SCOPE

Natural materials needed to construct the project will be obtained from new and existing borrow sites, commonly known as sand or gravel pits and rock quarries. These sources will be developed and accessed along the proposed pipeline corridor.

About 5,000,000 m^3 of borrow materials will be required for the project, including the pipeline right-of-way, access roads and facility sites. Of this project total, an estimated 2.23 million m^3 of borrow materials might be needed for developments in the SSA.

About 127 potential borrow sites have been identified for detailed field investigation for the project. This includes 55 potential sites in the SSA. Thirty-three are on Sahtu private lands and 18 on Crown lands. Four are on Commissioner's land (see Table 3-6).

An estimated 3,745,000 m^3 of borrow material could be obtained from these 55 sites.

Table 3-6: Summary of Potential Borrow Sites in the SSA

Borrow Site Number	Potential Borrow Material	Existing Pit or Quarry	Land Ownership	Expected Year(s) in Use	Land Use Designation (SPDLUP)
5.041PB	Sand and gravel	No	Private	2008-2009	General Use
6.011PB	Sand and gravel	No	Private	2008-2009	Mackenzie River SMA and General Use
6.011P	Gravel and sand	No	Private	2008-2009	General Use
20.200P	Shale	No	Private	2007-2009	General Use
5.036P	Sand	No	Private	2008-2009	General Use
6.012P	Sand and gravel	No	Private	2008-2009	General Use
20.043P	Shale	No	Private	2007-2009	General Use
5.043AP	Sand and gravel	No	Crown	2007-2009	Yeltea Lake and Manual Lake SMA
20.202P	Shale	No	Private	2008-2009	Mackenzie River SMA and Yeltea Lake and Manuel Lake SMA

Table 3-6: Summary of Potential Borrow Sites in the SSA (cont'd)

Borrow Site Number	Potential Borrow Material	Existing Pit or Quarry	Land Ownership	Expected Year(s) in Use	Land Use Designation (SPDLUP)
6.036AP	Sand	No	Private	2008-2009	Mackenzie River SMA and Yeltea Lake and Manuel Lake SMA
6.034PA	Sand with gravel	No	Private	2008-2009	Mackenzie River SMA
6.042CP	Sand	No	Private	2008-2009	Mackenzie River SMA and Yeltea Lake and Manuel Lake SMA
6.042BP	Sand	No	Private	2008-2009	Mackenzie River SMA and Yeltea Lake and Manuel Lake SMA
6.042P	Sand and bedrock	No	Private	2008-2009	Mackenzie River SMA
6.053P	Sand and gravel	No	Private	2008-2009	General Use
20.112P	Sand with gravel	No	Crown	2008-2009	General Use
20.113P	Sand	No	Private	2007-2009	General Use
6.089P	Gravel	No	Crown	2007-2008	General Use
7.003AP	Limestone	No	Crown	2008-2009	Lac à Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
20.114P	Sand and gravel	No	Crown	2007-2008	Lac à Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
7.006P	Limestone fragments with sand	No	Crown	2008-2009	Lac à Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
7.005P	Limestone	No	Private	2007-2008	Lac à Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
7.015P	Sand and gravel	No	Crown	2007-2008	General Use
7.018P	Limestone	No	Private	2007-2008	General Use
7.016P	Sand and gravel	No	Crown	2007-2008	General Use
7.021P	Sand	No	Private	2007-2008	Mackenzie River SMA
7.025P	Gravel	No	Private	2007-2008	Mackenzie River SMA

Table 3-6: Summary of Potential Borrow Sites in the SSA (cont'd)

Borrow Site Number	Potential Borrow Material	Existing Pit or Quarry	Land Ownership	Expected Year(s) in Use	Land Use Designation (SPDLUP)
7.035P	Sand and gravel	No	Private	2007-2008	Mackenzie River SMA
7.046P	Sand and gravel	No	Private	2007-2008	Mackenzie River SMA
7.054P	Sand and gravel	No	Crown	2007-2009	Mackenzie River SMA
7.070P	Sand and gravel	No	Private	2008-2009	General Use
7.073PB	Sand and gravel	No	Private	2008-2009	Mackenzie River SMA
7.073PA	Sand and gravel	No	Private	2008-2009	Mackenzie River SMA
7.078P	Sand and gravel	No	Private	2008-2009	General Use, Mackenzie River SMA
7.090P	Limestone	No	Crown	2008-2009	General Use
7.155AP	Gravel	Yes	Crown	2007-2008	Little Bear, Stewart Lake and Tate Lake SMA
7.155BP	Gravel	Yes	Private	2008-2009	Little Bear, Stewart Lake and Tate Lake SMA
20.201P	Limestone	No	Crown	2008-2009	General Use
8.058P	Sand	No	Crown	2008-2009	Mackenzie River SMA
20.086P	Sand	No	Private	2008-2009	Mackenzie River SMA
9.002PB	Sand and gravel	Yes	Private	2007-2008	Mackenzie River SMA
9.002PA	Sand and gravel	Yes	Private	2007-2008	Mackenzie River SMA
9.010PA	Limestone	Yes	Crown	2007-2008	Mackenzie River SMA
9.017P	Sand	Yes	Private	2007-2008	Mackenzie River SMA
9.024AP	Sand and gravel	Yes	Private	2007-2008	Mackenzie River SMA
9.037PB	Sand and gravel	No	Crown	2007-2008	Mackenzie River SMA
9.034PB	Sand and gravel	No	Crown	2007-2008	General Use, Mackenzie River SMA
9.034PA	Sand and gravel	No	Crown	2007-2008	General Use
9.038PB	Sand and gravel	No	Private	2007-2008	General Use
9.037PA	Sand and gravel	No	Crown	2007-2008	Mackenzie River SMA
9.038PA	Sand and gravel	No	Private	2007-2008	General Use

Table 3-6: Summary of Potential Borrow Sites in the SSA (cont'd)

Borrow Site Number	Potential Borrow Material	Existing Pit or Quarry	Land Ownership	Expected Year(s) in Use	Land Use Designation (SPDLUP)
7.057P	Limestone	Yes	Norman Wells Municipality	2006-2009	Mackenzie River SMA
7.049P	Sand and gravel	No	Norman Wells Municipality	2007-2009	Mackenzie River SMA
6.077P	Gravel	No	Fort Good Hope Municipality	2007-2008	Mackenzie River SMA
6.080P	Gravel	No	Fort Good Hope Municipality	2007-2008	Mackenzie River SMA

Borrow Site Development

A typical borrow site development is depicted in Figure 3-13.

The development schedule for the borrow sites will be determined by project needs during construction and, potentially, during operations. The sites will be developed for the components they will supply and will be reclaimed, as required.

The schedule at each site will be influenced by ice content of the borrow material. Sites with a high ice content might be excavated at least one year in advance, with the borrow materials likely to be excavated and stockpiled. The piles of high ice content materials might be allowed to melt and drain over the summer for use in the following winter. Other activities that might be required at various borrow sites during the summer include stripping overburden, excavating borrow material and stockpiling.

Most borrow sources will meet the applicable specifications for road and pad construction. However, where the material does not meet quality standards for pipeline backfill, it will be crushed or screened during site excavation. Materials might be screened to separate borrow material for different uses. Large material might be crushed to make them suitable for use by the project.

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PROJECT COMPONENTS

Gas and NGL Pipelines

The proposed pipeline route through the SSA extends about 503.5 km from the GSA to the DCR boundary, including about 230.9 km in the K'ahsho Got'ine District and 272.6 km in the Tulita District. The route also crosses through a 10.4 km segment of Sahtu private land that starts about 200 m south of the SSA/DCR boundary.

The gas pipeline will share a 50 m right-of-way with the NGL pipeline from the GSA boundary to a point near the Norman Wells compressor station at about KP 474.5, a distance of about 288.2 km. From there, the gas pipeline will continue south in a 40 m right-of-way for about 223.8 km, including the segment in the DCR. The NGL pipeline will deviate from the shared right-of-way and proceed about 1.9 km, within a 30 m right-of-way, to the interconnection with the Enbridge Norman Wells pipeline.

The pipelines in the SSA traverse 45 segments based on land ownership. These segments are shown, along with their location relative to areas identified in the SPDLUP, in Table 3-7 and Figure 3-14.

Table 3-7: Pipeline Segments in the SSA

Pipeline Segment	Area Identified in SPDLUP	Length (km)	Start	Finish
Crown Land – C1	Mackenzie River SMA	11.2	186.3	197.5
Private Land – P1	Mackenzie River SMA, General Use	31.0	197.5	228.5
Crown Land – C2	Yeltea Lake and Manuel Lake SMA	34.3	228.5	262.8
Private Land – P2	Yeltea Lake and Manuel Lake SMA	13.7	262.8	276.5
Crown Land – C3	Yeltea Lake and Manuel Lake SMA	1.2	276.5	277.7
Private Land – P3	Yeltea Lake and Manuel Lake SMA	9.5	277.7	287.2
Crown Land – C4	Yeltea Lake and Manuel Lake SMA	0.6	287.2	287.8
Private Land – P4	Yeltea Lake and Manuel Lake SMA, Fort Anderson Trail CA, General Use	20.6	287.8	308.4
Crown Land – C5	Mackenzie River SMA, General Use	16.5	308.4	324.9
Private Land – P5	Mackenzie River SMA	5.1	324.9	330.0

Table 3-7: Pipeline Segments in the SSA (cont'd)

Pipeline Segment	Area Identified in SPDLUP	Length (km)	Start	Finish
Crown Land – C6	Mackenzie River SMA	0.2	330.0	330.2
Commissioner's land – M1 (Fort Good Hope)	Mackenzie River SMA, Colville Lake Trail SMA, General Use	9.6	330.2	339.8
Private Land – P6	General Use	5.1	339.8	344.9
Crown Land – C7	General Use, Lac à Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA	33.6	344.9	378.5
Private Land – P7	Lac à Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA, General Use	24.2	378.5	402.7
Crown Land – C8	General Use	14.5	402.7	417.2
Crown Land – C9	General Use, Mackenzie River SMA	6.8	417.2	424.0
Private Land – P8	Mackenzie River SMA	26.5	424.0	450.5
Crown Land – C10	Mackenzie River SMA	21.8	450.5	472.3
Private Land – P9	Mackenzie River SMA	2.2	472.3	474.5
Private Land – P10	Mackenzie River SMA	0.5	474.5	475.0
Private Land – P11	Mackenzie River SMA	0.5	474.5	475.0
Commissioner's land – M1 (Norman Wells)	Mackenzie River SMA	13.5	475.0	488.5
Commissioner's land – M2 (Norman Wells-NGL)	Mackenzie River SMA	1.4	475.0	476.4
Private Land – P12	Mackenzie River SMA	24.4	488.5	512.9
Crown Land – C11	Mackenzie River SMA, Great Bear River CA, General Use	43.3	512.9	556.2
Private Land – P13	Mackenzie River SMA, Great Bear River CA	2.6	556.2	558.8
Crown Land – C12	Mackenzie River SMA, Great Bear River CA	4.4	558.8	563.2
Private Land – P14	Mackenzie River SMA	5.2	563.2	568.4
Crown Land – C13	Mackenzie River SMA	18.6	568.4	587.0
Private Land – P15	Mackenzie River SMA, General Use	14.0	587.0	601.0
Crown Land – C14	Mackenzie River SMA	10.5	601.0	611.5
Private Land – P16	Mackenzie River SMA	6.0	611.5	617.5
Crown Land – C15	Mackenzie River SMA, General Use	10.5	617.5	628.0

Table 3-7: Pipeline Segments in the SSA (cont'd)

Pipeline Segment	Area Identified in SPDLUP	Length (km)	Start	Finish
Private Land – P17	Mackenzie River SMA	7.1	628.0	635.1
Crown Land – C16	Mackenzie River SMA	0.1	635.1	635.2
Private Land – P18	Mackenzie River SMA	0.4	635.2	635.6
Crown Land – C17	Mackenzie River SMA	6.8	635.6	642.4
Private Land – P19	Mackenzie River SMA	0.7	642.4	643.1
Crown Land – C18	Mackenzie River SMA	5.5	643.1	648.6
Private Land – P20	Mackenzie River SMA	7.7	648.6	656.3
Crown Land – C-19	Mackenzie River SMA	8.9	656.3	665.2
Private Land – P21	Mackenzie River SMA	7.5	665.2	672.7
Crown Land – C20	Mackenzie River SMA, General Use	15.2	672.7	687.9
Private Land – P22	General Use	10.4	688.2	698.6
Total		513.9		

The 50 m wide pipeline right-of-way in the SSA traverses the Fort Anderson Trail conservation area identified in the SPDLUP, as well as four potential special management areas (Mackenzie River, Yeltea Lake and Manuel Lake, Colville Lake Trail, and Lac à Jacques/Turton Lake/Sam Macrae Lake/Yamoga Rock).

The 40 m and 30 m wide right-of-way are in the Mackenzie River special management area. In addition, part of the 40 m right-of-way is located in the Great Bear River conservation area, as identified in the SPDLUP.

General use zones are crossed by both the 50 m and 40 m pipeline right-of-way.

The gas and NGL pipelines will be buried and installed in separate ditches about 13 m apart. If necessary, they might be placed in a common trench where there are ice-rich, steep slopes and at unique watercourse crossings.

Pipeline Facility

For the SSA, there are two pipeline facilities being proposed, the Little Chicago and Norman Wells compressor stations. These facilities are described next in general terms and in detail in Section 7.

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Compressor Stations

Compressor stations are required to increase the pressure of the gas in the pipeline, to offset pressure losses caused by friction. They will be located along the gas pipeline route, at intervals of about 225 km, downstream from the Inuvik area facility.

The site for each compressor station will occupy about 9.5 ha, of which 6.2 ha will be fenced. Site preparation for the compressor stations is expected to start in 2006. The Little Chicago station will have an NGL pipeline located through the site.

Compressor stations will be designed for remote, unstaffed operation and will be accessible by helicopter and in some cases all-weather roads. Permanent living quarters for about eight people will be provided for operations and maintenance staff at the Little Chicago facility site. Living quarters are not presently planned for the Norman Wells compressor station, given its proximity to Norman Wells and access by municipal and project all-weather roads. Other on-site infrastructure requirements might also be reduced at this location.

Both of the compressor stations in the SSA will have an all-weather access road. A 6 km road will be constructed between the Little Chicago facility site and a proposed airstrip for the site. A 1 km road will be required to connect the Norman Wells compressor station to an existing municipal road.

Equipment and buildings will be modular to facilitate construction in remote areas. The stations will have a similar design, except for the changes necessary to accommodate different soil and terrain conditions at each site. They will also contain similar equipment, including:

- pipeline components, such as a mainline block valve assembly, a pig launcher and receiver facilities
- an inlet scrubber
- a gas turbine compressor package
- aerial coolers
- gas-to-gas heat exchangers
- utility gas equipment, including metering
- fuel gas equipment, including metering
- electrical power generation equipment

- controls and communications equipment
- safety equipment

Safety systems will include fire and gas detection, smoke detection, overpressure protection and an emergency shutdown system.

Effluent from the drainage systems will be handled in accordance with the waste management plan being developed for the project (see Section 8).

An artist's impression of a typical compressor station is shown in Figure 3-15.

Pipeline Appurtenances

Block Valves

Block valves will be installed along the gas and NGL pipelines at about the same time as the pipelines are installed. The block valves allow pipeline segments to be isolated for operations or maintenance.

In the SSA gas pipeline, block valve assemblies will be installed within the facility footprints of the Little Chicago and Norman Wells compressor stations, at the interconnection with the Enbridge pipeline system, and on the pipeline right-of-way at intermediate locations where potential future compressor and pump stations might be required. The NGL pipeline will have additional block valves installed at select watercourse crossings (see Figure 3-16, Figure 3-17, Figure 3-18 and Figure 3-19).

See Table 3-8 for proposed locations of block valves on the gas pipeline and Table 3-9 for proposed locations of block valves on the NGL pipeline.

Intermediate block valves will be mostly below ground in the SSA. However, these valves will have extensions about 1.2 m above ground to allow valve actuators to be installed. Risers with valves will also be installed. These will be used to depressurize the pipeline to permit pipeline maintenance.

The block valve assemblies will include blowdown and bypass valves to repressurize the pipeline for maintenance. The design of the gas pipeline block valve assemblies will include side valves that will permit future station piping to be connected without taking the pipeline out of service.

A main control center (MCC) in Calgary will be used to remotely monitor and control, as required, block valve functions in the SSA. The intermediate valve sites will be equipped with thermo-electric generators (TEG), which will produce limited power. Lights will only be used when operations or maintenance staff are present.

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Table 3-8: Intermediate Gas Pipeline Block Valve Sites

Valve Type	Site Name	Kilometre Post (KP)	Land Ownership	Land Use Designation (SPDLUP)
Block valve located within Little Chicago facility site	Little Chicago facility site	223.0	Private (K'ahsho Got'ine)	General Use
Block valve location	Loon River	309.7	Crown (K'ahsho Got'ine)	General Use
Block valve location	Chick Lake	390.6	Private (K'ahsho Got'ine)	Lac a Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
Block valve located within Norman Wells compressor station site	Norman Wells compressor station	475.5	Norman Wells Municipality	Mackenzie River SMA
Block valve location	Great Bear River	551.4	Crown (Tulita)	Great Bear River Conservation Zone
Block valve location	Little Smith Creek	622.6	Crown (Tulita)	Mackenzie River SMA

Figures 3.16 and 3.17 have been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Figure 3.18 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Figure 3.19 has been moved to reduce file size. To view it, click on the link to the figure in the web page List of Figures for this document.

Table 3-9: Intermediate Valve Sites on the NGL Pipeline

Valve Type	Site Name	Kilometre Post (KP)	Land Ownership	Land Use Designation (Sahtu Preliminary Draft Land Use Plan)
Manual block valve and check valve	Unnamed creek – downstream	235.3	Crown (K'ahsho Got'ine)	General Use
Main line block valve	Tieda River – upstream	273.5	Private (K'ahsho Got'ine)	Yeltea Lake and Manuel Lake SMA
Manual block valve and check valve	Tieda River – downstream	276.9	Crown (K'ahsho Got'ine)	Yeltea Lake and Manuel Lake SMA
Main line block valve	Loon River pump station – upstream	305.1	Private (K'ahsho Got'ine)	General Use
Isolation valve upstream of station	Loon River pump station – upstream	309.5	Crown (K'ahsho Got'ine)	General Use
Isolation valve downstream of station	Loon River – downstream	309.6	Crown (K'ahsho Got'ine)	General Use
Main line block valve	Hare Indian (Rabbitskin) River – upstream	324.2	Crown (K'ahsho Got'ine)	Mackenzie River SMA
Manual block valve and check valve	Hare Indian (Rabbitskin) River – downstream	330.8	Crown (K'ahsho Got'ine)	Mackenzie River SMA
Manual block valve and check valve	Jackfish Creek – downstream	338.9	Crown (K'ahsho Got'ine)	General Use
Main line block valve	Tsintu River – upstream	347.5	Crown (K'ahsho Got'ine)	General Use
Manual block valve and check valve	Tsintu River – downstream	352.2	Crown (K'ahsho Got'ine)	General Use
Main line block valve	Unnamed stream – upstream	365.2	Crown (K'ahsho Got'ine)	Lac a Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
Manual block valve and check valve	Unnamed stream – downstream	368.9	Crown (K'ahsho Got'ine)	Lac a Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
Main line block valve	Donnelly River – upstream	380.1	Private (K'ahsho Got'ine)	Lac a Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA
Manual block and check valve	Donnelly River – downstream	383.7	Private (K'ahsho Got'ine)	Lac a Jacques, Turton Lake, Sam Macrae Lake, Yamoga Rock SMA

Table 3-9: Intermediate Valve Sites on the NGL Pipeline (cont'd)

Valve Type	Site Name	Kilometre Post (KP)	Land Ownership	Land Use Designation (Sahtu Preliminary Draft Land Use Plan)
Main line block valve	Hanna River – upstream	404.6	Crown (K'ahsho Got'ine)	General Use
Manual block valve and check valve	Hanna River – downstream	416.0	Crown (K'ahsho Got'ine)	General Use
Main line block valve	Elliot Creek – upstream	431.2	Private (Tulita)	Mackenzie River SMA
Manual block valve and check valve	Oscar Creek – downstream	446.6	Private (Tulita)	Mackenzie River SMA
Norman Wells block valve and pig receiver	Norman Wells Enbridge Interconnect	476.4	MACA	Mackenzie River SMA

Pigging Facilities

Pigs are devices placed into pipelines to clean the inside of the pipeline or to monitor its condition and position. Pig launchers and receivers are facilities that enable pigs to be inserted into, or removed from, the pipeline (see the photograph provided in Figure 3-20).

Cleaning pigs are usually made of hard rubber or foam and may be ball or bullet-type. Monitoring or smart pigs, equipped with inertial-guidance technologies, will be used to monitor changes in pipeline centreline coordinates and assess ground movements that could lead to pipeline deformations and strains. Other types of smart pigs, such as magnetic flux or ultrasonic pigs, will be used to determine if areas of the pipelines have experienced potentially problematic metal loss.

On the gas pipeline, pig receivers and launchers will be installed at both the Little Chicago facility site and Norman Wells compressor station. On the NGL pipeline, a pig receiver will also be located adjacent to the existing Enbridge pump station in Norman Wells. There are no other pigging facilities proposed for the SSA.

Figure 3-20: Example of a Pig Launcher or Receiver

Cathodic Protection

The pipelines will be protected against external corrosion by a combination of an external coating and a cathodic protection system. This system will consist mainly of deep impressed current anode groundbeds that will be appropriately spaced to provide the pipeline with the requisite level of cathodic protection (see Figure 3-21 and Figure 3-22). Shallow groundbeds might also be considered in areas of discontinuous permafrost. Where required, a galvanic system might be used to complement the impressed current system.

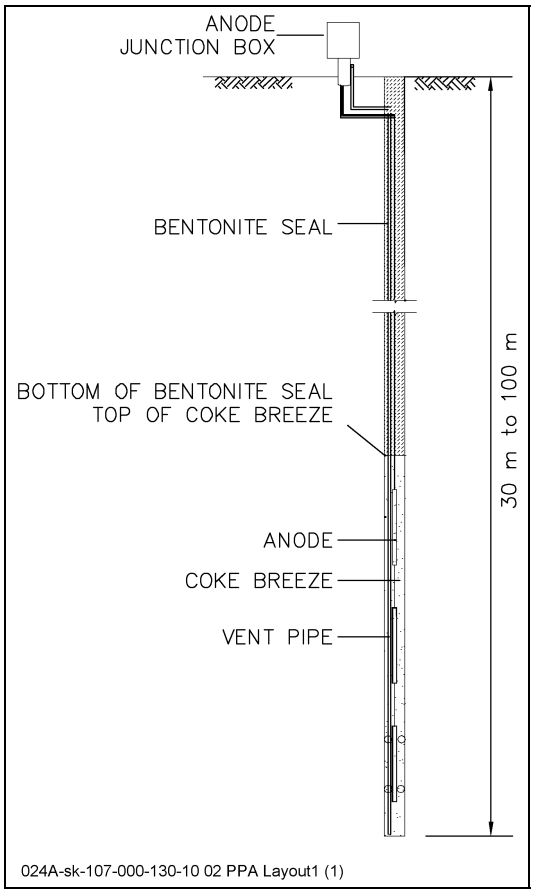

Figure 3-21: Typical Deep Anode Groundbed

The cathodic protection system will be shared between the gas and NGL pipelines and will be spaced, as required, to provide the pipelines with the requisite level of cathodic protection. Deep anode groundbeds will be installed inside the Little Chicago and Norman Wells compressor station footprints and along the pipeline right-of-way at:

- Loon River (KP-309.7)
- Chick Lake (KP-390.6)
- Great Bear River (KP-551.4)
- Little Smith Creek (KP-622.6)