Government of Northwest Territories

Watercourse Crossing Environmental Protection Plan Culvert Replacement at KM 147.0 of Highway 8 (Dempster Highway) Unnamed Creek

Project No. 2567
Revision A

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1 INTRODUCTION

The Government of the Northwest Territories Department of Infrastructure (GNWT-INF; “the client”) is planning to upgrade a culvert installation on an unnamed creek located at (UTM 8W) 552691 E 7485848 N. The crossing is situated in the Gwich’in Settlement Area (Figure 1). A new 3000 mm by 65.4 m culvert will be installed on the unnamed creek via a trenchless installation methodology, and the existing 2500 mm diameter culvert shall be decommissioned via grouting. Work is scheduled to occur in Q3&4 2022.

CCI Inc. (CCI) has been retained by the Government of the Northwest Territories (GNWT), to design the replacement and decommissioning of the existing culvert located at KM 147.0 of the Dempster Highway (Northwest Territories Highway 8) in the Northwest Territories.

CCI was retained by the GNWT to provide support for submitting additional information to complete a DFO Request for Review application for the project. There has been an ongoing discussion amongst and between CCI, the GNWT and the Fisheries and Oceans Canada (DFO) with regard to meeting the environmental requirements for a crossing pursuant to federal legislation, regulations and policy.

Figure 1. Location of the Unnamed Creek Culvert Upgrade Project at KM 147.0 of the NWT Highway 8.

2 OVERVIEW OF FEDERAL REGULATORY REQUIREMENTS

2.1 Transport Canada - Canadian Navigable Waters Act

The *Canadian Navigable Waters Act*, current to December 28, 2020 (Government of Canada 2020) defines a “navigable water” as, “…*a body of water, including a canal or any other body of water created or altered as a result of the construction of any work, that is used or where there is a reasonable likelihood that it will be used by vessels, in full or in part, for any part of the year as a means of transport or travel for commercial or recreational purposes, or as a means of transport or travel for Indigenous peoples of Canada*…” The unnamed watercourse does not meet this definition and is not a scheduled navigable waterway pursuant to the *Canadian Navigable Waters Act*.

2.2 Fisheries and Oceans Canada – *Fisheries Act*

On June 21, 2019, Bill C-68 received Royal Assent, and the new *Fisheries Act* (Government of Canada 2019a) became law. On August 28th, 2019, the fish and fish habitat protection provisions came into effect. In addition, the *Fish and Fish Habitat Protection Policy Statement* (Fisheries and Oceans Canada 2019) was approved by the Minister of Fisheries, Oceans and the Canadian Coast Guard and is effective as of August 28, 2019.

The amendments in the new *Fisheries Act* are intended to provide:

1. *Protection of all fish and fish habitat,*
2. *Protection against the death of fish, other than by fishing, and the harmful alteration, disruption or destruction of fish habitat,*
3. *Clearer permitting for development projects,*
4. *A new ability to enshrine inshore policies into regulations,*
5. *Better ability to protect biodiversity for the long-term,*
6. *The inclusion of Indigenous traditional knowledge to inform habitat decisions, and*
7. *An increased focus on habitat restoration and rebuilding fish stocks.*

Proponents of projects are responsible to:

8. *understand the types of harmful impacts their works, undertakings, or activities are likely to cause;*
9. *take measures to avoid harmful impacts, including following relevant standards, codes of practice, or regulations; and,*
10. *request an exception to the section 34.4 and 35 prohibitions from the Minister when it is not possible to avoid harmful impacts to fish and fish habitat, and abide by the conditions of any such exception. In most cases, this exception would be in the form of Ministerial authorizations granted to proponents under the Authorizations Concerning Fish and Fish Habitat Protection Regulations (Government of Canada 2021a)*

In order for proponents to carry out proposed works, undertakings, or activities, and be in accordance with the *Fisheries Act*, proponents are responsible for planning and implementing works, undertakings, or activities in a manner that avoids harmful impacts, specifically the death of fish, and the harmful alteration, disruption or destruction of fish habitat. If a proponent believes their works undertakings, or activities will result in harmful impacts to fish and fish habitat, the Department of Fisheries and Oceans will work with proponents to assess the risk of their proposed work, undertaking, or activity resulting in the death of fish or the harmful alteration, disruption or destruction of fish habitat and provide advice and guidance on how to comply with the *Fisheries Act.*

Section 34.2 of the *Fisheries Act* provides authority for the Minister to establish standards and codes of practice for avoiding the death of fish or the harmful alteration, disruption or destruction of fish habitat for routine activities. Standards and codes of practice are non-regulatory tools that specify: procedures, minimum requirements, the potential harmful impacts to be managed, and the measures to implement to ensure the protection of fish and fish habitat. If the measures set out in codes of practice or standards are implemented as described, the proponent is not likely to contravene the prohibitions against the death of fish or the harmful alteration, disruption or destruction of fish habitat.

Standards and codes of practice represent best management practices that have been determined to be the most effective and practical means of preventing harmful impacts to fish and fish habitat where there is a good understanding of the impacts to fish and fish habitat resulting from the works, undertakings, or activities being proposed. The DFO indicates codes of practice may be developed in collaboration with interested provinces and territories, Indigenous peoples, stakeholders, or proponents. They are used by the Department to guide proponents when designing works, undertakings or activities that take place in or near water. There are currently six interim codes of practice; beaver dam removal, culvert maintenance, end-of-pipe fish protection screens for small water intakes in freshwater, routine maintenance dredging, temporary cofferdams and diversion channels, and temporary stream crossings. Others will be added as they become available.

As of August 29, 2019, the Department of Fisheries and Oceans fish and fish habitat protection policy can be found on their "*Projects Near Water*" website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html). The website also provides links for services and information including request for review of projects, information on protecting fish habitat and, standards and codes of practice.

2.2.1 Project Review and Decision Making

For all proposed projects, proponents are encouraged to use standard guidance from the Department's website or seek expert advice from a qualified environmental professional to determine whether their proposed work, undertaking, or activity has the potential to cause impacts to fish and fish habitat. For any project in or near water, it is necessary to determine if the activities can be carried out in such a way as to prevent the harmful alteration, disruption or destruction of fish habitat. For example, no harmful alteration, disruption or destruction of fish habitat can be achieved by avoiding:

- conducting any work, undertaking or activity in water
- placing fill or other temporary or permanent structures below the high watermark

If the project cannot be carried out as described above, then the project must be submitted to DFO for their review. Additionally, if the work is done in a waterbody where according to the SARA mapping data there is one or more aquatic species listed under the SARA for either:

- *being a critical habitat,*
- *an extirpated, endangered, or threatened species is found (or potentially found), or*
- *a species of special concern is found (or potentially found),*

then the project must be sent to the DFO for their review.

Work will be carried out below the ordinary high-watermark therefore, the project must be submitted to the DFO for their review.

2.2.2 Duty to Notify

Section 38 of the *Fisheries Act* (Government of Canada 2019a) outlines specific responsibilities for persons who undertake projects that lead to occurrences that result in the death of fish or the harmful alteration, disruption or destruction of fish habitat. Should there be the death of fish or the harmful alteration, disruption or destruction of fish habitat, there is a duty to notify an inspector, fishery officer, a fishery guardian or other person prescribed by regulations when the death of fish or the harmful alteration, disruption or destruction of fish habitat occurs that is not authorized under the *Fisheries Act*, or when there is a serious and imminent danger of such an occurrence.

The Fisheries Act also requires pursuant to Section 38 that persons responsible for such works, undertakings or activities to take corrective measures and to provide written reports when there are such occurrences. Failure to notify, take corrective measures or report in such situations may result in penalties (Government of Canada 2019a).

It remains the responsibility of a person who contravenes the *Fisheries Act* to directly notify the DFO as soon as possible following the incident by either calling 1.855.852.8320, or sending an email to: Fisheries.Protection@dfo-mpo.gc.ca.

2.3 Fisheries and Oceans Canada – *Species at Risk Act*

The *Species at Risk Act* (Government of Canada 2019b) prohibits the killing, harming, harassment, possession, capturing or taking of a species listed as extirpated, endangered or threatened; the damage or destruction of a residence or the destruction of any part of the critical habitat of such a listed species, unless authorized by the Minister who is responsible for the species in question (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html). The Act establishes Schedule 1 as the official list of wildlife species at risk. The complete list is found on the species at risk public registry (Government of Canada 2019c). The Minister of Fisheries and Oceans Canada is responsible for the protection of aquatic species at risk wherever they are found with the exception of areas administered by the Parks Canada Agency.

To protect fish and fish habitat, including aquatic species at risk, their residences, and their critical habitat, efforts should be made to avoid, mitigate and / or offset harm. Following the measures to avoid harm will help comply with the *SARA*. The taking or capture of aquatic species listed under the *SARA* as endangered or threatened (e.g., during baseline environmental studies, site isolation, fish salvage, or shellfish relocation activities), or any entrainment or impingement of such species (e.g., at water intakes) is contrary to the *SARA* Section 32 and therefore requires approval from the DFO.

The species at risk public registry website (http://www.dfo-mpo.gc.ca/species-especes/fpp-ppp/indexeng.htm) was accessed on April 18, 2022 to determine if there are any aquatic species at risk found (or potentially found) within the vicinity of the proposed project location. The review of the *SARA* data determined there are no aquatic species at risk found, or potentially found, in or near the zone of impact of the proposed project location on the unnamed creek. Additionally, there is no critical habitat for any species found in or near the zone of impact of the proposed project location on the unnamed creek (Appendix A).

Overall, the advice and recommendations contained in this report follow the DFO's *Measures to Protect Fish and Fish Habitat*. A complete list of the *Measures to Protect Fish and Fish Habitat* for all projects is found in Appendix B.

3 PROJECT OVERVIEW AND ENVIRONMENTAL ASSESSMENT

The Government of the Northwest Territories Department of Infrastructure is planning to upgrade a culvert installation on an unnamed creek. A new culvert will be installed via a tunnel boring machine and the existing culvert will be decommissioned (Figure 1).

Over the past year, there has been an ongoing discussion amongst and between CCI, the GNWT and the DFO with regard to meeting the environmental requirements for a crossing pursuant to federal legislation, regulations and policy. CCI was retained by the Government of the Northwest Territories Department of Infrastructure to provide support for submitting additional information to complete a Request for Review to the DFO for the project.

Information required to support the Request for Review includes desktop assessments to describe the fish community and fish habitat within the vicinity of the proposed project. Additionally, a field assessment was also undertaken to update available desktop information and to characterize fish habitat at the proposed project site. This work was carried out for the GNWT-INF by Stantec Consulting Ltd. (Stantec) and is documented in their *Fish Habitat Assessment for Crossing Structure Replacement: NWT Highway 8 (Dempster Highway) at KM 147.0* memo report (Stantec 2019).

3.1 Aquatic Resource Assessment Methods and Results

3.1.1 Desktop Assessment

3.1.1.1 Fish Presence

Based on their research, Stantec (2019) reported on potential fish species presence in the Mackenzie Delta and that have the potential to be found in the watercourse at KM 147.0. They note the watercourse at KM 147.0 flows into the Mackenzie River, approximately 450 m downstream of the existing crossing location. Different life stages of these species have the potential to use the watercourse during the open-water season. The potential species (Stantec 2019) and their associated spawning times and lengths are presented in Table 1.

Table 1. Spawning Time and Average Length for the Potential Fish Species Present in the Watercourse at KM 147.0 of NWT Highway 8.

Common Name	Scientific Name	Spawning Timing	Average Length (cm)
Arctic grayling	*Thymallus arcticus*	May-Jun[1]	30-40[1]
Arctic lamprey	*Lampetra camtschatica*	Apr-Jul[1]	20-30[1]
Broad whitefish	*Coregonus nasus*	Oct-Nov[2]	41-50[2]
Brook stickleback	*Culaea inconstans*	May-Jul[1]	5[1]
Burbot	*Lota lota*	Feb-Mar[1]	40-60[1]
Cisco	*Coregonus artedi*	Sep-Dec[1]	20-30[1]
Dolly varden	*Salvelinus malma*	Sep-Nov[3]	38-61[3]
Finescale dace	*Phoxinus neogaeus*	Jun-Jul[1]	7[1]
Flathead chub	*Platygobio gracilis*	Jul-Aug[1]	20-30[1]
Lake chub	*Couesius plumbeus*	Apr-Aug[1]	5-9[1]
Lake trout	*Salvelinus namaycush*	Sep-Oct[1]	45-65[1]
Lake whitefish	*Coregonus clupeaformis*	Sep-Nov[1]	40-55[1]
Least cisco	*Coregonus sardinella*	Jul-Oct[4]	10-20[5]
Longnose dace	*Rhinichthys cataractae*	May-Aug[1]	5-9[1]
Longnose sucker	*Catostomus catostomus*	May-Jul[1]	30-50[1]
Ninespine stickleback	*Pungitius pungitius*	May-Jul[1]	5[1]
Northern pike	*Esox lucius*	Immediately after ice out[6]	40-50[1]
Northern redbelly dace	*Phoxinus eos*	Jul-Aug[1]	4-5[1]
Pond smelt	*Hypomesus olidus*	Jun[7]	10-20[7]
Rainbow smelt	*Osmerus mordax*	Mar-May[8]	10-25[8]
Round whitefish	*Prosopium cylindraceum*	Oct-Dec[1]	20-30[1]
Slimy sculpin	*Cottus cognatus*	May-Jun[1]	6[1]
Spoonhead sculpin	*Cottus ricei*	Aug-Sep[1]	8[1]
Spottail shiner	*Notropis hudsonius*	Jun-Jul[9]	6-8[1]
Trout-perch	*Percopsis omiscomaycus*	May-Aug[1]	7.5-10[1]
Walleye	*Sander vitreus*	Apr-May[1]	40-60[1]

Notes:
1. Joynt and Sullivan (2003)
2. Harper et al. (2012)
3. Hubartt (2008)
4. Roberge et al. (2002)
5. https://yukon.ca/en/least-cisco
6. https://www.dfo-mpo.gc.ca/species-especes/profiles-profils/northernpike-grandbrochet-eng.html
7. http://www.arctic.uoguelph.ca/cpl/organisms/fish/fresh/smelt/pondsmelt.htm#:~:text=Total%20length%20is%20no%20more,pike%2C%20and%20various%20salmon%20species.
8. https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/rainbow-smelt-2018.html
9. http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AFCJB28550

3.1.1.2 Aquatic Species at Risk Status

Online searches of the general status were retrieved on April 18, 2022 from the NWT Species at Risk Database (https://www.nwtspeciesatrisk.ca/content/nwt-species-infobase), and the COSEWIC and SARA Status of Species at Risk Public Registry (https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm). Species listed under the federal *Species at Risk Act* are afforded legislative protection. Table 2 contains the status of concern for the fish species.

Of the 26 fish species with potential presence in the vicinity of the proposed project, Arctic Grayling and Dolly Varden are species of management concern. Arctic Grayling and Dolly Varden are listed as *Sensitive* in the NWT Species Infobase List. Dolly Varden is listed as S*pecial Concern* under Schedule 1 of the *Species at Risk Act*.

Table 2. Northwest Territories and Federal Status of Fish in the Vicinity of the Proposed Culvert Upgrade Project.

Common Name	Scientific Name	NWT GSRank[1]	SARA[2]
Arctic grayling	*Thymallus arcticus*	Sensitive	Not at Risk
Arctic lamprey	*Lampetra camtschatica*	Undetermined	Not at Risk
Broad whitefish	*Coregonus nasus*	Secure	Not at Risk
Brook stickleback	*Culaea inconstans*	Sensitive	Not at Risk
Burbot	*Lota lota*	Secure	Not at Risk
Cisco	*Coregonus artedi*	Secure	Not at Risk
Dolly varden	*Salvelinus malma*	Sensitive	Special Concern
Finescale dace	*Phoxinus neogaeus*	Secure	Not at Risk
Flathead chub	*Platygobio gracilis*	Secure	Not at Risk
Lake chub	*Couesius plumbeus*	Secure	Not at Risk
Lake trout	*Salvelinus namaycush*	Secure	Not at Risk
Lake whitefish	*Coregonus clupeaformis*	Secure	Not at Risk
Least cisco	*Coregonus sardinella*	Secure	Not at Risk
Longnose dace	*Rhinichthys cataractae*	Secure	Not at Risk
Longnose sucker	*Catostomus catostomus*	Secure	Not at Risk
Ninespine stickleback	*Pungitius pungitius*	Secure	Not at Risk
Northern pike	*Esox lucius*	Secure	Not at Risk
Northern redbelly dace	*Phoxinus eos*	Secure	Not at Risk
Pond smelt	*Hypomesus olidus*	Undetermined	Not at Risk
Rainbow smelt	*Osmerus mordax*	Undetermined	Not at Risk
Round whitefish	*Prosopium cylindraceum*	Secure	Not at Risk
Slimy sculpin	*Cottus cognatus*	Secure	Not at Risk
Spoonhead sculpin	*Cottus ricei*	Secure	Not at Risk
Spottail shiner	*Notropis hudsonius*	Secure	Not at Risk
Trout-perch	*Percopsis omiscomaycus*	Secure	Not at Risk
Walleye	*Sander vitreus*	Secure	Not at Risk

[1]*(Government of Northwest Territories 2016)*; [2]*(Government of Canada 2019c)*

3.1.2 Aquatic Habitat Field Assessment

On August 31, 2018, two biologists conducted a field survey on the unnamed creek at the KM 147.0 crossing location (Stantec 2019). Fish habitat and riverine habitat parameters were assessed for a 300 m section of the unnamed creek from 100 m upstream to 200 m downstream of the crossing location (300 m downstream of the crossing location was not assessed due to safety and timing restrictions). Details of the riverine habitat inventory are found in the Stantec fish habitat assessment report (Stantec 2019).

At the crossing, spawning habitat for fish species which require gravel substrate for spawning was rated as poor immediately upstream and downstream of the culvert due to a lack of gravel substrate. Fines and instream vegetation present in the beaver dam pool downstream of the culvert may be suitable for northern pike spawning, or other species that prefer dense vegetation. The deep pool downstream of the culvert likely provides good rearing habitat, but overall rearing potential at the existing crossing is rated as moderate. The deep pool downstream may provide overwintering habitat for fish but at the crossing site and upstream of the crossing overwintering potential is rated poor due to shallow depths in these locations. Migration is rated as poor because the beaver dam may be a barrier or partial barrier to fish passage thereby limiting movement between the stream and Mackenzie River (Stantec 2019).

Stantec (2019) attempted to carry out electrofishing and trapping to determine fish presence in the vicinity of the project. Fish collection was not completed due to electrofisher malfunction during the field survey.

4 ENVIRONMENTAL MITIGATION RECOMMENDATIONS

The following best management practices (BMP) and mitigation measures will be implemented to ensure the project will not result in: the death of fish and the harmful alteration, disruption or destruction of fish habitat as per subsections 34.4(1) and 35(1) of the *Fisheries Act*, and the introduction of aquatic species into the water body that are not indigenous, as per section 10 of the *Aquatic Invasive Species Regulations* (Government of Canada 2021b).

4.1 Construction Timing

The unnamed creek is in NWT Zone 1 with respect to the DFO restricted activity timing windows (https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/nwt-eng.html). From the list of known timing for fall, spring/summer and winter spawners from the DFO web site, there are potentially 6 fall spawners, 5 spring/summer spawners and 1 winter spawner at the crossing location. From their assessment, Stantec (2019) recommended a winter construction period given the expectation that spawning does not occur due to poor substrate conditions, low flow and likely frozen to bottom conditions. At the time of the survey, upstream of the culvert, the north and south branches of the stream were noted to be generally shallow (less than 0.4 m in depth) riffle or run habitat and may freeze to the bottom during winter. This precludes the use of the upstream area of the culvert for overwintering fish, or by fall- and winter-spawning species whose eggs would incubate through the winter period (e.g., whitefish, cisco, trout, burbot) (Stantec 2019). However, an overwintering habitat survey would be required at and upstream of the culvert to verify available overwintering habitat and the use of this habitat by fish. Outside of winter, the best open window, which avoids the spring and fall spawning restricted activity windows, is July 15 to September 15. Instream work scheduled for the open window of July 15 to September 15 will avoid the spring / summer spawning time for arctic grayling, northern pike, walleye, rainbow smelt and longnose sucker and the fall spawning window.

4.2 Fish Passage

As part of the pre-engineering design phase, fish passage was developed using an approach that has been developed by Alberta Transportation. This approach was discussed with the DFO through a series of meetings. While remaining open to any approach to fish passage design, the DFO staff stated that their preference for design criteria for fish passage is to compare the average velocity in the culvert as determined from the 3Q10 discharge and to compare these results to the established fish swimming performance curves. As a result of those discussions, CCI used the DFO Fish Calculator to determine fish passage of the potential species identified at the KM 147.0 location for the proposed culverts. The detailed results of this study to accommodate fish passage are found in the Design Memo Report KM 147.0 (CCI 2022). In addition to the specific water velocity calculations, all the other design measures to accommodate fish passage over the expected range of flow conditions are also presented in detail. See drawings in Appendix C showing fish passage details.

4.3 General Measures

11. *Review the DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (Appendix B).*
12. *Equipment access to avoid the streambanks and to minimize disturbance to vegetation.*
13. *Remove all construction debris and properly dispose it above the high water mark and ensure it does not enter any water body.*
14. *Halt construction during periods of heavy precipitation. Monitor weather advisories.*
15. *Use only clean rock that is free of any deleterious substances for riprap. Material other than what is required to be excavated from the construction site will be from areas above the ordinary high water mark.*
16. *Operate machinery on land.*
17. *Machinery will be operated to minimize disturbance to the banks. Banks will be restored during the clean-up phase of construction operations.*
18. *Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water.*
19. *Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.*
20. *Equipment for in-stream use will use biodegradable oils and lubricants (e.g., vegetable-based hydraulic oil).*
21. *Isolation works will consist of sheet pile or mega bags filled with clean, sediment free rocks along with polyethylene sheet or tarpaulin.*

4.4 Construction, Isolation and Erosion Control Plan

4.4.1 Decontamination - Aquatic Invasive Species

Aquatic Invasive Species (AIS) and fish disease pose significant risks to the conservation and sustainability of native species and their habitat. These threats pose both ecological and economic impacts to fisheries, water management infrastructure, tourism, and local communities. Fish diseases (including parasites, bacteria and viruses) represent a substantial threat to the health of fisheries, particularly to species at risk. Biota of concern include, but are not limited to, plants and diseases or alien organisms. The introduction and / or spread of fish diseases has the potential to severely impact fish stocks in affected waters. Potential effects can be mitigated by:

1. Having all equipment free of any aquatic invasive species by decontaminating all equipment based on best practices. Excellent resources for decontamination are: *Decontamination Protocol for Watercraft & Equipment* (Alberta Environment and Parks 2020) and, *Decontamination of Equipment Used Within the Bed and Banks of a Waterbody*, Design Bulletin #112/2020 (Alberta Transportation 2020). Both documents are available online.
2. Cleaning equipment of all mud, dirt, and vegetation prior to the equipment entering the water body or the area adjacent to the water body.
3. Ensuring to remove any visible plant or plant fragments.

4.4.2 Worksite Dewatering Plan

As soon as each work area is isolated, and just as dewatering begins, a fish salvage will be carried out. Captured fish will be relocated downstream of the project work site. The isolated area will be dewatered gradually to reduce the potential for stranding fish. The worksite dewatering system will be set up with a pump that will be inserted into the accumulated water within the worksite. The water will be discharged on the outside of the downstream side of the work area, filtered, deposited into a settling basin, and finally re-introduced into the downstream flow at an equal or better quality than which it was extracted. Dewatering of the isolation area and the installation of the by-pass system will be done such that the water intake is screened with openings no larger than 2.54 mm and the velocities are such that they do not cause the entrapment or impingement of fish. Screen size and velocity requirements will be determined as per the DFO's *Freshwater Intake End-of-Pipe Screen Guideline* (Fisheries and Oceans Canada 1995) and the DFO's *Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater* (Appendix D).

4.4.3 Construction Sequencing Plan and Specific Protection Measures

Detailed drawings of the project sequencing and protection measures are provided in Appendix E. There will be five construction phases for this project as described below:

<u>Phase I: Beaver Dam Removal</u>

Construction Sequencing

1. Install pumps on the inlet (east) side of the crossing that will handle the volume of flow in the watercourse.
2. String hoses through the existing culvert to a discharge location on the west side of the Dempster Highway where scouring and downstream sedimentation from discharge energy is mitigated, downstream of the beaver dam location.
3. Dam the inlet side of the culvert and initiate pump around operations. Ensure pump capacity is equal to the volume of water traveling through the watercourse plus contingency pumps and hoses for high water events.
4. Initiate pump around of water ensuring that water is not allowed to build up on the inlet side of the culvert.
5. Access the outlet (west) side of the culvert from the north side of the crossing.
6. Remove the dam implementing the procedure and mitigation presented Fisheries and Oceans Canada (DFO) Interim Code of Practice: Beaver Dam Removal.
7. Once removal of the dam is complete, pump down remaining water level in the pool.
8. Backfill the pool with clean fill and rip rap to final outlet apron elevation.

Phase II: Culvert Installation Site Preparation

Construction Sequencing

1. Maintain pump around of water from Phase I.
2. Construct an isolation dam on the outlet (west) side of the crossing. All advice and best practices contained in the DFO's *Interim Code of Practice: Temporary cofferdams and diversion channels* will be applied.
3. Construct a work area on the outlet side of the crossing.
    a. Install the isolation dam from the south edge of the existing culvert, extending across the backfilled pool and key into the south bank of the channel, directly across from the south edge of the culvert.
    b. Discontinue pump around operations by removing the pumps and hoses and allow water to flow through the existing culvert. If leaks are found in the isolation dam, repair prior to moving to the inlet side of the crossing.
4. Construct a work area on the inlet (east) side of the crossing.
    a. Stake out the location of the jacking frame.
    b. Install pumps in the south fork of the watercourse, south of the jacking frame location, that will handle the volume of flow in the watercourse.
    c. String hoses from the pump location to the north channel to a location where scouring and downstream sedimentation from discharge energy is mitigated.
    d. Install a dam on the south side of the jacking frame and initiate pump around of water from to the north fork.
    e. Install the isolation dam on the north side of the jacking frame, allowing water to move from the isolated area through the existing culvert prior to completing the isolation to the edge of the existing culvert.
    f. Salvage surficial soils from the jacking frame work area and stockpile away from the watercourse.
    g. Remove grade cuts from the work area and stockpile away from the crossing separately from the salvaged surficial soils.
    h. Construct the jacking frame.
    i. When the jacking frame is complete, construct a diversion channel around the east side of the frame and line with rock cobble.
    j. With the diversion channel complete, remove the dam, discontinue pump around operations and allow water to flow around the jacking frame to the north fork and through the existing culvert.
    k. Place equipment on the work area.
    l. Install silt fencing where required on the edge of the work area to mitigate potential sedimentation into the watercourse.

Phase III: Culvert Installation

Construction Sequencing

1. When the work area is constructed and equipment is in place to begin installation of the new culvert, ensure the work areas on the inlet and outlet side of the crossing remain isolated.
2. Install 3 m culvert.
3. Complete the reclamation of the inlet and outlet sides of the 3 m culvert while still isolated.
4. Remove any deposited sediment from within the isolated worksite and ensure any disturbed instream areas have been stabilized prior to removal.

5. Maintain sediment control measures during removal and re-watering of instream worksite.
    a. Inlet Side:
        i. Remove the trenchless equipment and jacking frame on the inlet side of the 3 m culvert.
        ii. Install pumps in the south fork of the watercourse, south of the jacking frame location, that will handle the volume of flow in the watercourse.
        iii. String hoses from the pump location to the north channel to a location where scouring and downstream sedimentation from discharge energy is mitigated.
        iv. Install a dam on the south side of the jacking frame and initiate pump around of water from to the north fork.
        v. Widen the channel on the inlet side to accommodate flow to the installed 3 m culvert.
        vi. Recontour the channel of the original south fork of the creek channel.
        vii. Re-establish flow through the south fork of the creek channel
        viii. Install rock rip rap and armour the channel and contoured bank to the water line.
        ix. Seed and place coconut matting over the bank above the water line.
    b. Outlet Side:
        i. Complete the outlet apron on the outlet end of the 3 m culvert.
        ii. Install rock rip rap and armour the channel and contoured banks to the water line.
        iii. Seed and place coconut matting over the bank above the water line.

<u>Phase IV: Existing Culvert Decommissioning</u>

Construction Sequencing

1. Move the isolation dam on the inlet side of the crossing, isolating the existing culvert and allowing the water to move from the isolated area through the installed 3 m culvert, prior to completing the isolation to the edge of the 3 m culvert.
2. Install the isolation dam along the east edge of the newly contoured outlet channel, east of the 3 m culvert.
3. Construct a work area on the outlet side of the crossing.
    a. Level the outlet side of the existing culvert.
    b. Place grouting equipment on the work area.
    c. Install silt fencing where required on the edge of the work area to mitigate potential sedimentation into the watercourse.
4. Grout the existing culvert.
5. Complete the reclamation of the outlet side of the decommissioned existing culvert while still isolated.
6. Remove any deposited sediment from within the isolated worksite and ensure any disturbed instream areas have been stabilized prior to removal.
7. Maintain sediment control measures during removal and re-watering of instream worksite.
    a. Outlet Side:
        i. Remove equipment on outlet side of the existing culvert.
        ii. Complete the outlet apron on the outlet end of the existing culvert.
        iii. Install rock rip rap and armour the channel and contoured banks to the water line.
        iv. Install silt fencing along the toe of the road slope, between the road fill and the rock armour.

v. Complete seeding and mitigation to minimize erosion to the widened road embankment, including seeding and placement of coconut matting to the installed silt fencing.
vi. Remove isolation dam on the outlet side.
vii. Complete the remainder of the outlet apron through the placement of rock rip rap, where required.

b. Inlet Side
   i. Complete final recontouring and channel/bank armouring on the inlet side of the existing culvert.
   ii. Install silt fencing and seed disturbed areas on the inlet side of the crossing.
   iii. Install silt fencing along the outlet apron edge.
   iv. Complete seeding and coconut matting installation over work area on the outlet side.

<u>Phase V – Final Reclamation</u>

Depending on the soil types and the project footprint located at the crossing location, additional reclamation measures may be required on the outlet and inlet side of the crossing. These additional measures can include:

1. Streambank restoration through the installation of lifts and jute wrap, with willows placed between lifts, if road widening requires stabilization of banks on both the inlet and outlet side of the crossing.
2. Willow staking on the watercourse banks to stabilize disturbed areas and promote regrowth.
3. Additional silt fencing will be installed to avoid the potential movement of soils and sedimentation of the watercourse.
4. Additional seeding or installation of coconut matting to promote expedited regrowth and stabilization of the project footprint.

4.5 Environmental Monitoring Plan

4.5.1 Before and During Construction

Photographs and/or video recordings of the area upstream from the crossing site and downstream from the crossing site will be taken before and during construction. Additionally, photographs and / or video recordings at the crossing site, one of each bank taken from the opposite bank will be taken across the transect and of upstream and downstream to document preconstruction condition.

An Environmental Inspector (EI) will be on-site to oversee construction activities and monitor water quality. Total suspended solids (TSS) are the most significant water quality parameter associated with a sediment release. TSS monitoring will indicate if sediment has entered the watercourse, however, TSS cannot be measured in the field. As such, water quality monitoring will be carried out by measuring turbidity (NTU), since it is a recognized proxy for TSS and NTUs can be readily measured in the field. In general, water quality monitoring will be conducted along transects established within the estimated zone of impact or at least 400 m downstream, whichever is greater. At least one transect will be established upstream, beyond any influence of construction (typically +50 m), to provide control (i.e., background) data. The location of transects will be determined based on average width, channel characteristics and channel gradient extending to 400 m downstream of the crossing location. There will be four points of continuous sampling locations and five to seven points of hand sampling. TSS monitoring will be completed upstream (background) and downstream to quantify and qualify the extent of any sediment mobilized downstream during isolation of the workspace and any in-stream construction. Should TSS levels become elevated, construction will be suspended, and the stream will be allowed to recover. Construction methods will be adjusted to prevent further releases of sediment to the watercourse.

Remote sampling will be completed by daily hand samples using HF Scientific MicroTPW Handheld Turbidity Meters. For ice-covered conditions, WQM sample holes will be augured through the ice when it is safe to do so. During frozen-to-bottom conditions, the watercourse will be isolated for construction and visual monitoring will be conducted by the EI on site throughout to ensure conditions remain frozen-to-bottom.

Monitoring will follow the recommendations set out in the *Protocols Manual for Water Quality Sampling in Canada* (Canadian Council of Ministers of the Environment 2011) following the *Canadian Water Quality Guidelines* (Canadian Council of Ministers of the Environment 2008). Implications and effects on aquatic resources will be determined by an EI in consideration of habitat type and quality within the zone of impact.

5 EMERGENCY RESPONSE PLAN AND INCIDENT REPORTING

5.1 Overview

In general, emergency response plans include contingency measures to:

1. Stop work and contain any sediment-laden water and other deleterious substances.
2. Notify all applicable authorities in the area.
3. Promptly clean-up and appropriately dispose of the deleterious substances.
4. Ensure clean-up measures are suitably applied so as not to result in the further alteration of the environment.

In the event of either:

1. a refined product spill, or
2. a release of sediment,

it is the responsibility of a person who contravenes the *Fisheries Act* to directly notify the DFO as soon as possible following the incident by either calling 1.855.852.8320, or sending an email to: Fisheries.Protection@dfo-mpo.gc.ca.

Reportable releases include the following:

1. Any refined product release on or off lease.
2. Any substance release into a waterbody.
3. Any release that may cause or is causing an adverse effect.

The Construction Supervisor, EI and appropriate personnel shall review the following contingency measures for inadvertent releases with their contractors prior to commencement of work. When releases are discovered, the EI will inform the construction manager and the client's project manager as soon as possible. The client's Regulatory and Environment contacts will also be notified. Verbal notification to the regulator will be completed by the client. The Contractor is required to make all resources available for containment and clean up. Table 3 provides a list of contacts who should be notified immediately should a release or spill occur. The client will be responsible for reporting to regulatory agencies.

Table 3. Contacts for a Sediment Release or Refined Product Spill.

Contact	Phone
GNWT Project Manager, Alina Goldenberg	867.767.9086
Construction Supervisor, TBD	
DFO	1. 855.852.8320
CCI Aquatic Environment Specialist, Allan Locke*	403.801.1355

*For releases affecting a watercourse or waterbody

5.2 Contingency Measures: Refined Product Release

Should a refined product spill occur the recommended Spill Contingency Plan as outlined below should be followed. A spill is the release of a substance that may have an adverse effect on the environment. Should a spill occur, the first person on the scene shall immediately:

1. Stop work.
2. Assess the area for imminent danger.
3. Control the source of the spill, if possible and safe to do so.
4. Secure the area by taking actions to protect human life and the environment.
5. Contain the spill.
6. Notify the Construction Supervisor.

When notified of a spill, the Construction Supervisor shall:

- Secure the area by taking action to protect human life and the environment.
- Notify the appropriate emergency response agencies.
- Ensure the necessary personnel and equipment are mobilized, including the Area Oil Spill Cooperative if necessary.
- Contain the spill and initiate clean-up activity.
- When safe to do so and following containment, the Construction Supervisor or designate (e.g., Environmental Inspector) will immediately call 1.855.852.8320

5.3 Contingency Measures: Sediment Release

A sediment release is the flow of sediment-laden water into a watercourse caused by erosion or run-off. Should a sediment release occur, the following Sediment Release Contingency Plan must be implemented:

The first person on the scene shall immediately:

1. Stop work.
2. Notify the Construction Supervisor.

When notified of a sediment release, the Construction Supervisor shall:

1. Ensure the necessary personnel and equipment is mobilized.

2. Control the source of the sediment release, if possible and safe to do so.
3. Secure the area by taking action to protect human life and the environment.
4. Contain the sediment release.
5. When safe to do so and following containment, the Construction Supervisor or designate (e.g., Environmental Inspector) will immediately notify the client's representatives. The client will complete all regulatory reporting.

Following notification and containment, the Construction Supervisor shall:

1. Ensure to further contain the sediment release and begin cleaning up.
2. Notify the Environmental Inspector to have an aquatic environment specialist come to the site to quantify and qualify the release (i.e., collect samples for TSS analysis, collect turbidity readings), and advise on containment, clean up, impact on fish and determine the need for spill/release reporting, if required.
3. Work shall not resume until the spill has been contained and permission has been granted by the client.
4. Following containment, the Construction Supervisor or designate (e.g., Environmental Inspector) will immediately notify DFO (1.855.852.8320) as soon as possible following the incident.

5.4 Emergency Response Plan and Incident Reporting Summary

Emergency Response Plans are necessary to ensure inadvertent releases are stopped as soon as possible to limit impact to human health, to the environment and to meet the regulatory requirements pursuant to the *Fisheries Act*. In summary, upon discovery of an inadvertent release of either:

- a refined product spill, or
- a release of sediment.

it is necessary to:

1. Stop work immediately and contain any sediment-laden water and other deleterious substances.
2. Notify all applicable authorities in the area.
3. Promptly clean-up and appropriately dispose of the deleterious substances.
4. Ensure clean-up measures are suitably applied so as not to result in the further alteration of the environment.

6 POST-CONSTRUCTION MONITORING

Post-construction monitoring of the crossing site should be carried out to determine erosion and sediment control effectiveness and reclamation success. During the first growing season, just after spring break-up, the site should be assessed on a regular basis or until such time it can be concluded the erosion control measures are working properly. Following the first growing season, it is recommended the site be inspected, at a minimum, annually during the snow-free season. Site inspections should be conducted more frequently (especially after high flow events) until the permanent erosion control measures are well established.

Post construction monitoring should assess:

1. the physical condition of the crossing site,
2. slope / bank stability,
3. erosion control measures, and
4. physical integrity of restoration measures.

7 SUMMARY

This document has provided an overview of the federal requirements for using an isolation method to install a culvert. The report also provides details for the construction of the project and detailed environmental protection and mitigation recommendations. This report has been developed as support for a DFO Request for Review application. If there are any questions or concerns with this document, please notify CCI.

8 CLOSURE

The material contained in this report reflects CCI's professional judgment considering all available information at the time of preparation. Any use which a third party makes of this report or any reliance on, or decisions to be based on this report, are the responsibility of such third parties. CCI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

For and behalf of CCI Inc.

Prepared By:

Allan Locke

Allan Locke, Hon. B.Sc., P.Biol., R.P.Bio.
Aquatic Environment Specialist

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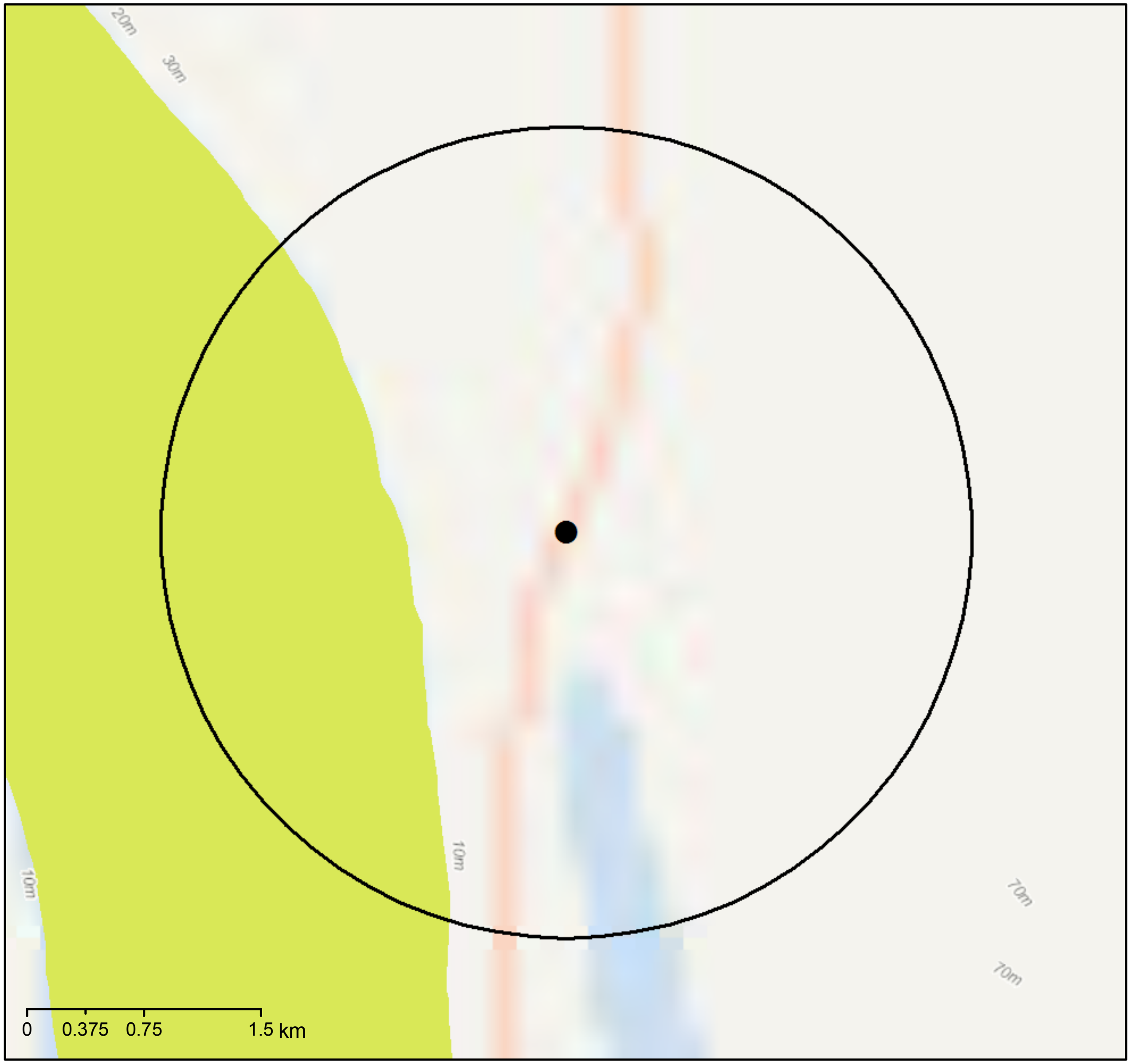
Appendix A: Aquatic Species at Risk Map

Aquatic Species at Risk Report

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada



One or more aquatic species listed under the Species at Risk Act are found (or potentially found) within the coloured areas.

- Critical Habitat
- Extirpated, Endangered, or Threatened
- Special Concern

How to use this information:

1. The map and species list are intended to provide a general overview of aquatic species at risk and their critical habitat that may occur within the mapped area.

2. To assess your project go to: www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html

If you encounter an aquatic species at risk in an area that is not currently mapped, please notify your regional Fisheries Protection Program office to ensure that you are compliant with the Species at Risk Act.
The official source of information for species at risk is the Species at Risk Public Registry www.sararegistry.gc.ca

To protect fish and fish habitat, including aquatic species at risk, their residences, and their critical habitat, efforts should be made to avoid, mitigate and/or offset harm. Following the measures to avoid harm will help you comply with the Fisheries Act and the Species at Risk Act.

Critical habitat for these species is found within the outlined area

Critical habitat is identified in recovery strategies or action plans for species listed under Schedule 1 of the Species at Risk Act as extirpated, endangered or threatened.

Name	Where Found	Species Status
	No critical habitat	

Species found (or potentially found) within the outlined area

Name	Where Found	Species Status
Dolly Varden - Western Arctic	Mackenzie River (Rivière)	Special Concern

Appendix B: Fisheries and Oceans Canada - Measures to Protect Fish and Fish Habitat

Measures to protect fish and fish habitat

Comply with the fish and fish habitat protection provisions of the *Fisheries Act* by incorporating measures to avoid:

- causing the death of fish
- harmful alteration, disruption or destruction of fish habitat in your work, undertaking or activity

Works, undertaking or activities where impacts to fish and fish habitat can be avoided if you can follow the measures to protect fish and fish habitat include:

- clear span bridges
- bridge maintenance
- on-land mineral exploration activities
- decking repairs for docks, piers, wharves and bridges

You're responsible for reviewing the complete list of measures and implementing those that are applicable to your work, undertaking or activity. If you can't completely implement the protection measures, check if your project needs a review.

Prevent the death of fish

You can prevent the death of fish by:

- avoiding killing fish by means other than fishing
- avoiding using explosives in or near water
- planning in water work, undertaking or activity to respect timing windows to protect fish, including:
  - their eggs
  - juveniles
  - spawning adults
  - the organisms upon which they feed and migrate

Maintain riparian vegetation

Measures to maintain riparian vegetation include:

- maintaining an undisturbed vegetated buffer zone between areas of on-land activity and the high water mark of any water body
- using existing trails, roads or cut lines wherever possible

- avoiding tree removal
- using methods to prevent soil compaction, such as swamp mats or pads

Carry out works, undertakings and activities on land

You can prevent the harmful alteration, disruption or destruction of fish habitat by avoiding:

- conducting any work, undertaking or activity in water
- placing fill or other temporary or permanent structures below the high water mark
- fording of the watercourse
- disturbing or removing materials from the banks, shoreline or waterbody bed, such as:
    - sand
    - rocks
    - aquatic vegetation
    - natural wood debris
- building structures in areas that:
    - may result in erosion and/or scouring of the stream bed or banks
    - are inherently unstable, like:
        - bends
        - meanders
        - floodplains
        - alluvial fans
        - braided streams

Maintain fish passage

Maintain fish passage by avoiding:

- changing flow or water level
- obstructing or interfering with the movement and migration of fish

Ensure proper sediment control

Ensure proper sediment control by:

- avoiding introducing sediment in the water, like:
    - silts
    - clays
    - sands
- developing and implementing an erosion and sediment control plan
    - installing effective erosion and sediment control measures to stabilize all erodible and exposed areas

  - regularly inspecting and maintaining the erosion and sediment control measures during all phases of the project
  - keeping the erosion and sediment control measures in place until all disturbed ground has been permanently stabilized
  - installing settling basin and/or filtration system for water flowing onto the site and water being pumped or diverted from the site, including:
    - holding back runoff water until suspended sediment has resettled in the settling basin and runoff water is clear
    - dewatering gradually to prevent sediment resuspension and bank destabilization
- disposing of and stabilizing all excavated material above the high water mark or top of bank of nearby waterbodies and ensuring sediment re-entry to the watercourse is prevented
- heeding weather advisories and scheduling work to avoid wet, windy and rainy periods that may result in high flow volumes and/ or increase erosion and sedimentation
- regularly monitoring the watercourse for signs of sedimentation during all phases of the work, undertaking or activity and taking corrective action if required
- using biodegradable erosion and sediment control materials whenever possible and removing all exposed non-biodegradable erosion and sediment control materials once site is stabilized
- operating machinery on land in stable dry areas
- stopping work and containing sediment-laden water to prevent dispersal
- installing temporary clear span bridges to accommodate expected high water flows and to not damage erodible banks
- limiting the impacts to stream or shoreline banks

Prevent entry of deleterious substances in water

Prevent entry of deleterious substances in water by:

- avoiding depositing any deleterious substances in the watercourse
- developing a response plan to be implemented immediately in the event of a spill of a deleterious substance
- keeping an emergency spill kit on site
- stopping work and containing deleterious substances to prevent dispersal
- reporting any spills of sewage, oil, fuel or other deleterious material whether near or directly into a water body
- ensuring clean-up measures are suitably applied so as not to result in further alteration of the bed and/or banks of the watercourse
- cleaning up and appropriately disposing of the deleterious substances
- planning activities near water such that materials and chemicals don’t enter the watercourse, including:
  - grout
  - paint
  - primers

  - degreasers
  - rust solvents
  - poured concrete
  - blasting abrasives
  - or other chemicals
- maintaining all machinery on site in a clean condition and free of fluid leaks to prevent any deleterious substances from entering the water
- washing, refueling and servicing machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water
- disposing all waste materials (including construction, demolition, excavation, commercial logging) above the high water mark of nearby waterbodies to prevent entry
- ensuring that building material used in a watercourse is handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish

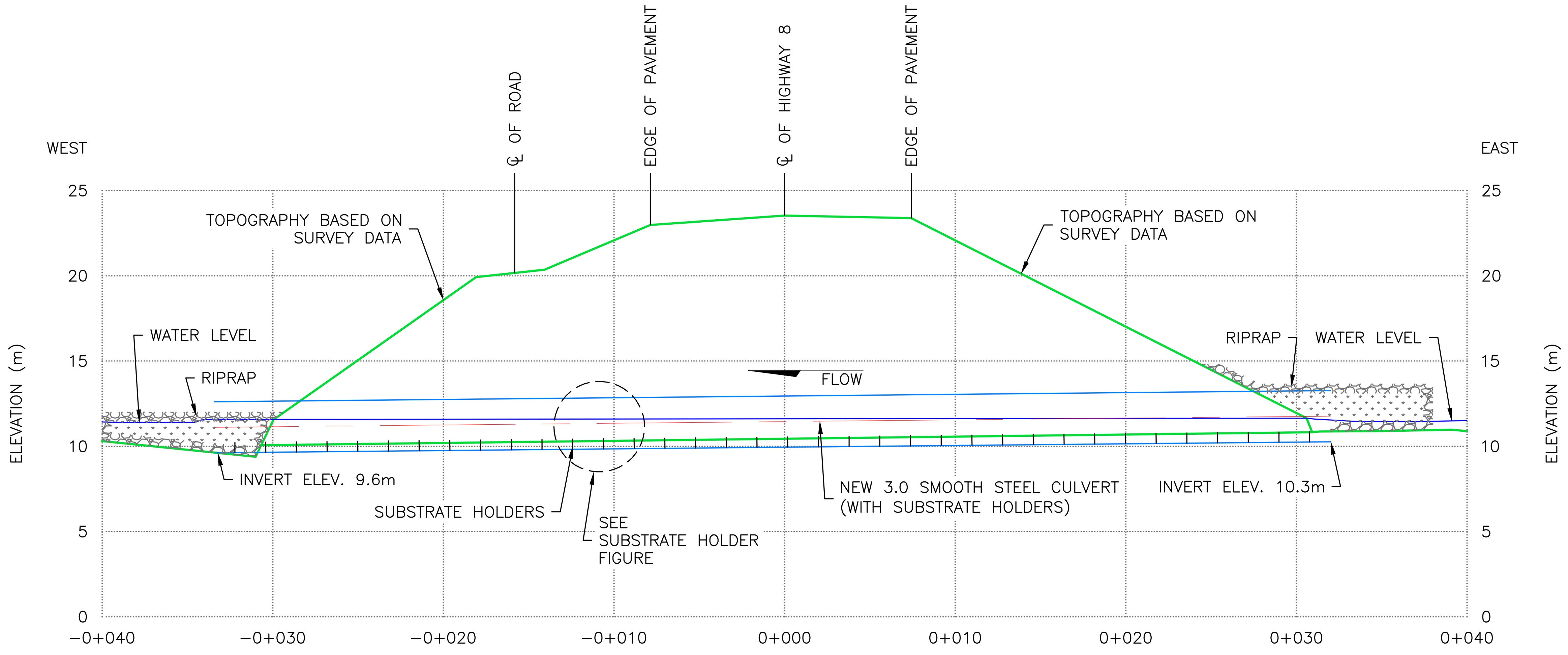
Related links

- 2019 changes to the *Fisheries Act*
- Request a review of your project near water
- Standards and codes of practice

Date modified:

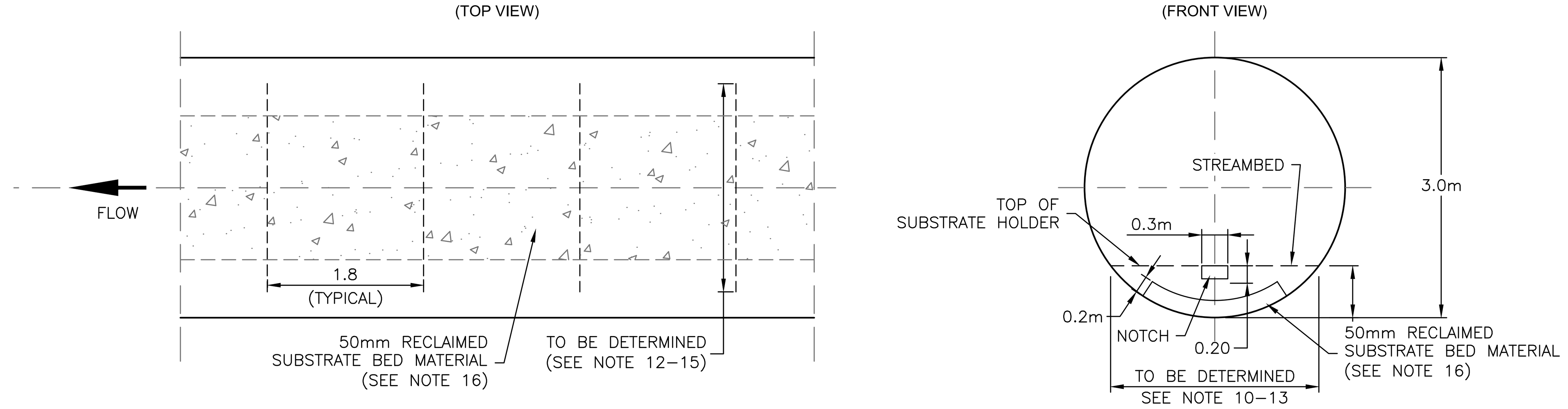
2019-08-28

Appendix C: Detailed Fish Passage Drawings



LONGITUDINAL SECTION THROUGH 3.0 CULVERT CENTRELINE

SCALE 1:250



SUBSTRATE HOLDER FIGURE

NTS

HYDROTECHNICAL DESIGN SUMMARY

- DRAINAGE AREA = $14.7km^2$
- FLOOD DESIGN DISCHARGE = $8.0m^3/s$
- FISH PASSAGE DESIGN DISCHARGE = $1.74m^3/s$

GENERAL NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. ALL WORK SHALL BE DONE IN ACCORDANCE WITH ALBERTA TRANSPORTATION STANDARD SPECIFICATIONS FOR BRIDGE CONSTRUCTION.
3. CONTRACTOR TO VERIFY ALL INVERTS OF EXISTING STRUCTURES PRIOR TO COMMENCING WORK. CONTRACTOR TO REPORT TO THE OWNER'S AUTHORIZED REPRESENTATIVE ANY DISCREPANCIES BETWEEN THE MEASURED INVERTS AND THE PIPE LOCATIONS SHOWN ON DRAWINGS PRIOR TO COMMENCING WORK.
4. BEFORE CONSTRUCTION ACTIVITIES COMMENCE, ALL WATER DIVERSION MEASURES AND EROSION CONTROL STRUCTURES SHALL BE INSTALLED ON BOTH SIDES OF THE WATERCOURSE.
5. ALL WORK SHALL BE DONE IN ACCORDANCE WITH PROJECT AGREEMENTS, REGULATORY APPROVALS, ENVIRONMENTAL PROTECTION PLAN AND SITE SPECIFIC REQUIREMENTS.

HEAVY ROCK RIPRAP AND NON-WOVEN GEOTEXTILE FABRIC

6. PRIOR TO INSTALLATION OF THE ROCK RIPRAP, THE APPROXIMATE 100mm OF SUBSTRATE BED MATERIAL SHALL BE STRIPPED AND STOCKPILED SEPARATELY. THE SUBSTRATE BED MATERIAL WILL BE PLACED ALONG THE LOW FLOW CHANNEL AND BETWEEN THE SUBSTRATE HOLDERS UPON COMPLETION OF THE ROCK RIPRAP.
7. HEAVY ROCK RIPRAP AND THE NON−WOVEN GEOTEXTILE SHALL BE SUPPLIED, DELIVERED, AND INSTALLED IN ACCORDANCE WITH THE ALBERTA TRANSPORTATION STANDARD SPECIFICATIONS FOR BRIDGE CONSTRUCTION.
8. PREPARE THE SUBGRADE FOR GEOTEXTILE AND RIPRAP TO THE REQUIRED LINES AND GRADES. COMPACT ANY FILL REQUIRED IN THE SUBGRADE TO A DENSITY OF APPROXIMATELY THAT OF THE SURROUNDING UNDISTURBED SOIL.
9. PLACE NON−WOVEN GEOTEXTILE FILTER FABRIC UNDER ALL HEAVY ROCK RIPRAP. PROVIDE A MINIMUM OF 400mm OVERLAP FOR JOINING TWO PIECES OF GEOTEXTILE TOGETHER. EXTEND GEOTEXTILE AT A MINIMUM OF 150mm BEYOND EDGES OF RIPRAP AND EMBED AT A MINIMUM 100mm AT SIDES OF RIPRAP.
10. AT THE CULVERT INLET, THREE LARGE CLASS 2 ROCK RIPRAP WILL BE PLACED IN ACCORDANCE WITH THE OWNER'S AUTHORIZED REPRESENTATIVE DIRECTION. THE INTENT OF THE CLASS 2 RIPRAP ROCKS IS TO PROVIDE A RESTING AREA FOR FISH. THE ROCK RIPRAP SHALL BE PLACED SO THAT THE TOP OF THE ROCKS ARE AT ELEVATION OF APPROXIMATELY 14.8m AND WILL BE PLACED TO MINIMIZE IMPACT TO THE FLOW.
11. IN THE OUTLET LOW FLOW CHANNEL, RECLAIMED SUBSTRATE BED MATERIAL SHALL BE PLACED WITHIN THE INTERSTITIAL SPACES BETWEEN THE ROCKS TO PROVIDE A CHANNEL FOR FISH MIGRATION. RECLAIMED SUBSTRATE BED MATERIAL SHALL ALSO BE PLACED WITHIN THE CULVERT.
    a. ESTIMATED SURFACE AREA COVERED BY FILTER FABRIC − $183.3m^2$
    b. ESTIMATED QUANTITY OF CLASS 1 ROCK RIPRAP − $64.3m^3$
    c. ESTIMATED QUANTITY OF CLASS 2 ROCK RIPRAP − $32.3m^3$

SUBSTRATE HOLDERS

12. SUBSTRATE HOLDERS TO BE PLACED AT A SPACING OF 1.8m. THE FIRST INTERIOR SUBSTRATE HOLDER AT THE OUTLET SHOULD BE LOCATED AS CLOSE TO THE DOWNSTREAM CULVERT OUTLET AS POSSIBLE AND SPACED ACCORDINGLY FROM THAT POINT TO THE INLET.
13. THE TOP OF THE SUBSTRATE HOLDERS HAVE BEEN DESIGNED TO BE APPROXIMATELY 0.6m ABOVE THE CULVERT INVERT AND ALIGNED WITH THE NATURAL WATERCOURSE BED AT THE INLET AND OUTLET. THE FINAL HEIGHT OF THE SUBSTRATE HOLDERS (ELEVATION 8.0m) WILL PARALLEL THE NATURAL WATERCOURSE BED. TO ENSURE THE TOP OF THE SUBSTRATE HOLDERS ARE ALIGNED WITH THE NATURAL WATERCOURSE BED AT THE INLET AND OUTLET, THE HEIGHT OF EACH SUBSTRATE HOLDER SHALL BE MEASURED AND CUT UPON COMPLETION OF THE INSTALLATION OF THE NEW 3.0m BORED CULVERT.
14. A NOTCH IS TO BE INSTALLED IN THE SUBSTRATE HOLDERS TO PROVIDE FOR FISH PASSAGE DURING LOW FLOWS. THE NOTCH SHALL BE CENTERED IN THE SUBSTRATE HOLDER AND MEASURE 200mm DEPTH BY 300mm WIDTH.
15. SUBSTRATE HOLDERS SHALL BE A MINIMUM OF 10mm THICK CARBON STEEL PLATE AND TO BE CONTINUOUSLY WELDED ALONG THE EDGE OF THE PLATE TO THE CULVERT PIPE BODY. THE WELD SHALL BE A MIN. 10mm FILLET WELD.
16. RECLAIMED SUBSTRATE BED MATERIAL SHALL BE PLACED TO A THICKNESS OF 50mm ALONG THE BOTTOM OF THE CULVERT BETWEEN THE SUBSTRATE HOLDERS.

HIGHWAY EMBANKMENT STABILIZATION AND BACKFILL AREAS

17. ALL EMBANKMENTS SHALL BE GRADED TO A SLOPE OF 1.5 HORIZONTAL TO 1 VERTICAL OR SHALLOWER UNLESS OTHERWISE NOTED.
18. NON−ORGANIC CLAY SHALL BE USED FOR THE BACKFILL MATERIAL. ALL BACKFILL MATERIAL SHALL BE FREE FROM FROZEN LUMPS AND ORGANIC MATERIAL. BACKFILL MATERIAL SHALL BE APPROVED BY OWNER'S AUTHORIZED REPRESENTATIVE PRIOR TO CONSTRUCTION.
19. THE AMOUNT OF FILL REQUIRED WILL VARY ACCORDING TO THE TYPICAL CROSS−SECTION SHOWN ON THE DRAWING.
20. TO ENSURE A PROPER BOND BETWEEN THE EXISTING AND NEW MATERIAL, VEGETATION ALONG THE SIDESLOPE SHALL BE REMOVED AND THE TOPSOIL EXCAVATED AND SALVAGED. THE SURFACE SHALL BE SCARIFIED TO A DEPTH OF 0.15m.
21. ALL MATERIAL PLACED IN EMBANKMENTS SHALL BE SPREAD AND BLADED SMOOTH IN SUCCESSIVE LAYERS, NOT TO EXCEED 0.15m WHEN COMPACTED AND TO THE FULL WIDTH OF THE CROSS−SECTION. EACH LAYER SHALL BE COMPACTED TO A MINIMUM OF 95 PERCENT OF STANDARD PROCTOR DENSITY AT OPTIMUM MOISTURE CONTENT.

NON−WOVEN GEOTEXTILE FILTER FABRIC	
SPECIFICATIONS AND PHYSICAL PROPERTIES	
	CLASS 1M, 1, 2, 3
GRAB STRENGTH	900 N
ELONGATION (FAILURE)	50%
CBR PUNCTURE STRENGTH	550 N
TRAPEZOIDAL TEAR	350 N
MINIMUM FABRIC LAP TO BE 400mm	

REFERENCE DOCUMENT NO.	DATE
1. 18-209 PPP Drafting	2020-02-18
2. 2567-EG-0203	2022-04-06
3. 2567-EG-0204	2022-04-06
4. 2567-EG-0206	2022-04-06
5. 2567-EG-0207	2022-04-06

ENGINEER AND PERMIT STAMPS

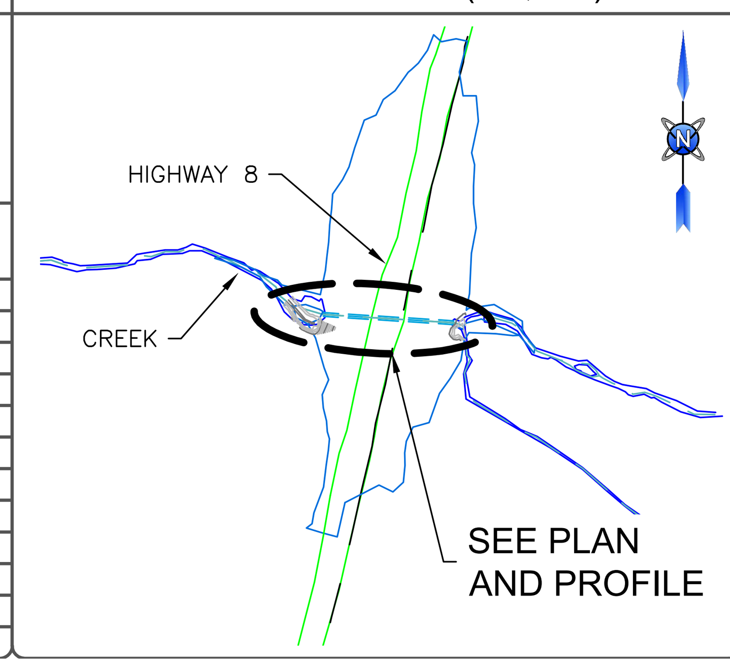
1:250

M 0 5 10 15 20 25

FT 0 10 20 30 40 50 60 70 80 90

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR PERMIT	2022-04-08	AN	MAL	AH	N/A	JLT	ES
ISSUED FOR REVIEW	2022-04-06	AN	MAL	AH	N/A	JLT	ES

LOCATION PLAN (1:2,000)



UTM - ZONE 8 - NAD 83 (CSRS)

GOVERNMENT OF THE NWT

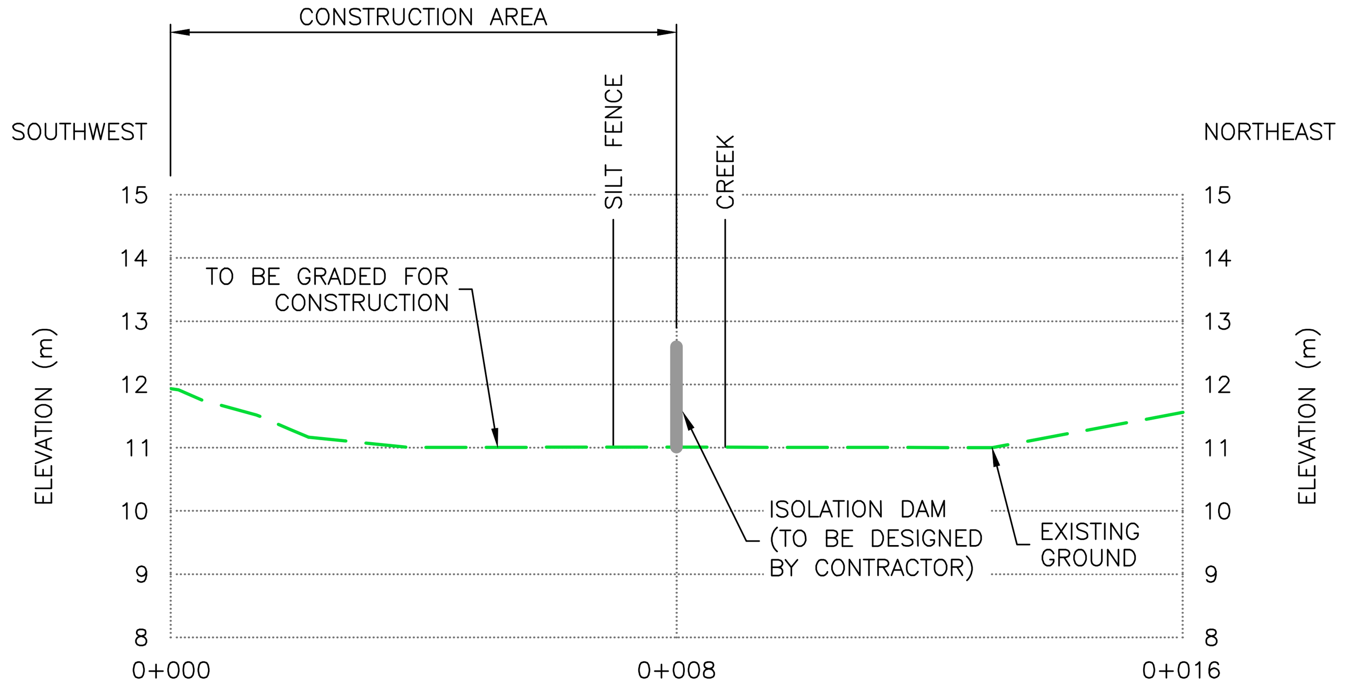
DEPARTMENT OF INFRASTRUCTURE

HIGHWAY 8 CULVERT REPLACEMENT PROJECT

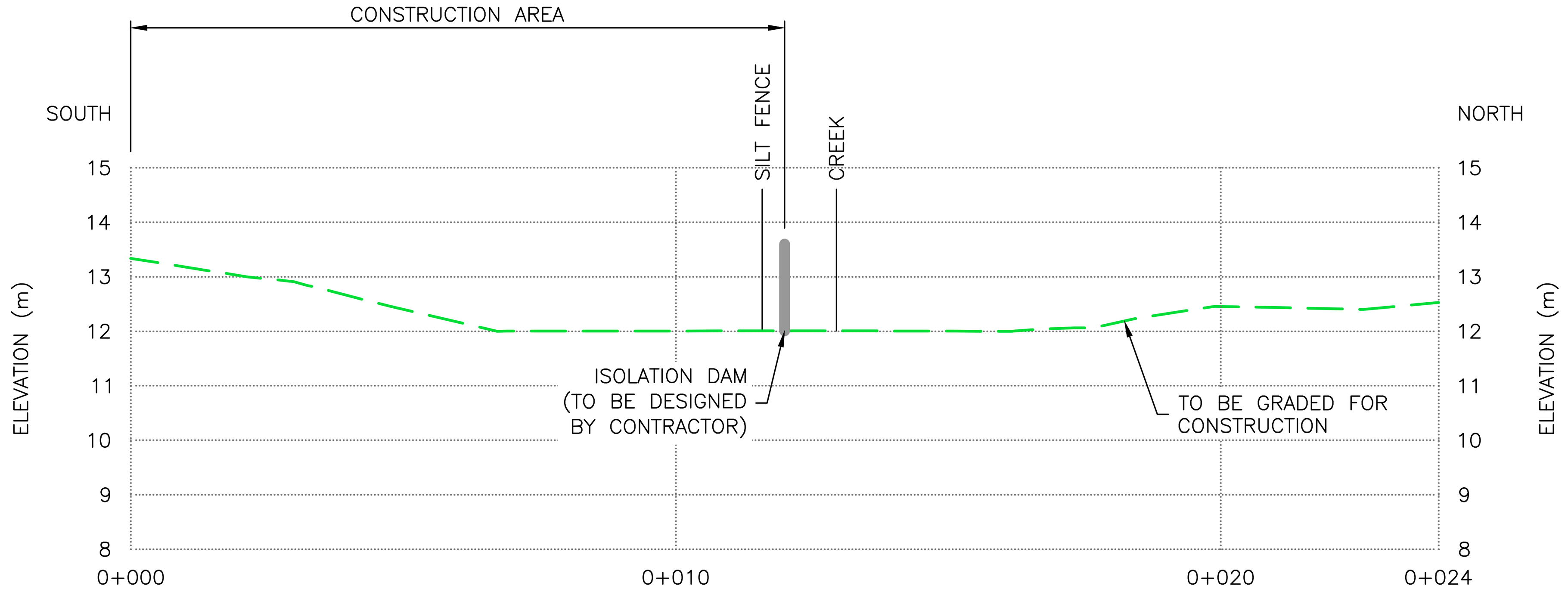
HIGHWAY 8 - NEAR TSIIGEHCHIC AUGER BORE CROSSING SUBSTRATE DETAIL AND NOTES

NEAR TSIIGEHCHIC - NWT

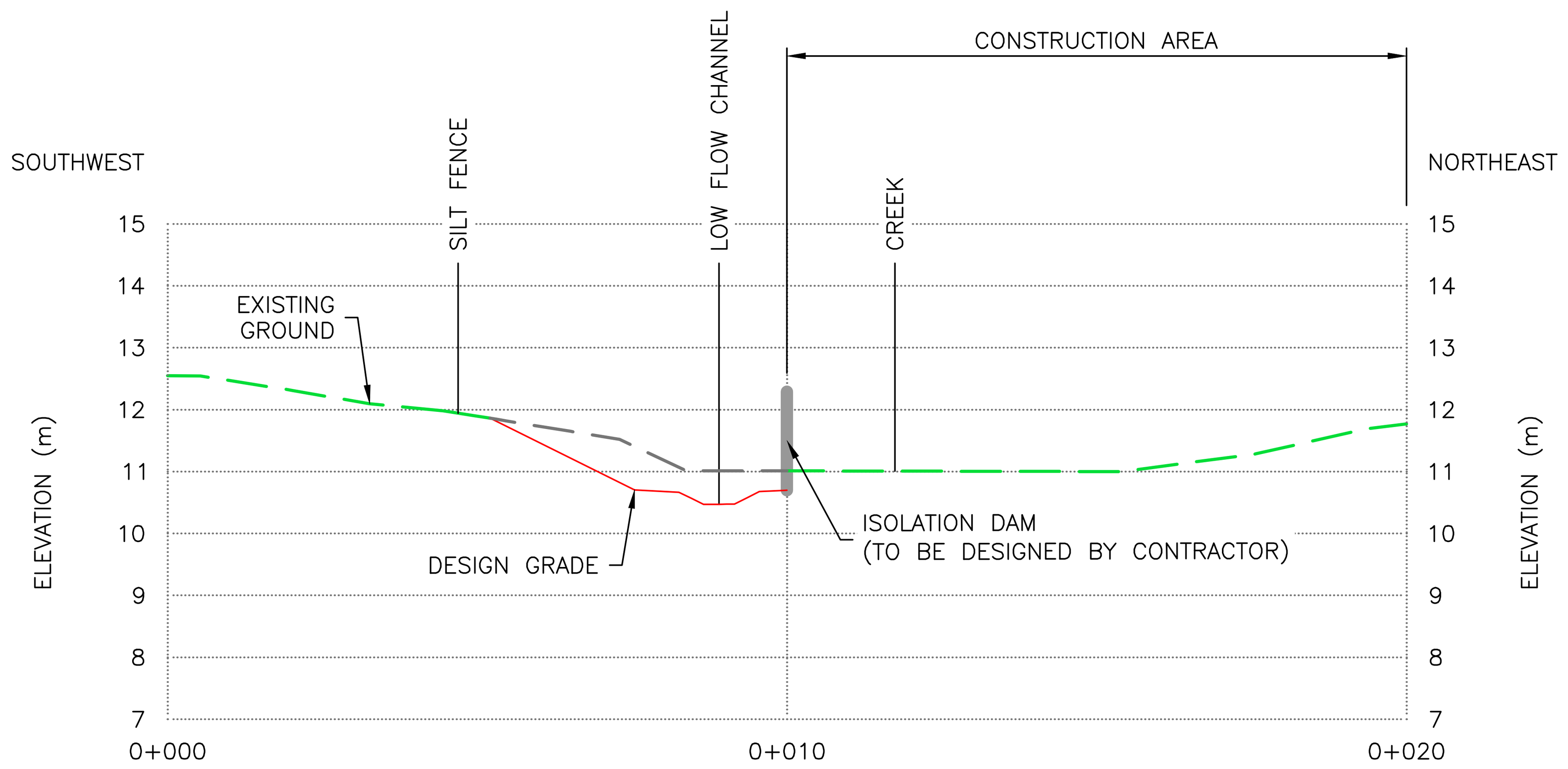
SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2567-EG-0205	B	5 OF 8



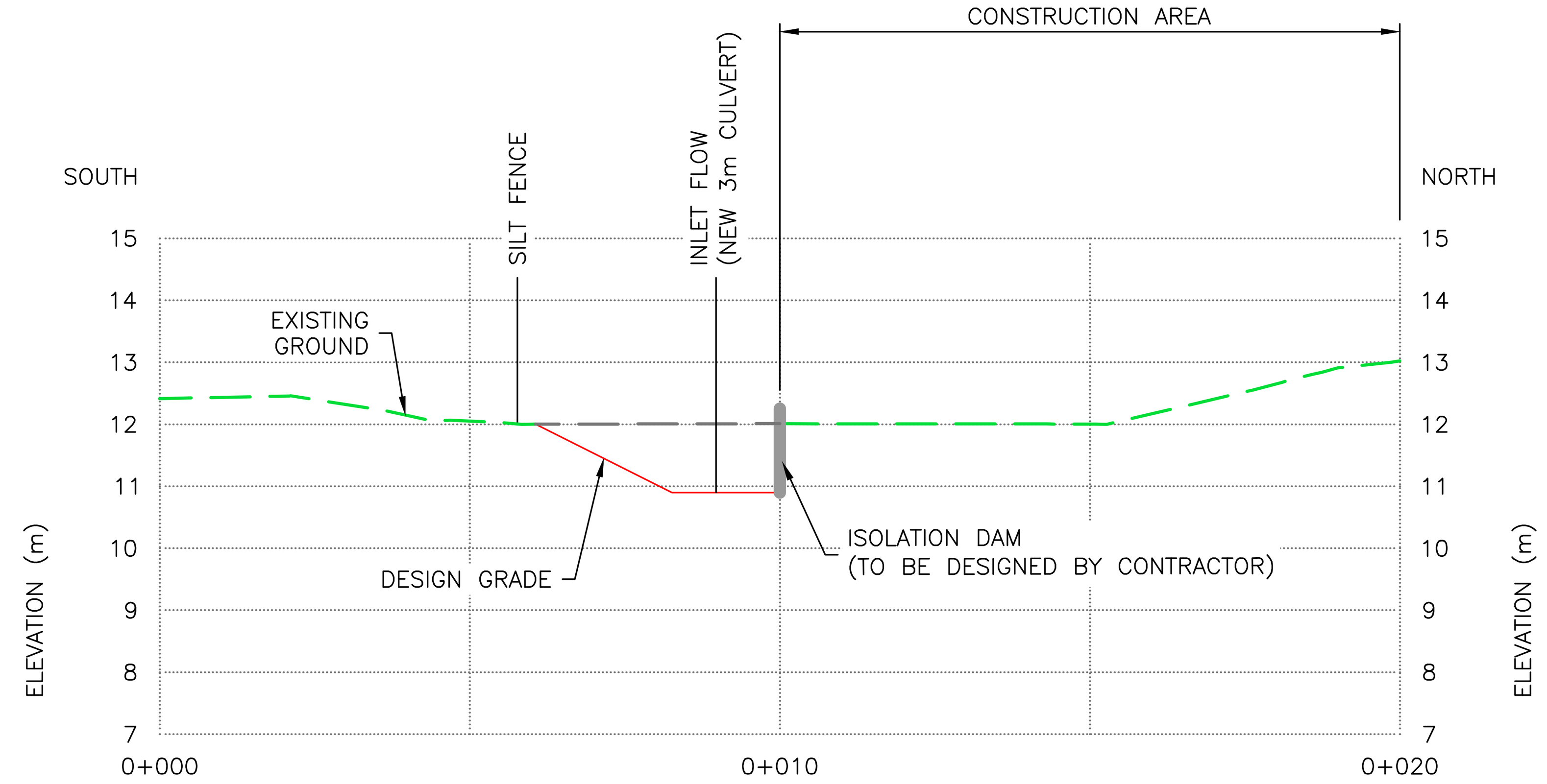
F-F PHASE I OUTLET DETAIL
SCALE 1:100



G-G PHASE I INLET DETAIL
SCALE 1:100



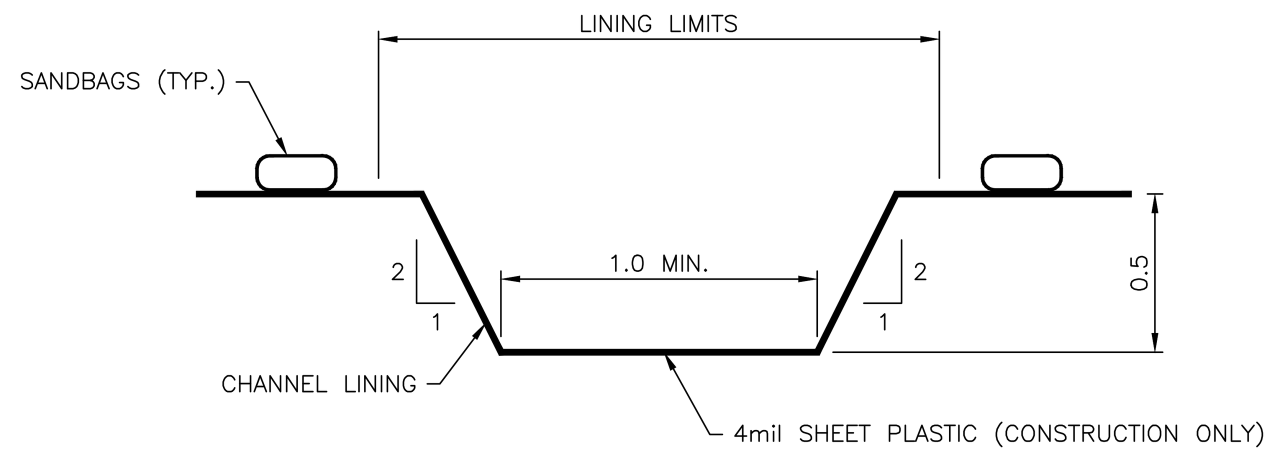
H-H PHASE II OUTLET DETAIL
SCALE 1:100



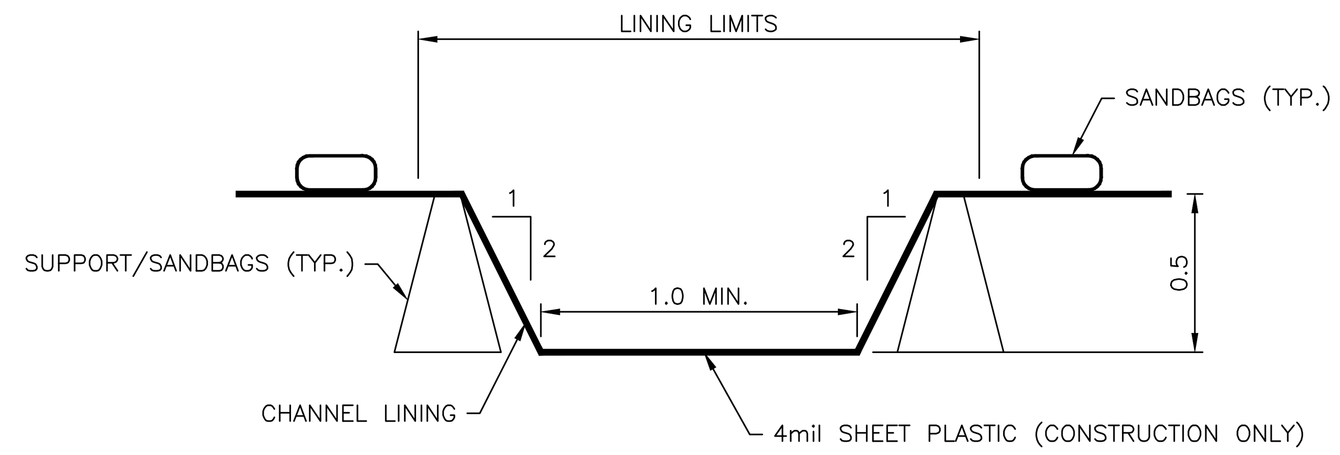
I-I PHASE II INLET DETAIL
SCALE 1:100

- FOR PLAN DETAIL, SEE DRAWING# 2567-EG-0206.

GENERAL NOTES
- CHANNEL MUST MAINTAIN FLOW AT A MINIMUM GRADE OF 1%.
- CONTRACTOR PLANS ARE TO BE SUBMITTED FOR APPROVAL PRIOR TO CONSTRUCTION (SEE NOTE 5 ON DRAWING 2567-EG-0207).



ISOLATION OPTION A
SCALE 1:20



ISOLATION OPTION B
SCALE 1:20

REFERENCE DOCUMENT NO.	DATE
1. 18-209 PPP Drafting	2020-02-18
2. 2567-02-API 1102-00	2020-05-19
3. 2567-EG-0203	2022-04-08
4. 2567-EG-0204	2022-04-08
5. 2567-EG-0205	2022-04-08
6. 2567-EG-0206	2022-04-08
7. 2567-EG-0207	2022-04-08

CCI

ENGINEER AND PERMIT STAMPS

PRELIMINARY NOT FOR CONSTRUCTION

1:20
M 0 1 2
FT 0 1 2 3 4 5 6

PIPELINE SPECIFICATIONS

	NPS 118
OUTSIDE DIAMETER (OD)(mm)	3000
WALL THICKNESS (WT)(mm)	25.4
GRADE	GRADE 3
PRODUCT	CULVERT
MATERIAL	STEEL
SPECIFICATIONS	ASTM A252

1:100
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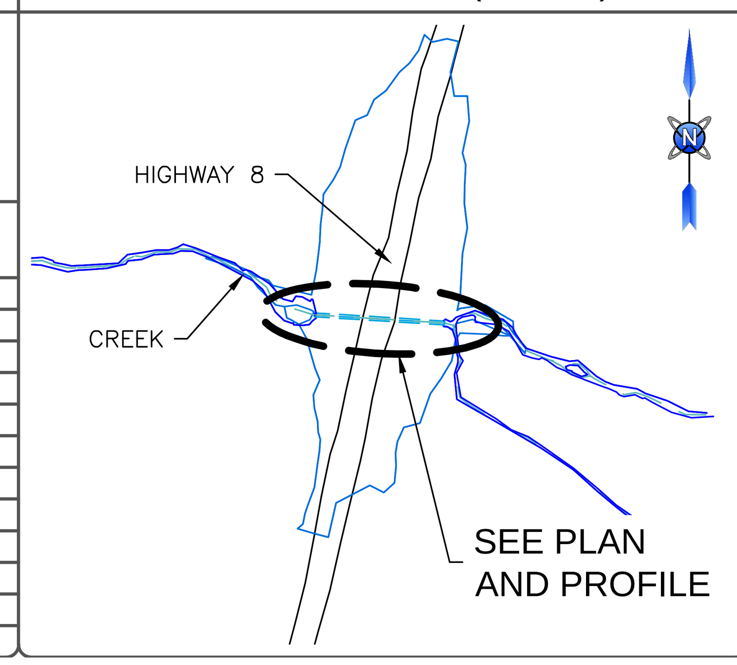
FT 0 10 20 30

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR PERMIT	2022-04-08	AN	MAL	NB	N/A	JLT	ES
ISSUED FOR REVIEW	2022-04-06	AN	MAL	NB	N/A	JLT	ES

LOCATION PLAN (1:3,000)



UTM - ZONE 8 - NAD 83 (CSRS)

Northwest Territories

GOVERNMENT OF THE NWT
DEPARTMENT OF INFRASTRUCTURE

HIGHWAY 8 CULVERT REPLACEMENT PROJECT
HIGHWAY 8 - NEAR TSIIGEHCHIC AUGER BORE CROSSING PHASE I & II PROFILES
NEAR TSIIGEHCHIC - NWT

SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2567-EG-0208	B	8 OF 8

File Name: S:\Current Jobs\2567-Gov of NWT-CulvertDesign\Eng\Drawings\02-Highway 8 – KM 147.0 near Tsiigehchic\IFP\2567-EG-0201-B BORE_PHASES_NOTES.dwg Date/Time: 2022-04-12 / 11:58:48 AM Last Saved By: Abdulkadir.Nur

Appendix D: Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater

Government of Canada Gouvernement du Canada

Canada

Fisheries and Oceans Canada

Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater

You must download and save this PDF form to your computer before filling it out.
How to download and open a PDF form

1 About this code of practice

This code of practice provides national guidance on the design, installation and maintenance of small end-of-pipe water intake fish screens to prevent entrainment and impingement of fish. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when a fish is held in contact with the intake screen and is unable to free itself.

The end-of-pipe fish screen code of practice describes best practices to follow when designing, installing, maintaining and cleaning low volume water intakes that have the potential to impact fish. This code of practice is for small-scale water intakes (e.g. irrigation, construction, municipal and private water supplies, mining exploration) where the water intake flow rate is up to 0.150 m^3/s, or 150 litres per second (L/s). Impacts related to fish habitat and changes in flow conditions are not covered by this code of practice.

When working in water, it is important to have a good understanding of local conditions. For example, water velocity, flow, depth, the type of fish species present and their abundance and swimming abilities are all important factors to consider when designing, installing, maintaining and cleaning small end-of-pipe water intake fish screens. This code of practice provides necessary information and guidance on the measures to follow to ensure maximum protection of fish. The sizing and design specifications of fixed screens in this code are exclusively for fish that have a minimum fork length of 25 mm. Entrainment and impingement impacts on eggs and larval fish can be minimized by following the measures below.

A project review is not required when the conditions and measures set out in this code of practice **and** all applicable measures to protect fish and fish habitat are applied.

This code does not remove or replace the obligation to comply with all applicable statutory and regulatory requirements in place by other sections of the *Fisheries Act*, or other federal, provincial, or municipal legislation and policies associated with water extraction.

2 You can use this code of practice if:

- There are no aquatic species at risk present in the work zone or the **affected area**. Consult our aquatic species at risk maps to determine where at-risk populations occur in Canada and where their critical habitat is located
- The water withdrawal is for small-scale water intakes, where the water intake flow rate is up to 0.150 m^3 /s, or 150 litres per second (L/s)
- You incorporate the measures in this code of practice and all other applicable measures to protect fish and fish habitat

Request a project near water review when the works, undertakings or activities do not meet all the criteria listed in this section.

3 Measures to protect fish and fish habitat for end-of-pipe fish screens

1 Fish screen design

Three criteria need to be considered when designing a fish screen for water intakes:

- Effective screen area
- Screen material
- Screen shape

1.1 Effective screen area

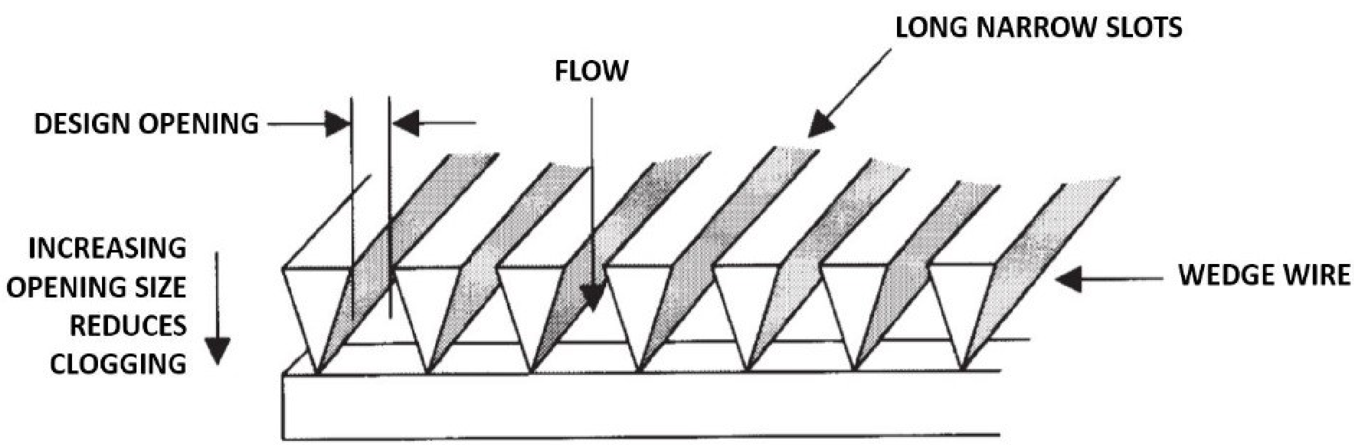
Larger screens reduce the approach velocity so fish are more likely to outswim the flow entering the intake. The screen area needed depends on the amount of water being withdrawn and the species of fishes that frequent the intake location. The total submerged screen area available for the free flow of water is referred to as the effective screean area.

- Use the End-of-Pipe Screen Size Tool to determine the effective screen area for your project
  - to protect fish from impingement or entrainment, the approach velocity (i.e., the water velocity into, or perpendicular to, the face of an intake screen) should not exceed the values set for each species
  - you should apply a precautionary approach when a species is absent or unknown by using the 'All/Unknown' option in the species selection list. This selection will determine the effective screen area for the weakest swimming fishes

1.2 Screen material

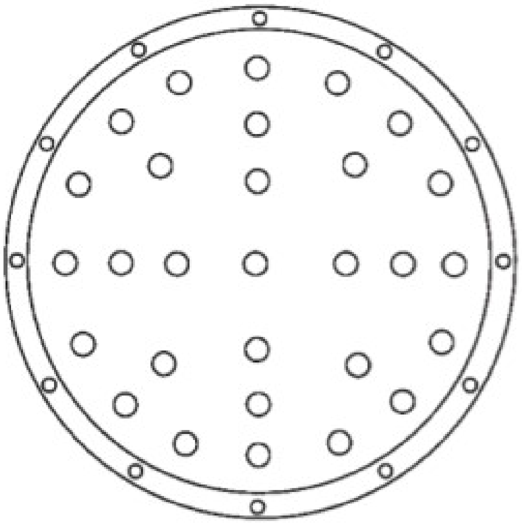
For a fish screen to prevent entrainment, the openings must be small enough so a fish cannot pass through. The narrowest dimension of any opening on the screen, regardless of opening shape, is referred to as the design **opening** (Figure 1). The maximum design opening for a fish of 25 mm fork length is estimated at 2.54 mm.

- Ensure the design opening of the screen material does not exceed 2.54 mm
- Ensure there are no protrusions on the screen surface of support structures that could injure fish
- Use welded wedge wire screens (Figure 2), whenever possible
- Ensure screen material is resistant to corrosion and UV light (i.e., brass, bronze, aluminum, monel metal, galvanized or stainless steel, plastics)
- Use material that minimizes clogging

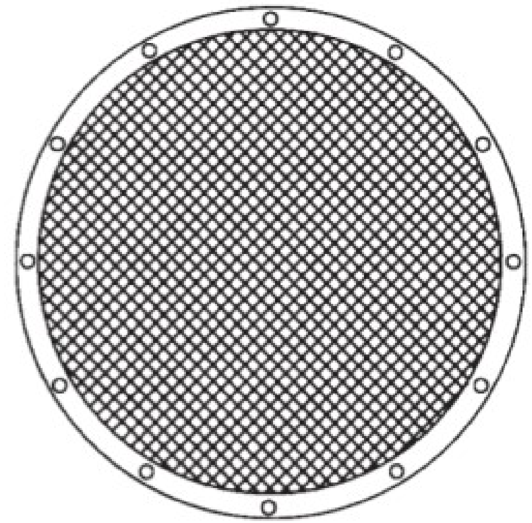


▶ Figure 1

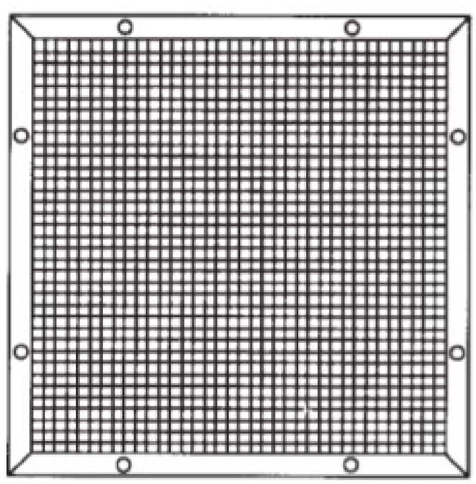
PERFORATED PLATE (PUNCHED)



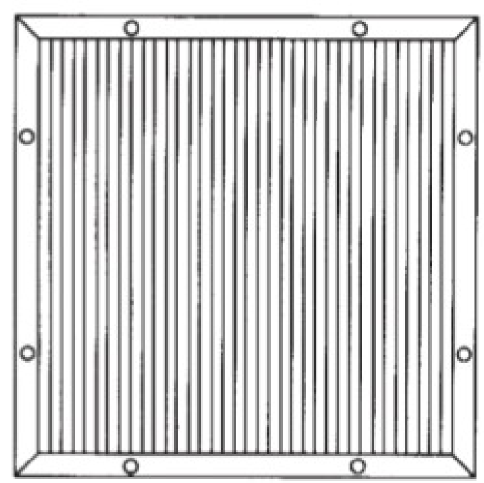
CIRCULAR MESH SCREEN



SQUARE MESH SCREEN

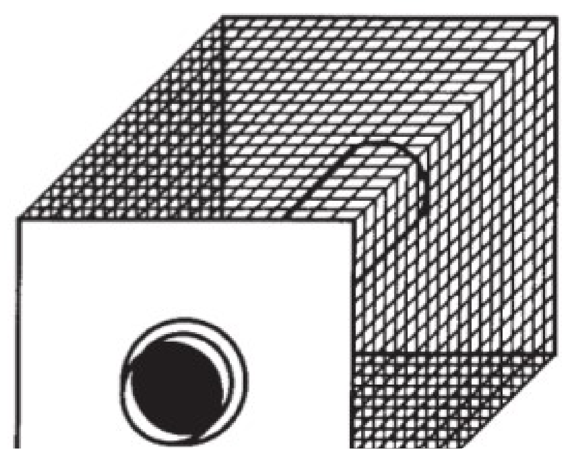


SQUARE WEDGE WIRE SCREEN



DRUM OR CYLINDER WITH PERFORATED PIPE

BOX-TYPE WITH MESH SCREEN

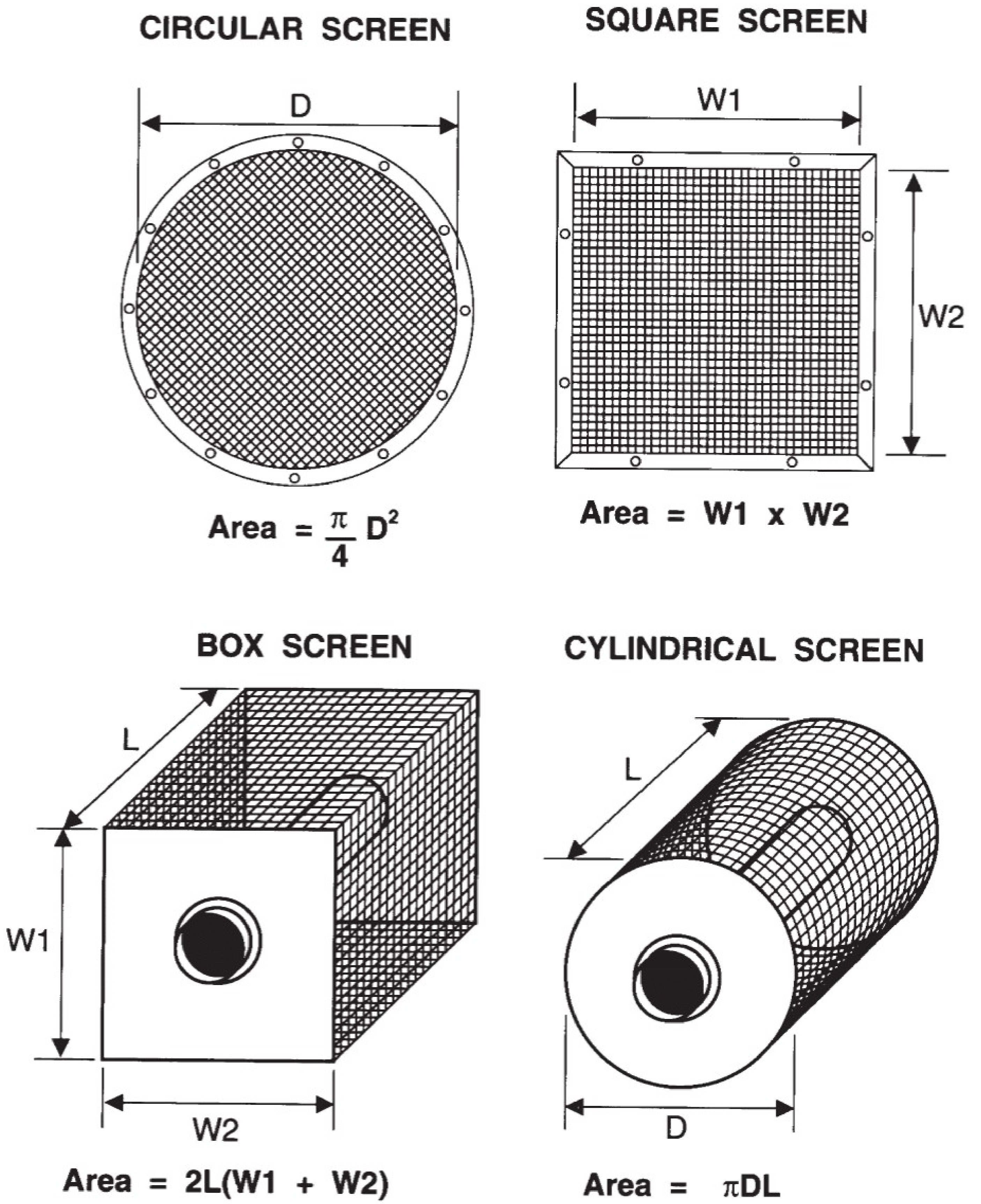


▶ Figure 2

1.3 Screen shape

Use a manifold on designs where the flow would be uneven across the surface of the screen (e.g.: cylindrical or box type) (Figure 3).

- Ensure the manifold is equal distance from the outer screen
- Cap the end of the manifold with a solid material


CIRCULAR SCREEN
D
Area = $\frac{\pi}{4} D^2$
SQUARE SCREEN
W1
W2
Area = W1 x W2
BOX SCREEN
L
W1
W2
Area = 2L(W1 + W2)
CYLINDRICAL SCREEN
L
D
Area = πDL

▶ Figure 3

2 Fish screen installation

Consider the following best practices when installing a fish screen:

- Plan in water work, undertaking or activity to respect timing windows to protect fish including their eggs, juveniles, spawning adults and/or the organisms upon which they feed and migrate
- Place screens away from natural or man-made structures that may attract fish that are migrating, spawning, or in rearing habitat
- Place screens in waters with low concentrations of fish throughout the year
- Orient the screen so any natural water flow passes across the surface of the screen material
- Place screens a minimum of 30 cm above the bottom of the watercourse to prevent the entrainment of sediment and benthos that dwell in the substrate
- Ensure all openings for guides and seals are smaller than the opening width of the screen material (2.54 mm) so fish cannot pass through
- Ensure there is enough structural support to prevent sagging or collapsing of the screen panel
- Account for the areas blocked by supports while meeting the effective screen area recommended in this code of practice
- Protect large screens with trash racks fabricated of bar (150 mm spacing is typical) or grating in areas where there is debris loading (i.e. woody material, leaves or algae mats)
- Check the approach velocity directly in front of the screen to ensure it does not exceed the designed approach velocity at any location
- Avoid withdrawing water from the littoral zone when possible
- When possible, avoid withdrawing water, or reduce the rate of water withdrawal, during critical timing windows to diminish the likelihood of entraining eggs and larval fish

3 Screen maintenance and cleaning

Debris or damage to screens can cause uneven intake flow across the screen surface. Uneven flow may result in higher intake velocities on some sections of the screen, increasing the likelihood of impinged fish. You can verify the pump's approach velocity to assess the need for screen cleaning using a flow meter. Keeping fish screens clean maintains their effectiveness for supplying water and protecting fish.

- Properly maintain cleaning apparatuses, seals and screens
- Turn off intake pump prior to the removal of the screen for cleaning and/ or maintenance

4 Project notification

Please submit a Notification Form (PDF, 50 KB) to your regional DFO office to help us improve this fish and fish habitat protection guidance over time.

5 Contact us

If you have questions regarding this Code of Practice contact the Fish and Fish Habitat Protection Program located in your region.

6 Glossary

Affected area
Area within which potential impacts from works, undertakings or activities are likely to occur.

Approach velocity
The water velocity measured directly in front of the intake screen.

Benthos
Organisms that live on or in the bottom sediments of a body of water.

Design opening
The narrowest dimension of any opening on the screen, regardless of opening shape.

Effective screen area
The area of the open spaces available for the free flow of water, including screen material but excluding major support structures.

Entrainment
Occurs when a fish is drawn into a water intake and cannot escape.

Fork length
The straight line distance measured from the tip of the nose to the fork of the tail of a fish.

Impingement
Occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself.

Intake flow rate
The amount of water withdrawn over time.

Littoral zone
The shallow water near shore. The depth of the littoral zone varies but is generally 2-5 meters deep in most freshwater systems.

Date modified:
2020-01-10

Appendix E: Detailed Project Design Drawings: Erosion Control and Isolation

PLAN : PHASE I

SCALE 1:200

PLAN : PHASE II

SCALE 1:200

REFERENCE DOCUMENT NO.	DATE
1. 18-209 PPP Drafting	2020-02-18
2. 2567-02-API 1102-00	2020-05-19
3. 2567-EG-0203	2022-04-08
4. 2567-EG-0204	2022-04-08
5. 2567-EG-0205	2022-04-08
6. 2567-EG-0207	2022-04-08
7. 2567-EG-0208	2022-04-08

CCI

ENGINEER AND PERMIT STAMPS

PRELIMINARY NOT FOR CONSTRUCTION

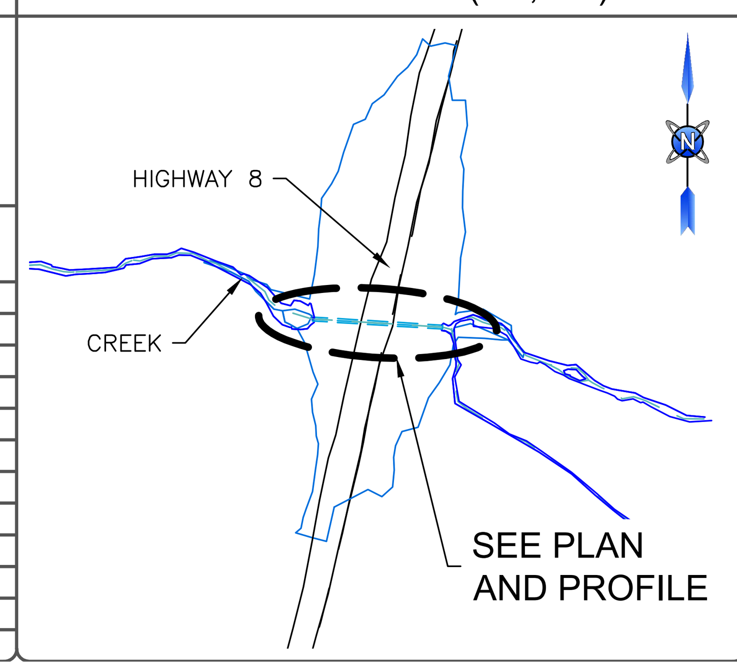
PIPELINE SPECIFICATIONS

	NPS 118
OUTSIDE DIAMETER (OD)(mm)	3000
WALL THICKNESS (WT)(mm)	25.4
GRADE	GRADE 3
PRODUCT	CULVERT
MATERIAL	STEEL
SPECIFICATIONS	ASTM A252

1:200
M 0 5 10 15 20
FT 0 10 20 30 40 50 60 70

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR PERMIT	2022-04-08	AN	MAL	NB	N/A	JLT	ES
ISSUED FOR REVIEW	2022-04-06	AN	MAL	NB	N/A	JLT	ES

LOCATION PLAN (1:3,000)



UTM - ZONE 8 - NAD 83 (CSRS)

Northwest Territories

GOVERNMENT OF THE NWT
DEPARTMENT OF INFRASTRUCTURE

HIGHWAY 8 CULVERT REPLACEMENT PROJECT
HIGHWAY 8 - NEAR TSIIGEHCHIC AUGER BORE CROSSING PHASE I & II
NEAR TSIIGEHCHIC - NWT

SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2567-EG-0206	B	6 OF 8

File Name: S:\Current Jobs\2567-Gov of NWT-CulvertDesign\Eng\Drawings\02-Highway 8 - KM 147.0 near Tsiigehchic\FP\2567-EG-0201-B BORE_PHASES_NOTES.dwg Date/Time: 2022-05-06 / 12:27:29 PM Last Saved By: Abdulkadir.Nur

PLAN : PHASE III

SCALE 1:200

GENERAL NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. THE ISOLATION SHALL BE CONSTRUCTED TO MANAGE A MINIMUM CONSTRUCTION DESIGN DISCHARGE OF $1.0 m^3/s$.
3. ALL WORK SHALL BE DONE IN ACCORDANCE WITH GOVERNMENT OF THE NORTHWEST TERRITORIES, DEPARTMENT OF TRANSPORTATION – EROSION AND SEDIMENT CONTROL MANUAL.
4. CONTRACTOR TO VERIFY ALL INVERTS OF EXISTING STRUCTURES PRIOR TO COMMENCING WORK. CONTRACTOR TO REPORT TO THE OWNER'S REPRESENTATIVE ANY DISCREPANCIES BETWEEN THE MEASURED INVERTS AND THE PIPE LOCATIONS SHOWN ON DRAWINGS PRIOR TO COMMENCING WORK.
5. CONTRACTOR TO PROVIDE ALL CONSTRUCTION EXECUTION PLANS, INCLUDING THE ENVIRONMENTAL MANAGEMENT PLAN AND EROSION AND SEDIMENT CONTROL PLAN, FOR REVIEW AND ACCEPTANCE PRIOR TO CONSTRUCTION.

PHASE I: BEAVER DAM REMOVAL

6. INSTALL PUMPS ON THE INLET (EAST) SIDE OF THE CROSSING THAT WILL HANDLE THE VOLUME OF FLOW IN THE WATERCOURSE.
7. STRING HOSES THROUGH THE EXISTING CULVERT TO A DISCHARGE LOCATION ON THE WEST SIDE OF THE DEMPSTER HIGHWAY WHERE SCOURING AND DOWNSTREAM SEDIMENTATION FROM DISCHARGE ENERGY IS MITIGATED, DOWNSTREAM OF THE BEAVER DAM LOCATION.
8. DAM THE INLET SIDE OF THE CULVERT AND INITIATE PUMP AROUND OPERATIONS. ENSURE PUMP CAPACITY IS EQUAL TO THE VOLUME OF WATER TRAVELING THROUGH THE WATERCOURSE PLUS CONTINGENCY PUMPS AND HOSES FOR HIGH WATER EVENTS.
9. INITIATE PUMP AROUND OF WATER ENSURING THAT WATER IS NOT ALLOWED TO BUILD UP ON THE INLET SIDE OF THE CULVERT.
10. ACCESS THE OUTLET (WEST) SIDE OF THE CULVERT FROM THE NORTH SIDE OF THE CROSSING.
11. REMOVE THE DAM IMPLEMENTING THE PROCEDURE AND MITIGATION PRESENTED IN DEPARTMENT OF FISHERIES AND OCEANS CANADA'S (DFO) INTERIM CODE OF PRACTICE: BEAVER DAM REMOVAL.
12. ONCE REMOVAL OF THE DAM IS COMPLETE, PUMP DOWN REMAINING WATER LEVEL IN THE POOL.
13. BACKFILL THE POOL WITH CLEAN FILL AND RIP RAP TO FINAL OUTLET APRON ELEVATION.

PHASE II: CULVERT INSTALLATION SITE PREPARATION

14. MAINTAIN PUMP AROUND OF WATER FROM PHASE I.
15. CONSTRUCT AN ISOLATION DAM ON THE OUTLET (WEST) SIDE OF THE CROSSING. ALL ADVICE AND BEST PRACTICES CONTAINED IN THE DFO'S INTERIM CODE OF PRACTICE: TEMPORARY COFFERDAMS AND DIVERSION CHANNELS WILL BE APPLIED.
16. CONSTRUCT A WORK AREA ON THE OUTLET SIDE OF THE CROSSING.
    A. INSTALL THE ISOLATION DAM FROM THE SOUTH EDGE OF THE EXISTING CULVERT, EXTENDING ACROSS THE BACKFILLED POOL AND KEY INTO THE SOUTH BANK OF THE CHANNEL, DIRECTLY ACROSS FROM THE SOUTH EDGE OF THE CULVERT.
    B. DISCONTINUE PUMP AROUND OPERATIONS BY REMOVING THE PUMPS AND HOSES AND ALLOW WATER TO FLOW THROUGH THE EXISTING CULVERT. IF LEAKS ARE FOUND IN THE ISOLATION DAM, REPAIR PRIOR TO MOVING TO THE INLET SIDE OF THE CROSSING.
17. CONSTRUCT A WORK AREA ON THE INLET (EAST) SIDE OF THE CROSSING.
    A. STAKE OUT THE LOCATION OF THE JACKING FRAME.
    B. INSTALL PUMPS IN THE SOUTH FORK OF THE WATERCOURSE, SOUTH OF THE JACKING FRAME LOCATION, THAT WILL HANDLE THE VOLUME OF FLOW IN THE WATERCOURSE.
    C. STRING HOSES FROM THE PUMP LOCATION TO THE NORTH CHANNEL TO A LOCATION WHERE SCOURING AND DOWNSTREAM SEDIMENTATION FROM DISCHARGE ENERGY IS MITIGATED.
    D. INSTALL A DAM ON THE SOUTH SIDE OF THE JACKING FRAME AND INITIATE PUMP AROUND OF WATER TO THE NORTH FORK.
    E. INSTALL THE ISOLATION DAM ON THE NORTH SIDE OF THE JACKING FRAME, ALLOWING WATER TO MOVE FROM THE ISOLATED AREA THROUGH THE EXISTING CULVERT PRIOR TO COMPLETING THE ISOLATION TO THE EDGE OF THE EXISTING CULVERT.
    F. SALVAGE SURFICIAL SOILS FROM THE JACKING FRAME WORK AREA AND STOCKPILE AWAY FROM THE WATERCOURSE.
    G. REMOVE GRADE CUTS FROM THE WORK AREA AND STOCKPILE AWAY FROM THE CROSSING SEPARATELY FROM THE SALVAGED SURFICIAL SOILS.
    H. CONSTRUCT THE JACKING FRAME.
    I. WHEN THE JACKING FRAME IS COMPLETE, CONSTRUCT A DIVERSION CHANNEL AROUND THE EAST SIDE OF THE FRAME AND LINE WITH ROCK COBBLE.
    J. WITH THE DIVERSION CHANNEL COMPLETE, REMOVE THE DAM, DISCONTINUE PUMP AROUND OPERATIONS AND ALLOW WATER TO FLOW AROUND THE JACKING FRAME TO THE NORTH FORK AND THROUGH THE EXISTING CULVERT.
    K. PLACE EQUIPMENT ON THE WORK AREA.
    L. INSTALL SILT FENCING WHERE REQUIRED ON THE EDGE OF THE WORK AREA TO MITIGATE POTENTIAL SEDIMENTATION INTO THE WATERCOURSE.

PHASE III: CULVERT INSTALLATION

18. WHEN THE WORK AREA IS CONSTRUCTED AND EQUIPMENT IS IN PLACE TO BEGIN INSTALLATION OF THE NEW CULVERT, ENSURE THE WORK AREAS ON THE INLET (EAST) AND OUTLET (WEST) SIDES REMAIN ISOLATED.
19. INSTALL 3m CULVERT (SEE 2567-EG-0201).
20. COMPLETE THE RECLAMATION OF THE INLET AND OUTLET SIDES OF THE 3m CULVERT WHILE STILL ISOLATED.
21. REMOVE ANY DEPOSITED SEDIMENT FROM WITHIN THE ISOLATED WORKSITE AND ENSURE ANY DISTURBED INSTREAM AREAS HAVE BEEN STABILIZED PRIOR TO REMOVAL.
22. MAINTAIN SEDIMENT CONTROL MEASURES DURING REMOVAL AND RE-WATERING OF INSTREAM WORKSITE.
    A. INLET SIDE:
    - REMOVE THE TRENCHLESS EQUIPMENT AND JACKING FRAME ON THE INLET SIDE OF THE 3m CULVERT.
    - INSTALL PUMPS IN THE SOUTH FORK OF THE WATERCOURSE, SOUTH OF THE JACKING FRAME LOCATION, THAT WILL HANDLE THE VOLUME OF FLOW IN THE WATERCOURSE.
    - STRING HOSES FROM THE PUMP LOCATION TO THE NORTH CHANNEL TO A LOCATION WHERE SCOURING AND DOWNSTREAM SEDIMENTATION FROM DISCHARGE ENERGY IS MITIGATED.
    - INSTALL A DAM ON THE SOUTH SIDE OF THE JACKING FRAME AND INITIATE PUMP AROUND OF WATER FROM TO THE NORTH FORK.
    - WIDEN THE CHANNEL ON THE INLET SIDE TO ACCOMMODATE FLOW TO THE INSTALLED 3m CULVERT.
    - RECONTOUR THE CHANNEL OF THE ORIGINAL SOUTH FORK OF THE CREEK CHANNEL.
    - RE-ESTABLISH FLOW THROUGH THE SOUTH FORK OF THE CREEK CHANNEL
    - INSTALL ROCK RIP RAP AND ARMOUR THE CHANNEL AND CONTOURED BANK TO THE WATER LINE (2567-EG-0203).
    - SEED AND PLACE COCONUT MATTING OVER THE BANK ABOVE THE WATER LINE.

    B. OUTLET SIDE:
    - COMPLETE THE OUTLET APRON ON THE OUTLET END OF THE 3m CULVERT.
    - INSTALL ROCK RIP RAP AND ARMOUR THE CHANNEL AND CONTOURED BANKS TO THE WATER LINE (2567-EG-0204).
    - SEED AND PLACE COCONUT MATTING OVER THE BANK ABOVE THE WATER LINE.

PHASE IV: EXISTING CULVERT DECOMMISSIONING

23. MOVE THE ISOLATION DAM ON THE INLET SIDE OF THE CROSSING, ISOLATING THE EXISTING CULVERT AND ALLOWING THE WATER TO MOVE FROM THE ISOLATED AREA THROUGH THE INSTALLED 3m CULVERT, PRIOR TO COMPLETING THE ISOLATION TO THE EDGE OF THE 3m CULVERT.
24. INSTALL THE ISOLATION DAM ALONG THE EAST EDGE OF THE NEWLY CONTOURED OUTLET CHANNEL, EAST OF THE 3m CULVERT.
25. CONSTRUCT A WORK AREA ON THE OUTLET SIDE OF THE CROSSING.
    A. LEVEL THE OUTLET SIDE OF THE EXISTING CULVERT.
    B. PLACE GROUTING EQUIPMENT ON THE WORK AREA.
    C. INSTALL SILT FENCING WHERE REQUIRED ON THE EDGE OF THE WORK AREA TO MITIGATE POTENTIAL SEDIMENTATION INTO THE WATERCOURSE.
26. GROUT THE EXISTING CULVERT.
27. COMPLETE THE RECLAMATION OF THE OUTLET SIDE OF THE DECOMMISSIONED EXISTING CULVERT WHILE STILL ISOLATED.
28. REMOVE ANY DEPOSITED SEDIMENT FROM WITHIN THE ISOLATED WORKSITE AND ENSURE ANY DISTURBED INSTREAM AREAS HAVE BEEN STABILIZED PRIOR TO REMOVAL.
29. MAINTAIN SEDIMENT CONTROL MEASURES DURING REMOVAL AND RE-WATERING OF INSTREAM WORKSITE.
    A. OUTLET SIDE:
    - REMOVE EQUIPMENT ON OUTLET SIDE OF THE EXISTING CULVERT.
    - COMPLETE THE OUTLET APRON ON THE OUTLET END OF THE EXISTING CULVERT.
    - INSTALL ROCK RIP RAP AND ARMOUR THE CHANNEL AND CONTOURED BANKS TO THE WATER LINE.
    - INSTALL SILT FENCING ALONG THE TOE OF THE ROAD SLOPE, BETWEEN THE ROAD FILL AND THE ROCK ARMOUR.
    - COMPLETE SEEDING AND MITIGATION TO MINIMIZE EROSION TO THE WIDENED ROAD EMBANKMENT, INCLUDING SEEDING AND PLACEMENT OF COCONUT MATTING TO THE INSTALLED SILT FENCING.
    - REMOVE ISOLATION DAM ON THE OUTLET SIDE.
    - COMPLETE THE REMAINDER OF THE OUTLET APRON THROUGH THE PLACEMENT OF ROCK RIP RAP, WHERE REQUIRED.

    B. INLET SIDE
    - COMPLETE FINAL RECONTOURING AND CHANNEL/BANK ARMOURING ON THE INLET SIDE OF THE EXISTING CULVERT.
    - INSTALL SILT FENCING AND SEED DISTURBED AREAS ON THE INLET SIDE OF THE CROSSING.
    - INSTALL SILT FENCING ALONG THE OUTLET APRON EDGE.
    - COMPLETE SEEDING AND COCONUT MATTING INSTALLATION OVER WORK AREA ON THE OUTLET SIDE.

PHASE V - FINAL RECLAMATION

30. DEPENDING ON THE SOIL TYPES AND THE PROJECT FOOTPRINT LOCATED AT THE CROSSING LOCATION, ADDITIONAL RECLAMATION MEASURES MAY BE REQUIRED ON THE OUTLET AND INLET SIDE OF THE CROSSING. THESE ADDITIONAL MEASURES CAN INCLUDE:
    - STREAMBANK RESTORATION THROUGH THE INSTALLATION OF LIFTS AND JUTE WRAP, WITH WILLOWS PLACED BETWEEN LIFTS.
    - WILLOW STAKING ON THE WATERCOURSE BANKS TO STABILIZE DISTURBED AREAS AND PROMOTE REGROWTH.
    - ADDITIONAL SILT FENCING WILL BE INSTALLED TO AVOID THE POTENTIAL MOVEMENT OF SOILS AND SEDIMENTATION OF THE WATERCOURSE.
    - ADDITIONAL SEEDING OR INSTALLATION OF COCONUT MATTING TO PROMOTE EXPEDITED REGROWTH AND STABILIZATION OF THE PROJECT FOOTPRINT.

REFERENCE DOCUMENT NO.	DATE
1. 18-209 PPP Drafting	2020-02-18
2. 2567-02-API 1102-00	2020-05-19
3. 2567-EG-0203	2022-04-08
4. 2567-EG-0204	2022-04-08
5. 2567-EG-0205	2022-04-08
6. 2567-EG-0206	2022-04-08
7. 2567-EG-0208	2022-04-08

CCI

ENGINEER AND PERMIT STAMPS

PRELIMINARY
NOT FOR
CONSTRUCTION

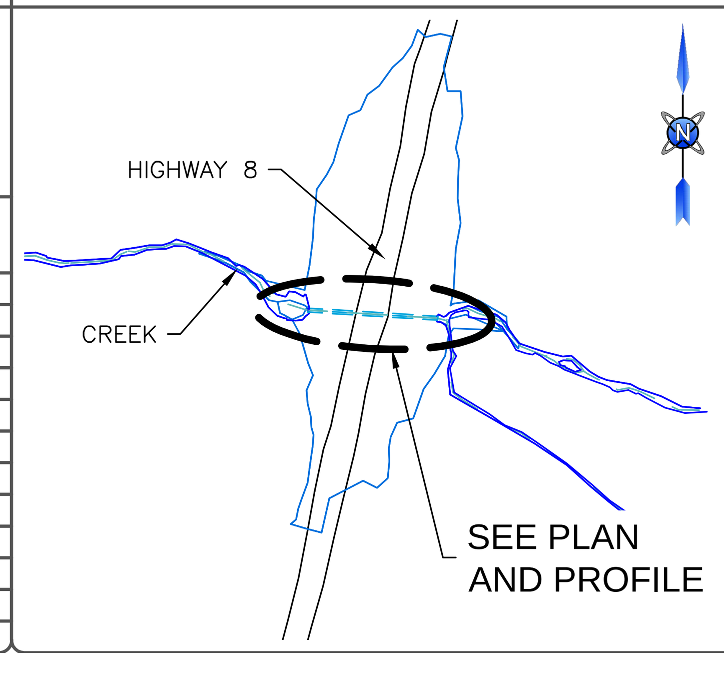
PIPELINE SPECIFICATIONS

	NPS 118
OUTSIDE DIAMETER (OD)(mm)	3000
WALL THICKNESS (WT)(mm)	25.4
GRADE	GRADE 3
PRODUCT	CULVERT
MATERIAL	STEEL
SPECIFICATIONS	ASTM A252

1:200
M 0 5 10 15 20
FT 0 10 20 30 40 50 60 70

DRAWING STATUS	DATE	DRN	CHK	DES	GEO	APR	CR
ISSUED FOR PERMIT	2022-04-08	AN	MAL	NB	N/A	JLT	ES
ISSUED FOR REVIEW	2022-04-06	AN	MAL	NB	N/A	JLT	ES

LOCATION PLAN (1:3,000)



UTM - ZONE 8 - NAD 83 (CSRS)

GOVERNMENT OF THE NWT
DEPARTMENT OF INFRASTRUCTURE

HIGHWAY 8 CULVERT REPLACEMENT PROJECT

HIGHWAY 8 - NEAR TSIIGEHCHIC AUGER BORE CROSSING
PHASE III AND NOTES

NEAR TSIIGEHCHIC - NWT

SCALE	DWG. #	REVISION	SHEET
AS SHOWN	2567-EG-0207	B	7 OF 8