (formerly Fish Research Licence)
- Department of Fisheries and Oceans Canada issued Species at Risk Act Permit
- Parks Canada issued Research and Collection Permit

2) Fish Collection Data

In accordance with the Guide to the Code of Practice (Alberta Environment 2001) data collected from fish capture will include at a minimum:

- the length of the study section;
- the type of equipment used, and the electrofishing effort made (seconds) and catch per unit effort (other active and passive fish capture methods may be used to augment electrofishing where required);
- all fish species captured, the number of each species and the location or habitat types where fish were captured;
- the fork length and weight of all sportfish species captured;
- the gender and maturity of sportfish species if externally determinable;
- the spawning potential; and
- during restricted activity periods, any evidence of spawning activity (redds, fish on redds, etc.) and determine where possible the presence of fish and fry at the crossing site.

Alberta Fisheries Management Branch (AFMB) Standard for Sampling of Small Streams in Alberta (2013[a]) provides additional guidelines for minimum information requirements for both general fish sampling and specific sampling methods. Information requirements for specific fish sampling methods are provided in the Section 3. Kingfisher will collect all information to meet the AFMB Standards for general fish sampling information as outlined below:

Sample Site Descriptors:

- Waterbody Name
- Waterbody ID
- Activity Date
- Crew Initials
- Starting Universal Transverse Mercator (UTM) coordinates
- Site Location Notes
- Project Site Number
- Water Temperature
- Conductivity
- Stream Stage (Dry, Low, Moderate, High, Flood)
- Wetted Width
- Maximum Depth

Fisheries Descriptors:

- Capture Method
- Sample Number
- Species
- Fork Length (mm)
- Total Body Weight (g)
- Injury Comments
- General Fisheries Comments

3) Fish Collection Methods

Selection of fish sampling gears are initial based of the following key points (Portt et al. 2006):

- the study question(s) that the investigators wish to answer;
- the habitats that are being investigated;
- the fish species that are being investigated; and
- the time of year when investigations will take place.

In addition to the key points listed above, Kingfisher also considers the catchability, efficiency, and lethality of fish sampling gears. In general, Kingfisher selects fish sampling gear that maximize catchability and efficiency of sampling efforts while minimizing the potential for fish mortality.

Standard Kingfisher fish collection methods, application information, and guidance documents are provided in Table C.1.

Table C.1. Standard Fish Collection Methods, Application Information, and Guidance Documents.

Fish Collection Method	Habitat Type	Water Depths	Fish species	Guidance Documents
Angling (A)	Lotic or lentic habitats	>0.1 m	Medium to large-bodied sport fish and some coarse fish	Vancouver Island University. 2010. Electrofishing: Theory, Safety and Uses Version 6.0; AFMB. 2004. Electrofishing Policy Respecting Injuries to Fish.; BCMELP. 1997. Fish Collection Methods and Standards Version 4.0; AFMB. 2013[a].Standards for sampling of small streams in Alberta; AFMB. 2013[a].Standards for sampling of small-bodied fish in Alberta; AFMB. 2013[c].Standards for the ethical use of fishes in Alberta; AESRD. 2015. Fish Research Licence Application – Fish Rescue Best Practices. BCMFLNRO. Freshwater Fishing Regulation. Alberta Government. Sportfishing Regulations. Portt et al. 2006. A review of fish sampling methods commonly used in Canadian freshwater habitats. Alberta Transportation. 2009. Fish Habitat Manual.
Backpack Electrofishing (A)	Primarily lotic	Between 0.1 m and 0.5 m	Most species and sizes	
Boat Electrofishing (A)	Primarily lotic	Between 0.5 m and 2.0 m	Most species and sizes	
Gillnetting (P)	Lentic	>0.5 m	Medium to large bodied sport and course fish	
Minnow Trapping (P)	Primarily lentic	>0.3 m	Small bodied forage fish species and some sport fish	
Seine netting (A)	Primarily lentic	<1.0 m	Most species and sizes	

(A)=Active Technique
(P)=Passive Technique

Angling

Angling equipment and rigging are usually geared toward specific fish species or groups of fish species. This allows angling efforts to be very effective at targeting specific fish species with minimal bi-catch. In most presence/absence sampling scenarios it is ideal to utilize gear that maximizes catchability, such as electrofishing or seine netting. capable of catching a wide variety of fish species. As such, angling is typically used for assessments that require sampling for a specific fish species that may not effectively be captured by other methods (i.e. Lake Sturgeon).

Angling is conducted in crews of two or more to maximize sampling effort. When multiple anglers are sampling a waterbody for multiple species anglers will use alternate rigging methods in an effort to expand the number of fish species and/or life stages of fish angling efforts could capture. Angling methods will largely rely on the experience of the crew members; however, all angling methods will comply with provincial sport fishing regulations.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) required angling specific information:

- Number of Anglers,
- Hours Fished per Angler

Backpack electrofishing

Electrofishing is the technique of passing electric current through the water to attract and immobilize fish for capture. It is most efficiently used in contained areas of small rivers and streams that are difficult to sample using nets or traps (BCMELP 1997).

The act of backpack electrofishing is conducted by sweeping the anode pole of electrofisher across and downstream towards the cathode tail and netter. The crew progresses upstream through the study area moving back and forth across the stream in a zigzagging pattern. For the purposes of providing comprehensive presence/absence data, backpack electrofishing crews will attempt to apply sampling effort evenly throughout all habitats present in the study area. Backpack electrofishing will be conducted by two-person crew. One of the two crew members will be a certified electrofishing crew leader who will operate the backpack electrofisher. The second crew member will capture immobilized fish with a fine mesh nylon or rubber net. Captured fish will be collected, and temporarily held in a water-filled pail carried by the second crew member or in live-well. Electrofishing can only effectively be completed when crew members can readily spot immobilized fish; as such, electrofishing surveys are not conducted when turbidity levels are elevated or when ice cover conditions are present.

Boat electrofishing

Boat electrofishing is conducted following the same principles as backpack electrofishing but is used on larger streams and shallow lakes where water depths prevent wading. Two types of boats are used, drift boats (passive) or jet boats (active), the former is typically used on small rivers that may not accommodate a power boat and the latter is used on larger systems that allow and require the mobility of a power boat. The basic components of the shocking system include a power supply, voltage and current regulator, cathode, anode, and safety circuits. Boats used for electrofishing are large enough to hold all the equipment and provide safe and adequate work space for the crew. The power is supplied to the boat electrofish via a gas-powered generator. The cathodes are suspended from the sides of the boats and the anodes are normally one or two booms protruding from the front of the boat (BCMELP 1997).

Boat electrofishing is conducted with a crew of 3 to 4 members when the boat electrofishing set up utilizes a movable anode. When the boat electrofishing set-up utilized a fixed anode, a crew of 2 to 3 members can operate the system effectively. The use of fixed or moveable anodes depends on the fish sampling objectives of the assessment. Movable anodes typically allow for greater control of the habitat sampled as such are considered optimal for presence/absence sampling.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) which stipulates collection of the following information:

- Electrofishing on-time
- Distance electrofished – 300 m or 40x the mean wetted width will be considered the minimum electrofishing survey distance
- Electrofisher Pulse width
- Electrofisher Frequency
- Electrofisher Voltage

Gillnetting

Gillnets are suspended in the water column at different deeps depending on the fish species type (pelagic, benthic, etc.) being targeted. Fish are captured when they swim into the meshes of the net and the maxillary or operculum area, teeth, spines, girth, or scales are caught on the mesh of the net as they attempt to pass through or free themselves from the mesh.

Net set times are dependent on whether the project requires non-lethal or lethal sampling. Gill nets are typically used when the sacrifice of fish is either necessary and/or where the risk (of gillnetting) to local fish populations is considered low. The length of the net set is a large factor in the amount of fish mortality observed. If deployed in lotic waterbodies they should be checked and cleared frequently (every two hours or less, particularly where non-lethal sampling is an objective). If deployed in lentic waterbodies they should be set overnight for no greater than 24 hours (AFMB 2013[b])

Gillnetting is conducted as per the B.C. standard procedure for gillnetting that has been developed for the use of gill nets in lakes for reconnaissance level inventories. The net consists of six nets or panels, 15.2 m long and of different mesh sizes, that are strung together in a "gang" to form a net 91.2 m long and 2.4 m deep. The mesh size is measured from knot to knot of a single, diagonally stretched mesh. Each mesh size is selective for a certain size fish (Table C.2), therefore, the individual panels used in the net have been chosen so the net is capable of catching a wide range of fish. The following is the standard order of the panels based on mesh size, the corresponding filament size used in the construction of the net and the mean fork length of the fish caught by each of the mesh sizes (BCMELP 1997; based on Hamley 1972):

Table C.2. Order, Mesh Size and Filament Size Standards relative to Fish Mean Fork Length (BCMELP 1997).

Order	Mesh Size (mm)	Filament Size (mm)	Fish Fork Length (mm)
1	25	0.20	114
2	76	0.25	345
3	51	0.20	228
4	89	0.30	380
5	38	0.20	178
6	64	0.25	280

Most gillnetting sampling requires the use of watercraft. As such, a minimum crew size of two is used during gillnetting. Crew size and number of watercraft employed for a gillnet fish sampling is dependent on project objectives, the size and number of nets set, and the project time frame.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) which stipulates collection of the following information:

- Date and time of net(s) set
- Date and time of net(s) lifted
- Mesh Size (mm)
- Length of net(s) set (m)
- Depth of net(s) set (m)
- Depth of net(s) set (m)

Minnow trapping (Gee trapping)

Minnow traps or Gee-minnow traps are used to target small-bodied fish in moderate to deep (>0.5 m) habitat where electrofishing becomes less effective, particularly on small-bodied fish. Due to the small size and easy of deployment of minnow traps, minnow trapping can be conduct by a single crew member (Portt et al. 2006); however, fish process requirements typically dictate a minimum crews size of two.

Minnow traps usually consist of two wire baskets held together by a clip and attached to a marker float. The baskets are interlocked and the clip is inserted to hold the two halves together. The float line is attached and the trap is positioned either on the bottom or suspended at a particular depth. The position of the trap is marked by the float attached to the line. Traps can be set with or without bait. Fish swim inside the traps through funnel shaped openings that guide them from a large opening near the outside of the trap to the narrow opening close to the centre of the trap. Once inside it is difficult for the fish to locate the opening and escape (BCMELP 1997).

Kingfisher will complete minnow trapping in accordance with AFMB Standards for Sampling Small-bodied fish in Alberta (2013[b]). When bait is used, the type and amount will be recorded. Traps will be set for a minimum of 18 (trapping) hours (trapping hours = # traps X hours of set time) and all traps will be checked at least once every 2 hours and cleared of fish.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) required trap netting specific information:

- Date and time of net(s) set
- Date and time of net(s) lifted
- Trap type
- Number of traps

Seine netting

Seine netting can be conducted by boat or by wading. Where possible Kingfisher utilizes seine netting to capture fish due to the relatively gentle nature of the capture method; however, the effectiveness of seine netting can be extremely limited by the presence of coarse substrates and fish cover forms (aquatic vegetation, woody debris, and overhanging bank) which foul the net, interrupt net pulls, and allow fish to escape.

Seine netting methods of retrieval and mesh size affects the selectivity of the gear towards certain species and sizes. In lentic habitat seine netting is conducted parallel to shore. The off-shore seiner walks in advance of the on-shore seiner. After seine pull is completed the off-shore seiner brings that end of the seine net to shore, then the seine is pulled in making sure that the lead line remains in contact with the bottom and the float line in contact with the surface (AFMB 2013[b]). In lotic habitat seine pulls vary depending on the habitat present and the presence/location fish cover forms and coarse substrates.

The configuration of seine nets can vary greatly depending on the application of the net and the target species; however, most nets have a braided leadline or rolled lead weights to weight the bottom of the net while the top of the net is typically supported by a floating corkline (BCMELP 1997). Kingfisher typically utilize seines ranging from 3.3 m to 30 m long and 1.2 m to 1.8 m deep with mesh sizes 0.125 mm to 2.5 mm.

Kingfisher will record all information to meet the AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) required seine haul specific information:

- *Net and mesh dimensions (m and mm)
- Area Sampled
- *Number of net pulls per area

*derived requirements based on AFMB Standard for Sampling of Small Streams in Alberta (2013[a]) and Standards for Sampling Small-bodied fish in Alberta (2013[b])

D) FISH HABITAT ASSESSMENT

1) Habitat Inventory/Habitat Mapping

Fish habitat data collection is conducted by Kingfisher crews traversing study area(s), typically from downstream to upstream either by boat (Large River Fish Habitat Assessments) or by wading (Small Stream Fish Habitat Assessments). Information collected from fish habitat assessments is inventoried in a sequentially ordered, spatially referenced manner, which is used to produce a habitat map or a habitat inventory catalogue depending on project requirements.

Small Stream Fish Habitat

Kingfisher standard small stream fish habitat assessments methods are adapted from R.L.& L. 1994 and Hawkins et al. 1993 that are outlined in the Alberta Transportation Fish Habitat Manual (2009). This habitat classification system identifies discrete channel habitat units that share homogeneous depth, velocity and cover. Application of this assessment method requires watercourses to display distinct channel habitat units such as pool, riffle, runs. Where multiple habitat units exist in parallel within a given length of the bankfull channel individual habitat units are broken out and the subject section of channel will be considered split habitat.

Habitat units are measured for wetted channel width, bankfull width and length to quantify habitat unit area. Where applicable habitat is present, habitat units are also classified by depth. Within each habitat unit fish cover type(s), substrate composition, riparian vegetation types and bank stability are quantified and recorded. Definitions of habitat units are provided in Table D.1. General depth classifications are provided in Table D.2. Fish cover types, streambed substrates, and riparian vegetation types are presented in Table D.3

Other in-channel features have the capacity to contribute to fish habitat, through a variety of pathways, such as increased cover and geomorphic heterogeneity, as well as limit fish habitat through fish passage restrictions and indirect changes to water quality. These features are not in themselves habitat units, but are record in sequential order with habitat units. These features are provided in table D.4.

The following tables provide information either directly from or adapted from the Alberta Transportation Fish Habitat Manual (2009)

Table D.1. Small Stream Fish Habitat Units, Symbols and Descriptions.

Habitat Unit	Symbol	Description
Cascade	CA	Extremely high gradient and velocity; extremely turbulent with enture water surface broken; may have short vertical sections, but overall is passable to fish; armoured substratel maybe associated with chutes and rapids
Chute	CH	Area of channel constriction, usually due to bedrock intrusions; associated with channel deepening and increase velocity
Rapids	RA	Extremely high velocity; deeper then riffle; substrate extremely coarse (large cobble/boulder); instream cover in pocket eddies and associated with substrae
Riffle	RF	High velocity/gradient relative to run habitat; surface broken due to submerged or exposed bed material shallow relative to other channel units; coarse substrate; usually limited instream or overhead cover for juvenile or adult fish (generally ≤ 0.5 m deep).
Run (glide)	R1+R1, R2, R3	Moderate to high velocity; surface largely unbroken; usually deeper than RF; substrate size dependent on hydraulics
Flat	F1+, F1, F2, F3	Area characterized by low velocity and near-uniform flow; differentiated from pool habitat by high channel uniformity; more depositional than R3 habitat
Pool	P1+,P1, P2, P3	Discrete portion of channel featuring increased depth and reduced velocity relative to riffle/run habitats; formed by channel scour.
*Backwater, snye, and impoundment habitat types have been removed because the functionality and form of these habitat types can be recorded through a combination of the listed habitat types and habitat in-channel features		

Table D.2. Small Stream Depth Classifications, Definitions, and Applicable Habitat.

Class	Definition	Applicable Habitat
1+	Class 1+ water depths are deeper greater than 1.5 m	Run (glide), Flat, Pool
1	Class 1 water depths range from 1 m to 1.5 m	
2	Class 1 water depths range from 0.5 m to 1.0 m	
3	Class 1 water depths range from 0.1 m to 0.5 m	

Table D.3. Substrate, Fish Cover and Riparian Vegetation Classifications, Symbols and Descriptions.

Classification	Symbol	Description
Fish Cover		
Woody Debris	WD	Submerged branches, logs, or tree roots
Overhanging Bank	OB	Undercut bank
Overhanging Vegetation	OV	Terrestrial vegetation hanging over or into the waterbody
Aquatic Vegetation	AV	Vegetation rooted below the waters surface
Boulder	BL	Coarse substrate either capable of providing slack water or with interstitial spaces large enough to provide cover for the fish species present
Deep Water	DW	Water deep enough to limit light perpetration, and view of the streambed
Substrate		
Fines*	Fn	<2 mm
Gravel (small & large gravels)*	Gr	2 – 64 mm
Cobble*	Cb	65 – 256 mm
Boulder*	Bl	>256 mm
Bedrock	Br	Single large unit of substrate or single large aggregated unit of substrate
Anthropogenic material	An	Human-made material (i.e. concrete) composing a element of the streambed substrate
Riparian Vegetation		
Grass/bryophytes	GR	Herbaceous, or bryophytic, low, non-woody plants
Shrubs	SH	Multiple woody stemmed low to medium height plants including sapling trees
Tress	TR	Single large woody stemmed plant
Exposed Fines	EF	Unvegetated bank substrate composed of soil.
Exposed Bedrock	EB	Unvegetated bank substrate composed of bedrock
Exposed Anthropogenic mat.	EA	Unvegetated bank substrate made of human-made materials

*defined by Overton et al 1997.

Table D.4. Small Stream In-Channel Features, Symbols, and Descriptions

Type	Symbol	Description
Substrate Ledge	SL	Area of bedrock, clay, or aggregated smaller streambed substrates intrusion into the channel; often associated with chute or plunge pool habitat, may have a vertical drop affecting fish passage
Log Ledge	LL	An area where large woody debris has fallen perpendicular to stream flow and has backed up streamflow and loose substrate on the upstream side, commonly associated with a plunge pool habitat on the downstream side
Debris Pile	DP	Debris pile (e.g., log jam) which influences instream habitat; include effect on cover
Beaver Dam	BD	Partial or complete beaver constructed impoundments
Anthropogenic Feature	AF	Human-made structure that protrudes into a waterbody, effecting either fish habitat or stream geomorphology
Falls	FA	Highest water velocity; involves water falling over a vertical drop; impassable to fish

Large River Fish Habitat

Kingfisher standard large river fish habitat assessment methods are adapted from R.L. & L. 1994 and are outlined in the Alberta Transportation Fish Habitat Manual (2009). Large river habitat classification methodology is intended for use on large watercourses that do not consistently exhibit specific habitat units such as pools, runs, and riffles. This methodology is primarily based on shoreline features including, substrate, water depth, bank form, bank stability, bank substrate, riparian vegetation, and large cover features like log jams. This methodology also involves the documentation of unique habitat features which can include tributaries, islands, shoals, cover forms, and areas of extreme depth. Table D.5. provides a break down of large river habitat types and common habitat features.

Table D.5. Large River Fish Habitat Components, Symbols and Descriptions

Type	Symbol	Description
Major Habitat Types		
Unobstructed Channel	U	Single main channel, no permanent island, side bars occasionally present, limited development of exposed mid-channel bars at low flow
Singular Island	S	Two channels around single, permanent island, side and mid-channel bars often present at low flow
Multiple Island	M	More than two channels and permanent islands, generally extensive side and midchannel bars at low flow
Bank Habitat Types		
Amoured/Stable	A1	Largely stable and at repose; cobble/small boulder/gravel predominant; uniform shoreline configuration; bank velocities low-moderate; instream/overhead cover limited to substrate and turbidity
	A2	Cobble/large boulder predominant; irregular shoreline due to cobble/boulder outcrops producing BW habitats; bank velocity low (BW)/moderate; instream/overhead cover from depth, substrate and turbidity
	A3	Similar to A2 with more boulder/bedrock; very irregular shoreline; bank velocities moderate-high with low velocity BW/eddy pools providing instream cover; overhead cover from depth/turbidity
	A4	Artificial riprap substrates consisting of angular boulder-sized fill; often associated with high velocity areas; shoreline usually regular; instream cover from substrate; overhead cover from depth/turbulence
Canyon	C1	Banks formed by valley walls; cobble/boulder bedrock; stable at bank-water interface; typically deep/high velocity water offshore; abundant velocity cover from substrate/bank irregularities
	C2	Steep, stable bedrock banks; regular shoreline; moderate-deep/moderate-fast water offshore; occasional velocity cover from bedrock fractures
	C3	Banks formed by valley walls, primarily fines with some gravel/cobble at base; moderately eroded at bank-water interface; mod-high velocities; no instream cover
Depositional	D1	Low relief, gently sloping bank; shallow/slow offshore; primarily fines; instream cover absent or consisting of shallow depressions or embedded cobble/boulder; generally associated with bars
	D2	Similar to D1 with gravel/cobble substrate; some areas of higher velocities producing riffles; instream/overhead cover provided by substrate/turbulence; often associated with bars/shoals
	D3	Similar to D2 with coarser substrates (cobble/boulder); boulders often imbedded; moderate-high velocities offshore; instream cover abundant from substrate; overhead cover from turbulence

Table D.5 Continued		
Erosional	E1	High, steep eroded banks with terraced profile; unstable; fines; moderate-high offshore velocity; deep immediately offshore; instream/overhead cover from submerged bank materials/vegetation/depth
	E2	Similar to E1 without the large amount of instream vegetative debris; offshore depths shallower
	E3	High, steep eroding banks; loose till deposits (gravel/cobble/sand); moderate-high velocities and depths; instream cover limited to substrate roughness; overhead cover provided by turbidity
	E4	Steep, eroding/slumping highwall bank; primarily fines; moderate-high depths/velocities; instream cover limited to occasional BW formed by bank irregularities; overhead cover from depth/turbidity
	E5	Low, steep banks, often terraced; fines; low velocity; shallow-moderate; no instream cover; overhead cover from turbidity
	E6	Low slumping/eroding bank; substrate either cobble/gravel or silt with cobble/gravel patches; moderate depths; moderate-high velocities; instream cover from abundant debris/boulder; overhead cover from depth/turbidity/overhanging vegetation

Symbols and definitions for common special habitat features are provide in Table D.6; however, special habitat features that maybe recorded during field assessments are not limited the features listed below.

Table D.6. Special Habitat Features, Symbols, and Descriptions.

Type	**Symbol**	**Description**
Pool	P	High, steep eroded banks with terraced profile; unstable; fines; moderate-high offshore velocity; deep immediately offshore; instream/overhead cover from submerged bank materials/vegetation/depth
Tributary Confluence	TC	Confluence area of tributary entering mainstem; tributary confluence [sub-classified according to tributary flow and wetted width at mouth at the time of the survey]
	TC1	Intermittent flow, ephemeral stream
	TC2	TC2 Flowing, width < 5m
	TC3	Flowing, width 5 - 15m
	TC4	Flowing, width 16 - 30m
	TC5	Flowing, width 31 - 60m
	TC6	Flowing, width > 60m
Shoal	SH	Shallow (< 1m deep), submerged areas in mid-channel or associated with Depositional areas around islands/side bars
	SHC	Submerged area of coarse substrates
	SHF	Submerged area of fine substrates
Backwater	BW	Discrete, localized area exhibiting reverse flow direction and, generally, lower velocity than main current; substrate similar to adjacent channel with more fines
Rapid	RA	Area with turbulent flow, broken surface (standing waves, chutes etc.), high velocity (>1 m/s), armoured substrate (large boulder/bedrock) with low fines
Snye	SN	Discrete section of non-flowing water connected to a flowing channel only at its downstream end, generally formed in a side channel or behind a peninsula (bar)
Slough	SL	Non-flowing water body isolated from flowing waters except during flood events; oxbows
Log Jam	LJ	Accumulation of woody debris; generally located on island tips, heads of side channels, stream meanders; provide excellent instream cover

2) Streambank Assessment

Kingfisher standard streambank assessment procedures are derived from the guidelines for complying with the code of practice for watercourse crossings section B physical assessment components (Alberta Environment 2001). At a minimum, five transects will be established within the study area perpendicular to stream flow. Each transect will be divided into three areas: Left Upstream Bank (LUB), Channel, and Right Upstream Bank (RUB). Table D.6 presents channel and streambank parameters that Kingfisher will collect at each transect.

Table D.6. Streambank Transect Parameters, Units and Descriptions.

Parameter Components	Parameter Units	Description
Channel Properties		
Wetted Width (m)	Metres	The distance across the wetted surface of the waterbody perpendicular to stream flows
Bankfull Width (m)	Metres	The distance between the LUB and the RUB at level of the 1:2 year highwater mark perpendicular to stream flows
Depths (m)	Metres	The distance from the water surface to a point vertically inline on the streambed
Velocity (m/s or s/m)	Metres per Second, Seconds per Metre	The distance travelled by flowing water per unit of time
Streambed Substrate (Fn,Gr,Cb,Bl,Br,An)	Fines, Gravel, Cobble, Boulder, Bedrock, Anthropogenic Materials	The material composing the bottom of a stream below the usual water surface
Instream Cover (WD, OV, AV, BL)	Woody Debris, Overhanging Vegetation, Aquatic Vegetation, Boulder	Submerged stream features that are capable of providing shelter for the fish species present within the waterbody
Bank Properties		
Bank Height (m)	Metres	The distance from the water surface to the top of the level of the 1:2 year highwater mark
Bank Angle (^{o})	Degrees	The angle of the slope of the bank from the waters surface to the 1:2 year highwater
Bank Cover (WD, OB, OV,)	Woody Debris, Overhanging Bank, Overhanging Vegetation	Bank features that are capable of providing shelter for the fish species present within the waterbody
Bank Substrate (Fn, Gr,Cb,Bl,Br,An)	Fines, Gravel, Cobble, Boulder, Bedrock, Anthropogenic Materials	The material composing the bottom of a stream below the usual water surface
Riparian Vegetation (GR, SH, TR, EF, EB, EA)	Grass/Bryophyte, Shrub, Tree, Exposed Fines, Exposed Bedrock, Exposed Anthropogenic Materials	Vegetation (or the absence of the vegetation) rooted with in the riparian area immediately adjacent to the bank
Bank Stability (S or U)	Stable or Unstable	Bank areas displaying slumping, fracturing, or other signs of erosion that would facilitate bank material entering the waterbody

3) Water Quality

Basic water quality parameters presented in Table D.7 will be measured at one location within the study area.

Table D.7. Basic Water Quality Parameters and Units of Measure.

Parameters	Parameter Units of Measure
Temperature	Degrees Celsius
pH	Potential of Hydrogen
Dissolved Oxygen	Milligrams per Litre
Conductivity	Mirco-Siemens per Centimeter
Turbidity	Nephelometric Turbidity Unit

4) Photographic Document

Photographs will be taken to document general site and habitat conditions as well as channel and bank features with the study area. At a minimum, photographic documentation will include the following:

- representative fish habitat and channel form within the study area;
- unique and/or important habitat or channel features;
- the waterbody looking upstream and downstream from the upstream end of the study area;
- the waterbody looking upstream and downstream from the downstream end of the study area;
- the waterbody looking upstream from the proposed right-of-way;
- the waterbody looking downstream from the proposed right-of-way;
- the waterbody looking upstream at the proposed right of way; and
- the waterbody looking downstream at the proposed right of way

E) LITERATURE CITED

Alberta Environment. 2001. Guide to the Code of Practice for Watercourse Crossings Including Guidelines for Complying with the Code of Practice (made under the Water Act and the Water (Ministerial) Regulation). Queen's Printer for Alberta. 29 p.

Alberta Environment and Sustainable Resource Development. 2015. Fish Research Licence Application – Fish Rescue Best Practices. 6 pp + Appendices.

Alberta Fisheries Management Branch. 2004. Electrofishing Policy Respecting Injuries to Fish – Fish Research Licences

Alberta Fisheries Management Branch 2013[a]. Standard for Sampling of Small Streams in Alberta (Public Version).

Alberta Fisheries Management Branch 2013b. Standard for Sampling of Small-bodied Fish in Alberta (Public Version).

Alberta Transportation. 2009. Fish Habitat Manual Guidelines and Procedures for Watercourse Crossings in Alberta. Edmonton, Alberta

B.C. Ministry of Environment, Lands and Parks, Fish Inventory Unit for the Aquatic Ecosystems Task Force, Resources Inventory Committee. 1997. Fish Collection Methods and Standards Version 4.0. The Province of British Columbia Resources Inventory Committee. 58 p.

Hamley, J.M. 1972. Use of the DeLury method to estimate gillnet selectivity. J. Fish. Res.Board Can. 29:1636-1638 p.

Hawkins, P. C., J. L. Kershner, P. A. Bisson, M. D. Bryant, L. M. Decker, S. V. Gregory, D. A. McCullough, C. K. Overton, G. H. Reeves, R. J. Steedman, and M. K, Young. 1993. A hierarchical approach to classifying stream habitat features. Fisheries Vol. 18, No. 6 (June): 12 p.

Overton, C.K., S.P. Wollrab, B.C. Roberts and M.A. Radko. 1997. R1/R4 (Northern/ Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook, General Technical Report INT-6TR-346, United States Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah, 73 p.

Portt, C.B., G.A. Coker, D.L. Ming, and R.G. Randall. 2006. A review of fish sampling methods commonly used in Canadian freshwater habitats. Can. Tech. Rep. Fish. Aquat. Sci. 2604 p.

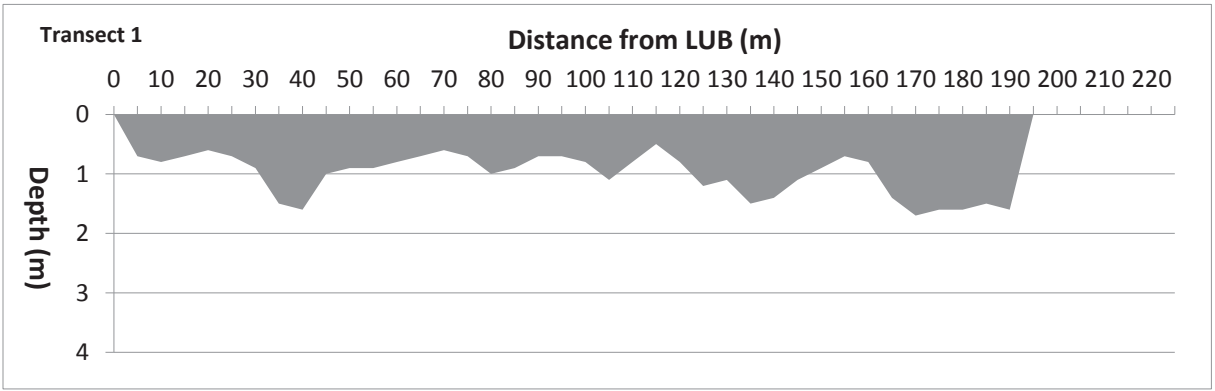
Overton, C.K., S.P. Wollrab, B.C. Roberts and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook, General Technical Report INT-6TR-346, United States Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah, 73 p.

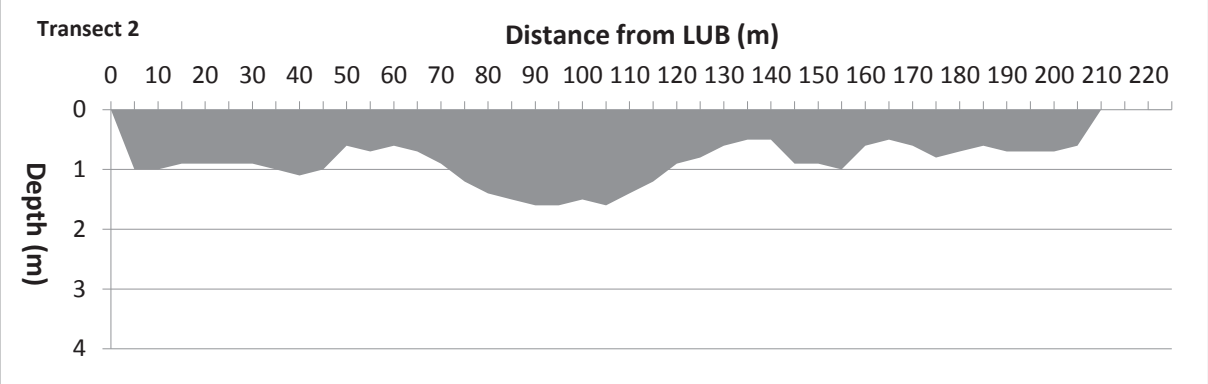
R.L. & L. Environmental Services Ltd. 1994. A general fish and riverine habitat inventory, Athabasca River, April to May 1992. NRBS Project Report No. 32, Edmonton, Alberta. 74 p + appendices.

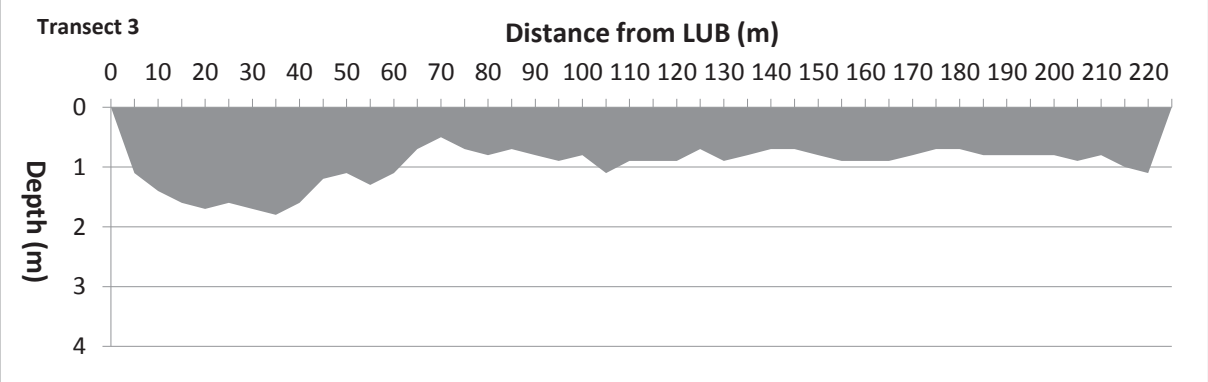
Vancouver Island University Natural Resources Extension Program. 2010. Electrofishing: Theory, Safety and Uses - Alberta Fish & Wildlife Electrofishing Standards Version 6.0. Vancouver Island University 76 p.

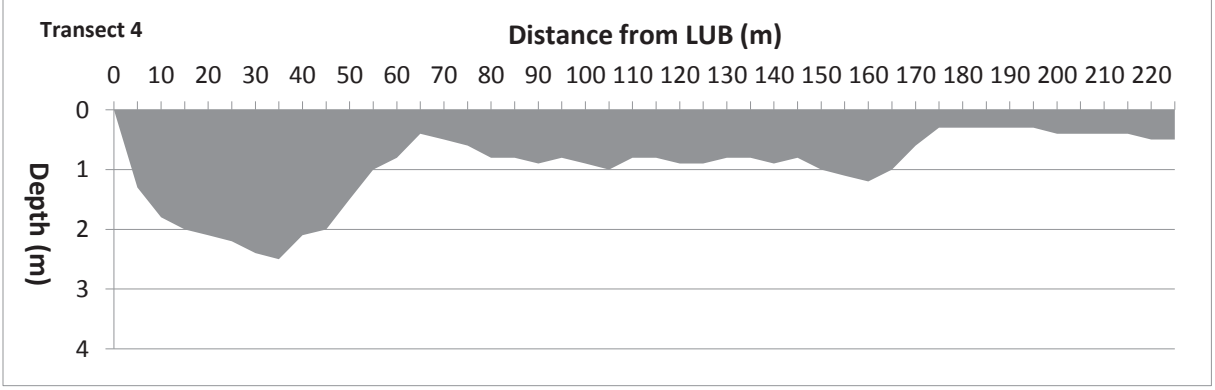
Appendix D

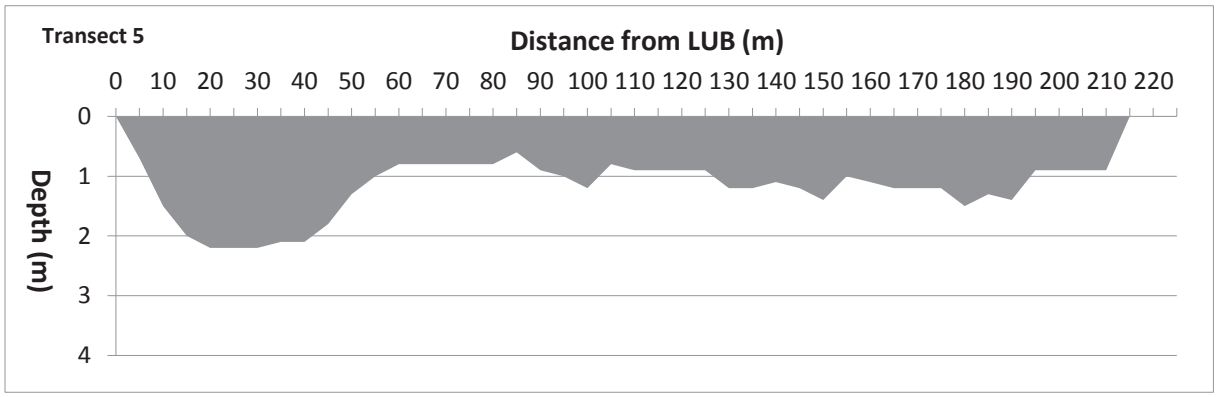
Transect Depth Profiles

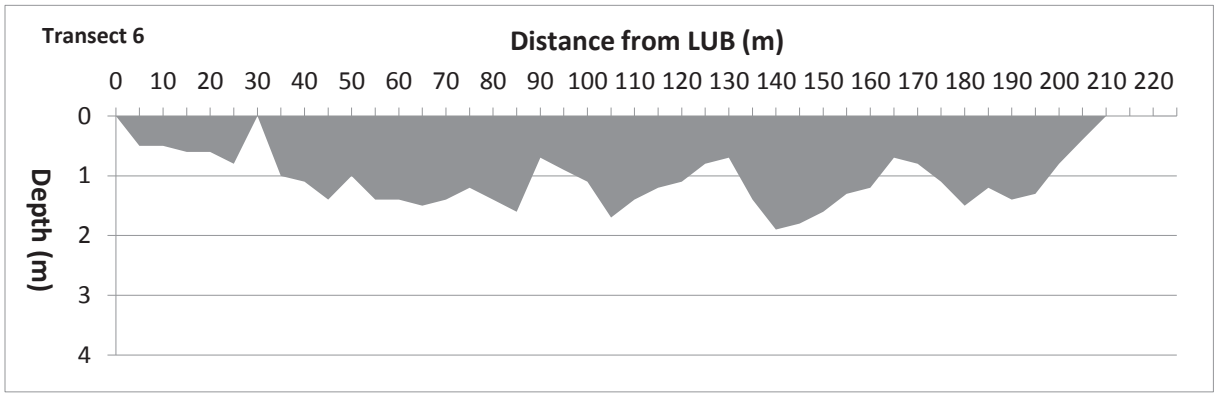

Transect 1
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4

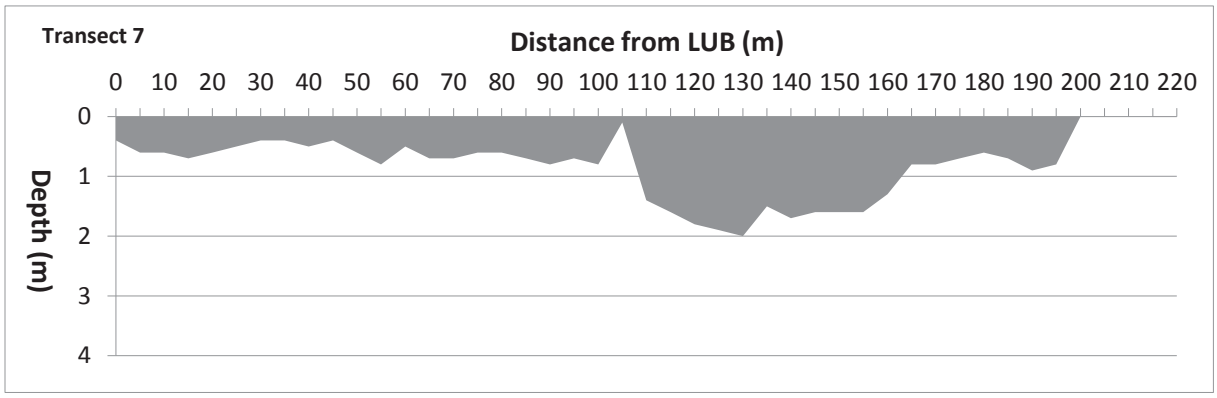

Transect 2
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4

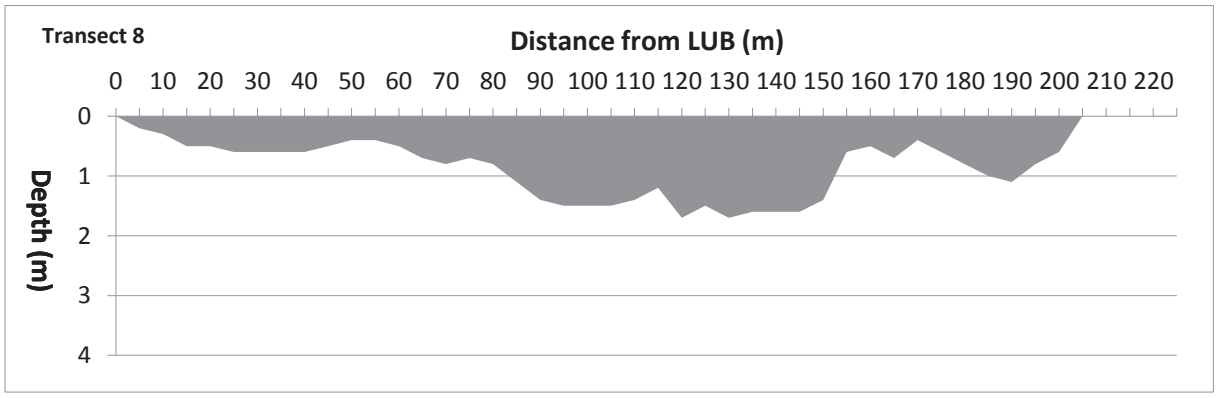

Transect 3
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4

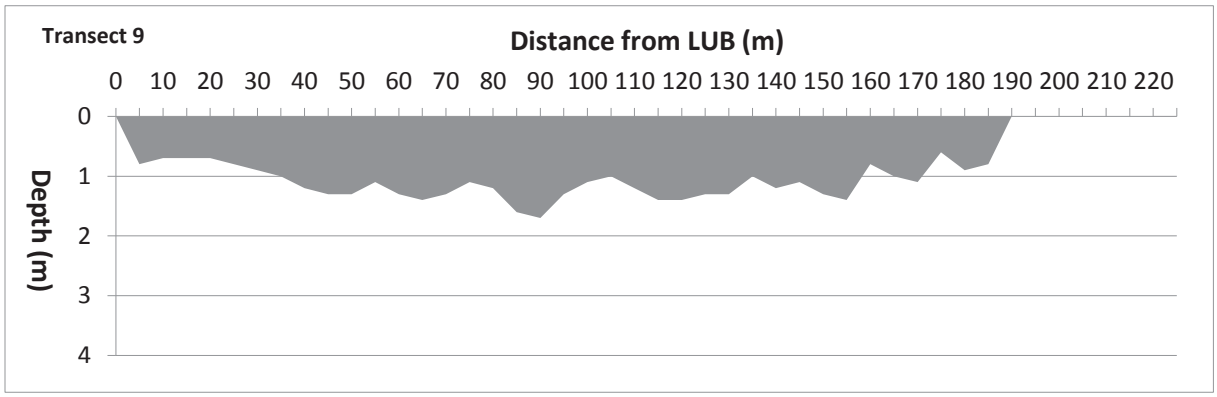

Transect 4
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4

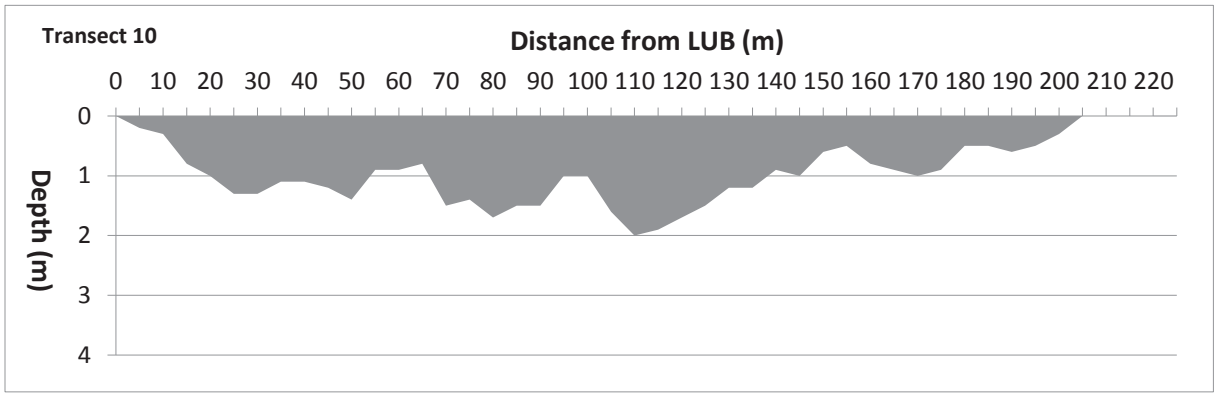

Transect 5
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4

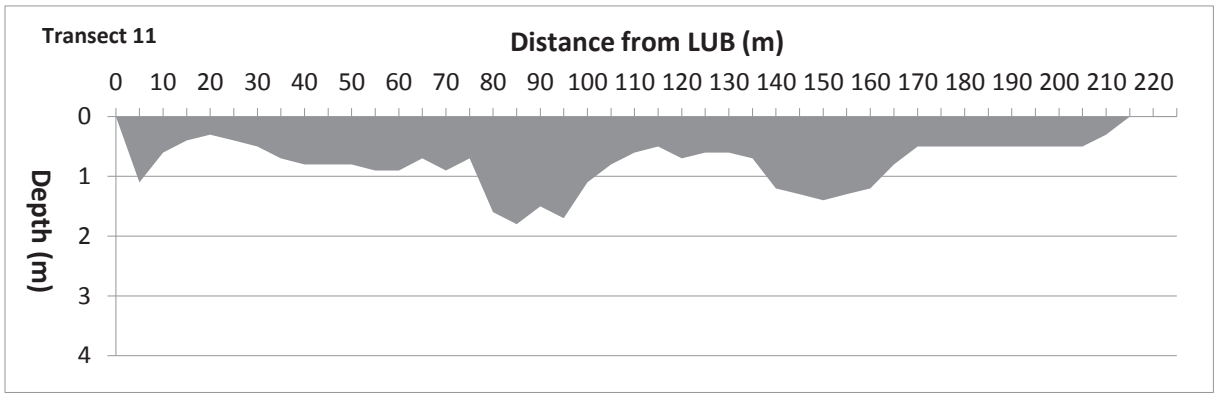

Transect 6
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4

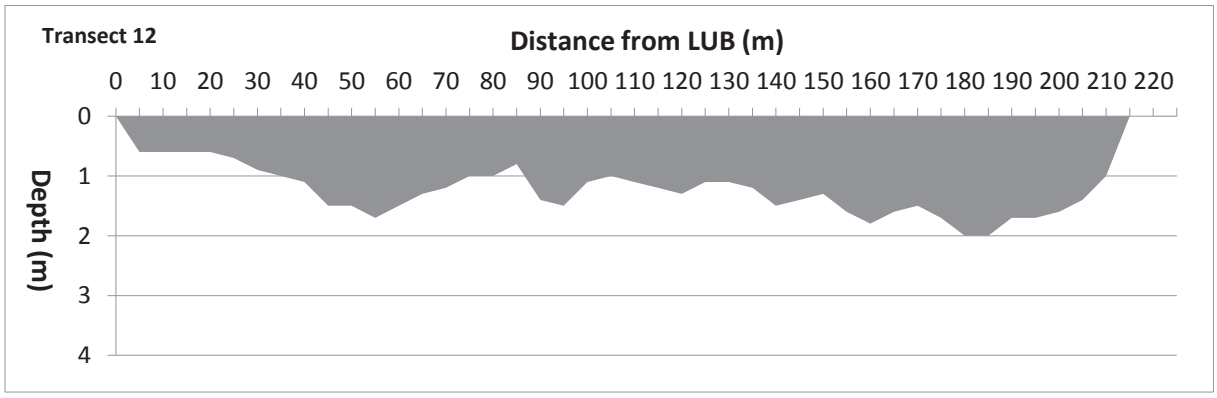

Transect 7
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4


Transect 8
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4


Transect 9
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4


Transect 10
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4


Transect 11
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4


Transect 12
Distance from LUB (m)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Depth (m)
0
1
2
3
4

Appendix E

Photographs

Plate 1 – Looking at the LUB on transect 1.

Plate 2 – Looking at the RUB on transect 1.

Plate 3 – Looking at the LUB on transect 2.

Plate 4 – Looking at the RUB on transect 2.

Plate 5 – Looking at the LUB on transect 3

Plate 6 – Looking at the RUB on transect 3.

Plate 7 – Looking at the LUB on transect 4.

Plate 8 – Looking at the RUB on transect 4.

Plate 9 – Looking at the LUB on transect 5

Plate 10 – Looking at the RUB on transect 5.

Plate 11 – Looking at the LUB on transect 6.

Plate 12 – Looking at the RUB on transect 6.

Plate 13 – Looking at the LUB on transect 7.

Plate 14 – Looking at the RUB on transect 7.

Plate 15 – Looking at the LUB on transect 8.

Plate 16 – Looking at the RUB on transect 8.

Plate 17 – Looking at the LUB on transect 9

Plate 18 – Looking at the RUB on transect 9.

Plate 19 – Looking at the LUB on transect 10.

Plate 20 – Looking at the RUB on transect 10.

Plate 21 – Looking at the LUB on transect 11.

Plate 22 – Looking at the RUB on transect 11.

Plate 23 – Looking at the LUB on transect 12.

Plate 24 – Looking at the RUB on transect 12.

Plate 25 – Looking upstream from ~ 200 m downstream of the Groat Road Bridge.

Plate 26 – Looking downstream at the downstream end of the study section.

Plate 27 – Looking upstream from the upstream end of the study section.

Plate 28 – Looking downstream from ~ 200 m upstream of the Groat Road Bridge.

Appendix H. Historical Resources

Alberta Culture and Tourism

HRA Number: 4715-16-0014-001
June 15, 2016

Historical Resources Act Requirements

Proponent: City of Edmonton
City of Edmonton 8th Floor, Century Place, 9803-102A Ave, Edmonton, AB T5J 3A3
Contact: Mr. Allan Bartman

Agent: Turtle Island Cultural Resource Management
Contact: Gareth Spicer

Project Name: **Groat Road Bridges Rehabilitation and Interchange**

Project Components: Municipal Road
Bridge

Application Purpose: Requesting HRA Approval / Requirements

Pursuant to Section 37(2) of the Historical Resources Act, a Historic Resources Impact Assessment is required for all or portions of those activities described in this application and its attached plan(s)/sketch (es). The Historic Resources Impact Assessment is to be conducted in accordance with the instructions outlined in the following schedule.

David Link

SCHEDULE OF REQUIREMENTS

ARCHAEOLOGICAL RESOURCES

Pursuant to Section 37(2) of the Historical Resources Act, a Historic Resources Impact Assessment for archaeological resources is to be conducted on behalf of the proponent by an archaeologist qualified to hold an archaeological research permit within the Province of Alberta. A permit must be issued by Alberta Culture and Tourism prior to the initiation of any archaeological field investigations. Please allow ten working days for the permit application to be processed.

1. Review of the results of the geotechnical work for this project is required to determine the extent of disturbance, the depth of intact sediments, and thus the potential for intact archaeological deposits across the proposed development footprints. Based on these results, and in consultation with Alberta Culture and Tourism, the nature of the Historical Resources Impact Assessment and Monitoring programs will be determined in more detail.
2. A deep testing program is required in areas of significant sedimentation.

SCHEDULE OF REQUIREMENTS (continued)

PALAEONTOLOGICAL RESOURCES

Pursuant to Section 37(2) of the Historical Resources Act, a Historic Resources Impact Assessment for palaeontological resources is to be conducted on behalf of the proponent by a palaeontologist qualified to hold a palaeontological research permit within the Province of Alberta. The Historic Resources Impact Assessment is to consist of a monitoring program. A permit must be issued by Alberta Culture and Tourism prior to the initiation of any palaeontological field investigations. Please allow ten working days for the permit application to be processed.

1. The monitoring program is required for the following locations: Areas of deep excavation (>2m) within the project footprint. This includes but is not limited to foundation work, excavations for deep pilings and sewer work.

2. No deep excavation activities (>2m) are to take place on the project until a professional consulting palaeontologist is on-site to monitor construction activities.

ABORIGINAL TRADITIONAL USE SITES

There are no Historical Resources Act requirements associated with Aboriginal traditional use sites of a historic resource nature; however, the proponent must comply with standard conditions under the Historical Resources Act, which are applicable to all land surface disturbance activities in the Province.

HISTORIC STRUCTURES

There are no Historical Resources Act requirements associated with historic structures; however, the proponent must comply with standard conditions under the Historical Resources Act, which are applicable to all land surface disturbance activities in the Province.

PROVINCIALLY DESIGNATED HISTORIC RESOURCES

There are no Historical Resources Act requirements associated with Provincially Designated Historic Resources; however, the proponent must comply with standard conditions under the Historical Resources Act, which are applicable to all land surface disturbance activities in the Province.

SPECIAL CONDITIONS

1. In addition to the special conditions detailed above, the proponent must abide by all Standard Conditions under the Historical Resources Act.

Lands Affected: All New Lands

Proposed Development Area:

MER	RGE	TWP	SEC	LSD List
4	24	52	31	5,11,12,13,14

Documents Attached:

Document Name	Document Type
bridges	Illustrative Material
interchange	Illustrative Material

Alberta Culture and Tourism

HRA Number: 4715-16-0014-003
February 16, 2017

Historical Resources Act Approval

Proponent: City of Edmonton
City of Edmonton 8th Floor, Century Place, 9803-102A Ave, Edmonton, AB T5J 3A3
Contact: Mr. Allan Bartman

Agent: Turtle Island Cultural Resource Management
Contact: Gareth Spicer

Project Name: **Groat Road Bridges Rehabilitation and Interchange Project: Access Ramps**

Project Components: Access Road
Bridge
Other - access ramp

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
Head, Regulatory Approvals &
Information Management

Lands Affected: All New Lands

Proposed Development Area:

MER	RGE	TWP	SEC	LSD List
4	24	52	31	12,13

Documents Attached:

Document Name	Document Type
project plan	Illustrative Material