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)

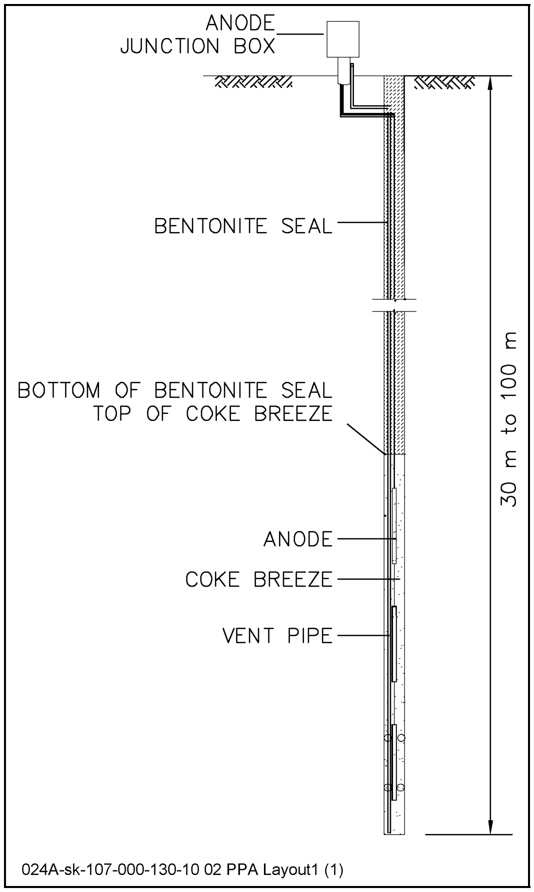

Figure 3-21: Typical Deep Anode Groundbed

Three of the anode groundbeds are situated in a general use zone, as identified in the SPDLUP. Three are in a special management area – one at Chick Lake, one at Great Bear River and one at Little Smith Creek.

A rock drill will typically be used to drill deep anode groundbeds in frozen and rocky terrain.

The anodes will be powered by rectifiers or TEGs. Rectifiers will be used where alternating current (AC) power is available at the facility sites. TEGs will be used at locations without a continuous supply of AC power.

Test stations, consisting of test leads connected to the pipeline and terminating in junction boxes mounted on posts, will be installed at about 3.0 km intervals along the pipeline right-of-way. The effectiveness of the cathodic protection system will be evaluated by taking measurements at the test stations of electrical potential of the pipeline with respect to the ground.

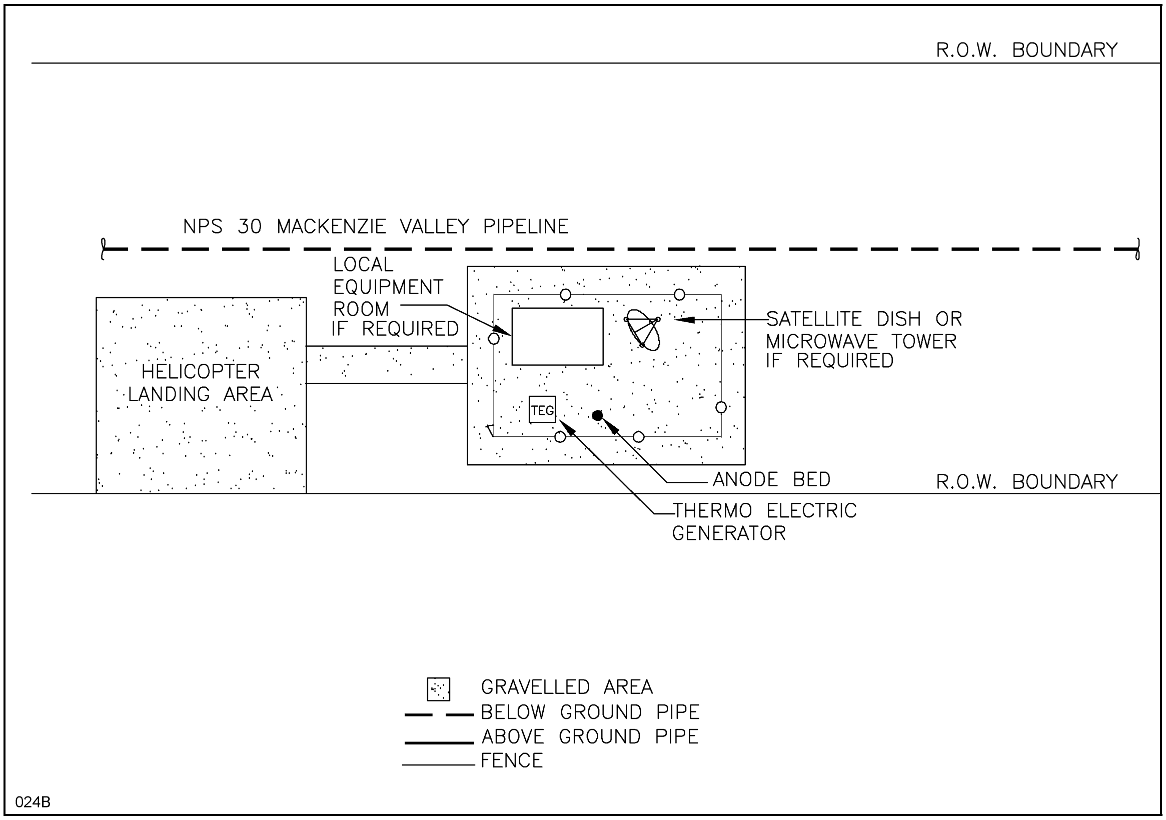

Figure 3-22: Typical Remote Cathodic Protection Deep Anode Bed Site

Signs and Markers

Appropriate signs will be specified and designed to warn the public, GNWT Department of Transportation and any third-party utility companies of the presence of the pipelines. These bilingual warning signs, in English and the regional Aboriginal language, will consist of the following:

- road crossing warning signs, which will be installed where the crossing pipeline enters and exits the road right-of-way and will be visible from the travelled surface of the road

- pipeline crossing warning signs, which will be installed adjacent to the intersection of crossing pipelines

- watercourse crossing signs, which, except for vegetated crossings, will be installed just back from the top of the bank on either side of the watercourse crossing, and if practical, will be visible from the centre of the channel

- signs which will be posted directly above the pipeline on any fence lines that are crossed, and placed on the support post of the aerial markers

- signs which will be placed on all posts installed to support cathodic protection test lead junction boxes

Aerial markers will be installed at about 5.0 km intervals along the pipeline, and will provide reference locations along the pipeline that will be visible from the air.

PIPELINE CONSTRUCTION

Construction Plan

In developing this plan, the following were considered:

- safety and emergency response
- concerns of local residents
- environmental protection
- regulatory requirements
- permafrost conditions
- seasonal constraints
- reduced daylight during the winter
- severe weather conditions
- coordination between the gas and NGL pipeline construction
- construction logistics
- infrastructure requirements
- specialized construction equipment
- select fill requirements

Public concerns considered in the construction planning process are described in Section 10.

Construction Spreads

The preliminary construction plan assumes that pipeline construction will be segmented into five construction spreads (see Appendix C) for each year of construction. These spreads will vary in length from about 120 to 160 km, with the shorter spreads for constructing both the gas and NGL pipelines.

The first year involves preparatory activities starting in the summer of 2006, such as building the infrastructure needed for construction and clearing the right-of-way and facility sites. The second and third years involve completing the preparatory activities and constructing the pipelines and associated facilities.

Most pipeline installation activities will be completed during the winter. Some activities, such as watercourse crossings, might be completed during the summer, where access to the work site is practical.

Construction Methods

Conventional winter pipeline and industrial facility construction methods and equipment will generally be used to build the proposed pipelines and associated facilities. Conventional winter construction techniques include:

- winterizing construction equipment and fuel tanks
- welding, followed by trenching
- lowering and backfill of the pipelines
- providing protection and housing for the workforce, including camp facilities, lighting and weather protection

Right-of-Way and Temporary Workspace

Right-of-Way Configuration

The pipeline right-of-way will provide work areas and travel areas to support safe and efficient construction. Figure 3-23, Figure 3-24 and Figure 3-25 show typical pipeline configurations for single and dual pipe alignments for right-of-way widths of 30 m, 40 m, and 50 m, respectively.

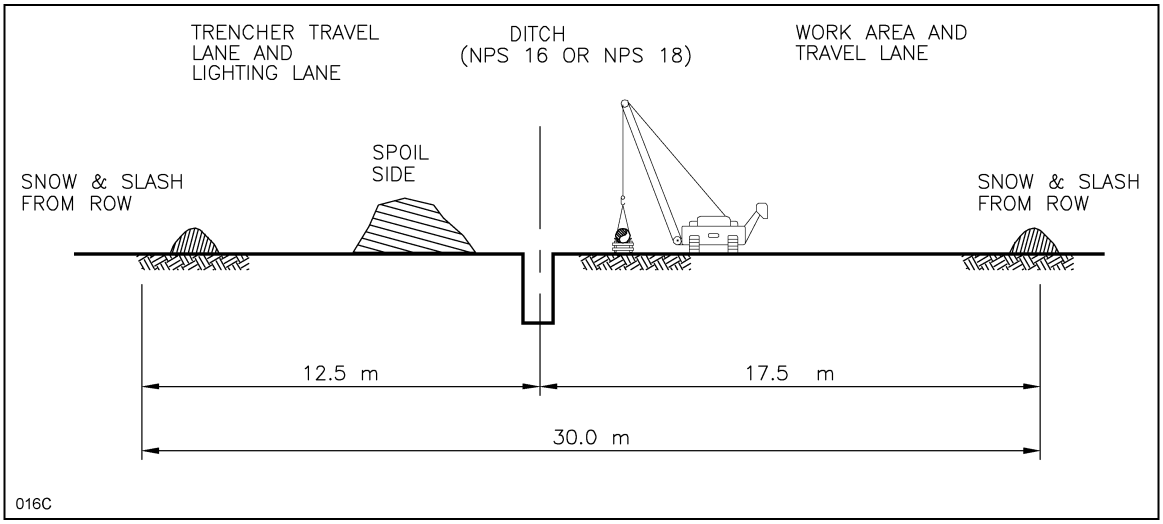

Figure 3-23: Typical Right-of-Way Configuration for Single Pipe (30 m)

A trencher travel lane will be located between the ditch spoil pile and the edge of the right-of-way. The lane will be between 3.5 and 5.0 m wide and will be used to move lighting plants and ditching equipment.

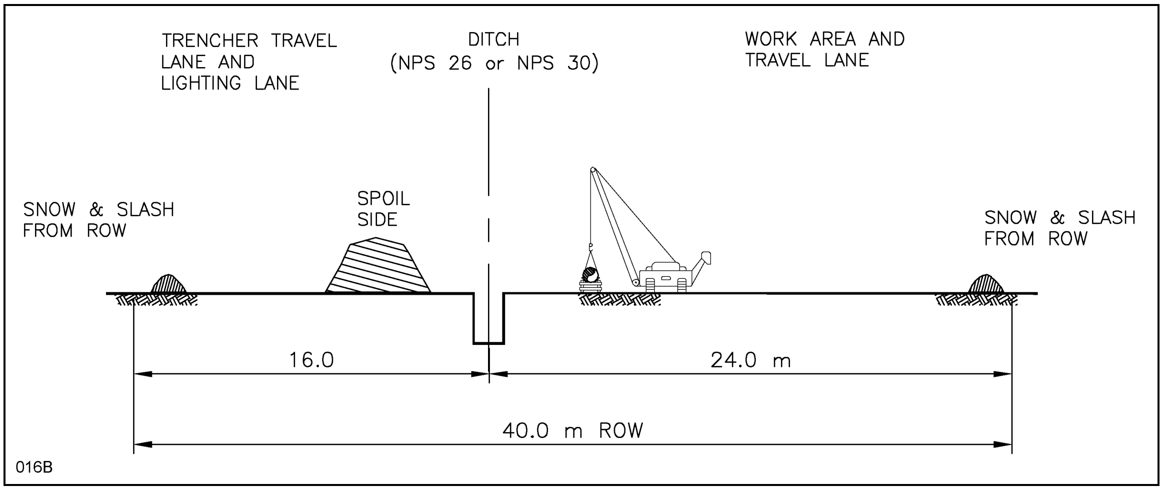

Figure 3-24: Typical Right-of-Way Configuration for Single Pipe (40 m)

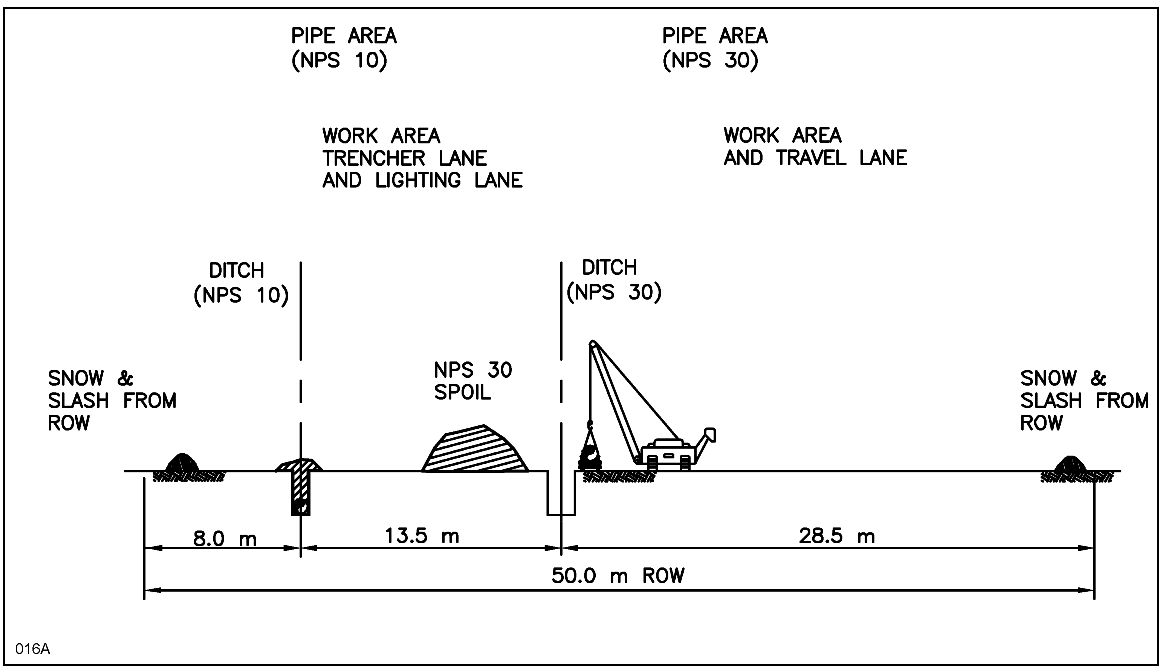

Figure 3-25: Typical Right-of-Way Configuration for Dual Pipelines (50 m)

A travel lane and work area will also be located within the right-of-way. Its surface will be prepared to safely accommodate the movement of construction equipment, including buses and pipe-stringing trucks. Over sensitive terrain and where practical, snow and ice pads will be constructed on the travel lane to facilitate the movement of construction equipment. An example of an active right-of-way during construction is provided in Figure 3-26.

Right-of-way preparation techniques suitable for several combinations of slope and soil conditions have been developed. These techniques include options to protect sensitive permafrost terrain to reduce potential thaw-induced erosion or instability resulting from disturbance of surface organic cover.

Steep longitudinal and sidehill slopes will be graded during construction to provide safe working conditions and for performance of the work (see Figure 3-27). Grading will depend on various factors such as slope angles, soil types and ice content. Unstable ice-rich slopes will typically be protected using snow, ice, or snow and ice work pads where practical, or will be remediated if grading is required.

Mitigation measures will be implemented both during and after construction to limit potential thaw settlement in permafrost areas. These measures might include, but are not limited to, revegetation, drainage control structures, surface insulation methods such as wood chips where available, and reclamation of graded slopes.

Temporary Workspace

Temporary workspace during construction will be required at a number of locations for the following uses:

- shooflies on the pipeline right-of-way
- watercourse crossings with defined banks
- turnaround areas or pushouts
- road, highway and pipeline crossings
- equipment storage areas
- deep grade or large slope sites
- sidebends
- sharp direction change areas
- valve sites
- pig launcher and receiver sites
- timber storage sites

The temporary workspace requirements for the pipelines through the SSA are estimated at 180.1 ha. This space is necessary for construction activities and is incremental to the right-of-way itself. Areas required for timber storage and bypasses on the pipeline right-of-way are excluded from this estimate and will be identified as construction planning and engineering progresses. The need for and size of additional temporary workspaces will be identified. The exact locations will be determined in the field during surveying, clearing and construction.

Figures 3.26 and 3.27 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.

Typical workspace requirements are depicted in Figure 3-28, Figure 3-29, and Figure 3-30 for a watercourse crossing, pushout area and sidebends.

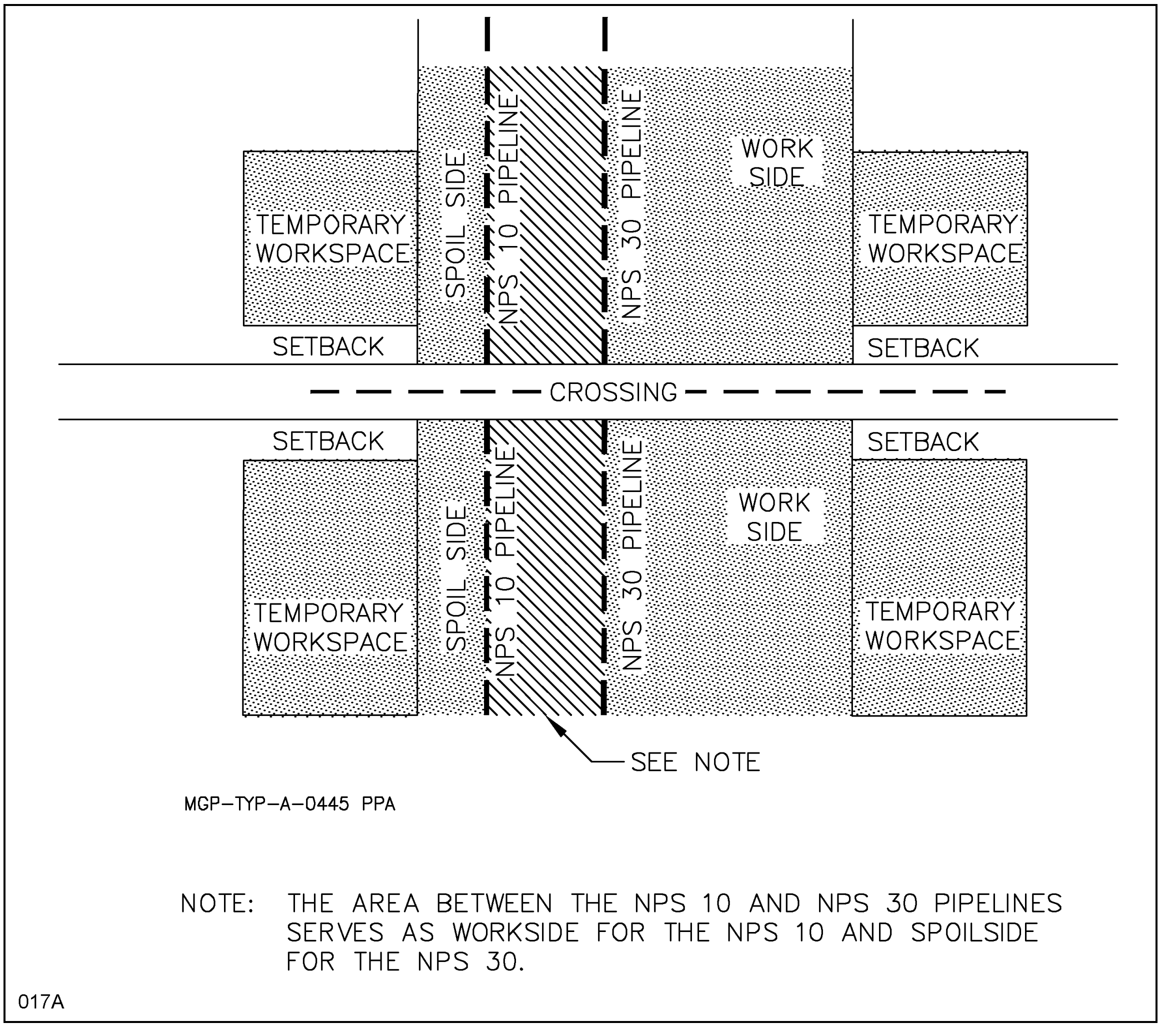

Figure 3-28: Typical Temporary Workspace at Watercourse Crossing – Dual Pipe Alignment

Clearing and Subsurface Investigations

The right-of-way and temporary workspace will be cleared for pipeline construction when ground conditions allow. The full width of the right-of-way might not be cleared in some areas, such as at the approaches to watercourse crossings with steep south-facing slopes. In the SSA, pipeline right-of-way clearing is expected to start in 2006 and end in 2009.

Before the start of right-of-way construction activities, the pipeline centreline will be located and staked within the identified route corridor. This will require clearing a line-of-sight for surveying, using hand tools where necessary, in forested or bush areas.

Figures 3.29 and 3.30 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.

Clearing and subsurface investigation activities include:

- surveying and marking the right-of-way and temporary workspace
- fencing or flagging areas to be avoided, such as environmentally sensitive sites
- clearing trees and shrubs from the right-of-way
- investigating subsurface conditions within the right-of-way

Trees and brush will be cut off at ground level. Non-merchantable timber and brush will be burned or windrowed on the edge of the right-of-way. Timber will be stockpiled for project use in storage areas adjacent to the right-of-way. Timber might be used as a source for wood chips or riprap to insulate slopes along the right-of-way, for log corduroy, or to aid in bridge construction (see Figure 3-31). If requested, timber will also be stockpiled for community use, where practical.

Figure 3-31: Example of Laying Log Corduroy on Travel Lane

Surface Preparation

The right-of-way surface will be levelled or graded to facilitate moving vehicles and equipment. Larger diameter pipe, such as the NPS 30 gas pipeline, requires larger construction equipment. This generally increases the extent of levelling that is required. Certain design locations such as side slopes, river crossings and steep gullies, typically require grading.

Before grading, loose surface material, including tree stumps and roots, will be windrowed to the edge of the right-of-way. Windrowed material might be distributed over the right-of-way during cleanup and reclamation.

The snow, brush and vegetative material that remain on the work side of the right-of-way will be compacted with light tracked equipment and then with rubber-tired equipment. More snow and water will be added and then the travel surface will be compacted, using progressively heavier equipment. Excess snow accumulations and loose surface material will be ploughed or blown to the side of the travel lane.

In sensitive terrain, disturbance of the surface organic layer will be limited by using protective blades or equivalent on ground engaging equipment, where practical.

The travel lane might be built up by adding water and snow for sensitive terrain, where practical. Snow will form the bulk of the constructed work side and travel lanes. Additional water might be used on steeper sidehills in sensitive terrain to provide a safe travel lane and workspace areas.

Dragging and surface-grading the travel lanes will achieve a smooth driving surface. Maintenance will be done on an ongoing basis, using conventional construction equipment, water and snow. The combined work area and trencher lane on the spoil side of the right-of-way might also be built up, but it will only be maintained while it is required to support the movement of equipment in the area.

Pipe Stringing and Bending

Once the right-of-way is cleared and levelled, pipe joints up to 24 m long will be transported by truck from the pipe stockpile sites and set up on the right-of-way on temporary supports or skids.

The pipeline must accommodate both horizontal and vertical changes in the right-of-way alignment. Where changes in the natural ground contours are greater than the ability of the pipe to bend naturally, joints of pipe will be bent on site to the desired degree of curvature, using a pipe-bending machine (see Figure 3-32), or the land will be graded as necessary, or a combination of both. If a large bend is required, pre-bent segments will be delivered to the right-of-way for installation.

Figure 3-32: Example of a Pipe Bending Machine on Pipeline Right-of-Way

Welding and Inspection

After welding is complete, each weld will be inspected to detect defects. Figure 3-33 is a photograph of a pipeline welding operation in winter.

Any defect will be repaired, or cut out and replaced. The welds will then be re-inspected and externally coated for protection from corrosion.

Figure 3-33: Example of Welding Shelters on Pipeline Right-of-Way

Trenching, Lowering In and Backfilling

As the welding operation is completed, a pipeline trench will be excavated using equipment, such as chain and bucket wheel trenching machines and backhoes (see Figure 3-34 and Figure 3-35). In frozen ground and rock, the ditch line might be ripped before excavation. Explosives, if needed, will be stored and transported in an approved manner.

Materials excavated from the trench, known as spoil, will be placed temporarily beside the excavated trench (see the left-most photograph in Figure 3-36).

Bedding materials, such as sand and gravel or urethane pillows, might be placed in the trench before the pipe is lowered, if the trench bottom is rocky or otherwise unsuitable. Free water that has collected in the trench might need to be pumped out. Sideboom tractors and backhoes will be used to lower pipe into the trench.

If the spoil material is suitable, it will be used as backfill over the pipe, after the pipe has been lowered in. If the spoil material is unsuitable, imported select material will be used as backfill. Spoil material might be considered unsuitable if it contains large rocks, boulders or large clumps of ice-rich material. Select material might be placed around the pipeline so as not to damage the coating. The trench is then filled with the remaining spoil.

Figure 3-34: Example of a Chain Ditcher

At sites that have subsurface water flow or steep slopes with high water erosion hazards, mitigation alternatives that will be considered for installation before the trench is backfilled include ditch plugs, surface diversion berms, trench breakers and subdrains. Flowing surface water and water forced to the surface by ditch plugs will be diverted off the right-of-way by diversion berms. Excess trench spoil material will be bermed over the pipeline or spread over the right-of-way as part of cleanup and reclamation.

Photographs of trenching, pipe lowering and backfilling cleanup are shown from left to right in Figure 3-36.

The pipeline cover will be a minimum of 0.9 m, with some sections, such as at watercourse crossings, requiring deeper burial. The minimum depth of cover under watercourses with defined beds and banks will be 1.2 m.

Settlement of backfill materials placed in the trench after the pipeline is installed depends on, among other things, the ice content of the soil placed in the trench. Ditch settlement in areas with high ice content soils might be offset with varying amounts of ice-free imported fill.

Slope Stability

Criteria to determine where site-specific slope designs are required have been developed for the project. These criteria include predicted thaw depth and slope stability, soil loading on the pipe, and right-of-way erosion potential.

Figure 3-35: Example of a Bucketwheel Ditcher

Figure 3-36: Examples of Trenching, Lowering in Pipe and Backfilling Cleanup

Slopes requiring site-specific design will be identified as the design progresses. Designs might include:

- installing thermally insulated pipelines, together with right-of-way wide insulation, such as wood chips, foam insulation, borrow material or other suitable material
- installing heat pipes or thermosiphons to reduce the depth of thaw bulbs
- narrowing the right-of-way clearing