Volume 7A: Construction Environmental Protection and Management Plan

ENBRIDGE NORTHERN GATEWAY PROJECT

Sec. 52 Application

May 2010
Preface to Volume 7A

Northern Gateway Pipelines Limited Partnership (Northern Gateway) proposes to construct and operate:

- an oil export pipeline
- a condensate import pipeline
- a tank terminal and marine terminal near Kitimat, British Columbia (referred to as the Kitimat Terminal)

The pipelines will be built in a common right-of-way (RoW) between an initiating pump station near Bruderheim, Alberta and the Kitimat Terminal near Kitimat, British Columbia. The marine terminal will accommodate transfer of oil into, and condensate out of, tankers.

These project components and activities are referred to collectively as the Enbridge Northern Gateway Project (the Project).

This volume contains the preliminary Construction Environmental Protection and Management Plan (EPMP) for the Project. The objective of Volume 7A is to provide guidance so that the Project is constructed according to applicable regulations. The section aligns with internal policies and procedures and satisfies commitments made during project development. A detailed Construction EPMP will be developed during detailed design and filed at least 60 days before construction starts.

For risk assessment and management of spills related to the pipelines, see Volume 7B. For risk assessment and management of spills related to the Kitimat Terminal, see Volume 7C.
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1 Introduction

Volume 7A contains the preliminary Construction Environmental Protection and Management Plan (EPMP) for the Enbridge Northern Gateway Project (the Project).

Mitigation measures and monitoring recommendations outlined in this preliminary Construction EPMP will be used to limit the magnitude, geographic extent and duration of potential environmental effects as a result of the Project.

The objective of the Construction EPMP is to provide guidance so that the Project is constructed according to applicable regulations. The Construction EPMP aligns with internal Northern Gateway policies and procedures and satisfies commitments made during project development.

The Construction EPMP has many purposes, including:

- identifying federal and provincial environmental regulations applicable to project construction
- identifying the permits, approvals and authorizations required
- identifying general and specific environmental protection measures to be implemented during construction
- forming part of the contract documents to be used by the construction contractors as the primary reference for general and specific environmental protection measures required during construction
- being a compliance document that describes the environmental initiatives of Northern Gateway Pipelines Limited Partnership (Northern Gateway), and specific regulatory commitments related to the Project
- being a reference handbook for environmental inspection staff to assist in the decision-making process and providing the foundation for environmental inspection and monitoring
- being an educational tool for the orientation and training of project personnel

A detailed Construction EPMP will be developed during the detailed engineering phase of the Project. It is expected that the detailed Construction EPMP will be comprised of a number of separate documents, each specific to the construction of unique project components (i.e., pipelines, tunnels, pump stations, and the Kitimat terminal). The documents will include general and specific protection measures and will be integrated into the environmental management approach for each project component.

The final Construction EPMP documents will be filed at least 60 days prior to the start of construction.
2 Project Overview

Northern Gateway is proposing to construct and operate:

- an oil export pipeline
- a condensate import pipeline (for this application, condensate is defined as low volatility hydrocarbon equivalent to diluent)
- a tank terminal and marine terminal (referred to as the Kitimat Terminal) near Kitimat, British Columbia

The marine terminal will accommodate the transfer of oil into, and condensate out of, tankers. These components and activities are collectively referred to as the Project.

The key components for constructing and operating the pipelines are:

- separate oil and condensate pipelines, each about 1,172 km long (slack chainage)
- a 50-m construction RoW, consisting of a 25-m wide permanent RoW and a 25-m wide temporary workspace will be cleared of vegetation, where needed. Extra temporary workspace, totalling approximately 10% of the construction RoW, will be needed at specific locations for highway, road, watercourse and utility crossings, grading along sloping terrain, timber salvage and other special circumstances. The location of the additional temporary workspace will be finalized during detailed engineering.
- ten pump stations, including an oil initiation station near Bruderheim, and a condensate initiation station at the Kitimat Terminal
- the Hoult and Clore tunnels (6.6 km and 6.5 km in length) and several aerial crossings of rivers
- all-weather road access and electrical power infrastructure for the pump stations and the Kitimat Terminal
- temporary and permanent access roads, construction camps, and other support infrastructure (e.g., staging areas, laydown areas and stockpile sites) required for construction
- block valves to be situated at the pump stations, selected watercourse crossings and other locations. Locations will be determined based on environmental sensitivity, geotechnical and volume factors, and the requirements for operations and maintenance
- scraper trap facilities at either end of the pipeline system and at selected intermediate pump stations
- cathodic protection systems for pipelines and tanks

The Kitimat Terminal will be located on the west side of Kitimat Arm in the Douglas Channel, near Kitimat, British Columbia. The Kitimat Terminal will consist of:

- a land-based tank terminal, including:
  - 14 tanks, with a capacity of 496,000 barrels each, and infrastructure for the tank terminal hydrocarbon tanks (11 oil and 3 condensate)
• space for two additional tanks
• a security fence around the land portion of the terminal
• a marine terminal including:
  • two tanker berths, each for loading oil and unloading condensate
  • one utility berth
  • other associated infrastructure
  • a security fence

Other key components for construction and operations at the Kitimat Terminal are:
• an internal network of roads between facilities
• an electric yard, substation and associated facilities
• construction trailers and offices (the environmental and socio-economic assessment [ESA] assumes a construction camp will be at another location)
• storage, maintenance and control buildings
• tanks for potable water in several of the buildings
• tanks for grey water and sewage adjacent to several buildings
• an impoundment reservoir to collect surface runoff water from the tank and manifold areas of the tank terminal
• an oil–water separator to treat runoff
• a firewater reservoir
• a vapour recovery unit (VRU)
• a recovered oil tank to hold oily water from the berth operations, and pumps to move oily water to the oil–water separator
• electric booster pumps to transfer condensate from the unloading berths to the condensate tanks
• a network of transfer pipelines on elevated racks to transport condensate from the berths to the condensate tanks, as well as other transfer pipelines to transport oil from the oil tanks to the berths
• oil and condensate metering and laboratory facilities
• a network of transfer pipelines to transport oil from the export oil pipeline into the oil tanks and to transport condensate from the condensate tanks to the initiating condensate pump
• a condensate initiating pump station to pump condensate into the condensate import pipeline
• a staging area adjacent to the utility berth for temporary storage of construction materials and other equipment
2.1 Construction Schedule

Construction of the Project is expected to begin in Q2, Year 1 and is expected to be completed in Q4, Year 4. The construction schedule has been designed to include considerations of the overall environmental effect of the Project. The pipeline portion of the Project is divided into 12 construction spreads that will span two winter and two summer seasons (i.e., two years). The RoW will be cleared before pipeline construction, under winter conditions, where practical. Pipeline construction on agricultural lands will generally occur during the summer. Construction of the pump stations and powerlines will be at the same time as pipeline construction. Construction of the Hoult and Clore tunnels will require about 2.5 years, and tunnel construction will be year-round. The Kitimat Terminal will be constructed over about three years, and construction will be year-round. See Table 2-1 for the construction schedule.

Table 2-1 Construction Schedule

<table>
<thead>
<tr>
<th>Construction Component</th>
<th>Start Date (by quarter)</th>
<th>End Date (by quarter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitimat Terminal</td>
<td>Q2, Year 1</td>
<td>Q3, Year 5</td>
</tr>
<tr>
<td>Hoult and Clore Tunnels</td>
<td>Q2, Year 1</td>
<td>Q4, Year 4</td>
</tr>
<tr>
<td>Powerlines</td>
<td>Q3, Year 2</td>
<td>Q4, Year 4</td>
</tr>
<tr>
<td>Pipelines</td>
<td>Q4, Year 1</td>
<td>Q4, Year 4</td>
</tr>
<tr>
<td>Pump stations</td>
<td>Q3, Year 2</td>
<td>Q4, Year 4</td>
</tr>
<tr>
<td>In-service</td>
<td></td>
<td>Q4, Year 4</td>
</tr>
</tbody>
</table>

NOTE:
Year 1 of construction is anticipated to be 2013.
3 Environmental Aspects of the Project

3.1 Setting

The oil pipeline will start at an initiating pump station near Bruderheim, Alberta and terminate at the Kitimat Terminal near Kitimat, British Columbia. The condensate pipeline will originate at an initiating station at the Kitimat Terminal and terminate near Bruderheim, Alberta. Within Alberta, the RoW will cross four natural subregions – Central Parkland, Dry Mixedwood, Central Mixedwood and Lower Foothills. These subregions consist of industrial, agricultural and urban environments as well as naturally vegetated regions. The terrain along the RoW in Alberta ranges from mostly flat near Bruderheim (except for the North Saskatchewan River valley just west of the station) to low relief with locally incised river and watercourse valleys near the Alberta–British Columbia boundary. The RoW is expected to cross 181 watercourses in Alberta.

In British Columbia, the Project will span five biogeoclimatic zones – Boreal White and Black Spruce, Engelmann Spruce – Subalpine Fir, Sub-Boreal Spruce, Mountain Hemlock and Coastal Western Hemlock. Forestry and oil and gas activities are common land use applications in northeastern British Columbia, and the terrain ranges from generally flat plateaus and rolling foothills to rugged mountain landscapes. The RoW is expected to cross 592 watercourses in British Columbia.

Habitat within the project development area (PDA) supports a wide variety of wildlife species. For information on species of special conservation status that might be present within the PDA, see Appendix A, Section A.3.26.

3.2 Environmental Components

Northern Gateway has committed to constructing the Project in an environmentally responsible manner. This Construction EPMP outlines protection measures for the environmental components that make up the ESA of the Project. Environmental components were identified in consultation with regulators, participating Aboriginal groups, resource managers, scientists and the public.
4 Regulatory Overview

The Project is regulated federally under the *National Energy Board (NEB) Act*, as the pipeline RoW crosses provincial boundaries. Relevant provincial regulatory requirements (e.g., general land use and crossing of provincially regulated lands) also apply. All necessary licences and approvals will be obtained before or during construction. Northern Gateway and its contractors and subcontractors will comply with all conditions in project permits, approvals, licences, certificates and project-specific management plans. These conditions will also be considered part of the contract documents.

4.1 Federal Regulatory Requirements

For a summary of the primary permits and approvals that may be required before construction starts, see Table 4-1. The project management team will work closely with federal agencies to obtain the necessary permits and authorizations before initiating construction.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Act or Regulation</th>
<th>Prohibition, Permit, Authorization, Notification, Condition or Approval</th>
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<tbody>
<tr>
<td>Federal</td>
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<tr>
<td>NEB</td>
<td><em>National Energy Board Act</em></td>
<td>• Section 33: provides detailed route approval</td>
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<td></td>
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<td>• Section 47: authorizes leave to open pipelines</td>
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<td></td>
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<td>• Section 52: provides a Certificate of Public Convenience and Necessity</td>
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<td>• Section 108: authorizes leave for construction on, along, or under a utility</td>
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<td>Fisheries and Oceans Canada (DFO)</td>
<td><em>Fisheries Act</em></td>
<td>• Section 20: provides for safe passage of fish</td>
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<td>• Section 22: authorizes obstruction of fish migration</td>
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<td>• Section 26: requires that the main channel is not obstructed</td>
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<td>• Section 30: provides for water diversions or intakes to have a fish guard or screen</td>
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<td>• Section 32: authorizes destruction of fish by means other than fishing</td>
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<td></td>
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<td>• Subsection 35(1): prohibits works or undertakings that result in harmful alteration, disruption or destruction (HADD) of fish habitat</td>
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<td>• Section 35(2): issues authorizations for HADD of fish habitat</td>
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<td>• Subsection 36(3): prohibits the deposition of deleterious substances in waters frequented by fish</td>
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<tr>
<td></td>
<td></td>
<td>• Subsection 37(1), requests plans and specifications to be submitted for review, where HADD of fish habitat or a deposit of deleterious substance results, or is likely to result, from an existing or proposed work or undertaking</td>
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<td>• Subsection 38(6): allows inspector’s orders to be enforced</td>
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<tr>
<td>Agency</td>
<td>Act or Regulation</td>
<td>Prohibition, Permit, Authorization, Notification, Condition or Approval</td>
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<tr>
<td><strong>Federal (cont’d)</strong></td>
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<tr>
<td>Transport Canada</td>
<td><em>Navigable Waters Protection Act</em></td>
<td>Section 5(1): issues permits for structures on, over, under, through or across water</td>
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<td>Department of Indian and Northern Affairs</td>
<td><em>Indian Act</em></td>
<td>Section 28: provides approval to cross an Indian Reserve</td>
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<td>Environment Canada</td>
<td><em>Canadian Environmental Protection Act, Disposal at Sea Regulations; Regulations Division 3, Part 7, Respecting Applications for Permits for Disposal at Sea</em></td>
<td>Section 127: provides permit for disposal at sea</td>
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<td></td>
<td><em>Fisheries Act</em></td>
<td>Section 36(4): issues ocean disposal permit</td>
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<td></td>
<td><em>Canadian Environmental Assessment Act</em></td>
<td>Section 5: requires an environmental assessment before a project is permitted</td>
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<td></td>
<td><em>Species At Risk Act</em></td>
<td>No permits or authorizations. Section 32 and 33: state that it is an offence to kill, harm, harass, capture or take an individual of a listed species; or to damage or destroy the residence of one or more individuals of a listed species</td>
</tr>
<tr>
<td></td>
<td><em>Migratory Birds Convention Act and Regulations</em></td>
<td>No permits or authorizations. Prohibits the killing or capturing of migratory birds, as well as any damage, destruction, removal or disturbance of their active nests. The Act applies to migratory insectivorous birds and other migratory non-game birds.</td>
</tr>
<tr>
<td>Natural Resources Canada</td>
<td><em>Explosives Act</em></td>
<td>Sections 6 and 7: provides Explosives Transportation Permit and Magazine Licence (for storage during construction)</td>
</tr>
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<td>Canada Transportation Agency</td>
<td><em>Railway Relocation and Crossing Act</em></td>
<td>Provides crossing permits developed between project personnel and the railway companies</td>
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4.2 Provincial Regulatory Requirements

After project approval from the NEB, Northern Gateway will seek several authorizations under provincial legislation to undertake activities ancillary to, but not necessary for, project construction and operations (see Table 4-2 for a summary of the provincial permits, approvals and notification).

Table 4-2 Potential Ancillary Provincial Permits, Conditions, Approvals and Notification Requirements

<table>
<thead>
<tr>
<th>Agency</th>
<th>Act or Regulation</th>
<th>Permit, Authorization, Notification, Condition or Approval</th>
</tr>
</thead>
</table>
| Alberta Environment | *Water Act* | Notification under the following codes:  
• The Code of Practice for Pipeline and Telecommunication Line Crossing a Waterbody  
• The Code of Practice for Crossing a Waterbody  
• The Code of Practice for use of Water for Hydrostatic Testing  
• The Code of Practice for Hydrostatic Test Water Discharge  
*Environmental Protection and Enhancement Act (EPEA)* | Notification under The Code of Practice for Discharge or Hydrostatic Testing of Petroleum Liquid and Natural Gas Pipelines |
| Alberta Sustainable Resource Development | *Public Lands Act* | • Pipeline Agreement (PLA)  
• Authority to enter Alberta Crown land for RoW clearing and construction  
• Environmental Field Reports |
| | *Alberta Forests Act* | • Licence to Cut issued for cutting timber for RoW construction and support facilities  
• Timber salvage and woody debris disposal  
• Burning Permit issued for burning slash  
• Road Use Permit issued for use of any permitted road  
• Special Use Permit issued for other special access |
| Ministry of Culture and Community Spirit (Historical Resources Management Branch) | *Historical Resources Act* | Historical Resources Act clearance letter/schedule Section 14:  
• Heritage Inspection and Investigation Permit  
• Site alteration permits |
| Alberta Human Resources and Employment, Workplace Health and Safety | *Occupational Health and Safety Act, Explosives Safety Regulation* | • Explosive Magazine Permit  
• Temporary Blasting Permit |
Table 4-2  Potential Ancillary Provincial Permits, Conditions, Approvals and Notification Requirements (cont’d)

<table>
<thead>
<tr>
<th>Agency</th>
<th>Act or Regulation</th>
<th>Permit, Authorization, Notification, Condition or Approval</th>
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</thead>
<tbody>
<tr>
<td>Alberta (cont’d)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alberta Health and Wellness</td>
<td>Public Health Act, Work Camps Regulation Occupational Health and Safety Act</td>
<td>• Permits for drinking water, food handling, food service and sewage disposal related to construction camp operation</td>
</tr>
<tr>
<td>Alberta Agriculture and Rural Development</td>
<td>Alberta Weed Control Act</td>
<td>• Invasive alien species classified as prohibited, noxious or nuisance classes</td>
</tr>
<tr>
<td>Alberta Transportation</td>
<td>Public Highways Act</td>
<td>• Certificates for temporary and permanent access roads accessing or crossing public highways or other utilities</td>
</tr>
<tr>
<td>British Columbia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ministry of Forests and Range</td>
<td>Forest Act</td>
<td>• Cutting Permit for all forested Crown lands in British Columbia where pipeline construction will occur</td>
</tr>
</tbody>
</table>
| Ministry of Forests and Range/ Forest Stewardship Division | Forest Act | Division 8.2: Occupant Licence to Cut (OLTC):  
• Master agreements will be signed and a schedule prepared (agreements are valid for three years)  
• Authority to salvage timber and for woody debris disposal |
| Ministry of Forests and Range | Forest and Range Practices Act | Section 22(1):  
• Road use permits and road permits  
• Includes riparian management areas |
| Ministry of Forests and Range | Forest Practices Code of British Columbia Act  
Forest Fire Prevention and Suppression Regulations | Burning Permit:  
• Burning Reference Number  
• Terrain stability assessed according to provincial guidelines  
• Fire preparedness plan is required if activity is scheduled for between April 1 and October 31. Plan must be submitted to the local Forest District, Attention: Zone Protection Officer. |
| Integrated Land Management Bureau | Forest Practices Code of British Columbia Act - Provincial Non-Spatial Old Growth Order | Section 4:  
• Protects areas of old growth forests |
Table 4-2  Potential Ancillary Provincial Permits, Conditions, Approvals and Notification Requirements (cont’d)

<table>
<thead>
<tr>
<th>Agency</th>
<th>Act or Regulation</th>
<th>Permit, Authorization, Notification, Condition or Approval</th>
</tr>
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<tbody>
<tr>
<td><strong>British Columbia (cont’d)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ministry of Agriculture and Lands – Pest Management</td>
<td>Weed Control Act</td>
<td>• Lists noxious weeds and imposes a duty on all land occupiers to control noxious plants</td>
</tr>
</tbody>
</table>
| Ministry of Agriculture and Lands – Integrated Land Management Bureau | Land Act | Section 14:  
• Crown Land Investigative Permit  
• Authority to clear and construct pipelines |
| Ministry of Agriculture and Lands – Agricultural Land Commission | Agricultural Land Commission Act and Agricultural Land Reserve Use, Subdivision and Procedures Regulation | Permit for non-farm use of agricultural land |
| Ministry of Agriculture and Lands – Fisheries and Aquaculture | Fisheries Act, Fisheries Protection Act | Section 28 of Fisheries Act and Section 6 of Fisheries Protection Act:  
• DFO notification if water bodies with fish are affected. Plans must be filed and approved. In all cases that will involve federal fisheries authorizations. British Columbia MAL-FA will also be involved. |
| Ministry of Environment – Water Stewardship Division | Water Act | Sections 8 and 9:  
• Permit of approval for activities in and around a watercourse  
• If diversions are permanent, approval is needed under Section 9 of the Water Act  
Section 8:  
• Permit for short-term use (water withdrawal for hydrostatic testing) or release of water |
| Ministry of Environment – Environmental Management Branch | Environmental Management Act | Oil and Gas Waste Regulation, Section 7:  
• Waste discharge permit for testing and disposing of test water with additives |
| Ministry of Environment – Water Stewardship Division | Environmental Management Act, Waste Discharge Regulations | Subsections 14 and 15:  
• Water discharge permits  
• Pipelines for transport of oil are designated industries and need permits for the discharge of any waste into the environment. Short-term permits can be obtained for construction waste. |
Table 4-2 **Potential Ancillary Provincial Permits, Conditions, Approvals and Notification Requirements (cont’d)**

<table>
<thead>
<tr>
<th>Agency</th>
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</tr>
</thead>
<tbody>
<tr>
<td>British Columbia (cont’d)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Ministry of Environment | British Columbia *Wildlife Act* | Section 7:  
- Prohibition for altering, destroying or damaging wildlife habitat or releasing substances harmful to wildlife or habitat in land set aside for wildlife, except by permit if applicant has complied with Section 78 of the *Environmental Management Act*  
Section 19(1):  
- Permit for an exemption for anything prohibited by the Act, including possession, taking, injuring, molesting or destroying a bird or its egg or the nests of an eagle, peregrine falcon, osprey, heron or burrowing owl  
Section 40:  
- Notification if temporary closure to hunting, trapping and guide outfitting is required during construction activity  
Section 75:  
- A person who kills or wounds wildlife, other than prescribed wildlife, either by accident or for the protection of life or property, must promptly report to an officer:  
  - (a) the killing or wounding, and  
  - (b) the location of the wildlife  
- Exemption Permit (if the action is authorized by regulation)  
- If beaver dams and lodges, muskrat dens could be disturbed |
| Ministry of Small Business, Tourism and Culture (Archaeology Branch) | *Heritage Conservation Act* | Site alteration permits |
| Ministry of Transport | *Transportation Act* | Section 62:  
- Use or occupancy permit to cross or use highway RoW for the pipelines |
| | *Industrial Roads Act* | Junction Permit:  
- Approval required to cross provincial highways with access roads |
5 Environmental Management

5.1 Organization of EPMP

The Construction EPMP identifies:

- general environmental protection measures related to project construction
- specific mitigation measures related to each construction activity
- where those mitigation measures will be applied

This preliminary Construction EPMP outlines the environmental management approach and protection measures that will be considered during construction of the pipelines and associated facilities. The general measures will be applied throughout the Project. The specific measures apply to specific construction phases and project components.

Appendix A of this document includes:

- contingency plans (see Appendix A.2), which describe the response to exceptional or unexpected events
- environmental management plans (see Appendix A.3), which describe the specific environmental management procedures that apply to ongoing, planned events associated with construction

Additional tools will be developed in conjunction with the final EPMP before construction. These tools will assist Northern Gateway in implementing protection measures and tracking all environmental obligations and requirements during construction, and include:

- environmental alignment sheets
- a compliance database
- environmental issues tracking

These tools will be posted on the restricted project website (see Section 6.1), for secure access by project personnel.

Environmental alignment sheets will be used to show the environmental protection measures required along the entire pipeline route. These site-specific sheets will identify environmental requirements and their locations (see Section 8.10). Critical environmental mitigation information will be copied from the environmental alignment sheets to the construction alignment sheets as a means to ensure environmental mitigation commitments are readily and easily available for construction purposes.

A comprehensive compliance database will be developed to track and implement all environmental commitments, permits and conditions related to project approval (see Section 6.5).

An environmental issues tracking list (see Section 6.6) will be created to record issues that arise during construction, so that mitigation measures can be implemented when and where necessary, and issues can be tracked to resolution.

Typical construction drawings will be provided for normal construction activities. These will be supplemented, as necessary, by site- or task-specific drawings and instructions.
6 Communication

6.1 Website

Northern Gateway will use a restricted project website as the primary means of sharing information among the project team and contractors. Project team members will have controlled access to the website to view detailed project information, such as:

- permit status, requirements and conditions
- clearances to start work
- watercourse crossing status
- revised field procedures
- controlled document updates
- compliance inspections and audit results
- regulatory and commitment tracking

Other available information will include watercourse-crossing status by construction spread, commitments tracking by construction spread and regulatory inspections and audits. The project website will be updated as required to include information such as construction schedules, regulatory approvals and construction status.

6.1.1 Documents

A complete set of environmental alignment sheets, authorizations and documents will be kept at each project construction field office for ready access by project construction and contractor personnel.

6.1.2 Regulatory Contact

All non-compliance and environmental incidents that exceed reportable criteria will be fully disclosed to the appropriate regulatory bodies as required by those regulators.

6.1.3 Construction EPMP Document Distribution

Controlled copies of the final Construction EPMP and associated environmental documents will be available to all key construction and contractor staff during the bidding process and during construction. A master document list will be created for the final Construction EPMP that identifies the controlled copy number, ownership of the document and the version number. Revisions, if necessary, will be controlled in a similar way.

6.1.4 Timing Constraints

Environmental timing constraints will be identified by Northern Gateway. If the construction schedule cannot change to accommodate the timing constraint, the mitigation measures will be discussed and resolved by both the project team and the appropriate authority, taking into account existing provincial and federal regulations, licences and necessary approvals.
Environmental timing constraints will be shown on the construction drawings and environmental alignments sheets.

### 6.1.5 Assessment Information

Results of preconstruction surveys to identify locations of environmentally sensitive features relevant to pipeline construction (e.g., unique landscapes and soils, nests, rare plants and animals, dens, mineral licks, traditional land use sites and areas, archaeological sites) will be provided to all contractors and project inspection staff. The construction drawings and environmental alignment sheets will have specific mitigation measures related to specific environmental information.

### 6.2 Environmental Orientation Program

An environmental orientation program will be developed and implemented so that project construction personnel are aware of the environmental requirements and sensitivities associated with the Project. The following are the core elements and sequence of the orientation program:

- Environmental inspectors will be hired before the start of construction, with sufficient lead-time to accommodate their training and allow them to participate in orienting other construction staff.

- Environmental inspectors will assist in preparing orientation presentations for their areas of responsibility. The presentations will be consistent with Northern Gateway’s policies and with agreements and applicable regulations.

- Before construction, environmental management and environmental inspection staff will deliver the environmental orientation program to construction activity inspection staff and the contractor senior supervisory staff. At that time, arrangements will also be made with the contractors to allow for the field orientation of general staff.

- Contractors will deliver an environmental orientation presentation, which will include a general environmental video about the Project and a review of information specific to the construction spread. Environmental inspectors might audit these orientations for compliance with project requirements.

- The presentations will include components on cultural awareness and information specific to the local territories or communities in the area.

- Regulatory representatives may attend the contractor environmental orientation presentations if they desire.

- All construction staff who complete the environmental orientation will receive an environmental handbook, a condensed version of the Construction EPMP, and wildlife and rare plant information sheets that contain photographs of the relevant species.

- The environmental inspectors will also retain descriptions of locations of sensitive heritage or palaeontological resources and identify these locations to construction management staff.
• Nobody will be allowed to enter any project work site, RoW, area of restricted access or associated infrastructure site until they have attended the environmental orientation and can show evidence that they have completed the orientation.

• Visitors to a project work site are to be escorted by an accredited person.

6.3 Environmental Inspection during Construction

The main objective of the environmental inspection program will be to monitor compliance with environmental commitments, undertakings and conditions of authorization, applicable environmental regulations, and Northern Gateway’s policies, procedures and specifications. The following discussion is only an outline of activities that will be needed for environmental inspection of the Project. A complete discussion of this task will be issued as part of the final Construction EPMP, and will be in place before project construction starts.

6.3.1 Roles

Following is a brief description of some of the key roles that will be in place for the environmental inspection program. Detailed roles and associated responsibilities will be defined within the final Construction EPMP.

**Project Manager**

The Northern Gateway project manager is responsible for the overall integration of the environmental requirements into the project scope. If unresolved environmental or engineering process conflicts occur, environmental and engineering management will request resolution by Northern Gateway senior management.

**Engineering Manager**

The Northern Gateway engineering manager is responsible for the overall implementation of the environmental requirements during project construction. This includes communicating with the environmental inspectors, construction managers and inspection staff, so that pipeline construction is completed with full consideration for the environmental requirements. The engineering manager will work jointly with the environmental manager to resolve environmental issues when brought forward from environmental inspectors.

**Environmental Manager**

The Northern Gateway environmental manager is responsible for consistent application of the Construction EPMP and consistent information flow to the environmental inspectors to meet commitments and federal and provincial regulatory requirements. The environmental manager will work with the engineering manager to resolve environmental issues.
Construction Manager

Construction managers are responsible for:

• coordinating the implementation of environmental requirements for all activities specific to their work areas during project construction (i.e., components related to construction of pipelines, facilities and marine terminal)

• fostering discussion between the environmental inspectors and activity inspection staff

• providing direction to the contractors

• reporting to Northern Gateway engineering management

Environmental Inspector

Environmental inspectors are responsible for:

• confirming that day-to-day construction activities are being implemented within the scope of environmental requirements

• confirming that all environmental commitments, undertakings and conditions of authorization are met, and that work is completed in compliance with applicable environmental regulations and Northern Gateway policies, procedures and specifications in the most efficient and effective way possible

• identifying if permit variances and or new mitigation strategies are required based on changes to construction plans in the field, and assist in the development of those mitigation strategies

• providing advice on major decisions, such as wet-weather shutdowns, or courses of action to deal with major unexpected environmental conditions. If the construction manager is not available, the environmental inspector has the authorization to shut down work on the right-of-way or select activities in the field, where events, if not corrected, would likely result in environmental injury or non-compliance.

• reporting any incidents, according to federal and provincial regulations, and advising Northern Gateway management about cleanup and disposal of the material and any affected soils or vegetation

• preparing and delivering environmental orientation presentations to Northern Gateway, regulatory and contractor staff, as directed by the Northern Gateway construction manager and the Northern Gateway environmental manager

• preparing daily and weekly reports

• preparing, collecting, organizing and disseminating all environmental information and documentation that arises during construction

• liaising with appropriate government agencies in cooperation with the Northern Gateway construction manager
• supervising on-site environmental resource specialist staff required to support the Project. Environmental resource specialists have specific expertise in field-related issues (e.g., soils, historical resources, fish, amphibians, rare plants, reclamation and wildlife).

• preparing environmental as-built documents using information collected from all relevant sources during project construction

• reporting any releases or environmental incidents in accordance with federal and provincial regulations

• tracking all environmental incidences and non-compliances

• organizing on-site meetings as requested by the Northern Gateway construction manager, and as the need arises, to address site-specific issues

• participating in discussions with landowners and occupants as requested by the land representative and the Northern Gateway construction manager

• reviewing construction methods with the Northern Gateway construction manager

Marine Mammal Monitor

A marine mammal monitor will be an appropriately trained individual who will serve as a dedicated lookout for marine mammals while working on a vessel or during construction activities that have the potential to cause an acoustic disturbance to marine mammals.

6.3.2 Daily and Weekly Reports

The environmental inspectors will submit daily reports to document the status and timely results of environmental activities. Daily reports provide an indication of progress to date and an opportunity to review and evaluate field decisions. The reports will be archived and accessible for future reference. The daily reporting system will consist of the following:

• Daily reports will be computer generated and transferred to the Project Management Team (designated recipients will be formally identified in the final Construction EPMP).

• Hard copies will be created for field use where specific actions are necessary.

• The construction manager will sign the report to acknowledge receipt. Relevant environmental inspection report findings will be cited in the construction daily reports, so that inspection results are communicated broadly to the construction teams. The reports will be numbered to allow reference notations to be made on the environmental alignment sheets. This will enable the reports to be accessed during reclamation and operations.

• An environmental inspector can create more than one report in a day.

• The reports will be written with the understanding that they could be reviewed by internal and external parties.
• Numbered and GPS-referenced digital photographs will be attached to the daily reports as necessary, and will reference the location on the route and the alignment sheet number.

• A specific notation box on the report will track the completion status of necessary work.

The environmental inspectors will submit weekly reports summarizing project status and environmental issues that occur during each week. Environmental issues will be followed up and resolved, and any required action plans will be developed through discussion between the environmental inspector and project manager, or with environmental regulatory agencies as required.

### 6.4 Environmental Audits during Construction

Independent third-party audits will be completed to confirm that all components of the final Construction EPMP are being considered and implemented during project construction. The audits will assess the effectiveness of the implementation of the Construction EPMP and examine conformance to environmental protection plans and commitments. Northern Gateway will consider one audit for each construction spread with a follow-up visit where deficiencies are noted.

#### 6.4.1 Key Audit Items

The third-party auditor, in consultation with Northern Gateway management, will develop an environmental protocol that includes, at a minimum, an assessment of:

- the use and availability of environmental documents, including the Construction EPMP
- training and orientation
- environmental reporting structure
- environmental records and filing of environmental records
- communication and regulatory contact system
- environmental emergency response
- environmental protection systems
- environmental inspections
- tracking and resolution of environmental issues during construction

### 6.5 Environmental Commitment and Permit Tracking

Commitments made in the application, during hearings, and in other documentation filed with regulatory agencies will be tracked in a compliance database during the lifecycle of the Project. The database will capture:

- commitments made during the consultation, application and regulatory review phases
- permit conditions that are part of the federal and provincial permitting applications and approvals issued for the Project
- non-compliance issues and regulatory follow-up actions and resolutions
6.6 Environmental Issues Tracking

Issues noted in daily and weekly environmental inspection reports will be entered into a database and tracked to completion. Other environmental issues that are raised during construction meetings, interactions with local regulators, or other sources, will also be entered and tracked. Findings from internal or external audits will also be tracked.

6.7 Environmental Emergency Response

An environmental emergency response plan will be in place so that emergency environmental situations are responded to quickly and efficiently. Environmental emergency response teams (EERTs) will be established to respond to emergencies that could affect the environment related to the Project. The EERTs will be located along the construction spreads. Their responsibilities will include maintaining and implementing additional mitigation measures to protect the environment during an emergency, and responding to adverse conditions and situations that require increased levels of care.

6.7.1 Emergency Mitigation Measures

The following mitigation measures will be implemented, as appropriate, for emergency protection of the environment during construction:

- Contractors will assemble EERTs to respond quickly to unforeseen situations or emergencies, as directed by Northern Gateway. A list of the EERT members’ contact information will be provided to Northern Gateway before work begins.
- Contractors will periodically submit to Northern Gateway a detailed list of all EERT members and the location of all equipment and materials designated for use by the EERTs. The list will be revised as required.
- The EERTs will be available 24 hours a day, seven days a week to respond immediately to environmental situations. Emergency response obligations will supersede other construction duties.

Northern Gateway and project management staff will confirm that contractors implement and maintain all emergency mitigation measures.

6.7.2 Materials and Equipment

Contractors will identify the locations of all emergency response materials. These materials will be stored separately from other construction materials. Key materials (such as absorbent materials and protective clothing) will be stored in mobile trailers.
7 Construction EPMP Consultation and Notification

7.1 Stakeholder Input

Northern Gateway initiated an extensive series of consultation and notification programs that included meetings with Aboriginal groups and stakeholders potentially affected by the Project. The purpose of the consultation program was to offer participating Aboriginal groups and stakeholders an opportunity to provide input on the scoping of issues for the Project. Information provided as part of the consultation program included details on project components, key contacts, schedules for field activities and timelines for filing the application.

7.2 Identified Stakeholders and Interested Groups

Stakeholders or interested groups that Northern Gateway has contacted about the Project include:

- Aboriginal groups within 80 km of the RoW or with Traditional Territory that is crossed by the RoW or could be affected by project activities
- Landowners and occupants, including Crown disposition holders, such as grazing lessees, forestry companies and others along the RoW and near associated facilities
- Land and resource users, including trappers, miners, guides and outfitters, eco-tourism operators, local land and resource industries, forest companies, range users and federal and provincial parks personnel
- Environmental non-governmental organizations (ENGOs)
- Municipalities near the pipeline route that are potentially affected by the Project, as well as non-government and community-based organizations, such as regional and local business associations, service clubs and social interest groups in the affected municipalities
- Regional and headquarter staff members of provincial agencies
- Federal and provincial government departments and agencies
- Stakeholders that identified themselves through the Northern Gateway website, toll free number or other means

7.3 Incorporation of Input into the Construction EPMP

Input from stakeholders and participating Aboriginal groups received during consultation has been assessed and incorporated where appropriate into this preliminary Construction EPMP.

Input from stakeholders and participating Aboriginal groups will continue to be collected during consultations held throughout the application process. Results of consultation will be incorporated into the final Construction EPMP and revised, as appropriate.
7.4 Notification of Construction to Regulatory Agencies, Landowners, Aboriginal Groups and Stakeholders

**General Contact**

Landowners, stakeholders, the Crown, participating Aboriginal groups and trappers will be notified of the intended construction schedule before the start of project construction.

Landowners and disposition holders will be contacted by a land representative or other authorized personnel before the start of construction on individual project components.

At least one month before the start of clearing, trappers whose fur management areas will be intersected by the RoW will be notified of the construction schedule by a land representative. In those areas where a trapline intersects or is near the RoW, the trappers will be requested to flag traps clearly or remove traps, for safety reasons.

All records of stakeholder communication will be maintained to track and manage issues.

**Regulatory Contact**

Before the start of each construction spread, construction, engineering, environmental and field inspection teams will meet with appropriate regulatory personnel to review and provide details for the necessary procedures.

Appropriate federal and provincial regulatory agencies, and interested municipal officials, will be informed of project developments through regular liaisons with key personnel, such as the environmental manager and the environmental inspector.

**Disclosure**

All non-compliance and environmental incidents will be fully disclosed to the appropriate regulatory authorities.
8 General Protection Measures

This section outlines general protection measures that apply to constructing all components of the Project, including:

- developing the RoW
- constructing the various ancillary facilities (such as pump stations, stockpile sites and access roads)
- completing the tank and marine terminal components at the Kitimat Terminal

Stakeholder input will continue to be collected during ongoing open houses, workshops and meetings. Stakeholder input will be considered and incorporated, as appropriate, into the final Construction EPMP, before the documents are finalized.

8.1 Helicopter Access

Northern Gateway will consider provincial wildlife guidelines in identified sensitive areas, for project use of helicopters. Northern Gateway will identify landing areas for field crews that require helicopter support.

8.2 Firearms

Construction personnel will be prohibited from carrying firearms or archery equipment while working on the Project or while using or occupying any project vehicles, except as expressly approved in writing in accordance with Northern Gateway Construction Safety Manual (CSM) variance procedure.¹

8.3 Recreational Activities and Vehicle Use

The use of all-terrain vehicles (ATVs) and snowmobiles by construction and operations personnel will be restricted to approved project-dedicated tasks.

Public Vehicle Access

Unauthorized public vehicle access during construction will be discouraged through the use of signs, gates and other appropriate measures.

Aboriginal groups and stakeholders, where practical, will be given the opportunity to review site-specific plans to address public access concerns before construction begins.

Gold Panning

Recreational gold panning by project personnel on the RoW will be prohibited within the PDA.

¹ CSM variance procedure defines protocols that must be met, as a minimum, including requirements for a written hazard assessment, recognized valid certification, a competency evaluation and secure storage.


Hunting and Fishing

Project personnel and contractors will be prohibited from hunting and fishing along the RoW, at the marine terminal, and at other construction sites during project construction. Crews staying in construction camps will also not be allowed to hunt or fish. Harvesting invertebrates will also be prohibited at the marine terminal site and ancillary facilities.

Discipline

Personnel who do not comply with the provisions of the Construction EPMP, company policies and standards, or who in general disregard the environment or local communities, will be disciplined. Disciplinary action could result in dismissal from the Project.

8.4 Right-of-Way Planning

Planning for the RoW will conform to the Grade Plan that will be developed for the Project (see Appendix A, Section A.3.1).

8.5 General Construction

Although the following plan focuses on hydrocarbon spills, in case of fuel, hydraulic fluid, or other chemical release, the same Spill Contingency Plan would be followed.

Construction Assessments

Interdisciplinary teams will conduct field assessments required during construction. The environmental inspector responsible for the construction spread will be responsible for the presence on site of personnel to protect environmental or cultural features.

Pre-job Meetings

Each construction discipline will hold pre-job meetings before work starts on each pipeline construction spread, and on the Kitimat Terminal and each infrastructure site, to address:

- construction issues
- general environmental issues
- contingency plans
- rules and regulations applicable to the construction area

These meetings will be open to regulatory agencies.

Debris Handling

Contractors will collect all construction debris (e.g., welding rods, oil cans, ropes, bands, timbers and caps) and other waste materials, and dispose of them in compliance with the Waste and Hazardous Materials Management Plan (see Appendix A, Section A.3.33).
Temporary Workspace

During construction, all activities will be confined to the RoW, temporary workspace, extra temporary workspace, the Kitimat Terminal, infrastructure sites, staging areas and approved access roads. Unauthorized use of land and trespassing will be discussed with contractors at the pre-job meetings.

Dust Suppression

Protection measures may be required to limit the amount of dust generated during construction by activities such as site excavation, grading, borrow extraction and vehicle movement on unpaved access roads. Specific dust control measures could include:

- enforcing speed limits on all access roads
- applying dust suppressants, including water or other approved agents, as needed. If water is applied, the construction manager will determine the amount and timing, to reduce the potential for surface runoff of sediment.

The Traffic Control Plan (see Appendix A, Section A.3.3) and the Atmospheric Environment Protection and Management Plan (see Appendix A, Section A.3.21) have further information.

Fences

Where existing fences are breached, temporary measures will be taken in consultation with the landowner or appropriate stakeholder. Gates will remain closed unless vehicle access is required.

Equipment Servicing

Servicing and fuelling of mobile construction equipment will done at least 30 m from water bodies, where practical. Spent oils, lubricants and filters will be collected and disposed of at an approved location. All fuel and service vehicles will carry at least 10 kg of suitable absorbent and incident response materials. Vehicles carrying more than 200 L of fuel or hazardous material will be equipped with kits that include, at least, a shovel and 25 kg of absorbent material. Kits will be subject to random inspections.

Planned service or repair of equipment with the potential for material releases (e.g., oil changes) will be completed within containment areas.

Equipment Condition

All equipment will arrive in a clean, well-maintained condition with the appropriate noise abatement fixtures in place (see the Noise Management Plan in Appendix A, Section A.3.22). The environmental inspection staff will have the authority to reject equipment that arrives at the site if the equipment’s condition is considered unacceptable.

Generators

Generators will be placed within bermed secondary containment areas, or will be housed within a structure that will contain any hydrocarbons. The equipment will be muffled to noise levels that meet provincial requirements.
Fuel and Hazardous Material Storage

Hazardous materials, chemicals, fuels or lubricating oils will not be stored within 100 m of watercourse banks or near any surface drainage location.

Contractors will dispose of fuels, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides and any other chemicals according to project protocols and, if needed, the Spill Contingency Plan (see Appendix A, Section A.2.1) will be implemented.

Long-term storage (i.e., for more than 30 days) of fuel or other hazardous materials will be in double-walled tanks. Short-term or portable fuel tanks, used to dispense fuel or other hazardous materials on site, will be situated within a dyked area that is lined with polyethylene of sufficient size to contain 110% of the tank volume. No fuel storage areas will be allowed within 100 m of a watercourse. All fuel storage sites will be visually monitored daily for storm water contamination. Storm water accumulations will be removed using a hydrovac pump and disposed of appropriately, according to the Storm Water Management Plan (see Appendix A, Section A.3.4).

Capacities for construction camp water supply pumps within 100 m of a waterbody will not exceed the 24-hour demand cycle. Day tanks must be dyked to contain 110% of the total tank volumes and have liners, or the tanks must be double walled. Fuel supply lines to the day tank will have a valve and be clearly marked to prevent damage from vehicle travel. Day tanks will be monitored daily for leaks.

8.5.1 Environmental Flagging

Before any physical disturbance related to construction, all resources and resource user facilities, as identified on the construction drawings and environmental alignment sheets or site drawings, will be flagged or fenced, such as:

- heritage resources (i.e., historic Aboriginal structures, features, culturally modified trees, burial sites)
- rare plant sites
- noxious weeds
- traditional use areas
- wildlife sites
- nests
- fish habitat
- trails used by hunting guide outfitters and trappers

Signage will be used to supplement flagging, where appropriate.

Flagging will be placed both upstream and downstream of fish habitat locations as clearing crews may work from either direction.

The environmental inspector will confirm the accuracy of all flagged areas, and after construction is complete, will replace flagging as required by site conditions. After reclamation is complete, all flagging will be removed from the PDA and disposed of at an approved landfill facility.
8.5.2 Clearing

A pre-clearing approval process will be implemented to confirm that all required permits and authorizations are in place and that all required actions have been completed (e.g., timber salvage and rare plant surveys before clearing starts. Current information on approvals will be posted on the restricted project website.

Before construction, timber will be salvaged and brush and non-merchantable timber will be cleared. Timber salvage will be managed according to the Timber Salvage Plan (see Appendix A, Section A.3.25). Handling and managing all wood will be controlled to protect against the spread of disease and insects.

Clearing in watercourse buffer areas will be done according to strategies outlined in the Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan (see Appendix A, Section A.3.15). Watercourse buffer zones next to trenched installation watercourse crossings will not be cleared of understorey vegetation until construction of the crossing begins.

Logged sites will not be grubbed or otherwise rendered erosion-prone until grading and construction starts in that area. Work on steep slopes will be limited or managed, to control surface runoff and the potential for watercourse sedimentation.

Where unavoidable soil effects occur (e.g., timber skidways and access to construction), erosion control structures will be installed, according to the Erosion and Sediment Control Plan (see Appendix A, Section A.3.5). These sites will be monitored monthly until the grubbing phase of construction starts and permanent controls, if necessary, are installed.

The PDA will be monitored after weather events that could cause erosion and sedimentation (e.g., intense rainstorms or rapid snowmelt events).

Manual Felling

Steep slopes and riparian management areas at watercourse crossings will be cleared by hand, where appropriate, as indicated on the environmental alignment sheets. The Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan has further information (see Appendix A, Section A.3.15).

Where timber felling is done by hand, stump height will be limited.

Mechanical Felling

Trees will normally be felled mechanically into the RoW, in a way that limits stump height.

Leaning Trees and Slash

Leaning or danger trees will be cut or removed and properly decked away from standing timber.

Damaged Trees and Fire Safety Hazard Reduction

Trees adjacent to the work site that have been damaged during clearing and construction will be felled and properly stockpiled. Damaged trees are defined as having a noticeable fracture of the bole, loss of 50% of the bark around its circumference, or undercut roots.
Non-Merchantable Timber
Machinery with rotary slashers and shear blades, or mulchers, will clear non-merchantable timber to ground level, where and when practical, to preserve the root mat.

Mountain Pine Beetle Infestation
For suspected wood infected with mountain pine beetle, the transport of wood from British Columbia to Alberta will follow protocols described in Government of Alberta, Sustainable Resource Development, Directive 20101-01.

Grubbing
Grubbing will only occur in forested areas where soil removal is required. Mechanical harvesting of trees, resulting in stumps as low as 10 cm, will greatly reduce the need to grub and grade the RoW. Specific directions for grubbing include:

- marking grubbing limits on site using fencing or flagging, before the start of construction, so that soils in adjoining areas are not disturbed
- grubbing will not commence before any subsequent activity without the installation of appropriate surface drainage control. Surface drainage control will be put in place as soon as practical.
- suspending grubbing when intense rainstorms or spring snowmelt could result in sedimentation
- taking the grubbing and snow material from the spoil side of the RoW, where a roach of snow and grubbing material is required to create a frost barrier over the ditch lines. Organic material on the work side will normally be piled on the work side edge when the work side RoW access is created. This prevents isolation and unequal distribution of the grubbing material because of the backfill roach. Special situations might require the frost roach to be placed on one side.
- preventing mineral soil and grubbing material from being windrowed into standing timber

Rollback
Timber or slash for use as rollback for access control will be salvaged and stockpiled in areas designated on the construction drawings and environmental alignment sheets the Access Management Plan has further information (see Appendix A, Section A.3.2).

Approvals to use merchantable timber for rollback and line-of-sight berms will be obtained.

Crop Removal
Whenever possible within the construction schedule, landowners will have the opportunity to salvage their own crops from the RoW. Landowners will be compensated for any crop damage that might occur.
Woody Debris Disposal

Woody debris (e.g., tree limbs and tops and other organic material that remains on the ground after logging) will be bulldozed into piles, as free of dirt and snow as possible. Additional organic material, such as stumps or grubbing material from the RoW, might be added with the intent of establishing clean piles for burning, chipping, grinding or rollback.

All fire control provisions specified in the burning permit, including requirements for items such as personnel and equipment, pile size, shape, distance from adjacent timber and mineral soil exposure, will be accommodated.

The Fire Response Contingency Plan (see Appendix A, Section A.2.2) will address considerations for burning activities.

After the spring, the burned pile locations will be scanned, using infrared technology, for hold-over fires.

Rollback Storage

Rollback includes wavered timber, stumps and logging slash. Timber might be used to construct temporary bridges, or might be pushed back onto the RoW after construction, for access control. Stumps can also be used as rollback to prevent access.Logging slash or mulch can be used to insulate frost for access extension, or to prevent erosion on cuts and fills in riparian areas.

8.5.3 Grading

Right-of-Way Planning

Grading will follow the right-of-way planning for the Project (see Appendix A, Section A.3.1).

Grade Spoil Placement

Grading will not occur until appropriate levels of topsoil have been salvaged and stored.

Grade material will be stored as close to the point of removal as possible, and will not overlap on topsoil storage piles.

In summer, grade material will not be stored on non-stripped areas unless a well developed sod or vegetative mat exists, to assist with clean removal and placement.

In winter, grade material can be stored on non-stripped areas, if the grade material is scheduled to be replaced during the same winter. Stockpile sites will be marked with survey lathe where the grade material and the topsoil are similar in colour, or where the potential exists for the stockpile to be covered in snow.

Topsoil Placement

Topsoil will be placed on the high side of grade cuts where practical, to prevent overlap of the grade spoil.
**Replacement**

Grading will be conducted to enable stable contours and drainage patterns to be re-established, during cleanup, unless otherwise indicated by the environmental inspector in consultation with the appropriate regulatory authorities.

Where the original contour cannot or should not be restored, an alternative contour will be established that is not susceptible to erosion and mass movement. The displaced grade material will be spread along the RoW or transported to approved disposal locations.

**Geotechnical Stability**

Because of slope instability, full grade replacement, or replacement with native material, might not be possible. Displaced material from these areas will be spread elsewhere along the RoW, or transported to approved disposal locations.

Areas identified with geotechnical issues will be documented on the construction drawings and environmental alignment sheets.

**Rip-Rap Corduroy**

Corduroy road with grade material caps will be placed as indicated on the construction drawings and environmental alignment sheets.

- Rip-rap corduroy will be installed using approved design and materials.
- Geotextile material will be used if required.
- Rip-rap will be left in place if approved by the Forestry Officer.
- Provisions will be made for cross drainage as appropriate.

**Watercourse Grading**

Grubbing will be delayed on slopes adjacent to a watercourse, or within 10 m of the watercourse banks, until construction of a crossing is imminent.

Root grubbing will be restricted near watercourses. Grubbing will be limited within 10 m of a watercourse to the extent practical, except along the trench line. Where practical, an undisturbed organic mat will be left on the work side, to limit the potential for introducing sediment into the watercourse.

The following measures will be implemented, where appropriate, to limit the risk of siltation:

- Grading will be completed away from watercourses to reduce the risk of material entering a watercourse.
- Fill material will not be placed in a watercourse during grading.

The Vehicle and Equipment Watercourse Crossing Plan (see Appendix A, Section A.3.14) and the Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan (see Appendix A, Section A.3.15) have further information.
8.5.4 Topsoil and Root Zone Salvage

**General Salvage Measures**

Topsoil will generally be salvaged as indicated on the construction drawings and environmental alignment sheets. Deviation from procedures and recommended salvage depth might be required in specific locations, because of natural soil variability that cannot be captured at the level of detail in the alignment sheets. Such deviation will be approved by the environmental inspector in consultation with a qualified soil scientist.

Where a new procedure, which has not been submitted in the approval process, is required, Northern Gateway will apply for a variance of procedure to the appropriate regulatory agencies. The Soils Protection and Management Plan has further information (see Appendix A, Section A.3.7).

**Wet Conditions**

If extensive precipitation causes very moist to wet soils, which could compromise the accuracy of topsoil salvage operations, the salvage operations might be suspended. Salvage operations will not be restarted until conditions improve and approval has been provided by the environmental inspector. The Weather Event Siltation Contingency Plan has further information (see Appendix A, Section A.2.4).

**Agricultural Areas**

Full-width stripping will be applied over the length of the agricultural land along the RoW. Special circumstances might require the limited application of ditch width or blade width stripping. In such situations, heavy equipment traffic on the work side of the RoW will be carefully controlled to avoid soil compaction and rutting. Treed areas with agricultural potential will be given the same consideration. The Soils Protection and Management Plan has further information (Appendix A, Section A.3.7).

**Graded Areas**

In areas where grading is required, the topsoil, or the surface organic and mineral layer, will be stripped and salvaged for the full width of the graded area.

**Extra Width**

Where the trench will be extra wide, the width of topsoil stripping will generally be increased. This is expected at side bends, watercourse crossings, third-party pipelines, and road and rail crossings.

**Muskeg Areas and Organic Soils**

Muskeg, wet areas and organic soils will be conserved when noted on the construction drawings and environmental alignment sheets, or as directed by provincial regulatory authorities, or if the material is required for reclamation efforts for project infrastructure.
Crown-Owned Treed Land

Crown-owned treed land not specified for agricultural development will be grubbed with specified inclusion depths of mineral soil, to meet the reclamation and regulatory requirements of the particular jurisdiction.

Access Road Approaches

Subsoil will be used to construct bar ditch ramps. The environmental inspector might approve the use of surface organic material for ramps in specific circumstances. All ramps will be removed during cleanup to discourage vehicle travel along the RoW.

Watercourses

Grubbing and topsoil stripping will be suspended within the riparian management area or the buffer zone at watercourses, except along the travel side, if necessary for installing a vehicle crossing. The organic mat will be left undisturbed within the remainder of the riparian management area or buffer zone to reduce the potential for introducing sediment into the watercourse. The remaining topsoil will be stripped when the watercourse is graded for construction.

Waterbodies

Reduced stripping widths and special soil handling procedures will be considered for waterbodies (i.e., sloughs, wetlands and shallow lakes) where specific resource potential has been identified, such as:

- rare plants
- rare plant habitat
- rare ecological communities and wildlife (waterfowl) habitat

Windrow Gaps

In the topsoil windrow, gaps will be left that coincide with ditch soft plugs, spoil gaps and pipe gaps, at locations strategic to:

- farming operations (e.g., access to livestock water supply and movement of farm equipment)
- Aboriginal groups
- wildlife movement
- drainage patterns

The section on right-of-way planning has further information (see Appendix A, Section A.3.1).

Compaction

Topsoil with low levels of organic matter, or with fine textures and susceptible to compaction, will be stripped over the appropriate area, or will not be stripped and will be treated with water or tackifiers to stabilize the soil particles.
Three-Lift Stripping

Where the potential exists for the B horizon to be degraded by rock, textural or chemical characteristics within the underlying C horizon, soils will follow a three-lift soil handling procedure, where required on agricultural land. These areas will be indicated on the construction drawings and environmental alignment sheets with reference to the appropriate summer or winter procedure and confirmed on site because stripping is often not required as anticipated.

Foreign Line Exposure

Unless hydrovac systems are used, contractors will salvage topsoil before excavating, to expose foreign lines. Hydrovac cuttings and slurry will be disposed of onto subsoil in stripped areas or into specially constructed sumps. Hydrovac contractors will provide copies of their operations and emergency response plans for approval before starting operations.

Associated Infrastructure

Topsoil will be stripped over the entire construction area. Where the permanent use area is smaller than the construction area, the topsoil from the permanent use area will be stockpiled separately for long-term storage.

Topsoil storage locations will have erosion controls and will be located far enough away from project operations to avoid potential contamination.

Staging Areas and Pipe Yards

Traffic lanes in staging areas and stockpile sites that require all-weather summer access will be stripped, where required.

Soils Specialist

A soils specialist will be available to the Project on an on-call basis to provide advice, assist with resolving special situations, or assist in identifying soils that require special handling.

8.5.5 Winter Measures on Agricultural Lands

Topsoil Salvage

Winter topsoil will be stripped to at least the trench width plus the space required to contain the backfill roach. Wider stripping widths might be applied depending on equipment and soil characteristics. In areas requiring grading, topsoil will be stripped the full width of the grade area. Specialized equipment, described in the following topic, will be used when required to achieve the desired accuracy.
Specialized Equipment

Winter topsoil stripping requires specialized equipment to strip the frozen topsoil accurately to the required depth and width. Specialized equipment includes:

- modified backhoes
- carbide cutting edges for bulldozers and graders
- multishank rippers
- modified wheel trenchers
- access road reclaimers (drum rippers)
- winter step blades

Snow Roaching

Where required to prevent frost penetration into the ditch line, snow might be ploughed into and over the stripped area. Snow containing substantial amounts of topsoil will not be used for snow roaching.

Blading Spoil Area

Winter ditch line stripping assumes that the spoil will be placed on a hard, smooth, frozen surface to help clean backfill and reduce topsoil loss. If the spoil area is rough or is characterized with loose surface topsoil, it will be bladed to the edge of the spoil side before the trench is excavated.

Spoil Area Snow

Snow in the spoil area will be left in place, provided the spoil area is smooth and the snow is not required for preventing frost. If a snow layer is left intact before trenching begins, a clean backfill may be obtained.

8.5.6 Watercourse Crossing Protection and Mitigation Measures

The following environmental protection measures apply to all watercourse crossings. Watercourses are defined as continuous channels with defined beds and banks that convey water and that are identified, either on 1:20,000-scale provincial maps or in the field, as having continuous defined channels with a mineral soil bed.

Many watercourses have intermittent or seasonal flow. Drainage channels that convey water intermittently, or that do not have a defined bed and banks, are not considered watercourses according to the above definition.

The objectives of the protection and mitigation measures for watercourse crossings are to:

- maintain terrain integrity, including natural hydrological regimes and slope stability
- limit adverse environmental effects
- comply with the habitat protection provisions of the Fisheries Act
- comply with the principle of no net loss of productive fish habitat outlined in DFO’s Policy for the Management of Fish Habitat
• comply with all provincial regulatory requirements including the applicable Alberta and British Columbia procedures for RoW and vehicle crossings
• comply with all regulatory, permit and approval conditions
• employ environmentally and economically responsible construction practices at all times, using applicable industry standards
• protect riparian areas near watercourse crossings
• maintain the ecosystem function of riparian areas

Permitting
Applicable permits or authorizations will be obtained before crossing activities start. The Pipeline Watercourse Crossing Plan has a list of permits (see Appendix A, Section A.3.16).

Fording
No watercourses will be forded unless otherwise approved through discussions between the responsible regulatory agency and Northern Gateway. Where approval has been granted, measures will be implemented where appropriate to limit environmental effects of fording watercourses, including:
• timing
• limits of frequency
• the type and location of fording sites
• the type and condition of equipment
• inspecting equipment for leaks and condition before fording

Physical Warning Devices
To alert construction contractors of watercourse crossings and associated riparian habitat, flagging and signs will be used both up and down stream.

Scheduling
Instream watercourse crossing activities will be conducted during the allowable work windows (or outside the restricted activity periods) that have been identified for the particular crossing, unless a variance is specifically approved by federal and provincial fisheries authorities.

No unpermitted construction activities will be allowed within a restricted activity period, unless the watercourse is dry or frozen to the bottom during construction, or trenchless techniques are being used.

Riparian Buffers
Clearing in riparian areas will be limited to removing trees and shrubs on the work side and ditch line area, where practical.

Grubbing will occur just before grading and will be limited to the width required to create a safe travel surface and allow the vehicle crossing structure to be installed.
The Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan (see Appendix A, Section A.3.15) has more information on riparian buffer zones.

**Equipment Leaks**

Equipment being operated within 100 m of watercourse crossings will be checked at least once a day for leaks. Equipment being operated instream will be cleaned and checked before it enters the watercourse and will be continually monitored visually for leaks. All leaks will be repaired and cleaned up immediately. Incidents will be recorded and reported as required by provincial guidelines.

**Navigation**

Signage will be posted for watercourses that can be navigated by boat (in summer) or snowmobile (in winter) to indicate the navigational hazard for the required distances up and downstream of the crossing.

**Extra Temporary Workspace**

A buffer of undisturbed understorey vegetation will be left in place at least 10 m from the edge of the high-water mark to the edge of the extra temporary workspace, unless specified otherwise by the environmental inspector. The decision criteria for watercourse crossing buffer widths will be used to determine the buffer width. The Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan has further information (see Appendix A, Section A.3.15).

**Vehicle and Equipment Crossings**

The vehicle crossing methodology will reflect the sensitivity of the watercourse and will complement the pipe installation technique. The selection criteria for the applicable methodologies are in the Vehicle and Equipment Watercourse Crossing Plan (see Appendix A, Section A.3.14) and the Pipeline Watercourse Crossing Plan (see Appendix A, Section A.3.16).

**Pipe Activities**

The pipe drag section will be completed before trenching is completed, according to the construction schedule. On smaller crossings, the pipe drag section will be completed before excavation begins.

**Crossing Technique**

Open-cut, isolated and trenchless methods will be considered for watercourse crossings along the pipeline route. The management plans that contain environmental considerations and mitigation measures related to watercourse crossings are:

- Pipeline Watercourse Crossing Plan (see Appendix A, Section A.3.16)
- Horizontal Drilling Plan (see Appendix A, Section A.3.17)
- Aerial Pipeline Crossing Plan (see Appendix A, Section A.3.18)
- Water Quality and Substrate Composition Monitoring Plan (see Appendix A, Section A.3.19)
Excavation

The excavation of each crossing will be planned so that appropriate excavation equipment and backup equipment will be on site, or available without delay, and can meet the needs of site sensitivity, speed, depth, width and length.

Non-isolated, open-cut crossings will be completed as quickly as possible, to limit the amount of sediment movement because of trenching.

Open-cut excavations will be managed to control the silt plume, to allow the fish a respite from ditching operations.

Instream structures, such as large woody debris and boulders that provide cover for fish, will be removed from the expected area of disturbance before construction begins, and replaced at appropriate locations after construction is complete.

Spoil Handling

Trench spoil stored on land will be contained to prevent runoff water with silt from entering the clean watercourse channel.

Topsoil will be salvaged before the trench spoil is stored on land.

At large open-cut crossings, material placed instream will allow for the passage of fish and boats through the thalweg after construction. Appropriate notices and signage will be posted before construction, indicating upcoming activity.

Where the surface bed material is considered superior habitat, it will be stockpiled separately from the underlying material for special replacement.

Backfill

At isolated crossings, backfill will be completed to limit siltation of the watercourse. The source of suitable backfill material will be determined before crossing activities begin. Aggregate material required at the watercourse crossing will be available during backfilling operations.

Grade Replacement

In winter, replacing material on the banks and approach slopes might be deferred until after spring breakup when the work surface has thawed. This is to prevent the mass movement of soil into the watercourse crossing during spring break up.

Fish Salvage

Fish will be salvaged from any areas of a watercourse crossing that are dewatered for isolation purposes.
Pumping

Leak-free hoses will be used to pump silt-laden ditch water to locations that will prevent the water from directly entering the watercourse. Mitigation strategies for pumping include distance, vegetation, bale corrals, filter systems, and using settlement sumps, each of which will be considered according to the sensitivity of the site.

Generators will be located and contained in ways that limit the risk of leaking fluid into nearby water bodies.

Intake Screening

Water intakes will be screened according to the Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995).

Intake structures will be constructed according to the following criteria:

- Screen material will be either stainless steel, galvanized steel, aluminum, brass, bronze or other approved material.
- Screen mesh size (the space between strands) will not exceed 2.54 mm.
- A screen area of 1 m² will be provided for each 0.03 m³/s of water entering the intake.
- Screens will be adequately supported with stiffeners or backup material to prevent excessive sagging.
- Screens will be protected from damage with a trash rack or similar device.
- Screens will be readily accessible for cleaning and inspection.

Emergency Erosion Control Equipment

In anticipation of extreme weather, contractors will be directed to have a mobile trailer equipped with adequate siltation control equipment including silt fence, pumps, hose and other tools necessary for installation. If extreme weather events occur, the necessary heavy equipment will be used to control siltation of sensitive watercourses. Where access might be in conflict with environmental damage shutdown (see Appendix A, Section A.2.3), extra equipment and supplies might be stockpiled at watercourses. The Weather Event Siltation Contingency Plan has further information (see Appendix A, Section A.2.4).

Watercourse Diversions

Watercourse diversions might be required to divert high-flow, braided or meandering watercourse channels temporarily or permanently, to assist construction access or pipeline installation. The following measures will be employed, as appropriate, for watercourse diversions:

- The permitting and approval process must be completed before diversions are constructed.
- The diversion channel will be located and constructed to limit, as much as possible, any bank erosion and the length of natural channel that will be affected or abandoned.
• Temporary diversion channels may be constructed with appropriate dimensions and gradients to transport expected flows, to limit the environmental effects of the diversion on the downstream watercourse.

• Energy dissipation and erosion measures must be installed before temporary diversions are installed and before water is diverted into a new channel.

• Permanent diversion channels may be constructed on identified watercourses, to incorporate natural channel characteristics such as meander patterns, pools and riffles.

• Diversion channels may be constructed before removing bank plugs.

• Fish will be salvaged from any temporarily or permanently abandoned reach of channel.

• Contractors will notify Northern Gateway 72 hours before starting construction of watercourse diversions, to confirm that resource specialists will be on site for salvaging fish, as required.

• Temporary diversion channels might be lined with a polyethylene liner (or other appropriate material), as approved by Northern Gateway.

• Permanent diversion channels will be lined with suitable substrate material such as channel liner, clean granular material or clean rock, to maintain the integrity of fish habitat.

Reclamation

Watercourse crossings will be reclaimed to maintain or enhance stability and restore fish habitat values. Reclamation for each watercourse crossing will be planned individually according to the reclamation protocol. Reclamation will follow the measures outlined in the Watercourse Reclamation Plan (see Appendix A, Section A.3.20).

Fencing

Fencing will be erected at watercourse crossing locations, to:

• prevent livestock accessing the watercourse crossing location

• protect the watercourse, where the values of the watercourse are threatened by the presence of the livestock

Water Quality

At sensitive watercourse crossings, water quality will be monitored for silt load as required. Further information is provided in the Water Quality and Substrate Composition Monitoring Plan (see Appendix A, Section A.3.19), the Hydrology Protection and Management Plan (see Appendix A, Section A.3.27), and the Hydrogeology Protection and Management Plan (see Appendix A, Section A.3.28).
8.5.7 Construction Cleanup

The following general cleanup measures will be implemented:

- The environmental inspector will determine the locations where soil compaction is an issue and will approve mitigation measures. In areas of compaction where the topsoil is not in place, the subsoil will be ripped to a sufficient depth to relieve compaction. In areas where the topsoil is in place, a special subsoiler will be used to limit admixing.

- In agricultural and treed land, the stripped subsoil surface will be smoothed to prevent admixing when the topsoil is replaced and cultivated.

- On agricultural land, rocks and roots will be picked on the RoW to approximate the conditions of the adjacent land. On land that is to be incorporated into crop land, the woody material will be removed to meet the landowners’ reasonable objectives. The rock collected by the picking operation will be disposed of at locations as directed by the environmental inspector, if considered necessary by Northern Gateway. The first pass of rock picking will occur on subsoil during machine cleanup.

- All slopes will be restored to preconstruction profile except where geotechnical recommendations or regulatory approval indicates that full replacement is not prudent or practical. Northern Gateway will consult with appropriate regulators to establish the terms of grade replacement.

- Northern Gateway’s environmental and craft inspection staff will make sure contractors are informed of the replacement requirements during the RoW planning process.

- Final cleanup activities will be scheduled and timed according to local climate and environmental conditions.

- If any winter construction sections cannot be cleaned up the following summer because of access limitations, final cleanup will be completed during the subsequent winter.

- Topsoil will be replaced to a uniform thickness that corresponds to the thickness of the surrounding topsoil horizon, or to a depth acceptable for vegetation rooting. In cultivated areas, topsoil will be replaced on the RoW to a uniform thickness over the height of the ditch line crown.

- On arable land, the areas on which topsoil has been replaced will be further prepared to restore the soil tilth. Cultivation depth will not exceed the topsoil depth.

- If frost or frozen conditions are persistent during cleanup on agricultural lands, the cleanup activity will be suspended until the soil and ditch have completely thawed.

- The level of cleanup, or surface roughness objectives, will be discussed with regulatory representatives in each jurisdiction and adjusted to meet the local land management objectives.

- On Crown treed land, residual slash, organic materials, duff and mineral soil mixture might be bladed over the spoil and work areas.

- Surface drainage across the RoW will be restored.
• Slash material salvaged for use as rollback for erosion control will be spread on steep slopes as directed by the environmental inspector, in consultation with the geotechnical engineer. Rollback will not be placed in areas where it would be detrimental to slope stability. Rollback for erosion control will be flattened by a bulldozer or other heavy tracked equipment to make sure it is in contact with the ground.

• All fences and gates will be replaced and will match the fencing of the connecting fenceline (e.g., number of strands). New posts and bracing will be installed to project standards and will meet or exceed the standard of the connecting fence.

• All temporary access will be removed as outlined in the Access Management Plan (see Appendix A, Section A.3.2).

• Erosion control structures will be positioned in consultation with the environmental manager, environmental inspector and a geotechnical engineer. Placement of appropriate erosion control devices will be according to the season and site location. The Erosion and Sediment Control Plan has further information (see Appendix A, Section A.3.5).

8.5.8 Reclamation

Reclamation refers to standard measures taken during construction to limit adverse environmental effects and return affected lands to a stable condition and equivalent land capability. Reclamation includes activities such as:

• contouring surfaces
• installing drainage and erosion control structures
• replacing topsoil
• revegetating
• managing disturbed sites

Agricultural lands will be returned to their former use. Hay land and improved pasture will be revegetated according to land owner or lessee specifications.

Objectives

Reclamation objectives are established to promote stability of the ground surface and to control erosion. The broad objectives of the reclamation are to:

• promote soil stability
• encourage the re-establishment of natural plant communities
• re-establish drainage patterns, watercourses and wetland communities

Project Revegetation Program

The goals of revegetation during reclamation are to:

• establish species that provide erosion control, but do not persist indefinitely or invade undisturbed areas
The revegetation program includes the following main elements:

- Exposed mineral soils will be seeded with reclamation grasses to promote re-establishment of a vegetated surface, except in areas where natural recovery is the selected revegetation method. A mixture of five to six grasses will be applied at any location. Because moisture conditions can vary along the RoW and, on a smaller scale, across the RoW, the mixture will include grasses adapted to dry, moist and wet soil conditions. See Appendix A, Table A-13 for a list of suitable revegetation species.

- Revegetation species that are nonpersistent, i.e., last one to two years, grow rapidly, and include annual cover crops such as fall rye, will be used for stabilization and erosion control on erosion-prone areas, such as steep slopes.

- Revegetation seeding will use commercially available varieties of species native to the PDA, depending on their availability. If there are seed shortages, non-native species or natural recovery options will be considered.

- A more intensive seed treatment will be provided in areas where erosion is likely (e.g., slopes on rights-of-way and access roads, graded RoWs and borrow sites). Such treatment includes a mixture of native grasses, a short-lived cover crop and fertilizer.

- In areas where the risk of erosion is low, the backfilled ditch will be seeded with a short-lived cover crop and fertilized, except where the ditch backfill is entirely organic. Rights-of-way and temporary facility sites (e.g., construction camps, pipe laydown areas), where the surface organic mat remains substantially intact, should revegetate naturally without seed treatment. Trees may also be planted to assist reforestation of infrastructure sites.

**Natural Recovery**

Natural recovery is a term used to describe disturbed sites (in native plant communities) left to revegetate naturally from the soil seedbank and propagules that come onto the site from adjacent undisturbed areas. Planting a heavy grass cover can impede recovery of disturbed plant cover. For initial erosion control, planting annual crops rather than perennial grasses may enhance the establishment of native species from seed within the soil seedbank, with further assistance from natural encroachment by plant species.

Natural recovery is considered appropriate for the Project if:

- the goal of revegetation is to establish a native plant community
- the risk of soil erosion is low, or the site is protected by light seeding of an annual crop or by erosion-control products
- the organic layers have viable propagules
adequate plant propagules are available adjacent to the site, and the shape and size of the site allows those propagules to disperse easily onto the disturbed site

- the amount of non-native species in the surrounding vegetation is minor or can be controlled
- revegetation is not hindered by other site factors, such as drought or soil chemistry
- the site is not subjected to heavy grazing or intensive recreational use

The RoW will be divided into reclamation units, based on physiographic region, surficial materials and plant communities. Site-specific reclamation prescriptions will be developed for the RoW and temporary facilities after construction plans are finalized, and will be indicated on the construction drawings and environmental alignment sheets. For a summary of factors that will influence the revegetation treatment and a list of possible revegetation treatments, see Table 8-1.

### Table 8-1 Revegetation Decision Process

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<th>Influencing Factor</th>
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<tr>
<td>Physiographic region</td>
<td>• Apply revegetation species suitable for the regional climate and surficial materials</td>
</tr>
<tr>
<td>Erosion risk:</td>
<td>• Natural recovery&lt;br&gt;• Seed mix, cover crop and fertilizer</td>
</tr>
<tr>
<td>• low</td>
<td></td>
</tr>
<tr>
<td>• moderate to high</td>
<td></td>
</tr>
<tr>
<td>Surface material:</td>
<td>• Natural recovery&lt;br&gt;• Seed treatment depending on erosion risk&lt;br&gt;• Natural recovery</td>
</tr>
<tr>
<td>• organic</td>
<td></td>
</tr>
<tr>
<td>• mineral</td>
<td></td>
</tr>
<tr>
<td>• rock or coarse gravel</td>
<td></td>
</tr>
<tr>
<td>Weeds:</td>
<td>• Natural recovery&lt;br&gt;• Annual cover crop or seed mix</td>
</tr>
<tr>
<td>• problematic</td>
<td></td>
</tr>
<tr>
<td>• not present or problematic</td>
<td></td>
</tr>
<tr>
<td>Protected area</td>
<td>• Natural recovery&lt;br&gt;• Enhanced reclamation</td>
</tr>
</tbody>
</table>

### General Measures

Reclamation methods, techniques and structures will be approved or specified by Northern Gateway and the regulators. Where local Aboriginal traditional knowledge is relevant to reclamation, it will be considered and, where practical, incorporated into reclamation plans.

The following reclamation measures will be applied to the Project (the Vegetation Protection and Management Plan has additional information [see Appendix A, Section A.3.24]):

- Drainage patterns will be re-established similar to original conditions.
- Watercourses and wetland communities and their approaches will be re-established.
• Reclamation at watercourses will occur as soon as practical after backfilling. Permanent site-specific erosion and sediment control measures will be implemented according to the environmental alignment sheets and any specific drawings that may be established for specific areas, unless otherwise approved by Northern Gateway to adjust for site conditions and suitability.

• Erosion and sediment control structures will be repaired and, if practical, the structures will be removed when reclaimed sites are stable.

• Sediment fences or other temporary measures will be removed after vegetation is established, as specified by Northern Gateway.

• Where travel along the RoW is required after reclamation, low-ground-pressure vehicles, including ATVs, or foot travel will be used to the extent practical.

• Berms might be used instead of sediment fences, if ATV traffic is expected.

• Windfall will not be removed unless it presents a safety or operational risk, or if specified by Northern Gateway.

• Seed and fertilizer will be applied in selected areas.

• Shrubs and trees will be planted in specific locations to enhance terrain stability, aesthetic, and wildlife and fisheries habitat qualities, as outlined in the Freshwater Aquatic Resource and Habitat Protection and Management Plan (see Appendix A, Section A.3.29).

• The spread of invasive weed species should be controlled by implementing the Weed and Clubroot Management Plans (see Section A.3.34).

• Soils at risk of wind or water erosion will be stabilized using appropriate combinations of tackifiers, mulches, roll-out matting, straw crimping and other structures considered necessary to promote soil conservation and assist in revegetation.

• Reclamation will be timed to coincide with final cleanup, allowing for seasonal change. Interim seeding will be considered where the time between machine and final cleanup is extended because of summer access difficulties.

**Watercourse Reclamation**

Watercourse reclamation is critical for mitigating against long-term environmental effects on water quality, fish and fish habitat. Watercourse reclamation protects bed and bank stability, pipeline integrity and restores or enhances fish habitat. Stabilization and reclamation of the RoW will effectively limit erosion and sedimentation to watercourses.

The Watercourse Reclamation Plan has information about the specialized needs of reclamation in and around watercourses (see Appendix A, Section A.3.20).
8.5.9 Enhanced Reclamation and Post-Construction Monitoring

The Enhanced Reclamation Plan will address specific activities that are typically beyond what is routinely included in a pipeline reclamation plan and are designed to enhance ecological integrity of affected lands within the PDA. Enhanced reclamation sites and reclamation measures will be identified and documented in the separate Enhanced Reclamation Plan that will be developed for the Project.

The Enhanced Reclamation Plan will:

- be developed in consultation with the appropriate regulatory agencies, participating Aboriginal groups and stakeholders
- incorporate local Aboriginal traditional knowledge where practical
- potentially include details about:
  - controlling weeds
  - reseeding with native seed mixes
  - enhancing wildlife habitat
  - planting low-growing plants (for wildlife screening or other specific uses)
  - using specialized instream and bank stabilization reclamation techniques
  - managing sensitive soils

Post-construction monitoring will also be implemented to determine the effectiveness of the enhanced reclamation and other protective measures, including regular reporting to the NEB and other regulatory agencies, as appropriate. The monitoring results will be used to adjust the protection measures outlined in this document, as appropriate.

8.6 Environmental Resource Protection Measures

Government agencies have developed guidelines and best management practices for several environmental resources. Where possible, these will be integrated into the development of site-specific protection measures.

8.6.1 Wildlife Protection Measures

Although efforts will be made to avoid, limit or mitigate potential effects on wildlife and wildlife habitat wherever they occur, certain locations in the PDA are known to be particularly sensitive. These areas will be a focus for the wildlife protection measures in the Wildlife Protection and Management Plan (see Appendix A, Section A.3.26).

Guidelines and best management practices are in place for many wildlife species that might be affected by project activities, including the Trumpeter Swan, Sharp-tailed Grouse, various raptors, migratory birds, mountain goats, ungulates including woodland caribou, grizzly bear, furbearers, bats, and amphibians (including coastal tailed frog). These management practices will be integrated into site-specific plans. Where disturbance is unavoidable, project staff will consult with the appropriate regulator (British Columbia Ministry of Environment [BC MoE], Alberta Sustainable Resource Development [ASRD],...
Canadian Wildlife Service (CWS)) and, as appropriate, interested and affected Aboriginal groups to identify possible options and management strategies to be implemented.

Northern Gateway will monitor the effectiveness of mitigation measures and make adjustments as required to allow adaptive management.

8.6.1.1 General Wildlife Mitigation Measures

The following general wildlife protection measures will be implemented:

- Clearing for pipeline construction in sensitive wildlife habitat (including areas with nesting migratory birds, bears, woodland caribou, moose, mountain goats and amphibians) will be scheduled to avoid identified sensitive seasons and life-stages whenever possible.

- Special wildlife conservation measures will be implemented in the most sensitive wildlife areas. Northern Gateway will work with wildlife management agencies in British Columbia and Alberta and others to identify sensitive sites and develop special habitat protection measures, including:
  - reducing or relocating the temporary workspace
  - siting project infrastructure (e.g., stockpile sites, construction camps) outside sensitive wildlife areas
  - using terrain or RoW alignment to reduce line of sight, as well as feathering the margins of the RoW
  - limiting the area of the RoW cleared during construction
  - limiting the area of RoW maintained during operations
  - using wildlife monitors

The following protection measures will also be implemented:

- Protocols will be in place for managing potential wildlife–human interactions, including food and waste storage measures to deter bears and other wildlife from construction camps and other work areas.

- Northern Gateway will develop and implement a worker education program to make project personnel aware of wildlife issues, required best operating practices, worker responsibilities and reporting requirements.

- Project personnel will be prohibited from feeding, harassing or destroying wildlife on or near the RoW or project infrastructure.

- Project personnel and contractors will be prohibited from hunting and fishing along the RoW, at the marine terminal and at other construction sites during project construction. Crews staying in construction camps will also not be allowed to hunt or fish.

- Northern Gateway will establish speed limits for all project vehicles on project roads and the RoW. Vehicles will reduce speed in the presence of wildlife.
• Wildlife incidents and potential interference with wildlife or key wildlife features will be reported to the project environmental inspector. Examples include sightings of rare or endangered species, any expected interference with previously unidentified wildlife features (e.g., nests, dens, beaver dams or licks), wildlife vehicle collisions; nuisance wildlife, and wildlife found (alive or dead) in association with project activities. The observations will be recorded in daily reports and marked on the environmental alignment sheets. As appropriate, the environmental inspector will notify the provincial or federal wildlife authorities, affected trapline holders, and/or the local police detachment.

• Pre-disturbance surveys will identify important wildlife habitat features.

• During construction, sites that were noted, flagged or fenced during preconstruction surveys to protect sensitive wildlife habitat will be left undisturbed, where possible.

• Wetlands will be protected by using existing watercourse crossings where possible, limiting removal and disturbance of soil near wetlands and watercourses leading to wetlands, grading away from wetlands to avoid sedimentation and maintaining natural drainage patterns when storing excavated material.

• Aircraft will follow required flight guidelines (e.g., flight corridors, minimum altitudes and minimum distances from sensitive areas) to reduce disturbance to wildlife.

• Disturbance to sensitive wildlife will be reduced through access management. Northern Gateway will:
  • develop an Access Management Plan in collaboration with wildlife agencies, participating Aboriginal groups, and stakeholders, monitoring the effectiveness of the plan, and making adjustments as necessary
  • where possible, use existing roads, RoWs and watercourse crossings, and locate infrastructure near existing roads
  • prohibit project personnel from the recreational use of temporary access roads and the RoW
  • deactivate and rehabilitate temporary access roads
  • implement seasonal road closures
  • avoid unauthorized use of the ROW through the use of physical barriers, such as large berms, rolled back slash, rock piles, guarded or locked gates, and appropriate signage at key entrance points and other sites
  • Where possible, habitat connections in key areas will be maintained by placing coarse woody debris, appropriate vegetation, or both, within the RoW. This will provide linkages between forested areas, where it does not pose a wildfire hazard, and will assist the regrowth of vegetation on the RoW, where possible.
• Temporary workspaces will be revegetated with native species that reflect the surrounding vegetation, except where regulatory agencies indicate that natural succession is preferable. Growth and encroachment of native vegetation will not be controlled, unless necessary for operations or maintenance, or to control noxious weeds.

• The length of the open trench will be limited, and hazards will be fenced, if they have been identified, to facilitate the movement of wildlife. The project will maintain trench breakers and gaps in windrows and raised pipes at intervals that have been developed in consultation with regulators and identified on the alignment sheets.

### 8.6.1.2 Taxa-Specific Mitigation Measures

The following taxa-specific protection measures will be implemented, where appropriate:

**Birds:**

• Clearing of natural vegetation will occur outside of the breeding season of migratory birds.

• Setbacks will be implemented for Trumpeter Swan lakes avoiding long-term development (roads, pipelines, infrastructure) within 500 m of the high-water mark on identified lakes or waterbodies (i.e., those with Trumpeter Swan nests and young) and avoiding activity within 800 m of the high-water mark of identified lakes or waterbodies, as well as aerial reconnaissance, between April 1 and September 30. Setbacks will be implemented around nests of sensitive bird species, by avoiding clearing and disturbance within:
  - 200 m of active Bald Eagle nests and year-round disturbance within two tree-lengths of nests
  - 100 m of active Osprey nests and year-round disturbance within one tree-length of nests
  - 100 m of Northern Goshawk nests between February 15 and August 15
  - 400 m of identified Short-eared Owl nests
  - within 100 m of identified Sprague’s Pipit nests
  - 1,000 m of known Sharp-tailed Grouse lek sites

**Mammals:**

• Clearing areas that have a high potential for fisher natal denning will be avoided during the natal denning period (March through April).

• Northern Gateway will develop and implement protocols for avoiding and managing bear–human conflicts, including measures to detect and deter bears from project infrastructure, bear awareness and safety training, and a bear response plan, and consider the availability and use of bear detection and deterrent systems to reduce bear–human conflicts.

• Project activities will avoid sensory disturbance to key grizzly bear denning habitat between March 1 to May 31 and in spring feeding areas between April 15 and June 15.

• To reduce mortality, Northern Gateway will discourage bears from using the RoW near transportation corridors by planting non-palatable natural vegetation. In areas farther from transportation corridors, revegetation of low-growing berry-producing shrubs will be promoted.
• To conserve moose, Northern Gateway will maintain or enhance willow and dogwood browse in riparian areas and along decommissioned roads (except in identified caribou herd areas or near major roads) and avoid development in key moose winter habitat and during critical periods in winter (October to April).

• Mountain goat setbacks will be implemented.

Northern Gateway will limit effects on the woodland caribou by:

• situating the pipeline route in valley bottoms (which avoids preferred high-elevation old growth habitat uses in late winter)

• avoiding the use of seed mixtures that will attract ungulates (particularly in woodland caribou herd areas and near roads) during reclamation

• avoiding disturbance of identified key woodland caribou habitat during critical restricted activity periods

Northern Gateway will explore opportunities, in consultation with other stakeholders where needed, to reduce the density of linear features (such as roads and RoWs) in caribou herd ranges and grizzly bear population units that are affected by project activities.

Northern Gateway will implement sensory disturbance buffers around bat hibernacula as follows:

• 125-m wide from October 1 to April 31

• 100-m wide year-round

• 125-m wide around maternity roosts from May 1 to August 31

Construction activities will be restricted within 200 m of active wolf dens and rendezvous sites between March 15 and June 15.

Northern Gateway will limit effects on amphibians by:

• implementing a 100 m setback in the Alberta Parkland Natural Region for ponds used by Canadian toads for living, breeding or hibernating

• implementing coastal tailed frog conservation measures at trenched watercourse crossings, by:
  • establishing a 30 m setback from suitable water courses for the frog
  • acquiring required permits and conduct salvage and relocate egg masses, tadpoles, juveniles and adults found in the RoW

• salvaging and replacing boulders and rocks

• maintaining water flow characteristics and pool:riffle ratio

• preventing stream banks from eroding

• salvaging and replacing saplings, shrubs and herbaceous cover within 5 m of the stream bank
• evaluating opportunities to enhance habitat
• using culverts to avoid creating artificial breeding ponds near active access roads, to reduce road mortality of dispersing juveniles

Northern Gateway will limit effects on reptiles by:
• implementing year-round sensory disturbance buffers for herptile hibernacula that are at least 30-m wide in British Columbia and 100-m wide in Alberta. The Wildlife Protection and Management Plan (see Appendix A, Section A.3.26) contains descriptions of the measures for protection of species of concern. As further baseline information on species at risk in the PDA is obtained, and new guidelines for managing effects on wildlife and species at risk are developed, these will be incorporated into project mitigation and monitoring strategies, where possible.

8.6.2 Fisheries Protection Measures
The following plans contain fisheries protection measures:
• The Freshwater Aquatic Resource and Habitat Protection and Management Plan (see Appendix A, Section A.3.29), which has general fisheries resource protection measures.
• The Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan (see Appendix A, Section A.3.15), which describes measures for fish habitat and watercourse crossings.
• The Pipeline Watercourse Crossing Plan (see Appendix A, Section A.3.16), which has measures for the protection of fish and fisheries resources.
• The Access Management Plan (see Appendix A, Section A.3.2), which outlines measures to limit increased access and fish harvesting.

Additional fisheries protection measures include:
• prohibiting project personnel and contractors from hunting and fishing (see Section 8.6.1)
• incorporating local Aboriginal traditional knowledge, where practical
• developing site-specific protection measures and environmental alignment sheets during detailed design and permitting

8.6.3 Vegetation Protection Measures
Information about vegetation protection measures is contained in the Vegetation Protection and Management Plan (see Appendix A, Section A.3.24).

Assessment Identifications
All vegetation features requiring mitigation measures will be marked on the construction drawings and environmental alignment sheets. Local Aboriginal traditional knowledge will be considered when assessing which vegetation features require mitigation measures. Additional information for protecting vegetation resources will be included on the construction drawings and environmental alignment sheets.
Timbered Land

Where practical, changes to the RoW, marine terminal, access roads, powerline easements and infrastructure sites will be selected to use existing disturbances, such as seismic lines, existing pipeline RoWs, existing powerline easements, existing roads and natural clearings, to limit the amount of new disturbance and potential access clearing for the Project.

Rare Plants

In the spring and summer before construction, but after the pipeline centrelines are marked, a site-specific rare plant survey will be done in areas of high potential for rare plants. If previously unidentified rare plants or plant communities are found at the construction sites or on the RoW during the survey, appropriate mitigation measures will be implemented.

Before the start of clearing and construction, all identified rare plants or communities will be flagged or fenced to limit any disturbance. Mitigation measures for these sites will be communicated to contractor personnel before construction, to confirm that the procedures involved are fully understood.

Rare plant mitigation measures will be site-specific and might include installing exclusion fencing, using snow bridges, transplanting, collecting seed, and rearing or holding plants off-site. In some situations, the contractors might be made responsible for watering and caring for salvaged rare plants.

Wetlands

A minimum 30-m setback distance from wetlands will be implemented where possible. When wetlands are crossed, the following mitigation measures will be considered, where practical:

- The use of extra temporary workspace will be limited.
- Grubbing will be limited to the ditch line.
- Wetlands will be accessed during frozen ground conditions.
- A log corduroy will be built, or other measures implemented, for heavy machinery alongside the wetlands.
- Peat and mineral soils will be salvaged separately in shallow peat wetlands, and replaced in the same order.
- Wetlands affected by the Project will be allowed to recover naturally.

8.6.4 Weed Control

Information about weed control is contained in the Weed and Clubroot Management Plans (see Appendix A, Section A.3.34) and the Vegetation Protection and Management Plan (see Appendix A, Section A.3.24).
Assessment Identifications
All weed locations that were assessed before construction as requiring mitigation measures, will be marked on the construction drawings and environmental alignment sheets. Additional information for proper management of weeds will be included on the construction drawings and environmental alignment sheets.

Discovery of Weeds during Construction
In the spring and summer before construction (after the pipeline centre lines are marked on the RoW), a site-specific weed survey will be done in areas of high potential for weeds. If previously unidentified weeds are found during that survey, appropriate mitigation measures will be implemented.

Construction Mitigation Measures
Weed mitigation measures that may be implemented include:
- contractor education and awareness
- enhanced equipment cleaning
- equipment movement restrictions and traffic controls
- specific soil handling requirements
- cutting
- spraying via a licensed applicator

Post-Construction
Weeds will be identified after construction through monitoring and operations activities. Mitigation measures may include cutting, cultivating or spraying, as appropriate. The Weed and Clubroot Management Plans have further information (see Appendix A, Section A.3.34).

8.7 Heritage and Palaeontological Resources Protection
Information about heritage and palaeontological resource protection is contained in the Archaeology Discovery Contingency Plan (see Appendix A, Section A.2.5.1), the Palaeontology Discovery Contingency Plan (see Appendix A, Section A.2.5.2), and the Heritage Resources Protection and Management Plan (see Appendix A, Section A.3.31).

Assessment Identification
All heritage and palaeontological sites requiring mitigation measures will be marked on the construction drawings and environmental alignment sheets. Additional information for protection of heritage and palaeontological resources will also be included on the construction drawings and environmental alignment sheets.
Discovery of Historical and Paleontological Resources during Construction

If previously unidentified heritage or palaeontological resources are found during construction, activity in the area will be halted until the:

- environmental inspector and cultural and palaeontological specialists have been notified
- appropriate provincial cultural and historical resources division has been informed
- site vegetation is cleared

Specialists will contact the Archaeology Branch of the British Columbia Ministry of Tourism, Culture and the Arts, the Historic Resources Management Branch of Alberta Culture and Community Spirit, and local Aboriginal groups.

Any Aboriginal traditional land use sites or areas that are identified during project-related studies, and that have approval to be disclosed, will be shown on the construction drawings and environmental alignment sheets. Aboriginal monitors from the community who identified the site or area may be assigned to confirm acceptable implementation of any site-specific mitigation measures recommended by the community, as in the Non-traditional Land Use Protection and Management Plan (see Appendix A, Section A.3.32).

8.8 Contingency Plans

Northern Gateway has developed environmental contingency plans for environmental protection (see Appendix A, Section A.2), which include:

- Spill Contingency Plan
- Fire Response Contingency Plan
- Environmental Damage Shutdown or Work Modification Contingency Plan
- Weather Event Siltation Contingency Plan
- Heritage Resources Discovery Plan
- Wildlife Encounter Contingency Plan
- Horizontal Directional Drilling (HDD) Contingency Plan

8.9 Specific Protection and Management Plans

Environmental protection and management plans specific to project activities (i.e., procedures and practices) will be applied to control the environmental effects of the Project. These plans will be refined during detailed engineering and planning for the Project, and will be reviewed by inspection personnel participating in different construction activities. Aboriginal groups that have expressed an interest in participating might also review the plans.

These plans (see Appendix A, Section A.3) include:

- Right-of-Way Planning Plan
- Access Management Plan
- Traffic Control Plan
- Storm Water Management Plan
- Erosion and Sediment Control Plan
• Shelterbelt Protection Plan
• Soils Protection and Management Plan
• Backfill Management Plan
• Blasting Management Plan
• Acid Rock Management Plan
• Waste Rock Management Plan
• Concrete Works Management Plan
• Tunnel Installation Plan
• Vehicle and Equipment Watercourse Crossing Plan
• Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan
• Pipeline Watercourse Crossing Plan
• Horizontal Directional Drilling Plan
• Aerial Pipeline Crossing Plan
• Water Quality and Substrate Composition Monitoring Plan
• Watercourse Reclamation Plan
• Atmospheric Environment Protection and Management Plan
• Noise Management Plan
• Geology and Terrain Protection and Management Plan
• Vegetation Protection and Management Plan
• Timber Salvage Plan
• Wildlife Protection and Management Plan
• Hydrology Protection and Management Plan
• Hydrogeology Protection and Management Plan
• Freshwater Aquatic Resource and Habitat Protection and Management Plan
• Marine Aquatic Resource and Habitat Protection and Management Plan
• Heritage Resources Protection and Management Plan
• Non-Traditional Land Use Protection and Management Plan
• Waste and Hazardous Materials Management Plan
• Weed and Clubroot Management Plans

8.10 Environmental Alignment Sheets and Typical Drawings

The environmental alignment sheets are site-specific construction drawings that will show most environmental requirements. Each requirement and its location will be identified. Typical construction drawings will be provided for normal construction activities, but will be supplemented, if necessary, by site- or task-specific drawings and instructions.
9 Protection Measures for Pipeline Construction

This section introduces protection measures that are specific to pipeline construction. These measures would be implemented in addition to the general protection measures (see Section 8).

9.1 Trenching

During trenching, the following measures will apply, where appropriate:

- Gaps in the trench spoil pile will coincide with gaps in topsoil, grade and the pipe. Soft or hard plugs will be left in the trench where the ditch is left open for extended periods.
- Trench spoil will be placed to maintain a separation of 1 m between topsoil and subsoil piles. Overlap of the trench spoil and topsoil will not be allowed.
- As trenching proceeds, locations where trench wall instability affects non-stripped topsoil areas will be identified. If non-stripped topsoil areas are sloughing into the trench, ditching operations will be suspended until the topsoil is stripped wide enough to prevent loss.
- In areas requiring blasting, the ditch line should be ripped before blasting starts.
- The correct blasting restrictions will be in place for length, charge size, time delay and shielding to suit the location, and will be indicated in the final engineering specifications. The Blasting Management Plan (see Appendix A, Section A.3.9) has further information.
- During excavation of hard and soft plugs, access to the spoil side for tracked excavators will be controlled to maintain separation of the topsoil and subsoil windrows.
- To prevent the flow of water along the trench, hard or soft plugs will be left at strategic locations, where the open trench could dewater a wetland community, or flood other areas.

9.1.1 Trench Water Management

9.1.1.1 General Measures

The following measures will be used where, appropriate, to manage trench water:

- The amount of open trench will be limited at any one time, to the extent practical.
- Soft plugs will be installed or hard plugs will be maintained to limit the amount of continuous open trench, as specified by Northern Gateway.
- Grading practices or other water controls will be used to divert surface water away from the open trench.
- If water levels or flow rates within the trench could overwhelm existing trench water control measures allowing sediment-laden water to affect sensitive wetlands or watercourses, the trench will be dewatered or backfilled or a hard plug will be maintained.
• Breaks will be left in spoil piles so that trench water accumulated behind trench plugs is directed off the disturbed area into well-vegetated areas or to a swale or chute to reduce the potential for sediment-laden water to enter a watercourse or wetland community.

• After installation of the pipelines, trench breakers, cross berms and drains will be installed at watercourses, wetlands and along steep slopes, as specified by Northern Gateway.

• Where trench dewatering is needed to remove inflowing groundwater, shallow groundwater use within 500 m of the area will be reviewed to determine the potential effects on nearby wells or dugouts.

9.1.1.2 Trench Dewatering

If the ditch requires dewatering before the pipe is lowered in, water will be pumped into appropriate sediment filtering devices in a way that does not cause erosion or allow any unfiltered water to re-enter a watercourse or wetland community.

The following measures will be implemented where appropriate so that dewatering does not cause environmental effects:

• The pump intake will be elevated from the bottom of the trench to avoid pumping deposited sediment.

• Trench dewatering in areas identified as having potential acid-generating (PAG) rock drainage will require Northern Gateway’s approval, as indicated in the Acid Rock Management Plan (see Appendix A, Section A.3.10).

• All areas that are to receive discharged water will be approved by construction inspection with the assistance of the environmental inspector.

• A containment area for trash pumps will be built using appropriate berms or liners to prevent contamination of the soil.

• Discharge outlets for all pumping operations will be equipped with flow dissipaters where the outflow has the potential to cause erosion.

• The discharge area will be monitored so that conditions do not become too silted for adequate natural filtration to occur.

9.1.2 Stringing, Welding and Lowering-in

The following measures will apply, where appropriate, to stringing, welding and lowering-in the pipelines:

• Turn-around points for stringing trucks will be located during the RoW planning process in natural clearings, where possible, and will be approved by the environmental inspector.

• Contractors will provide appropriate gaps in soil windrows, strung pipe, set-up welded pipe and open ditches, to accommodate cross-RoW travel by wildlife, trappers and agricultural operations. Alternatively, for set-up pipe, a ground to bottom-of-pipe clearance of 1.5 m will be considered as a gap in the pipe for wildlife crossings. The section on right-of-way planning (see Appendix A,
Section A.3.1) and the Shelterbelt Protection Plan (see Appendix A, Section A.3.6) have further information.

- The Environmental Damage Shutdown or Work Modification Contingency Plan (see Appendix A, Section A.2.3) will be initiated where rutting the soil has the potential to harm the soil horizons.
- Debris from sandblasting will be collected.
- During bevelling operations, the pipe bevel shaving debris should be collected, to prevent livestock and wildlife from ingesting the shavings.
- Where spray or paint-on coatings are applied, a tarp of sufficient size to block overspray from contacting the ground will be placed under the operation. Overspray is not considered toxic.
- The hours of work for pipe activities near human populations will be monitored and subject to discussions with the local population, to meet local regulations and residents' wishes.
- All welding refuse will be collected as generated by each welding rig.

9.1.3 Pressure and Leak Testing

9.1.3.1 Hydrostatic Testing

All required permits or licences will be obtained from regulatory agencies for water withdrawal and discharge for short-term use for hydrostatic testing of the pipelines, including:

- as identified in the British Columbia Water Act, approval might be needed to withdraw or discharge water
- compliance with the Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995)

The following measures will be implemented where appropriate during hydrostatic testing:

- Northern Gateway will approve water withdrawal sources for hydrostatic testing before the withdrawal is started, and the withdrawal will not exceed maximum withdrawal rates specified by permits or authorization letters, or as otherwise directed by the environmental inspector or regulatory agencies. The environmental inspector might further limit withdrawal at any location to maintain flow within the watercourse or waterbody outlet, thus providing free passage of both ascending and descending fish during the period of withdrawal.
- Stream flow measurements will be collected daily while water is being withdrawn, or as specified by the environmental inspector.
- Any leaks in the fill and discharge lines will be controlled to prevent erosion.
• The environmental inspector or authorized representative will review the water withdrawal, discharge and testing points before testing begins, to reduce the potential for environmental effects.

• Northern Gateway will determine the appropriate medium required (i.e., air or water) and any additives necessary. Hydrostatic test additives will only be used if preapproved. Biocides added to the test medium will be checked for non-persistent toxicity. Methanol used for testing or drying the pipe will be captured for recycling and reuse.

• All hydrostatic test water will be sampled and sent to a laboratory for testing under the codes of practice for hydrostatic testing before discharge.

• Hydrostatic test water that is deemed suitable for discharge will be discharged into the same watershed, unless otherwise approved by Northern Gateway (after consultation with the appropriate regulatory authorities). The location of all areas that are to receive discharged water will be approved by Northern Gateway and the appropriate regulatory authorities.

• All discharged water will be directed through a diffusion device, pumped to a sediment pond, or dissipated over a vegetated area, temporary rip-rap or other stable surface material to reduce the potential for soil erosion.

• Discharge areas will be monitored and, if saturated conditions occur, the discharge locations will be changed, under the direction of the environmental inspector.

• Pumping equipment used for testing within 100 m of watercourses will be contained within a bermed area lined with polyethylene sheeting and absorbent material that is capable of containing any fluid leaks. The machinery will be shrouded to prevent grease or particulate matter being sprayed.

• Sediment reduction methods such as sediment mats, silt fences, sandbags and coffer dams will be used to protect downstream fish, fish habitat and water users from increased sedimentation or reduced water quality.

• Debris and water collected during pipeline pre-testing will be collected and disposed of appropriately.

• Before water trucks are used for testing, Northern Gateway will check and clean them, as needed.

• Northern Gateway will obtain written landowner consent before dewatering on private land.

9.1.3.2 Air Testing

Where practical and approved by the NEB, air testing may be selected instead of hydrostatic testing for some sections of the pipeline. The environmental inspector, construction manager and safety officer will develop a job-specific environmental response plan for the testing.
9.1.4 Backfilling

The following measures will be taken, where appropriate, when backfilling the trench to prevent compaction related to backfill activities (the Backfill Management Plan [see Appendix A, Section A.3.8] has additional information):

- Spoil will be moved back into the trench in a way that prevents loss or mixing of topsoil with spoil material.
- Topsoil will not be used to pad the pipe under any circumstances.
- Soil conservation methods will be followed.
- Where mechanical padding has been used on agricultural land, a layer of rock-free soil will be placed over the rock layer in the trench so it does not contact the topsoil after it is replaced.
- Where sand padding has been used on agricultural land, the displaced spoil that cannot be adequately feathered out on the RoW will be removed to an approved location.
- The height of the crown or roach will depend on land use, seasonal considerations and soil characteristics. The decisions will be specific to the particular area. The environmental inspector will provide recommendations on the appropriate crown and roach height.
- The amount of snow in the backfill will be limited, to reduce the time for thawing and settling the backfill in the trench.
- The length of open trench will be limited, to avoid weather effects and to facilitate the movement of wildlife. Areas where a hazard has been identified related to the open trench will be fenced to prevent entry.
- Trench breakers and gaps in windrows and raised pipes will be maintained at appropriate intervals and at defined wildlife movement corridors, as identified on the environmental alignment sheets.
- Strategically placed openings will be left in roaches and crowns to allow for temporary and permanent drainage across the RoW. Stub berms will be placed, where necessary, to prevent movement of surface water down the trench line.
- Trench plugs and subdrains will be installed to work together with surface drainage structures, to control the persistent subsurface and surface flow of water. The exact locations will be finalized in the field in consultation with the environmental manager or the environmental inspector and, where warranted, with a geotechnical engineer.
- Excess bedrock will be disposed of at excess cut disposal area locations approved by the environmental inspector. The bedrock and shot rock, excluding acid rock, might be used for bank stability at watercourse crossings, or for access control at road crossings. The Blasting Management Plan (see Appendix A, Section A.3.9) and the Waste Rock Management Plan (see Appendix A, Section A.3.11) have further information. For bank stability at watercourse crossings, bedrock or shot rock will only be used with the approval of both a qualified hydrotechnical engineer and the appropriate regulatory agencies.
• A geotechnical engineer will be available to provide expertise to the environmental inspection staff if problems occur related to sand padding.

• The environmental inspection staff will communicate all special requirements to the craft inspection staff for transmittal to the contractors.

9.2 Tunnelling

The Tunnel Installation Plan (see Appendix A, Section A.3.13) contains specific protection measures for tunnel construction.
10 Protection Measures for Facilities Construction

In addition to the general protection measures (see Section 8), this section identifies specific protection measures for constructing the following facilities:

- pump stations
- scraper trap facilities
- permanent and temporary access roads and shooflies
- staging areas
- construction yards
- construction camps
- powerlines
- pipe laydown areas
- borrow sites
- excess cut disposal areas

10.1 Siting

Infrastructure sites such as construction camps, pipe laydown areas and staging areas will be sited near the RoW to support construction. Pump stations are required near the hydraulic optimum point for efficient operation.

Siting of infrastructure will consider:

- re-use of previously disturbed sites, where practical
- construction needs for pipelines and facilities
- site-specific conditions such as drainage, slope and vegetation
- community input
- presence of wildlife, rare plants and historical and cultural resources
- construction camps, stockpile sites, staging areas and excess cut disposal areas will be set back more than 30 m from fish-bearing water bodies
- proximity to existing communities
- the requirements of provincial regulatory agencies
- site-specific layout for dwellings, parking, materials storage and equipment staging and servicing
- salvage of topsoil before construction (see Section 8 for further information)
10.2 Construction Camps

10.2.1 Construction Camp Firebreak
Construction camp firebreaks will meet the intent of provincial regulations and will be located inside the non-grubbed area.

10.2.2 Construction Camp Water
The following protection measures related to construction camp water will be implemented:

- If a water well is needed for any construction camp, a permit will be obtained, if required, and the work will be performed under provincial water well drilling requirements. Wells will be situated to avoid any potential effects on surface water resources during the construction and maintenance of the well. All water wells will be up-gradient from sewage-holding areas.
- If a surface water source is required to meet construction camp needs, a permit will be obtained. Withdrawal will be according to the permit requirements.
- Water used for human consumption will meet provincial potable water standards at construction camps.

10.2.3 Construction Camp Waste, Waste Water and Sewage Disposal
The following protection measures for construction camp waste, waste water and sewage disposal will be implemented, where appropriate:

- All kitchen waste sumps and garbage holding areas will be fenced to prevent wildlife from entering.
- Solid, kitchen and sewage waste might be stored on site until removed by an appropriately licensed hauler to an approved treatment or disposal facility. Northern Gateway might also apply for on-site treatment and disposal at construction camps.
- Sewage management will be according to provincial permitting requirements for managing sewage waste from industrial construction camps.
- Grey water will be disposed of by full recapture in tankage for transport to an approved off-site location, or into an approved septic system, as determined by provincial regulators.
- Incinerators that meet provincial standards will be used to dispose of waste that meets approved incinerator criteria.

10.3 Storm Water Management
The downhill side of sites will be bermed with subsoil and trenched to collect surface runoff where the site is determined to be at risk. Where subsoil is not available or trenching is not possible, alternatives might be considered. Topsoil will not be used for constructing surface runoff berms.
Where warranted, the bermed and trenched area will drain into a settlement sump system for collecting silt or contaminated water. The sumps will be constructed with a baffle system to limit silt transfer, and the outlet will have a way of shutting off the exit flow if the water is contaminated. Contaminated water will be pumped out and taken to an approved disposal site. The sumps will be placed at an appropriate distance from any water body. Depending on local site conditions and topography, it might be necessary to place the sumps closer to water bodies. Under these circumstances, increased levels of surface water monitoring, pumping and disposal will be needed.

Additional measures might be taken, as needed, to control the amount of erosion and sediment-laden runoff potentially entering a nearby water body, as indicated in the Storm Water Management Plan (see Appendix A, Section A.3.4) and the Erosion and Sediment Control Plan (see Appendix A, Section A.3.5).

The Concrete Works Management Plan (see Appendix A, Section A.3.12) outlines the measures where concrete works are required.

10.4 Removal and Decommissioning of Temporary Facility Sites

The following protection measures will be implemented, where appropriate, related to decommissioning of temporary facility sites (e.g., small temporary disturbances such as waste sumps, water wells and drainage contours):

- Temporary facility sites will be decommissioned at the same time as other construction activities stop, unless otherwise directed by regulatory authorities.
- Waste sump contents will be disposed of at an approved waste disposal facility. Waste sumps will be pumped out and reclaimed.
- Wells and sumps will be abandoned under provincial regulatory requirements.
- Grade contours will be restored to preconstruction conditions, unless provincial regulatory authorities direct otherwise, and topsoil will be replaced for proper rooting of vegetation during reclamation.

10.5 Powerlines

The following protection measures will be implemented, where appropriate, to protect the riparian environment from the effects of powerline installation:

- DFO’s Pacific Region Operational Statement for Overhead Line Construction will be followed.
- The Forest Practices Code of British Columbia’s Fish-stream Crossing Guidebook will be followed for semipermanent watercourse crossings, (e.g., for culverts and bridges). However, the Code will be superseded by the DFO operational statement where there is overlap.
- Existing disturbances, including access roads and existing powerline easements, will be used.
- The pipeline route will be designed to avoid, or limit the number of, watercourse crossings.
• Watercourse crossings will be constructed perpendicular to the watercourse, to limit the disturbance to riparian vegetation. Shrubs, stumps and root systems will be left in place within 30 m of watercourses or other fish habitat, as long as vehicles can pass. No permanent or temporary structures (e.g., islands, poles or crib works) will be constructed below the high-water mark of any watercourse, and all temporary or permanent structures will be located beyond the top of the bank to prevent erosion.

• No powerline poles will be placed within the bed or banks of watercourses or wetlands.

• Structures will not be built on meander bends, braided watercourses, alluvial fans, active floodplains or any other area that is unstable and could result in erosion and scouring of the structure.

• Stream banks will not be graded for the approach of a watercourse crossing.

• Mature timber will be removed using harvesting methods that limit ground disturbance in riparian areas.

• The powerline easement will not be grubbed, except where required for pole and wire installation.

• Grading will be restricted to the access needed for removing timber and installing power poles. No long-term access will be maintained on the powerline easements.

• Any post-harvest area soil disturbance will be revegetated using organic material salvaged from access road clearance. This will be supplemented by seeding of fast-germinating agronomic species in areas at high risk for surface soil erosion and invasion by weedy plants.

• Powerlines and vegetation on powerline easements will be maintained using the BC Hydro Approved Work Practices for Managing Riparian Vegetation (BC Hydro 2006).

• During operations, vegetation along the powerline easement will be allowed to re-establish with minimal clearing (e.g., clearing pathways and removing tall-growing trees) until the area is decommissioned, reclaimed and restored.

Further protection measures are provided in the Vehicle and Equipment Watercourse Crossing Plan (see Appendix A, Section A.3.14) and the Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan (see Appendix A, Section A.3.15).

10.6 Borrow Pits

Site-specific borrow pit protection plans will be developed for each borrow pit once the sites are finalized. General protection measures (see Section 8) will apply to all borrow pits.

10.7 Reclamation

Reclamation of temporary and permanent facilities is subject to the same reclamation requirements as outlined under general protection measures (see Section 8).
11 Protection Measures for the Kitimat Terminal Construction

In addition to the general protection measures (see Section 8), this section outlines the protection measures that apply specifically to construction of the Kitimat Terminal.

11.1 General Protection Measures at the Kitimat Terminal

A minimum 60-m firebreak will be maintained around the developed facilities within the Kitimat Terminal. The Kitimat Terminal will also include excess cut disposal areas on land, for excess cut material from the tank terminal (e.g., rock and soil), a topsoil storage area (for reclamation) and a construction laydown area. The location and specifications for these ancillary areas will be outside the Kitimat Terminal security fence.

11.2 Kitimat Terminal Buffer Zones

Unless not practical, or as required for permanent facilities or construction, wetlands, watercourses and marine areas within the work zone will have a 30-m buffer of undisturbed land from the high-water mark and fish-bearing watercourses to the construction zone. Silt fencing will be installed along the perimeter of the buffer zone in areas where up-gradient work might result in erosion and sediment-laden runoff entering the watercourse. The edge of the buffer zone will be flagged and inspected before any site disturbance activities.

A 150-m wide marine safety zone will also exist seaward of the berth structures at the marine terminal.

11.3 Marine Sediment and Erosion Control

Where mitigation measures for marine sediment and erosion control are not defined in the contract specifications or construction drawings, the contractor will develop a marine sediment erosion and protection plan before construction begins. The plan will incorporate the following documents, covering protection measures to mitigate the effects of marine sedimentation:

- A map of existing conditions including contours, water features, vegetation type, soil type, sensitive areas (steep slopes, erodible soils and wet areas), dominant features, access roads, utilities and property lines.
- A grading plan and construction timetable including existing and finished contours, the limits of soil disturbance, areas of construction phases, access roads, utilities and structures, the location of disposal areas and the boundaries for riparian buffers.
- A site plan showing the erosion prevention and sediment control measures planned for the site, including the limits of soil disturbance, riparian buffer limits, location of structural control measures (and engineering details), areas of seeding and mulching and storm water pathways.
Northern Gateway will monitor the sediment plume, to verify the predicted effects on sediment and water quality for both contaminants and total suspended solids (TSS) and determine the effectiveness of the mitigation measures used to limit sediment and contaminant release during dredging and blasting. Northern Gateway will require contractors to meet the intent of applicable regulations regarding marine sedimentation, including:

- monitoring the sediment plume generated during dredging and blasting, at distances to be established through consultation with DFO, to confirm that levels meet British Columbia water quality guidelines for TSS and turbidity. In addition, if TSS levels exceed the water quality guidelines outside the PDA, then additional analysis of samples for contaminants such as polycyclic aromatic hydrocarbons (PAHs) will be included, to assess dispersal of these contaminants in Kitimat Arm.

- protecting sediment and water quality further through measures outlined in the:
  - Weather Event Siltation Contingency Plan (see Appendix A, Section A.2.4)
  - Storm Water Management Plan (see Appendix A, Section A.3.4)
  - Erosion and Sediment Control Plan (see Appendix A, Section A 3.5)
  - Shelterbelt Protection Plan (see Appendix A, Section A.3.6)
  - Acid Rock Management Plan (see Appendix A, Section A.3.10)
  - Concrete Works Management Plan (see Appendix A, Section A.3.12)

- monitoring the effectiveness of all protection measures during construction

- treating surface water runoff from the tank and manifold areas of the tank terminal by directing it to, and storing it in, the impoundment reservoir. Excess surface water runoff from the impoundment reservoir will be released into the marine environment through a subtidal, perforated pipe. Before being released to the marine environment, excess water from the impoundment reservoir will be tested to confirm that the concentration of hydrocarbons is less than 15 parts per million. Surface water runoff from the area outside the tank and manifold areas will be controlled, so that this water will be released outside the boomed zone of the berths, to the extent practical.

- considering a preconstruction trap-and-release program from March to July, to relocate Dungeness crab away from the areas affected by sedimentation. Any such program will be determined through consultation with the regulatory authorities.

### 11.4 Clearing

In addition to the general protection measures (see Section 8), the following measures will be implemented, to mitigate the effects of clearing at the Kitimat Terminal. Where disturbance is unavoidable, Northern Gateway will consult with the appropriate regulator and, as appropriate, interested and participating Aboriginal groups to identify possible options and management strategies to be implemented:

- Bird nests, including those of Bald Eagles and Marbled Murrelets, will be identified, flagged and monitored.

- Clearing of old-growth forests will be avoided or limited in the PDA, to the extent possible.
• If active Marbled Murrelet nests are discovered, efforts will be made to establish a 200-m buffer of undisturbed vegetation around the nest site. This buffer will provide a habitat patch of approximately 10 ha that will protect the nest from sensory disturbance caused by loud and disruptive activities. The buffer will remain in place until a professional biologist confirms that the young have fledged or are otherwise no longer present. Where disturbance is unavoidable, Northern Gateway will consult with appropriate regulators to identify possible options and management strategies.

• A year-round no-clearing buffer of at least a two-tree length radius will be established around any Bald Eagle nest found in or near the Kitimat Terminal. During the nesting season (determined in consultation with the CWS), a minimum buffer radius of 200 m will be maintained around active nests. Every effort will be made to maintain an even larger area free of human disturbance during the nesting season.

• To avoid nesting and rearing periods, the preferred clearing time will be determined in consultation with the CWS. Where disturbance is unavoidable, Northern Gateway will consult with the appropriate regulators to identify possible options and management strategies.

• Adjustments to the infrastructure design might be made to accommodate the nest of any bird directly protected under the British Columbia *Wildlife Act*, whether the nest is active or not. If redesign is not possible, or if an adequate buffer area cannot be provided for the nest, a provincial biologist will be consulted, and an alternative nest management plan will be developed to the satisfaction of regulatory agencies.

11.4.1 Marine-Sensitive Zones

Marine-sensitive zones (MSZs), as defined in the Forest Practices Code: Riparian Management Area Guidebook (BC MoF 1995, Internet site), include herring spawning areas, shellfish beds, marsh areas, existing aquaculture sites, juvenile salmonid rearing areas and adult salmon holding areas. Clearing operations adjacent to a MSZ will adhere to the following practices:

• Stream discharge into the MSZ will be considered before beginning clearing operations.

• All floating debris entering the marine environment from clearing operations will be disposed of so that it does not re-enter or contaminate the aquatic environment. This will be done by:
  • removing limbs and tops before yarding and avoiding long flight paths over water bodies to avoid re-introducing logging debris to the marine environment
  • using perimeter booms to contain debris entering the marine environment from clearing operations
  • sweeping the water surface periodically, to capture floating debris before it sinks
11.5 Marine Dredging

Dredging will be required for construction of the berth structure foundations. Dredged material will be disposed of on land at excess cut disposal areas. To limit the effect of dredging on water quality and the marine environment, the following measures will be implemented, where appropriate:

- Dredging will be implemented according to permits or approvals.
- The sediment plume generated during dredging will be monitored (see Section 11.3).
- Local Aboriginal groups will be consulted to identify periods when sounds might disrupt traditional activities, and planning will be adjusted where practical.
- The least invasive method of dredging, such as a clam dredge, will be used where it is technically feasible, to limit sedimentation.
- Dredging will be controlled so that mobile marine species can escape.
- Silt curtains will be placed strategically during dredging, to limit the dispersion and duration of sediments and limit sedimentation effects on sensitive species.
- Inwater activities, such as dredging and blasting, will be developed in consultation with DFO.
- If historical artifacts or remains are discovered, the contractor will suspend operations, and notify the construction manager and environmental inspector of the discovery. The environmental inspector will contact the heritage resources team lead, who will report to the appropriate responsible authorities.
- If a hydrocarbon or hazardous material release occurs, a response will be implemented according to the Spill Contingency Plan (see Appendix A, Section A.2.1).

11.6 Marine Drilling

The following measures will be implemented, where appropriate, to mitigate the effects of drilling operations on environmental resources:

- The Noise Management Plan (see Appendix A, Section A.3.22) will be followed, and local Aboriginal groups will be consulted to identify periods when sounds might disrupt traditional activities. Planning will be adjusted where practical.
- Cuttings from routine drill operations will be returned to the sea on an ongoing basis during drill operations.
- Additives used for marine drilling will be tested for toxicity and preapproved by Northern Gateway.

11.7 Marine Blasting

Underwater blasting will be conducted according to the DFO Guidelines for the Use of Explosives in Canadian Fisheries Waters. These guidelines indicate the setback distances and threshold of instantaneous pressure changes with peak particle velocities. The guidelines are required to protect fish and marine mammals from the effects of detonations in and near water. If the guidelines cannot be followed for any reason, Northern Gateway will obtain a Section 32 authorization from DFO.
The Blasting Management Plan (see Appendix A, Section A.3.9) describes the mitigation measures that will be implemented to protect fish and marine mammals from blasting activities.

### 11.8 Pile Drilling

Current ESA assumptions are that no pile driving activities will be associated with the marine terminal. The construction of the main berth structure marine foundations will use rock-socketed piles or other non-pile foundations. Dredging and blasting will be required at each pile location. All rock-socketed piles will be installed using drilling techniques.

### 11.9 Marine Noise

Noise generated at the site during construction activities will largely result from operating heavy construction vehicles, blasting, drilling and pile installation activities related to construction of the docking infrastructure. The following protection measures will be implemented, where appropriate, to mitigate the effects of noise generated by land- or marine-based construction:

- High-effect activities are to be avoided, where possible, within 200 m of active nests. An even larger area should be free of human disturbance during the nesting season, where possible.
- The timing of work windows for inwater infrastructure site preparation and construction activities, such as pile drilling, dredging and blasting, which are known to produce loud noise, will be determined in consultation with DFO.
- An observer trained in identifying marine mammals will complete a marine mammal survey of the local area of Kitimat Arm before blasting or drilling, during periods of mammal abundance. If any marine mammals are observed, blasting and drilling operations will cease until the area up to and beyond the radius of the predetermined danger zone (which will be calculated from blasting specifications) is clear of marine mammals, or until appropriate mitigation measures are developed and implemented.
- During construction, marine mammal surveillance will be carried out up to and beyond the radius of the predetermined danger zone.
- Blasting and rock hammering in the marine environment will be rescheduled whenever a marine mammal, such as a killer whale, humpback, fin, grey or minke whale, harbour porpoise, Pacific white-sided dolphin or Steller sea lion is observed within the predetermined danger zone.
- Construction activities will be modified during eulachon migration and spawning in February and March, if required.
- Aboriginal traditional knowledge will be considered when determining mitigation measures.
11.10 Powerlines

The following measures will be considered, where applicable, to mitigate the effects of new powerlines on birds at the Kitimat Terminal:

- Energized surfaces will be covered with protective devices manufactured for wires, conductors, powerline insulators and powerline bushings, to protect ravens, eagles and other birds of prey from electrocution.

- Placement of perch deterrents such as triangles, single dowels, multiple points and antiperching irons will be investigated.

- Safe, alternative perch sites will be provided, so that perching birds, especially raptors, stay away from energized conductors.

11.11 Marine Transportation and Vessels during Construction

The Spill Contingency Plan (see Appendix A, Section A.2.1) outlines the protection measures that will be implemented to mitigate any incidents.

11.11.1 Vessel Traffic

Supply vessels and barges will be used to transport equipment, fuel and other material and supplies to the work site, including hazardous materials. If ships are used for transport, smaller self-propelled vessels or barges might also be required to move materials to shore. To limit potential interference of vessels during construction with local fishing boats, construction activities will be scheduled outside fishing seasons, where possible.

The following general protection measures will be implemented, where appropriate, to protect marine and migratory birds and marine mammals from vessel traffic and vessel operations during construction:

- Work will be scheduled during daylight hours.

- Project-related vessels will be alerted about the hazards of bird strikes occurring because of deck lighting, particularly on nights when visibility is poor. All bird strikes will be reported to the environmental inspector.

- Workers at the marine berths will be instructed to report any collisions of birds and structures.

- A marine mammal reporting program (call-in procedure) will be established at the Kitimat Terminal, so that vessel operators are aware of marine mammals present in Kitimat Arm, and can take appropriate precautions to avoid them.

- During construction, project-related vessels will operate at slow speeds, to limit the intensity of acoustic emissions and decrease the likelihood of striking marine mammals.

- The Wright Sound to Caamaño Sound area is considered a core humpback whale area. To decrease the likelihood of a lethal strike, vessels will travel at a maximum speed of 8 to 10 knots in that area.
• In other parts of the confined channel assessment area (CCAA), vessel speeds will not exceed 12 knots.

• Vessel operators will slowly increase vessel speeds and avoid rapid acceleration, which is a loud activity.

• Tugs, terminal skiffs and other project-related vessels specific to the Kitimat Terminal will be required to be fitted as practical, with propulsion systems that are expected to generate lower levels of underwater noise and be maintained in a way that limits underwater noise (e.g., by design or modification of engines, propellers or architecture). Propellers of all project-related vessels will be well maintained, as poorly maintained propellers are known to increase underwater noise.

11.11.2 Ballast and Bilge Water

During construction, all project-related vessels will follow the requirements for ballast water management and discharge under the Canadian Shipping Act, Canadian Ballast Water Management Control and Management Regulations, and will implement an International Maritime Organization (IMO)-approved ballast water management plan, to limit the number of invasive marine species being imported into Canadian waters. Oily ballast water will not be discharged at the Kitimat Terminal. Solid waste and liquid waste will be managed according to the Canadian Shipping Act. Bilge water will be transported off-site by a third-party contractor for treatment and disposal.
12 References

12.1 Literature Cited


DFO. 1995. *Freshwater Intake End-of-Pipe Fish Screen Guideline*. Department of Fisheries and Oceans. Ottawa, ON.

12.2 Internet Sites


## 13 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACCS</td>
<td>Alberta Culture and Community Spirit</td>
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<tr>
<td>ALC</td>
<td>Agricultural Land Commission</td>
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<td>ALR</td>
<td>agricultural land reserve</td>
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<tr>
<td>ANHIC</td>
<td>Alberta Natural Heritage Information Centre</td>
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<tr>
<td>ARD</td>
<td>acid rock drainage</td>
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<td>ARMP</td>
<td>Acid Rock Management Plan</td>
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<tr>
<td>ASRD</td>
<td>Alberta Sustainable Resource Development</td>
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<tr>
<td>ATV</td>
<td>all-terrain vehicle</td>
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<td>BC CDC</td>
<td>British Columbia Conservation Data Centre</td>
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<tr>
<td>BC MoE</td>
<td>British Columbia Ministry of Environment</td>
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<td>BC MoF</td>
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<td>CAB</td>
<td>Community Advisory Board</td>
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<td>CAB</td>
<td>criteria air contaminants</td>
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<td>CAPP</td>
<td>Canadian Association of Petroleum Producers</td>
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<td>CCAA</td>
<td>confined channel assessment area</td>
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<td>CCME</td>
<td>Canadian Council of Ministers of the Environment</td>
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<td>CEPA</td>
<td><em>Canadian Environmental Protection Act</em></td>
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<tr>
<td>CGG</td>
<td>Canadian Coast Guard</td>
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<tr>
<td>CMT</td>
<td>culturally modified tree</td>
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<td>CO₂</td>
<td>carbon dioxide</td>
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<td>CPCN</td>
<td>Certificate of Public Convenience and Necessity</td>
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<td>caribou protection plans</td>
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<td>Canadian Petroleum Products Institute</td>
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<td>EERT</td>
<td>environmental emergency response team</td>
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<td>Environmental Management System</td>
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<td>environmental non-government organization</td>
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<td>ESA</td>
<td>Environmental and Socio-economic Assessment</td>
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<td>FMA</td>
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<td>GHG</td>
<td>greenhouse gas</td>
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<td>GPS</td>
<td>global positioning system</td>
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<td>HAP</td>
<td>hazardous air pollutant</td>
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<td>HADD</td>
<td>harmful alteration, disruption or destruction</td>
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<td>HDD</td>
<td>horizontal directional drilling</td>
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<td>Abbreviation</td>
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<tr>
<td>HRMB</td>
<td>Historical Resources Management Branch</td>
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<td>HSE</td>
<td>health, safety and environment</td>
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<td>LiDAR</td>
<td>light detection and ranging imagery</td>
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<td>LRMP</td>
<td>Land and Resource Management Plan</td>
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<td>least risk period</td>
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<td>License to Cut</td>
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<td>Land Use Planning Area</td>
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<td>MBCA</td>
<td>Migratory Birds Convention Act</td>
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<td>MSZ</td>
<td>marine-sensitive zone</td>
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<td>NEB</td>
<td>National Energy Board</td>
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<td>NTU</td>
<td>nephelometric turbidity units</td>
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<td>OCP</td>
<td>Official Community Plan</td>
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<td>OLTC</td>
<td>Occupant – Licence to Cut</td>
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<td>PAG</td>
<td>potential acid-generating</td>
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<td>polycyclic aromatic hydrocarbon</td>
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Appendix A Contingency Plans and Environmental Management Plans
A.1 Introduction

Appendix A describes in detail the environmental protection measures that will be used during project construction, and contains:

- contingency plans (see Section A.2), which delineate responses to exceptional or unexpected events (e.g., discovery of historical resources)
- environmental management plans (see Section A.3), which delineate specific environmental management procedures that apply to ongoing, planned events associated with construction (e.g., timber salvage, sediment and erosion control, watercourse reclamation)

The Construction EPMP, including this appendix, provides a preliminary description of the mitigation measures that will be implemented so that construction occurs in a way that protects the environment. Once detailed design and route selection have been completed, the Construction EPMP will be updated for project personnel to use as a guidance document for construction. The final Construction EPMP will be filed with the NEB at least 60 days before construction starts.

See Table A-1 for construction activities and related contingency and management plans. The intent of this table is to clarify what plans should be reviewed in relation to a specific construction activity.
## Table A-1  Construction Activities and Related Contingency and Management Plans

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<th>Contingency or Management Plan</th>
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### Appendix A: Contingency Plans and Environmental Management Plans

#### Table A-1  Construction Activities and Related Contingency and Management Plans (cont’d)

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Table A-1  Construction Activities and Related Contingency and Management Plans (cont’d)

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A.2 Contingency Plans

A.2.1 Spill Contingency Plan

This plan is also applicable to fuel, hydraulic fluid or chemical releases.

During construction, contractors will be responsible for prevention, preparedness and response on their work sites. A priority for Northern Gateway is to prevent incidents through good work practice and preparedness.

Contractors’ emergency response equipment and materials will be stored on site and as close to the work areas as possible. If required, additional response equipment may be sourced through local service providers in British Columbia and Alberta. For quick access to supplementary equipment, contractors will maintain contact with emergency response suppliers near their work sites.

Contractors will maintain an up-to-date inventory of response materials at each land-based construction work site. Materials needed on site include:

- appropriate protective clothing and safety equipment
- bags of bulk absorbents
- synthetic absorbents such as pads and booms
- polyethylene rolls
- shovels
- rakes
- a trash pump
- hoses designed for hydrocarbon transfer
- a tank for temporary storage of recovered hydrocarbons
- a container for the temporary storage of excavated contaminated soils
- communications equipment

Additional equipment, including booms and skimming equipment, may be required at crossings on larger rivers and waterbodies. Information about requirements for these situations will be provided during detailed planning and permitting.

A.2.1.1 Initial Response

Assessment

The incident and its location will be assessed to define safety hazards, the human and environmental resources at risk of being affected, and the degree of likelihood that the situation could escalate into a larger incident. The greatest priorities will be to:

- protect people, property and the environment
- stop the source of the materials release
- contain the hydrocarbons and other materials
Response Actions

The following actions will be undertaken:

- The first person on the scene will begin the Spill Response Checklist (see Table A-2).
- The construction manager or environmental inspector will immediately be responsible for:
  - taking action to protect human life
  - designating an on-site safety manager
  - notifying the appropriate provincial disaster services and local police or RCMP, as required
  - mobilizing the necessary personnel and equipment
  - implementing measures to stop the source of the materials release, contain it and begin cleanup
- The contractor will make available all resources needed for containment and clean up.
- After emergency services have been contacted, and initial response has occurred, the construction manager or environmental inspector will notify Northern Gateway’s environmental staff.
- The environmental inspector will measure and document the extent of a materials release by taking photographs, drawing a sketch map, and taking detailed notes regarding the circumstances of the incident, containment efforts and any other relevant information.
- The contractor will implement suitable mitigation and remediation plans.

Northern Gateway will submit detailed reports, for incidents of a reportable nature, to the Transportation Safety Board and or other applicable agencies, as required by law.

Table A-2  Response Checklist

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<th>Action</th>
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<td>Assess the safety hazards, and identify the materials released.</td>
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<td>Advise people in the vicinity to leave.</td>
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<tr>
<td>When it is safe to do so, control the danger to human life (i.e., remove any sources of ignition).</td>
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<tr>
<td>Based on the nature of the hazard, and if safe to do so, eliminate the source of the incident.</td>
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<tr>
<td>Immediately obtain the assistance of others and begin activities to contain and clean up.</td>
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<tr>
<td>Notify the construction manager and the environmental inspector.</td>
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<tr>
<td>Make note of dangers to the environment and cleanup actions that may be necessary.</td>
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<tr>
<td>Prepare written reports as directed by the environmental inspector.</td>
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A.2.1.2 General Containment Procedures

The following are the general guidelines:

- The first person on the scene will begin the Spill Response Checklist, which includes:
  - assessing the safety hazards of the situation
  - removing any sources of ignition, if safe to do so
  - identifying the type of hydrocarbon, stopping the source and containing the source as soon as it is safe to do so
  - consulting with Northern Gateway’s environmental staff for advice on cleanup, and for notification of relevant authorities, as required by law. There is an expectation that applicable Aboriginal groups will receive notification of incidents.

- Containment measures will be immediately initiated to limit the spread of the released materials, limit the effects on water bodies or other areas of the environment, and prevent damage to property.

- If the source is a leaking fuel tank, the contents will be transferred into another truck, tank or other appropriate and secure container.

- Traffic on contaminated soils will be limited.

- Culverts will be blocked to limit downstream travel of the materials release.

- Natural depressions or constructed berms will be used for on-land containment.

- Containment berms will be deployed in water.

- All free hydrocarbons will be collected and transported to an approved waste treatment facility.

- Sorbent materials will be applied to contain and recover material.

- Heavily contaminated soil and vegetation, as well as used sorbent material, will be collected and disposed of at an approved waste treatment and disposal facility.

- The event will be documented by preparing a sketch with dimensions showing the location and a report describing the type of incident, causes, and the cleanup and reclamation procedures undertaken.

- Fencing will be put up to restrict wildlife from accessing the contaminated area, if considered necessary.

- Final cleanup and reclamation will occur after appropriate laboratory analysis of contaminants and as approved by the appropriate regulator.
A.2.1.3 Training and Awareness

All construction staff will receive health, safety and environmental orientation training, which will include a section on prevention and response awareness.

Operators of commercial vehicles that routinely carry hydrocarbon products to, or around, the job site will take response training and will carry a response kit appropriate for the products they transport.

General Guidelines

Pollution prevention will be discussed at daily tailgate meetings to promote awareness and good practice.

Contractors will be expected to inspect their equipment daily, including a visual examination to identify any leaks, drips or damage, and to regularly perform preventive maintenance.

Contractors will be expected to take additional precautionary measures during any construction work that may affect a watercourse.

Safety in Handling Hydrocarbons

Contractor personnel assigned to response will be trained in the safety and risk aspects for all hydrocarbons that are kept and handled on site. Responders will be familiar with the risks associated with each hydrocarbon type, and will have personal protective equipment and clothing necessary to protect themselves and their coworkers.

Fire and Explosion Prevention

A small fire can escalate into a larger incident, such as an explosion, large fire or forest fire. Therefore, every materials release will be treated as a potential fire and explosion risk. Depending on the size of the incident and the associated risks, an outer perimeter security zone might be established around the area to keep nonessential personnel a safe distance away. An inner security zone will also be established and maintained. Only necessary and trained response personnel will be allowed into the inner zone. Each responder must wear appropriate safety equipment and protective clothing. Other personnel will be expected to stay out of the inner zone, so that no ignition sources are introduced.

If present on site, firefighters will be responsible for maintaining the security of the inner zone perimeter. They will continuously monitor for ignition sources and the general safety of the responders. The police or on-site security personnel will maintain the outer perimeter security zone.

Response

Initial response will follow the Spill Contingency Plan. The contractor, in consultation with Northern Gateway, will direct the response effort.
Reporting

The construction manager, environmental inspector, or both, will report all incidents to Northern Gateway. When a reportable event occurs, Northern Gateway will notify the appropriate authorities and agencies as required by law. If immediate notification is not possible, notification will be made as soon as practical.

If warranted, Northern Gateway will notify the local police detachment and fire department if their assistance is needed to protect the public, or provide security.

If there is a risk of fire or forest fire from a materials release, Northern Gateway will notify the nearest fire department and the provincial department of forestry. A safety watch will be maintained at the incident site throughout the emergency phase of the response.

Protocols for reporting will be included in the final EPMP.

Investigation

Northern Gateway will record and track all incidents and they will be investigated to determine causes, and to determine if any corrective actions are necessary. Northern Gateway believes that due diligence will foster continuous improvement in preventing incidents, including hydrocarbon spills. The situation and location will be assessed to define the:

- safety hazards
- human and environmental resources that are at risk of being affected
- likelihood of the situation escalating into a larger incident

A.2.1.4 Response to Spills on Land

Liquids will be recovered using granular or synthetic absorbent materials. An adequate inventory of absorbent materials will be kept at each construction site.

Contaminated soil will typically be removed with a shovel, backhoe, front-end loader or excavator. Removed soil will be placed in an appropriate container and transported to an approved disposal site. See Table A-3 for containment techniques. See Table A-4 for cleanup techniques.

A.2.1.5 Response to Spills in Winter

Contaminated snow will be placed in suitable containers and removed from the work site for proper disposal at an approved disposal site.

A.2.1.6 Response to Spills in Wetlands

Wetlands are land between terrestrial and aquatic systems where the water table has typically remained at or near the land surface long enough to promote wetland or aquatic processes (as indicated by poorly drained soils, hydrophilic vegetation, and various kinds of biological activity that are adapted to a wet environment). Examples include marshes, prairie potholes, shallow open water, swamps and fens (National Wetlands Working Group 1988).
Table A-3  Containment Protocols for Use on Land

<table>
<thead>
<tr>
<th>Technique</th>
<th>Primary Use</th>
<th>Controlling Variables</th>
<th>Environment Effects</th>
<th>Major Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyke using concrete barriers and sandbags</td>
<td>• Temporary containment in all seasons, using concrete road barriers and earth or sandbags to seal the gaps between the concrete barriers</td>
<td>• Availability of sufficient concrete barriers and sandbags or earth material</td>
<td>• Possible surface disturbance; may have to excavate slight depressions for concrete barrier, which may cause excessive erosion, especially on steep slopes in spring</td>
<td>• A 10-person crew with crane or helicopter support can build 10 m of dike per hour</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Earth-moving equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Picks and shovels</td>
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<td></td>
<td></td>
<td>• Sandbags, earth, sand and gravel</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Work crew (6 to 10)</td>
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<td></td>
<td></td>
<td>• Water ballast boom</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pumps to fill ballast chambers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Water supply</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Picks and shovels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Ground rods to secure the boom to the ground</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Sandbags may be needed to support the boom</td>
</tr>
<tr>
<td>Water-ballast containment boom</td>
<td>• Temporary containment of hydrocarbons in above-freezing temperatures</td>
<td>• Boom can withstand potential rock punctures</td>
<td>• Possible minor surface disturbance if ground under boom has to be stabilized to prevent erosion, especially on steep slopes</td>
<td>• Work crew (6 to 10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Availability of water supply to fill the ballast chamber with water</td>
<td></td>
<td>• Water ballast boom</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gradient of slope – not practical for use on steep slopes; need to secure boom to the ground</td>
<td></td>
<td>• Pumps to fill ballast chambers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Water supply</td>
</tr>
<tr>
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<td></td>
<td>• Picks and shovels</td>
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<td></td>
<td></td>
<td></td>
<td>• Ground rods to secure the boom to the ground</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Sandbags may be needed to support the boom</td>
</tr>
<tr>
<td>Technique</td>
<td>Primary Use</td>
<td>Controlling Variables</td>
<td>Environment Effects</td>
<td>Major Resources</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Large-volume low-pressure deluge flushing with ambient temperature water (flooding) | To move hydrocarbons down slope onto a water surface for containment with booms, or into a trench  
Hydrocarbons on water can be moved using water jets, and concentrated for recovery with vacuum systems or skimmers | Availability of water for deluge flushing  
Availability of pump systems with appropriate hoses and fittings  
Availability of a water surface to receive the removed hydrocarbons | Surface disturbance  
Removal of soil organisms  
Low-pressure flushing has the least effect  
If trenching is needed to reach a high water table, surface disturbance and removal of soil organisms will occur | Work crew  
Pumping systems with appropriate hoses and fittings  
Down-slope containment and recovery equipment  
Water supply  
Trenching equipment (if needed) |
Containment
In addition to the methods available for containment on land, an ice slot technique (see Table A-5) may also be used.

Recovery and Cleanup
One or more of the following techniques may be used for recovery in wetlands:

- sorbents
- vacuum systems
- in-situ burning

Northern Gateway will consult with local government agencies as necessary to determine whether natural recovery is acceptable in the jurisdiction. For more detail on additional recovery techniques, see Table A-6. If the site is not left to recover naturally, Northern Gateway will develop a site-specific cleanup plan.

A.2.1.7 Response to Spills in Muskeg

Guidelines for Initial Response
Guidelines for initial response in muskeg environments are similar to those for land and in wetlands.

Containment
In addition to these guidelines, water-ballast containment booms can be used (see Table A-7).

Cleanup
For cleanup in muskeg environments, see Table A-8.

A.2.1.8 Response to Spills in or Near a Watercourse
Emergency response will be consistent with procedures described in the Pipeline Oil Spill Response Plan. Emergency response will be tailored to the watercourse size and sensitivity. Contingency and response plans for the larger and more sensitive crossings will be adapted to the watercourse, the crossing method and the construction method. These plans will be developed during detailed engineering and permitting.

Near a watercourse, an earthen dyke or berm will be built to contain materials. For difficult construction near steep-sloping banks on a watercourse, a containment dyke might be built before construction, to prevent a hydrocarbons from reaching a watercourse. Northern Gateway, the contractor and the environmental inspector will make the decision to build such a dyke.

 Releases into a watercourse will be contained with booms. A boom will be used to impede the surface flow or to direct the spill into slower moving water. This should allow absorbent materials or skimming methods to be used for recovery. Multiple booms may be necessary.
### Table A-5  Containment Protocols for Use in Wetlands

<table>
<thead>
<tr>
<th>Technique</th>
<th>Primary Use</th>
<th>Controlling Variables</th>
<th>Effects on Environment</th>
<th>Major Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice slots</td>
<td>• To stop migration under ice where a water current exists</td>
<td>• Availability of equipment</td>
<td>• Native vegetation killed, contamination of water and organic soil</td>
<td>• Work crew</td>
</tr>
<tr>
<td></td>
<td>• If an under-ice current exists, ice slots can deflect hydrocarbons to a collection point</td>
<td>• Ice thickness for safety of response personnel</td>
<td></td>
<td>• Chain saws for cutting ice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Velocity of under-ice current</td>
<td></td>
<td>• Hand tools for removing ice</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Current meter</td>
</tr>
</tbody>
</table>

### Table A-6  Clean Up Protocols for Use in Wetlands

<table>
<thead>
<tr>
<th>Technique</th>
<th>Primary Use</th>
<th>Controlling Variables</th>
<th>Effects on Environment</th>
<th>Major Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorbents</td>
<td>• To clean up small amounts of hydrocarbons in an isolated area</td>
<td>• Availability of sufficient sorbents</td>
<td>• Little environmental damage, except for shoreline disturbance caused by foot traffic</td>
<td>• Work crew</td>
</tr>
<tr>
<td></td>
<td>• Sorbents can be used manually or a sorbent boom or pompoms secured to a rope can be used to intercept floating hydrocarbons where a water current exists, or where wind is blowing the hydrocarbons across the water surface, or where the hydrocarbons can be directed on water with water jets</td>
<td>• Season – not practical in winter</td>
<td>• Sorbents must be disposed of in an environmentally acceptable way</td>
<td>• Sorbents (boom, pompoms, sweeps with rope-towing member, pads)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Handles with bracket for holding sorbent pads or pompoms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Small pump with hoses and fire nozzle to direct hydrocarbons on water toward the sorbents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Appropriate disposal for used sorbents</td>
</tr>
<tr>
<td>Technique</td>
<td>Primary Use</td>
<td>Controlling Variables</td>
<td>Effects on Environment</td>
<td>Major Resources</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| In-situ burning | • To reduce hydrocarbon volume when other techniques are unsuitable or would cause more damage to an area  
  • Used in areas where heavy equipment would cause environmental damage  
  • Used in areas unsafe for cleanup crews  
  • Decision to burn should be made as soon as possible to take advantage of light ends in the hydrocarbons; weathered hydrocarbons are difficult to ignite | • Suitability of site to contain a controlled burn  
  • Fire hazard rating must be low  
  • Government approval is needed  
  • High volatility is necessary  
  • Shallow penetration is necessary | • Burning of surface vegetation and surface soils | • Trained work crew  
  • Trained firefighters  
  • Firefighting equipment  
  • Ignition system  
  • May need:  
    • helicopter with under-slung ignition system  
    • refuelling system for ignition  
    • bonding and grounding equipment to dissipate static electricity during fuelling  
    • pumpable fuel supply and gelling agent for helicopter ignition system  
    • air-to-ground radio equipment with headsets |
### Table A-7  Containment Protocols for Use in Muskeg

<table>
<thead>
<tr>
<th>Technique</th>
<th>Primary Use</th>
<th>Controlling Variables</th>
<th>Effects on Environment</th>
<th>Major Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water ballast containment boom</td>
<td>• To prevent migration of hydrocarbons from a site</td>
<td>• Availability of equipment</td>
<td>• Native vegetation killed, contamination of water and organic soil</td>
<td>• Work crew</td>
</tr>
<tr>
<td>(beach boom)</td>
<td></td>
<td>• Availability of water to fill the lower chamber of the water-ballast boom</td>
<td></td>
<td>• Water ballast containment boom</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Pumping equipment to fill water ballast chambers</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• On-site water supply or water truck</td>
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</tr>
</tbody>
</table>

### Table A-8 Cleanup Protocols for Use in Muskeg

<table>
<thead>
<tr>
<th>Technique</th>
<th>Primary Use</th>
<th>Controlling Variables</th>
<th>Effects on Environment</th>
<th>Major Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-situ burning</td>
<td>• To remove hydrocarbon coatings from vegetation without disturbing the drainage pattern of the muskeg</td>
<td>• Suitability of site to contain a controlled burn</td>
<td>• Burning of surface vegetation and surface soils</td>
<td>• Trained work crew</td>
</tr>
<tr>
<td></td>
<td>• In-situ burning is most effective when the ground and plant roots are covered by about 10 cm of water.</td>
<td>• Requirements: a low fire hazard rating, government approval, volatility, shallowness of penetration, good site access. If site access is difficult, a helicopter-deployed ignition system may be needed.</td>
<td></td>
<td>• Trained firefighters</td>
</tr>
<tr>
<td></td>
<td>• Used when other techniques are not suitable or would cause more disturbance to an area.</td>
<td></td>
<td></td>
<td>• Firefighting equipment</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Ignition system</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>• May need:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• helicopter with under-slung ignition system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• refuelling system for ignition</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• bonding and grounding equipment to dissipate static electricity during fuelling</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• pumpable fuel supply with a gelling agent for</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• helicopter ignition system</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• air-to-ground radio equipment with headsets</td>
</tr>
</tbody>
</table>
Any contained liquid will be pumped into one or more temporary storage devices, such as a stationary tank, portable tank, bladder, tanker truck or vacuum truck. Bulk absorbent materials, such as peat moss or clay-based granular sorbents, will be used to recover any remaining free hydrocarbons. Contaminated soils will be excavated and transported to an approved disposal site.

Construction contractors will have trained response personnel and containment materials readily available when construction activities occur in or near a watercourse. The contractors will be responsible for training all staff and subcontractors in response procedures.

A.2.1.9 Response to Spills in the Marine Environment During Construction

Construction contractors will have trained response personnel and containment materials readily available when construction activities occur in a marine environment. Skimmers and other equipment will be used to recover hydrocarbons and other hazardous liquids. Emergency response equipment will be stored near marine or estuarine environments. Booms may be predeployed in marine construction areas to contain hazardous materials releases.

Liquid may be pumped into one or more temporary storage devices, such as a stationary tank, portable tank, bladder, tanker truck or vacuum truck. Bulk absorbent materials, such as peat moss or clay-based granular sorbents, will be used to recover remaining free hydrocarbons. Contaminated soils will be excavated and transported to an approved disposal site.

Management for Marine Spills During Construction

If a construction related spill were to occur, a spill manager or on-scene commander will be assigned by Northern Gateway, to direct the response, including operations, safety, logistics support, and planning support.

The manager will be responsible for documenting, hour by hour, the actions taken during the response. Logs will be used to compile the initial report and the detailed report, and will be submitted to the Transportation Safety Board and other appropriate regulatory agencies.

Marine Incident Reporting

During construction, all incidents will be reported immediately to the environmental inspector. The environmental inspector will contact the Transportation Safety Board, Canadian Coast Guard and other appropriate provincial and federal agencies, when a material release meets their reporting criteria. The Spill Contingency Plan (see Section A.2.1) will include emergency contact numbers for all federal and provincial regulatory authorities.

The following agencies may have jurisdiction over some aspect of a response:

- British Columbia Ministry of Environment (BC MoE)
- British Columbia Ministry of Forests and Range (BC MoF)
- British Columbia Ministry of Tourism Culture and the Arts, Archaeology Branch
- Fisheries and Oceans Canada (DFO)
- Canadian Coast Guard (CGG)
• Transport Canada
• Environment Canada
• Canadian Wildlife Service (CWS)

If warranted, Northern Gateway will notify the local police detachment and fire department, if assistance is required to protect the public, or provide security.

Response Equipment

For construction work adjacent to or over a watercourse, emergency response equipment will include:

• two deployment boats suitable for safe work in the water current on the watercourse
• containment booms at least 60 cm high
• suitable anchors
• sufficient mooring and securing lines
• a hydrocarbon recovery device
• a device for storing recovered hydrocarbons

The contractor will have suitable support vessels and crew on site during the marine construction period for boom deployment, anchoring, adjustment and recovery.

Recovery and Cleanup

If booms are already in place for fuel transfers, and in specific areas of the construction site, a release will likely be contained. If the construction site has no booms already in place, then a boom will be deployed as quickly as possible to contain the floating hydrocarbons.

Hydrocarbons on the surface of water can be blown, using a sea-water pump with hoses and fire nozzle, and concentrated against a containment boom at a point suitable for recovery. The hydrocarbons can then be recovered with absorbent materials or another recovery device, such as a skimmer.

Recovered hydrocarbons will be stored temporarily in a secure storage container. Temporary storage containers will be covered for security reasons and to prevent hydrocarbon overflow caused by rain or snowfall. Recovered hydrocarbons will be transported to a government-approved disposal site as soon as possible. The operator of the truck carrying the recovered hydrocarbons and water will take the necessary precautions to prevent leakage onto a roadway or other surface. Transportation of dangerous goods placards are mandatory.

If the shoreline is contaminated, it will be flushed gently with seawater using an adjustable fire nozzle, to remove stranded hydrocarbons back into the water for recovery along with any other floating hydrocarbons inside the containment boom.

Response Resources

During construction, the contractor’s response equipment will be stored on site and in the environmental emergency response trailer.
If the Kitimat Terminal contractor requires additional response assistance, both personnel and equipment will be available from Burrard Clean Operations in Kitimat. The contractor must execute a service agreement with a response service contractor before starting construction work.

Additional response equipment will be available through equipment caches in British Columbia. The caches are available in cooperation with:

- Enform (formerly Western Canadian Spill Services Ltd. [WCSS])
- Canadian Petroleum Products Institute (CPPI)
- Burrard Clean Operations, a division of Western Canada Marine Response Corporation (WCMRC)
- other private-sector spill response contractors

To enable quick access to supplementary equipment, the contractor will be required to contact emergency response suppliers close to their work sites.

Once marine construction is completed, response equipment will be available at the marine berth and other key locations before commissioning the Kitimat Terminal.

Marine Incident Investigation

Northern Gateway will record and track all incidents and investigate to determine causes and any corrective action required to prevent similar incidents. The findings will be documented and communicated to appropriate authorities. Northern Gateway believes that due diligence in this area will foster continuous improvement in incident prevention.

A.2.1.10 Remediation and Reclamation

An incident site will be remediated to meet applicable regulatory standards. When applicable, a site will be revegetated according to methods described in the Vegetation Protection and Management Plan (see Section A.3.24). Reclamation methods and techniques will be applied, as outlined in Section 8.5.8, to restore the site to as close to its original condition as practical.

A.2.2 Fire Response Contingency Plan

Before construction and during regular safety briefings, the contractors will identify the fire boss, who will inform construction crews of:

- the fire danger rating for the area
- fire hazards
- location of firefighting equipment
- fire suppression procedures

All vehicles will carry firefighting equipment according to the British Columbia Forest Fire and Suppression Regulation and the Alberta Forest and Prairie Protection Regulation. Additionally, all motorized equipment must carry a fully charged fire extinguisher.
During construction, adequate firefighting equipment according to the guidelines specified in the *Forest and Prairies Protection Act* in Alberta and the British Columbia Forest Protection Code, will be available on the work site. If a fire occurs, the contractors will immediately use the firefighting equipment required to contain and control the fire, and will notify the Northern Gateway fire boss or authorized representative, who will then notify the BC MoF or Alberta Sustainable Resource Development (ASRD).

**A.2.2.1 Fire Reporting Procedure**

All fires of any size will be reported if a firefighting response is activated. If the Northern Gateway fire suppression team cannot extinguish the fire within 15 minutes of the first suppression team arriving on site, or the fire exceeds 0.1 ha in size, all Northern Gateway fire suppression team members will focus on safety, and prioritize the protection of team members. At the start of firefighting activities, or during any re-grouping period, information will be provided to the provincial agency responsible for the area of the fire (see Figure A-1).

**A.2.2.2 Wildfire Preparedness**

Northern Gateway may seek a streamlined process for managing project-related wildfires. The streamlined process will be determined by discussions with provincial regulators and the NEB. In the absence of a streamlined process, the following contingency plan was developed as an interim measure.

A large portion of the RoW is on Crown land in forested areas. In British Columbia, burning will be managed under the *Forest Practices Code of British Columbia Act* through the Forest Fire Prevention and Suppression Regulation. In Alberta, fires will be managed through the *Forest and Prairies Protection Act*. Installation of a pipeline is an industrial activity which has a medium to high fire risk. The Project will involve blasting, large engines, welding and grading, all of which are potential fire hazards. Regulations require that appropriate firefighting equipment be on site, including hand pumps, shovels, fire extinguishers, mattocks and communications equipment.

Northern Gateway will report all fires affecting an area of more than 1 m². To achieve this, Northern Gateway will use various fire-detection sources, such as:

- all employees and contractors on the Project
- fire lookouts
- observations during helicopter flights for other work tasks on the Project
- construction personnel patrolling the ground at night during burning activities
- the cooperation of other local industries

**A.2.2.3 Designated Responsibilities**

Common responsibilities or instructions exist for everyone assigned to respond to a fire. The following guidelines will be implemented at the start of a fire.
**FIRE REPORTING PROCEDURE**

**Caller Information:**
Name: ___________________________ Telephone No. ____________
Company: ________________________________________________________________________
Address: ________________________________________________________________________

**In Area Because:**
Local resident _______ Recreation ________________
Working _______ Other ________________

**Fire Location:**
In Alberta:
LSD _____ of section _____ Township _____ Range _____ W _____ Mer.
In British Columbia:
Other description: __________________________________________________________________

**Fire is burning in the:**
Ground ____________________
Bush ____________________ (provide timber type)

**On-site Information:**
Agricultural land ____________________________ (stubble, windrows, etc?)
Other ________________________________________________________________________

**Rate of spread is:**
Not moving ______________________________
Moderate ______________________________ (Less than a normal walk?)
Fast ______________________________ (More than a normal walk?)
Any people at the fire? Yes _____ No _____ Don’t know _____
Is property threatened? Yes _____ No _____ Don’t know _____
Is road access available? Yes _____ No _____ Don’t know _____
If yes, describe road access ______________________________________________________
Is water readily available? Yes _____ No _____ Don’t know _____
Any other observations? __________________________ (lightning, recreation, vehicles, people in the area?)

**Unable to see fire, only smoke visible:**
Colour: light grey _______ Column: intermittent _______

**Smoke Information**
medium grey ___ scattered ___ dark grey ___ light ___ black ___ heavy ___

If at any time Northern Gateway has any third-party information about the intentional cause of any wildfires, Northern Gateway will call Crime Stoppers at 1-800-222-TIPS (8477).

This form is adapted from British Columbia and Alberta fire call-in procedures.

**Figure A-1 Fire Reporting Procedure Form**
When the fire boss receives notification of a fire, a fire suppression team will be assigned immediately, and provided, at least, with:

- a reporting location and time
- the likely length of the assignment
- a brief description of the assignment
- route information
- a designated communications link, if necessary

Different regulatory agencies will have additional requirements.

The fire suppression team will bring specialized supplies and equipment required for the job, and will confirm whether adequate personnel and supplies are available to respond to the fire until it is extinguished.

After arriving at the scene of the fire, the fire suppression team will inform the fire boss about the size of the fire, using the following definitions:

- Class A = 0 to 0.1 ha
- Class B = greater than 0.1 ha to 4 ha
- Class C = greater than 4 ha to 40 ha
- Class D = greater than 40 ha to 200 ha
- Class E = greater than 200 ha

Radio communication about the fire site location and condition will use clear text, i.e., not radio code, such as providing:

- the fire event location along the RoW (e.g., KP 620.5)
- the fire class (e.g., Class A)

If the fire exceeds Class A, the fire boss will call in outside firefighting resources.

The fire suppression team will obtain a briefing from the fire boss, so they understand their assignment and the availability of firefighting equipment.

Actions to be taken by the fire suppression team include:

- acquiring necessary work materials, and locating and setting up the workstation
- organizing and briefing any subordinates assigned to the fire suppression team
- briefing the relief team at the end of each operational period and, as necessary, at the time they are demobilized from the fire site
- completing required forms and reports and providing them to the supervisor or the fire boss before leaving
- demobilizing according to the Fire Response Contingency Plan (see Section A.2.2)
A.2.2.4 Fire Suppression Team Buildup

Fire suppression team buildup will consist of assigning several smaller teams to respond to the fire. The built-up stages are determined by a physical count of the number of firefighters (operational staff) assigned to the incident.

The following four built-up stages will be used on the Project:

- Type 1 – 150 plus personnel
- Type 2 – 26 to 150 personnel
- Type 3 – 9 to 25 personnel
- Type 4 – 1 to 8 personnel

Northern Gateway’s primary response to a fire will be through a Type 4 fire suppression team. If the fire event exceeds the suppression capability of a Type 4 team within the first 10 minutes of suppression activities, the fire boss will reinforce the site with an additional Type 4 team to form a Type 3 team.

A.2.2.5 Fire Response

A fire boss and a backup fire boss for each construction spread will be designated and provided with suitable training in the areas of fire suppression techniques, fire behaviour and fire line safety, and will be familiar with firefighting techniques and equipment. The fire boss and each backup boss will be equipped with mobile communication equipment, to contact local fire protection agencies.

A.2.2.6 Construction during Fire Suppression Activities

Welding and other activities that may result in additional fires will be suspended during periods of high wind and when fire suppression equipment is actively being used elsewhere.

Smoking will be prohibited outside vehicles when the fire hazard is high or extreme.

A.2.2.7 Field Firefighting Equipment

Northern Gateway intends to negotiate reasonable standards for the firefighting resources and equipment required for the Project. The following equipment descriptions were derived from the regulations and do not take into account the scope and size of the Project. Therefore, they may be modified through negotiations with regulatory representatives.

All large equipment, such as bulldozers and side booms, will carry:

- two fully charged fire extinguishers (one with an Underwriters Laboratories of Canada [ULC] rating of at least 1A 5BC and one with a ULC rating of at least 3A 10BC)
- one long handled round-nosed shovel
- one Pulaski tool or mattock

All small equipment (with a load capacity of less than 1,000 kg) will carry one fully charged fire extinguisher with a ULC rating of at least 3A 20BC.
Slash burning crews must work within 200 m of two fully-charged fire extinguishers, each with a ULC rating of at least 3A 10BC, in addition to other firefighting equipment that may be required by forest district or municipal regulators. A first-call firefighting equipment station will also be established within 200 m of the work site.

A water truck will be maintained on the RoW near slash burning activities during spring, summer and fall, during periods of high fire hazard, and when large slash piles (greater than 2 m high and 3 m diameter) are burned. Each water truck will have one independent water pumping unit. A portable pump unit and a water source of at least 4,500 L may be substituted, if a water truck cannot be provided because of the terrain, the size of a work site, or the lack of available surface water on site.

First-call firefighting equipment stations will each consist of:

- either an axe, Pulaski tool or a mattock for each person on a Type 4 team
- two long handled round-nosed shovels
- one 18 L water backpack for every three team members
- one hand pail and four heavy sacks
- one barrel of at least 200 L of water

One first-call firefighting equipment station will be made available to each Type 4 fire suppression team.

A.2.2.8 Central Firefighting Equipment Cache

In addition to any other requirement of any regulation, Northern Gateway will manage a number of central equipment caches from which it can deliver the previously described firefighting equipment to any site along the RoW within two hours of notification.

A.2.2.9 Fire Prevention

Before construction and during regular safety briefings, the contractors will inform construction crews of fire hazards, locations of firefighting equipment and fire suppression procedures.

All construction personnel will be informed of the proper disposal methods for spent welding rods, cigarette butts and other hot or burning material.

Construction equipment will be maintained in good working condition, and exhaust and engine systems will be checked regularly and equipped with spark arrestors or mufflers. All machines will be kept free of accumulations of flammable material. All hydrocarbon and hydraulic lines will be in sound condition. Radiators will be checked periodically to determine if they are free of obstructions that may cause overheating.

Burning permits, if approved by the construction manager, will be obtained from the appropriate municipal or county office or from ASRD or the BC MoF for authorization before burning or clearing brush and slash. No unauthorized open fires are permitted.
Burning slash will not be permitted if the fire hazard is high or extreme. Once burning is approved by the construction manager and all appropriate municipal and regulatory authorities, burning can begin. If burning is delayed, slash will be stored along the RoW edges in natural clearings, at cut line intersections, or in approved push-outs. Alternatively, the slash will be mulched and spread on the RoW surface.

Slash burning areas will be kept to a size that can be safely burned by available personnel in one 24-hour period. Adequate personnel will be present to keep the fire contained within its intended boundaries. This includes detecting and suppressing spot fires outside the fire’s intended perimeter.

Slash and root piles and their associated firefighting equipment and staffing needs will be determined under the following constraints:

- Small open fires will be limited to piles no more than 2 m high and 3 m in diameter. Before a fire is ignited, all combustible material must be removed for at least 1 m in all directions from the waste material to be burned. The distance from any slash, snag, standing tree or wooden structure must be at least twice the diameter (or width) of the waste material, whichever is greater, or at least 2 m, if twice the diameter (or width) of the waste material is less than 2 m. Fires managed under these conditions require a burning permit in Alberta. During ignition and until all fires are extinguished, there must be at least one person at the burn area who actively patrols to prevent the fires from spreading, and is equipped with one first-call firefighting equipment station.

- Large open fires that are more than 50 m from combustible material, and exceed the size limits of small open fires, require a burning reference number in British Columbia and a burning permit in Alberta. During ignition, and until all risk of the fires spreading is eliminated, at least one person must be at the burn area, actively patrolling to prevent the fires from spreading. This person must be equipped with one first-call firefighting equipment station. Each adjacent open fire is to be separated by a fuel break of at least 10 m. The total distance between the first and last burning pile will not exceed 200 m when only one person is used to patrol large open fires. All fires must be extinguished within 14 days of the date of the burning reference number or burning permit being issued.

- Large open fires for root-raked materials that exceed the size limits of small open fires require a burning reference number in British Columbia and a burning permit in Alberta. All combustible material must be removed for at least 30 m in every direction from the perimeter of the root-raked material. During ignition, and until all risk of the fires spreading is eliminated, at least one person must be at the burn area, actively patrolling to prevent the fires from spreading. This person must be equipped with one first-call firefighting equipment station. The total distance between the first and last burning pile will not exceed 200 m when only one person is used to patrol large open fires. All fires must be extinguished within 14 days of the date of the burning reference number or burning permit being issued.
- Large open fires that are less than 50 m from combustible material, and exceed the size limits of small open fires, require a burning reference number in British Columbia and a burning permit in Alberta. During ignition, and until all risk of the fires spreading is eliminated, at least two people must be at the burn area, actively patrolling to prevent the fires from spreading. They must be equipped with one first-call firefighting equipment station and either a piece of heavy equipment that is suitable for fighting fires or a water delivery system. Before a fire is ignited, a fuel break will be established around the fire to prevent the fire from spreading, and the fuel break must be equal to, or greater than, twice the diameter (or width) of the pile or windrow to be burned. Each adjacent open fire is to be separated by a fuel break of at least 10 m. All fires must be extinguished within 14 days of the date of the burning reference number or burning permit being issued.

A small Type 3 fire suppression team, as defined in this plan, will deal with open fires that spread, or threaten to spread. The Type 3 fire suppression team will have the contents of two first-call firefighting equipment stations available to them, along with one water delivery system and one piece of heavy equipment suitable for firefighting on the burn area.

Any time a fire is set under the authorization of a burning reference number or permit, the permit holder must have the permit at the fire site. The permit will be made available upon request. If the permit is cancelled, the fire will be extinguished and a renewal for the permit will be secured before the fire can be reset.

Northern Gateway will activate the following fire spread prevention measures at all controlled burning sites:

- Burning woody debris (tree limbs and tops, roots, stumps and other organic material that remain on the ground after logging) will occur on stripped mineral soil or on burning sleds. Burning directly on organic soil will be avoided.

- Burns will be scheduled to avoid windy, gusty conditions. Whenever possible, burns will be planned for late in the day (after 6:00 p.m.).

- Fireguards will be established at all burn sites. Fireguards will be wide enough and free of burnable materials. A fire watch will be established at all burn sites. The fire watch will pay particular attention to spot fires that start from sparks from the burn site.

- Fire suppression tools will be made ready at all burn sites before ignition, and enough water will be on site to handle the size of the fire.

- If several bush piles are on site, only the number of piles that can be kept under control will be lit.

- When the burn is completed, final extinguishing will be accelerated by dispersing any smouldering ash or accumulations of burning debris.

- Persistent hot spots left to burn out will be well guarded.

- All vehicles will be parked in cleared or mowed open areas within the approved work limits. Vehicles will not be parked on easily combustible areas, such as tall dry grass or shrubs.

- When explosives are used along, or next to, the RoW, a fire watcher will remain at the location for at least 30 minutes after detonation, unless a longer period is required under regulations.
A.2.3 Environmental Damage Shutdown or Work Modification Contingency Plan

If heavy rains or unexpected thawing of frozen soils lead to rutting, which may damage the soil structure or result in admixing, work will be suspended until conditions improve. Environmental inspectors will be trained to identify soils that are too soft, as a result of rain or thawing, to allow work to continue. If modifying the work procedure would allow work to continue without rutting causing soil damage, modifications could be implemented after consultation between the construction manager and the environmental inspectors. Methods such as corduroying and matting will be used to limit adverse effects, where completing the work is urgent. Work will be suspended if excessive wet conditions occur that lead to structural damage of the soil. Indicators of structural damage include:

- excessive build-up of mud on equipment tires or tracks
- evidence of substantive slipping or skidding of wheels
- abnormal rutting of the topsoil layer, allowing admixing of soil layers
- pooling of water on the RoW and access routes

When forecast weather conditions could result in these indicators, contingency measures will be established beforehand. These measures will help to limit disturbance to terrain and soil structure.

Contingency measures for high precipitation or wet soil include:

- considering suspension of construction activities until the ground has dried out sufficiently to allow normal traffic to continue working in unaffected areas (as cleared by the environmental inspector), until conditions improve
- restricting access to the affected areas to equipment with low ground-pressure ratings (extra-wide tires or tracks)
- implementing corduroy construction techniques for potentially affected areas using suitable, non-salvageable timber
- installing swamp mats or geotextiles at potentially affected areas

Contingency measures for thawed or thawing soils include the measures for high precipitation or wet soil, and:

- using snow packing, ploughing, or both, to induce frost development and increase the load-bearing capability of the thawed or thawing surface
- restricting access to evening through early morning when the ground is frozen, if appropriate

Contractors will prepare work modification plans if extreme weather events are forecast. The plans will include detailed criteria for assessing the need for suspending activities because of wet, thawed or thawing soil conditions.
A.2.4 Weather Event Siltation Contingency Plan

Storm water management is necessary for:

- controlling erosion
- maintaining suitable water quality
- preventing sediment-laden water from entering receiving waterbodies

The potential for severe weather (e.g., heavy precipitation events or rain on snow) will be monitored by Northern Gateway, and the need for special preparations will be communicated to contractors, as warranted. Siltation control measures will be taken in severe weather in addition to the ongoing erosion and siltation control measures in the Erosion and Sediment Control Plan (see Section A.3.5).

In anticipation of extreme weather, contractors will be directed to have a mobile trailer equipped with adequate siltation control equipment, including a silt fence, pumps, hose and other tools necessary for installation. If extreme weather occurs, essential heavy equipment will be used to help control siltation of sensitive watercourses.

The following short-term measures for extreme storm water control will be implemented, where appropriate, and adapted to the circumstances:

- Culverts and other site drainage works will be cleaned, so they convey water as intended, and the possibility of blockages and backup is reduced.
- Existing sediment capture and control works will be cleaned, so they are fully effective during the expected weather.
- Additional perimeter ditches will be constructed, to divert overland flow from excavations or exposed areas.
- Check dams or gravel lining will be added to site ditches.
- Sheetimg will be applied to steep, nonvegetated or erodible slopes.
- Clean granular material will be added to work and travel surfaces in areas of fine or erodible soils.
- Temporary berms will be constructed, to keep watercourses in their channels and out of the trench.
- Runoff flows with heavy sediment loads will be diverted into natural depressions or purpose-built sediment ponds.

Where access may conflict with environmental shutdown, extra equipment and supplies might be stockpiled at watercourses. Contractors will follow the General Provisions for Emergency Siltation Control (see Section A.2.4.1). If a storm is predicted, contractors will implement additional controls in the active work areas, so that runoff leaving the site meets the requirements for TSS.
A.2.4.1 General Provisions for Emergency Siltation Control

All storm water management mechanisms, including sediment ponds, will be in place after grading and grubbing activities, as outlined in the Storm Water Management Plan (see Section A.3.4). Contractors will be responsible for implementing general storm water management measures. Water leaving storm water management systems will meet approved water quality standards.

Where appropriate, Northern Gateway will use the following measures to comply with regulated storm water management requirements:

- Contractors will maintain sufficient quantities of silt fence, hay mulch, washed rock, geotextile fabric and erosion control blankets on site to address erosion and sediment control as the work progresses.
- Siltation control devices, such as a silt fence, will be installed around the perimeter of the construction site to prevent sediment from leaving the site.
- The amount and duration of soil exposure will be as small as possible.
- Once an area is brought to final grade, exposed surfaces will be either seeded and mulched, or covered with well-graded washed rock, hay mulch, and geotextile fabric or erosion control blankets.
- Banks and grade cuts that have a high potential for erosion will be stabilized.
- Drainage near construction sites will be controlled, and ditches will be provided as needed to prevent surface water from entering excavated areas.
- Pipe outlet sediment traps will be used to intercept and retain sediment-laden runoff so that sediment can settle out.
- Any damage caused by equipment or erosion will be repaired immediately.
- Excavated or fill materials will not be stockpiled within 10 m of a watercourse.
- Diversion ditches will be used to convey clean water around specific work areas.

Corrective action will be developed and implemented if Northern Gateway inspection staff identifies noncompliance with erosion and sediment control provisions. Construction activities might require shutting down until the noncompliance is satisfactorily corrected.

A.2.5 Heritage Resources Discovery Plan

A.2.5.1 Archaeology Discovery Contingency Plan

The Alberta *Historical Resources Act* and British Columbia’s *Heritage Conservation Act* require that construction activities be halted and the Minister be informed when heritage resources are encountered. If heritage resources are encountered during construction, the following should be contacted sequentially:

- the environmental inspector
- the environmental manager
- Northern Gateway construction management
- the professional archaeologist monitor on site, if available
• the heritage resources team lead
• local Aboriginal representatives, as appropriate

The heritage resources team lead will then take responsibility and advise additional individuals and agencies, as appropriate, including:

• the Historical Resources Management Branch of Alberta Culture and Community Spirit
• the Archaeology Branch of the British Columbia Ministry of Tourism, Culture and the Arts
• local Aboriginal groups

Typical cultural remains that might be encountered include:

• standing or collapsed historical structures (barns, houses, outbuildings)
• historical period middens or dumps
• historical period artifacts, such as ceramics, glass, metal
• precontact period lithic or stone flakes or tools
• precontact period ceramics
• animal bones and bone fragments, which may be burnt black, calcined white or butchered
• precontact or historical period stone features, such as tipi rings, cairns, or fieldstone building foundations
• culturally modified trees (CMTs), both pre- and post-1846 A.D.
• burials or other human remains

A.2.5.2 Palaeontology Discovery Contingency Plan

Areas with only low or moderate palaeontological potential will not be monitored by a professional palaeontologist. However, fossils may be found in these areas. In Alberta, it is required by law to report all fossils found during construction. For consistency, a similar process will be followed in British Columbia.

The protocol that will apply if a fossil is discovered includes:

• stopping operations near the find to avoid any further damage or disturbance to the specimen
• notifying the construction manager and the environmental inspector of the discovery. The construction manager or environmental inspector will redirect operations to a safe distance away from the find (at least 20 m).

The environmental inspector will:

• safely recover the fossil, if loose, to prevent loss or further damage
• barricade or flag off the area where the fossil was identified, to prevent further disturbance by equipment or personnel
• contact a designated palaeontologist and describe what was found and where
The palaeontologist will evaluate the information to determine the likelihood of the find being important, and will consult with the appropriate regulatory authorities, as required. A decision will be made on whether to resume construction with no restrictions, or to preserve the site until the palaeontologist arrives.

A.2.6 Wildlife Encounter Contingency Plan

This plan contains measures to limit the interactions personnel may have with wildlife during construction.

A.2.6.1 Environmental Interest

Threats to personnel include encounters with bears, any animals with young, moose (when in rut) and rabid animals such as foxes, wolves and beavers. Wildlife encounters have the potential to distress animals to the point of altering feeding and breeding behaviour. Physical injury or death to wildlife could also occur.

A.2.6.2 Contingency Procedures

**Marine Mammal Encounters**

All personnel will be advised of the appropriate procedures to use during a marine mammal encounter. The following measures will be implemented by contractors and Northern Gateway personnel if marine mammals are observed close to project-related vessels during construction:

- No personnel shall approach, feed or harass wildlife if encountered.
- Take all normal precautions to avoid a collision, such as assigning a marine mammal monitor while conducting work on a vessel. A marine mammal monitor will be an appropriately trained individual who will serve as a dedicated lookout for marine mammals during construction activities that have a potential to cause an acoustic disturbance to marine mammals.

Mammal sightings will be recorded by the environmental inspector or marine mammal monitor and be reported to the environment manager. Upon assessing the situation, the environment manager will report to DFO, when appropriate. The CWS and provincial wildlife officers will be contacted about wildlife encounters in sensitive areas.

**Terrestrial Wildlife Encounters**

The following measures will be implemented, where appropriate, by contractors and Northern Gateway personnel to reduce the likelihood of wildlife encounters.

- No personnel shall approach, feed or harass wildlife.
- Firearms will not be permitted on or near the work site. Hunting by project employees will be prohibited.
- All food waste will be properly contained and disposed of regularly at an approved facility.
• The CWS and provincial wildlife officers will be contacted about encounters with rare or endangered wildlife species. Regulatory authorities will determine the appropriate action to take.

• Personnel will be advised of the potential occurrence of rare or endangered wildlife in areas of project activity.

• No pets will be allowed at the construction sites.

• If a large animal (e.g., deer) is struck by vehicles or equipment, the environmental manager or environmental inspector and provincial wildlife officer will be notified. A summary of these occurrences will be prepared and made available to Aboriginal groups, if requested, through the appropriate Northern Gateway contact.

• Project personnel will be directed to always yield to an animal.

• Project personnel will be alert to the signs of animal presence (e.g., tracks, droppings) and report any findings to the environmental inspector and construction manager.

**Training Requirements**

All personnel working on the site will receive Construction EPMP orientation training.

Marine mammal observers will be trained by Northern Gateway to spot marine mammals within the predetermined danger zone established for marine areas of the Project.

**Records**

Contractors will maintain records of environmental training.

If a wildlife encounter occurs, an incident report form will be filed for including in the weekly project reports to Northern Gateway.

**A.2.7 Horizontal Directional Drilling Contingency Plan**

**General Requirements**

Federal and provincial regulatory agencies require a plan to be developed for directional drilling operations, as well as monitoring during construction. Monitoring will watch for drilling fluids or the water used from entering waterbodies. Northern Gateway has adjusted the plan so that the most stringent regulatory needs with the Department of Fisheries and Oceans Canada and in the Province of Alberta or British Columbia are incorporated. Based on these inputs, the contingency plan for HDD crossings will include the following:

• Environmental protection measures will be considered for reducing potential adverse effects on the aquatic environment.

• A contingency plan will be developed between Northern Gateway and the drilling contractor, to be implemented if potential problems arise resulting from adverse conditions or crossing method failures. The plan will take into account restricted activity periods.
Hydraulic fracture (frac-out) response measures and environmental monitoring requirements will be specified.

The following regulatory and industry considerations were included during contingency plan development:

- Recommendations developed by the Canadian Association of Petroleum Producers (CAPP) contained in their guideline: Planning Horizontal Directional Drilling for Pipeline Construction (CAPP HDD).
- Specifications and recommendations by a Northern Gateway qualified aquatic environment specialist, according to Alberta Environment’s Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body.
- Operational statements, developed by DFO in Alberta and British Columbia for work performed under applicable operational statements documents.

The Horizontal Directional Drilling Contingency Plan is an action plan and guide for emergency procedures, notifications, responsibilities, control points, safety, media and reporting requirements. Regular communication and training will be implemented so that the plan is well understood by all contractors and employees.

### A.2.7.1 Frac-Out Response

If the drill operator detects a loss of drilling fluid or a drop in pressure, the drill operator will stop drilling and will notify the project HDD supervisor and the environmental inspector that a potential frac-out has occurred. The project HDD supervisor will notify the construction manager and initiate the appropriate response, and the appropriate regulatory authorities will be contacted.

Depending on the nature and extent of the frac-out, the following measures will be implemented, as appropriate:

- Turbidity and TSS monitoring will continue in the watercourse crossing and downstream locations, independently of the frac-out containment. One contractor-appointed person may be assigned to accompany the environmental inspector during routine water quality sampling (every two to four hours) for safety and because of liability.
- Personnel appointed by the drilling contractor will search for drilling fluid escaping to the surface in upland areas. They will search locations where an abrupt change in slope occurs, and near entry and exit points. Ground covered in snow will be probed, to determine whether mud is present under the snow.
- As fluid loss normally occurs in fault zones, fracture zones, or seams of coarse material, fluid migration does not always reach the surface, thus making detection difficult. If no surface migration is evident, then Northern Gateway will present and discuss the operational plan for possible plugging agents. Northern Gateway will also provide personnel to examine the RoW locale, including an area 100 m on each side of the RoW. Operations may resume if fluid does not present a hazard to the environment, as determined by Northern Gateway and the appropriate regulatory bodies.
If a frac-out is discovered on land within the riparian zone, a length of culvert will be driven into the ground, or sandbags will be placed around the frac-out. A vacuum pump, mud pump, or both, will be used to remove any contained drilling fluid. If access is limited by the terrain or vegetation cover, the frac-out will be contained by sandbags, filter cloth, plastic sheets and other locally available materials. Portable mud pumps or other transport methods will then be used to remove the contents of the frac-out. It will be pumped out of the riparian area, if possible, and transported to an approved disposal site.

Where a frac-out is underwater, and it is practical to do so, a culvert will be lowered around the origin of the bentonite plume and forced into the substrate. The culvert will be capped with a plastic housing until its contents can be removed by vacuum hose. A vacuum hose will be lowered into the culvert containing the fluid. Fluid will be pumped either directly to a vacuum truck, back to the drill site or into a mud tank or sump on shore. If the sump is within the riparian zone, the fluid will be pumped back to a vacuum truck to be disposed of appropriately. Other methods of removal will be tried if this approach is inadequate or not practical.

Where frac-outs have occurred in water, aqua-dams or sheet plates may be installed in the river to create an eddy effect upstream of the frac-out.

Once the frac-out is controlled (plugged by methods listed in the HDD Execution Plan or contained and pumped to the rig), and all necessary agencies have been notified and consulted, drilling operations will continue, paying particular attention to the fracture points and any other area that has the potential to leak fluids.

After the frac-out has been contained and cleaned up, the culverts will be removed and the area will be restored. On land, this may require steam cleaning, water washing, hydrovacing and surface scraping the area. In the water, it will require hydrovacing physical areas of the substrate until all of the bentonite has been satisfactorily removed.

If the frac-out occurs in the winter, investigations will be made via ice-augered observation holes followed by similar cleanup procedures. Cleanup procedures will be adapted to meet the conditions of the site and the types of activities.

### A.3 Environmental Management Plans

Plans will be prepared during detailed design and permitting and will be submitted to the appropriate regulatory authorities before construction. The following sections outline major plans and principles.

#### A.3.1 Right-of-Way Planning

As part of the RoW planning process, the Grade Plan will be created to document the decisions made during RoW planning. Environmental evaluations that will be required before any physical grading takes place include those for soils, fish and wildlife, vegetation and traditional use cultural or historical resources. The evaluations will focus on the environmental parameters that were the subject of the ESA and NEB approval, and the appropriate environmental considerations will be incorporated into the Grade Plan.
The following will be considered during RoW planning activities:

- RoW planning teams will consist of an environmental inspector, a grade activity specialist, a contractor grade specialist or foreman, and appropriate environmental discipline specialists. Where requested by local Aboriginal groups, Aboriginal representatives will be included.

- The Grade Plan for each construction spread may be created in sections to allow physical work to start.

- The Grade Plan will address topics such as:
  - changes to topsoil stripping methods
  - likely grade cut locations
  - approximate depth of the grade cut
  - potential topsoil placement and grade spoil placement locations
  - terrain hazards
  - areas where extra temporary workspace may be required

- Where the RoW planning process indicates an activity has the potential to affect a valued environmental resource, (e.g., a rare plant or an archaeological site), mitigation strategies that might be implemented include:
  - avoiding the resource by moving the extra temporary workspace to an area adjacent to the RoW
  - narrowing the work area
  - deviating the RoW
  - moving or transplanting the resource
  - fencing or flagging the resource
  - excavating materials
  - shielding the resource with geotextile or other materials
  - applying trenchless technology
  - applying specific reclamation plans
  - altering the construction timing or schedule

- Any member of the environmental team may escalate the environmental resource evaluation to include Northern Gateway environmental management, where warranted by the magnitude of the environmental resource or the construction problem.

- Once the Grade Plan has been approved, it cannot be changed or amended by the contractors without Northern Gateway construction management approval. No change will be approved until it is examined by the appropriate environmental resource specialists.
A.3.1.1 Managed Passage Gaps

The RoW will cross various roadways and wildlife paths. Gaps will be managed on a project basis to encompass all activities and mitigation installations during and after construction. The following gap creation and maintenance measures will be implemented, where appropriate:

- The location of passage gaps will coincide, to the extent possible, with farm trails, logging roads and trails, open-cut roads, trappers’ trails, wildlife movement corridors, and pipeline testing requirements. Existing bored road crossings will also be included in the planning.
- The placement of gaps will be determined according to need, or if requested (i.e., the spacing and frequency of gaps will not be uniform).
- Gaps on farms will be wide enough to accommodate farm equipment. Farm gaps may be listed on the landowner line list, or placed during construction.
- Wildlife and other passage gaps may be identified on the environmental alignment sheets (to be made available before construction starts) or placed at the discretion of the environmental inspector during construction. Local Aboriginal groups and regional provincial wildlife regulatory representatives will be consulted to determine gap location, spacing and frequency.
- All gaps will be subject to temporary closure for approved periods to permit efficient construction. The timing will be variable, but 48 hours will be the minimum for any activity.
- When the locations of gaps are being determined, the following will be considered:
  - locations of grubbing piles, topsoil piles and grade material stockpile sites
  - placement and duration of spoil piles
  - strung pipe short jointing
  - welded pipe tie-in requirements
  - welded pipe skidded heights
- expected duration of the open trench

A.3.2 Access Management Plan

A.3.2.1 Introduction

Access management is part of a comprehensive strategy that will address potential environmental effects of the Project. Northern Gateway will consult with resource managers, participating Aboriginal groups and stakeholders as project planning proceeds, and will update the construction Access Management Plan within 60 days of project construction starting.

Developing new access could lead to:

- increased opportunities for camping, hunting and touring
- stimulation of other economic developments or exploration
- competition with other existing land use activities, such as traditional use, resource development, trapping, recreation and outfitting businesses
- disturbance of fish and wildlife populations
- reduced wilderness aesthetics
- erosion and sedimentation of watercourses crossed by the RoW, access roads or trails
- potential for an increase in forest fires
- loss of productive forest land base
- unauthorized access to private property

Northern Gateway intends to manage access consistent with the environmental management objectives of the areas crossed by the pipeline route and the directions of regulatory agencies responsible for such areas.

The Access Management Plan will maintain a balance between the requirements for safe pipeline operations and the protection of fish and wildlife and associated resource use. It will integrate all of Northern Gateway’s documented access management commitments, including site-specific measures arising from the consultation workshops and discussions with resource managers. Local Aboriginal traditional knowledge that is relevant to access will be considered and, where practical, incorporated into the Access Management Plan.

Access management measures will adhere to the following objectives, where applicable:

- Implement access management measures, where appropriate, so access to the areas near the pipeline route does not increase or decrease.
- Limit access to maintain the integrity of the pipelines and associated infrastructure.
- Respect existing and traditional access corridors and limit access-related conflicts with other resource users in the area.
- Restrict or limit access to private lands.
- Control unwanted public access to the RoW and project infrastructure with measures such as signage, gates, earthen berms, coarse woody debris, revegetation and vegetation screens (such as planted trees), and slash and rock piles.
- Allow necessary access for operations activities, such as visual inspection and maintenance, and for emergencies.
- Limit the potential for predators to access and travel easily on the RoW.
- Limit the disturbance of high quality habitat for species of management concern.
- Support coordinated access planning and management with other stakeholders in the area, to allow for consistent standards of access management and effective protection of fish and wildlife and their habitats in the long term.
A.3.2.2 Project Access Characteristics

The area cleared for construction access will include upgraded roads, new roads, the RoW and adjacent temporary workspace, as needed. The width of the cleared area will depend on several factors, including:

- the slope of the terrain
- the ability to share temporary workspace with adjacent land uses, such as roads
- locations of topsoil and subsoil storage areas
- the locations for log decking sites
- location of woody slash material for use as rollback for access and erosion control

Access for construction will consider traffic volume and type of equipment, the location and protection of environmental features, and safety factors. For HDD crossings, clearing will be limited to that required for access along the RoW, if alternate access is not readily available.

A.3.2.3 Environmental Compliance

Northern Gateway will manage access to project activity areas in an environmentally responsible way. To meet the requirements of the Project, several initiatives will be developed and integrated throughout the final Construction EPMP, such as:

- adaptive engineering and design
- environmental education and orientation
- environmental inspection
- environmental audits
- issue resolution
- post-construction monitoring and adaptive management

A.3.2.4 Consultation

During planning for the Project, Northern Gateway has organized and held meetings and workshops with Alberta and British Columbia government agencies, trappers, outfitters, Aboriginal groups and groups with commercial interests. The following are some of the topics raised during project-specific consultation, and during past projects:

- Aboriginal groups want to be involved in access management planning.
- Public or third-party access could threaten the safety or integrity of pipeline infrastructure.
- Increases in hunting pressures and natural predation on local wildlife could result from the development of additional access.
- Access management planning should accommodate operations and maintenance of the pipelines and associated infrastructure.
- Using existing access for some areas of project activity could limit use by the general public.
- Access management options should limit incompatible uses or adverse effects on wildlife and wildlife habitat along the RoW (e.g., line of sight and travel along the RoW).
• Provincial governments should be responsible for initiating, coordinating and implementing regional access management plans.

• Traditional and newly developed access on Crown land, that is or could be used by the public, should not be unnecessarily restricted unless known hazards exist for the public.

Consultation will continue during the development of the Access Management Plan as part of the final Construction EPMP.

To control access effectively, mitigation measures will be implemented and monitored during construction and operations. The Access Management Plan will be viewed in conjunction with the Traffic Control Plan developed for the Project (see Section A.3.3). Site-specific access management measures for all phases will be shown on the construction drawings and environmental alignment sheets.

A.3.2.5 Access for Aboriginal Groups

Northern Gateway will make provisions for Aboriginal groups to access the RoW by:

• providing opportunities for Aboriginal groups to harvest medicinal and food source plants before the RoW and pump station sites are cleared, if the RoW or pump stations overlap traditional use areas of Aboriginal groups residing near the PDA

• considering requests by Aboriginal groups for firewood from the clearing slash

• facilitating ongoing access for Aboriginal trappers and hunters to their traplines and hunting trails during active construction, through breaks in the rollback at flagged trails and strategically placed trench plugs

A.3.2.6 Preconstruction and Construction Access Control Measures

Northern Gateway has developed a project access map that identifies existing and new access roads. Where possible, Northern Gateway will use existing roads and RoWs to limit disturbance, including:

• routing the RoW parallel to, or overlapping, existing linear disturbances (roads, seismic lines, pipelines)

• using existing access roads where available

• coordinating the development of new (temporary) roads with other industrial operators

• locating facilities near existing roads, to limit the disturbance to remote areas during maintenance

• using existing watercourse crossings, where possible

The following access control measures will be implemented, where appropriate:

• Before the use of any access, contractors will place shoo-fly signs indicating the number of the access. This information will be marked on construction access maps and properly indicated, so the access is clearly visible.
• Important site-specific features, such as rare plants, den sites, protected stands of trees, traditional gathering areas or other cultural features and heritage resources, will be flagged or fenced before clearing or construction activities occur.

• Reforested cut blocks will be identified and flagged to exclude construction traffic, unless specifically approved and included within RoW or workspace boundaries.

• Signs prohibiting unauthorized vehicle travel during construction will be posted to deter public access. This will help to limit increased access and fish harvesting.

• Northern Gateway will coordinate with other industrial operators near project activities to develop and maintain access restrictions or control measures throughout construction.

• Construction personnel will carpool or use buses, when possible, to limit vehicle traffic between lodging and work site locations.

• Northern Gateway will prohibit project personnel from the recreational use of temporary access roads and the RoW.

• Project traffic will be confined to the RoW and designated access roads and construction sites.

• A speed limit will be enforced along the RoW, to avoid project-related mortality of wildlife.

• Gates will be locked or staffed.

A.3.2.7 Post-Construction and Operations Access Control Measures

Access control measures for operations and post-construction will be determined based on input received during consultation, extensive map and aerial photograph interpretation, and aerial reconnaissance of the RoW. Specific locations considered for access control include:

• where the RoW intercepts pre-existing roads and cutlines

• where the potential exists for access to:
  • sensitive areas
  • important habitat and traditional areas

At selected locations, access control will include one or more of the following measures:

• Revegetate temporary access and work areas and riparian areas along the RoW to restrict access.

• Replant at selected locations to provide long-term access control, limit lines of sight and re-establish wildlife habitat.

• Roll back slash material and timber.

• Install rock or other suitable material barriers, using material from blasting and grading to limit access (excludes pre-existing access).
A.3.2.8 Decommissioning Temporary Access

All temporary access will be reclaimed after construction, unless specified. The following cleanup and revegetation measures will be used to decommission temporary access:

- All temporary roads (including shoo-flies) and construction sites will be deactivated and rehabilitated with native vegetation, to prevent use and to provide cover for wildlife.
- Weather permitting, cleanup will occur as soon as practical where construction access is no longer necessary.
- Except as limited by terrain stability and other considerations, all grade cuts will be restored to stable contours, approximating preconstruction conditions, or according to regional provincial regulatory requirements.
- Cross-ditches and diversion berms will be installed on moderate to steep slopes to divert surface water off the RoW. The exact locations of cross ditches and diversion berms will be finalized in the field in consultation with the environmental inspector and a geotechnical engineer where appropriate.
- Tracked equipment might be used to pack and imprint the surface. Track cleat imprints will be perpendicular to the fall line of the slope, where practical. Track cleat imprinting will not be allowed in locations where safety could be compromised.
- Decommissioned access roads will be replanted to block access, restore riparian vegetation, provide erosion control, limit lines of sight and reclaim selected habitat areas. All watercourse crossings, watercourse banks and approach slopes will be restored to stable contours using local material, and will be revegetated as needed with the appropriate seed mix and woody plant materials.
- Shrub transplants, brush layering using local native stock, or bioengineering techniques, will be employed to enhance slope stability and restore riparian habitat features at designated watercourses. The environmental inspector will determine the extent of these measures in consultation with a fisheries specialist and construction management.
- All temporary bridge spans will be removed and banks stabilized to preconstruction conditions.
- Slash material salvaged for use as rollback for access control will be distributed evenly over the RoW as directed by the environmental inspector. Rollback for access control will not be “walked down” with heavy equipment during its application.
- Applicable provincial agencies will be consulted to develop the appropriate seed mixes of native species. Seed mixes and locations will be identified before construction.

A.3.2.9 Post-Construction Monitoring

A post-construction program for monitoring the success of access controls will be established in cooperation with provincial and federal regulators. The program will focus on access control installations, reclamation, revegetation, erosion control and slope stability. Monitoring is critical for determining the effectiveness of existing access control measures and making adjustments as needed.
A.3.3 Traffic Control Plan

The Traffic Control Plan will limit or prevent vehicle and equipment movements on the RoW and other approved access roads. The plan is part of the overall objective to limit environmental effects in the PDA. The Traffic Control Plan considers factors related to the interaction of humans, wildlife, vegetation, historical resources and soils. The following mitigation measures and protocols will be integral to the success of the plan:

- Northern Gateway will confine all project traffic to the RoW, designated access roads and construction sites.
- Where project-related dust generated on or off the RoW or associated access is detrimental, the dust may be controlled by applying water or tackifier, or further reducing speed limits.
- Low-ground-pressure vehicles, including ATVs and tracked equipment, can be used where practical.
- Where traffic has a considerable effect on an environmental feature, vehicle pooling will be enforced, or alternative access will be used to redirect the flow of nonessential traffic.
- Where historical or environmental features are time sensitive, traffic will be scheduled to avoid sensitive periods.
- Where important features exist, additional turnaround points may be created along the RoW to direct traffic away from the feature. Whenever possible, the turnaround points will be constructed in natural openings.
- Areas and features where traffic controls are in effect will be flagged or have signs, to enhance compliance.
- Where the feature is speed sensitive, speed limits for the RoW and access roads will be reduced.
- In high-risk areas on project roads and the RoW, and in critical wildlife areas or in the presence of wildlife, speed limits will be reduced.
- Where the soil is damaged by compaction, admixing and loss, traffic will be limited, redirected or stopped, and the Environmental Damage Shutdown or Work Modification Contingency Plan (see Section A.2.3) will be implemented.

A.3.4 Storm Water Management Plan

During construction, site preparation and the use of heavy vehicles will expose the soil and make it susceptible to erosion. Precipitation, flowing water, steep slopes and highly erodible soils are all factors that increase the potential for erosion.

Storm water management systems will be designed to:

- control the entry of surface runoff from the surrounding area
- contain the silted or contaminated runoff from an infrastructure site
- work as a part of the containment system at a site
Measures to control erosion and sedimentation from project surfaces are outlined in the Erosion and Sediment Control Plan (see Section A.3.5). Contingency measures for extreme weather conditions are provided in the Weather Event Siltation Contingency Plan (see Section A.2.4).

### A.3.4.1 General Provisions

All storm water management mechanisms, including sediment ponds, will be in place after grading and grubbing activities. Unless otherwise stated, contractors will be responsible for implementing general storm water controls, including installation, maintenance and removal. Water that leaves the storm water management systems will meet approved water quality standards.

Northern Gateway will implement the following measures, where appropriate, to maintain compliance with applicable storm water management requirements:

- Contractors will maintain sufficient quantities of silt fence, hay mulch, washed rock, geotextile fabric and erosion control blankets on-site to address drainage, erosion and sediment control.
- Drainage near construction sites will be controlled and ditches will be provided as needed, to prevent clean surface water from entering excavations or areas of disturbed and erodible soils.
- Siltation control devices, such as a silt fence, will be installed around the perimeter of the site to prevent overland flow from transporting sediment off the site.
- Northern Gateway will monitor heavy precipitation and rain-on-snow events, and communicate to contractors the need for any additional preparations. The Weather Event Siltation Contingency Plan (see Section A.2.4) contains additional information.
- If a storm event is predicted, contractors will implement additional controls in the active work areas, so that runoff leaving the site meets the requirements for total suspended solids. Banks and grade cuts with a high potential for erosion will be stabilized.
- Pipe outlet sediment ponds will be used to intercept and retain sediment-laden runoff, so that sediment can settle out.
- If processed fresh water must be discharged into the marine environment, it will be released from a discharge pipe at a substantial distance from the marine terminal. Release will be timed with the outgoing tides, to limit the effect on water temperature and salinity.

### A.3.4.2 Sump Construction on Infrastructure Sites

Bermed and trenched areas on infrastructure sites will drain into a settlement sump for collecting silt or contaminated water. The sumps will be constructed with a baffle system to limit silt transfer, and the outlet will have a way of shutting off the exit flow if the water is contaminated. Contaminated water will be pumped out and taken to an approved disposal site.
A.3.4.3 Diversion Ditches

Diversion ditches, used to convey clean water around specific work areas, will be positioned to dissipate flow in the direction of a watercourse or vegetated dispersion area. Diversion ditches may also be constructed along the top of cut slopes, especially if the slope is very steep or the soils are prone to erosion.

There are two types of diversion ditches: temporary and permanent. Temporary diversion ditches will be installed as an interim measure to assist during construction. Permanent diversion ditches will be installed as an integral part of an overall runoff water control system and will remain in place after construction.

Installation and Maintenance

The following guidelines apply to diversion ditches:

- Diversion ditches will be installed after grubbing or grading to intercept surface runoff or maintain drainage patterns across the RoW.
- Diversion ditch outlets will be large enough to handle runoff flow volumes.
- Where the conveyance of clean water is required, diversion ditches (temporary or permanent) will be lined with non-erodible material.
- Where high flow volumes could overflow a diversion ditch, it may be necessary to construct a berm on the downslope side, to contain the flow.

A.3.4.4 Flow Checks

Flow checks will be installed in diversion ditches to control sediment-laden runoff. Flow checks will be installed across drainage ditches throughout cut sections and adjacent to inlets and outlets of culverts.

Installation and Maintenance

The following guidelines apply to flow checks:

- Flow checks will be constructed of clean gravel.
- Flow checks will be keyed into the slopes and the bottom of the ditches.
- The ends of the flow check will be higher than the middle, to allow water to flow over the centre of the flow check, and to prevent scouring of the slopes.
- Flow checks will continue until vegetation is sufficiently established to be an effective deterrent to sediment-laden runoff.
- Contractors will monitor flow checks during the construction phase, and will clean them out after each storm, or when the accumulated sediment reaches a depth of 300 mm immediately upstream of the control device.
A.3.5 Erosion and Sediment Control Plan

A.3.5.1 Introduction

Erosion control involves installing structures, such as silt fencing and berms, to control siltation and erosion caused by construction activities. Site-specific erosion protection and control measures will be determined by geotechnical and erosion control specialists, with assistance from an environmental inspector and through completion of a risk-based assessment. Erosion similar to that occurring in areas adjacent to the RoW is considered normal, and will not be specifically controlled unless an environmental or engineering risk factor is identified.

The primary risk categories for sediment and erosion are:

- human risk
- infrastructure integrity
- siltation of water resources
- topsoil admixing and soil characteristics
- soil loss
- hindrance to reclamation

Natural erosion risk agents are wind, water and mass movement as a result of subsurface drainage regimes.

General protection and control measures, identified before construction, will be stipulated on the construction drawings and environmental alignment sheets. Additional inspection will be completed between clearing and grading, particularly where sites will be left for an extended period. Additionally, erosion risk assessments will be carried out after a site has been graded, and again during cleanup.

Erosion protection and control measures will include clearing restrictions, RoW planning, state-of-the-art designs for berms, rollback, subdrains, matting, gabions, silt fencing, tackifiers, seeding, planting, imprinting, straw crimping, rock armouring and timber trenches.

For watercourse crossings, sensitivities of upland areas will be assessed to determine the need for erosion and sediment control plans.

This plan addresses conditions encountered during construction and post-construction. During construction, the effective use of sediment and erosion control measures depends upon timely intervention, as a result of anticipating conditions that would initiate a response and responding to an event quickly.

Generally, temporary measures will be replaced by more permanent measures during cleanup and reclamation.

Table A-9 presents a list of erosion and sediment control measures that may apply to the Project.
### Table A-9 Summary of Erosion and Sediment Control Measures

<table>
<thead>
<tr>
<th>Control Measures</th>
<th>Comments</th>
<th>Principal Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Large Slope Areas</td>
</tr>
<tr>
<td>Erosion Protection – Vegetative Cover</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Grass and legume seeding</td>
<td>Effective permanent surface stabilization measure; effectiveness of seeding alone is limited on steeper slopes</td>
<td>✓</td>
</tr>
<tr>
<td>Erosion control blanket with seeding</td>
<td>Effective for immediate protection of small critical areas, such as channels and steep slopes; costly but very effective</td>
<td>✓</td>
</tr>
<tr>
<td>Other vegetative cover</td>
<td>Effective erosion control; tree and shrub cuttings and transplants; provides habitat value (shading, overhang protection)</td>
<td>✓</td>
</tr>
<tr>
<td>Erosion Protection – Non-Vegetative Cover</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Straw mulch</td>
<td>Very effective, especially if crimped into the surface</td>
<td>✓</td>
</tr>
<tr>
<td>Gravel sheeting</td>
<td>Useful for permanent cover where vegetation cannot be grown, or to control seepage; may require filter beneath</td>
<td>✓</td>
</tr>
<tr>
<td>Rock rip-rap</td>
<td>Effective and economical, within limits; widely used to control channel and bank erosion</td>
<td>✓</td>
</tr>
<tr>
<td>Other bank protection</td>
<td>Bank restoration alternatives are outlined in the Watercourse Reclamation Plan (see Section A.3.20)</td>
<td>✓</td>
</tr>
<tr>
<td>Runoff Control – Slope Modification</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Slope flattening</td>
<td>May be economical where surplus fill and adequate width are available, or where flattening cut slopes would provide needed borrow fill</td>
<td>✓</td>
</tr>
<tr>
<td>Slope benching</td>
<td>Effective if sufficient width is available; positive drainage needed, and uncontrolled overflow down slope must be prevented</td>
<td>✓</td>
</tr>
</tbody>
</table>
### Table A-9 Summary of Erosion and Sediment Control Measures (cont’d)

<table>
<thead>
<tr>
<th>Control Measures</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Large Slope Areas</td>
</tr>
<tr>
<td>Runoff Control – Temporary Runoff Control</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Diversion berms and drains</td>
<td>Important, effective and economical way of controlling surface runoff and erosion; may be temporary or permanent</td>
<td>✓</td>
</tr>
<tr>
<td>Chutes (spillways)</td>
<td>Very effective for conveying runoff down steep, confined slopes; may be temporary or permanent; careful design necessary, with outlet protection</td>
<td>✓</td>
</tr>
<tr>
<td>Ground-water control (e.g. French drains)</td>
<td>Limits slope failures caused by seepage</td>
<td>✓</td>
</tr>
<tr>
<td>Runoff Control – Check Dams</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Straw bale and silt fence check dams</td>
<td>Effective for controlling channel erosion and sediment transport until permanent protection is established; requires occasional maintenance</td>
<td></td>
</tr>
<tr>
<td>Sandbag check dams</td>
<td>Sandbags are less stable than bales; lack filtering ability</td>
<td></td>
</tr>
<tr>
<td>Permanent check dams</td>
<td>For reducing channel gradient and velocity; need very careful design; costly</td>
<td></td>
</tr>
<tr>
<td>Runoff Control – Other Runoff Controls</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Trench blocks</td>
<td>Prevent ditch line channelling of water and potential erosion; used in conjunction with diversion berms</td>
<td></td>
</tr>
<tr>
<td>Sediment Interception</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Vegetative buffer strips</td>
<td>Very effective for intercepting sediment; economical and easily maintained</td>
<td></td>
</tr>
<tr>
<td>Silt fences (geotextile)</td>
<td>Useful for intercepting sheet flow sediment</td>
<td>✓</td>
</tr>
<tr>
<td>Silt fences (burlap)</td>
<td>Suitable for very small sheet flow for up to 3 months</td>
<td>✓</td>
</tr>
<tr>
<td>Straw bale barriers</td>
<td>Effective for sheet flow for 3 to 6 months</td>
<td>✓</td>
</tr>
</tbody>
</table>
Table A-9  Summary of Erosion and Sediment Control Measures (cont’d)

<table>
<thead>
<tr>
<th>Control Measures</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Large Slope Areas</strong></td>
</tr>
<tr>
<td>Sediment traps</td>
<td>Useful for controlling runoff where topography is suitable and sufficient space is available</td>
<td>✓</td>
</tr>
<tr>
<td>Filter berms</td>
<td>Permeable gravel or stone berms permit water filtration; more effective with filter cloth</td>
<td>✓</td>
</tr>
<tr>
<td>Outlet protection</td>
<td>Occasionally necessary to dissipate water discharge at chute, berm, culvert and other outlets; may be temporary or permanent</td>
<td>✓</td>
</tr>
</tbody>
</table>

Ongoing monitoring and maintenance of erosion and sediment control devices will be done by on site environmental crews on a regular basis during construction, and after storm events.

Rip rap, straw bales and other erosion control devices will be routinely checked, and repaired or replaced as needed. Sediment control devices such as silt fences and sediment traps will be cleaned and repaired, as required, particularly after storm events.

### A.3.5.2 Site-Specific Measures

Application of site-specific sediment and erosion control measures will consider terrain, erosion sensitivities and fisheries values. Preliminary site-specific sediment and erosion control plans will be subject to field modification to comply with the final grade and cleanup condition of the RoW.

### A.3.5.3 Erosion and Sediment Control

A surface erosion hazard assessment can rate the susceptibility of exposed soil to water erosion when protective vegetation is removed and soils are exposed. Soil erosion rates are generally highest for the first year after mineral soils are disturbed or exposed.

The potential for detachment and suspension of soil from a disturbed site depends on mass movement hazards and on the site factors that caused the erosion. Site-specific factors, such as slope gradient, length and uniformity and soil texture, will vary along the RoW. Protective measures will be implemented during construction to limit mass movement hazards and erosion. These measures will include the control of surface, subsurface and ditch line flow along the RoW (see Table A-9).

Sedimentation from dry, ephemeral drainages and upland areas near flowing watercourses will also be considered when determining required mitigation.
A.3.5.4 Considerations for Specific Methods

**Mulching**
Mulch, hay, or an approved equivalent will be used for temporary erosion control on exposed slopes after final grade has been established. Mulching will filter sediment and limit the effect of rain and the velocity of overland flow, by allowing runoff to infiltrate the soil.

**Application and Maintenance**
The following guidelines apply to mulching:

- A uniform layer of mulch will be applied to exposed soil in areas as directed by the environmental inspector.
- Mulch will be applied on the surface of exposed ground as soon as possible after final grade has been established.
- Mulch may be placed as a temporary erosion control on unseeded areas or immediately after hydroseeding.
- Mulch will be spread by hand, or with a mulch blower, evenly and uniformly over the designated areas.
- A tackifier may be applied after the mulch is applied. If a tackifier is not used, the mulch will be mechanically incorporated into the soil surface using a mulch crimper, sheep’s foot roller, and punch roller, or by scarification with a tracked vehicle.
- The mulch will be maintained by remulching bare spots exposed by wind or water.

**Erosion Control Blanket**
Biodegradable erosion control blankets or approved equivalents will be used to temporarily stabilize and protect exposed soil until vegetation is re-established, particularly on steep slopes and where erosion hazard is high.

**Installation and Maintenance**
The following guidelines apply to erosion control blankets:

- Blankets and staples will be installed according to the manufacturer’s specifications.
- For placement in ditches, erosion control blankets will be placed parallel to the centreline of the ditch.
- End joints will be staggered.
- Blankets will be routinely checked, especially after windy conditions. Additional staples might be needed to hold the blanket in place.
**Silt Fence**

Silt fences are used on land as temporary sediment control measures, and are commonly used to surround a disturbed work site.

**Installation and Maintenance**

The following guidelines apply to silt fences:

- Stakes will be placed a maximum of 2.5 m apart at a depth of approximately 0.5 m.
- Silt fences will be installed according to the manufacturer’s instructions.
- Where the geotextile fabric is joined to provide a continuous run, the ends will be securely fastened and overlapped by at least 0.5 m.
- The ends of the barrier will be angled upstream.
- Silt fences will be inspected before expected major rainfall and during and after periods of prolonged rainfall.
- Silt fences will be cleaned when the sediment reaches one third of the height of the barrier.

**Sediment Ponds**

Site-specific plans will have priority when determining where sediment ponds might be used. To mitigate siltation, flocculation may be combined with using a sediment pond. Where flocculation is needed, types and rates of flocculation will be developed according to the manufacturers’ recommendations, based on jar test results.

**Installation and Maintenance**

The following guidelines apply to sediment ponds:

- Sediment ponds will be sized to allow for adequate settling.
- Non-erodible material, such as rip-rap, will be placed at the outlet of the sediment ponds to prevent scour.
- Sediment ponds will be inspected before expected rainfall and during and after periods of prolonged rainfall.
- Accumulated material will be removed as necessary from sediment ponds, such as when the sediment is within 300 mm of the crest of the outlet or when the pond is 60% full.
- Discarded sediment will be placed in a designated area where it will not re-enter a watercourse.
- When no longer needed, sediment ponds will be removed and the area will be levelled and revegetated.
A.3.5.5 Watercourse Crossings

The following general measures will be modified on a site-specific basis, to limit the suspended sediment entering sensitive watercourses:

- Temporary silt fences will be installed in areas where surface runoff might transport fines and silts to watercourses. Sediment interceptor methods will be used during construction as a contingency method, and will remain in place at the banks of the watercourse as a long-term mitigation measure. The environmental inspector is responsible for the effective use and maintenance of erosion and sediment control measures.

- Cross-ditches and diversion berms will be constructed on steep disturbed slopes, to divert surface runoff from the RoW and into well-vegetated areas away from watercourses. The location of the permanent diversion berms will be determined in consultation with the environmental manager and environmental inspector. If warranted, a geotechnical engineer will be consulted, to consider the final grade configuration and other site-specific conditions. Berms will be installed immediately down slope of all trench breakers (ditch plugs).

- As appropriate, surface imprinting such as cat tracking or straw crimping will be implemented as a runoff control measure on selected approach slopes. On steep erosion-prone approach slopes, erosion control matting or other suitable techniques will be considered.

- Additional erosion and sediment control materials will be available for ready use, to limit the suspended sediment entering watercourses. During pipe installation, this will include contingency materials such as bypass pumps, sandbags, polyethylene sheets, straw bales and silt fence materials, to intercept overland flow and trap suspended solids. Shovels and larger excavating equipment will be used if surface drainage patterns need to be modified to manage surface flow. Some of these measures may require extra temporary workspace.

- Disturbed areas may be reseeded as soon as they are no longer required for project access or other purposes. The approved seed mixture may include a cover crop to prevent surface erosion.

- Further information on watercourse crossings is provided in the Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan (see Section A.3.15).

A.3.5.6 Instream Sediment Control

Methods to limit the locations, dispersion and extent of sediment transported downstream include the following:

- A qualified professional will determine the type, design and placement of instream sediment controls.

- Instream sediment controls will be designed to reduce water velocities and allow suspended materials to settle.

- Where approved by the environmental inspector, in consultation with a hydrotechnical engineer, instream filter berms constructed using non-woven geotextile fabric may be used combined with shot rock, or crushed rock, check dams.
• Sediment mats will be used to trap large amounts of bedload and suspended sediment. The mats will be removed after construction, but biodegradable mats can be used during bank restoration.

• Instream controls will be installed before construction begins.

• Sediment control structures will be maintained during construction, and will include:
  • reinstalling and replacing structures, where necessary
  • removing accumulated sediment (disposing of sediments where they will not re-enter a water body)

• Unless otherwise determined, instream controls will be removed before spring freshet if they are used through winter; if they are used during fall, they will be removed before freeze-up.

A.3.5.7 Subsurface Drainage Control
Drainage along unconsolidated backfilled trenches may cause instability and erosion, and result in the blockage or sedimentation of watercourses, or weakened pipe integrity. Thus, subsurface drainage will be diverted from the backfilled trench. The following practices will be used, as appropriate, for drainage:

• Trench breakers will be constructed of sandbags, bentonite mixed with local soils, urethane foam, or other compacted impervious materials. They will be installed to force bellhole seepage along the pipeline trench to the surface on steep slopes. The locations for trench breakers will be determined by on-site investigation, considering the potential for subsurface flow, erodibility of backfill material, and degree of slope. Geotechnical input will be provided in areas prone to instability. The location of the trench breaker will be marked before backfilling.

• Trench breakers will be installed adjacent to watercourses, at edges of wetlands and on other similar sites where unconsolidated backfill or organic materials are prone to washing out.

• Subdrains or pole drains will be installed to divert shallow groundwater flow from the RoW and to improve slope stability.

• Trench breakers will be installed on each side of a wetland that the pipeline crosses, where the wetland might drain into the pipeline trench.

A.3.6 Shelterbelt Protection Plan
The degree of protection and mitigation measures needed to maintain or restore shelterbelt functions will be carefully considered during the environmental planning process.

A.3.6.1 Planning Process
The environmental planning process will provide a first-level evaluation to determine which shelterbelts meet the criteria for special construction actions. Land negotiations will be the second level. In some situations a shelterbelt may be designated for protection even if the landowner has not considered it important.
A shelterbelt will be considered appropriate for receiving transplants, reduced clearing or a road bore if:

- the shelterbelt appears to have been deliberately planted by any landholder
- the shelterbelt is previously unbroken along its length
- reasonable alternative access is granted by the landowner or regulatory representative
- removing the shelterbelt over the RoW will cause a visual interruption in an area where aesthetics are important
- specific wildlife protection requirements exist
- trees are sparse in the area
- the tree or bush size is large enough to provide benefits for aesthetics and erosion prevention
- the shelterbelt can easily be incorporated with a road bore
- the soil near the shelterbelt is erosion prone
- the landowner has asked for a shelterbelt during land negotiations

A.3.6.2 Reduced Clearing and Existing Line Use

Where alternative access is not practical, or openings exist on adjacent existing pipeline RoWs, a shelterbelt may be considered for reduced clearing and use of the existing opening. In these situations the contractors may be directed by Northern Gateway to:

- obtain permission to travel on the work side of the existing RoW
- schedule the bore of the shelterbelt ahead of pipeline ditching
- confirm the bore pipe section is long enough to allow a crossover travel space by the shelterbelt to the existing clearing opening
- reduce clearing to 4 m on the work side of the RoW and perform a standard bore
- transplant the shelterbelt trees or shrubs from the required clearing width to a location adjacent to the RoW for later replacement. This will be done only if the moisture regime and condition of the shelterbelt vegetation in the area provides a good prospect for vegetation survival.

A.3.7 Soils Protection and Management Plan

The objectives of the mitigation measures included in the Soils Protection and Management Plan are to:

- limit the extent of surface disturbance
- limit soil admixing
- limit soil compaction, rutting and puddling
- manage soil erosion risk
- limit soil loss (because of burial and inadequate salvage)
- prevent or limit soil contamination
- prevent or limit any other environmental effects on soil physical, chemical and biological properties
Soil capability can be affected by soil surface and subsurface deterioration and loss of soil through erosion or unintended burial of topsoil. Soil quality can also be altered by changes in soil acidity from input of acidifying emissions.

**A.3.7.1 Regulatory Standards Specific to Soils**

Several regulatory standards in Alberta and British Columbia relate to soils and will be applied to the Project. These requirements are primarily related to conservation and reclamation legislation that specifies that equivalent land capability will be restored on land used for the construction and operation of an industrial pipeline.

**Alberta Regulatory Standards**

In Alberta, regulatory standards related to soil are specified in the *EPEA* and the Conservation and Reclamation Regulation.

The following are definitions of relevant terms according to Alberta legislation:

- **Equivalent land capability** – the ability of the land to support various land uses after conservation and reclamation that are similar but not necessarily identical to the capacity that existed prior to an activity being conducted on the land.

- **Conservation** – includes all practical and desirable methods for preventing and mitigating disturbance, salvaging soil resources for use in reclamation and controlling wind and water erosion.

- **Reclamation** – designing and implementing activities during operations, handling material, contouring, revegetating and re-establishing surface water resources with the objective of equivalent land capability restoration.

Land used for the construction and operation of an industrial pipeline (i.e., specified land) will:

- be returned to an equivalent land capability through conservation and reclamation
- meet the spirit of the regulation with respect to the conservation and reclamation on both private and public lands

Although the Project is regulated by the NEB, the environmental protection guidelines specified in the Guide for Pipelines: Pursuant to the *Environmental Protection and Enhancement Act* and Regulations (Alberta Environment 1994) provide direction for reducing environmental effects during construction and reclamation. The considerations that are listed for activities such as clearing, topsoil salvage, grading, trenching, lowering-in and backfilling and soil replacement, may be useful to limit the environmental effect of activities on the soil.

**British Columbia Regulatory Standards**

In British Columbia, regulatory requirements related to soil differ in forested lands and the agricultural land reserve (ALR). The Pipeline and Facilities Operations Manual (BC OGC 2005) provides general guidelines on most applicable legislation for pipeline development.
In forested Crown lands in British Columbia, a Licence to Cut agreement will be obtained for each forest district where pipeline construction will occur. The agreement incorporates provisions of the *Forest Act* and the *Forest and Range Practices Act* and Regulations, including the Forest Planning and Practices Regulation that addresses terrain stability and soil disturbance and that specifies:

- a definition of sensitive soils, a maximum amount of soil disturbance that may take place in areas with and without sensitive soils, and that the Minister may require rehabilitation of compacted soils
- that landslides and gullying, which cause an adverse environmental effect, will be prevented
- that natural site drainage patterns will be maintained during activities, if possible, or altered to be compatible with natural patterns by the time of the following freshet
- that soil exposed by construction will be revegetated if possible within two years

Although the Project is regulated by the NEB, the British Columbia Oil and Gas Commission has guidelines for pipeline development within the ALR. These guidelines are considered in soil data collection and subsequent assessment and mitigation planning. For ALR lands, the information that might be required includes:

- a pre-site assessment, according to Schedule A from the Provincial Agricultural Land Commission (ALC), that provides information on the site and includes:
  - a general description of surficial geology
  - agricultural land capability
  - land use
  - drainage and topography
  - specific information on soil quality, quantity and profile
  - photographs and maps
- a site reclamation plan, according to Schedule B from the ALC, that provides details of the process for restoring the soil to an equivalent topographic and soil condition that existed before development
- a report with evidence that:
  - the development has surface landowner consent
  - existing and proposed buildings and structures occupy an area of less than 450 m² (or 17 acres) per quarter section
  - the pipeline owner has obtained advice regarding site assessment, construction and land reclamation from a reclamation specialist with at least two years related experience

Within two years of installation and reclamation of the pipelines, a post-reclamation analysis (according to Schedule B of the ALC) will be conducted by an individual with appropriate training. A certificate of restoration may then be obtained.
A.3.7.2 Topsoil Salvage

Northern Gateway intends to construct in agricultural sections of the RoW under summer conditions. However, scheduling difficulties may arise in certain areas that will require winter construction.

Right-of-Way Planning

See Section A.3.1 for RoW planning for the Project. The process of RoW planning coordinates activities such as access, topsoil stripping and grading.

General Measures

In general, topsoil will be salvaged as indicated on construction drawings and environmental alignment sheets. Changes in procedure and depth will be required in specific locations. Topsoil stripping will only be undertaken during daylight hours, unless specifically approved by the environmental inspector. Where a new procedure is required, Northern Gateway will make an application to the appropriate regulatory authority for a variance of procedure, if the new procedure was not submitted in the approval process, or is required because of unforeseen circumstances.

Summer topsoil salvage assumes that the topsoil can be removed and placed accurately without special equipment. When cold weather persistently compromises the topsoil stripping accuracy, winter stripping measures will be used.

Winter Measures on Agricultural Lands

Topsoil Salvage

Winter topsoil stripping will cover at least the trench width plus the space required to contain the backfill roach. Wider stripping widths may be applied depending on equipment and soil characteristics. In areas requiring grading, topsoil will be stripped for the full width of the grade area. Specialized equipment will be applied as required to achieve the desired accuracy.

Advance Stripping

Advance topsoil stripping under summer conditions will be considered, to limit the effects on soil.

Secondary Stripping

Secondary stripping under summer conditions will occur as required, during final cleanup, so that the spoil displaced by the pipe diameter is properly feathered out.

Equipment

Winter topsoil stripping requires specialized equipment to strip the frozen topsoil accurately to the required depth and width. Specialized equipment, which will be used according to site conditions, includes:

- modified backhoes
• carbide cutting edges for bulldozers and graders
• multishank rippers
• modified wheel trenchers
• road reclaimers (drum rippers)
• winter step blades

**Snow Roaching**

Where required to prevent frost penetration into the ditch line, clean snow may be ploughed into and over the stripped area. Snow containing substantial amounts of topsoil will not be used for snow roaching.

**Blading Spoil Area**

Winter ditch line stripping assumes that the spoil will be placed on a hard, smooth, frozen surface, to facilitate clean backfilling and limit topsoil loss. If the spoil area is rough or is characterized by loose surface topsoil, it will be bladed to the edge of the spoil side before trench excavation.

**Spoil Area Snow**

Snow on the spoil area will be left in place, provided the spoil area is smooth and the snow is not required for frost prevention. If a snow layer is present before trenching and is left intact, it will facilitate clean backfilling.

**Winter Road Approaches**

Large or deep approaches will be built with subsoil, or a subsoil–snow mix, where the volume of stripped topsoil from the crossing site is not sufficient to fill the bar ditch. Small or shallow approaches may be built with stripped topsoil from the crossing site, and built to prevent admixing.

**Stripping Depth**

The overall quality of topsoil handling is achieved through a combination of procedure, space and accuracy during removal, placement and replacement. The stripping depth accuracy is a function of correctly interpreting the soil characteristics and properly using and applying the equipment and methodology. The following guidelines apply to stripping depth during construction:

- The construction drawings and environmental alignment sheets will have a topsoil depth listed for each soil type that has been correlated with sections of the RoW.
- The depth of stripping will be indicated on the environmental alignment sheets as “strip to depth or to colour change”. The depth of topsoil to be stripped will be determined by a soils specialist based on texture, colour, structure and chemical characteristics.
Tackifier Application

A stabilizing tackifier will be considered (to prevent topsoil or subsoil loss) where topsoil or subsoil is at risk because of wind erosion, low moisture content, low organic matter content, texture or high traffic levels. Soils at risk will be determined by the environmental inspector in consultation with a soils specialist. Decisions will be made to apply a stabilizing tackifier to the soil windrows or traffic zones based on discussions among the environmental manager, the environmental inspector and the construction manager or their designate. Within 24 hours of being notified, contractors are responsible for providing a tackifier approved by Northern Gateway for use on the Project.

Stripping Width

Summer

Summer topsoil stripping will consist of the full RoW width minus the topsoil storage areas. Reductions may be allowed to protect specific environmental resources, facilitate winter conditions, or to solve specific construction and engineering problems.

Under summer conditions, full width stripping and grubbing will be the preferred method because of the two-pipe construction sequence. Full width stripping will place the topsoil on one or both sides of the RoW, depending on space restrictions and grade requirements. Full width grubbing, with the appropriate inclusion of mineral soil, will normally place the material on both sides of the RoW, so that roaches left over the trenches do not impede the replacement of the material to the spoil or work sides of the RoW. The actual width of the full width stripping may increase or decrease to:

- accommodate:
  - additional grading
  - ditches of extra depth and width
  - low soil stability
  - three-lift requirements
- protect specific environmental resources

Stripping of only the spoil, ditch or work area will be considered in specific areas where:

- a construction or environmental benefit exists
- the use of the passing lane is still required, but its use can be curtailed over a limited distance
- the topsoil can be placed entirely on the spoil side of the RoW
- the topsoil over the passing lane is not prone to erosion or structure damage

Stripping of only the spoil and ditch areas will be considered in specific locations where:

- a construction or environmental benefit exists
- the topsoil on the work and passing lanes is thick enough to prevent transmission of compaction to the subsoil
• the wet weather shutdown can be managed
• the topsoil over the passing lane is not prone to erosion or structure damage

Where a total RoW width reduction is necessary, placement of the salvaged topsoil on the work and passing lanes may be considered. In that case, the topsoil will be flattened over the work and passing lanes to be driven on. Stripping of only the excavation or trench areas will be considered where:
• a construction or environmental benefit exists
• topsoil on the work and passing lanes is thick enough to prevent transmission of compaction to the subsoil
• wet weather shutdowns can be managed
• topsoil over the passing lane is not prone to erosion or structure damage
• the spoil area allows for backfill without compromising the topsoil by subsoil deposition or topsoil or sod scalping

A reduction in stripping, or no stripping, will be considered where:
• the topsoil or organic layer is homogeneous to the trench depth
• the mixture of the trench material is considered beneficial, or not harmful, to the trench and spoil areas

Reductions will be indicated on the construction drawings and environmental alignment sheets, or as specified by the environmental inspector in the field during construction.

In agricultural areas under summer conditions, topsoil stockpile sites will be placed on topsoil, and subsoil will be placed on subsoil. Subsoil may be placed on sod in specific areas, if it is considered of sufficient quality to facilitate clean replacement without topsoil loss. In treed or crown areas, subsoil may be placed on the duff layer where the inclusion of subsoil or loss of surface material is acceptable to regulatory authorities.

**Winter**

Winter topsoil stripping in agricultural areas includes the width of the excavation areas plus all grade areas. Grubbing in treed or crown areas will be full width and include the appropriate amount of mineral soil. If the appropriate amount of mineral soil cannot be included because of frozen conditions, the grubbing material will be stripped according to agricultural methods. Winter topsoil stripping methods assume that stripping long distances under frozen conditions over wide areas is not practical or accurate. It also assumes that spoil and grade materials can be placed on a hard smooth frozen topsoil surface, and removed without compromising the topsoil. If the spoil area is rough or is characterized by loose surface topsoil, it will be bladed to the edge of the spoil side before trench excavation.

For most of the pipeline route, the two pipes will be placed in separate trenches, closely spaced. The topsoil will first be stripped over the expected width of the first trench plus an additional width of 30 to 50 cm to contain the backfill roach. The topsoil will be bladed to the spoil side edge of the RoW. Construction of the first pipe will proceed in the normal direction. Following backfill of the first trench,
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the second trench line will be stripped with the topsoil stockpiled on the work side beside the trench. The topsoil will be flattened to facilitate construction of the pipe. Construction of the second pipe will proceed in the normal direction. Backfill may be done with a backhoe blade to prevent damage to the first pipe. Topsoil will not be replaced under winter conditions. Spoil displaced by the pipe diameter will be feathered out after secondary stripping under summer conditions, during final cleanup. In locations of extra trench depth and width, the topsoil from the two expected excavation areas may be considered continuous and stripped at the same time. In these areas, it will be stockpiled on either the spoil side or work side edges of the RoW.

Where the two pipes will be placed in a single trench, the topsoil will be stripped over the expected width of the trench plus an additional width of 30 to 50 cm to contain the backfill roach. The topsoil will be stockpiled beside the trench on the work side and flattened to facilitate pipe fabrication, or it will be bladed to the spoil side or work side of the RoW. Topsoil will not be replaced under winter conditions. Displaced spoil by the pipe diameter will be feathered out after secondary stripping conducted under summer conditions, during final cleanup of the RoW.

**Specific Resource Mitigation Measures**

**Thick Topsoil in Agricultural Areas (Malmo soil series)**

Thick topsoil is defined as a surface soil layer (A horizon) that is more than 25 cm deep. Agricultural areas with thick topsoil will be identified on environmental alignment sheets. The following mitigation measures apply to agricultural areas with thick topsoil:

- Standard two-lift soil handling for two-ditch construction will be conducted according to Northern Gateway typical drawings for two-lift soil handling.
- Adequate additional temporary workspace will be available for soil salvage and stockpiling of thick Malmo topsoils.
- Topsoil will be salvaged as directed, stockpiled and directly replaced after backfill operations.

**Solonetzic and Gravelly Soils in Agricultural Areas**

Soils within agricultural areas that are Solonetzic or gravelly require special soil salvage and replacement procedures and will be identified on environmental alignment sheets.

The following specific measures will be applied where saline or saline-sodic soils occupy more than 100 m of the RoW:

- Three-lift soil handling for construction in non-rocky or rocky subsoils will be done according to Northern Gateway typical drawings for three-lift soil handling.
- Adequate extra temporary workspace will be acquired for segregating saline or saline-sodic spoil material from other soils and subsoils.
- Saline-sodic subsoil materials will be directly replaced and compacted in stages to maximize returns to the trench. This will be followed by direct replacement of upper subsoil materials and direct replacement of salvaged topsoil.
The following specific measures apply where soils with gravelly subsoil exist:

- Three-lift soil handling for construction in rocky subsoils will be done according to typical drawings for three-lift soil handling.
- Adequate extra temporary workspace will be acquired for separating gravelly spoil material from better quality upper subsoil and topsoil (to be indicated on the environmental alignment sheets).
- For both Solonetzic and gravelly soils, direct on-site supervision by a soil specialist is required to assist in applying mitigation measures (i.e., three-lift soil handling) to allow modification of stripping depths if necessary. This will be especially important in Solonetzic soils where colour contrast between the topsoil and the dark B horizon is generally poor.

**Thick Peat Soils (Muskeg)**

Thick peat soils are defined as recent organic deposits that are typically more than 1 m deep. These areas will be shown on the environmental alignment sheets. The following measures will be applied in areas with thick peat soils:

- Construction through peat and saturated soil will be conducted according to typical drawings.
- No additional measures to protect the travel lane will be required if construction in thick peat soils occurs under frozen soil conditions.

### A.3.8 Backfill Management Plan

The following measures will be implemented where appropriate during backfilling.

**Topsoil Spoil Separation**

Spoil will be moved back into the trench in a way that prevents loss or mixing of topsoil.

**Topsoil Padding**

Topsoil will not be used to pad the pipe under any circumstances.

**Mechanical Padding**

Where mechanical padding has been used on agricultural land, a layer of rock-free soil will be placed over the rock layer in the trench, so the rock layer does not contact the topsoil after it is replaced.

**Sand Padding**

Where sand padding has been used on agricultural land, the displaced spoil that cannot be adequately feathered out on the RoW will be removed to an approved location.

**Trench Compaction**

To reduce subsidence, backfill material will be compacted in the trench.
Crown and Roach Heights

The height of the crown or roach will depend on land use, seasonal considerations and soil characteristics. The decisions will be specific to the particular location. The environmental inspector will provide recommendations on the appropriate crown and roach height.

Displaced Material

Excess spoil material will be spread evenly over the stripped area to acceptable crown heights.

Winter Backfill

Under winter conditions, the spoil material will be roached over the trench line and contained entirely within the stripped width area.

The spoil side of the RoW, or other areas where the spoil pile has been placed on nonstripped portions of the RoW, will be bladed with a grader to remove residual spoil.

Snow, ice and organic materials will not be included in backfill.

Open Trench

The length of the open trench will be limited to avoid weather- and wildlife-related effects. Areas where a hazard has been identified in association with the open trench will be fenced to prevent entry.

Three Lift

Where required on agricultural areas, C and B horizon replacement and packing will be performed to provide a uniform depth, if possible, without damaging the pipe. If C horizon trench spoil cannot be returned to the trench entirely, because of displacement caused by the pipe diameter, the residual will be spread evenly over the spoil area on C horizon material.

Trench Line Drainage

Strategically placed openings will be left in roaches and crowns to allow for temporary and permanent cross-drainage on the RoW. Stub berms will be placed where necessary to prevent movement of surface water down the trench line.

Trench Plugs and Subdrains

Trench plugs and subdrains will be installed to combine with surface drainage structures in controlling the persistent subsurface and surface flow of water.

The exact locations of trench breakers (ditch plugs) and subsurface drains will be determined in the field, in consultation with the chief inspector or the environmental inspector and, where warranted, with the geotechnical engineer.
Excess Bedrock

Excess bedrock and shot rock will be disposed of at locations approved by the environmental inspector. The bedrock and shot rock, excluding acid rock, may be used for bank stability at watercourse crossings, where directed and approved by a qualified hydrotechnical engineer and the appropriate regulatory authorities, or for access control at road crossings. The Blasting Management Plan (see Section A.3.9) has additional information.

A.3.8.1 Padding and Displaced Spoil

Rock trench or spoil with unacceptably high coarse fragment content is expected to occur for considerable lengths along the RoW. This will require rock shielding the pipe or using special backfill methods. The special backfill methods may include the use of mechanical padders or trucking in sand or clay from other areas. On nonagricultural lands, the options for handling large rocks that are not being returned to the trench are:

- scattering on the RoW according to the regulatory requirements of the jurisdiction
- trucking to a permanent grade fill area
- stockpiling for use at watercourse crossings, access control and other projects, if suitable

A soils specialist will be available to provide expertise to the environmental inspection staff in judging problems related to sand padding.

The environmental inspection staff will communicate all special requirements to the craft inspection staff for transmitting to the contractors.

Mechanical Padding

On agricultural land, the mechanical padding material that comes in contact with the replaced topsoil (over the spoil area) will not have a detrimental effect on the soil or the field work. If the B horizon is rock-free before construction, the soils will be considered for three-lift soil handling. If the B horizon is of the same rock composition as the C horizon, the mechanical padder will leave a lift of spoil material on the spoil area below the initial screening lift. The rock deposited behind the padder will be backfilled on top of the fine sifted soil in the trench or trucked away to account for the pipe displacement. The last lift that contains fines and rock similar to the preconstruction B horizon will be placed over the fill in the trench, and any remaining displaced material will be feathered out over the spoil areas. Any displaced volume of rock considered unacceptable will be taken to a permanent grade fill area or stockpiled for use at watercourse crossings and other projects.

Sand Padding

The following guidelines apply to sand padding:

- If sand padding is required on agricultural land, three-lift soil handling will be considered. If displaced rock material cannot be feathered out properly, it will be trucked to a permanent grade fill area or stockpiled for use at watercourse crossings and other projects, if suitable.
- The appropriate borrow pit or surface mining disposition will be obtained if sand or clay material for padding is to be obtained from a source off the RoW.
A.3.9 Blasting Management Plan

A.3.9.1 General Provisions

Geological testing will be conducted before blasting, to evaluate the potential for generating acid runoff. Information about managing acid rock is provided in the Acid Rock Management Plan (see Section A.3.10).

All blasting operations will consider the effects on wildlife, fisheries and human habitation and implement the following mitigation measures where appropriate:

- Potentially affected human populations will be notified and consulted before blasting.
- Potentially affected utilities and facility owners will be notified and consulted before blasting.
- Blasting activity and the duration of the concussion pollution control will be timed through the use of packaged products near waterbodies.
- Disturbances from drilling operations will be considered when charges are placed.
- Refuse materials will be collected.
- Noise reduction and mitigation measures will be implemented. Blasting mats will be placed on top of the holes to limit the scattering of blast debris around the area.
- Individual charges will be divided into a series of smaller charges by using decking with multiple delays.
- All shock tubes and detonation wires will be recovered and removed after each blast.
- Where blasting is within 500 m of groundwater wells, additional information will be collected from the nearby wells, as indicated in the Hydrogeology Protection and Management Plan (see Section A.3.28).

A.3.9.2 Terrestrial Drilling

Drilled holes will be required for placing charges to blast rock. In addition to the noise abatement measures outlined in the Noise Management Plan (see Section A.3.22), the contractor will consider the following protection measures, where appropriate, to mitigate the effects of drilling operations:

- Access for land drilling will be cleared of vegetation following clearing procedures (see Section 8.5.2).
- All drilling materials and associated solid wastes will be disposed of in an approved way.
- Dust will be controlled during construction and drilling by applying water, when necessary.

A.3.9.3 Instream and Marine Blasting

This section provides guidelines on methods and practices which are intended to prevent or avoid the destruction of fish, or any potentially harmful effects on fish habitat that could result from the use of explosives.
Where underwater blasting is required, the activity will be conducted according to DFO Guidelines for Using Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998). These guidelines indicate the setback distances and threshold of instantaneous pressure changes with peak particle velocities that are required to protect fish and marine mammals from the effects of detonations in and near water. If the guidelines cannot be followed for any reason, a Section 32 authorization will be obtained from DFO.

Northern Gateway will consult with DFO in finalizing the Blasting Management Plan, and will consult with the appropriate DFO regional and area authorities as early as possible in the planning process, to identify:

- possible alternatives to using explosives
- the biological resources and their habitats at risk
- effective mitigation measures
- the timing of work windows

The following mitigation measures will be used, where appropriate, to limit environmental effects during instream or marine blasting:

- In addition to DFO, Northern Gateway will consult with the relevant authorities, where provincial or territorial resource agencies manage the administration of fisheries.
- Northern Gateway will assess the use of confined or unconfined explosives in or near waters that may contain fish, and will assess opportunities to use other potentially less destructive methods.
- The use of ammonium nitrate–fuel oil mixtures will not be allowed in or near water, because of the production of toxic by-products (ammonia).
- After a charge is loaded in a hole, the hole will be backfilled (stemmed) with angular gravel to the level of the substrate–water interface, or the hole will be collapsed to confine the force of the explosion to the formation being fractured.
- All shock tubes and detonation wires will be recovered and removed after blasting.
- During blasting activities, if a marine mammal is detected in a predetermined danger zone or buffer area, blasting will be suspended, until the mammal is beyond the radius of the predetermined danger zone. This is to limit the exposure of marine mammals to blasting effects. This area will be determined by predictive acoustic modelling.
- During construction, marine mammal surveys will be done up to and beyond the radius of the predetermined danger zone, calculated from blasting specifications.
- Blasting and rock hammering in the marine environment will be rescheduled whenever a marine mammal, such as a killer whale, humpback, fin, grey or minke whale, harbour porpoise, Pacific white-sided dolphin, or Steller sea lion is observed within the predetermined danger zone.
- No explosive is to be knowingly detonated within 500 m of any marine mammal.
- No explosive is to be detonated in or near fish habitat that produces, or is likely to produce, an instantaneous pressure change (i.e., overpressure) greater than 100 kPa (14.5 psi) in the swimbladder of a fish.
- For underwater blasting, bubble curtains will be used to contain shock waves.
- Silt curtains will be placed strategically during blasting, to limit the dispersion and duration of suspended sediments, and limit sedimentation effects on sensitive species.
- All blasts will be designed and approved by a certified and project-authorized blaster and will be designed in a way that limits the risk to fish or fish habitat.
- The sediment plume generated during blasting will be monitored at distances to be established through consultation with DFO, to confirm that levels meet British Columbia water quality guidelines for total suspended solids and turbidity. In addition, if total suspended solids levels exceed the water quality guidelines outside the PDA, then additional analysis of samples for contaminants such as PAHs will be included, to assess dispersal of these contaminants in Kitimat Arm.

A.3.9.4 Shot Rock

Shot rock generated by blasting or ripping of the RoW for grading purposes (other than PAG) may be:
- replaced in the area from where it was removed, provided the area will be stable for reclamation and terminal integrity
- locally transferred down the RoW to the nearest stable area
- transferred to specific areas on or off the RoW, for use as armouring or as ballast for other construction operations, such as access road construction
- used for bank stability at watercourse crossings (with the approval of both a qualified hydrotechnical engineer and the appropriate regulatory agencies), or for access control at road crossings (excluding acid rock)

A.3.10 Acid Rock Management Plan

A.3.10.1 Introduction

The Acid Rock Management Plan (ARMP) describes the approach and commitment to construct the Project in a way that protects the environment. The plan can be considered a provisional description of the general and specific mitigation measures that will be applied for the Project. Once detailed design and route selection have been completed, additional details will be included in the ARMP, which will be used as a guidance document for construction and project personnel. The ARMP will document regulatory requirements so that the Project is constructed according to applicable regulations, internal policies and procedures.

A.3.10.2 Acid Rock Drainage and Metal Leaching

Acid rock drainage (ARD) and metal leaching refer to:
- increased acidity and metal concentrations in runoff and seepage water flowing from rock that contains reactive sulphide minerals, such as pyrite (FeS₂)
- metal leaching that may or may not require the presence of high acidity
Exposing acid rock to water and oxygen results in oxidation of the sulphide minerals, which produces sulphuric acid as a by-product. The sulphuric acid may dissolve other minerals and cause the release of metals to the environment. ARD is a natural process that is enhanced by excavating sulphide-bearing rock. The British Columbia Government has released several reports that describe the current practices for dealing with PAG rocks. These reports include:

- Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (Price and Errington 1998)

Although most of the published studies relate to mine developments and may not apply directly to a linear development such as a pipeline, Northern Gateway is committed to applying the principles contained in these reports, where appropriate, in developing site-specific ARD management plans in areas where PAG rock is identified. Northern Gateway has conducted field investigations for areas of PAG rock along the RoW and has identified options for mitigation measures (see Volume 3, Appendix E for the two ARD reports). Both reports will be updated to reflect the final route alignment, and site-specific ARD management plans will be developed before construction.

Acid rock drainage management along the RoW will involve:

- identification – before and during construction, potential ARD locations along the RoW will be determined through visual identification and field sampling programs
- assessment – any ARD sites identified along the RoW will be assessed using methods consistent with those used at other ARD sites, to determine possible effects on the surrounding environment that may result from pipeline construction. The initial assessment of PAG material may be visual, or the result of field-based analytical methods.
- avoidance – wherever possible, excavation or use of PAG rock will be avoided
- prevention – during construction, accepted methods will be used to prevent ARD from occurring, wherever possible
- mitigation – if PAG materials are encountered during construction, mitigation of the site will use accepted practices for ARD mitigation, to limit effects on the surrounding environment
- management – any ARD sites created because of pipeline construction will be managed to limit effects on the surrounding environment

A.3.10.3 Areas of Potential Acid-Generating Rock

A preliminary assessment of the presence of PAG rocks has been done along the pipeline route (see Volume 3, Appendix E). The results indicate that widespread deposits of acid-generating rocks are unlikely along the pipeline route, but there are localized and short stretches of up to a few kilometres each. A final location list will be developed during detailed design.
A.3.10.4 Potential Construction Sources of Potential Acid-Generating Material

Although studies done to date indicate that it is unlikely that widespread deposits of acid-generating rocks will be encountered along the pipeline route, there may be opportunities for PAG material to be exposed during construction. Table A-10 details potential for acid rock drainage for each potential construction source.

Table A-10 Potential Acid-Generating Material Sources from Construction Processes

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
<th>ARD Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trenches</td>
<td>Primary method for placement of the pipelines.</td>
<td>• Represents the most extensive excavation method along the RoW.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Limited acid rock drainage if the trench is placed in overburden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Trenches will be excavated and pipelines placed relatively quickly; time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for ARD assessment and generation is limited.</td>
</tr>
<tr>
<td>Grade construction</td>
<td>Cuts for RoW construction, tunnel portals or other facilities,</td>
<td>• Compared to trenches, a large volume of material is excavated for each</td>
</tr>
<tr>
<td></td>
<td>including the Kitimat Terminal.</td>
<td>unit length of pipeline. However, rock cuts will only occupy short sections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>along the pipeline route.</td>
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<tr>
<td></td>
<td></td>
<td>• Surface area of cut faces and exposed rock in the surface of the grade</td>
</tr>
<tr>
<td></td>
<td></td>
<td>may be large and impossible to backfill or cover in steep sections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fill material may contain PAG rock.</td>
</tr>
<tr>
<td>Quarry or borrow pits</td>
<td>Construction materials obtained from nearby rock outcrops or</td>
<td>• May contain PAG rock.</td>
</tr>
<tr>
<td></td>
<td>surficial deposits.</td>
<td></td>
</tr>
<tr>
<td>Watercourse crossings</td>
<td>Directional drilling</td>
<td>• Directional drilling may encounter PAG rock unobserved from the surface</td>
</tr>
<tr>
<td></td>
<td>Conventional trench placement</td>
<td>requiring management of the drill cuttings and possibly exposed surfaces</td>
</tr>
<tr>
<td></td>
<td>Aerial (elevated) crossing</td>
<td>in hole.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PAG rock may be exposed adjacent to watercourse in conventional trenches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or foundations for aerial crossing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Rip rap used for slope stability may contain PAG rock.</td>
</tr>
</tbody>
</table>
Table A-10  Potential Acid-Generating Material Sources from Construction Processes (cont’d)

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
<th>ARD Comments</th>
</tr>
</thead>
</table>
| Tunnels         | Two tunnels are planned for the RoW. Current plans include disposing of the rock at or near the tunnel openings. | • Relatively large volumes of waste rock, which may be PAG, are to be managed compared with other construction activities.  
• Interior surfaces of the tunnels may contain PAG rock requiring management; poor quality drainage may require mitigation. |
| Grade exposure  | Rock hillside is exposed, to create stable slopes.                           | • Exposure of large surface areas of PAG rock to air and precipitation                                    |

SOURCE: Volume 3, Appendix E

A.3.10.5  Acid Rock Drainage Management Planning

A construction response plan will be developed that will prescribe the procedures to be used during pipeline construction, to:

- identify the presence of PAG rocks
- establish the procedures to excavate and manage the PAG rock
- determine the most effective method of mitigating the potential effects of the acid-generating rock on the environment, based on site-specific conditions
- establish post-construction monitoring procedures, as appropriate, to confirm the effectiveness of the mitigation measures

The methods of controlling acid rock drainage, where encountered, will depend on site-specific conditions, including:

- the geology and mineralogy of the rock
- the volume of PAG rock that will be excavated
- overburden thickness
- local topography and drainage conditions
- the environmental sensitivity of the adjacent area

A.3.10.6  Mitigation Strategies

Site-specific mitigation strategies will be developed after detailed design and will be incorporated into the environmental alignment sheets. The following possible general mitigation strategies have been developed to support the Project and will be implemented where appropriate.
Avoidance

Minor refinements of the pipeline route might be used to avoid exposing PAG rock. Although avoidance is the most effective mitigation strategy, it may not be practical for all potential ARD occurrences, given the many environmental and engineering constraints of the pipelines. Other potential mitigation strategies are described below.

Subaqueous Disposal

After avoidance, underwater disposal is generally considered to be the most effective strategy to prevent formation of ARD, as it essentially prevents oxidation of sulphide minerals and associated metal leaching. Underwater storage can be in fresh water or ocean water. Freshwater storage can be in natural or artificial structures. However, problems can arise with subaqueous disposal if PAG rock is allowed to oxidize before submersion. Soluble oxidation products may release stored acidity, metals, or both, when submerged. Underwater storage does not reduce the potential for PAG rock to generate acid or leach metals if the rocks are exposed in the future.

The federal Fisheries Act governs the protection of fish and fish habitat. It prohibits waste disposal in natural, fish-bearing water bodies without a permit. The Canadian Environmental Protection Act (CEPA) regulates ocean disposal of waste rock, and aims to prevent marine pollution from uncontrolled disposal of waste at sea. The Act outlines the various information requirements for disposal that must be fulfilled before disposal schemes are approved. Generally, all practical, land-based options must be evaluated before ocean disposal is considered.

Subaqueous disposal is not suited to a long, linear pipeline project because numerous facilities would likely be required in remote areas with difficult access (i.e., areas with potentially long hauling distances). However, subaqueous disposal may be a viable option for a few specific areas, such as the Kitimat Terminal or the Clore and Hoult tunnels. Further evaluation is required before Northern Gateway can determine the potential use of subaqueous disposal.

Covers

Covers are widely used to limit surface water and precipitation infiltration into PAG waste rock piles. Covers can also provide erosion control and growth media for vegetation. Covers have been used successfully in many situations and are a practical ARD control measure.

Covers can be used to shield exposed rock faces, as well as waste rock piles. Shotcrete is commonly applied to the surface of exposed rock to limit water flow and infiltration. Other types of covers, such as synthetic spray-on sealants may also be effective in certain circumstances, where rock surfaces require isolation from water and oxygen.

Covers can potentially be integrated into the overall design of pipeline trenches and roaches. They can also be applied to rock exposures and used on excess cut disposal areas on or off the RoW.
**Blending**

Blending is incorporating PAG waste material with non-PAG waste material, or an alkaline material such as limestone. The objectives of blending include maintaining neutral pH conditions and neutralizing potential acidic drainage in situ.

Substantial amounts of materials handling, potentially including crushing, are required to achieve an ideal blend, where sulphides are in close contact with acid-consuming materials, giving a homogeneous, net-acid-consuming mix. Acidic water that is produced locally can migrate away from the point of origin, but may be rapidly neutralized by contact with carbonate minerals.

Blending can be completed on the RoW using on-site equipment such as bulldozers or backhoes to mix limestone, gravel or sand with PAG material before backfilling the trench. Although ideal, blending could be difficult to implement along the RoW, given the limited temporary workspace.

Layering or lining the pipeline trench with limestone may be a mitigation measure where sulphides have been identified. In addition, limestone can be efficiently incorporated into the trench backfill or used as part of the cover material during roach construction. Adding sufficient limestone to achieve a minimum 4:1 ratio of non-PAG to PAG will be adequate to neutralize PAG rock. Locations that could benefit from adding limestone will be determined on a site-by-site basis.

**Disposal at an Existing Managed Site**

Another mitigation option is disposing of PAG waste rock at existing disposal sites. This option would require further investigation.

**Water Management**

**Diversions**

Diversions are most effective for avoiding mixing pristine waters with potentially affected waters or PAG material, and can be used with excavated or exposed rock. For exposed rock, surface water can be diverted around the cut face, or drain pipes can be installed to drain groundwater. Under certain circumstances, drainage channels can be lined with limestone to provide added neutralization capacity. However, these limestone channels should be used with caution as they are prone to failure if not used properly. They are most effective when used in combination with other mitigation methods and not as a stand-alone method.

**Monitoring**

Monitoring the water quality may be necessary where PAG materials are encountered, or where neutral metal leaching may occur. Post-construction monitoring might be required in locations where potential problems have been identified. Simple measurements of pH and conductivity can indicate if acid drainage is developing. Metals analysis of seepages or watercourse flows can be used to indicate the occurrence of neutral leaching. Minor exposures of PAG rock may have no discernable influence on the water quality of nearby watercourses or waterbodies.
Water Treatment Options

The objective of water collection and treatment is to contain, neutralize and precipitate leached products at a downstream location. Water treatment can involve simple passive treatment structures such as sediment ponds, limestone drainage trenches, or more complex structures, such as constructed wetlands or active water treatment using a lime treatment plant.

A.3.11 Waste Rock Management Plan

The Waste Rock Management Plan will be updated, as appropriate, and submitted before the initiation of project construction.

The reclamation success of waste rock piles is typically increased when the piles are capped with soil materials or overburden materials that have adequate fines to provide the water holding capacity necessary for the site’s climatic conditions. Nevertheless, reclamation has been successful on various uncapped waste rock piles throughout the province of British Columbia. The success of direct revegetation of waste rock piles depends on several factors. The first, and likely most restrictive, factor is the geological composition of the rock, including:

- resistance to weathering
- particle size distribution of weathered products
- geochemical characteristics of the rock, such as metals leaching and PAG

The second factor is the size of the rock fragments, including:

- range in size, which can vary in blasted rock, and can strongly influence water drainage through the pile
- percentage of large rock fragments (e.g., cobbles, stones and boulders) at the surface of the rock pile, which can affect the area available for revegetation

The third factor is the slope conditions, both length and angle of slope.

Geographical constraints of the construction site and the type and size of equipment being operated will also have major influences on the physical characteristics of the waste rock pile. The size and shape of the waste rock pile may also affect internal physical and chemical processes.

Construction methods can affect the degree of compaction and the particle size distribution. Four general methods are commonly employed, each producing piles with very different distributions of rock particle size:

- End-dumping – waste rock is dumped directly over the crest of the dump face from a truck. In this construction activity, the fine particles are generally concentrated near the crest, and the coarsest particles collect beyond the slope toe. In a field simulation of dumping methods, an end-dumped slope had three distinct particle size groupings: a fine upper zone, a very coarse toe zone, and an evenly distributed, evenly graded zone along the remainder of the slope (Nichols 1986). Slope height did not change the type of gradation, but it did reduce the amount of segregation.
• Push-dumping – waste rock is dumped near the crest of the pile by truck or conveyor and then the material is pushed over the crest with a bulldozer. In field simulations of rock piles constructed using this method, the coarse particles collected at the toe of the slope, but the fines were not segregated at the top. Furthermore, the extent of coarse-material segregation was much less for push-dumped than end-dumped material (Nichols 1986).

• Free-dumping – waste is hauled into disposal areas with concurrent dumping, spreading and compacting in layers of approximately 2 m in height. This method resulted in little segregation of particle sizes and considerably more compaction than the previous two methods.

• Direct placement – waste is placed directly on the land surface, where it is seldom built in lifts. This method provides little segregation of particles. The degree of compaction achieved will depend on the degree to which the track packing or compaction equipment is used.

Revegetation can be established directly on portions of angle-of-repose waste rock slopes, but because of the segregation of particle sizes, the coarse materials seldom support plant growth. Access for revegetation is also severely limited by the angle of these slopes, and aerial applications of seed and fertilizer are typically the only methods available for these slopes. Waste rock piles that are resloped to 28 or 30° are often more successfully revegetated because of the redistribution of fines across the slope, which is achieved by pushing the finer upper zone materials over the coarser materials further down the slope. The options for revegetation are greatly increased on these resloped waste rock piles, as the sites can be accessed by some tracked machinery and by tree planters.

Apart from the materials composing the waste rock pile, the other prime factor in the success of revegetation is climate conditions. As the pipeline route crosses many climate zones, the reclamation success on rock piles is likely to vary among the zones. Species selection for revegetation will be strongly influenced by the climate conditions and the water-holding capacity of the waste rock materials. Generally, revegetation success in wetter zones will be greater and more rapid than in drier and colder zones.

A.3.12 Concrete Works Management Plan

Cement is alkaline, and wash water from spoiled concrete or from the cleaning of the mixer trucks and pipe delivery systems can be expected to have a high pH level. Similarly, spoiled concrete or wash water would contain additives and agents, some of which are toxic to aquatic species. Aggregates, particularly fine sand fractions washed from spoiled concrete or discharged into the environment, might result in direct mortality or habitat destruction.

The following protection procedures will be implemented to limit the environmental effects from pouring concrete during construction:

• Pre-cast structures will be used, wherever practical.

• Wash water from cleaning the concrete trucks will be discharged either at the concrete manufacturer’s place of business (assuming the plant is near the work site) or, alternatively, at a wash water sediment pond. Such discharges will be of minimal volume and will not occur in the buffer zone of a watercourse, wetland or other environmentally sensitive area.
• Miscellaneous concrete equipment cleaning will involve minimal discharge volumes, and will not occur in the buffer zone of a watercourse, wetland community or other environmentally sensitive area.

• Residual concrete, including concrete resulting from cleaning of concrete pumping equipment and rejected concrete batches, will be disposed of at concrete collection stations.

• If necessary, hardened concrete will be disposed of on site in an approved disposal pit.

• All works involving the use of concrete, cement, mortars, and other Portland cement or lime-containing construction materials, will not deposit, directly or indirectly, any sediments, debris, concrete, concrete fines, wash water or contact water into or about any watercourse. Concrete materials cast in place will remain inside formed structures. A carbon dioxide (CO₂) tank with regulator, hose and gas diffuser will be readily available during concrete work, to release CO₂ into the affected area to neutralize pH levels if a release of materials occurs. A small, bermed area for washing down equipment will be provided for the wash-down water from concrete delivery trucks, concrete pumping equipment, and other tools and equipment.

• pH levels in the receiving water of the isolated work site will be monitored often, until construction is complete. Emergency measures will be implemented if downstream pH values change more than 1.0 pH unit, measured to an accuracy of ± 0.2 pH units from background levels, or are recorded to be below 6.0 or above 9.0 pH units.

• Any water that contacts uncured or partly cured concrete will be isolated and held until the pH level is between 6.5 and 8.0 pH units, and the turbidity is less than 25 nephelometric turbidity units (NTUs) measured to an accuracy of ± 2 NTUs.

• All concrete work will be completely isolated from any water in, or entering into, any watercourse, except where it can be shown that unfavourable pH and turbidity conditions will not occur, and with the approval of Northern Gateway.

• Water that contacts uncured or partly cured concrete during activities like exposed aggregate wash-off, wet curing, or equipment washing, will be prevented from directly or indirectly entering a watercourse.

• All cast-in-place concrete and grouting will be completely isolated from fish-bearing waters for at least 48 hours, if the ambient air temperature is above 0°C, and for at least 72 hours if the ambient air temperature is below 0°C, subject to the foregoing exceptions.

• Releases of sediments, debris, concrete fines, wash or contact water will be reported immediately, as indicated in the Spill Contingency Plan (see Section A.2.1). If possible, the materials will be removed from the water immediately and emergency mitigation and cleanup measures implemented.
A.3.13 Tunnel Installation Plan

A.3.13.1 Introduction

The pipeline route crossing the Coast Mountains will require the construction of two tunnels through north Hope Peak and Nimbus Mountain.

The tunnels will be constructed using tunnel boring, drilling and blasting techniques, or a combination of these methods. Each tunnel will have a finished width of approximately 5.5 m, and will result in an estimated 400,000 m$^3$ of waste rock being generated. Tunnel construction will require the management of groundwater flow. The likelihood of encountering acid-generating rock during tunnel construction is considered to be low, as indicated in the Acid Rock Management Plan (see Section A.3.10).

Three permanent access roads will be required to the tunnel portals, to accommodate access during pipeline construction and operations. The west and central roads will use existing forestry roads, which will be upgraded as required (e.g., widening some areas, installing new or upgraded bridges). The east road is the only new road. Details on access management will be developed in cooperation with appropriate Aboriginal groups and regulatory agencies as part of the ongoing engineering and environmental planning work.

Mitigation activities at the tunnel construction sites include:

- access to the tunnels will be controlled by appropriate access management methods (i.e., no public access)
- acid-generating rock, if encountered, will be managed in accordance with current British Columbia regulations for metal leaching and acid rock drainage
- spoil areas will be reclaimed to applicable provincial standards and codes of practice

Subsurface Conditions

A geological mapping and drilling program has been initiated to assess the geology and geotechnical characteristics of the tunnel area. Rock types in the Nimbus Mountain and north Hope Peak areas consist primarily of various granitic intrusions of the Coast Plutonic Complex and andesite, tuff and rhyolite flow sequences of the Telkwa Formation. North- to northwest-trending faults cut all rock units. Faults are present on both Nimbus Mountain and north Hope Peak.

The two tunnels will be constructed in rock, except possibly for short sections in soil at the tunnel portal areas. Preliminary evaluations of expected tunnelling conditions are based on an estimate of rock mass characteristics in the rock units and fault zones. In general, the bedrock conditions are assessed as favourable for tunnelling. The exception will be areas within and adjacent to fault zones where sheared and broken rock are expected and will result in poor ground conditions for tunnelling. A zone of weaker rock also occurs near the west end of the Clore tunnel, and will be considered in detailed design. Fault zones have the potential to release higher volumes of water into the tunnel from water stored in the broken rock mass of the fault.
A.3.13.2 Tunnel Design

The tunnels will be configured for two pipelines and a roadway within the tunnel for a lightweight inspection or maintenance vehicle. A tunnel section approximately 5.5 m in diameter has been proposed as the conceptual cross-section design.

Ground support will be installed during construction to provide a permanently stable tunnel arch and walls. Ground support will be selected on the basis of rock mass classification, which will be derived from geological mapping obtained at the advancing tunnel face.

A.3.13.3 Site Hazard Management

The area of project activities is close to active avalanche slopes, where snowfall is heavy and 24-hour snowfall accumulations in the range of 1 m are not uncommon. Although tunnel construction will be ongoing for three winters, construction camps and work areas will be in areas safe from avalanche hazards. Tunnel portal locations have been selected to avoid direct avalanche hazards. However, terrain exposed to avalanche hazards will include sections of the access roads and some of the project work areas, particularly for the work in the Clore River valley and the Hoult Creek valley. A program to control avalanche hazards will be implemented during the winter construction season by certified avalanche technicians operating from the construction camps at Clore River and Hoult Creek.

A.3.13.4 Access and Construction Camps

The three construction camps required for contractor crews and project support personnel are:

- one in the Clore River valley, to support work for both the west heading of the Clore tunnel and the east heading of the Hoult tunnel
- one in the Clore River valley, near the east heading of the Clore tunnel
- one in the Hoult Creek valley, near the west heading of the Hoult tunnel

Access to the Clore River valley and Hoult Creek will be on existing forest service roads. These roads will require upgrading at some locations to support project requirements. A new access road will be required to the east portal of the east tunnel, connecting the tunnel portal area to existing logging roads in Gosnell Creek. Access to the tunnel portals will require temporary construction bridges for the east and west portals of the Clore tunnel, and the west portal of the Hoult tunnel.

A.3.13.5 Tunnel Construction

Shallow bedrock conditions are expected in tunnel portal areas. Tunnel portal development is expected to involve open cuts in rock and soil, with slopes supported by shotcrete and ground anchors, or cut to a stable angle.
The tunnels will be constructed by a drill-and-blast method, or by twin tunnel boring machines. Under good ground conditions, a single excavation and support cycle will typically be completed during each shift by the crew in each heading. Slower progress is expected in poorer ground conditions. The potential for high-pressure water-bearing fault zones has been identified. Measures to limit the negative effect of high-pressure groundwater zones include:

- drilling probe holes ahead of the tunnel face in areas with suspected water-bearing fault zones
- pre-grouting water-bearing zones ahead of the face, to limit groundwater inflow
- installing tunnel lining

The tunnels will likely be constructed by simultaneous excavation from two headings on each tunnel. The contractor is expected to operate three eight-hour shifts per day, seven days a week. Construction is expected to take between three and three and a half years to complete, depending on advance rates and ground conditions. If tunnel boring machines are used, the tunnels will primarily be constructed from one heading for each tunnel located in the middle tunnel area.

**A.3.13.6 Waste Disposal**

Constructing the two tunnels is estimated to generate about 400,000 m$^3$ of waste rock (including a 30% bulking factor). An excess cut disposal area of about 20 ha will be required near each tunnel portal. The most suitable locations for the excess cut disposal areas will be determined during a site reconnaissance, once the locations for the tunnel portals have been firmly established.

Preliminary drill holes and other information indicate that the rock formations along the tunnel alignment are generally not potential acid-generating rocks. Localized zones of PAG rocks might be encountered during tunnel excavation, when monitoring for PAG rocks occurs. If such zones of PAG rocks occur, mitigation plans for controlling acid rock drainage from the tunnels, both during and after tunnel construction, will be developed as indicated in Acid Rock Management Plan (see Section A.3.10). Neither the volume of seepage water that will flow from the tunnels during and after construction nor the concentration of contaminants in the water is known. During construction, a sediment pond will be required at each tunnel portal, to treat seepage water before it is released off-site.

Where possible, excess cut disposal areas will be set back at least 30 m from fish-bearing watercourses.

During detailed design, further site investigations, including geochemical testing of rocks and groundwater, will provide a more reliable assessment of the potential sources and concentrations of contaminants that may be generated by tunnel construction. However, because of the limitations associated with subsurface investigations of tunnels at this depth, the selection and design of mitigation measures will be based on the actual conditions encountered during tunnel excavation.
A.3.13.7 General Plans for Tunnel Construction

**General**

Environmental protection and management plans established for the Project will apply to the construction of the tunnels and associated works. Good management and construction practices will be applied, so that adverse effects on water quality, aquatic biological components, fish habitat and fisheries resources will not occur near the tunnel areas.

Sedimentation of watercourses will be prevented during construction activities through the use of appropriate mitigation measures (see Sections A.2.4, A.3.4, and A.3.5). Provincial and federal guidelines will be followed when selecting appropriate mitigation measures.

Northern Gateway will conduct a water quality monitoring program and provide progress information to the tunnel contractor. Throughout the Project, environmental inspectors will remain in contact with government agencies and representatives assigned to the Project. All affected disposition holders will be notified of the start date and timing of construction activities.

**Permits and Approvals**

Northern Gateway and the contractor will obtain all applicable permits or authorizations before construction starts. Applicable regulators will be kept informed of tunnel construction activities and schedules.

**Awareness**

Preconstruction meetings and training sessions on project environmental protection measures, procedures and plans will include Northern Gateway, its agents and contractor and other representatives. Tailgate meetings will be held daily and before implementing any new construction techniques, so that safety and environmental questions specific to the new construction are clearly communicated and understood. Contingency plans for addressing and mitigating potential problems resulting from adverse conditions or failure will be reviewed with all key personnel before construction starts.

**Clearing**

Efforts will be made to limit interference with existing land uses in the area, by timing construction activities. Surface disturbances, such as grading and vegetation clearing, will be limited.

**Site Erosion and Runoff**

Appropriate construction procedures will be undertaken for aquatic habitat preservation and restoration. Run-off barriers such as silt fencing, berms, boulder breaks, rock check dams and woven geotextile fabric silt fence, will be installed around disturbed areas and soil stockpile sites, as required, to prevent the transfer of sediments into watercourses.
Monitoring

The contractor will establish and operate sediment ponds and water treatment facilities to collect and treat seepage water discharging from the tunnels. The environmental inspector will execute the environmental monitoring plan. Water quality monitoring will include monitoring of water discharging from sediment ponds. Details of the water quality monitoring for tunnel seepage water will be similar to the procedures outlined in the Acid Rock Management Plan (see Section A.3.10).

A.3.13.8 Environmental Summary

The planning process for the tunnel construction is in the preliminary stage. However, the environmental disturbances and effects that will result from the tunnelling process are generally understood. Specific environmental plans will be created for the following aspects of tunnel construction, as part of the Tunnel Installation Plan:

- avalanche safety program
- tunnel portal access restriction
- tunnel portal work areas
- staging and construction camp areas for clearing, grading and waste water management
- tunnel water mitigation and disposal
- acid rock mitigation methodologies
- shot rock disposal areas
- special access roads
- associated potential effects on wildlife, fisheries, vegetation and historical resources
- watercourse crossings for pipe and road

When the tunnel locations are selected, the environmental planning process will be refined to include protection requirements to reflect any unique challenges that may occur.

A.3.14 Vehicle and Equipment Watercourse Crossing Plan

A.3.14.1 Introduction

Watercourse crossings for vehicles and equipment will be required along the pipeline route and access roads at two distinct times during construction:

- when the RoW is cleared of timber
- during pipe installation

As timber clearing on the RoW is expected to occur primarily under fall to winter conditions, it may be done well in advance of pipeline construction. The decision process for installing all vehicle watercourse crossings will meet federal and provincial requirements, and will consider the duration of use and the potential effects on fish and fish habitat.

The expected effects that will require and receive special controls associated with locating vehicle watercourse crossings are:

- approach grading
• bank disturbance during installation and removal
• bed disturbance during installation and removal
• siltation as a result of shakedown of soils when equipment is crossing

Access at watercourse crossings will be managed through specific crossing techniques for clearing, construction and operations. All installations will be appropriate for the sensitivity of the watercourse, the frequency of use and type of equipment. All temporary bridges and vehicle support installations will be removed, and the surrounding areas will be restored when construction is complete.

A.3.14.2 Alignment
The routes for access roads will be selected to limit the number of watercourse crossings, but within the context of other factors (e.g., safety, constructability and costs). Where crossings are necessary, Northern Gateway will comply with all regulatory permits and approvals.

A.3.14.3 Clearing
A key factor in planning vehicle watercourse crossings is the distinction between pipeline requirements and clearing requirements. Vehicle watercourse crossings for clearing operations may not be the same as the vehicle watercourse crossings for pipeline construction, because:
• fewer crossings are expected during clearing, compared with during pipeline construction
• crossing structures will normally not be left in place in the period between clearing and pipeline construction
• winter structures installed for frozen or dry crossings may not be appropriate for summer construction
• requirements for vehicle watercourse crossing installations will be determined in conjunction with provincial and federal regulators. If lower grade crossings are appropriate for clearing, they will be placed on the ditch line, to avoid increasing the overall disturbance width.

A.3.14.4 Selection
The choice of vehicle and equipment watercourse crossings depends on several factors, including:
• watercourse discharge
• season and duration of the installation
• sensitivity of fish habitats
• engineering needs
• cost and availability of materials
• cost of installation, maintenance and deactivation

Vehicle and equipment watercourse crossings will comply with all federal and provincial acts, regulations and codes of practice. The crossing method selected, construction and corresponding mitigation measures will follow DFO operational statements and provincial guidelines and best practices, where practical, otherwise the appropriate provincial and federal agencies will be consulted beforehand for the necessary approvals and authorizations.
Crossings are expected to include:

- clear span bridges
- multispan bridges
- open-bottom culverts
- closed-bottom culverts
- winter fills (snow or log)
- ice bridges

Under select circumstances, watercourses may be forded. However, this technique will not be used unless approved through discussions between the responsible regulatory agency and Northern Gateway. Where approval has been granted, appropriate measures to limit environmental effects of fording on the watercourse will be implemented, as specified by Northern Gateway.

A.3.14.5  Scheduling

Installing and removing vehicle watercourse crossings for access roads will be completed within DFO-approved work windows (see Section A.3.14). In British Columbia, work windows refer to the period when instream work is allowed, and in Alberta they refer to the restricted activity periods (RAPs) when instream activity is limited. To reduce confusion between the two provincial systems, Northern Gateway has adopted the term least risk period (LRP) for the preferred construction timing.

Work during the Alberta RAPs is not allowed, unless one of the following conditions is met:

- No work is undertaken within the channel of a fish watercourse or fisheries-sensitive zone, and the risk of sediment delivery is low.
- The work is on a non-fish-bearing watercourse and the appropriate measures are taken to prevent the delivery of sediments into fish habitat.
- The watercourse channel at the crossing is completely dry during construction, alteration or deactivation activities.
- Construction, alteration or deactivation activities on a non-fish-bearing watercourse that is a direct tributary to a fish-bearing watercourse are carried out in isolation, by temporarily pumping or diverting the flow around the work site.

If these conditions are not met, and work in and about a watercourse must proceed outside the LRP, federal and provincial fisheries authorities must be contacted to discuss the variance, and the environmental inspector will be present during the construction operations.

A.3.15  Watercourse Crossing Buffer Zone Width and Riparian Area Management Plan

Riparian areas adjacent to watercourses will be protected so that aquatic habitats are not adversely affected. Riparian areas provide vegetation, a key component of fish habitat, and also act as a filter and barrier to prevent the introduction of silt into the watercourse during precipitation or thaw events.
A.3.15.1 Riparian Buffer Zones

The establishment of riparian buffer zones at watercourse crossings is addressed generally in federal and provincial manuals and guidebooks. However, a consistent buffer zone width at watercourse crossings is not evident in any federal government regulations or standards. Enbridge Environmental Guidelines for Construction (2003) as well as Enbridge best practices implemented on recently constructed projects provide the basis for determining buffer zone widths and general riparian area protection measures.

At watercourses, the following riparian buffer zone and protection measures will be implemented where appropriate:

- For construction activities adjacent to, or across, fish-bearing watercourses, a buffer zone of 16 m will be established.
- For construction activities adjacent to, or across, non-fish-bearing watercourses, a buffer zone of 10 m will be established.
- For trenchless crossings a setback from fish habitat will be established, where possible, to retain riparian vegetation and function. However, setback dimensions will vary with the setting and method.
- Removal of vegetation and construction activities within the buffer zone will be limited.
- The edge of the riparian buffer zone will be flagged before any site disturbance activities occur.
- For a pipeline crossing of a watercourse, any extra temporary workspace will be located outside the buffer zone, and that portion of the buffer zone will not be cleared. However, site-specific topographic conditions, complex isolated crossings and trenchless crossings may require extra temporary workspace within the buffer zone. In this case, the location, size and time of clearing of the extra temporary workspace will require approval from the environmental inspector.
- The size of any extra temporary workspace will be kept to the minimum necessary to conduct the work safely.

During pipeline watercourse crossing construction, removing riparian vegetation will be limited and will be a graduated process. The following additional measures will be implemented where appropriate, so that effects on the riparian areas and adjacent watercourses are limited:

- Clearing and grading will be restricted to the minimum necessary to safely complete the work.
- Clearing within the buffer zone for trenchless crossings, if required, will be limited as much as possible. Clearing may be required for a travel lane, sightline, and additional extra temporary workspace specifically authorized by the environmental inspector as noted previously.
- Clearing watercourse approach slopes and banks will be postponed until immediately before crossing construction except, if required, to install vehicle crossing structures. Where earlier clearing is approved by the environmental inspector, the vegetative ground mat and root structure will be left intact.
• Trees will be felled away from watercourses and away from the limits of the RoW, to limit damage to watercourse banks, beds and adjacent trees. Hand clearing will be conducted, if necessary to limit disturbance. Trees, debris and soil inadvertently deposited within the high watermark will be removed in a way that limits disturbance of the bed and banks.

• Grubbing will be restricted to the trench line, areas requiring grading and workside areas, where necessary, so that equipment can pass safely.

• Erosion control will be implemented as soon as possible after riparian vegetation removal.

**A.3.15.2 Riparian Management Zones**

At fish-bearing watercourses, a Riparian Management Zone of 30 m will be established. Habitat protection measures within this zone will include the following:

• Measures to limit ground disturbance in riparian areas, which may include:
  • hand felling on steep slopes
  • trees being cabled skidded to piles located outside the Riparian Management zone. See Cutting and Skidding Timber in Section A.3.25.3 Timber Salvage.

• Measures to limit erosion in riparian areas, grading, soil replacement and erosion controls (to be completed as soon after construction as possible). See Section A.3.20 Watercourse reclamation plan.

• Riparian areas will be seeded as soon after construction as possible and shrubs will be planted as required. See Section A.3.24 Vegetation Protection and Management Plan.

• Large woody debris will be incorporated into selected riparian reclamation plans in order to provide wildlife habitat and to limit access. See Section A.3.24 Vegetation Protection and Management Plan.

In addition to defining the inclusion zone for various activities, the 30 m Riparian Management Zone is the minimum setback for:

• construction camps, stockpile sites, staging areas and excess cut disposal areas
• wetlands
• tailed frogs in coastal watersheds
• fish bearing watercourses on the Kitimat Terminal site

**A.3.16 Pipeline Watercourse Crossing Plan**

**A.3.16.1 Legislation, Codes of Practice and Guidelines Application**

The Pipeline Watercourse Crossing Plan has been developed considering federal regulations and policy under the *Fisheries Act*, Alberta and British Columbia legislation, regulations, codes of practice and guidelines, and the document published by CAPP (2005), which was endorsed by DFO. Vehicle and equipment watercourse crossings are described in the Vehicle and Equipment Watercourse Crossing Plan (see Section A.3.14).
A.3.16.2 Federal Regulations

DFO will be the primary regulator for watercourse crossings that the pipeline route intersects. DFO administers the habitat protection provisions (Section 35) of the *Fisheries Act*, while Environment Canada, under a 1985 Memorandum of Understanding with DFO, administers those provisions of the *Fisheries Act* dealing with the control of pollution (Section 36) (see Section 4.1).

The *Fisheries Act* was enacted to protect fish, fish habitat and water frequented by fish, and to provide for sustainable fisheries in Canada. In the *Fisheries Act*, the nine sections (paraphrased below) most likely to pertain to project watercourse crossings are:

- Section 20 – provides for safe passage of fish
- Section 22 – provides for flow of water and passage of fish
- Section 30 – provides for water diversions or intakes to have a fish guard or screen
- Section 32 – prohibits the destruction of fish by any means other than fishing, except as authorized by DFO or regulation
- Subsection 35(1) – prohibits works or undertakings that result in HADD of fish habitat
- Subsection 35(2) – allows for the authorization of HADD by DFO
- Subsection 36(3) – prohibits the deposition of deleterious substances in waters frequented by fish
- Subsection 37(1) – where HADD of fish habitat or a deposit of deleterious substance results or is likely to result from an existing or proposed work or undertaking, DFO may request plans and specifications to be submitted for review
- Subsection 37(2) – where the Minister is of the opinion that contravention of Subsection 35(1) or 36(3) is being or is likely to be committed, DFO may order modification, or restrict or close an undertaking subject to Governor in Council approval
- Subsection 38(6) – allows for enforcement of inspector’s orders

DFO has developed tools to promote the protection of fish and fish habitat, the foremost of which is the Policy for the Management of Fish Habitat. Additional guidance and advice is provided in the following documents:

- Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995a)
- Fish Habitat Conservation and Protection: Guidelines for Attaining No Net Loss (Department of Fisheries and Oceans 1995)
- Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat (DFO 1998)
- DFO Guidelines for use of Explosives in Canadian Fisheries Waters (Wright and Hopky 1998)
- Pipeline Crossings in the Prairies Area. Interim Operational Position Statement (DFO 2005)
A.3.16.3 Alberta Regulations

The Alberta *Water Act* and its regulations have driven the development of the Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body. The Code sets out the engineering and aquatic environment protection standards that must be met. The classification system is sensitivity based. Other Alberta legislation including the *EPEA* and the *Public Lands Act* are also covered by the Code. Alberta legislation has also set forth the Code of Practice for Watercourse Crossings under the authority of the *Water Act*, which establishes the objectives, standards, and conditions to be met when undertaking the activity of constructing or removing vehicle watercourse crossings.

A.3.16.4 British Columbia Regulations

Watercourse crossings in British Columbia are primarily regulated by the *Fisheries Act*, Section 35(2). British Columbia also has codes and guidelines that are applicable to watercourse crossings such as British Columbia Oil and Gas Commission’s Oil and Gas Handbook, the Fish-stream Crossing Guidebook (a component of the Forest Practices Code of British Columbia) and the Forest Engineering Handbook.

British Columbia’s watercourse classification was developed for the Forest Practices Code but is also used for other regulations. It is primarily based on channel width and fish population. However, other factors such as watercourse gradient are also important. The Fishstream Identification Handbook states that watercourses with a gradient greater than 20% are unlikely to have fish presence, while those of 16 to 19% have low probability and 12% to 16% have a moderate probability.

The Oil and Gas Commission’s Stream Crossing Planning Guide (BC OGC 2004, Internet site) addresses both road and pipeline crossings for the various watercourse classifications in terms of seasonality, site conditions and fisheries values. The guide was meant to serve as a supplement to the Fish-stream Crossing Guidebook (BC MoF 2002), and defers to this document for selection criteria to determine the appropriate RoW crossing method. Although the BC OGC will not be involved in the approval process for the Project, this guide provides a useful framework to aid in determining appropriate RoW crossing techniques.

A.3.16.5 Method Selection

The most suitable method for a pipeline watercourse crossing considers a number of factors, which include:

- fish and fish habitat, including the species that are expected to be present at the crossing location at the time of construction
- wildlife habitat, such as migration routes for animals and nesting areas for birds
- Aboriginal, community and stakeholder input
- geotechnical aspects, including HDD feasibility, the stability of the valley slopes and the risk of debris flow
- hydrotechnical aspects such as flow volumes and channel stability
Discussions regarding watercourse crossings are ongoing with representatives from the Department of Fisheries and Oceans Canada, Environment Canada and provincial agencies.

The Project involves a considerable number of watercourse crossings with many factors that must be considered when selecting a preferred crossing method. For these reasons, a two-stage process was developed for the Project to select the preferred crossing method at each of the watercourse crossing locations.

**Initial Screening Process**

The initial screening process determines the preferred crossing method based on meeting threshold conditions related to:

- engineering and constructability
- fish and habitat sensitivity
- flow rate expected at the time of construction
- channel width

The preferred crossing methods for watercourse crossings that were below threshold conditions with no other identified limiting conditions are open cut and isolation.

**Site Review Process**

Once the crossing methods had been decided for the initial watercourse, selected watercourse crossings were reviewed in detail. These crossings had a potential for constraints related to:

- the environment
- engineering aspects
- geotechnical aspects
- constructability
- operability
- cost
- public consultation

Initial preferred methods (open cut, isolation or trenchless) and alternates have been assigned to all of these crossings. However, the crossing methods have been identified for environmental assessment purposes only. The crossing methods for all review sites will be determined during detailed design.
A.3.16.6 Explanation of Methods

Open-Cut
Open-cut crossings allow for excavation of the trench through a dry or wet channel with no requirement to separate the flow in the construction area from the rest of the channel. Flow is not interrupted. The primary environmental mitigations associated with this method are rapid execution, enhanced excavation methods and machinery, controlled placement of spoil materials, silt plume management and backfill alternatives.

High Volume Pumping
High volume pumping is a variation of open cut that limits the volume and velocity of water passing through the construction zone. Pumps are installed upstream of the crossing and the water is directed through hoses around or across the construction zone to a point downstream. The primary mitigation is the same as for open cuts, with the addition of a reduced transfer and transport of sediment from the construction zone.

Isolations
Isolations, including silt curtains, dam and pump, dam and flume, and coffer damming, are intended to separate the construction zone from the main flow of the watercourse and maintain clean downstream flow. The methods try to prevent upstream flow from entering the construction zone, and to prevent silted water from leaving the construction zone. This is accomplished by installing upstream and downstream dams or curtains across the excavation. Primary mitigation includes constructing the dams from acceptable materials to meet the sensitivity of the crossing, fish salvage, sizing the pumps and flumes correctly, dissipating the pump or flume outflow, controlling ditch water, and performing the entire operation in the correct sequence.

Diversion
Flow diversions intend to separate the construction zone from the water flow by the creation of a temporary channel elsewhere in the floodplain. Primary mitigation includes lining the temporary channel to limit silt, sizing the channel to maintain similar depths and velocities, rapid execution, correct placement of trench materials, and managing trench water.

Trenchless
Trenchless installations including HDD, aerial, boring, ramming, and micro tunnelling, are intended to pass under or over the crossing site causing reduced or no disturbance to the channel, banks and riparian areas. Primary mitigations include vehicle crossing restrictions, clearing and grading reductions, containment of site activities and water quality monitoring.
A.3.16.7 Number of Trenches

At trenched crossings, one or two trenches might be excavated to contain the two pipes. The determination of the number of trenches will depend on watercourse characteristics, geotechnical conditions, the weighting method, substrate materials, ditch stability, and the length and weight of the drag section.

A.3.16.8 Special Watercourse Assessments

The pipelines intersect many watercourses on the RoW, and some of these locations were considered control points for pipeline routing. Many of the watercourse crossing locations could be a challenge for general construction and installation of the pipelines. A special watercourse assessment team was organized to provide a detailed analysis of biophysical, fisheries, construction and access conditions at selected crossing locations. The results will lead to recommendations on the most suitable crossing methods, site-specific mitigation measures, possible compensation and habitat enhancement, and other information critical to developing a suitable watercourse crossing.

A.3.16.9 Agency Discussions

Since the fall of 2005, Northern Gateway has organized regular meetings with DFO representatives from Alberta and British Columbia who will coordinate the review of the Project to discuss watercourse crossing methods for the Project. In the spring/summer of 2006 and again in 2009, workshops were held with Regional DFO representatives from Prince George, Terrace, and Calgary. These workshops will continue as additional data and information becomes available and input is considered. In addition, discussions, meetings and field visits are planned with DFO, Environment Canada and provincial agency representatives.

A.3.17 Horizontal Drilling Plan

A.3.17.1 Drilling Plan Considerations

For each watercourse crossing, general HDD construction considerations will include the:

- geotechnical assessment
- fisheries assessment
- river hydrology
- topographic profile

At each crossing, Northern Gateway and the drilling contractor will review the geotechnical assessment and engineered design crossing documents. Based on this review, the drilling contractor will provide a drilling plan for each HDD crossing. The plan will incorporate information from the geotechnical report, and the contractor will be informed of potential adverse subsurface conditions that could affect steering, hole stability, fluid circulation and pull back. Path trajectories will be planned by the contractor before directional drill starts, and will generally reflect the design drawings. However, changes may be made to accommodate the contractor's equipment, or if additional information becomes available.
Northern Gateway will conduct a water quality monitoring program and provide progress information to the drilling contractor. All affected disposition holders will be notified of the start date and timing of construction activities. The contractor and Northern Gateway will jointly develop an emergency response plan to deal with fluid releases. The plan will be developed according to the guidelines in the Horizontal Directional Drilling Contingency Plan (see Section A.2.7).

A.3.17.2 Regulatory Requirements

The regulatory requirements relating to HDD watercourse crossings include:

- notification in accordance with the Alberta Water Act Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body Including Guidelines for Complying with the Code of Practice (Alberta Environment 2001b, Internet site)
- notification pursuant to DFO Interim Operational Position Statement: Pipeline Crossings in the Prairies Area (DFO 2006, Internet site)
- notification pursuant to DFO Pacific Region Operational Position Statements for Directional Drilling (DFO 2007a, Internet site)

A.3.17.3 Protection Measures

The following protection measures will be implemented where appropriate.

Permits and Approvals

All necessary HDD crossing approvals will be obtained before construction. Inconsistencies between conditions of different approvals will be resolved before construction.

Notice

Notification will be provided 10 working days before any HDD activities start. Notice will include description of activities and schedule. Applicable regulators will be kept informed of all HDD schedules.

Awareness

Northern Gateway will hold a preconstruction HDD meeting with its agents, contractors and other representatives before project construction starts. Additional meetings will be held before starting construction in a new area and before implementing a new construction technique, so that environmental questions specific to the new construction are clear and understood. The contingency plans for potential problems resulting from crossing method failures or adverse conditions, taking into account any restricted activity periods, will be reviewed at this meeting. All key project personnel working in the RoW will be informed of these plans.
Contingency Crossing Methods

A contingency crossing plan will be complete and available for each HDD crossing, to be implemented if the HDD method is unsuccessful. The alternative crossing methods, such as open-cut or isolation, may create instream disturbances. The applicable regulatory body will be notified according to the permit conditions.

Frac-Out Response Plan

Contractor responsibilities, including frac-out response, are outlined in the Horizontal Directional Drilling Contingency Plan (see Section A.2.7). The plan is provisional and is generally consistent with industry standards. This plan will be reviewed before construction starts, and will be submitted to appropriate regulatory authorities. All on-site personnel will be informed of the plan.

HDD Equipment

Before any crossing work starts, all required materials will be stockpiled on site. Surface water runoff and seepage controls will be installed before construction and maintained throughout installation.

All HDD equipment will be assembled and checked for proper operation before activities start. All fuelling, servicing or washing of mobile construction equipment will occur at least 30 m from all watercourse crossings, to limit the potential for water pollution.

Interference

Every effort will be made to limit interference with the activities of other land disposition holders in the area.

HDD Survey and Staking

Before starting any drilling operations, the drilling contractor or surveyor will clearly flag the entire expected drill path, including both sides of the watercourse.

Soil Salvage and Protection

The HDD entry site will be used for the pilot hole, reaming, cleaning and pipe pullback operations. The topsoil or duff and mineral soil in this area will be stripped and stored to the side, away from the work area. The subsoil will then be levelled, and a berm large enough to control surface runoff will be constructed around the site.

The exit site work area will be prepared to the size stated in the construction drawing. Similar to the entry site, the HDD site will be stripped and topsoil stored to the side. Subsoil will be levelled and the area will be bermmed.

The staging area will be long enough to accommodate the construction for the overall curve distance of the crossing. During drilling periods, the pipeline contractor will haul the pipe to the layout area and will string, weld, x-ray and coat the joints, and then place the pipe on pipe rollers when the section is ready for installation. For major or sensitive crossings, the pipe drag section will be tested for leaks before it is installed. The fully installed section will be re-tested as part of pipeline pressure testing.
Drilling Fluid

The drilling fluid composition will consist of bentonite and fresh water. Additives to control mud chemistry are often used to improve drilling conditions and performance. Additives in the drilling fluid other than sawdust, nut shells or bentonite pellets require the approval of Northern Gateway, in consultation with the appropriate regulators. A list of pre-approved additives will be developed before drilling work starts.

Drilling Pressure and Rates

Drill fluid pressures and drilling rates will be monitored at all times by a trained operator and inspector, to watch for pressure spikes that could lead to a frac-out. Downhole annular pressure monitoring will be provided.

Monitoring

If a frac-out occurs, the environmental inspector will begin the water quality monitoring program, to:

- provide feedback to the contractor
- identify potential effects on water quality
- oversee the implementation of environmental protection measures during construction

See Section A.3.19 for the Water Quality and Substrate Composition Monitoring Plan.

Drilling Fluid Monitoring

Both the drilling contractors and project management will be diligent during all aspects of directional drilling, to limit the potential for releases of drilling fluid. If a frac-out occurs, all effects resulting from fluid migration to the surface will be addressed.

Appropriate measures for containing drilling fluid or incorporating alternative drilling methods will be implemented. The HDD contractor will have sufficient equipment on site to deal quickly with any incidents.

If drilling fluid or pressure loss is detected by the drilling operator, additional efforts will be made to determine whether a frac-out has occurred. Response measures outlined in the Horizontal Directional Drilling Contingency Plan will be implemented (see Section A.2.7). Water quality will be monitored to determine whether a frac-out has caused fluids into the watercourse.

If a frac-out is detected, the contractor will implement strategies to seal or plug off fractures, to limit the loss of circulation. The contractor will also implement a procedure for tracking fluid loss and for sealing frac-outs.

Fluid Containment

The work area and entry point will be monitored during drilling, to detect potential losses to the surface. If losses are detected where a watercourse may be affected, drill rig production will stop, and drilling fluid will be contained, cleaned up and transferred back to the rig before drilling operations resume.
Dewatering

Dewatering of containment pits, sumps or ditches will require drilling fluids to be vacuumed into a pump truck and disposed of at an approved facility, or in an approved way. Discharge of contaminated fluids on site will not be permitted.

Drilling Fluids and Cuttings Disposal

Drilling fluid consists of clay particles mixed with water. In accordance with ERCB Directive 50, all excess drilling fluid and cuttings that cannot be disposed of on site will be hauled to an approved disposal site. The BC MoE is expected to accept these guidelines with review and comment.

Demobilization

After the pullback is complete, the drill rig and all equipment from both sides will be dismantled and removed from the work sites. After the pipelines are tied-in, the topsoil will be replaced and the site will be cleaned up.

All disturbed areas, where bare soil has been exposed, will be reclaimed to project specifications.

A.3.17.4 Detailed Design

Drawings for each HDD crossing plan will be prepared and approved by Northern Gateway. The plan will take into account the geotechnical data, topographic profile, river hydrology, the fisheries assessment, vertical elevations, horizontal distances, expected drilling pressures, water supply and risks.

A.3.18 Aerial Pipeline Crossing Plan

A.3.18.1 Background

Northern Gateway prefers the aerial method of pipeline crossing construction at several water bodies. The aerial method may also be used as an alternative, if other trenchless methods fail. The decision to select the aerial method for this Application will be based principally on avoiding an unacceptable risk of failure, or unacceptable pipeline integrity, if an alternative method is used.

A.3.18.2 Detailed Design

Detailed plans and drawings for each aerial crossing will be prepared by Northern Gateway. The plans will take into account the geotechnical data, topographic profile, river hydrology, biophysical and land use concerns, vertical elevations, horizontal distances, water supply and risks. Detailed design will include identifying measures to confirm that the terrain on which the support structures are constructed:

- is secure (considering the potential for surface erosion, the slope stability and hydrological events)
- meets all safety and operations requirements

Once detailed design is complete, the appropriate regulatory agencies will be consulted, environmental protection measures will be developed, and all necessary permits and approvals will be obtained.
A.3.19 Water Quality and Substrate Composition Monitoring Plan

A.3.19.1 Introduction

Surface water quality is determined by the presence and quantity of substances in water, and mainly depends on watershed characteristics and hydrological flow patterns. Project construction and operations have the potential to influence surface water quality primarily through:

- development (i.e., clearing and grading)
- instream activities
- project releases (i.e., storm water, waste water and emissions)

Three major project-related effects on water quality, with associated mitigation measures, have been considered in this plan:

- altered runoff effects on water quality
- altered TSS concentrations from channel substrate disturbance
- altered water quality

Effects on water quality could result from changes in surface runoff from project-related watershed disturbances, such as:

- instream construction activities and related sediment disturbances
- point source releases and airborne deposition from project emissions

A.3.19.2 Objectives

The objectives of the Water Quality and Substrate Composition Monitoring Plan are to:

- assess water quality and substrate composition in pre- and post-construction conditions
- provide information to assist in protecting aquatic resources
- assist in maintaining or modifying the construction or operations methodology
- improve general understanding of the nature of waterbodies near the Project
- provide compliance and related project information

A.3.19.3 Watercourse Monitoring Plan

The plan will document the following on an individual or watercourse classification basis:

- locations of sampling transects upstream and downstream of the watercourse crossing
- sampling depths
- sampling frequency and duration

The information will be collected by a qualified specialist. During construction, the specialist will frequently inform the environmental inspection staff of the results, and provide advice about the significance of the information. The environmental inspection staff will use the information to maintain or modify the construction activities, in cooperation with the craft inspection staff and the contractor. Monitoring information will be shared with regulatory authorities upon request, or when a problem is identified.
Communication will be maintained between the environmental inspector and construction manager during the water quality monitoring program, to confirm that sediment monitoring is completed in a professionally and safely, and that the data collected meets or exceeds the requirements of Northern Gateway and regulatory agencies. The environmental inspector will participate in a preconstruction start-up meeting with the construction team. Northern Gateway representatives will review monitoring plans and schedules and discuss procedures for handling high sediment loads. A construction briefing will be held for each watercourse crossing, to describe the potential effects of the sediment monitoring criteria on construction activities, and to comply with regulatory approvals. The objective of the field discussions is to improve the quality of each crossing.

**A.3.19.4 Water Quality Monitoring Methods**

The environmental inspector will implement the monitoring plan at selected watercourse crossings with high fisheries values, high value wetlands for amphibians, and where incidents dictate the need for monitoring. The monitoring plan will also include monitoring sediment plumes in the marine environment. Contractor personnel may be assigned to accompany the environmental inspector during sampling intervals. The plan will provide methodology for TSS monitoring by correlated turbidity measurements.

**Turbidity – TSS Relationship**

Turbidity, expressed as NTUs, will be used to provide a surrogate measurement of TSS in mg/L, as turbidity is more readily measured in the field. The least squares linear regression method will determine the relationship between TSS and NTU, using artificially loaded water samples with clay materials and gravimetric analysis of suspended solids for each water sampling location.

The predicted relationship will be used as a tool during the monitoring program to predict real-time TSS values during drilling. Water samples will be collected during construction as part of the quality assurance and quality control (QA/QC) component of the program, and will be similarly analyzed after drilling. Field turbidity samples will be analyzed using a portable turbidity meter.

**Field Sampling**

The field-sampling program will be done during all construction activities. Sediment monitoring involves an adaptive management approach to deal with the seasonal variations and characteristics of the particular water body, as well as construction activities and scheduling. Sampling will include routine monitoring of small watercourses and detailed sampling on transects at major crossings.

Where required, monitoring in the marine environment will monitor the sediment plume generated during dredging and blasting. Monitoring distances will be established through consultation with DFO.

**Point Samples**

Point samples will be collected at locations upstream and downstream of watercourse crossings during routine construction monitoring.
Monitoring Transect Locations

At major crossings and HDD sites, turbidity conditions will be monitored at approximately six transects (with variability allowed), e.g., two upstream and four downstream sites. The upstream transects will be 100 m (US1) and 200 m (US2) above the crossing zone, and will provide information on background levels of turbidity and identification of HDD fractures occurring upstream of the crossing. Downstream transect DS1 will be 100 m downstream of the crossing zone, and downstream transect DS2 will be approximately 200 m downstream. The third (DS3) and fourth (DS4) downstream transects will be approximately 300 m and 400 m downstream.

Suspended Sediment Sampling Methods

In summer, water quality will be sampled using a well bailer from a boat or from shore. In winter, water quality samples for turbidity analysis will be collected through ice-augered holes using a well bailer.

Turbidity samples will be analyzed using a portable turbidity meter. Each sample will be agitated vigorously until all settled solids are suspended, then a 15 ml subsample will be withdrawn and placed in a test vial. The outside of the vial will be cleaned and dried, to reduce the chance of false readings caused by substances on the outer surface of the vial, which could diffract light away from the turbidity meter’s sensor.

For QA/QC, selected samples measured for turbidity will be collected and returned to an analytical laboratory for analysis. QA/QC sampling will be undertaken daily during the monitoring program and will consist of duplicate samples from selected sites. QA will also include consistent preparation of all samples and frequent calibration of the meter.

Digital photographs will be taken of excavation, drilling and containment measures each day and during any events that could affect turbidity.

Other Water Quality and Quantity Parameters

Conductivity, pH and dissolved oxygen will be measured daily at sampling locations both upstream and downstream of construction.

HDD Watercourse Crossing Monitoring

If pressure loss or fluid loss occurs, continuous monitoring will be conducted at all downstream transects. After mitigation of the fracture, sampling will continue at transects immediately downstream and upstream of the frac-out site until background or near-background turbidity levels are obtained.

Any changes to the frequency of turbidity sampling will be decided on site by the environmental inspector, but the frequency will remain sufficient to describe spatial and temporal changes in water quality. Based on the conditions observed during monitoring, slight modifications to the sampling locations and frequency might be required. However, these modifications will not compromise the quality or integrity of the program.
TSS Variances in the Field

TSS concentrations immediately downstream of construction outlets will be used as the benchmark for identifying variances of the corresponding Canadian Council of Ministers of the Environment (CCME) guidelines. If the TSS concentrations at a location exceed the CCME guidelines for short-term exposure, the environmental inspector will immediately notify the construction manager that additional mitigation measures are needed to limit TSS levels.

If the turbidity levels continue to exceed the guidelines, a variance report will be filed and all instream construction activities will be shut down or modified upon the direction of the environmental inspector, until the source of high TSS is identified and corrective action has been taken. Construction may resume when corrective measures have been completed to the satisfaction of the environmental inspector, and TSS levels are below the CCME guidelines.

A.3.20 Watercourse Reclamation Plan

A.3.20.1 General

Watercourse reclamation is critical for mitigation against long-term environmental effects on water quality, fish and fish habitat. It enhances bed and bank stability, pipeline integrity and, ultimately, restores or enhances fish habitat. Stabilization and reclamation of the RoW will effectively limit erosion and sedimentation to watercourses.

The techniques described in the following are widely used and are cost-effective ways of stabilizing watercourses, and reclaiming and enhancing habitat. Specific techniques will be selected based on existing conditions at each watercourse crossing (e.g., habitat features at and adjacent to the crossing, flow, erosion and slope). Post-construction access requirements and third-party activities are also considered in technique selection. Site-specific stabilization and reclamation techniques will be developed during the planning and assessment of crossing locations.

The objectives of the mitigation measures in the following sections are to:

- limit adverse effects
- comply with the habitat protection provisions of the *Fisheries Act* and the principle of “no net loss of productive fish habitat” included in DFO’s policy for the management of fish habitat
- comply with all regulatory permits and approval conditions
- use environmentally and economically responsible construction practices according to applicable industry standards

Watercourse reclamation will generally occur as soon as practical after construction. Additional reclamation works may be done in response to post-construction monitoring.
A.3.20.2 Mitigation Measures

General

Northern Gateway will implement the following general practices, where appropriate:

- All sites will be reclaimed to a state comparable to that existing before the work.
- Watercourse bed and banks will be recontoured and restored as closely as possible to the preconstruction profile to maintain long-term bank stability. The natural sinuosity, depth, width and thalweg of the watercourse will be maintained, where appropriate.
- Gravel and cobble substrates will be salvaged before trenching, and replaced as part of restoration.
- Instream cover features, such as large woody debris and boulders, will be salvaged before trenching, and replaced as part of restoration, subject to hydrotechnical review.
- Instream restoration of a watercourse will occur in isolation of the flow, to the extent possible.
- The watercourse bed and banks will be stabilized and reclaimed after backfill of the trench, unless otherwise directed. Stabilization is required until complete watercourse reclamation can be implemented. This could depend on the construction schedule, access removal, time of year and weather conditions.
- Existing cover provided by undercut banks or overhanging vegetation will be re-established, or habitat enhancement techniques used, as specified by Northern Gateway.
- At specified watercourse crossings, disturbed portions of the watercourse bed will be capped with channel liner, clean granular material or clean rock.
- Prominent drainage patterns along approach slopes will be returned to a condition that approximates preconstruction, by matching the existing drainage patterns in adjacent undisturbed areas:
  - The RoW will be graded to a stable slope and erosion and sediment control measures will be used to protect the watercourse.
  - Northern Gateway will assess sites that do not have a site-specific erosion and sediment control plan, and will identify appropriate mitigation measures to limit the potential for erosion and sedimentation.
- Segregated topsoil or organic material will be replaced over the trench line on the banks and buffer zone of the watercourse, and seeded with an approved seed mix.

A.3.20.3 Bank Stabilization Techniques

All reclamation methods, techniques and structures will be approved or specified by Northern Gateway in conjunction with regulatory authorities. Watercourse reclamation techniques will be conducted in isolation of the flow, if site conditions and methods permit. The replacement of topsoil, transplanted native vegetation or seed and mulch will occur at Northern Gateway’s discretion. The following provides a general description of the bank stabilization techniques that may be used on the Project.
Rock Rip-Rap

Rock rip-rap bank stabilization is very durable and provides long-lasting protection against bank erosion. Northern Gateway will consider this technique for use on high-velocity watercourses.

Channel Liner

Installation of channel liner may be considered for watercourses that have a low flow velocity and do not support sensitive fish habitat at the crossing location. Such watercourses include those with an organic bottom and low shallow banks.

Brush Layering

Brush layering involves placing layers of branches interspersed between layers of soil. The branches are placed in a criss-cross pattern, so the tips protrude just beyond the face of the slope, where they limit runoff and erosion. The soil layers are wrapped in biodegradable geotextile fabric. This technique is suitable for watercourses where bank stability is good, but where soils are prone to erosion, as both the fabric and the brush act as interceptors. It may also be used in conjunction with other stabilization and reclamation techniques.

Log Walls and Crib Walls

Log and crib wall structures are low-bank stabilization structures typically used in combination with overhead cover to provide shelter, safety, feeding, and resting opportunities for fish in smaller watercourses. These structures maintain nearshore watercourse depth and bank slope, and may deteriorate over time to restore a natural bank. A live log or crib wall may be created by placing live willows (or other appropriate species) perpendicular to the watercourse flow, and projecting them from the structure at or above the waterline.

Tree Revetments

Tree revetments incorporate trees at the toe of the watercourse bank or slope. Trees are anchored to the bank and angled downstream to reduce watercourse velocity and provide a refuge for fish. The more branches and foliage on the tree, the more protection and habitat are provided. These structures may also be used to improve channel conditions, such as the pool–riffle ratio and meanders. Hydrotechnical aspects will be considered in the decision to use tree revetments, because the anchored trees may trigger lateral erosion or log jams, in some watercourses.

Root Wads

Root wads reduce watercourse currents in similar way to tree revetments. Root wads are root systems of large trees anchored into the bank or watercourse bed. They effectively limit erosion and provide and enhance fish habitat. Hydrotechnical aspects will be considered in the decision to use root wads, because the anchored root wads may trigger lateral erosion or log jams, in some watercourses.
Transplanting

Transplanting involves inserting individual plants or sod from the immediate area or nursery stock into the watercourse bank in a way that allows the plants to take root and grow. This technique creates a root mat that stabilizes the soil by reinforcing and binding soil particles together. Transplanting can be used in conjunction with other stabilization techniques.

Live Staking

Live staking involves inserting vegetative cuttings, such as dormant willow or dogwood, into a watercourse bank. Eventually the cutting will develop a root mat that stabilizes the soil by reinforcing and binding soil particles together. Live stakes can be used in conjunction with other stabilization techniques. They are typically planted in a random pattern.

A.3.20.4 Instream Habitat Reclamation Techniques

All reclamation methods, techniques and structures will be approved, or specified, by Northern Gateway in conjunction with regulatory authorities. Watercourse reclamation techniques will be conducted in isolation of the flow, if site conditions and methods permit. Installing topsoil, transplanted native vegetation and seed and mulch will occur at Northern Gateway’s discretion. The following is a general description of instream habitat reclamation techniques that may be used on the Project.

Deflectors

Current deflectors are structures commonly used to manipulate instream habitat. They can be adapted to site conditions and a variety of watercourse sizes. Deflectors can effectively direct currents to desired locations, develop meander patterns, deepen and narrow channels, deepen pools, scour sediment, increase water velocities, maintain low water temperatures and enhance pool–riffle ratios. Deflectors may be constructed of logs, rocks, boulders, gabions or various combinations of these materials. Structures are typically built in series and in conjunction with other watercourse reclamation measures. Hydrotechnical aspects will be considered in the decision to use deflectors, because the deflectors may trigger lateral erosion or log jams, in some watercourses.

Log and Rock Weirs

Weirs are low profile multipurpose structures created from a variety of materials and are used to create pool habitat, raise water levels and collect and hold spawning gravel. These structures are most suitable for small watercourses with a moderate to high gradient. Weirs are considered for placement in straight reaches similar to that of riffle areas. The hydraulic characteristics of the watercourse are taken into consideration when designing and placing log and rock weirs.

Boulder Clusters

Boulder clusters are groups of rocks placed in various patterns to provide instream fish habitat. In deeper sections and during high flows, this type of habitat will support adult fish. These structures also effectively provide mid-stream current deflection and resting areas to aid in migration. Boulders will
typically be clustered in various patterns so they do not direct current against an existing unprotected bank. The hydraulic characteristics of the watercourse are taken into consideration when designing and placing boulder clusters.

### A.3.20.5 Monitoring

Watercourse reclamation activities will be monitored during construction and at regular intervals after construction. All necessary permits will be obtained and complied with. Post-construction monitoring will focus on persistence and effectiveness. Where reclamation is not successful, corrective measures will be recommended.

### A.3.21 Atmospheric Environment Protection and Management Plan

#### A.3.21.1 Regulatory Requirements Specific to Atmospheric Environment

Atmospheric environment refers to the air in the region surrounding the pipelines, the Kitimat Terminal and infrastructure sites. The key project issues related to air quality are the environmental effects of potential added emissions of criteria air contaminants (CAC), hazardous air pollutants (HAP) and greenhouse gases (GHGs).

Air quality was assessed in the context of project-related emissions and ground-level concentrations for the air contaminants of interest.

#### A.3.21.2 General Protection Measures

Many of the substances considered in this assessment will comply with federal and provincial air quality standards, objectives and guidelines, which have been established by regulatory authorities with the intent of protecting human, wildlife and ecosystem health.

The intent of the following mitigation measures is to comply with federal and provincial air quality standards, objectives and guidelines for relevant CACs and HAPs during all project phases:

- Low-sulphur fuels will be used for construction equipment, where they are locally available.
- Proper equipment maintenance schedules will be followed to limit emissions from construction equipment.
- Dust emissions will be controlled by applying dust suppressants, as necessary. Proper scheduling will further limit dust emissions by avoiding dust-generating activities during periods of high winds. The amount of disturbed area will be limited, to prevent generating dust.
A.3.22 Noise Management Plan

A.3.22.1 Specific Noise Mitigation Measures

The following mitigation measures will be implemented, where appropriate, to address increases in noise levels during site preparation and construction of the pipelines, the Kitimat Terminal and infrastructure sites:

- Noise abatement and construction scheduling will be considered at noise-sensitive locations and during noise-sensitive times, to limit disruption to sensitive receptors.
- Regular inspection and maintenance of construction vehicles and equipment will be done, to confirm that they have effective mufflers installed and worn parts are replaced.
- Only the size and power of tools necessary will be used, to limit noise from power tool operations.
- Vehicle speed limits will be enforced.
- Access roads will be maintained, to limit vehicle noise and noise from vibration.
- Equipment will be turned off when not in use.
- Quieter methods and quieter equipment will be used.
- Noisy equipment will be enclosed, and baffles used, to limit the transmission of noise beyond the construction site.
- Low altitude flights will be avoided, except as required for the safety and security of the pipelines, and all air traffic will be restricted to daytime hours.
- Stationary equipment, such as compressors and generators, will be located away from noise receptors.
- Equipment parts generating excessive noise will be replaced or repaired.
- Electric motors, pumps and auxiliary equipment that meet acoustic industrial standards will be purchased.
- Noise barriers, berms or enclosures will be used for equipment installed at the Kitimat Terminal.
- Electric motors, pumps and auxiliary equipment that meets current acoustic industrial standards will be used.
- Diesel plant units will be provided with efficient intake and exhaust silencers.
- Truck drivers and mobile equipment operators will be informed about not using engine retarder braking in noise-sensitive areas.
- The enclosure and cladding of pump station buildings will be designed so that the walls and roof material absorb noise effectively.
Blasting Noise Mitigation

The following mitigation measures will be used for blasting noise:

- The blast design will be optimized, blasts monitored, and the blast design revised, as required.
- Affected residents and Aboriginal groups will be notified 24 hours before blasting.
- Where appropriate, blasting will be confined to between 0800 and 1900 hours and, where possible, blasting will be avoided when temperature inversions occur.

A.3.23 Geology and Terrain Protection and Management Plan

A.3.23.1 Introduction

A decrease in terrain integrity can occur because of construction, operations and decommissioning of the pipelines. At the same time, a range of geological and geomorphological processes (geohazards) can potentially affect pipeline integrity and other project infrastructure (e.g., tunnels, access roads, powerlines, pump stations, construction camps, stockpile sites and the Kitimat Terminal).

The RoW crosses six physiographic regions. From east to west they include; the Eastern Alberta Plains, Southern Alberta Uplands, Alberta Plateau, Rocky Mountains, Interior Plateau and the Coast Mountains. The six physiographic regions include a variety of terrains with the potential to be affected adversely by naturally triggered or construction-related geomorphic processes, and with varying potentials for conditions that may affect the pipelines and related infrastructure.

Terrain integrity risks have been assessed according to the potential for the pipeline construction to cause changes in environmental conditions, as well as the degree of risks posed by various geohazards that may affect the pipelines and related infrastructure. Engineering design and routing risk assessments help identify and solve geology and terrain challenges before installation of the pipelines. Mitigation measures, such as those required to control erosion and maintain terrain stability, protect the RoW. Elements such as environmental inspection and monitoring are used on an ongoing basis to identify potential problems and help confirm that mitigation is effective. Considerable overlap exists between engineering aspects and environmental aspects, and ongoing input and interaction from both environmental and engineering (including geotechnical) personnel throughout the design, construction, operations and decommissioning phases has been and will be implemented, to resolve problems effectively. The environmental alignment sheets that will be available before construction will indicate the type and severity of the hazards, along with appropriate mitigation measures (including reference to appropriate drawings and reports), once they have been fully assessed by the engineers.

A.3.23.2 Summary of Geohazards by Physiographic Region

Eastern Alberta Plains

The Eastern Alberta Plains consists of mostly flat to gently sloping or rolling terrain with a few areas of moderate slopes. The only major watercourse crossing is the North Saskatchewan River. Surficial materials include glaciolacustrine silty clay, eolian and silty clay glacial till deposits. Bedrock is weak but
only exposed in a few areas and does not typically affect slope stability along the RoW. Slides are shallow to (infrequently) moderately deep. Terrain geohazards are almost all very low to low, except for the moderate geohazards at the North Saskatchewan River watercourse crossing and a few incised gullies. Geohazards can be mitigated to very low to low conditions during pipeline construction.

**Southern Alberta Uplands and Alberta Plateau**

The Southern Alberta Uplands and Alberta Plateau physiographic regions comprise flat to gently sloping terrain incised by several major watercourse valleys including the Athabasca, Little Smoky, Waskahigan, Simonette, Latornell, Smoky, Wapiti and Redwillow Rivers. Slopes on major watercourse valleys are gentle to steep. Surficial materials include mostly glaciolacustrine silty clay, and eolian and silty clay glacial till deposits. Bedrock is typically weak, except in parts of the Alberta Plateau where it is strong. Bedrock, glaciolacustrine silty clay, and silty clay glacial till are involved in moderately deep to deep-seated slides that give rise to existing moderate to locally high geohazards that can be mitigated satisfactorily.

Upland geohazards are typically very low to low. Erosion, siltation and revegetation will require consideration in some areas (e.g., moderate slope segments, sandy eolian soils) but can be mitigated satisfactorily at reasonable costs.

Existing moderate to high geohazards on some of the major approach slopes to watercourses will be mostly mitigated by routing around problem areas, combined, in a few cases, with using specific construction methods and monitoring. Existing lateral erosion and (in a few cases) downcutting hazards are high, but will be mitigated by design as required. Overall, mitigated geohazard levels on watercourses, major approach slopes and in other areas are expected to be low.

**Rocky Mountains**

The Rocky Mountains region commonly has areas of moderate slopes, with some high and steep slopes. The pipeline route also borders on areas of high slopes through several valleys, and is at relatively high elevations between the Murray and Parsnip Rivers in British Columbia. The only major watercourse crossing is the Murray River. Surficial materials include glaciolacustrine clay, glaciofluvial sand and gravel, as well as glacial till in major valleys and outwash valleys, thin veneers and blankets of glacial till on higher elevation areas, muskeg in both closed depressions and as extensive veneers on higher areas, and colluvium on some sideslopes. The character of the glacial till varies from typically silty clay in the east to sandy silts with some clay in the west. Bedrock formations include relatively well indurated sedimentary rocks near Tumbler Ridge, and various metamorphic, sedimentary and metavolcanic formations to the west. Limestone is present in several parts of this segment, but identified karst areas were avoided during routing. Potential stability aspects include shallow slides in surficial materials, rock and snow avalanches and debris flows. Some alluvial fans may be subject to avulsion, and lateral stability of watercourses occurs in some areas. Shallow sliding and erosion or sedimentation occur throughout this segment, particularly on sidehills. Bedrock formations that may be subject to acid rock drainage have been identified in two parts of this area.
Existing geohazards are moderate to high and will be mitigated by a combination of routing and engineering solutions, to provide low geohazard levels during operations. Engineering solutions to address geohazards will be fully described in the final Construction EPMP and identified on the environmental alignment sheets, to be prepared before construction starts.

**Interior Plateau**

British Columbia’s Interior Plateau is characterized by rolling to ridged terrain, with typically gentle to moderate slopes, but some areas of steep slopes along bedrock ridges and through some watercourse valleys. Surficial materials include:

- extensive glaciofluvial outwash deposits along existing valleys and former outwash channels
- extensive areas of glaciolacustrine clay typically in valleys and on lower areas of the route
- extensive and widespread sandy silt glacial till deposits including large areas of drumlinoid deposits (elongate ridges diagonally across the route)

Bedrock formations include strong metasedimentary and metavolcanic formations with some areas of intrusions.

Deep-seated slides constituting a high geohazard were avoided at the Stuart River by routing and preliminary design methods. Other slides are typically shallow to moderately deep and will be mitigated by routing and engineering design. Engineering solutions to address geohazards will be fully described in the final Construction EPMP and identified on the construction environmental alignment sheets.

Some areas of steep terrain have potential erosion or siltation risks posed by pipeline construction. These areas will be mitigated by appropriate engineering design and by surface and groundwater control and drainage. Local occurrences of rock potentially prone to acid rock drainage (likely infrequent) may occur. Overall, the geohazards through the Interior Plateau can be mitigated by routing and engineering design.

**Coast Mountains**

The Coast Mountains region of British Columbia has the highest proportion of environmentally sensitive terrain when compared with the other regions. This is a reflection of the steep topography combined with locally unstable bedrock, the occurrence of glaciomarine sediments and higher seismic hazards. Rugged terrain occurs in some parts of the area with steep slopes, including alpine areas, where snow and rain precipitation is high. Other parts of the area include level to gently rolling terrain (e.g., much of the lower Kitimat Valley). Two tunnels will bypass some of the most rugged alpine terrain. Surficial deposits include extensive glaciofluvial sand and gravel in much of the area. Thin silty sand or sandy silt glacial tills overlie rock in many of the upland areas. Glaciomarine silts and clays and extensive alluvial and glaciofluvial deposits occur in the lower Kitimat Valley. Some of the glaciomarine clay layers tend to be thin and laterally discontinuous. No evidence of quick marine clays has been found to date, in the part of the Kitimat Valley that the pipeline route crosses. Bedrock formations include metavolcanics and metasediments that have been intruded by Coast Plutonic granitic-type rocks. Local and very scattered occurrences of potentially acid-generating rocks may occur.
In alpine and steep valley sideslope areas, debris flows and groundwater blow-off piping failures could occur naturally or be triggered by some of the existing road construction, in some cases. Slides triggered by sensitive glaciomarine clays have occurred extensively in some parts of the lower Kitimat Valley. However, the pipeline route avoids all known slide areas. Tsunami risks posed mainly by subaqueous slides may exist in Kitimat Arm, and further investigations are ongoing to determine the risk level posed by tsunamis to the docking facilities. The Coast Mountains Region is the only part of the RoW where appreciable seismic motion may occur. However, the level of motion would be much less than for other coastal areas farther south. Some areas have moderate to possibly high risks posed by potential liquefaction and lateral spreading, but these risks will be mitigated mainly by routing, to the extent required. Overall, there are several areas of existing moderate to high risks. Mitigation methods including routing, construction of the two tunnels, and engineering design are expected to reduce all risks to low to moderate.

A.3.23.3 Geohazards

The following summarizes the main geohazards that have been identified.

Deep-Seated Instability

As used in this report, the term deep-seated slide refers to slides more than 10 or 15 m deep. Deep-seated slides may occur along weak clay layers in both soil and rock, such as near horizontal weak clay layers in glaciolacustrine deposits and weak clay layers in some of the bedrock sequences. Some of the largest slides, such as those along the east side of the Wapiti River, may extend for more than 0.5 km back from the river, and may be several tens of metres to over 100 m deep. These have been avoided by routing.

Many of the deep-seated slides move relatively slowly with creep rates of only millimetres per year in some cases. Increased water pressures along the slide surfaces, or toe erosion, can result in large increases in movement rates, of over several metres per day for short periods. The higher movement rates are generally mostly likely to occur on slopes at angles well above the residual friction angles (slopes steeper than 10° to 12°, approximately). Where ongoing movement has resulted in the deep-seated slides retrogressing to overall slope angles approaching the residual friction angle, the chances of rapid large movements are thought to be low.

Deep-seated slides are present at several of the major watercourse crossings, including the Little Smoky, Smoky, Wapiti, Stuart and Morice Rivers. Wherever possible, avoiding deep-seated slide areas is the preferred option, but it may not be possible for all of the watercourse crossings because of the prevalence of such slides. Where the route crosses the slides, mitigation methods and monitoring may be required, depending on the situation. Directional drilling under the slide is another crossing method that may be considered, depending on other geotechnical and design factors.

Shallow to Moderately Deep Slides

Shallow to moderately deep slides (up to 10 to 15 m deep) occur within many of the weaker soil or rock materials and are often on steeper slope segments than the deep-seated slides. In addition, shallow to moderately deep slides often occur on top of the deep-seated slides because of the disturbance and cracking in the shallower materials caused by underlying deep-seated movement. The underlying slides
typically have much higher rates of movement than the deep-seated slides and may respond rapidly to changes in pore pressure conditions. A special class of shallow to moderately deep slides may occur in some of the glaciomarine clays near Kitimat where very large strength losses may occur in some sensitive zones. Shallow slides may be substantial source of sedimentation locally. Mitigation measures for shallow to moderately deep slides include surface and groundwater management, avoidance where possible, grading, and/or buttressing the toe.

Earthflows consist of shallow (typical depths up to possibly 10 m or more) masses of completely re-moulded soil that “flow” slowly down slope. No large areas prone to earthflows have been identified to date along the pipeline route during the geotechnical work, although such slides have been found in the past in some of the glaciolacustrine soils in British Columbia. Earthflow type movements have occurred in some of the glaciomarine slides north of Kitimat. To the extent possible, where areas prone to such movements have been identified, they have been avoided during RoW routing.

Groundwater blow-off failures are groundwater induced failures that lead to extreme piping (internal erosion) of the soil. They typically form in bedded glaciofluvial deposits along steep slope segments where groundwater flows from permeable layers becomes blocked. This is commonly associated with the near surface soil being reworked by vegetation, frost or other mechanisms. When the stored groundwater builds up sufficient pressure, the surficial layers may be blown off and large amounts of stored groundwater drain rapidly, causing erosion of a canyon with an amphitheatre-shaped head scarp. Subsequent sloughing may also occur. Groundwater blow-off failures are common on some of the glaciofluvial terraces in central British Columbia. The RoW routing has generally avoided the steep terrace fronts where possible, and no examples of large failures along the route are presently known. Some small to moderate sized failures have occurred near the Athabasca River watercourse crossing, at a few locations in the upper Kitimat Valley and along Klo Creek. Mitigation measures, if required, include avoidance, groundwater drainage controls, and soil retention techniques (for example by rock mats).

Debris Flows

Debris flows can occur when “debris” (accumulations of fluvial and colluvial materials along watercourses) is mobilized by high watercourse flows and/or groundwater seepage. The resulting mixture of water and soil can sweep down the watercourse channel, causing erosion in some areas and deposition in other areas. A few watercourses in the Rocky Mountains and Coast Range may be subject to debris flows. With respect to the pipelines, the main hazards include erosion at the watercourse crossing and avulsion where debris is deposited and blocks a channel of a creek, causing a change in channel location. Both forms of erosion could result in pipeline exposure, coating damage and/or pipeline damage. Rupture as an immediate consequence of the debris flow is considered to be unlikely based on past experience with similar events.

Consolidation Settlement

Normally consolidated clay or peat may be subject to settlement where additional loading, such as fills, are placed. This is an infrequent hazard along the RoW route, based on present conditions, although it could occur in a few areas in the future due to access road construction, site development or other causes. The hazard assessment in this report is only for areas where there appears on the basis of present
knowledge to be a hazard posed by existing fills, including the existing hydraulic fills in the lower Kitimat Valley. Future fill placements are not included and no such locations are known to the authors.

**Karst Induced Settlement or Displacement**

Apparent dolines (down-dropped areas formed by karst processes, i.e., solution of limestone) have been identified at some locations through the Rocky Mountain physiographic region. Sink holes (smaller down-dropped areas or areas where loss of ground has occurred) are also present. Ground subsidence has also induced the formation of multiple scarps and/or other slope movements that may have associated lateral movements in a few areas. One primary mitigation method is avoidance during routing – the method used for all known areas along the route. Mitigation measures during construction include additional investigation, special backfills allowing small ground movements to occur without affecting the pipelines, surface pipelines, and/or monitoring.

**Rock Fall**

This includes both rock fall from rock cliffs and falls of boulders from very steep colluvial or till slopes above the pipelines. Rock toppling, rock falls and other failures of jointed rock masses occur in a few locations near the route. Most of the rock fall areas identified to date have been in the Coast Mountains. Other areas prone to rock fall may exist along other parts of the route such as on the east side of the pass through the Rockies. The primary consequence of rock falls, if there is any consequence at all, might be denting or, in a more serious event, penetration of the pipelines. Mitigation measures will depend on the extent of the problem and include avoidance, scaling, anchoring, extra depth of cover, deflector berms, or fills and/or special protection.

**Stream Erosion**

Stream erosion includes the possibility of lateral erosion, reoccupation of subchannels, and/or downcutting exposing the pipelines. The possibility of secondary interactions such as lateral erosion triggering slope instability may also occur. Lateral erosion conditions will be considered during detailed design of trenched crossings. Mitigation methods include installing the pipelines below the depth of potential scour across the affected areas, directional drilling, microtunnelling and similar methods to go under the area, or possibly an aerial crossing above the area affected. Other methods include riprap installation, groynes, spurs and other similar installations, which can often be installed in the dry rather than requiring instream work.

Avulsion (channel switching such as on alluvial fans) is a special case of watercourse erosion. Where avulsion occurs on a large fan, the watercourse may relocate to a different part of the alluvial fan, potentially 100 m or more from the original watercourse crossing, and potentially causing downcutting erosion over an area of the pipelines where erosion was not allowed for in the design of the crossing. Avulsion may be triggered by a variety of events such as high flows (rain and/or melting snow), ongoing deposition along the watercourse channel, or debris flows or avalanches blocking the channel. Avulsion may be an important consideration for a few watercourse crossings east of Tumbler Ridge near Kinuseo Creek, along parts of the upper Kitimat Valley, and in a few other localized areas along the route.
Mitigation measures include directional drilling or deep trenching across the fan, crossing the fan near the head where the lateral extent of avulsion is limited, or avoiding the area (routing).

Avalanches

Avalanches include the movement of snow, sediment and debris by snow avalanche. Even large avalanches do not usually directly affect a buried pipeline; however, above-ground structures such as aerial crossings could be affected. Avalanches may also result in the blocking of watercourse channels, subsequently resulting in avulsion or downcutting erosion. Changes to surface drainage conditions after major avalanches coupled with periods of rapid snow melt are an important consideration that could result in exposure of the pipelines if suitable mitigation measures are not undertaken. Avalanches across access roads could also affect the ability to access and respond to various pipeline situations. The direct and indirect consequences of avalanches may include denting or mechanical damage, coating damage or exposure. Avalanche impacts on aerial structures could include ruptures, but no likely areas are presently known. Mitigation methods include avoidance of above-ground pipeline structures in vulnerable areas, detailed analysis of avalanche conditions, deep cover, deflector berms and various avalanche control techniques.

Lateral Spreading

Lateral spreading involves lateral movement of ground typically but not necessarily triggered by a seismic event. Movement may occur on a weak layer, such as a weak, sensitive marine clay layer in the Kitimat Valley area, or potentially due to liquefaction of underlying loose materials such as sand (no such areas are known along the RoW). A lateral spread could involve large lateral movements and, as such, could have major impacts on the pipelines. Principal mitigation measures include avoidance of areas prone to such events (routing), design of the pipeline systems to withstand the movements, decoupling the pipelines from the soil movement using surface pipeline technology, and ground improvement or drainage.

Liquefaction

Liquefaction is one manifestation of a larger category of soil cyclic mobility phenomena caused by seismic events. Liquefaction typically involves loss of strength of granular materials such as loose sand, usually but not always because of seismic shaking. Liquefaction can result in severe settlement, displacement and related problems. The hazard requires the presence of loose saturated granular materials such as sand or silt. The only area where the potential for this hazard has been identified is in parts of the lower Kitimat Valley including areas of hydraulic fill.

Seismic Motion

There have been no failures anywhere in the world of major cross-country buried, conventionally constructed, welded steel pipelines due to seismic shaking that Northern Gateway is aware of and the prevalence of seismic shaking for the RoW is much lower than for other pipelines in other parts of the world. The engineering design and construction will take appropriate account of seismic shaking and other seismic design aspects as appropriate. Note that this comment applies to the pipelines. Appropriate
seismic design will be required for all facilities, particularly for plant facilities and other infrastructure at the west end of the Project. Slides might be exacerbated by seismic motion; for this report, the slide hazards are covered in the various hazards discussed above.

**Wind and Shallow Stream or Overland Erosion**

Wind and water erosion are two of the main agents of siltation, which is a potentially widespread occurrence along the RoW, particularly during and immediately after construction. The main consequences are environmental, including potential effects on watercourses and fish. Mitigation methods include routing to avoid these areas, ground and surface water control, revegetation, erosion matting, straw/hay mulching, and also design and construction of surface grading, access, and infrastructure and pipeline components.

**A.3.23.4 Summary**

The risks presented by geohazards can be effectively managed. To be effective, monitoring, inspection and mitigation of environmentally sensitive terrain must be ongoing throughout the lifespan of the pipelines and infrastructure. This requires ongoing assessment of types, frequency and magnitude of geohazards that have the potential to compromise pipeline integrity, infrastructure, the environment, human health, safety and other socio-economic aspects of the Project and communities along the RoW. The overall aim of the work, which will continue through pipeline operations, is to identify moderate and high risk categories and reduce the risks as far as possible, preferably to low.

**A.3.24 Vegetation Protection and Management Plan**

**A.3.24.1 Regulatory Requirements Specific to Resource**

Several regulatory standards in Alberta and British Columbia relate to vegetation will be applied to the Project. Although the Project is regulated by the NEB, these Acts, regulations and guidance documents provide direction for limiting environmental effects during construction, reclamation and remediation. Provincial and federal regulatory requirements for vegetation are primarily related to timber harvesting, conservation of rare plants and sensitive ecosystems, and the control of invasive alien species.

**Alberta Regulatory Requirements**

Under the *Public Lands Act*, Northern Gateway is required to obtain a Pipeline Agreement (PLA) which allows pipeline construction in a defined RoW. As part of the PLA, an environmental field report will have to be prepared in which the timber harvesting plans, including schedules and volumes, will be specified.

Rare plants, rare plant communities and their locations are listed in Alberta Natural Heritage Information Centre (ANHIC) tracking and watch lists (Gould 2006, 2000) and the wild species lists from Alberta Sustainable Resource Development (ASRD 2005, Internet site). The lists from ANHIC and ASRD do not provide legislated protection, but rather recommend avoidance or other mitigation measures.
The Alberta *Weed Control Act* and Regulations were developed to control the spread of invasive alien species. The Act defines what an invasive alien species is, and ranks the known plants according to their economic and environmental effect into prohibited, noxious and nuisance classes.

**British Columbia Regulatory Requirements**

The *Forests and Range Practices Act* states that a cutting licence must be obtained for all forested Crown lands of British Columbia where pipeline construction will occur.

The Act also defines and discusses regulatory aspects regarding rare and invasive species, including the ability of the Minister to designate any plant species or ecosystem not listed as rare or sensitive, and the maintenance or reestablishment of natural barriers to plant migration. Rare plants, rare ecosystems and their locations are listed in the British Columbia Conservation Data Centre (BC CDC).

The British Columbia *Weed Control Act* was developed to protect natural resources and industry from the adverse effects of foreign weeds. The Act lists noxious weeds and imposes a duty on all land occupiers to control designated noxious plants.

**Federal Regulatory Requirements**

A primary goal of the Canadian *Species at Risk Act (SARA)*, among others, is to protect endangered or threatened plant species and save them from extinction or extirpation. The Act contains action plans for several rare species and measures to avoid or limit the disturbance of habitat.

**Specific Protection Measures**

Specific protection measures for rare plants, sensitive ecosystems and plant communities will be developed case by case. However, where rare plants or sensitive ecosystems are identified before construction, various techniques could be used to limit any adverse effects on the population or community. These techniques might include:

- avoiding the population or ecosystem
- replacing stripped topsoil containing native vegetation seed bank (rollback)
- transplanting the population to another site for post-construction reclamation

**Seeding and Seed Mixes**

Seed mixes and application rates will be developed in consultation with provincial and federal regulatory authorities, along with reclamation professionals and stakeholders involved in reclamation activities. Table A-11 provides a list of suitable revegetation species that will be used to develop seed mixtures appropriate for each reclamation unit. The RoW and ancillary disturbances will be allowed to revegetate naturally where site conditions are favourable.
## Table A-11  Suitable Species for Revegetation

<table>
<thead>
<tr>
<th>Species (Preferred Variety)</th>
<th>Botanical name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern wheatgrass (Elbee)</td>
<td><em>Agropyron dasystachyum</em></td>
</tr>
<tr>
<td>Intermediate wheatgrass (Chief)</td>
<td><em>Agropyron intermedium</em></td>
</tr>
<tr>
<td>Slender wheatgrass (AEC Highlander)</td>
<td><em>Agropyron trachycaulum</em></td>
</tr>
<tr>
<td>Awned wheatgrass (AEC Hillcrest)</td>
<td><em>Agropyron trachycaulum var. unilaterale</em></td>
</tr>
<tr>
<td>Violet wheatgrass (AEC Mountaineer)</td>
<td><em>Agropyron violaceum</em></td>
</tr>
<tr>
<td>Spike bentgrass (west coast)**</td>
<td><em>Agrostis exarata</em></td>
</tr>
<tr>
<td>Hair bentgrass (Ticklegrass)</td>
<td><em>Agrostis scabra</em></td>
</tr>
<tr>
<td>Sloughgrass (Egan)</td>
<td><em>Beckmannia syzigachne</em></td>
</tr>
<tr>
<td>Mountain bromegrass</td>
<td><em>Bromus carinatus</em></td>
</tr>
<tr>
<td>Fringed bromegrass</td>
<td><em>Bromus ciliatus</em></td>
</tr>
<tr>
<td>Alaska bromegrass (west coast)**</td>
<td><em>Bromus stichensis</em></td>
</tr>
<tr>
<td>Bluejoint reedgrass</td>
<td><em>Calamagrostis canadensis</em></td>
</tr>
<tr>
<td>Tufted hairgrass (Nortran)</td>
<td><em>Deschampsia caespitosa</em></td>
</tr>
<tr>
<td>Tufted hairgrass (Bering)</td>
<td><em>Deschampsia caespitosa var. beringensis</em></td>
</tr>
<tr>
<td>Slender hairgrass (west coast)**</td>
<td><em>Deschampsia elongata</em></td>
</tr>
<tr>
<td>Blue wildrye (west coast)**</td>
<td><em>Elymus glaucus</em></td>
</tr>
<tr>
<td>Fuzzy-spiked wildrye</td>
<td><em>Elymus innovatus</em></td>
</tr>
<tr>
<td>Red fescue (west coast)**</td>
<td><em>Festuca rubra ssp. arenicola</em></td>
</tr>
<tr>
<td>Rocky Mountain fescue (ARC Vista)</td>
<td><em>Festuca brachyphylla</em></td>
</tr>
<tr>
<td>Junegrass (ARC Mountain View)</td>
<td><em>Koeleria macrantha</em></td>
</tr>
<tr>
<td>Alpine bluegrass (AEC Glacier)</td>
<td><em>Poa alpina</em></td>
</tr>
<tr>
<td>Canada bluegrass (west coast)**</td>
<td><em>Poa compressa</em></td>
</tr>
<tr>
<td>Glaucous bluegrass (Tundra)</td>
<td><em>Poa glauca</em></td>
</tr>
<tr>
<td>Fowl bluegrass</td>
<td><em>Poa palustris</em></td>
</tr>
<tr>
<td>Kentucky bluegrass (Nugget)</td>
<td><em>Poa pratensis</em></td>
</tr>
<tr>
<td>Spike trisetum (ARC Sentinel)</td>
<td><em>Trisetum spicatum</em></td>
</tr>
</tbody>
</table>

### Cover crops

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Ajax Italian rye</td>
<td><em>Lolium multiforum</em></td>
</tr>
<tr>
<td>Regreen wheatgrass hybrid</td>
<td><em>Triticum aestivum x Agropyron elongata</em></td>
</tr>
<tr>
<td>Quick Guard triticale hybrid</td>
<td></td>
</tr>
<tr>
<td>Slender wheatgrass</td>
<td><em>Agropyron trachycaulum</em></td>
</tr>
<tr>
<td>Spike bentgrass (west coast)**</td>
<td></td>
</tr>
<tr>
<td>Hair bentgrass (Ticklegrass)</td>
<td></td>
</tr>
<tr>
<td>Alaska bromegrass (west coast)**</td>
<td></td>
</tr>
</tbody>
</table>
Table A-11  Suitable Species for Revegetation (cont’d)

<table>
<thead>
<tr>
<th>Species (Preferred Variety)</th>
<th>Botanical name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluejoint reedgrass</td>
<td><em>Calamagrostis canadensis</em></td>
</tr>
<tr>
<td>Tufted hairgrass (Nortran)</td>
<td><em>Deschampsia caespitosa</em></td>
</tr>
<tr>
<td>Tufted hairgrass (Bering)</td>
<td><em>Deschampsia caespitosa var. beringensis</em></td>
</tr>
<tr>
<td>Slender hairgrass (west coast)**</td>
<td><em>Deschampsia elongata</em></td>
</tr>
<tr>
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<td><em>Elymus glaucus</em></td>
</tr>
<tr>
<td>Red fescue (west coast)**</td>
<td><em>Festuca rubra ssp. arenicola</em></td>
</tr>
<tr>
<td>Canada bluegrass (west coast)**</td>
<td><em>Poa compressa</em></td>
</tr>
<tr>
<td>Fowl bluegrass</td>
<td><em>Poa palustris</em></td>
</tr>
<tr>
<td>Spike trisetum</td>
<td><em>Trisetum spicatum</em></td>
</tr>
<tr>
<td>Italian rye (Ajax)</td>
<td><em>Lolium multiforum</em></td>
</tr>
<tr>
<td>Regreen wheatgrass hybrid</td>
<td><em>Triticum aestivum x Agropyron elongata</em></td>
</tr>
<tr>
<td>Quick Guard triticale hybrid</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**

** Indicates a west coast species selection placed into seed production in 2007 by PICKSEED Canada Inc.

The following general measures will be implemented where appropriate for seeding activity:

- Species native to the area will be used where suitable seed stock is available.
- Where Aboriginal groups have demonstrated traditional use of a particular species, efforts will be made to incorporate the species into the revegetation plan.
- Seed will be applied at rates to be specified in the environmental alignment sheets, unless otherwise directed by the regulatory authorities.
- Fertilizer may be applied.
- Only certified Canada No. 1 seed will be used, where appropriate and when available, to limit the introduction of invasive species.
- Muskeg and wetlands will not be seeded, unless otherwise specified by the regulatory authorities.
- Agricultural lands will be seeded as specified by the landowner or lessee. Landowners may be given the opportunity to seed their own land provided their seeding schedule does not place the land at risk of erosion.
- Seed will be applied to scarified ground, or harrowed after application, where required by local conditions.
Revegetation specifications will be indicated on the environmental alignment sheets. Use of fertilizer is to be determined based on soil conditions and in consultation with provincial and federal regulatory agencies. Seed application may include:

- aerial broadcast seeding using either a helicopter or fixed wing aircraft
- ground broadcast seeding using ATVs, argos or tractors
- drill seeding, which is the primary method of seeding on agricultural lands, using either a zero-till drill or press drill
- using native seed, or allowing the vegetation to grow back naturally without any re-seeding or fertilizer use

Appropriate seed mixes of native species will be developed through consultation with the applicable provincial agencies. The seed mixes to be used and the locations for application will be determined before construction.

For suitable grasses for revegetation of areas disturbed in the PDA, see Table A-11.

A.3.25 Timber Salvage Plan

A.3.25.1 Introduction

The Timber Salvage Plan has been prepared to assist in planning, scheduling and implementing the salvage of merchantable timber on the RoW and associated infrastructure sites (e.g., access roads, powerline easements, construction camps and storage areas).

Associated tasks include:

- informing regulatory authorities and obtaining Crown approvals for forestry activity in Alberta and British Columbia
- securing “tenure holder” participation in a comprehensive timber salvage program, including the “sale” of salvaged timber

Advance planning will secure, from the provincial regulators and entitled forestry stakeholders, the timely approvals necessary for the salvage and disposal of clearing debris before pipeline construction.

Timber salvage will involve two stages:

- planning
- timber salvage

A.3.25.2 Planning

Planning will involve:

- identifying stakeholders
- obtaining provincial approvals
- supervising on-site activities
Stakeholder Identification

Northern Gateway will contact stakeholders well in advance of scheduled pipeline construction, to understand how specific land tenures are affected by project construction, and to discuss potential mitigation options. Stakeholders will be informed of the clearing schedule and may choose, if their tenure allows, to use their timber before the Project’s clearing crews. For forestry stakeholder groups and affiliates, see Table A-12.

Table A-12 Forestry Stakeholder Groups

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Affiliates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsible authorities</td>
<td>Alberta</td>
</tr>
<tr>
<td></td>
<td>• Ministry of Sustainable Resource Development (ASRD)</td>
</tr>
<tr>
<td></td>
<td>• Lands and Forest Service</td>
</tr>
<tr>
<td>British Columbia</td>
<td>• Ministry of Forests and Range (BC MoF)</td>
</tr>
<tr>
<td>Private landowners (with timber resources)</td>
<td>• Private landowners</td>
</tr>
<tr>
<td></td>
<td>• Federal parks and First Nations</td>
</tr>
<tr>
<td></td>
<td>• Provincial parks and other provincially owned land tenures</td>
</tr>
<tr>
<td>Private owners of Crown timber</td>
<td>Area-based timber tenure holders</td>
</tr>
<tr>
<td></td>
<td>• Forest Management Agreement (FMA) holders (in Alberta)</td>
</tr>
<tr>
<td></td>
<td>• tree farm licensees (in British Columbia)</td>
</tr>
<tr>
<td></td>
<td>• woodlot (in British Columbia)</td>
</tr>
<tr>
<td></td>
<td>• community forests (in British Columbia)</td>
</tr>
<tr>
<td>Occupants of Crown land</td>
<td>Volume-based timber tenure holders:</td>
</tr>
<tr>
<td></td>
<td>• replaceable tenures:</td>
</tr>
<tr>
<td></td>
<td>• major licensees (in British Columbia)</td>
</tr>
<tr>
<td></td>
<td>• coniferous and deciduous quota holders (in Alberta)</td>
</tr>
<tr>
<td></td>
<td>• small loggers (in Alberta)</td>
</tr>
<tr>
<td></td>
<td>• non-replaceable tenures:</td>
</tr>
<tr>
<td></td>
<td>• timber sale licenses (TSLs) (in British Columbia)</td>
</tr>
<tr>
<td></td>
<td>• License to Cut (LTC) (in British Columbia)</td>
</tr>
<tr>
<td></td>
<td>• cutting permits and PLAs (in Alberta)</td>
</tr>
<tr>
<td></td>
<td>• community salvage tenures (in British Columbia)</td>
</tr>
<tr>
<td></td>
<td>• grazing licensees and lessees (in British Columbia)</td>
</tr>
</tbody>
</table>

Securing Approvals

The priority will be to obtain broad approvals, i.e., regional as opposed to district, for project requirements (e.g., timber salvage, debris disposal, temporary watercourse crossings and project timber).

Timely approvals will be obtained for:

- all project uses of RoW timber, such as stringers, rollback, berms, embankments, corduroy and matting
- harvest and removal of all salvageable stands
Crown Approvals

Federal
A Certificate of Public Convenience and Necessity (CPCN) is issued by the NEB.

Provincial Regulatory Authorities in Alberta
Approval under the Alberta Public Lands Act provides the authority necessary to go on Alberta Crown land for the purpose of RoW clearing and construction.
Alberta Sustainable Resource Development administers approvals related to timber salvage and woody debris disposal (although these aspects may be governed by various pieces of legislation).
All FMA holders will be contacted and compensatory agreements will be reached, subject to appeals to ASRD’s forest area manager. The Alberta portion of the route intercepts two FMAs.

Provincial Regulatory Authorities in British Columbia
Authorization to enter British Columbia Crown land and to clear and construct pipelines is issued under the British Columbia Land Act. Authorities related to timber salvage and woody debris disposal are governed under various pieces of legislation, but are administered by the BC MoF, possibly with the assistance of the British Columbia Oil and Gas Commission.
It is expected that an Occupant – Licence to Cut (OLTC) will be obtained for each of the six BC MoF districts intersected by the RoW.

Private Approvals
Stakeholder requirements for timber use and debris disposal will be indicated on the environmental alignment sheets and communicated directly to the work crews, as requirements are likely to change often along the route.

A.3.25.3 Timber Salvage

Assessment of Merchantable Timber
Northern Gateway will assess the potential for salvaging merchantable timber on forested stands within the area cleared for project activities. Protection measures, such as insect pest management, waste disposal and fire hazard reduction, will be planned, approved and implemented. Specific directions will also be included on the environmental alignment sheets, as appropriate.
**Timber Salvage Options**

**Advance Timber Salvage by Timber Tenure Holders**

On a KP-by-KP basis, and according to the clearing schedule, each stakeholder will be contacted about conducting their own timber salvage program, provided it fits within the project clearing schedule. Typically this salvage will use all hardwood and softwood stands of merchantable size.

**Salvage during Clearing by Contractors**

Merchantable timber that remains after the window for stakeholder salvage has closed will be scheduled for removal by contractors.

The contractor will conduct salvage operations in a way that limits butt shatter, breakage and off-RoW disturbance. The expected quality of harvested timber will be up to the standards of use set by the mills predesignated to receive the salvaged timber.

Based on a spatial timber assessment for the entire area of project activities, the probable and final log deck locations for storing merchantable timber or slash will be identified on the environmental alignment sheets. Distance between piles, slope, riparian habitat, ground conditions and other environmental constraints will be considered when selecting log deck locations.

Log decks will either be adjacent to the travel (work) side, just off the RoW, or moved to preselected locations off the RoW, to limit the loss of standing timber and accommodate subsequent hauling of logs. Piles will be oriented so that the butt face is generally adjacent to, and parallel with, the access trail. Every log deck will have a global positioning system (GPS) reference.

Hauling timber from the area of project activities will be an integral part of construction planning. To facilitate construction, all wood will be removed on schedule. The handling and management of wood will be controlled to protect against the spread of disease and insects.

**Timber and Clearing Debris for Project Use**

Timber that is not salvaged for local mills may be salvaged for the project’s internal use either during or after construction. Uses include:

- round wood for constructing rip-rap or corduroy
- slash and stumps for access or erosion control
- hogged mulch that can be used for frost retention, access road construction and erosion control

Timber and clearing debris required during construction will be stockpiled adjacent to the RoW in designated locations as close as possible to the eventual end-use location.
Logging Process

Cutting and Skidding Timber

Tree length harvest systems will be used along most of the pipeline route. With this system, individual trees are directionally felled and transferred on skids (limbs on) into full tree piles along the route. If specified in the approval, separate piles will be made for individual species (or groups of species) and diameter classes (e.g., sawlogs, pulp and hog).

When pile locations are determined, riparian habitat, wet ground and adverse grade will be considered. Uphill or excessively long skids will be avoided, where possible.

Two methods of tree length harvesting will be employed:

- the feller buncher–grapple skidder method, which will be used predominantly for logging on level and gradually sloped terrain
- manual felling (with cable skidding), which will be used on steep slopes and sensitive sites.
  
  Cut-to-length systems may also be used.

Temporary Access Road and Bridge Access

Temporary trails and access roads will be constructed to link all of the piles along a particular RoW segment so that log processors can access and remove the tree limbs in the piles. Temporary bridges and other forms of wetland and watercourse crossings will be indicated on the environmental alignment sheets, as will any additional protection measures resolved with the regulatory agencies.

Disposal of Clearing Debris

Section 8.5.2 provides information on the procedures and protection measures related to the disposal of clearing debris.

A.3.26 Wildlife Protection and Management Plan

A.3.26.1 Introduction

Reduced habitat availability and increased risk of mortality are the primary factors that could cause a given species to be locally extirpated from the pipeline route, thus reducing species diversity (i.e., the number of species present in the area).

Similarly, infringement on minimum habitat area requirements, isolation of habitat patches and disruption of landscape-scale linkages are the primary factors that could contribute to habitat fragmentation and thus reduce functional habitat connectivity for wildlife along the pipeline route. The way fragmentation affects a given species relates to how much the species uses its habitat.
A.3.26.2 Regulatory Requirements Specific to Wildlife and Habitat

The federal, provincial and regional regulatory requirements that apply to the Project, for protecting wildlife and habitat, are described in the following sections.

**Federal Regulatory Requirements**

Environment Canada administers *SARA*, the *Migratory Birds Convention Act (MBCA)*, the *Fisheries Act* and the *Canada Wildlife Act*, and functions as the administrative authority for implementing the Federal Policy on Wetland Conservation. The Federal Policy on Wetland Conservation sets a goal of no net loss of wetland community functions, either on federal lands or because of federal programs or activities. Both *SARA* and the *MBCA* provide wildlife and habitat-related directives that Northern Gateway has considered in developing the project-specific environmental protection and management plans.

**Species at Risk Act**

The federal *Species at Risk Act* consolidates requirements under the *Canada Wildlife Act*, the *MBCA* and the *Wild Animal and Plant Regulations of the International and Interprovincial Trade Act* for the protection of special wildlife and species at risk. The purposes of *SARA* are to:

- prevent Canadian indigenous species, subspecies and distinct populations of wildlife from becoming extirpated or extinct
- provide for the recovery of endangered or threatened species
- encourage the management of other species to prevent them from becoming at risk

*SARA* Schedule 1 species at risk that occur within the area of project activities in British Columbia and Alberta include the following:

- Woodland caribou (boreal population), listed as threatened (occurs in Alberta and British Columbia)
- Woodland caribou (southern mountains population), listed as threatened (occurs in Alberta and British Columbia)
- Marbled Murrelet, listed as threatened (occurs in British Columbia)
- Short-eared Owl, listed as a species of special concern (occurs in Alberta and British Columbia)
- coastal tailed frog, listed as a species of special concern (occurs in British Columbia)
- western toad, listed as a species of special concern (occurs in Alberta and British Columbia)

**Migratory Birds Convention Act**

The *MBCA* prohibits the killing or capturing of migratory birds, as well as any damage, destruction, removal or disturbance of active nests. The *MBCA* applies to migratory game birds (ducks, geese, swans and shorebirds), migratory insectivorous birds and other migratory non-game birds. Raptors, including hawks, eagles, falcons and owls, are not included under the *MBCA*. However, their nests are protected by the relevant provincial legislations.
Section 6 of the MBCA prohibits the disturbance or destruction of a nest, egg, nest shelter or duck box of a migratory bird. Section 35 also prohibits, with some exceptions, the deposit of harmful substances in waters frequented by migratory birds anywhere in Canada. Project activities must align with the requirements of the MBCA. Concordance with the MBCA involves mitigating potential adverse effects, as well as preclearing nest searches, where appropriate, so that nests are not destroyed or disturbed.

**Alberta Regulatory Requirements**

Alberta’s Wildlife Act protects most vertebrate animals from direct harm or harassment, except as allowed by regulation (e.g., hunting or trapping). Legal designation provides additional protection for selected listed species and their residences listed in the Alberta regulation. Thirteen species are managed as listed species (i.e., endangered or threatened) in Alberta, according to the designations in the provincial Act. Of these, three species occur within the area of project activities and all are listed as threatened in Alberta:

- woodland caribou
- northern leopard frog
- Trumpeter Swan

In addition, the general status of all species in Alberta has been assessed by the provincial government. The general status exercise has been used to determine which species are at risk or may be at risk of extinction, which ones are sensitive to human activities or natural events, and which are considered secure in Alberta. Species that may be at risk receive a detailed status assessment, which is used to determine whether there is reason to recommend that a species be considered at risk and given legislative protection as endangered or threatened under Alberta’s Wildlife Act. Currently, 11 species are considered at risk in Alberta, two of which may be present in the area of project activities:

- northern leopard frog
- Trumpeter Swan

In addition, 14 species are considered may be at risk in Alberta, five of which may be present in the area of project activities:

- Short-eared Owl
- grizzly bear
- northern myotis
- wolverine
- Canadian toad

**British Columbia Regulatory Requirements**

The British Columbia Wildlife Act protects vertebrate animals from direct harm or harassment, except as allowed by regulation (e.g., hunting or trapping). Legal designation provides additional protection for selected red-listed and blue-listed species and their residences. Legal designation as endangered or threatened under the Act increases the penalties for harming a species, and also enables the protection of habitat in wildlife management areas. Currently, three species are listed as endangered in British Columbia:

- White Pelican
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Appendix A: Contingency Plans and Environmental Management Plans

- Burrowing Owl
- Vancouver Island marmot

One species, the sea otter, is listed as threatened.

None of these species occurs within the PDA, so specific mitigations or management plans are not necessary to address their habitat needs.

Section 34 of the British Columbia Wildlife Act, which fits with the federal requirements of the MBCA, also specifically protects the nests of:

- eagles, peregrine falcons, gyrfalcons, osprey and herons, year-round. (All of these species occur in the area of project activities.)
- all other birds, when they or their eggs are in the nest

British Columbia species at risk (threatened) that are affected by forest or range management are included in the province’s identified Wildlife Management Strategy. The needs of identified wildlife species can be met through a combination of protected wildlife habitat areas, general wildlife measures, and higher level plan recommendations, all of which are legal requirements. Identified wildlife species that may be affected by the pipeline construction include:

- tiger salamander
- coastal tailed frog
- Great Blue Heron
- Short-Eared Owl
- Keen’s long-eared myotis
- woodland caribou (three populations: mountain, boreal, northern)
- grizzly bear
- wolverine

Northern Gateway is committed to developing mitigation measures for these species, where applicable, to align with the requirements of the Forest and Range Practices Act and the British Columbia Forest Practices Act.

**Regional Guidelines**

Both Alberta and British Columbia rely on regional and subregional integrated resource planning to make consensus-based land and resource management decisions. Land and resource management plans (LRMPs) cover subregional areas of approximately 15,000 to 20,000 km². Each of these LRMPs establishes the direction for land use and specifies resource management objectives and strategies. Between Alberta and British Columbia, the PDA traverses portions of nine land use planning areas (LUPAs):

- White Area
- Green Area
- Dawson Creek
- Prince George
The management directives outlined in the integrated resource plans are used to guide lower level plans, such as the operational rules of forest practices, riparian area management and biodiversity management. Resource development projects, including timber tenures, long-range forest management plans, oil and gas exploration and linear facilities operate under the umbrella of the integrated resource plan. However, higher level regional plans also guide the integrated resource plans, and management direction in the integrated resource plans includes both levels of information.

Each of the integrated resource plans includes wildlife and wildlife habitat management direction, but the amount of information is dictated by a combination of the wildlife sensitivities of each planning area and the level of participant and resource agency input to each plan.

A.3.26.3 Resource and Stakeholder Priorities

Maintenance of the viability of the wildlife resource is important to Aboriginal groups and project stakeholders. During consultation meetings held by Northern Gateway, Aboriginal groups and stakeholders identified several priorities regarding the Project’s effects on wildlife. The cumulative effect of industrial development and activity on wildlife was a concern, including the increased access to remote areas and increased use of roads. Also of concern was the acoustic effect of the pipelines and the associated support structures on local wildlife.

Additionally, Aboriginal groups and stakeholders expressed their desire for Northern Gateway to adhere to activity work windows designed to limit the adverse effects of the Project on wildlife, particularly in birthing and wintering areas.

Habitat fragmentation was identified as a major concern by many stakeholders. Existing problems with habitat connectivity are the result of development in the South Peace Region, and there is concern that cumulative effects will adversely affect some species, such as grizzly bear, caribou, wolverine and birds. Habitat fragmentation may occur through linear disturbances, such as the establishment of RoWs and access roads. Increased access by new roads may increase the amount of hunting in previously inaccessible areas.

Stakeholders were particularly concerned about project effects on birds. Northern Gateway was requested to heed its obligations under SARA, and conduct baseline surveys to detect the presence of those species listed under Schedule 1.

Concern was also expressed for mountain caribou in the nearby Burnie Lake and Telkwa Pass areas of British Columbia, which are close to the PDA.
A.3.26.4 General Protection Measures

Potential project effects on wildlife can be limited by applying best management practices during pipeline route planning, siting and construction. Typically, mitigation for effects on wildlife and wildlife habitat are in one of the following four categories:

- spatial avoidance
- temporal avoidance
- sensory disturbance
- access control

Spatial Avoidance

Spatial avoidance refers to the physical avoidance by the RoW, pump stations and other infrastructure, of locations that are sensitive or critical to wildlife. As its primary wildlife protection measure, Northern Gateway has routed the pipelines to avoid, wherever feasible, sensitive wildlife habitats and habitat features. Where reasonably possible, wildlife and habitat features purposely avoided by pipeline routing include known:

- Trumpeter Swan nesting wetlands
- waterfowl staging and breeding wetlands
- mountain goat winter ranges
- ungulate winter ranges
- grizzly bear den sites
- woodland caribou calving areas

Temporal Avoidance

If spatial avoidance of a habitat feature is not feasible, and the RoW must be close to wildlife habitat features, project-related activities near these habitat features will be restricted to seasons or times of non-critical wildlife use. This general wildlife protection measure will protect the specific seasonal needs of wildlife species, such as breeding, calving and movement.

Generally, site clearing for the RoW and pump stations is planned for the fall or winter season for most construction spreads, thus avoiding the critical spring nesting period for birds, and the spring calving period for ungulates in most areas. If any area contains early winter habitat for the northern ecotype caribou, then additional mitigation measures will need to be implemented.

Sensitive periods have been identified for a few wildlife species and species groups inhabiting the RoW, and many of these periods have been included as restricted activity periods (Alberta) or reduced risk work windows (British Columbia), in recommended land use guidelines at the provincial or regional level. Such activity restrictions have been identified for:

- Trumpeter Swan nesting wetlands (Alberta)
- mountain goat winter ranges (Alberta and British Columbia)
- ungulate winter ranges (Alberta and British Columbia)
- moose winter ranges (Alberta and British Columbia)
Sensory Disturbance

Provincial flight altitude restrictions will followed during project construction, to avoid sensory disturbance to a variety of wildlife species, particularly from helicopter activities (except where take-off and landing is required, and safety requires variance).

Access Control

Roads and trails influence wildlife in several ways, including reducing the presence of habitat features, increasing negative edge effects, and altering movement patterns. However, the most adverse effect on wildlife is increased mortality risk because of additional predator access, trapping, hunting, poaching and more-frequent human encounters because of easier access into wildlife habitats.

The Project is planned to be an access-neutral development. This means that Northern Gateway will try to leave the access in any given area in a condition that meets the environmental management objectives that were in place before the Project, unless a regulator or stakeholder identifies otherwise. Temporary access roads will be decommissioned and travel on permanent roads will be monitored and controlled (i.e., types and speed of vehicles).

The Project’s Access Management Plan (see Section A.3.2) will cover the development (type, amount and distribution), use (industrial and public) and reclamation (when appropriate) of all forms of project-related linear features (e.g., the RoW, temporary and permanent roads, cut lines and trails, seismic lines and powerline easements).

A.3.26.5 Specific Resource Features – Locations, Occurrences and Habitat

Species-Specific Land Use Management Guidelines

Some government and industry agencies in Alberta and British Columbia have developed guidelines and best management practices for selected wildlife species, species groups and ecological regions to assist land managers, land owners and land users in avoiding or limiting potential adverse effects on wildlife from land use activities.

The guidelines are primarily targeted to specific wildlife key areas or sites that play an essential role in sustaining local and regional populations of the identified wildlife species or species group. These guidelines are either provincial or regional in scope and are intended to be applied with judgment that considers the specific physical and vegetative characteristics of an area, as well as the types of existing land uses at and adjacent to the area.

Northern Gateway will consider these guidelines in the development of site-specific protection measures for individual wildlife species.

Relevant recommended land use guidelines and best management practices will be used for the following:

- Trumpeter Swan
- raptors (general)
- ungulate winter range
- mountain goat winter range
• woodland caribou
• coastal tailed frog

**Trumpeter Swan**

Trumpeter swans are listed as a threatened species under Alberta’s *Wildlife Act*, and are protected against hunting and the destruction of nests. Trumpeter swans are sensitive to human disturbance. Human activity in breeding areas may decrease survival of eggs or cygnets. Trumpeter swans that are disturbed repeatedly may not nest or may abandon existing nests. Therefore, the breeding population depends on current management practices and habitat protection.

To support the continued recovery of Trumpeter Swans, ASRD has developed industrial land use guidelines, which recommend that the following conditions be applied to activities near Trumpeter Swan habitat:

- For all activities:
  - April 1 to September 30 – no activity within 800 m of the high-water mark of identified lakes or water bodies
  - April 1 to September 30 – no direct flights over identified lakes or water bodies
  - no long-term development (e.g., access roads, wells, pipelines) within 500 m of the high-water mark on identified lakes or water bodies
- For timber harvesting:
  - no timber harvesting within 200 m of high-water mark for identified lakes or water bodies
  - establishment of a special management zone for timber harvesting between 200 m and 500 m from high-water mark, with a detailed plan, is required

These land use guidelines for industrial activity near Trumpeter Swan nesting wetlands have been developed for Alberta only. No similar guidelines exist for Trumpeter Swans in the British Columbia portion of their range. For this Project, Northern Gateway will develop site-specific measures based on ASRD recommendations for both Alberta and British Columbia, where practical.

**Raptors**

Raptors are birds of prey and include falcons, hawks, ospreys, owls and eagles. The management objective for raptors is to maintain their populations through habitat protection, including their hunting (food source) and nesting areas. The British Columbia Ministry of Sustainable Resource Management has developed a guidebook, the *Best Management Practices Guidebook for Raptors in British Columbia: Guidelines for Integrating Raptor Conservation with Urban and Rural Land Developments*. The land use recommendations included in that document will be applied to raptor nests in both Alberta and British Columbia.

Raptor and heron nests are also protected by both the Alberta *Wildlife Act* and the British Columbia *Wildlife Act*. Where project activities could affect the nests of these birds, the project design will be adjusted to accommodate the nests, whether they are active or not. If redesign is not feasible, or if an
adequate buffer area cannot be provided, a provincial biologist will be consulted, and an alternative nest management plan will be developed to the satisfaction of regulatory agencies. If the nest has to be relocated, Northern Gateway will apply to the provincial government for an exemption to the relevant provincial *Wildlife Act*.

Most site-clearing activities are planned to avoid the peak nesting period. A raptor nesting survey will be completed just before the start of clearing, to confirm the presence of nests in the area of project activities. The environmental inspector, in cooperation with the resource specialists, will determine the frequency for monitoring active nests during construction. A year-round minimum no-clearing buffer of at least a two tree-length radius will be established for any Bald Eagle nest found in or near areas of project activity. During the nesting season (March through mid-August), a buffer of 200 m will be maintained around active nests. Clearing will only be allowed from September to January to accommodate Bald Eagle nesting and rearing.

**Ungulate Winter Range**

Key ungulate winter ranges play a disproportionately large role, given their localized size and distribution, in maintaining the overall productivity of ungulate populations. These ranges allow for a substantial portion of the breeding population to survive into the next year.

Industrial activity within and adjacent to key wintering areas can add stress and increase energy drain for animals. They may be forced to move about more than normal and even relocate to less favourable habitat. Industrial activity may also create temporary and permanent access that exposes animals to additional nonindustrial disturbances and greater pressure from predators. In the interest of maintaining productive ungulate populations, ASRD has developed industrial land use guidelines for operation in and around ungulate winter range. The following excerpts are taken from the Recommended Land Use Guidelines for Key Ungulate Areas (note: in Alberta, these guidelines apply to moose, elk, mule deer and white-tailed deer; separate guidelines exist for woodland caribou, bighorn sheep and mountain goat):

- New permanent access development is not recommended. Where permanent access is essential, an access management plan and associated approval will be required to address the need to limit disturbance to wildlife and degradation of associated habitat.

- Where limited temporary access is required, it will be designed and managed to limit disturbance to wildlife and degradation of associated habitat.

- General timing restrictions in Northern (Boreal) Alberta are from January 15 to April 30. Guidelines will be applied by Alberta provincial regulators in an equitable fashion for all industrial sectors within a region, recognizing that some flexibility is required for site- and area-specific conditions and particular land use activities. For example:
  
  - timing restrictions may be adjusted in exceptional and localized situations if other considerations are applied that still protect the wildlife resource
  
  - where localized temporary valley crossings are required to access adjacent tableland areas outside the key ungulate areas, some guidelines might not apply
where a key ungulate area is fully embedded within a caribou range, only the timing guideline for the 
key ungulate area will continue to apply:

• the remainder of the caribou land use guidelines will apply to the entire area, including the key 
ungulate area
• the caribou timing guideline, where applicable, will apply only to the caribou range adjacent to 
the key ungulate area

Formal legal establishment of ungulate winter ranges and associated objectives began under the British 
Columbia Forest Practices Code and will continue under the Forest and Range Practices Act. To date, 40 
approved ungulate winter ranges occur in British Columbia, ranging in size from under 500 ha for 
black-tailed deer on Vancouver Island to over 800,000 ha for mountain caribou in the interior. Each of 
these identified ungulate winter ranges prescribes stand-level and landscape-level resource objectives that 
are intended to protect, create or maintain ungulate winter range for the target species.

Mountain Goat Winter Range

Mountain goat winter ranges are characterized by a lack of persistent or melt-crusted snow along cliffs, 
and steep terrain interspersed with vegetation. Suitable winter ranges may be at lower elevations where 
snow is less abundant and persistent, or on relatively unforested, steep, mostly south-facing slopes where 
snow sheds rapidly. Mountain goats use those portions of winter ranges on slopes exceeding 40 degrees. 
At lower elevations, particularly near the coastal portions of their range, a conifer canopy may benefit 
wintering mountain goats by intercepting and redistributing snow, and by providing forage. In contrast, 
goats wintering on interior ranges, where snowfall is great, tend to avoid dense stands of conifers that 
accumulate snow.

In British Columbia, goat winter ranges have been formally identified as part of the provincial ungulate 
winter range program. Land use for activities in and around these goat winter ranges are largely derived 
from directions in the regional LRMPs, which recommend setbacks of up to 3 km around some goat 
winter ranges. The Morice LRMP guidelines for mountain goat winter ranges recommend no main road 
access within 3 km of known goat trails or habitats and no repeated aircraft flights within 2 km of 
occupied goat habitat regardless of the season. Conversely, directions in the Kalum and Lakes LRMPs 
contain the following recommendations:

• No access roads will be developed within 500 m of identified goat winter range polygons.
• Ground-based industrial development within 500 m of identified goat winter range will be confined to 
June 15 to October 31.
• Aerial-based industrial activities within 2,000 m line of sight of goat winter range will be confined to 
June 15 to October 31.
In Alberta, recommended guidelines have been developed for industrial land use activities within and adjacent to identified critical goat (and sheep) ranges. However, these guidelines are intended to apply only to the Goat and Sheep Land Use Zone in Alberta; project activities do not occur in this zone. In addition, the Alberta land use guidelines for mountain goats are designed to provide year-round security by avoiding:

- disturbances during the spring kidding season
- conflicts with hunters during late summer and fall in alpine areas
- stresses on animals restricted to localized areas during the critical winter season

**Woodland Caribou**

Land use guidelines and recommendations for industry activity in woodland caribou ranges are driven by the fact that woodland caribou are considered a species at risk provincially in both Alberta and British Columbia, as well as federally. In Alberta, woodland caribou are listed as at risk, and are considered threatened under the Alberta *Wildlife Act*. In British Columbia, three different ecotypes of woodland caribou are recognized, and the conservation status of each is different. Mountain ecotype woodland caribou are on the provincial red list, while certain populations of the northern ecotype woodland caribou are on the provincial blue list, and boreal ecotype woodland caribou are at immediate risk of extirpation. All three ecotypes of woodland caribou recognized in British Columbia overlap with the area of project activities. Federally, all woodland caribou occurring in the Southern Mountain National Ecological Area, including all mountain ecotype caribou and some northern ecotype caribou, are considered threatened. Boreal caribou are also considered threatened, while northern caribou are considered a species of special concern.

In British Columbia, no land use guidelines or recommendations have been developed for activity in caribou ranges. Draft strategies are in production, but have thus far not been released or adopted by agencies such as the British Columbia Oil and Gas Commission. As a result, the fallback land use recommendations come from the British Columbia Forest Practices Code, where woodland caribou are an identified wildlife species and are therefore subject to the accounts and measures for managing identified wildlife.

For the Alberta portion of their range, ASRD and representatives from the oil and gas industry have developed operating guidelines for industry activity in caribou ranges in west-central Alberta and in the west-central caribou range. The intent of these initiatives is to provide direction on oil and gas industrial activities related to operational access development and maintenance within west-central Alberta caribou ranges.

Several range teams have been formed to develop local recovery and management plans tailored to the range conditions and population trends for individual caribou herds in Alberta. The west-central range team will address the management requirements of the Naraway and Little Smoky herds (among others), which overlap slightly with the area of project activities. As part of the Application, caribou protection plans (CPPs) will be completed for each of the Naraway and Little Smoky herds. These CPPs are a requirement for regulatory approval in Alberta, and they will describe the industrial activities that Northern Gateway is proposing within the Naraway and Little Smoky caribou ranges. They are a critical basis for the collaborative effort between government and industry to protect caribou by managing overall
changes to habitat and overall disturbance levels. CPPs become an integral part of any authority via an administrative condition placed on that authority.

Northern Gateway is required to submit CPPs for the Project because it is a new project that requires access through caribou ranges. Plans for each winter’s work will be submitted by October 15, with amendments accepted until November 30. There is no submission deadline for CPPs or amendments relating to summer work. The Government of Alberta will review and respond to CPPs within two weeks.

CPPs are submitted to:

- allow the provincial government to predict the level of activity and habitat disturbance in each caribou range
- document Northern Gateway’s commitment to work within the land use strategy
- meet the requirements of the relevant caribou range plan, once range plans are developed

According to templates provided by Alberta Environment, the CPPs developed by Northern Gateway will include:

- a description of the work to be undertaken, identifying locations and extent of work
- a description of the land area that will be affected by the work
- a detailed description of caribou conservation measures
- a schedule for the work
- a map showing the location of all work to be completed

**Coastal Tailed Frog**

Within the area of project activities, coastal tailed frogs are limited to cool, permanent, mountain watercourses in the Coast Mountains. Coastal tailed frogs are on the provincial blue list in British Columbia and are designated federally as a species of special concern. Their reliance on forested riparian areas associated with high-elevation headwater watercourses also results in the species being an identified wildlife species under the British Columbia Forest Practices Code. As a result, coastal tailed frogs are also subject to the accounts and measures for managing identified wildlife.

Coastal tailed frogs were recorded in 18 watercourses intersected by the pipeline route, and the construction activities associated with those watercourse crossings will take into account the habitat requirements of coastal tailed frogs. Several sources provide general land use recommendations for coastal tailed frogs. The Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia lists the following best management practices for amphibians in fast-flowing watercourses:

- During reclamation, reclaim moist forested habitat with abundant coarse woody debris along watercourses (at least 30 m wide on both banks), where required.
- Take special care to avoid siltation of watercourse habitats.
- Avoid altering watercourse-flow patterns, and maintain small pools within watercourses (pocket or stream pools) and abundant instream cover.
Maintain clean and stable cobble and boulder gravel substrates, natural step-pool channel morphology and watercourse temperatures within tolerance limits.

Maintain microclimatic, hydrological and sedimentation regimes, to:
- limit the frequency of occurrence of extreme discharge events
- limit the mortality rate of tailed frogs during floods
- meet foraging and dispersal requirements of the adults and metamorphs

Maintain riparian forest.

Maintain important structural elements (e.g., coarse woody debris).

Maintain water quality and naturally dispersed water flows.

Limit risk of windthrow.

Where access roads are required:
- construct roads to limit site disturbance and reduce groundwater interception in the cutslope
- use sediment-control measures in cut-and-fill slopes (e.g., grass-seeding, armouring ditchlines and culvert outfalls)
- deactivate roads but limit digging and disturbance to adjacent roadside habitat
- limit site disturbance during harvesting, especially in terrain polygons with high sediment transfer potential to natal watercourses
- fall and yard trees away from, or bridging, all other watercourse channels (ephemeral or perennial) within the wildlife habitat area, to limit channel disturbance and slash loading

Where watercourse crossings are required, the type of crossing structure and any associated roads will be designed and installed in a way that limits effects on the coastal tailed frog instream and riparian habitats. Use temporary clear span bridges where practical.

Do not use chemical applications (e.g., dust-palliative polymer stabilizers and soil binders that can be sprayed within ditchlines).

Do not use pesticides.

Wherever possible and practical, augment management zones using wildlife tree retention areas.

Manage watercourse reaches adjacent to any tailed frog watercourse according to riparian management recommendations.

Prevent fish introductions and rechannelization of areas supporting tailed frog populations.

Maintain slash-free headwater creeks and forested riparian buffers, especially within fragmented areas.

In many cases, the mitigation requirements for coastal tailed frog habitat can be met through parallel establishment of old-growth management areas and riparian management areas. Both guidelines stem from the results-based British Columbia Forest Practices Code, and are also applicable to other disciplines.
such as vegetation and fisheries. Although riparian management guidelines provide a measure of protection for riparian habitats, they are intended particularly for watercourses with game fish. Many coastal tailed frog populations are found in small headwater watercourses with no fish (i.e., watercourses classified as S4 to S6), therefore, Northern Gateway will also apply a 16-m riparian management area to non-fish-bearing watercourses, where practical.

**Areas and Locations of Interest**

Based on the previously described land use recommendations and guidelines, and on wildlife protection regulations, Northern Gateway will implement several mitigation measures in areas where project activities may adversely affect wildlife species. This information will be tabulated in the commitment database and shown on the environmental alignment sheets.

Where disturbance is unavoidable, Northern Gateway will consult with the appropriate regulator and, as appropriate, interested and participating Aboriginal groups to identify possible options and management strategies to be implemented.

**A.3.27 Hydrology Protection and Management Plan**

**A.3.27.1 Introduction**

The construction, operations and decommissioning of the pipelines could affect surface water runoff (hydrology) and sediment transport (geomorphology). Effects on surface water resources could result from:

- clearing vegetation
- disturbing the surface of land
- disturbing watercourse beds and banks
- withdrawing water
- disposing of waste water
- developing access roads
- obstructing flow

These activities have the potential to affect:

- annual water yield
- peak and drought (low) flow
- surficial soil erosion
- sediment delivery to surface channels
- instream sediment concentrations
- channel geomorphology

**A.3.27.2 Regulatory Requirements Specific to Surface Water Resources**

Many of the project-related effects can be managed by applying mitigation methods during design and construction. The design and construction of the Project will comply with applicable provincial and federal policies for the protection of water resources, and appropriate mitigation techniques will be
employed during construction and operations of the Project. Applicable legislation, codes of practice and guidelines include:

- The *Fisheries Act*, Government of Canada
- The *Navigable Waters Protection Act*, Government of Canada
- The *Water Act*, Province of Alberta
- The *Water Act*, Province of British Columbia
- Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body (Alberta Environment 2001b, Internet site)
- Code of Practice for Watercourse Crossings (Alberta Environment 2001c, Internet site)
- Code of Practice for the Temporary Diversion of Water for Hydrostatic Testing, Province of Alberta (Alberta Environment 2001a, Internet site)
- Pipeline Associated Watercourse Crossings (CAPP 2005)
- The *Forest Practices Code of British Columbia Act*

### A.3.27.3 General Protection Measures

Mitigation of expected effects can be incorporated into the engineering design of the Project or implemented in the field via specified measures during construction and operations. General resource protection measures and mitigation strategies relating to protection of watercourses and limiting project-related effects on surface water hydrology and sediment generation are described in Section 8.

Where applicable, specific mitigation strategies will be implemented to reduce the potential for recurrent disturbances to, or degraded stability of, watercourse crossings, including:

- designing temporary and permanent access road crossings to convey the appropriate design discharge without adversely affecting the hydrology or hydraulics of the channel being crossed
- designing watercourse crossings for placement below the 1:100 year scour depth of the channel, unless otherwise directed. The pipeline sagbends will be set back sufficiently from the tops-of-bank to limit the risk the pipelines could be exposed to because of lateral channel movement. This may involve deep burial of the pipelines some distance beyond the top-of-bank line on either or both sides of the channel, as assessed by a qualified engineer.
- considering the following where the pipeline route crosses mountainous terrain:
  - for the burial design across alluvial fans, consider the potential for sudden channel avulsions and debris flows, which may require additional depth of cover over an extended pipeline reach
  - for crossings of degrading channels, consider the potential for future downcutting will be taken into account in assessing pipe cover requirements
- routing the pipelines and access roads to avoid areas of increased local scour, such as at severe bends or channel confluences
• restoring and revegetating the RoW as soon as practical after construction, as discussed in the Watercourse Reclamation Plan (see Section A.3.20)

• returning the channel bed and banks to a stable configuration immediately upon completion of each pipeline crossing. Riparian areas will be revegetated as soon as practical after construction.

A.3.28 Hydrogeology Protection and Management Plan

A.3.28.1 Introduction

Groundwater quantity includes the components of groundwater flow rates and flow patterns that describe the quantity and direction of groundwater flow. Groundwater quality describes the chemical quality of the groundwater and is measured by determining the concentration of chemical parameters specific to the potential effect. Groundwater quality has natural variation, and different environmental settings will determine the expected quality criteria.

Only the communities of Kitimat, Burns Lake, Fort St. James and Bear Lake in British Columbia have any documented use of groundwater, although numerous private wells are likely to occur along the pipeline route. Groundwater use is more widespread in Alberta and fairly intense use occurs between Whitecourt and near Bruderheim. Springs have been identified within 500 m of the pipeline route in the Alberta Plateau, Southern Alberta Uplands and Rocky Mountain regions. Additional springs could possibly be within 500 m of the pipeline route within these regions and the Interior Plateau region.

A.3.28.2 Regulatory Requirements Specific to Groundwater Resources

Existing groundwater use is protected in both British Columbia and Alberta under the British Columbia Water Act and the Alberta Water Act. Groundwater withdrawals in Alberta for industrial and municipal purposes typically will be licensed under the Alberta Water Act. For construction camps, water requirements of less than 1,250 m³/a are exempt from licensing. The British Columbia Water Act does not require groundwater use to be licensed, although withdrawals of more than 75 L/s must be reviewed under the British Columbia Environmental Assessment Act.

Temporary dewatering might be needed during trenching to remove groundwater from the trench. Under the Alberta Water Act, temporary diversions of groundwater of up to 5,000 m³ are permissible in the Green Area without requiring an approval.

A.3.28.3 General Protection Measures

General protection measures for groundwater will be considered where applicable, and include the following:

• If groundwater withdrawals are planned, groundwater assessments will be prepared by a qualified hydrogeologist. These withdrawals will be according to the groundwater evaluation guidelines for both British Columbia and Alberta. Groundwater assessments require the evaluation of potential effects on local groundwater users or potential surface water interactions.
Groundwater well locations, as provided through the available provincial databases, will be indicated on the environmental alignment sheets. Areas where groundwater wells are common include Burns Lake in British Columbia and much of the Eastern Alberta Plains, Alberta Plateau and Southern Alberta Uplands regions. Information collected will include:

- a review of the depth and distance of the finished well relative to blasting activities
- a review of the possible connection of the aquifer used by the well to the area of blasting
- the results of an appropriate pump test to verify the baseline well yield
- analysis of a water sample for major ion chemistry

Confirm locations of wells and shallow groundwater supply sources before construction. These areas will be marked on the environmental alignment sheets. The Blasting Management Plan (see Section A.3.9) has further information.

A.3.29 Freshwater Aquatic Resource and Habitat Protection and Management Plan

A.3.29.1 Introduction

Pipeline construction, operations and decommissioning activities might interact directly and indirectly with fisheries resources and habitats near areas of project activities and in the immediate surrounding regions. These activities include watercourse crossing installation (access roads and pipelines), access road construction and riparian vegetation clearing. All of these activities have the potential to affect fish habitat availability and fish abundance. These activities might also intensify fishing pressure because of increased access to fish-bearing watercourses close to project activities.

The greatest potential adverse effect on fish populations is increased mortality risk from introducing excessive sediment or hazardous materials into watercourses at watercourse crossings. In addition, the risk to habitat productive capacity results from the loss or alteration of instream habitat and riparian vegetation.

Potential adverse effects can be avoided through good planning and applying appropriate mitigation during site preparation and construction. The following practices are some of the mitigation options.

- Least risk period (LRP) – Alberta uses RAPs that limit instream work, while British Columbia uses instream work windows that allow instream activities. For the Project, LRPs have been adopted for both Alberta and British Columbia. The objective is to protect spawning habitats, egg incubation and early life history stages of important fish species.

- Vegetation and overburden management – The objective is to meet the standards that require no net loss or a net gain in habitat resulting from instream or riparian works. This allows activities such as hazardous tree removal to be completed with minimal effects on adjacent riparian vegetation.

- Sediment, runoff and erosion control – The objective is to meet the standards of the Water Act for water quality and protection of fish populations and downstream habitats.
Work area isolation – The main objective is to meet water quality standards and protect aquatic species and habitat during instream work, by isolating the work area from flow. Implementing proper flow isolation maintains the integrity and viability of downstream fish populations and habitats during instream construction activities. Work area isolation is accomplished by installing dam and pump or flume structures around the work area, creating temporary diversions, or by dewatering the isolated area.

Fish rescue – The objective is to collect fish from potentially affected areas and move them to other aquatic habitats.

Deleterious substance management – The objective is to prevent the release of any deleterious substance into a watercourse as a result of instream works.

Environmental monitoring – The objective is to provide a high level of environmental protection during instream and riparian activities.

Site restoration (cleanup and reclamation) – The objective is to meet the standards that require no net loss or gain in habitat productivity as a result of instream or riparian works. Site restoration will also prevent potential post-construction effects, such as channel bank erosion.

Access management – An objective of the Access Management Plan (see Section A.3.2) is to control access by hunters and anglers to pristine areas. Construction of new roads required for various project-related activities will improve accessibility to remote regions along the pipeline route. In these areas, increased project- and non project-related anthropogenic activity (e.g., angling, hunting and outdoor recreation) may have an effect on existing pristine habitats and fish and wildlife populations.

A.3.29.2 Regulatory Requirements Specific to Freshwater Fish Habitat

The HADD of fish habitat is prohibited by Section 35(1) of the Canada Fisheries Act. Fish habitat is defined by the Fisheries Act as “spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.” In British Columbia, the layout and design of pipeline routes, including watercourse crossings, are considered and approved under the Petroleum and Natural Gas Act, and are not subject to the Forest Practices Code. However, the construction, maintenance and deactivation of pipeline routes are covered under the code and provisions of the forest road regulations.

Part 7 of the British Columbia Water Regulation, and various industry standards and practices were also considered.

Policies and guidelines that are to be followed include:

- Alberta’s Guide to the Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body, Including Guidelines for Complying with the Code of Practice (Alberta Environment 2001b, Internet site)
- British Columbia’s Standards and Best Management Practices for Instream Works (BC MWLAP 2004, Internet site)
- British Columbia’s Fish-stream Crossing Guidebook (BC MoF 2002)
A.3.29.3 General Protection Measures

For the Project, a risk assessment framework has been created according to DFO’s Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (DFO 2007b, Internet site) and incorporates risk analysis and mitigation measures from Pipeline Associated Watercourse Crossings (CAPP 2005). Although the CAPP document addresses risk management at a very high level, more refined and appropriate pathways of effects and risk management framework were applied for the Project. Watercourse crossings were analyzed, to determine:

- the ranking related to the DFO risk determination matrix
- site-specific mitigation measures to be used for each major drainage

Most of the mitigation measures described in the following were adapted from the Pipeline Associated Watercourse Crossing manual (CAPP 2005). Other referenced material included Standards and Best Management Practices for Instream Works (BC MWLAP 2004, Internet site).

Riparian Zone Habitat Quality and Availability

Project-related activities have the potential to affect riparian zone habitat quality and availability by reducing, altering or completely removing vegetation from riparian areas. Effects from these activities can reduce the quality and quantity of valued habitat contributing to the sustainability of healthy fish population and production. Potential effects on riparian vegetation usually involve the temporary (less than five years) reduction of cover and shading features, and may occur during all project phases.

The potential for sediment deposition in watercourses is highest after construction of watercourse crossings for the pipelines and access roads, and for several years after installation, before riparian vegetation becomes established enough to reduce sediment loadings to watercourses.

Any temporary effects as a result of riparian vegetation alterations will be mitigated by implementing a revegetation program along affected riparian areas.

Instream Habitat Quality and Availability

Several biological and physical indicators were used to determine habitat sensitivity and the scale of adverse effects, in an effort to limit the level of risk to fish and habitat productive capacity. For specific watercourses, identified as being of high risk, additional mitigation measures, such as alternative crossing methods, will be considered to reduce the overall risk. For the sites with a high rating, some of the site-specific mitigation measures are outlined in the following.

Fish Mortality Risk

Project activities may increase the risk of fish mortality through changes in access to habitats, altered fish passage, increased angling pressure, and entrainment in machinery. The greatest potential risk to fish mortality may occur from:

- instream construction activities
- water extraction during construction
• potential accidents and malfunctions, such as the release of deleterious substances to watercourses during all project phases
• increased angling pressure (direct mortality)

Installing valves at the beginning of high value or high risk areas (e.g., major watercourse crossings) can prevent hydrocarbons from entering watercourses directly.

**Watercourse Crossing Methods**

Northern Gateway will implement the most appropriate watercourse crossing method (e.g., trenchless or isolation) and apply safeguards to coincide with the level of watercourse sensitivity, to mitigate potential effects associated with pipeline construction. The Pipeline Watercourse Crossing Plan has information about selecting the watercourse crossing method (see Section A.3.16).

**Instream Construction Activities**

Disruption of water flow will be prevented during watercourse channel trenching, by implementing standard temporary diversion procedures (see Section 8.5.6). This will maintain flow to important downstream fish-bearing habitats.

Mitigation of potential instream habitat losses by using avoidance has been implemented to the extent possible. The project design already incorporates some degree of potential effects avoidance, including realigning the pipeline route to cross as few critical habitats in watercourses as possible.

DFO will determine whether the loss of instream habitat will result in a loss of fish and habitat productive capacity and, therefore, warrants compensation (DFO 1986).

Equipment being operated within 100 m of watercourse crossings will be checked at least once a day for leaks. Equipment being operated instream will be cleaned and checked before it enters the watercourse and will be continually monitored visually for leaks. All leaks will be repaired and cleaned up immediately on discovery. Incidents will be recorded and reported, as required by provincial guidelines.

**Restoration of Watercourse Banks**

Where practical, Northern Gateway will use a bioengineered approach to restore watercourse banks at each watercourse crossing, as outlined in the Watercourse Reclamation Plan (see Section A.3.20).

**A.3.29.4 Specific Fisheries Habitat Protection Measures**

Because of the large number of watercourse crossings, specific fisheries habitat protection measures will be shown on the construction drawings, environmental alignment sheets and in the compliance database (see Sections 6.5 and 8.10).
A.3.30  Marine Aquatic Resource and Habitat Protection and Management Plan

For measures to protect marine aquatic resources and habitat, see Section 10 and the following plans:

- Spill Contingency Plan (see Section A.2.1)
- Wildlife Encounter Contingency Plan (see Section A.2.6)
- Blasting Management Plan (see Section A.3.9)

A.3.31  Heritage Resources Protection and Management Plan

A.3.31.1 Introduction

Heritage resources include historical, archaeological and palaeontological sites that may be covered under the Alberta Historical Resources Act, the British Columbia Heritage Conservation Act, Aboriginal interests, British Columbia's Archaeological Impact Assessment Guidelines, and the Canadian Environmental Assessment Act. These resources are important and value to the scientific, cultural and public communities. They include:

- precontact archaeological sites
- historical sites
- pre-1846 culturally modified tree (CMT) sites
- palaeontological sites

A.3.31.2 Regulatory Requirements Specific to Heritage Resources

Each of the provinces has its own heritage act, heritage legislation and regulatory body. Archaeological permits are required and granted to qualified archaeologists, and are specific to each province. A palaeontological permit is required in Alberta.

In Alberta, the Historical Resources Act is administered by the Historical Resources Management Branch (HRMB) of Alberta Culture and Community Spirit (ACCS). The HRMB is responsible for:

- reviewing and approving archaeological permits
- reviewing and accepting permit reports (including site-specific mitigation measures)
- reviewing ESA documents related to heritage resources
- providing historical resource clearance for projects

The Royal Tyrrell Museum of Palaeontology issues permits and reviews permit reports for palaeontology. Final clearance and requirements for palaeontology are issued by the HRMB of ACCS.

In British Columbia, archaeological sites predating A.D. 1846 are administered and reviewed by the Archaeology Branch as specified in the British Columbia Archaeological Resource Management Handbook. The Heritage Branch is responsible for structures and sites of historical age (post-1846). However, post-1846 Aboriginal heritage sites, are recognized in the British Columbia Environmental Assessment Act and may be protected under the Heritage Conservation Act under agreement with Aboriginal groups.
Because of the fragile and nonrenewable nature of heritage resources, taking site inventories, assessments and mitigation will occur before construction starts. The results of the impact assessments will be reviewed by local Aboriginal groups and accepted by the Alberta HRMB, the Alberta Royal Tyrrell Museum of Palaeontology and the British Columbia Archaeology Branch. The permit reports, with the results of the site inventory and assessment program, will be submitted to the provincial regulators for review and heritage resource clearance for the Project. After reviewing the reports, the regulators will specify the project-related mitigation requirements for each site. Participating Aboriginal groups may also contribute recommendations during their review of the reports.

In British Columbia, a Site Alteration Permit is required for any heritage resource site that is protected under the Heritage Conservation Act and that will be affected by project activities. A Site Alteration Permit must be applied for through the British Columbia Archaeology Branch. As pre-1846 CMT sites are protected in British Columbia, this includes vegetation clearing as well as ground disturbance activities.

Protection of palaeontological resources is regulated under the Canadian Environmental Assessment Act and the Alberta Historical Resources Act. No provincial legislation is yet in place in British Columbia, but it is under development. The regulations require that palaeontological resources be protected from destruction or removal during construction activities. A key sensitivity is vertebrate material (e.g., dinosaur bones), although any fossil site that yields material of high heritage value is protected.

A3.31.3 Resource, Aboriginal Group and Stakeholder Priorities

Heritage resources are typically of interest to the general public. However, of particular importance to Aboriginal groups are:

- sites of precontact age
- sites of cultural affiliation
- historical sites of identified Aboriginal origin, including:
  - residential and domestic sites (e.g., remnants of pit houses, teepee rings and cabins)
  - post-1846 CMT sites

These sites represent the physical evidence of long-term land use by Aboriginal groups.

As a result, Aboriginal groups may indicate an interest in, and the desire for input into, the project-related heritage resources impact assessments. Input has so far included participation in the development of field methodology and field reconnaissance, results reporting, site interpretation and definition of site-specific mitigation options. Meetings with resident Aboriginal groups in both provinces will continue to be scheduled, to:

- discuss program results
- solicit information about site interpretation and value
- identify concerns
- develop an acceptable mitigation strategy for sites in potential conflict with project activities
Recommendations to provincial regulators regarding site mitigation will reflect the results of these meetings.

Local landowners also have an interest in heritage resource sites, particularly in historical sites that are linked to their own family history on the land. Landowners may request a detailed record of a specific historical site for their descendents, if the buildings will be affected by project activities.

A strong public interest in fossils exists, and two stakeholder groups, the Tumbler Ridge Museum and Dinosaur Centre and the Palaeontological Society of the Peace, have had direct input into the Project. The Tumbler Ridge Museum and Dinosaur Centre has asked that baseline palaeontological studies be completed in British Columbia, so that the resource potential of an area is known before construction starts. All vertebrate material (i.e., dinosaurs, mammals and fish) is viewed as rare, and special measures to protect these fossils have been requested. The Palaeontological Society of the Peace has asked that the results of the palaeontology studies be disclosed. The Tumbler Ridge Museum and Dinosaur Centre has also requested a plan to deal with:

- recognizing fossils uncovered during construction – not all fossils are easily recognizable by the layperson, and fossils with high heritage value can easily be destroyed from lack of recognition
- recovering fossils – fossils must be removed in a way that limits damage and be accompanied by information on location, stratigraphic occurrence and context

### A.3.31.4 General Protection Measures

For cultural resource sites, the following mitigation strategies will be implemented where appropriate:

- All cultural resource sites will be verified relative to the final survey of the PDA.
- Important cultural resource sites will be avoided by rerouting pipelines, relocating infrastructure, and selecting trenchless watercourse crossing methods.
- Site-specific mitigation will be implemented, and potentially includes one or more of the following:
  - shovel testing program
  - backhoe/deep testing
  - controlled surface collection of cultural materials
  - controlled excavation of a site sample
  - monitoring topsoil stripping
  - monitoring trenching activities
  - monitoring vegetation removal
  - monitoring rock art sites relative to wave action and increased localized environmental acidity
  - detailed mapping and recording of historical buildings
  - documentary research of historical buildings and sites
  - collection and analysis of stem round samples for CMT sites
- Aboriginal groups will be consulted about site significance, interpretation and mitigation options.
- Collection or damage of heritage resources by project personnel will be prohibited.
- Heritage resource protection will be included in project personnel training and orientation.
For palaeontological resources, the following mitigation strategies will be implemented where appropriate:

- Known palaeontological sites will be avoided, or fossil collecting will occur before disturbance, where sites cannot be avoided.
- A professional palaeontologist will monitor construction in areas where strata with high palaeontological potential will be disturbed.
- Construction workers will be educated about how to recognize a fossil and what to do if a fossil is uncovered during construction.
- Fossil collecting by project personnel will be prohibited.

**A.3.31.5 Specific Protection Measures**

**Known Cultural Resource Site Locations**

As outlined previously, avoidance is the preferred mitigation measure for all cultural resource sites with heritage value. The first step is to verify the location of all identified cultural resource sites relative to the PDA. If sites are in potential conflict with project activities, avoidance is the preferred option. This can occur through pipeline reroutes, infrastructure relocations, or trenchless watercourse crossing methods. If avoidance is not possible, the range of additional options varies by the condition, integrity, size and location of a site as follows:

- For precontact, non-CMT sites, options include:
  - additional subsurface testing such as backhoe and shovel testing
  - controlled surface collection
  - controlled excavation, including specialized analysis of materials such as radiocarbon dating, blood residue analysis, soil sample flotation for seeds, charcoal and phytoliths and faunal analysis

- For CMT sites, options include detailed recording, such as:
  - identifying diagnostic characteristics
  - acquiring specific measurements of the tree
  - taking a core or stem round sample of the cultural modification, followed by laboratory analysis

- For historical sites, options include:
  - detailed recording of standing structures
  - detailed feature mapping
  - additional subsurface testing
  - additional documentary research
  - controlled surface collection
  - controlled excavation
In addition, mitigation that may also be considered includes monitoring activities such as topsoil stripping, trenching or removing vegetation. Site-specific mitigation measures will be identified on the environmental alignment sheets.

**Areas of High Cultural Resource Potential**

Monitoring topsoil stripping and trenching activities will be considered in areas of high cultural resource potential. For example, watercourse crossing locations in British Columbia and the Alberta Green Area are of high potential, but cannot be deep tested before impact because of lack of access. Monitoring high potential areas during construction provides an opportunity to assess areas of deeper deposition that cannot be tested before impact, and also provides a check on the pre-impact field assessment methodology. Construction monitoring of cultural resource sites or areas of high potential will be completed by a trained professional archaeologist. These locations will be identified on the environmental alignment sheets.

**Palaeontological Education Program**

The Project is a large-scale development where ground disturbance will occur over a long distance for an extended period. Although monitoring by a professional palaeontologist is only practical in areas with the highest palaeontological potential, palaeontological resources will also likely be discovered in other areas. A palaeontological education program will be implemented to:

- inform construction supervisors of the legal requirements of reporting fossil discoveries in Alberta
- teach construction workers and supervisors how to recognize a fossil
- provide construction workers and supervisors with procedures to follow if a fossil is found

A ban will be placed on fossil collecting by project personnel, to limit the indirect effects of many project workers in newly accessible areas of high palaeontological potential.

**Known Fossil Sites**

As much as possible, known palaeontological sites will be avoided during construction. Where avoidance is not possible, fossil collecting at sites with high heritage value will be completed before construction begins.

**Areas of High Palaeontological Potential**

Monitoring by a professional palaeontologist will occur in areas where construction will disturb strata with high palaeontological potential.

**Monitoring in Areas of High Palaeontological Potential**

In areas of high palaeontological potential, a professional palaeontologist will monitor for palaeontological resources during construction. The monitor will observe all grading and trenching as it occurs. Standing the minimal safe distance away from the construction equipment, the monitor will inspect the trench as it is progressively excavated and will check excess cut material as it is disposed of on the RoW. Periodically, the monitor will signal the operator to pause, and move in for closer
examination of the excess cut disposal area or trench. If continuous monitoring is not possible (e.g., multiple locations are being excavated at once), the monitor must at least inspect the trench and excess cut disposal area before backfilling occurs. If the monitor is not on site, operators will stop excavation and advise the environmental inspector if they encounter fossils. The environmental inspector will then call the monitor to their location.

If fossils are noted, the palaeontologist will determine the heritage value of the material. Fossils with low value will be noted and photographed. Some fossils might be set aside for collection if they can provide any scientific information. For fossils with moderate values, representative collections will be made. Discovery of fossils with low and moderate values slows down the excavation process but does not stop construction. The monitor works closely with the operators to maintain safety while recording information and inspecting and collecting fossils. For fossils with high heritage values, such as dinosaur bones, a temporary halt to excavations is called while the monitor reports the find to, and consults with, the Royal Tyrrell Museum of Palaeontology in Alberta. Under the Alberta Heritage Resources Act, any fossils found during construction must be reported immediately to the Royal Tyrrell Museum of Palaeontology. With an on-site palaeontological monitor, construction will only stop if fossils with high heritage values are encountered, and the monitor will provide information regarding site dispensation to the operators and Northern Gateway.

In Alberta, the Royal Tyrrell Museum of Palaeontology will determine the next steps after construction is stopped. The monitor might be directed to collect any exposed material, or to make a shallow excavation adjacent to the find to determine the extent of the fossiliferous horizon. In rare cases, a full palaeontological excavation will be required and pipeline construction will be temporarily suspended on the area of fossiliferous material until appropriate mitigation has been completed.

In British Columbia, a monitoring program similar to that required in Alberta will be followed.

**A.3.32 Non-Traditional Land Use Protection and Management Plan**

**A.3.32.1 Introduction**

The following land use components were established for assessment purposes:

- forestry operations
- trapping, hunting and recreational fishing
- nonconsumptive recreational activities, and recreation and protected areas
- granular, mineral, and oil and gas resources
- agricultural and private land activities

Together, these categories encompass the range of effects on land and resource use activities, institutions and stakeholders in the PDA.
A.3.32.2 Regulatory Requirements Specific to Non-Traditional Land Use

**Alberta**

In Alberta, Crown or public lands are divided into the White and Green Areas, and are administered under the *Public Lands Act* by the Public Lands and Forests Division of ASRD. In the White Area, public land is part of the settled agricultural landscape and is typically interspersed with primarily private lands. Other resource uses are also accommodated, including:

- development activities for oil and gas extraction (through agreements for well sites, access roads and pipelines)
- sand and gravel extraction
- recreational activities
- industrial activities

Lands in the White Area are managed for soil and water conservation, and to protect fish and wildlife habitat.

In the Green Area, the primary land use is timber production, and a large proportion of the land base consists of land under forest management agreements. The Green Area accommodates surface access for:

- the oil and gas industry
- recreational uses
- livestock grazing
- sand and gravel extraction
- industrial development

In Alberta, the only approved regional plan to date along the RoW is the Eastern Slopes Policy, which stipulates eight broad land use zones prioritized for protection, resource management or development (ASRD 1984).

**British Columbia**

Provincial forests in British Columbia cover 85% of Crown land in the province, and are administered by the British Columbia Ministry of Forests and Range under the *Forest Act*, the *Forest and Range Practices Act* (which replaced the *Forest Practices Code of British Columbia Act* in 2004), and a protocol agreement with the British Columbia Ministry of Agriculture and Lands (formerly the British Columbia Ministry of Crown Lands). Crown land other than provincial forests is administered under the *Land Act* by the British Columbia Ministry of Agriculture and Lands, Crown Lands Branch.

In British Columbia, the LUPAs that are within 500 m of the RoW are:

- Dawson Creek
- Prince George
- Fort St. James
- Vanderhoof
- Lakes District
The LUPAs are subregional in scale and are subdivided into resource management zones (RMZs). Management direction, through the formulation of objectives and strategies, was developed for each RMZ to provide the context for resource management activities and to guide operational planning within the zones.

In the District of Kitimat, land use is broadly guided by the municipality’s 1987 Official Community Plan (OCP) and more specifically by existing zoning bylaws.

In the Rural Regional Electoral Districts of Kitimat–Stikine, Bulkley–Nechako, Fraser–Fort George and Peace River, the OCPs form the basis for regulatory bylaws guiding land use and land use management. The Project complies with these OCPs that support and accommodate development activities, as well as with provincial acts, regulations and codes.

A.3.32.3 Specific Resource Features and Locations

**Alberta**

Land use zones that need to be considered during all project phases are the critical wildlife habitat zones which “protect ranges or terrestrial and aquatic habitats that are crucial to the maintenance of specific fish and wildlife populations” (ASRD 1984).

**British Columbia**

Three RMZs requiring special project management attention and consultation with stakeholders and regulators both before and during activities planned in the area are:

- Monkman Park protected area in the Dawson Creek LUPA
- Tazdli Wiyez Bin/Burnie-Shea Park protected area in the Morice LUPA
- Stuart River Protected Area in the Fort St. James LUPA

Other RMZs that will require attention to specific conservation objectives include all those designated as special RMZs, including:

- Murray River Corridor
- Parsnip High Elevation
- five unnamed special RMZs in the Lakes District LUPA
- Gosnell–Thautil
- Morice River
- grizzly bear benchmarks and linkages
A.3.32.4 Specific Non-Traditional Land Use Protection Measures

Forestry Operations

The following measures will be implemented, where appropriate, to mitigate potential adverse effects on forestry operations:

- Where requested by forestry stakeholders, localized rerouting of the RoW will be considered to avoid and eliminate loss of long-term research plots and silviculture sites.
- Affected timber-tenure holders will be compensated for loss of harvestable land base and loss of merchantable timber, based on the entitlement of bundle of rights.
- Northern Gateway will facilitate access to timber resources by providing RoW crossings and crossing agreements to accommodate present and future forestry traffic. For any forestry access road used by Northern Gateway, road use and maintenance agreements will be made between Northern Gateway and the forestry companies that hold maintenance obligations and use the roads to conduct forestry operations.
- Mountain pine beetle infestation will always be considered during planning, clearing and construction. Considerations will be included in the Licence to Cut Agreement, as mentioned in the Timber Salvage Plan (see Section A.3.25).

Trapping, Hunting and Recreational Fishing

The following measures will be implemented, where appropriate, to mitigate potential adverse effects on trapping, hunting and recreational fishing:

- Compensate affected trappers if lost revenue is proven to be directly attributable to project activities, according to established industry and provincial protocols.
- Northern Gateway will provide advance notice for trappers before starting construction.
- Northern Gateway will provide advance notice of construction schedules to Alberta and British Columbia fish and wildlife branches.
- Where identified by the trapper, access will be maintained during construction.

Protected Areas and Nonconsumptive Recreational Activities

The following measures will be implemented, where appropriate, to mitigate potential adverse effects on nonconsumptive recreational activities, and recreation and protected areas:

- Northern Gateway will remain in communication with Monkman Pass Memorial Trail project coordinators to implement collaborative opportunities.
- Northern Gateway will work with the British Columbia Ministry of Forests to determine possible ways to avoid RoW intersection with the Greg Duke Memorial Recreation Site.
- Northern Gateway will post warning signs and provide advance notice about construction activities during the peak snowmobiling period.
Granular, Mineral, and Oil and Gas Resources

The following measures will be implemented, where appropriate, to mitigate potential adverse effects on granular, mineral and oil and gas resources:

- Before construction, Northern Gateway will notify all oil and gas and mineral tenure holders with dispositions within 500 m of the RoW, to coordinate planned activities.
- Northern Gateway will work with existing pipeline RoW holders along the project RoW to use their RoWs (e.g., the Alliance Pipeline), to limit the area of disturbance of the PDA, and maximize land area for potential future development activities.

Agricultural and Private Land Activities

The following measures will be implemented, where appropriate, to mitigate potential adverse effects on agricultural and private land activities:

- Before construction, Northern Gateway will notify farmers, ranchers, livestock owners and other private land owners about the construction schedule, to allow livestock to be moved to other pastures. Northern Gateway will close gates after project vehicles have moved through them.
- Northern Gateway will consult with livestock owners to identify cattle watering locations. If there is direct overlap between cattle watering locations and watercourse crossing locations, Northern Gateway will help identify alternative cattle watering locations or options in discussion with the landowner.
- Limited amounts of temporary fencing along the RoW may be erected where alternate pastures are not available reasonably close to the affected parcels of land.
- Northern Gateway will provide trench breakers (ditch plugs) and gaps in the windrowed soil storage along the RoW.

A.3.33 Waste and Hazardous Materials Management Plan

All project personnel will abide by federal, provincial, company and project-specific requirements for storing, handling, transporting, disposing of, and reporting releases of, products and waste materials that are potentially hazardous to the environment.

Awareness of these requirements will be integrated, as appropriate, into various levels of an environmental orientation program (see Section 6.2).

Project contractors will be responsible for complying with applicable permits, codes, regulations and industrial standards for waste management. The environmental inspectors or other authorized inspectors will audit the implementation of construction waste management policies and procedures for handling and disposing of waste. If a release occurs, the Spill Contingency Plan (see Section A.2.1) will be implemented.
Northern Gateway is committed to operating in an environmentally responsible way during all project phases. The following general guidelines will be implemented:

- All reasonable preventive measures will be taken to avoid the release of waste or hazardous materials into the environment.
- All incidents involving waste and hazardous material will be reported to the environmental inspectors and to the appropriate regulatory authorities, according to applicable regulations (see Section A.2.1).
- All spills of waste and hazardous material will be cleaned up as quickly as possible.
- Where a choice of hydrocarbons exists, the one least hazardous for the application will be selected.
- Waste will be recycled whenever possible.
- Hazardous and waste materials will, to the extent feasible, be disposed of or moved to a secure staging area, as required.

For the waste management regulations and guidelines applicable to the Project, see Table A-13.

<table>
<thead>
<tr>
<th>Table A-13 Waste Management Regulations, Guidelines and Code of Practice</th>
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</thead>
</table>
| **Federal** | Onshore Pipeline Regulations  
Workplace Hazardous Materials Information System (WHMIS)  
*Transportation of Dangerous Goods Act (Canada)*  
Transportation of Dangerous Goods Regulations (Canada)  
*Canadian Environmental Protection Act* |
| **British Columbia** | *Environmental Management Act*  
Special Waste Regulation  
Spill Reporting Regulation  
British Columbia Oil and Gas Waste Regulation  
Forest Practices Code  
Rules and Regulations Governing Oil and Gas Pipelines (British Columbia)  
*Transport of Dangerous Goods Act (British Columbia)* |
| **Alberta** | *Environmental Protection and Enhancement Act*  
Code of Practice for the Release of Hydrostatic Test Water from Hydrostatic Testing of Petroleum Liquid and Gas Pipelines  
Waste Control Regulation  
*Pipeline Act*  
Emergency Preparedness and Response Requirements for the Petroleum Industry  
Waste Control Regulation  
Substance Release Regulation  
*Oil and Gas Conservation Act* and Regulations  
*Transportation of Dangerous Goods Act* |
| Enbridge | Health, Safety and Environment (HSE) Field Handbook Version 5.0 (March 2006) |
A.3.34 Weed and Clubroot Management Plans

Although clubroot is a soilborne disease, not a weed, it is addressed because of its relevance to the Project, and is discussed in conjunction with weeds because it has common mitigation measures, specifically, equipment cleaning.

A.3.34.1 Weed Management Plan

Objective

The objective of the Weed and Clubroot Management Plans is to prescribe methods to prevent and control the spread of restricted, noxious and invasive plants during all project phases.

Short-Term Objectives

Short-term objectives will be implemented in pre-construction and construction and include:

- identifying locations of restricted and noxious weeds and invasive plant species on infrastructure sites, along the RoW and on access roads
- preventing the spread of restricted and noxious weeds and invasive plants, by implementing effective mitigation measures

Long-Term Objectives

Long-term objectives will be implemented after construction, and during operations and maintenance, and include the following:

- reducing existing infestations to a level equivalent to that observed in adjacent lands with equivalent or similar land use
- preventing the spread of noxious and invasive plants along the RoW and around infrastructure sites
- considering preventive, nonchemical weed management when designing, planning and constructing new facilities or when conducting operations and maintenance activities. Actively evaluating and using new weed management techniques and practices to improve weed management programs.

Reporting and Accountability

Northern Gateway is committed to implementing the Weed and Clubroot Management Plans effectively, and to having the plans well documented, reviewed and revised regularly. Review and revision will take place at least every three years, so that the most effective vegetation monitoring and weed control practices are used to achieve the objectives.

The six elements of the Weed and Clubroot Management Plans are:

- prevention
- identification
- monitoring
- treatment thresholds
• treatment options
• evaluation

Prevention

Prevention is the least expensive and most effective way to halt the spread of noxious and invasive weeds. Preventing the establishment or spread of weeds will rely upon:

• educating workers about the importance of managing weeds
• properly identifying weed species
• avoiding or treating existing weed populations
• incorporating mitigation measures that prevent weed seeds or other plant parts from establishing new or larger populations

Identification

Northern Gateway will conduct pre-disturbance weed surveys before clearing the PDA, to determine whether weed populations that may pose a particular challenge for control or successful reclamation are present. Vegetation specialists will record the location of noxious and restricted weeds and invasive plants threatening uninfested, highly susceptible sites along the RoW. These locations will be identified on the environmental alignment sheets along with corresponding cleaning stations.

Monitoring

Monitoring will consist of regular inspections to determine the aerial extent of weed problems, and will provide the information needed to decide:

• whether treatments are necessary
• the best treatment options
• the best timing of treatments

Monitoring will be conducted by a vegetation specialist. Baseline weed assessments will be conducted for all infrastructure sites and the RoW to assist in determining treatment thresholds, and to determine whether the objectives of the Weed and Clubroot Management Plans are being achieved.

Aerial reconnaissance of the RoW and facilities will be conducted in a helicopter at low speed and altitude at least once every three years in early to mid-July, when both early- and late-blooming weeds occur. Where potential problem areas are identified during the aerial reconnaissance, ground assessments will be conducted as soon as possible. Necessary follow-up weed control will begin within one month of the aerial reconnaissance.

Weed monitoring on the ground will be done at least twice during the growing season. Weed surveys will include walking in a meandering pattern within the entire infrastructure site or along the RoW to identify weeds present, and recording species of concern. A similar, unaffected site will also be assessed near the construction site. A weed monitoring form will be completed as least once per growing season for each
infrastructure site and for each segment of the RoW where a weed assessment is required, as determined by:

- the most recent aerial reconnaissance
- construction activities along the RoW
- landowner concerns

Weed species and distribution within lands adjacent to a project site or segment of the RoW will also be documented, to address the threat of the spread of weeds.

Weed control activities will take place in the spring, summer or fall depending on the following factors:

- weed species identified
- optimal time for treatment of the target species
- treatment priority
- ideal treatment type

Weed control activities will be conducted as often as a vegetation specialist determines is warranted, based on the available and effective treatment strategies, and until the weed problems have been reduced to below the threshold level.

**Treatment Threshold**

Treatment of weeds along the pipeline route and at project infrastructure sites is required when the treatment threshold is reached.

All noxious and restricted weeds will be reduced and maintained at levels of density and distribution equivalent to, or less than, levels on adjacent lands with equivalent or similar land use.

Weed treatment will comply with relevant provincial regulations, including the *Weed Control Act*.

**Treatment Options**

When an established treatment threshold has been surpassed, the approved course of action will consider all options available for the particular vegetation complex. The following will be considered when selecting the most appropriate treatment:

- protection of water bodies
- landowner requirements
- type of equipment being used
- potential for drift
- the soil type
- the slope of the ground

Treatment priority will be determined by the level of risk (see Table A-14).

Depending on the type of vegetation to be controlled on or adjacent to its facilities, Northern Gateway or its contractors will consider various nonchemical (mechanical and manual) and chemical (herbicide) weed management options. An integrated approach combining chemical and nonchemical treatment options is generally most effective when tailored to weed species and conditions.
Table A-14  **Site Risk Levels for Weed Control**

<table>
<thead>
<tr>
<th>Priority</th>
<th>Purpose or Intent</th>
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| 1        | High Risk  
To stop the spread of invasive plants threatening uninfested or highly susceptible sites, including cultivated, hay and pasture lands. Weedy areas along the RoW will be considered to be Priority 1 if the vegetation specialist identifies a high potential for weeds to spread and invade agricultural areas, or if the site is adjacent to roads, railways or waterways. |
| 2        | Moderate Risk  
To stop the enlargement of sites in less susceptible areas. This includes sites adjacent to lands that have a well-established vegetation cover and are therefore less susceptible to invasive or weed species introduction. |
| 3        | Low Risk  
To stop the enlargement or contain sites on and adjacent to industrial lands.                                                                        |

Once treatment priorities and thresholds have been established, a timeline and list of treatment areas will be developed and an appropriate treatment will be determined and evaluated based on:

- bare ground versus vegetated
- location of the problem
- accessibility to the problem vegetation (terrain, slope remote areas)
- safety of Northern Gateway personnel, contractors and the public
- short- and long-term effects of the methods being considered
- expected efficacy of the methods being considered
- benefits and limitations of each method
- cost-effectiveness of each method
- environmental considerations such as proximity to water sources, water bodies, food growing or planted for human consumption, riparian areas, wildlife and fish habitat
- the choice of herbicide, herbicide properties and toxicity, and appropriate application methods, techniques and equipment

**Evaluation**

The effectiveness of the Weed and Clubroot Management Plans will be evaluated every three years. More frequent post-treatment evaluations are mandatory for all treatment areas after herbicide application.

Accurate records of weed monitoring results, and all weed control activities, will be retained by Northern Gateway at the appropriate regional office. Paper and electronic copies of these records will also be maintained by the environmental manager.
A.3.34.2 Clubroot Management Plan

Introduction

Clubroot is a soilborne disease that affects canola, mustard and other crops in the cabbage family. It is considered a pest under the *Agricultural Pests Act* and was first detected in a canola field near Edmonton in 2003 (Alberta Agriculture and Food 2007, Internet site). Clubroot disease is spread through spores that rest in the soil and that can survive for up to 20 years. Symptoms will vary depending on the growth stage of the crop at the time of infection. Early infection at the seedling stage can result in wilting, stunting and yellowing of plants. In later stages, infected plants will ripen prematurely and seeds will shrivel. Infection can be confirmed by checking for gall formation on roots (Alberta Agriculture and Food 2007, Internet site). Canola crops that are infected with clubroot disease will also show a reduction in yield.

Field approaches, headlands and low, wet areas are potentially sensitive to clubroot disease, but occurrences are not limited to these locations. Clubroot disease might be present in fields west of Bruderheim, and it has been identified in the County of Westlock and Barrhead (Alberta Agriculture and Food 2007, Internet site). A clubroot disease management plan will be activated in this general area.

New information regarding clubroot disease continues to become available as stakeholders and agriculture industry specialists learn more. The new information will be reviewed before construction, to confirm that the appropriate mitigation measures are being applied.

Mitigation Measures

Prevention is the best mitigation measure. The basic philosophy behind preventing the spread of clubroot disease is to prevent topsoil from one field, which may be contaminated with clubroot spores, from being transported to other cultivated fields.

The best available way to prevent the spread of clubroot disease is to clean vehicles, equipment and footwear, so that topsoil is not carried from one land parcel to the next.

General Measures

For clubroot management, traffic between quarter sections and in wet weather will be limited to the extent feasible. Project personnel must be extra cautious about soil transfer on slightly wet soil, and avoid working in very wet soil conditions.

Foot Traffic

When travelling on foot between cultivated quarter sections, and before crossing into another field, project personnel should clean their footwear and equipment (e.g., shovels) that have been in contact with topsoil.
Vehicles and Equipment

- All vehicles, ATVs and equipment driving on topsoil (i.e., before topsoil has been stripped or after topsoil has been replaced), or involved in topsoil handling activities, should be clean when they arrive on site. Every effort will be made to keep vehicles clean.

- If vehicles make major mobilizations (e.g., if work is conducted at the east end and then equipment is remobilized to start work at a different location farther west), vehicles will be thoroughly cleaned (e.g., power washed), before starting at the new location.

- Before moving between cultivated fields (i.e., at changes in land use or road crossings) along the RoW, project personnel will remove as much soil as possible, and sweep or brush off fine soil particles, from trucks, ATVs and equipment.

- Basic shovel cleaning, compressed air and shovel cleaning, as well as power washing and misting with a disinfectant should be planned as part of the clubroot and weed control program.

- Equipment involved in clearing, brushing and topsoil handling will be cleaned at designated cleaning stations, as indicated on the environmental alignment sheets.

A.4 References

A.4.1 Literature Cited


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