APPENDIX D
SOIL HANDLING AND REVEGETATION MITIGATION MEASURES

SPRINGBANK OFF-STREAM RESERVOIR PROJECT
Environmental Impact Assessment

Volume 4: Appendices
Appendix D

Soil Handling and Revegetation Mitigation Measures

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March 2018

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Executive Summary

The soil handling and revegetation mitigation measures for the Springbank Off-stream Reservoir Project (the Project) sets the context for surface disturbance and reclamation material salvage, and it outlines soil replacement and revegetation practices that are consistent with end land use objectives.

The discussion of soil handling measures (salvage, stockpiling, replacement on disturbed areas) is meant to provide general guidance only as it is expected that conditions in the field will not be uniform but vary across the landscape.

These discussions are directed toward the establishment of a stable, self-sustaining landscape that will function with minimal intervention during dry operations. Soil replacement and revegetation is limited to the immediate post-construction timeframe (initial re-establishment of vegetation cover, landform stabilization, erosion limitation) and subsequent maintenance (monitoring and repairs as required).

A description of possible post-flood operations mitigation is presented along with general short and long-term monitoring plans.

Abbreviations

ACIMS	Alberta Conservation Information Management System
AEP	Alberta Environment and Parks
ASRD	Alberta Sustainable Resource Development
C&R Plan	conservation and reclamation plan
ECO plan	Environmental Construction Operations plan
EIA	environmental impact assessment
EPEA	*Environmental Protection and Enhancement Act*
FSL	full service level
GLIMPS	Geographic Land Information Management Planning System
IPCC	Intergovernmental Panel on Climate Change
LAA	local assessment area
NPK	nitrogen, phosphorous, potassium
PDA	project development area
RAP	restricted activity period
SARA	*Species at Risk Act*
the Project	Springbank Off-stream Reservoir Project
ToR	terms of reference

1.0 REGULATORY CONTEXT

The submission of soil handling and revegetation mitigation measures for the Springbank Off-Stream Reservoir Project (the Project) is to comply with the intent of Section 2.9 of the provincial terms of reference(ToR) for the environmental impact assessment (ESRD 2015). This section of the ToR specifies a conservation and reclamation plan (C&R) as part of the EIA report for the Project; however, review of *Environmental Protection and Enhancement Act/EPEA* (GOA 2017) and the Conservation and Reclamation Regulation (GoA 2016) indicate that the Project does not meet the criteria for specified land so a C&R plan is not required. The following outlines the specific pieces of legislation to this effect.

Part 6, Conservation and Reclamation, Duty to Reclaim – Section 137 in the *EPEA* (GOA 2017) states,

(1) An operator must

> *(a) conserve specified land,*
>
> *(b) reclaim specified land, and*
>
> *(c) unless exempted by the regulations, obtain a reclamation certificate in respect of the conservation and reclamation*

Part 1 – Definitions in GoA (2016) defines specified land as follows,

(t) *"specified land" means land that is being or has been used or held for or in connection with*

> *(i) the construction, operation or reclamation of a well, an industrial pipeline or a battery,*
> *(ii) the construction, operation or reclamation of an oil production site,*
> *(iii) the construction, operation or reclamation of a municipal pipeline,*
> *(iv) the construction, operation or reclamation of a telecommunication system or transmission line,*
> *(v) the construction, operation or reclamation of a mine, pit, borrow excavation, quarry or peat operation,*
> *(vi) the construction or reclamation of a roadway,*
> *(vii) the conduct or reclamation of an exploration operation,*
> *(viii) the reclamation of a railway, or*
> *(ix) the construction, operation or reclamation of a plant,*

The definitions of specified land do not include lands that are to be developed for water management infrastructure; therefore, the Project is exempt from the requirement to submit a conservation and reclamation (C&R) plan for approval under *EPEA*.

Regulatory Context
March 2018

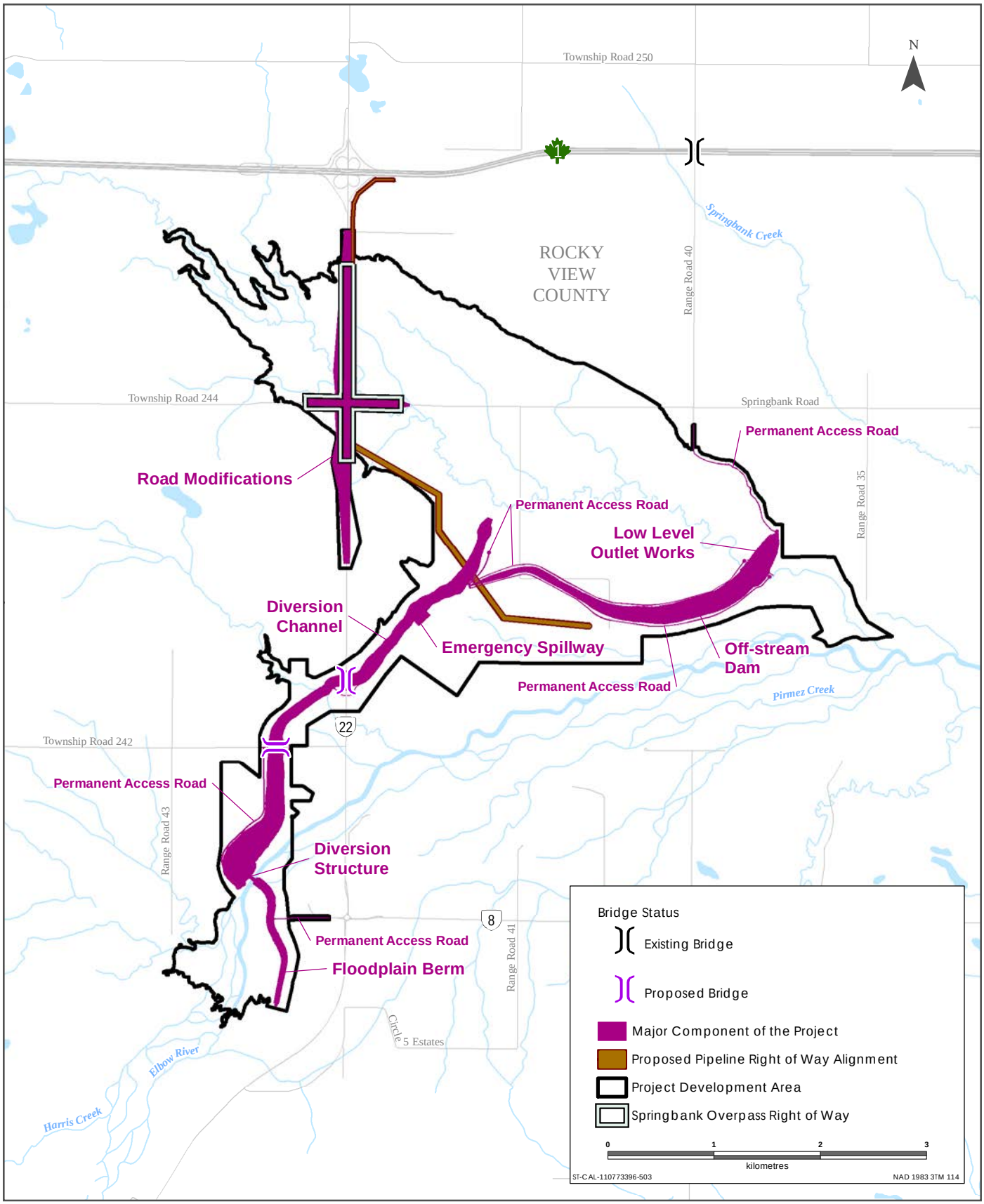
The soil handling and revegetation mitigation measures outlined hereafter were partially informed by the following acts and guidelines:

- the *Environmental Protection and Enhancement Act/EPEA* (GoA 2017))
- the *Conservation and Reclamation Regulation* (GoA 2016a)
- the *Soil Conservation Act* (GoA 2010a)
- the Alberta Wetland Policy (AEP 2013) and Alberta Wetland Mitigation Directive (AEP 2017a)
- the *Water Act* (AEP 2017b*)*
- Alberta Transportation guides for borrow excavations (Alberta Transportation 2013a, 2013b, 2013c)
- Code of Practice for Pits (GoA 2004)
- Alberta Transportation's Erosion and Sediment Control Manual (Alberta Transportation 2011a)
- Field Guide for Erosion and Sediment Control (Alberta Transportation 2011b)
- Grass Seed Mixtures Used on Highway and Bridge Projects (Alberta Transportation 2005)

2.0 PROJECT DEVELOPMENT AREA AND PROJECT COMPONENTS

2.1 PROJECT DEVELOPMENT AREA

The project development area (PDA) occupies 1,440 ha and encompasses the maximum anticipated area of physical disturbance associated with the construction and operation of the Project; it includes the permanent Project physical works and the off-stream reservoir to the extent potentially affected during the design flood (see Figure 2-1).



Sources: Base Data - ESRI, Natural Earth, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Project Development Area and Project Features

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2.2 PROJECT COMPONENTS

The following section provides a high-level outline of the major Project components to set the context for the mitigation measures that follow. A more detailed description of each component is in Volume 1, Section 3.2.

2.2.1 Permanent Features

Permanent features are those that will remain in over the operating life of the Project. These are described in Table 2-1 and shown on Figure 2-2.

Table 2-1 Project Components

Component[1]	Description[1]
Diversion structure	Three structures that work together to divert floodwater into the diversion channel • diversion inlet: gated concrete structure – 44 m wide, 14.6 m high • service spillway: gated concrete structure – 49 m long, 14.6 m high • floodplain berm: embankment of earth – 1,000 m long, max 51 m wide and 7.5 m high • auxiliary spillway: concrete cutout in the floodplain berm – 250 m long, 1.8 m lower than crest of floodplain berm
Floodplain berm	Embankment of earth that will constrain flow within the active channel of the Elbow River and direct it through the diversion inlet. • 1,000 m long, max 51 m wide and 7.5 m high
Diversion channel	A channel for conveying floodwaters from the Elbow River to the dry reservoir • length: 4,700 m • bottom width: 22 m • 4H:1V side slopes
Emergency spillway	A concrete structure on the diversion channel that would operate in flows higher than the design flood to limit the water depth in the reservoir • length: 200 m
Off-stream dam	Dam embankment: earth fill • crest Length: 3,959 m • maximum structure height: 27 m • maximum base width: 205 m • crest width: 10 m

Table 2-1 Project Components

Component[1]	Description[1]
Off- stream reservoir	After construction of the dam, this will be a dry basin for floodwater retention • surface area: 884 ha (6,200 m long and 2,000 m wide) • maximum design water depth: 25 m • surface area at design storage capacity: 816 ha
Low-level outlet works	A gated outlet structure and stream channel system for releasing floodwater from the reservoir to the Elbow River • low-level outlet: 1.5 m wide, 1.8 m tall and 250 m long • trash rack prevents large debris from entering the discharge conduit, which consists of a 225 m long, 2,440 mm (96") pipe which discharges into a 50 m long concrete flume with energy dissipation to reduce the speed of the water entering the channel
Permanent access and service roadways	Access roads that will be required for on-going infrastructure maintenance. • floodplain berm access along crest of the berm. Access to Highway 22 by a link that follows a provincial easement • access ramp from diversion structure along west side of diversion channel • access road along east side of diversion channel from diversion structure to west end of off-stream dam • access roads from west end of dam along the inner and outer bases of the dam to turnarounds at each end of the low-level outlet works • access road from west end of dam along the dam crest to a turnaround at the east end • north emergency access road around the reservoir perimeter connecting the east end of the dam with Springbank Road
Spoil sites	Area(s) where material excavated from the diversion channel with properties that are unsuitable for construction will be placed, either temporarily before disposal or permanently and landscaped. It also includes sites for the storage of topsoil and subsoil for post-construction replacement.
Road modifications	Associated works. • Highway 22 raised above the reservoir full service level (FSL) in the location of the future southbound twinning lanes • bridge on Highway 22 over the diversion channel • new raised intersection (overpass) at Highway 22 and Springbank Road/Township Road 244 • bridge on Township Road 242 over the diversion channel • upgrade of Range Road 40 to a County Collector classification to act as a detour for Springbank Road during a flood

Table 2-1 Project Components

Component[1]	Description[1]
Existing utilities	Associated works. • pipeline retrofitting • pipeline relocations/realignments • transmission line pole/tower relocations
NOTE: [1] values are approximate and subject to change prior to completion of final design	

2.2.2 Temporary Features

Temporary features are those that will be required during site preparation and infrastructure construction but not during Project operations, so they will be reclaimed when no longer needed. These features are described in Table 2-2 and shown on Figure 2-2.

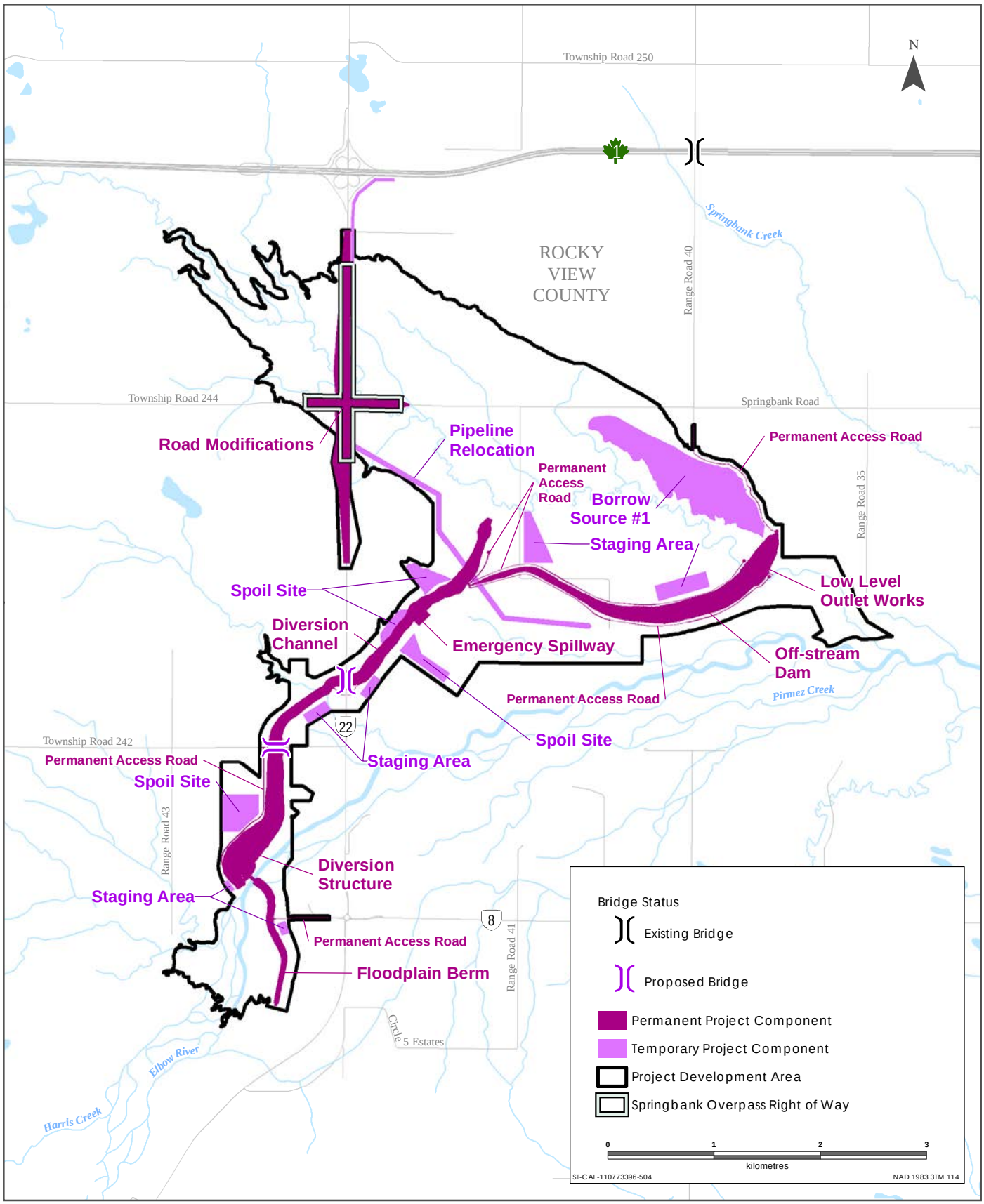
Table 2-2 Temporary Features

Component	Description[1]
Access roads	Access roads that will be required during Project construction include those outlined in Table 3-1 plus any additional routes needed to meet construction requirements. Locations and extents will be determined at the time of construction.
Laydown areas	Tentative locations for contractor laydown areas are shown on Figure 2-2. Additional sites will be determined as Project design is finalized and before construction begins. These could include: • the contractor's site office • vehicle maintenance and refueling areas • areas for storage of trench spoil from the diversion channel
Borrow Source #1	The preliminary project design supports a volumetric balance between the material excavated from the diversion channel with that required to construct the off-stream dam. However, should fill material be required one potential borrow area has been designated inside the boundaries of the reservoir as shown on Figure 2-2 • Borrow Source #1
Soil stockpiles	Topsoil and subsoil will be salvaged from all areas where temporary and permanent disturbances are proposed. • Preliminary spoil sites are shown on Figure 2-2; soil will be stockpiled there. If additional areas are needed they will be delineated as construction progresses.

Table 2-2 Temporary Features

Component	Description[1]
Replaced portion of Highway 22	Once the new lanes of Highway 22 are in service, the existing lanes that have been replaced will be closed and decommissioned.
Elbow River diversion channel and floodplain berm	The channel and berm are required for a temporary diversion of the Elbow River to allow construction of the service spillway in the dry. The channel will be restored to its original location and the berm removed once construction of the service spillway is complete

NOTE:
[1] values are approximate and subject to change prior completion of final design



Sources: Base Data - ESRI, Natural Earth, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Permanent and Temporary Features of the Project

3.0 ENVIRONMENTAL SETTING

The information used to describe the environmental setting in which the Project will be constructed is taken from the Valued Component (VC) sections in Volume 3A.

3.1 LAND USE

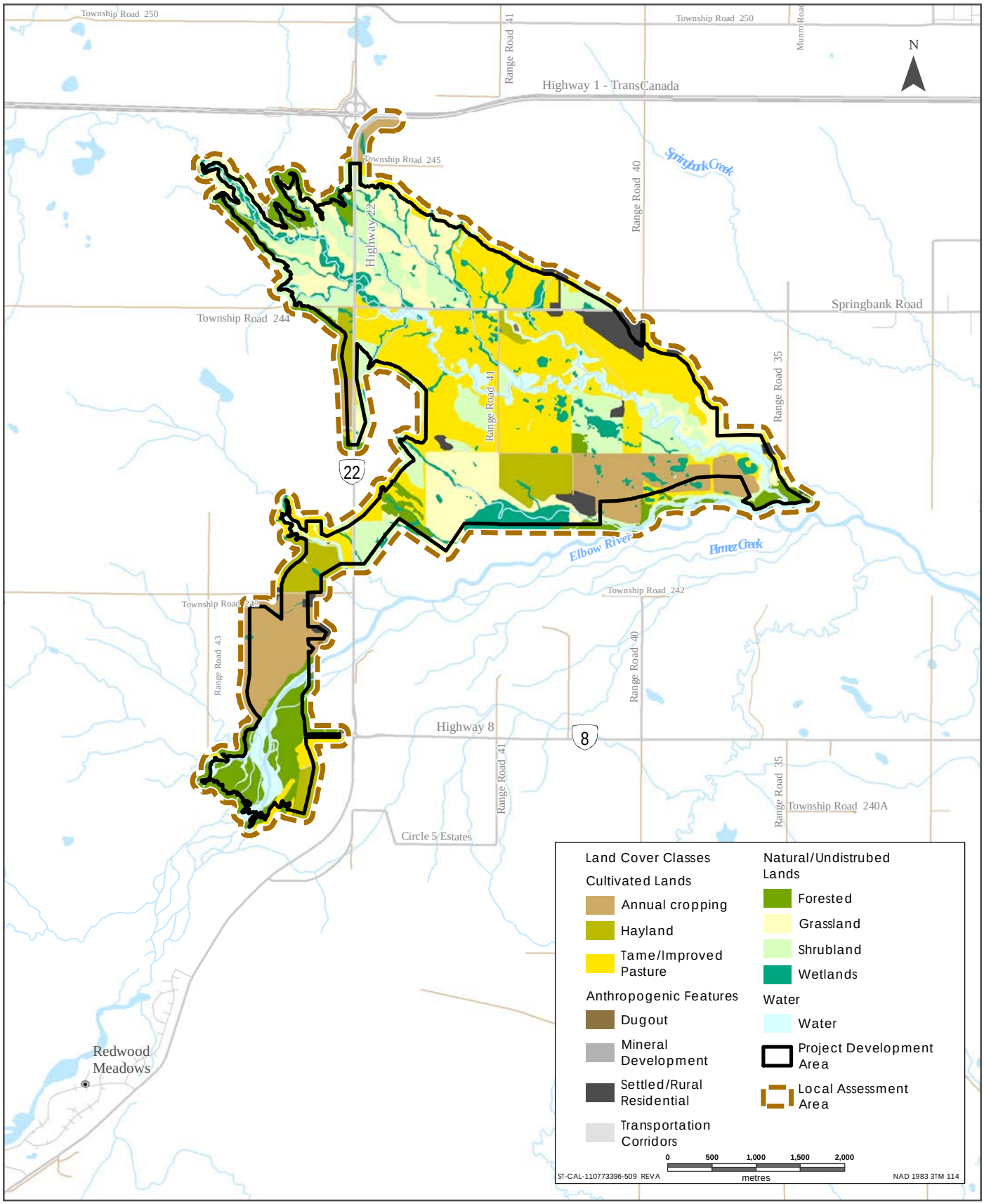
3.1.1 Land Cover Classes

Vegetation baseline mapping use ecosite phases and wetland classes combined into broader land cover classes for the local assessment area (LAA) and PDA, as provided in Table 3-1 and shown on Figure 3-1. Further details on land cover are found in Volume 3a, Section 10 Vegetation and Wetlands.

Table 3-1 Land Cover Classes in the LAA[1] and PDA

Land Cover Classes	Areas (ha/%)	
	LAA	PDA
Cultivated Lands		
Annual cropping	201.6/10.7	138.5/9.6
Hayland	107.8/5.7	82.8/5.8
Tame/Improved Pasture	498.8/26.4	411.5/28.6
Subtotal	808.3/42.8	632.8/44.0
Natural/Undisturbed Lands		
Forested	194.6/10.3	105.6/7.3
Shrubland	254.1/13.5	197.6/13.7
Grassland	252.4/13.4	213.0/14.8
Wetlands	146.8/7.8	121.8/8.5
Subtotal	847.9/44.9	638.0/44.3
Anthropogenic Features		
Transportation Corridors	44.3/2.3	30.4/2.1
Settled/Rural Residential	52.9/2.8	35.2/2.4
Dugouts	1.2/0.1	0.5/<0.1
Subtotal	98.5/5.2	65.5/4.5
Water		
Subtotal	131.8/7.0	103.1/7.2
Total	**1,886.5/100**	**1439.9/100**

NOTE.
[1] for consistency the land cover metrics have been generated for the Terrain-Soils LAA



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.

Land Cover Classes in the Local Assessment Area and Project Development Area

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3.1.2 Weeds

The Alberta *Weed Control Act* and *Weed Control Regulation* (GoA 2010b) require that prohibited noxious weeds must be destroyed and noxious weeds controlled on lands occupied or controlled by a person or entity. Methods of weed control will be compatible with the location and extent of infestations and survival of native plants.

No prohibited noxious weeds were found in the PDA during field surveys; however, six noxious weed species were observed:

- downy chess (Bromus tectorum)
- creeping thistle (*Cirsium arvens*)
- field bindweed (Convolvulus arvensi)
- hound's-tooth (Cynoglossum officinale)
- tall buttercup (*Ranunculus acri*)
- perennial sow-thistle (*Sonchus arvensis*)

Additional information regarding weeds and invasive species is provided in Volume 3a, Section 10 Vegetation and Wetlands.

During construction, the contractor will implement appropriate weed-control measures consistent with accepted management practices.

Control and prevention of the spread of prohibited noxious and noxious weeds will be evaluated on a site-specific basis and will incorporate the following practices and methods:

- mechanical control, such as mowing (preferred, if timed correctly can be very effective)
- hand-picking and disposal (preferred, although labour-intensive, it may be the best option for steeper slopes or other challenging sites)
- cultural control of weeds (i.e., seeding of competitive species)

To control small occurrences of persistent infestations the application of non-residual herbicides may be considered when and where required (e.g., for species that cannot be adequately controlled by other means such as Canada thistle which can reproduce and spread vegetatively [AARD 2015]).

If the use of herbicides is deemed necessary, a licensed industrial pesticide applicator will be contracted to select and apply all herbicides in compliance with the weed control plan, and the *Environmental Code of Practice for Pesticides* (ESRD 2010b).

3.2 TERRAIN AND SOILS

The LAA for soils and terrain is the PDA plus a 100 m buffer and encompasses an area of 1,886 ha.

3.2.1 Terrain Units

Table 3-2 outlines the distribution of terrain units in the LAA and PDA. For further information, see Volume 4, Appendix G, Terrain and Soils Technical Data Report.

Table 3-2 Terrain Units in the LAA and PDA

Terrain Unit	Extent	
	LAA, ha/%	**PDA, ha/%**
Glaciolacustrine (LG)	1,311.8/69.5	1,099.3/76.3
Till (M)	254.2/13.5	123.6/8.6
Fluvial (F)	271.3/14.4	187.6/13.0
Organic (O)	35.4/1.9	21.6/1.5
Glaciofluvial (FG)	8.1/0.4	4.3/0.3
Colluvium (C)	4.0/0.2	3.1/0.2
Open water (N)	1.0/<0.1	0.0/0.0
Bedrock (R)	0.6/<0.1	0.4/<0.1
Total	**1,886.4/100**	**1439.9/100**

3.2.2 Soil Series and Map Units

The soil series and variants found in the PDA are grouped into the soil map units shown in Table 3-3 and Figure 3-2. For further information, see Volume 4, Appendix G, Terrain and Soils Technical Data Report.

Table 3-3 Distribution of Soil Map Units in the LAA and PDA

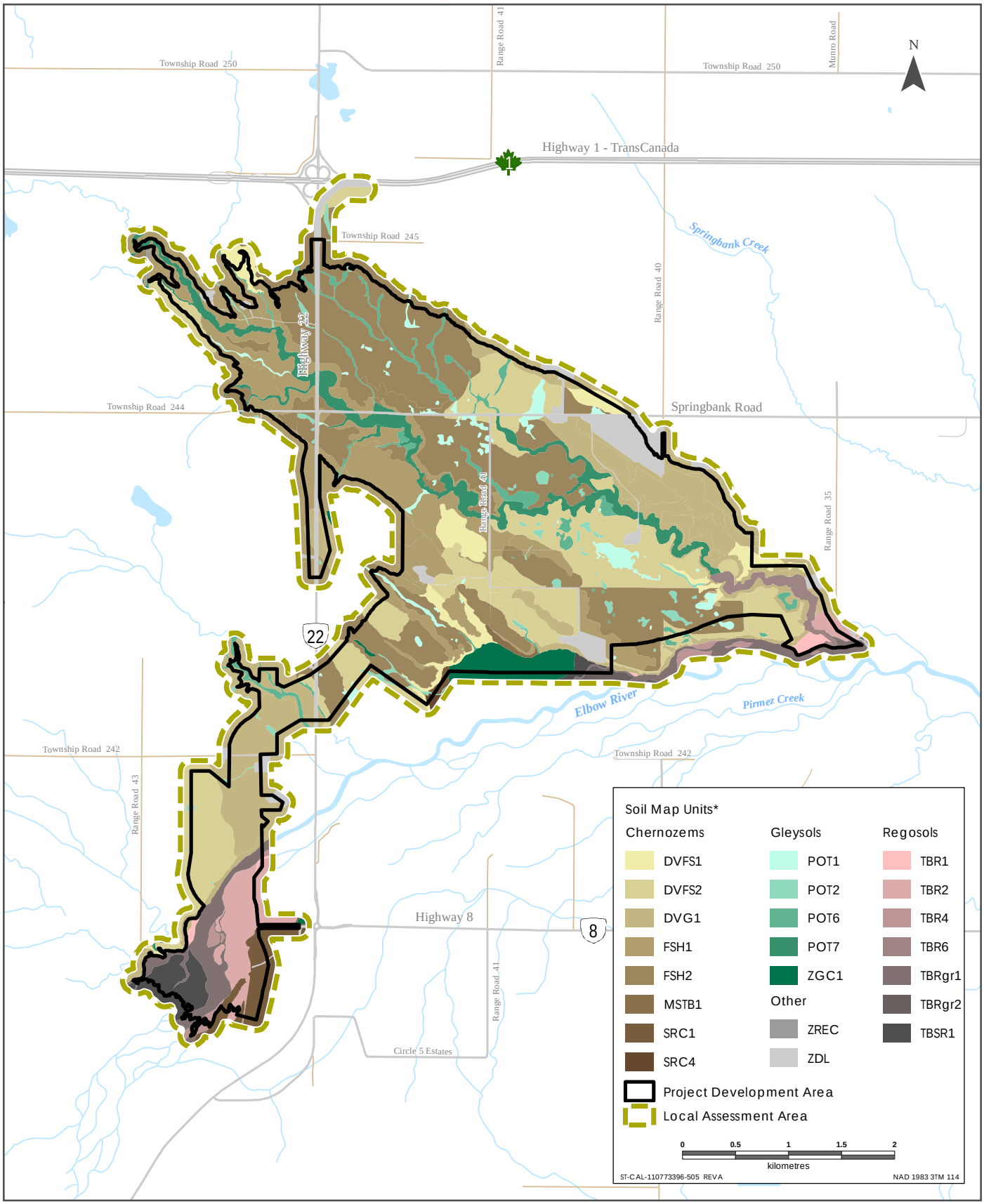
Soil Subgroup	Soil Map Unit	Topsoil Depth/ Subsoil Depth (cm)	Reclamation Suitability Rating, Topsoil/Subsoil	Agricultural Land Capability[1]	Extent[2]	
					LAA ha/%	PDA ha/%
Orthic Black, Calcareous Black Chernozems	Dunvargan -Fish Creek (DVFS)	25/25	Fair/Poor	3	359.5/19.1	287.7/20.0
	Dunvargan (DVG)	25/25	Fair/Poor	3	281.4/14.9	191.9/13.3
	Fish Creek (FSH)	25/25	Fair/Poor	3	713.9/37.9	576.5/40.0
Calcareous Black Chernozem	Sarcee (SRC)	30/0	Poor/Fair	3	38.1/2.0	15.5/1.1
Orthic Humic Gleysol	Pothole Creek (POT)	25/30	Poor/Poor	6	175.2/9.3	160.1/11.1
Orthic Regosol	Twin Bridges (TBR)	20/0	Good/Good	3 (7, gravelly variant)	182.3/9.7	116.4/8.1
Rego Black Chernozem	Mesa Butte (MSB)	20/0	Good/Good	4	2.8/0.1	2.8/0.2
Coarse Gleysolic	Coarse Gleysols (ZGC)	30/15	Poor/Fair	5	35.0/1.9	23.1/1.6
Reclaimed Soil	Reclaimed (ZREC)	30/0	Fair/Poor	3	1.1/<0.1	<0.1/<0.1
Not Classified[3]	Existing Disturbances (ZDL)	N/A	N/A	N/A	97.1/5.1	65.8/4.6
Total					**1,886.4/100**	**1,439.9/100**

NOTES:

[1] See Volume 3A, Section 9 for a description of the Land Suitability Rating System for Agricultural Crops.

[2] Areas and proportions might not add up to totals because of rounding.

[3] Not Classified – Existing disturbances such as roads, farmsteads and other areas of disturbed soil.



Sources: Base Data - Government of Alberta, Government of Canada, Thematic Data - Stantec Ltd.
** Refer to section D7.3.2.3 for detailed Soil Map Unit descriptions.*

Soil Map Units in the Local Assessment Area and Project Development Area

4.0 CONSERVATION

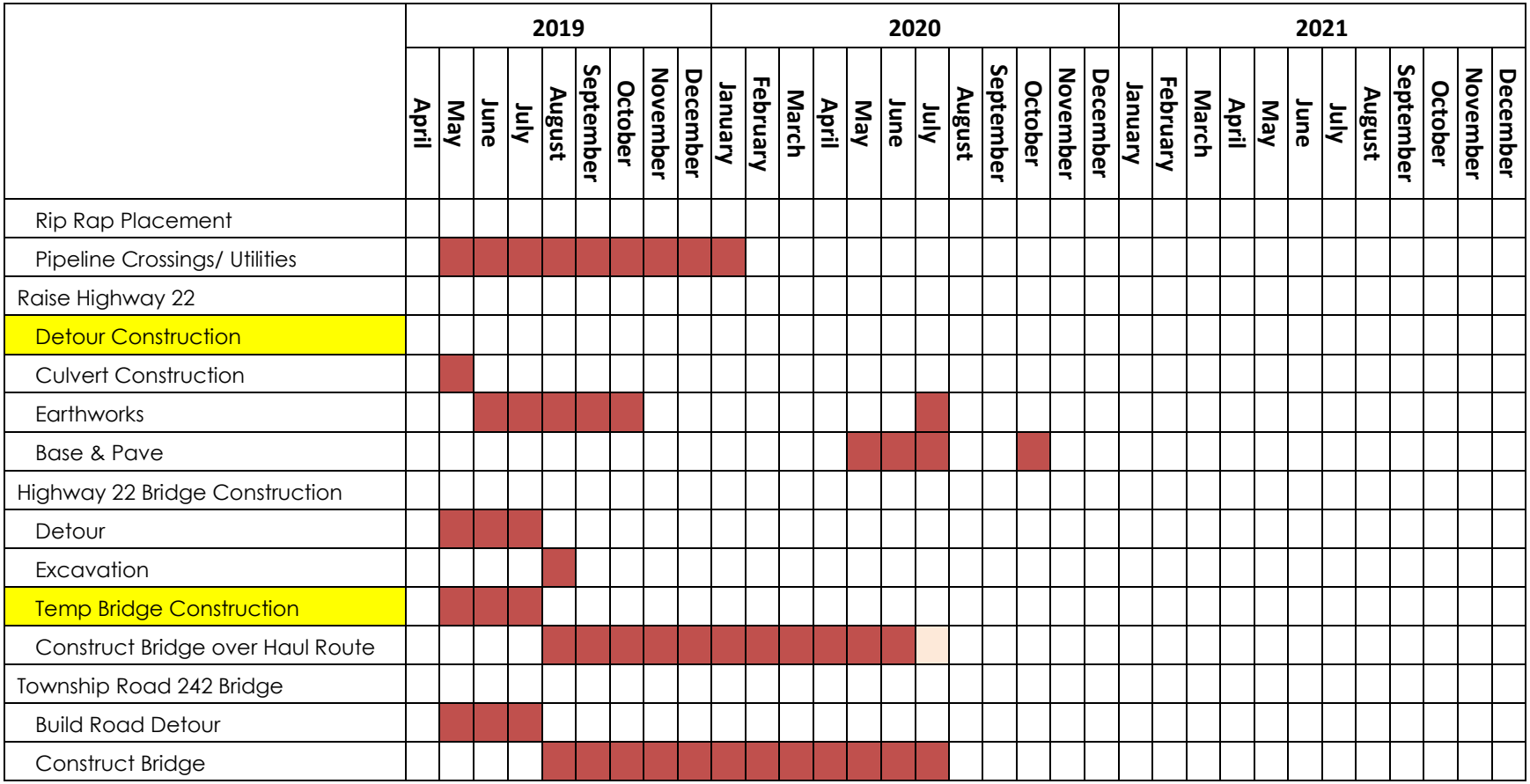
4.1 PROJECT SCHEDULE

The Project schedule, Table 4-1, provides the proposed timing of site clearing, material salvage and construction activities. Reclamation activities will follow the completion of construction segments.

Table 4-1 Project Schedule (tentative)

	2019									2020												2021											
	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
Mob																																	
Structures																																	
In-Stream Work																																	
River Diversion																																	
Service Spillway Structure																																	
Floodplain Berm																																	
Diversion Channel																																	
Channel Excavation																																	
Diversion Inlet Structure																																	
Emergency Spillway																																	
Diversion Channel Outlet Structure																																	
Storage Dam Outlet Structure																																	
Earthworks (Dam Embankment)																																	
Topsoil Stripping & Replacement																																	
Common Excavation & Placement																																	
Impervious Fill (Dam Core)																																	

Table 4-1 Project Schedule (tentative)



4.1.1 Associated Disturbances

There are associated disturbances that are required for development of the Project but are not components of the Project infrastructure: upgrading of at least one electrical transmission tower, relocation of buried pipelines; and modifications to Highway 22, Springbank Road, and installation of bridges. In the case of relocated pipelines, it is expected that the utility companies will employ their preferred contractors to carry out the work and these contractors will develop the appropriate, detailed environmental protection plans. The relocation of the transmission tower and pipelines will be the responsibility of the utility companies.

Surface disturbances are required for the new Highway 22 lanes, Highway 22–Springbank Road intersection, and Highway 22 and Township Road 242 bridges over the diversion channel. These developments will follow the relevant procedures outlined in the Standard Specification for Highway Construction (Alberta Transportation 2010). In general, these would include the following:

- acquire the full extent of lands necessary for the proposed works
- obtain crossing and/or shared use agreements as necessary for any foreign utilities
- conduct Alberta One Call locates, sweep and stake right-of-way including any extra temporary workspace areas (locates must be kept up to date over full construction period)
- relocate fences where necessary
- clear work areas of vegetation as required
- salvage topsoil and subsoil and windrow along sides of right-of way isolated from work areas (or in separate topsoil and subsoil stockpiles if this is more practical)
- construct new roadbed and bridge structures
- pull salvaged subsoil back across stripped areas, cultivate as required to de-compact
- spread salvaged topsoil back across stripped areas, cultivate and seed with an appropriate mixture (e.g., Alberta Transportation's recommended native or agronomic seed mix for Zone 6, AIT 2005)
- restring/replace fences as necessary
- monitor reclamation success and integration of weed and erosion control programs as necessary with the standard maintenance program for Highway 22

4.2 CONSERVATION PRINCIPLES

Successful site reclamation depends on the careful planning and implementation of material salvage measures related to the defined end land use objectives for the Project. The following general principles pertain to the conservation aspect of the plan:

- The Project is not located in an area where clubroot infestations have been recorded (AAF 2017a); however, all construction equipment will be cleaned appropriately before coming onsite to prevent inadvertent introduction of this disease (AAF 2017b).
- The surface disturbance footprint(s) will be limited to reduce environmental effects given the constraints imposed by the requirements of facility construction and contractor and public safety.
- Site clearing and soil salvage activities will be conducted in a way that conserves soil to optimize its quality and quantity for mitigation of surface disturbances.
- Soil handling will only take place when the ground surface is dry and trafficable (i.e., dry or frozen) to reduce the potential for admixing, compaction and or rutting that might result in adverse effects on soil quality (Alberta Environmental Protection 1998).
- Material salvage and stockpiling strategies are based on the soil conditions at the site, the land capability of the original landscape, the post-construction landscape uses and objectives, and the soil replacement prescriptions required to obtain an acceptable land capability.
- To the degree practical, the reconstructed landscape will have land capabilities equivalent to what is present under existing conditions; this does not infer that identical uses will occur but the potential to support similar uses will exist.
- By placing salvaged soil to the appropriate thickness and quality, and with the inputs of natural processes over time, the reconstructed landscape will support land uses similar to those supported by naturally occurring soils.
- Revegetation prescriptions are directed by the necessity to quickly re-establish surface cover that will stabilize disturbed surfaces and provide erosion control while, in the longer term, supporting vegetation communities that are consistent with the defined end land objectives.
- The proposed end land use is an Integrated Management Area; see Section 6 for details.
- An environmental supervisor would be present during all soil handling operations. This individual would be familiar with large earthworks projects (preferably in the general area of the Project) and be a professional agrologist or suitable equivalent.

4.3 CLEARING

Clearing will occur in those areas where temporary or permanent features are required. Some additional clearing might occur outside the surveyed boundaries of a particular feature, such as an access road, for safety reasons. In Table 4-2, the construction footprint accounts for about 860 ha, which are designated as contingency areas should the need arise during construction to disturb further lands in addition to those described as either temporary or permanent features. The extent and location of these disturbances will be determined at that time and might be needed for such uses as:

- vehicle maintenance /refueling/storage
- stockpiling of spoil material that cannot be accommodated in the predetermined sites
- topsoil and/or subsoil stockpiles for material that exceeds the capacity of the currently assigned locations

4.3.1 Merchantable Timber

The Project does not fall inside the boundaries of any Forest Management Areas as determined by a surface public land standing search of Alberta Energy's Geographic Land Information Management Planning System (GLIMPS) conducted in September 2016 (Alberta Energy 2016).

Alberta Transportation will salvage merchantable timber; specific plans for salvage and disposition of the timber will be developed as part of the detailed Project design.

4.3.2 Non-merchantable Timber and Slash

The uses or disposal of non-merchantable timber and slash (i.e., coarse woody material) have not been finalized but may include the following:

- spread as rollback to prevent erosion of exposed soil (e.g., on soil stockpiles)
- chipped and used in ways consistent with applicable guidelines such as ASRD's *Industry Directive 2009-01: Management of Wood Chips on Public Land, External Directive* (ASRD 2009)
- landfilled
- timber and slash will not be incorporated into soil stockpiles as it can have adverse effects on soil nutrient ratios (i.e., carbon: nitrogen).

Final uses will be determined in consultation with AEP and Rocky View County.

Table 4-2 Site Clearing by Project Feature

Feature	Annual Cropping	Hayland	Pasture	Forested	Shrubland	Grassland	Wetlands	Water	Industrial[1]	Settled[2]	Total
Permanent Features											
Diversion channel[3]	28.6	7.3	7.8	3.5	11.0	4.6	1.1	0.6	0.7	0.3	65.5
Floodplain berm and buffer	0.0	2.0	1.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	8.4
Off-stream reservoir	18.6	4.9	4.2	0.0	4.5	4.0	3.8	2.0	0.5	0.0	42.5
Access and service roadways	2.7	0.9	1.4	0.3	0.4	0.7	0.2	0.2	0.2	0.2	7.2
Highway 22 bridge	<0.1	<0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.4
Highway 22 – Springbank Road intersection	2.2	7.2	3.2	1.7	7.2	4.3	3.4	0.8	14.6	0.0	44.6
Subtotal	52.1	22.3	17.6	10.9	23.1	13.6	8.5	3.6	16.3	0.5	168.5

Table 4-2 Site Clearing by Project Feature

Feature	Annual Cropping	Hayland	Pasture	Forested	Shrubland	Grassland	Wetlands	Water	Industrial[1]	Settled[2]	Total
Temporary Features											
Laydown areas	6.6	2.5	8.9	0.3	2.4	0.0	0.6	0.5	0.0	0.0	21.8
Borrow Source #1[4]	0.0	0.0	50.3	0.0	4.5	1.4	0.0	0.0	0.6	5.2	62.0
Soil stockpile sites	10.2	0.0	4.6	5.0	1.9	2.0	2.2	0.0	0.0	0.0	25.9
Construction footprint	109.4	74.3	275.6	47.1	106.2	84.4	47.4	67.6	23.4	25.0	860.4
Subtotal	126.2	76.8	339.4	52.4	115.0	87.8	50.2	68.1	24.0	30.2	970.1
Total	178.3	99.1	357.0	63.3	138.1	101.4	58.7	71.7	40.3	30.7	1138.6

NOTES:

[1] Industrial includes mainly roads and related industrial disturbances.

[2] Settled includes farmsteads, rural residential and related disturbances.

[3] Diversion Channel includes diversion structure, emergency spillway and related works.

[4] Borrow Source #1 will be opened to provide fill for the dam only if material in addition to that removed from the diversion channel is required. It will be developed and reclaimed in compliance with the requirements of Alberta Transportation 2013b and GoA 2004.

4.3.3 Clearing Schedule

Most bird species are protected under the *Migratory Birds Convention Act* (GoC 1994) and/or the *Alberta Wildlife Act* (GoA 2016b). Regulatory guidance to reduce risk of incidental injury or mortality recommends avoiding activities (e.g., vegetation clearing) that could result in the destruction of residences (e.g., nest) and habitat. Activities should also be avoided when and where they coincide with the breeding period of migratory birds and raptors.

Certain restricted activity periods will be integrated into the clearing schedule or accommodated in compliance with regulations. The following examples apply specifically to breeding birds:

- the primary nesting period in Bird Conservation Region 11 for migratory birds is from April 15 to August 15 with consideration for migratory species at risk extending to August 31
- the primary nesting period for raptors is from March 1 to August 15
- overall, the recommended Restricted Activity Period (RAP) is from March 1 to August 31
- no vegetation removal between April 15 and August 31 to avoid the breeding season for migratory birds (*Migratory Birds Convention Act and Migratory Birds Regulation,* GoC 1994)
- if vegetation clearing activities are scheduled to occur within the RAP for migratory birds and raptors, a qualified wildlife biologist must inspect the site for active nests within seven days of the proposed vegetation removal activities for each site.
- if an active nest or den is found, it will be subject to a provincial or federal disturbance setback buffer and site-specific mitigation measures (e.g., non-intrusive monitoring). Non-active raptor nests and dens are still protected year-round.
- clearing cannot begin until appropriate mitigation measures are implemented after consultation with and direction from Alberta Environment and Parks (AEP).

Further information on surveying, staking, clearing and grubbing will be presented in the prime contractor's project-specific ECO Plan (Alberta Transportation 2017).

4.4 SOIL HANDLING

Specific areas where surface disturbance will be required for the Project are outlined in Table 4-3. However, as Project design and planning is refined additional areas will probably be required. Because these areas are currently not defined in either their location or extent they have not been included in the following salvage and material balance calculations. If extra space is required, it will be developed in the temporary feature indicated as Construction Footprint, see Figure 4-1.

The following general guidelines will inform soil conservation in the areas, with more prescriptive measures being developed when sites have been finalized.

- survey and stake the boundaries of all potential surface disturbances
- clear vegetation as described in Section 4.4
- strip topsoil from those areas where construction activities are proposed (e.g., service roads, spoil stockpiles) and store in a location where rehandling is not likely to be required
- suspend topsoil stripping when soil is wet or during high winds
- strip subsoil from areas where potential contamination might occur (e.g., vehicle fueling and service areas, spoil stockpiles)
- stockpile like on like, i.e. topsoil can be stored on topsoil but areas designated for subsoil storage must have topsoil salvaged first
- topsoil and subsoil should be stored in stockpiles physically separated to reduce potential admixing

4.4.1 Wetlands

There are 8.5 ha of wetlands located under the permanent Project features, 4.7 ha under the temporary features and a further 47.4 ha in the construction footprint. Disturbance to wetlands on private or provincial land requires approval under the Alberta *Water Act* and must follow the goals of the *Alberta Wetland Policy* (AEP 2013).

The goal of the *Alberta Wetland Policy* is to conserve, restore, protect and manage wetlands in Alberta. The policy covers natural and restored wetlands including fens, bogs, swamps, marshes, creeks, rivers and drainages. Where disturbances to wetlands is proposed adherence to the *Alberta Wetland Mitigation Directive* (AEP 2016) is required. The Directive outlines at length the three principles of wetland disturbance and mitigation:

- avoidance

- minimization of disturbance (this may include a commitment to reclaim wetland disturbances)
- where the avoidance and minimization still result in the reduction or loss of permanent wetland areas, replacement (typically payment in-lieu but other options are outlined in the *Directive*)

Alberta Transportation will determine how wetland disturbances are to be handled and obtain all necessary approvals and permits before construction begins.

4.4.2 Soil Salvage

Topsoil and upper subsoil will be salvaged to the depths and extents outlined in Table 5-3 to generate the volumes of suitable resources necessary to produce the closure land capability classes necessary to support he end land use objectives for the Project.

In those locations where only topsoil is being salvaged the depths in Table 4-3 provide a certain level of guidance; however, the colour transition between the topsoil and subsoil is visually apparent in most cases which provides useful guidance for equipment operators. Most of the soil map units have similar reclamation suitability ratings so that minor amounts of over-stripping into the upper subsoil should have no adverse effects on topsoil quality.

Table 4-3 Topsoil and Subsoil Salvage Prescriptions and Volumes

Feature	Extent, ha	Depth, m		Volume, m^3	
		Topsoil	Subsoil	Topsoil	Subsoil
Temporary Features[1]					
Construction Laydown Areas	21.7	0.25	0.25	54,250	54,250
Soil Stockpile Sites[2]	25.8	0.25	0.25	64,500	64,500
Floodplain Berm Buffer	5.4	0.25	0.25	13,500	13,500
Subtotal	52.9			135,250	135,250
Borrow Source #1[3]	61.9	0.25	0.25	154,770	154,770
Subtotal	87.2			218,020	218,020
Construction Footprint[4]	860.3	0.25	0.25	N/A	N/A

Table 4-3 Topsoil and Subsoil Salvage Prescriptions and Volumes

Feature	Extent, ha	Depth, m		Volume, m^3	
		Topsoil	Subsoil	Topsoil	Subsoil
Permanent Features					
Diversion Channel[5]	65.4	0.25	0.25	163,500	163,500
Floodplain Berm	3.1	0.25	0.25	7,750	7,750
Off-Stream Reservoir Dam[6]	42.5	0.25	0.25	106,260	106,250
Access and Service Roadways	7.5	0.25	0.25	18,750	18,750
Subtotal	118.5			296,260	296,260
Highway 22 & Springbank Road Overpass	44.5	0.25	0.25	111,250	111,250
Total[7]	277.8	N/A		597,530	597,530

NOTES.

N/A – Not applicable

[1] These are the known disturbances that will be required during Project construction. Additional areas might be needed.

[2] Salvage volume assumes full topsoil and subsoil stripping will be required; see bullets in introduction to this section for stripping guidelines.

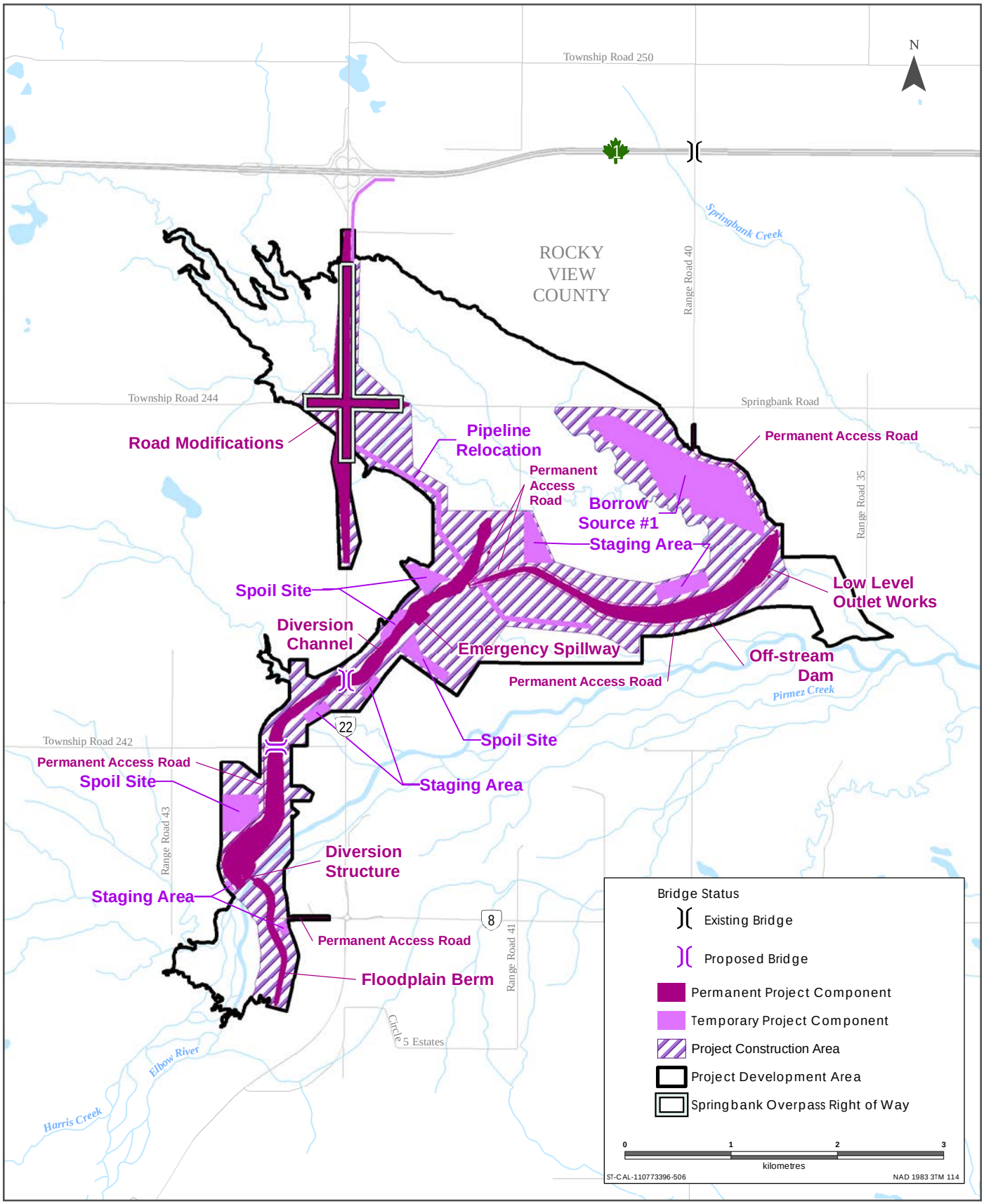
[3] Borrow Source #1 will be opened to provide fill for the dam only if material in addition to that removed from the diversion channel is required. It will be developed and reclaimed in compliance with the requirements of Alberta Transportation 2013b and GoA 2004.

[4] Construction footprint: encompasses areas in the PDA that might be required for currently undetermined uses, no locations or extents of these potential sites have been established. Its extent has not been included in the total.

[5] Includes diversion structure and emergency spillway

[6] Includes outlet structure

[7] PDA excludes the construction footprint, see footnote 4.



Sources: Base Data - ESRI, Natural Earth, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Project Features and Construction Footprint

Stantec

4.5 SOIL STOCKPILES

Salvaged topsoil and subsoil will be retained in stockpiles in a manner that limits the potential for losses in soil quality and soil quantity during the construction phase so the material will be readily available for replacement. Salvaged soil will be stored at the salvage sites shown in Figure 2-2. The following describes the management of the stockpiles:

- topsoil and subsoil can be temporarily stockpiled in windrows then transported to the designated topsoil and subsoil stockpile locations
- will be placed on stable foundations
- will be easily accessible for use during temporary/interim or final site reconstruction
- will be situated so they are not likely to require disturbance or relocation until replacement commences (to reduce possible losses as a result of re-handling of the material)
- soil will be stockpiled on like material (the topsoil will be salvaged in the area of the subsoil stockpile prior to subsoil placement)
- where possible, stockpiles will be placed so that they do not block natural drainage patterns
- will have a preferential maximum height of 5 m
- will have maximum 3 (horizontal):1 (vertical) side slopes
- segregation of material types, i.e. physical separation (1 m minimum) will be retained to limit potential admixing of topsoil and subsoil
- will be managed for weed occurrences (see Section 3.1.3)
- will be identified by signage and soil stockpile information will be included on as-built diagrams for reference

Final stockpile locations, orientation and dimensions will be determined during construction planning or construction, based on site conditions, scheduling and other pertinent factors by Alberta Transportation's Contractor and Environmental Inspector.

4.6 EROSION MITIGATION

After the vegetation cover has been removed, exposed soil is subject to potential erosion by the action of wind or water. To prevent or reduce the extent of loss by these environmental factors, the following mitigation will be used (other mitigation will be defined upon finalization of detailed construction plans)

- spray affected areas with water to stabilize the surface (for erosion by wind, an emergency measure that will be short-lived)
- spray affected areas with a tackifying agent (typically biologically based glues capable of stabilizing a surface for the medium term, i.e. up to a year)
- spray affected areas with hydromulch (tackifier with added organic fibre, also medium term)
- apply erosion control matting to affected areas (relatively expensive, labour intensive and best-suited to small areas, medium-term)
- spread non-merchantable timber/slash, if available, over the affected areas to protect from further erosive effects (long-lasting and effective, if available)
- seed with a fast growing, non-persistent cover crop such as Dahurian wild rye (*Elymus dahuricus)* to provide a stabilizing root mat and surface cover

Most of these procedures are applicable to either areas that have been stripped for construction or soil stockpiles.

5.0 SOIL REPLACEMENT AND REVEGETATION

Revegetation of areas disturbed is guided by the proposed end land use or uses for the site. This includes temporary disturbances, such as contractor laydown areas, and permanent infrastructure, the principal component being the reservoir.

5.1 PROPOSED END LAND USES

The preferred end land use for the PDA is an Integrated Management Area that would consist of four land use zones as shown on Figure 5-1.

5.1.1 Conservation Zone

Area A is located on the north side of the Elbow River and to the south of the reservoir. This part would be reclaimed as a naturalized area, which might support low intensity recreation (non-consumptive forms). There are no plans to establish formal access trails or facilities in this area.

5.1.2 Primary Reservoir Basin

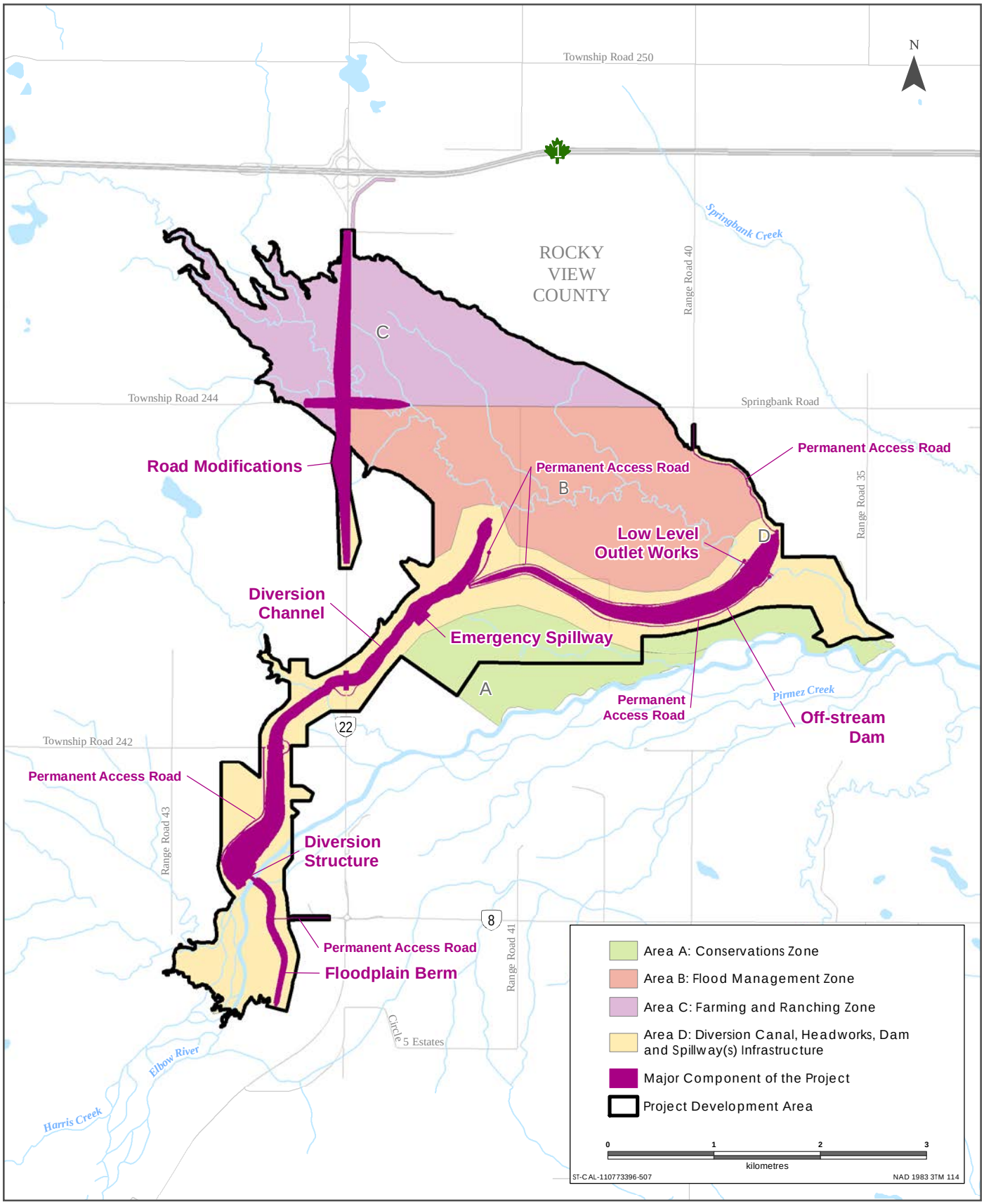
Area B is the reservoir that will be owned and operated by AEP for flood attenuation. This area is tentatively designated for research on scientific research into the effects of flooding on the landscape, ecological resiliency and post-flood management options. Limited public access will be permitted during dry operations between post-flood events, but no recreational facilities will be put in place (e.g., no parking lots, trails, restrooms).

5.1.3 Option for Lease/Grazing

Area C is generally north of the Springbank Road and west of Highway 22 and would be inundated at the design flood. These lands will remain under private ownership and management. Current land uses, which are mainly agricultural, can continue.

5.1.4 Dam and Reservoir Infrastructure

Area D includes the off-stream reservoir, low-level outlet works, diversion channel, and the floodplain berm. These are the functional components of the Project, located on lands owned by AEP that will be fenced to deter public access for safety and operational reasons.



Sources: Base Data - ESRI, Natural Earth, Government of Alberta, Government of Canada
Thematic Data - ERBC, Government of Alberta, Stantec Ltd

Proposed End Land Uses for the Project Development Area

5.2 COVERSOIL REPLACEMENT

Replacement coversoil prescriptions for the various landscape features are based on the following factors:

- temporary and permanent project infrastructure features
- salvage material volumes
- the end land uses as described above

Undisturbed soil profiles consist of topsoil that overlies subsoil and unaltered parent materials; however, this is not the case with soil that has been salvaged and is replaced in the landscape. The replaced materials might be technically the same if what is removed is replaced in two lifts, but they will be functionally different. Soil structure, drainage and other internal profile relationships that have evolved over time in response to external inputs (e.g., weather and climate, vegetation cover) to form the natural soil profile will have been disrupted. For this reason, the replaced topsoil and subsoil (often referred to as upper and lower lift) are more correctly described as replacement coversoil material to differentiate them from undisturbed, naturally occurring soils.

5.2.1 Associated Disturbances

See Section 4.1.1 for a general discussion of mitigation measures for:

- temporary surface disturbances associated with the relocation of buried pipelines along the east side of Highway 22, under the diversion channel and reservoir
- surface disturbances required for the new Highway 22 lanes, Highway 22–Springbank Road intersection, and Highway 22 and Township Road 242 bridges over the diversion channel

Neither of these disturbances is included in the following discussion on coversoil replacement and revegetation because, even though they are related to the Project, they will adhere to the specific construction procedures outlined in the environmental protection plans developed by the contractors selected to undertake the work.

5.2.2 Project Infrastructure

After rough grading of permanent features has been completed, areas where soil replacement and revegetation occur would be de-compacted, as directed by the environmental inspector. Typically, cultivating in two passes at 90 degrees to each other to a depth of 20-25 cm is sufficient to break up any hardpan layer that would impede root penetration and moisture movement.

Topsoil and, where applicable, subsoil that has been salvaged and stockpiled during construction will be replaced on the site, as listed in Table 5-1.

Subsoil and topsoil that was salvaged from a temporary feature (e.g., the construction laydown areas) will be replaced on that same feature; therefore, there will be no change in the material volumes at those sites.

Soil replacement on the permanent features will follow specific design requirements of each feature and the available material volumes.

Where topsoil or subsoil salvage volumes are surplus to the minimum replacement needs, the surplus will be applied to any feature where it might improve the potential for revegetation success. One example is the south-facing slope of the dam where an additional 10 cm has been prescribed to improve the viability of vegetation establishment. South-facing slopes receive more solar insolation than north-facing slopes. This would increase evapotranspiration and causing these locations to be drier. Increasing the depth of the topsoil/upper lift will provide more soil moisture holding capacity to support the vegetation.

After the subsoil (lower coversoil) and topsoil (upper coversoil) replacement operations are finished, the surface will be track-packed to stabilize it before seeding.

Table 5-1 Coversoil Replacement by Project Feature

Feature	Total Material Available, m^3		Area Requiring Soil Replacement, m^2		Replacement Depth, cm		Replacement Volume, m^3		Surplus Material, m^3	
	Topsoil	Subsoil	Topsoil	Subsoil	Topsoil	Subsoil	Topsoil	Subsoil	Topsoil	Subsoil
Permanent Features										
Diversion channel	163,500	163,500	172,000		20	10	34,400	17,200	129,100	146,300
Floodplain berm	7,750	7,750	39,215	39,215	20	10	7,750	3,875	0	3,875
Off-stream dam	106,260	106,260	425,000		25	25	106,250	106,250	0	0
South slope of dam[1]	0	0	205,250	0	10	0	20,525	0	0	0
Total	277,510	277,510	842,465	636,215	N/A		168,925	127,325	108,585	150,185
Temporary Features										
Floodplain berm buffer areas	13,500	13,500	5.4	5.4	25	25	13,500	13,500	0	0
Construction laydown areas	54,250	54,250	21.7	21.7	25	25	54,250	54,250	0	0
Soil stockpile sites[2]	64,500	64,500	25.8	25.8	25	25	64,500	64,500	0	0
Total	135,250	135,250	52.9	52.9	25	25	135,250	135,250	0	0
Borrow Source #1[3]	154,770	154,770	61.8	61.8	25	25	154,770	154,770	0	0

NOTES:

[1] This location is targeted for an extra 10 cm of topsoil (upper coversoil) in addition to the prescribed minimum depth to improve the ability of the soil to support vegetation growth.

[2] Salvage volume assume full topsoil and subsoil stripping will be required; see introduction to section 4.5 for stripping guidelines.

[3] Borrow Source #1 will be opened to provide fill for the dam only if material in addition to that removed from the diversion channel is required. It will be developed and reclaimed in compliance with the requirements of Alberta Transportation 2013b and GoA 2004.

5.3 REVEGETATION

The revegetation program would establish a permanent cover consisting of species mixes that are compatible with the surrounding vegetation communities, to the degree practical, that will grow quickly and stabilize the reclaimed landform surfaces. To best achieve this goal, disturbances will be revegetated with native species.

Species mix selection will start with that prescribed in Design Bulletin No. 25, Grass Seed Mixtures Used on Highway and Bridge Projects (AIT 2005) for Seed Mix Zone 6 – Lower Foothills (see Table 5-2).

Table 5-2 Alberta Infrastructure and Transportation Recommended Native Seed Mix[1]

Common Name	Latin Name	% by Dry Weight
Slender Wheatgrass	*Elymus trachycaulum*	30
Smooth Wildrye	*Elymus glaucus*	20
Northern Wheatgrass	*Agropyron dasystachyum*	10
Tickle Grass	*Agrostis scabra*	10
Fringed Brome[2]	*Bromus ciliatus*	10
Tufted Hairgrass	*Deschampsia cespitosa*	10
Foothills Rough Fescue	*Festuca campestris*	10
NOTES: [1] see also BrettYoung 2017 [2] Fringed Brome shall be coated		

This basic native species reclamation mix can serve as a starting point from which to develop suitable variations and allow diversification of communities in the PDA that are consistent with the end land uses as outlined in Section 5.1. The species composition of representative pre-disturbance and adjacent ecosites at specific locations will be reviewed when formulating additional species mixes. Information on the pre-disturbance ecosite phases and species composition is available in Volume 3a, Section 10 Vegetation and Wetlands.

Consideration might also be given to planting trees and shrubs on some of the reclaimed sites if it will not interfere with the operational requirements of the Project and is consistent with the end land use objectives.

Seeding will be carried out using methods appropriate for the location, as determined by the contractor and environmental inspector:

- drill seeding
- hand seeding
- hydro-mulching

Further discussion of potential seeding techniques can be found in Alberta Transportation (AT n.d.).

Certain areas of riprap, such as the headcut prevention section adjacent to the floodplain berm, are to be planted with willow cuttings/nursery stock to provide a robust, erosion resistant surface cover.

5.4 SHORT AND LONG-TERM MONITORING PLANS

Monitoring during construction will be the responsibility of the contractor and included as part of the Project-specific environmental protection plan. This program could be extended into the first season or two after revegetation, as part of the construction contract.

The objective of monitoring programs is to confirm that the mitigation measures and practices, as implemented, have effectively reestablished all disturbed areas to conditions that will support the end land use objectives: functioning ecosystems that can support a variety of potential applications.

Alberta Environment and Parks will be responsible for instituting short and long-term monitoring programs for the Project lands. The following discussions outline commonly accepted procedures that might be considered.

5.4.1 Short-term Monitoring

Short-term monitoring is typically focused on assessing the rate of establishment of a healthy vegetation cover, and the quick recognition and mitigation of soil erosion. It typically occurs shortly after construction is finished and at pre-determined intervals during the first few growing seasons.

Vegetation and soil erosion monitoring are interdependent because healthy vegetation cover is an essential means of reducing potential soil erosion on reclaimed sites. The following vegetation characteristics might be assessed in areas that have been disturbed and reclaimed or revegetated:

- estimate of percent surface cover (living, non-living)

- seedling vigour
- evidence of disease
- presence and density of non-native and invasive species
- recording of bare areas that require immediate mitigation
- photo monitoring of representative plots

Soil monitoring will focus on compaction, erosion and areas of poor vegetation growth. An initial assessment will be done to determine overall site conditions and note where potential issues might arise. The following soil parameters might be assessed:

- satisfactory soil replacement depth (i.e., topsoil)
- near and subsurface compaction
- electrical conductivity
- sodium adsorption ratio
- pH
- macronutrient status (NPK)
- recording of bare areas, evidence of surface erosion, slumping or other indicators that require additional mitigation measures

5.4.2 Long-term Monitoring

The objective is the establishment and maintenance of self-sustaining native vegetation communities and stable structures and landforms that are consistent with the defined end land objectives for the Project.

Vegetation monitoring should continue at a regular schedule, at least twice annually (late spring and early fall) and after any time that dry operations are reestablished after the post-flood phase.

Deficiencies identified during monitoring inspections will be addressed by applying supplementary mitigation measures, such as:

- additional or infill planting where survival is low
- planting alternate species more suited to site conditions as they evolve
- detailed soil analysis to assess factors that might be adversely affecting vegetation establishment

- the addition of fertilizer or organic amendments, if appropriate
- implementing targeted erosion mitigation measures, if required, such as installing erosion-control matting on areas where surface stabilization and vegetation establishment prove challenging

5.5 UNCERTAINTIES

There are a variety of factors that might influence the effectiveness of the proposed reconstruction and revegetation programs. A brief discussion of two of the more critical ones follows.

5.5.1 Climate Change

Climate change presents challenges when attempting to assess its potential effects on the end land use objectives for the Project. These challenges relate to uncertainties about the degree of and timeframe, although it is generally expected to be a gradual versus abrupt occurrence, over which climate change trends could occur. Key considerations include:

- direct effects include the influences of change over time in climate parameters such as temperature and precipitation regimes
- indirect effects include other influences that could be affected by climate change, such as changes in soil moisture, ground water or stream flow availability
- success of revegetation activities depends on prevailing weather conditions at the time of and following coversoil placement and seeding

General trends applicable at the regional scale are identified in IPCC (2007) and include:

- warming is projected to be greatest over land and at northern latitudes
- poleward shift of extra-tropical storm tracks with consequent changes in wind, precipitation and temperature patterns
- expected increase in precipitation at higher latitudes

Recent climate change research relevant to Alberta (Barrow and Yu 2005, 2006; Lemmen and Warran 2004; Khandekar 2002) outlines a range of potential climate change effects that include:

- air temperatures will be warmer on average, and peak temperatures might be higher than historical averages
- warmer temperatures might lead to increased evaporation, decreased soil moisture and potential lowering of the water table

- degree days are projected to increase, which implies a longer growing season or an increase in available heat for plant growth during the growing season
- precipitation is expected to increase annually but decrease during the summer months

Should these trends occur to some degree, it is likely that a general decrease in plant-available moisture would result, thereby imposing further limitations on land capabilities. Combined with higher temperatures, this effect could produce conditions that result in:

- a level of change that may be within the range of environmental tolerances for some species thereby having minimal effects on them
- a level of change that exceeds the tolerance range of some species thereby causing a shift in the composition of vegetation communities from the present mixed naturally occurring and agronomic species.

Short and long-term monitoring which feeds into an adaptive management program might require reassessment of the suggested planting prescriptions. Native species mixes might have to be adjusted accordingly.

5.5.2 Wildfires

A direct response to warmer, drier weather and climatic conditions as discussed above is an expected increase in the frequency of wildfires.

Fire has the effect of resetting vegetation and forest communities to early successional stages or favouring species that are fire tolerant or better adapted to withstand effects of fire. Because the greater part of the disturbed and reclaimed areas in the PDA will initially have grass-shrub cover, the effects of fire will have less of an effect on succession than if the area was heavily forested.

The principal effects of wildfire are related to reduced infiltration of precipitation and the resultant potential for increases surface flow and erosion where the vegetation cover has been burnt off. Prairie grass land communities are adapted to wildfire and recover rapidly once they are well developed because the root mat tends to survive even though the top growth has been removed.

The potential increase in erosion following a fire would be expected to be of greatest concern in the early years after restoration while the vegetation cover is becoming established and the soil surface might not have become well stabilized by the root networks, accumulated surface organic matter cover (i.e., dead plant material) and plants themselves.

6.0 POST-OPERATIONS MAINTAINENCE AND MITIGATION

6.1 DRY OPERATIONS

During dry operations, the diversion inlet gates will be closed and the service spillway gates will be open. The gate system and its operation will be checked according to a routine maintenance schedule. The maintenance schedule will also include inspections of the floodplain berm, diversion channel and associated structures with repairs being completed as necessary (e.g., structural, soil replacement, revegetation). Data from the inspections will feed into the adaptive management system and allow both immediate and longer term resolution of any issues.

Erosion control measures installed to protect the walls and floor of the channel will be inspected on a regular schedule for evidence of erosion or other damage and repaired as necessary. The associated access roads, emergency spillway and diversion outlet will be inspected at the same time and maintained as necessary. The dam embankment, its access roads and low level outlet works also will also be inspected for damage as part of the regular maintenance program.

During non-flood periods, surface runoff from rain storms and snow melt snow, as well as streamflow from watercourses intersected by the diversion channel, will flow into the channel and into the reservoir. The low-level outlet will remain open to carry the flow of the existing tributary over which the dam was built. Water draining from the diversion channel and the drainage ditches at the base of the dam will also flow through the outlet structure. Additional discussion of dry operations is available in Section 3.4 (Volume 1, Project Description).

6.2 POST-FLOOD OPERATIONS

The Project is designed to function when flows in the Elbow River exceed 160 m^3/s. This will trigger the diversion inlet gates to be opened and flood water to flow through the diversion channel into the off-stream reservoir. The water will be retained until the operational management procedures indicate it is safe to begin draining the reservoir through the low-level outlet works back into the Elbow River. The depth of water and length of time it is retained in the reservoir will be a function of the severity of the flooding and integration of project operations with the overall Elbow River watershed flood management system.

Until a flood occurs, it is not possible to provide a definitive post-operation mitigation plan. However, a general outline of anticipated events is presented here:

- Most of the coarse material that is entrained in the diverted flow (cobbles, gravel, coarse sands) will likely be deposited in the diversion channel as the flow velocity decreases.

- The fine fractions (sand/silt/clay) are likely to stay in suspension longer, settle out and be deposited in the reservoir.
- The depth of the deposited sediments will be a function of the overall composition of the sediment load and length of time the water is held in the reservoir.
- The effects from sediment deposition would be expected occur mainly in the lower levels of the reservoir, which will remain inundated for longer periods of time and where the opportunity for entrained material to settle out is greater.
- The reservoir has been designed so that it can function as required with up to 10% of its capacity lost (i.e. filled with sediment). It is, therefore, not necessary to remove post-flood deposits that do not reach this level, unless their presence might adversely affect other components of the Project.
- After a flood, the reservoir would be inspected for the deposited materials (physical properties, depth, extent, locations) and, other than removing the debris as necessary to maintain stream flow, no additional mitigation measures should be necessary.
- Mitigation measures that could be implemented will depend on the results of the inspections, and might include:
  - do nothing and monitor to see if certain areas require seeding
  - stabilize and repair areas where soil has been eroded, replace lost topsoil and seed
  - if sediments do accumulate to more than a pre-determined depth, wait until the ground dries out and monitor to see if the vegetation recovers naturally
  - if the surface develops a crust that is impeding vegetation regrowth, harrow to break up the crust, monitor regrowth and seed as necessary

These alternatives are consistent with proposed end land use plan for Area B, which is tentatively designated for research on scientific research into the effects of flooding on the landscape, ecological resiliency and post-flood management options.

Frequent monitoring would be required to make sure that suitable mitigation measures can be applied for the conditions, the vegetation becomes re-established and disturbed areas are rapidly stabilized.

Post-flood operations are described in greater detail in Section 3.6 (Volume 1, Project Description).

7.0 SUMMARY

In addition to the measures described in this plan, pre-construction planning and construction activities will follow all applicable provincial Codes of Practice, terms and conditions attached to the Project-specific *Environmental Protection and Enhancement Act* (EPEA) approval and the appropriate industry best management practices for construction projects of this type.

Attention to the careful salvage, stockpiling and replacement of coversoil material should provide conditions for successful site recovery and achieving the broad end land use objectives.

Mitigation is limited to the immediate post-construction timeframe (initial re-establishment of vegetation cover, landform stabilize, erosion limitation) and subsequent post-flood maintenance (monitoring and repairs as required).

Regular site inspections will allow the evaluation of site recovery and provide data for comparison with the end land use objectives. The results may indicate the need for additional actions or realignment of the goals.

8.0 REFERENCES

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