CROSSINGS

This subject describes the land use activities and construction techniques that will be used to install the pipelines across different types and sizes of watercourses in the GSA, including those that require approval under Section 6 (b) and (c) of the MVLUR. Watercourse crossings that meet the threshold criteria for a Type B water licence under the *Northwest Territories Waters Regulations* will be addressed in a related application.

In addition to pipeline watercourse crossings, this subject describes the land use activities and construction techniques that will be used to cross watercourses, ravines, and other depressions encountered during the construction of access roads and the pipeline travel lane. Crossings of third-party pipelines, highways and roads are also described.

WATERCOURSE CROSSINGS FOR PIPELINES

The proposed pipelines through the GSA cross 127 watercourses. The construction techniques that might be used at watercourse crossings include open cut and isolated (i.e., open cut with either fluming or dam and pump techniques). There are no trenchless (horizontal directionally drilled or HDD) or aerial crossings proposed for the GSA.

Crossing Criteria

The criteria that will be considered in designing the watercourse crossings include stream type and scour potential, streambed soil conditions, subsoil type, water flow during construction, bank stability, potential geothermal effects, environmental constraints, and community input.

The feasibility of the technique that will be used at each watercourse crossing will be verified in the field by confirming that the subsoil conditions are appropriate. Alternate construction techniques will be developed for isolated crossings. If there is no flow, or if there are no issues concerning fish or fish habitat, open cut crossings will be used at these sites.

The watercourses that will be crossed by the pipeline have been grouped into four main types, as described next.

Large Watercourse Crossings

These are water channels that appear with a name on 1:50,000 Government of Canada topographic maps and have a perennial flow and drainage area greater than 1,000 km^2. No large watercourse crossings have been identified for the GSA.

Active I Watercourse Crossings

These are water channels that have perennial flow and flow through the winter or only partially freeze to the riverbed in winter. They typically provide suitable feeding and holding areas for large-bodied fish species. Six Active I watercourse crossings have been identified in the GSA.

Isolated crossings are proposed for five of the Active 1 watercourses. These are located near KP-4.3, KP-27.1 and KP-31.6 as well as across the Travaillant River (KP-76.8) and the Thunder River (KP-155.1). The remaining Active I watercourse crossing will be done using open cut as no issues relating to fish or fish habitat have been identified.

Active II Watercourse Crossings

These are watercourses that have defined banks and substrate but are frozen to the bed or have no flow during the winter. Eleven Active II watercourse crossings have been identified in the GSA.

Vegetated Channels

Vegetated channels are ephemeral watercourses that might be depressions or swales and are used by fish only for short periods during high water levels, if at all. These channels flow primarily during spring runoff and have no discernible banks or evidence of annual sediment transport. One hundred and ten vegetated channels have been identified along the right-of-way in the GSA.

No ponded water or lakes will be traversed in the GSA.

Construction Techniques

Open Cut Crossing

An open cut technique is appropriate for crossing vegetated channels and Active II watercourses, and for Active I and large watercourses that cannot be crossed in a practical way by an isolated or trenchless method.

Open cut crossings involve excavating a trench in the watercourse bed using a mechanical ditcher, dragline, dredge, clam, backhoe or other similar machinery. Depending on the size and depth of the watercourse, the equipment might operate from a barge.

Work Area

The construction crew will ensure that there is sufficient temporary workspace for spoil, material and equipment stockpiles, pipe preparation activities and access to both sides of the crossing. The right-of-way grading crew will install a vehicle crossing of the water course on the work side of the right-of-way as close as practical to the crossing location, allowing for the movement of personnel and equipment around the watercourse crossing site. Typical bridging descriptions are discussed in the topic entitled Access Road and Travel Lane Crossings.

Pipeline Installation

The pipeline crossing trench will be excavated. The spoil material will be placed on the crossing banks or, for very large rivers, in the stream channel. If there is water flow present, breaks will be left in the pile to maintain continuous flow of the water. Areas of highest water velocity will be avoided to the extent practical. The pre-welded sections of pipe will be lowered into the ditch for backfilling. Backfill of native or imported materials will be completed as quickly as practical.

Completion

The watercourse bed will be reclaimed as closely as is practical to pre-construction conditions. When the vehicle crossing is no longer required, it will be removed. No spoil will be left on the ice after construction.

In some cases, the stream might be diverted within the wetted perimeter by damming or sheet piling to allow excavation “in the dry” for half the crossing at a time.

A typical open cut crossing schematic is shown in Figure 3-33.

Due to the winter construction period, vegetated channels will be dry or frozen to the bottom and will therefore be crossed by regular trenching techniques.

Isolated Crossing

An isolated crossing technique will be used rather than an open cut method when water flow through a location is anticipated at the time of construction, in combination with potential issues concerning fish and fish habitat. It involves damming the watercourse to permit excavation while maintaining clean water flow around the crossing location using pumps or flumes. This reduces turbidity and sedimentation downstream of the crossing.

Work Area

The construction crew will require sufficient temporary workspace for spoil, .material and equipment stockpiles, pipe preparation activities and access to both sides of the crossing. The right-of-way grading crew will install a vehicle crossing of the watercourse on the work side of the right-of-way as close as practical to the crossing location. This will allow for the movement of personnel and equipment around the crossing site. See the typical drawings of temporary bridge crossings (Figure 3-39 to Figure 3-43).

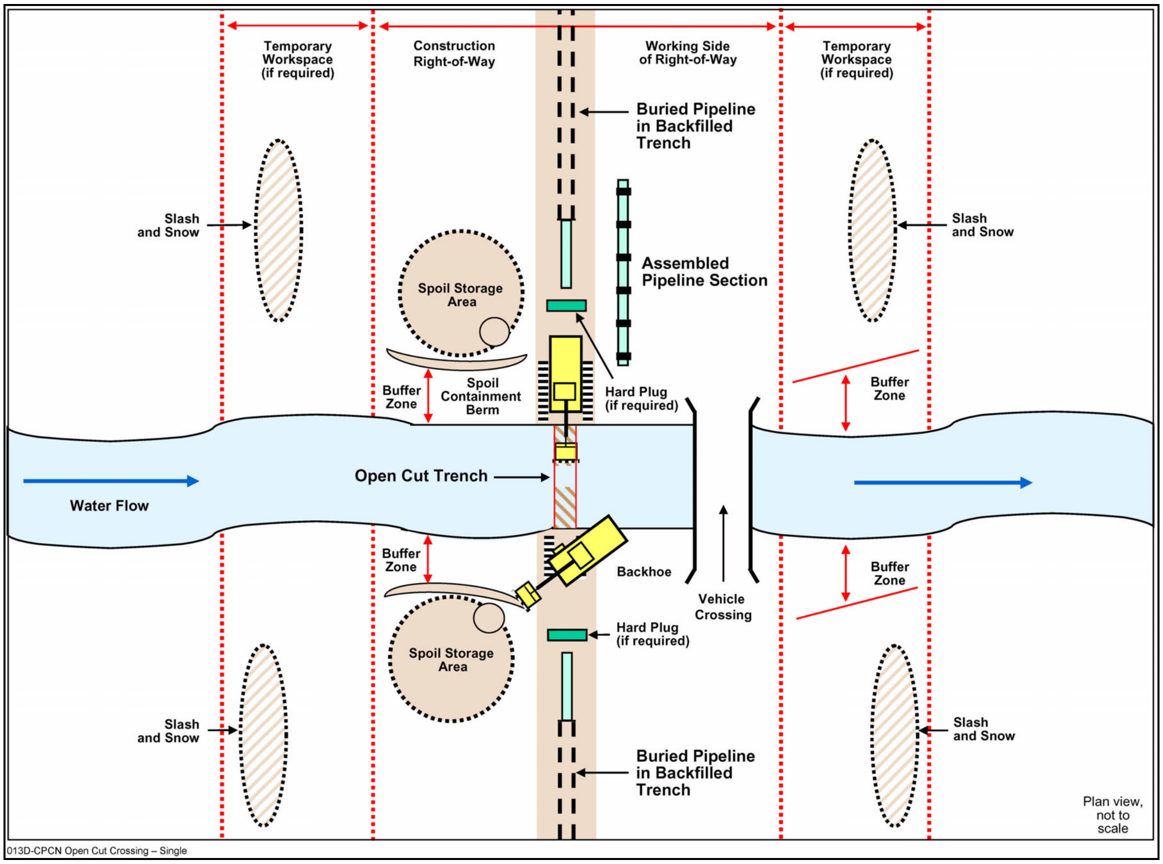

Figure 3-33: Typical Open Cut Watercourse Crossing

Pump Installation

Pumps will be installed and checked for sufficient flow to match natural watercourse volumes. Clean water will be pumped around the excavation site and released back into the watercourse downstream of the crossing location.

Dam Construction

Ice and snow at the crossing location will be removed to prepare the bed and banks of the watercourse for the installation of the dams. The upstream dam will be constructed first, using sandbags, metal plates, and aqua dams to channel the water toward the pumps. The downstream dam will then be constructed in the same manner to isolate the crossing.

Pipeline Installation

The crossing trench will be excavated with the spoil being placed away from the stream channel. The pre-welded sections of pipe will be lowered into the ditch for backfilling. Backfill of native or imported materials will be done from the centre of the crossing back toward the banks.

Completion

The watercourse bed will be stabilized and reclaimed. The downstream dam will be removed first, followed by the removal of the upstream dam. Bypass machinery will then be shut down and removed to restore the natural watercourse flow.

A typical isolated crossing, showing a dam and pump technique, is provided in Figure 3-34. A photograph of an example is shown Figure 3-35.

A dam and flume procedure is similar to a dam and pump procedure except that a flume between the upstream and downstream dams is used for the water bypass instead of pumps. Flumes are used if the water flow is too great for pumps to handle or due to potential issues concerning fish and fish habitat, as this method allows fish passage during construction.

A typical fluming procedure is shown on the schematic in Figure 3-36. A photograph of a flume crossing is shown in Figure 3-37.

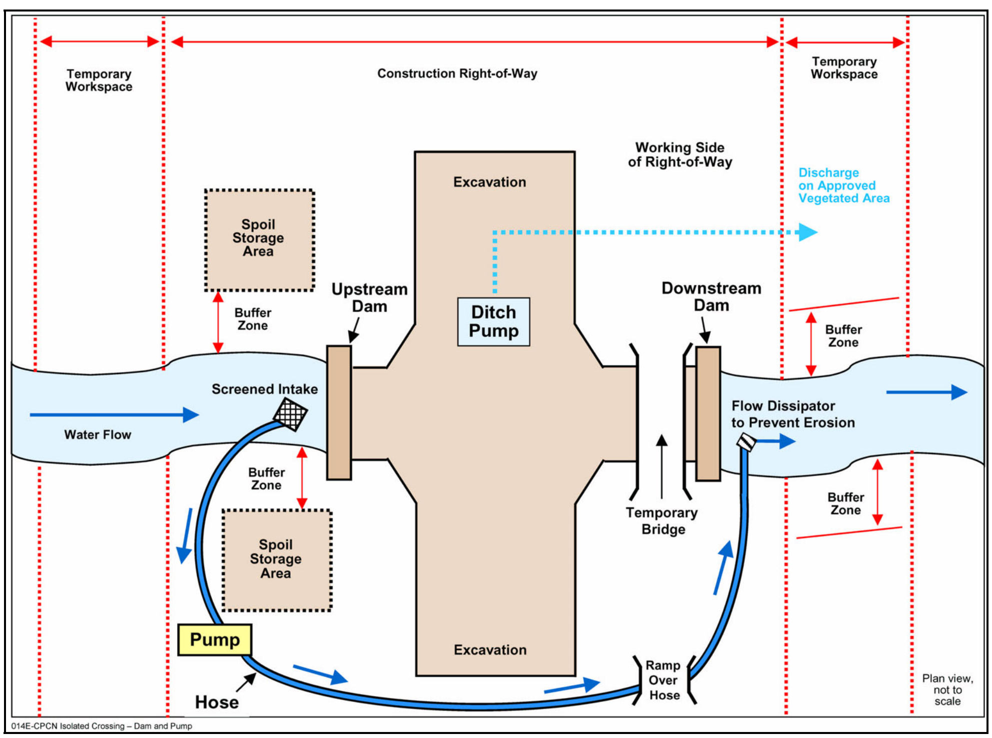

Figure 3-34: Typical Isolated Crossing – Dam and Pump

Figure 3-35: Example of Isolated Dam and Pump Crossing

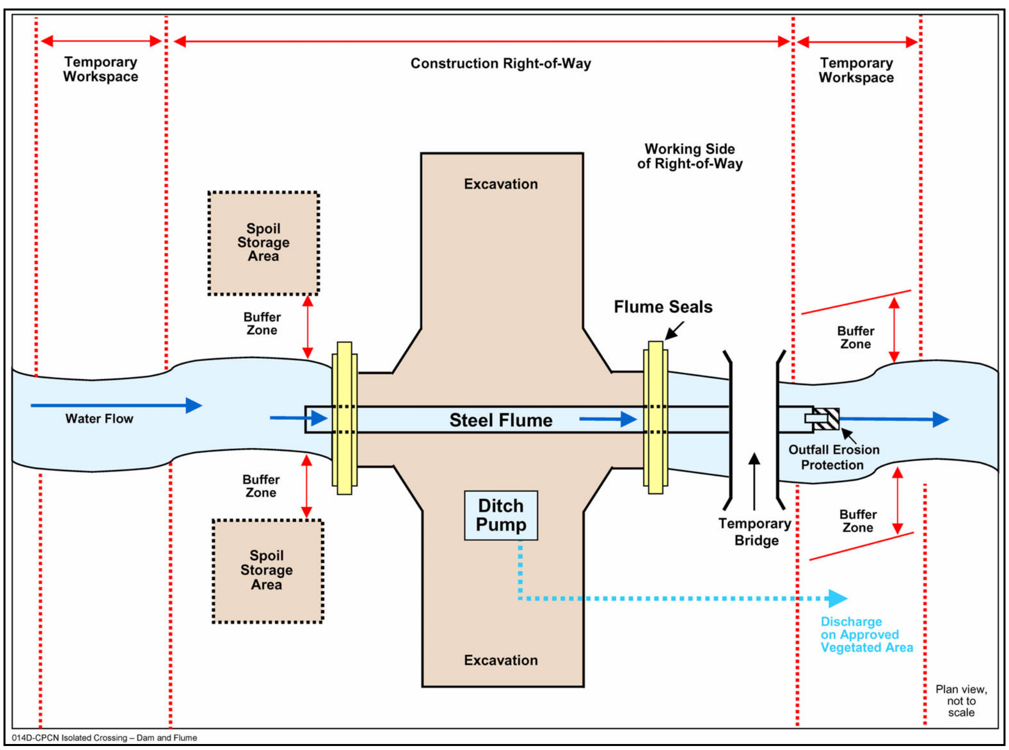

Figure 3-36: Typical Isolated Crossing – Dam and Flume

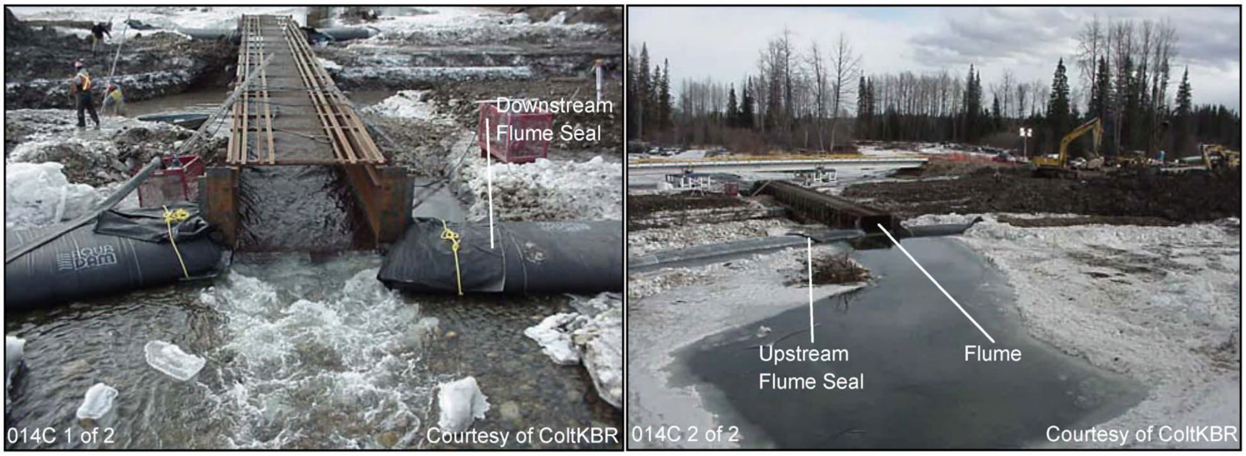

Figure 3-37: Examples of an Isolated Dam and Flume Crossing

Weighting at Watercourse Crossings

Pipe sections installed using conventional open cut techniques in open water conditions might be weighted with concrete-coated pipe or bolt-on concrete weights to provide negative buoyancy (see Figure 3-38).

Dry or fully frozen crossings with sufficient mineral soil cover might not require weighting. Insulation might be applied to the pipeline at the crossings to reduce potential frost bulb formation, or thaw settlement, or both.

Figure 3-38: Example of Concrete Weights to Counter Buoyancy

Signs and Markers

Pipeline markers will be installed at the banks of the Active 1 and II crossings during construction and for operations purposes.

ACCESS ROAD AND TRAVEL LANE CROSSINGS

Construction vehicles will use existing bridges, where feasible. In the absence of such bridges, one of six main techniques might be used to cross watercourses encountered during construction of access roads - permanent bridges, temporary bridges, culvert crossings, timber fill crossings, ice bridges or snow fill crossings. Typical drawings for each of these techniques (excepting permanent bridges) are shown in Figure 3-39 through Figure 3-43.

Permanent Bridges

Permanent bridges are often used on all-weather roads that cross flowing watercourses and on winter roads where the travel season needs to be extended in the fall and spring. Supports will be installed on each bank and a span will be built across them. A site-specific design will be required at each of these sites.

Temporary Bridges

Temporary structures might be used on winter roads and in conjunction with the pipeline right-of-way to cross watercourses with unstable beds and banks or ones that are too deep, too wide, or too fast flowing for other crossing methods. Common structures include flatbed rail car frames or longer Bailey bridges.

Timber mat supports are sometimes built at each end before the temporary bridges are installed. Ramps will be built from snow, ice or granular material. Curbs might be required to prevent mud or debris from entering the watercourse.

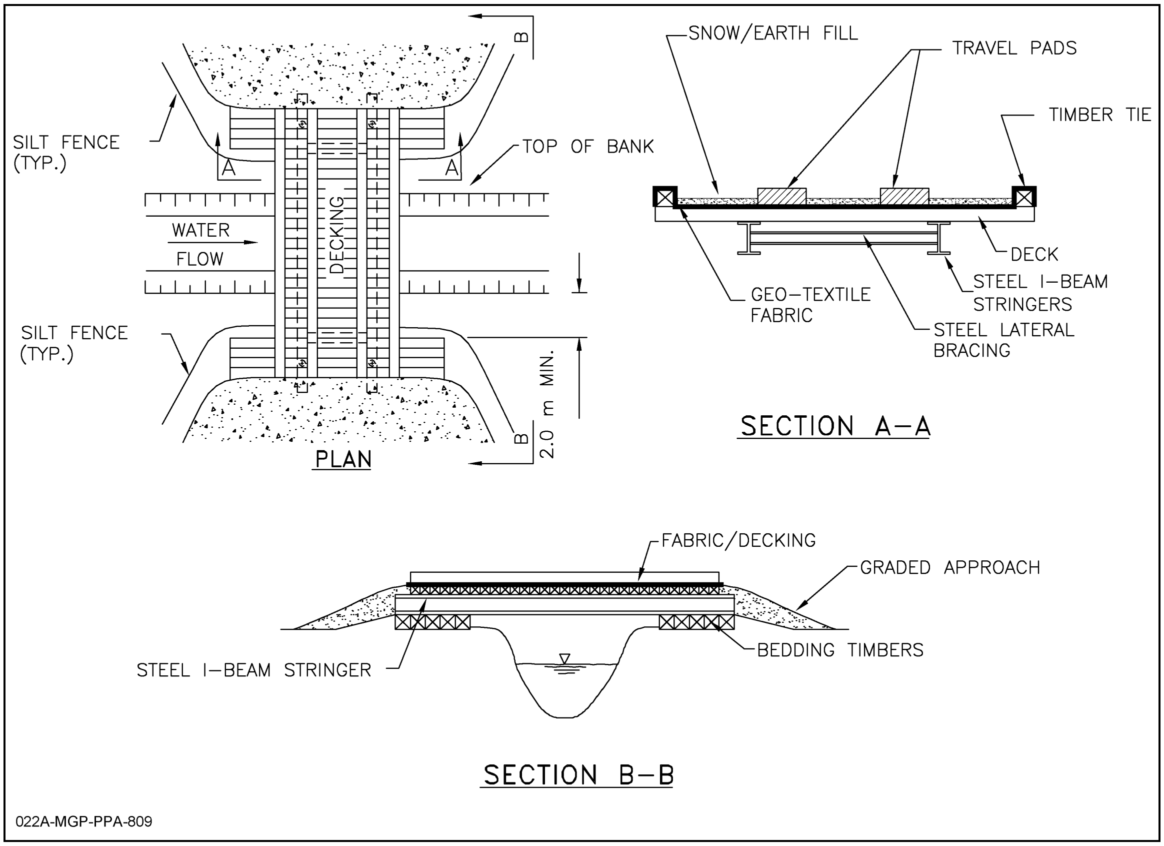

Figure 3-39: Typical Temporary Bridge Structure

Culvert Crossings

Culverts might be used where sediment control and continuous passage of fish is required. Culverts are often used in all-weather roads. The culverts will be put into place, the ends will be sandbagged and the ramps will be installed, covered with clean granular fill, and compacted for traffic. The outlet sides might be rip-rapped for erosion control. If used for winter construction only, the culverts and ramps will be removed before spring breakup.

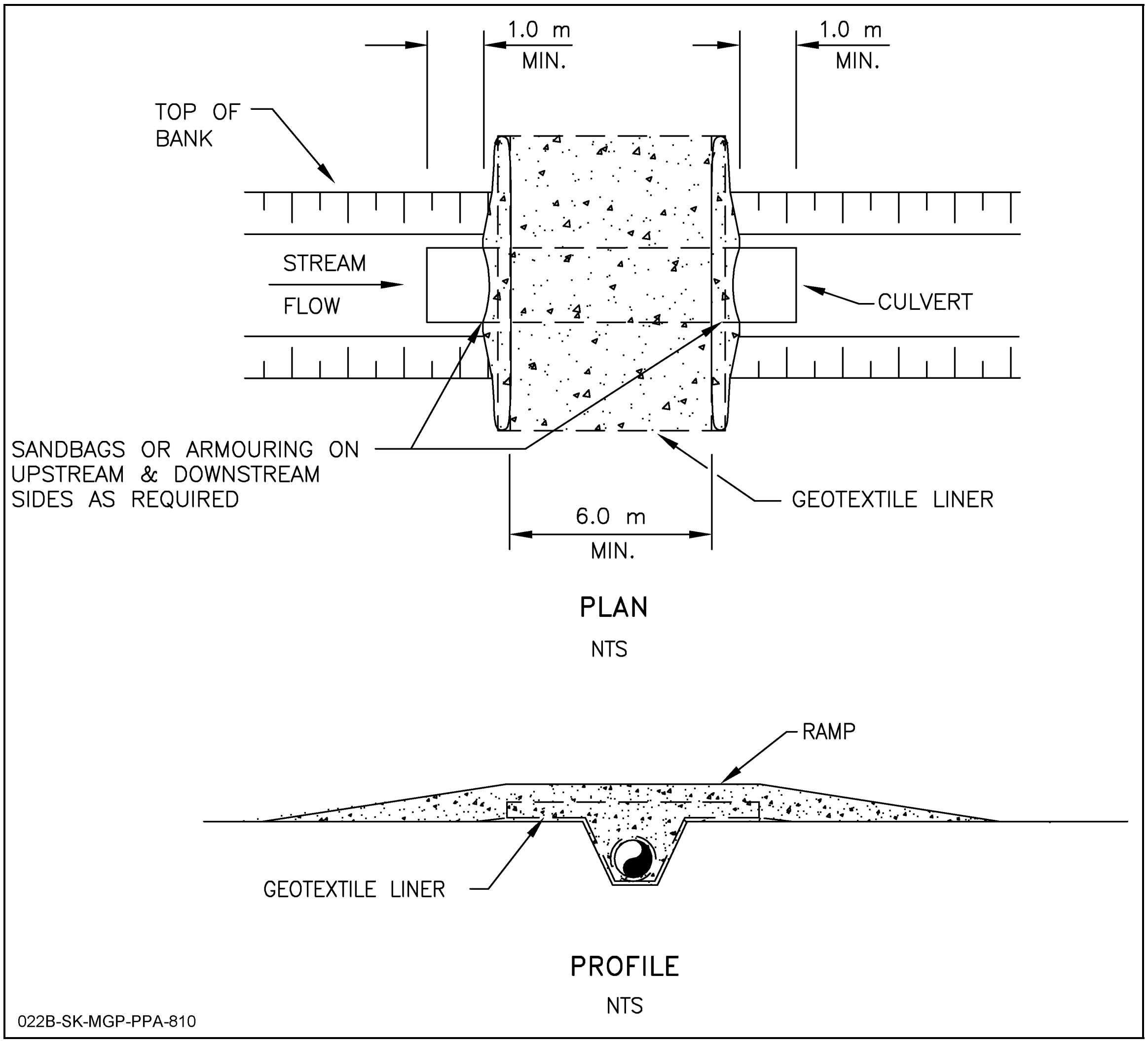

Figure 3-40: Typical Culvert Crossing

Timber Fill Crossings

Timber fill crossings might be used to cross shallow streams with intermittent flow, gently sloping banks, and no fish passage concerns. They might also be warranted in seasons or areas with low snow, where there might not be enough material for a snow or ice fill crossing. Timber mats or timber logs cabled together are used as a base, which is covered with compacted snow to bring the crossing up to grade. Timber and debris will be removed before spring breakup.

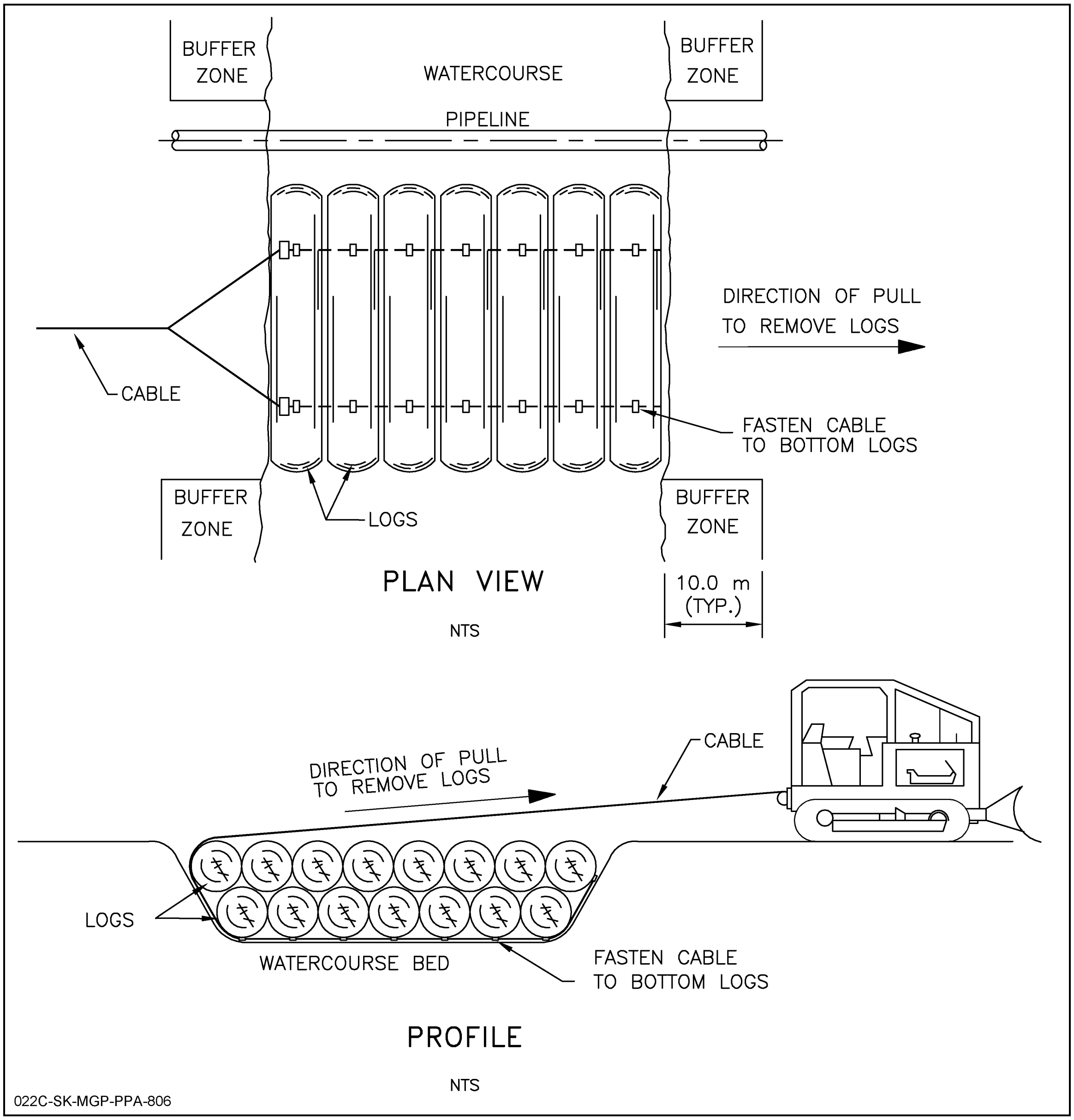

Figure 3-41: Typical Timber Fill Crossing

Ice Bridge Crossings

Ice bridges might be used where there is ample supply of water and the crossing location has gently sloping banks. Once a safe ice thickness at the crossing is reached, snow cats will be used to push snow berms onto each side of the crossing. The travel surface will be flooded in repeated lifts, between the snow berms, to increase the load bearing capacity. Regular maintenance will be required and the bridges will be notched before spring breakup, thereby ensuring free flowing melt water.

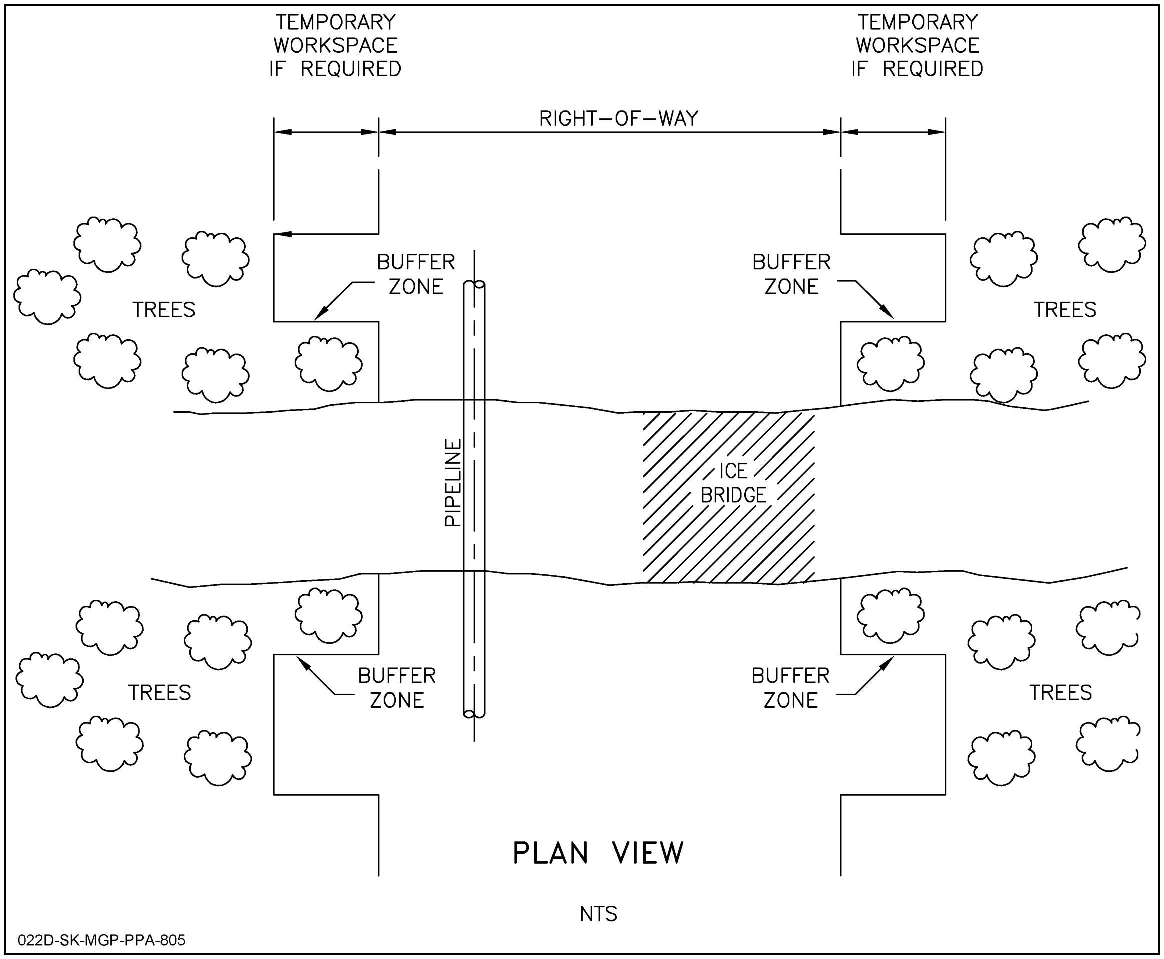

Figure 3-42: Typical Ice Bridge Crossing

Snow Fill Crossings

Snow fill crossings might be used where there is intermittent or no winter flow, the crossing has gently sloping banks, there is ample snow supply, and an ice bridge or temporary bridge structure is not warranted. Snow will be collected from nearby areas or made artificially by snowmaking systems. The travel surface will be built up with repeated lifts of compacted snow and water. As with ice bridges, snow fill crossings will be notched before spring breakup.

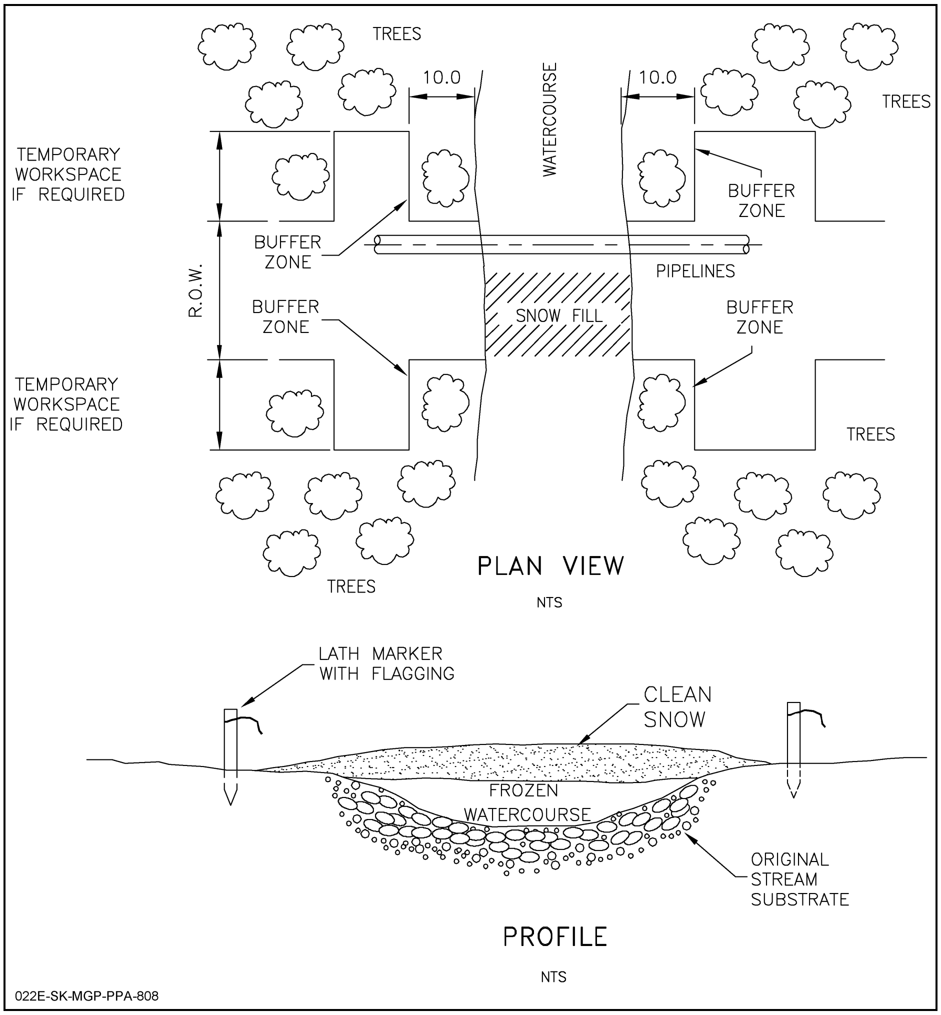

Figure 3-43: Typical Snow Fill Crossing

HIGHWAY, ROAD AND PIPELINE CROSSINGS

No crossings of pipelines or all-weather roads owned or operated by third parties have been identified for the pipelines through the GSA.

SUMMARY OF PROJECT EFFECTS AND MITIGATION

An overview of the potential effects of the proposed development activities on the biophysical and human environmental settings in the GSA, along with a brief description of the primary strategies for mitigating those effects, is contained in this subject. Detailed descriptions of potential effects and primary mitigation strategies are provided in Section 8. Environmental protection plans (EPPs) will also be developed. The framework is described in Section 11.

The potential biophysical effects of the proposed pipelines and components have been assessed within a one-kilometre wide corridor generally centred along the proposed pipeline route. The findings from this regional assessment were included in the EIS that was submitted to the Joint Review Panel in October 2004.

In addition, environmental studies have been conducted outside the pipeline corridor, where needed, to include infrastructure sites required for construction, such as barge landings, borrow sites, camps, access roads and water sources. The study results, along with the regional findings in the EIS, have been used to identify the potential environmental effects of the development activities in this application.

Biophysical Effects

Typical project activities could result in a number of potential effects on the biophysical environment in the GSA, depending on the type of activity, location, climate and the timing of construction. Typical effects from construction, before mitigation, include but are not limited to:

- increased gaseous emissions
- changes in ground and slope stability, drainage patterns and water and wind erosion
- alteration of uncommon landforms
- soil loss and changes in soil quality, drainage, and physical and chemical characteristics
- removal, burial, mechanical damage or alteration of vegetation
- removal, burial, mechanical damage or alteration of heritage sites

- localized direct and indirect effects on wildlife habitat, localized disruptions to wildlife movement and limited wildlife mortality
- localized alteration to fish and fish habitat
- changes in water and sediment quality
- increased intermittent and continuous noise levels

Primary Biophysical Mitigation

Examples of typical measures that might be used to reduce the effects of development activities include but are not limited to:

- employment of local environmental and wildlife monitors
- constructing primarily in the winter and other periods that avoid sensitive wildlife and fish timing windows
- reducing the footprint of disturbance
- reducing grading and leveling to that required for a safe and efficient working surface
- implementing appropriate drainage, sediment, erosion and slope stability controls
- enforcing traffic and access controls
- avoiding environmentally sensitive areas where practical
- protecting heritage resources
- applying good site management practices for dust suppression
- considering efficiency in equipment selection
- applying best management practices to reduce fuel use
- maintaining equipment exhaust systems

EFFECTS ON THE HUMAN ENVIRONMENT

An overview of the potential effects of the proposed development activities on the human environment in the GSA, including effects on the people and the economy of the region, on traditional culture, on non-traditional land and resource use, on protected areas and on heritage resources is contained in this topic.

Effects

The focus has been on identifying the potential effects of development sites and activities that are closest to the communities, or that could affect resources and activities with high local values, or that might be important to the functioning of the community. Examples of the latter include roads, airports and barge landings.

Economic effects were determined from simulations using employment and expenditure estimates. The simulations (of direct, indirect and induced economic effects) were done using the Statistics Canada's inter-regional input-output model (I-O model). However, because this model only produces results at a territorial or provincial level, effects in the Northwest Territories were allocated to the GSA and the other regions.

Summary of Effects on the People and Economy of the GSA

The proposed development activities are expected to have a long term, positive influence on the people and economies in the communities of Fort McPherson, Tsiigehtchic, Inuvik and the GSA as a whole. Among other things, this influence will be reflected in increased employment, income and business opportunities, capacity development, and the potential for new infrastructure. The influences are assessed and explained at a regional level. General trends are applicable to all GSA communities, and where appropriate, community specific effects are also described.

In the shorter term, spending decisions by some individuals will affect the quality of life of these income earners, their families and their communities. These decisions will also increase the demands on resources and facilities that deliver social, health and protection services to the communities. Inflationary pressures, including on housing in Inuvik, might also occur in the early phases of the project.

Both facilitating and inhibiting influences on traditional harvesting might result from the development. Time spent on harvesting activities might be reduced for some workers and families. However, the wages from project employment might also be used to acquire new and better equipment for more efficient and productive harvesting. Project-related employment might also add to a slow, ongoing decline in Aboriginal language use and culture preservation within the GSA.

During construction, the potential project effects on the people and economy of the GSA include:

- capital expenditures and project-related procurement estimated at over $350 million

- some expanded business and labour force capacity and opportunities

- increased labour force participation rates, to 78% from 74%
- employment rate growth, to 70% from an average of 61%
- decreased unemployment rates, to 10% from 17%
- population increases, mostly in Inuvik, estimated at about 450 people in the peak activity year of 2008
- temporary creation of up to 400 project-related jobs a year for GSA residents
- generation of about $80 million in labour income, including $41 million in direct project related income
- elevated levels of alcohol abuse and related violence and illness, family relationship stress, contagious diseases and STIs

During the operations phase, potential project effects on the people and economy of the GSA include:

- a part of $140 million in average annual operations expenditures in the NWT will be spent in the GSA
- some expanded business and labour force capacity and opportunities
- an average of about 210 jobs a year for GSA residents, generating about $15 million a year in labour income

Inuvik is expected to experience most of the procurement, employment and labour income effects because of its size, location and function as a regional transportation and administrative centre.

Primary Human Environmental Mitigation

In recognition of the potential for adverse effects, mitigation strategies have been developed that might be implemented by the project in conjunction with the GNWT, communities, local authorities, service providers, and other third parties. Given the range and magnitude of potential effects, a co-coordinated and collaborative response from the project and these other parties is necessary.

Examples of primary mitigation strategies include:

- developing a procurement plan to build business capacity in the GSA and manage project-related procurement and expenditures
- giving preference to qualified, competitive businesses for the provision of certain good and services

- working with the GNWT, educational institutions, and Aboriginal associations and communities to address education and training needs to optimize project-related employment for NWT residents
- developing a database of potential workers to match skill sets and identify training needs
- implementing hiring policies that provide preference for direct project hiring in the North
- initiating money management programs and enabling workers to assign part of their wages to savings accounts to encourage positive lifestyle choices
- enforcing policies for alcohol and drug-free workplaces and camps
- implementing measures to help sustain community health
- providing Aboriginal workers with flexible work schedules to accommodate traditional harvesting and other Aboriginal cultural, family and community needs, where practical
- supporting community-based traditional lifestyle initiatives that promote traditional harvesting and positive relationships with communities
- negotiating harvester compensation agreements with the hunters' and trappers' committees or other relevant authorities
- providing cultural awareness training to all workers on the project to promote appreciation and respect for Aboriginal people and their culture
- supporting cultural activities and events that are consistent with the project principles and practices
- periodically providing country foods in the construction camps
- providing construction camps with Aboriginal language reading material, and Aboriginal language radio and television broadcasts, tapes and CDs, where available