REPORT

Wetland Assessment and Impact Report - 2022 Update

Premier Tech Horticulture Clearwater Peat Harvest Project

Submitted to:

Alberta Environment and Parks
Red Deer - North Saskatchewan
Rocky Mountain House District
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Distribution List

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Premier Tech Horticulture (Premier Tech) to provide support for Premier Tech's *Water Act* Application for the Clearwater peat harvest Project (Clearwater Project; the Project). Golder was commissioned to respond to Supplemental Information Requests (SIRs) received from Alberta Environment and Parks (AEP) on May 28, 2019 and September 15, 2021. This document supersedes the existing *Water Act* Application prepared in 2017 for the Project (Golder 2017).

The Project is located within the Clearwater River watershed, about 10 km northeast of the Town of Caroline. Premier Tech's Surface Material Lease (SML090026) is located in portions of Sections 1, 2 and 3 of Township 37, Range 7, West of the 5th Meridian (Figure 1). The Local Study Area (LSA) includes the Project footprint and 100 m buffer, covers 286.8 hectares (ha), and is located within a peatland, 153.4 ha of which are proposed to be harvested or disturbed (Figure 1). The total area associated with the Project footprint including upland and wetland areas is 155.5 ha. Of the total 153.4 ha of wetland area to be impacted by the Project, the total area of harvestable peat between the five harvest sections is estimated to be 135.9 ha.

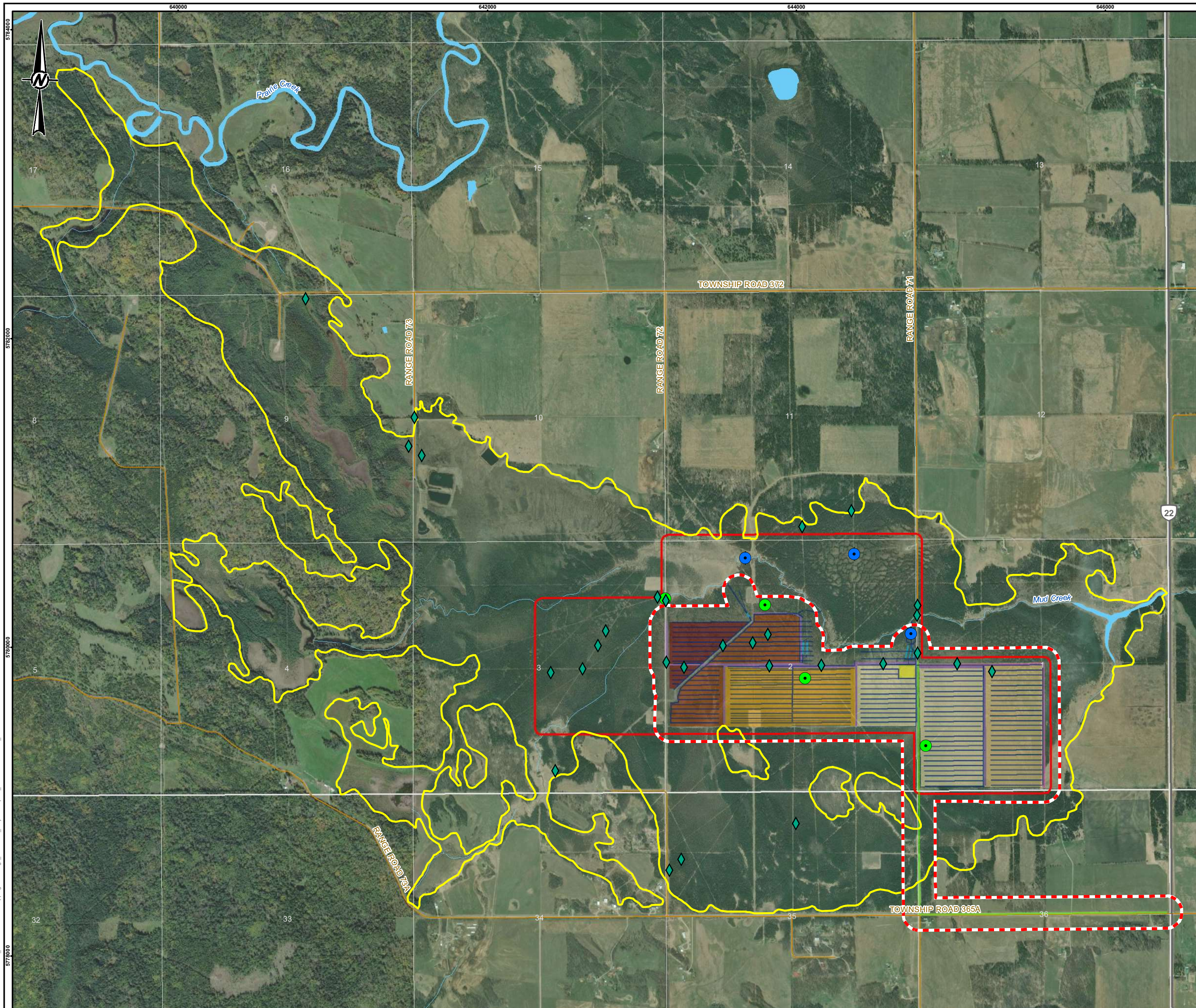
The original Development Plan and surface material lease (SML) application (Premier Tech 2010) for the Project included six harvest sections between Sections 1, 2, and 3-37-7-W5M. The Project footprint has since been updated to be developed in two phases: Phase 1 Development will include Sections 1 and 2-37-7-W5M, and Phase 2 Development will include Section 3-37-7-W5M. This application will focus on Phase 1 of the Project; Phase 2 will be submitted as an amendment or new application following regulatory consultation with AEP.

Under the Alberta *Water Act* (Government of Alberta [GOA] 2000), an Approval is required for any activity that may directly impact a natural water body. Furthermore, the Alberta Wetland Policy (GOA 2013) was implemented in the White Area (i.e., Settled Area) of the province on June 1, 2015, and anyone proposing wetland impacts in the White Area is required to submit applications or notifications using all applicable Wetland Policy directives, guides and assessment tools (GOA 2015a,b,c, 2016, 2017a, 2018a).

The wetland mitigation hierarchy that all *Water Act* Approval applicants are expected to follow from the most preferred to least preferred option is as follows (GOA 2013, 2018a):

- avoid impacts or loss of the wetland
- minimize wetland impacts and provide applicable compensation
- compensate for unavoidable wetland impacts or loss

This report was prepared in support of the Alberta *Water Act* (GOA 2000), the Alberta Wetland Policy (GOA 2013), and the Alberta Wetland Assessment and Impact Report Directive (GOA 2017a).



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 2017 DETAILED WETLAND SURVEY POINT
- 2017 WETLAND CLASSIFICATION POINT
- 2020 DETAILED VEGETATION SURVEY POINT
- PROJECT LEASE BOUNDARY
- TERRESTRIAL LOCAL STUDY AREA - PROJECT FOOTPRINT + 100 M BUFFER
- CURRENT WETLAND BOUNDARY

PROJECT FOOTPRINT COMPONENTS

- ACCESS ROAD
- MAIN ACCESS ROAD
- MAINTENANCE
- DRAINAGE DITCH
- SEDIMENT POND
- YARD SITE

HARVEST SECTIONS (PHASE 1)

- YEAR 1
- YEAR 2
- YEAR 3
- YEAR 4
- YEAR 5

0 500 1,000

1:25,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
WETLAND DELINEATION AND PROPOSED PROJECT FOOTPRINT

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	KS
PREPARED	LMS
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
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2.0 ASSESSMENT METHODS

Golder completed a desktop and field assessment of the wetland within the LSA following directives and guidelines outlined under the Alberta Wetland Policy (GOA 2013, 2015a,b,c, 2016, 2017a, 2018a). Pathway 5 in the Alberta Wetland Identification and Delineation Directive was chosen to identify and delineate the wetland because the wetland boundaries are complex and sometimes indistinct in historical and current aerial photographs, and the wetland area within the LSA has been disturbed by construction of roads and well pads (GOA 2015a).

2.1 Desktop Review

2.1.1 Desktop Searches

A desktop assessment of the natural and anthropogenic landscape features in the local watershed for the wetland was completed prior to performing the field survey. A desktop review for special designations or environmental sensitivities within the LSA was completed using the following resources:

- The Historical Resource Value for the LSA (Alberta Culture and Tourism 2017) was assessed to determine whether historical resources were present or if there is a high potential for their presence, including archaeological, paleontological, historical, natural and cultural resources.
- Alberta Energy Regulator's (AER) Authorization Viewer (AER 2017) was searched for existing and historical *Environmental Protection and Enhancement Act* (EPEA) approvals and *Water Act* Licences and Approvals associated with the LSA and adjacent wetlands.
- The Disposition Spatial Processing Tool (DSPT) (GOA 2017b) was queried for any other industrial surface activities within the LSA.
- The Alberta Conservation Information Management System (ACIMS) on-line database (Alberta Environment and Parks [AEP] 2017a) was searched for historical occurrences of listed provincial plant species or sensitive ecological communities.
- The Fish and Wildlife Management Information System (FWMIS) (AEP 2017b) was queried for historical occurrences of listed fish and wildlife species.
- Fisheries and wildlife sensitivity mapping layers (AEP 2017b) were referenced to determine if any layers (e.g., key wildlife and biodiversity zones, special access zones, locations of sensitive wildlife and/or vegetation features) intersect the LSA[1].

2.1.2 Desktop Delineation

A comprehensive desktop interpretation of historical and recent aerial photographs was completed in conjunction with a review of topographic maps to assess drainage patterns, watersheds, and catchment areas.

2.1.3 Historical Aerial Photograph Review

A review of historical aerial photographs of the LSA was completed by obtaining aerial photographs for selected years from AEP's Aerial Photographic Record System (AEP 2016a). Aerial photographs from 1950 to present

[1] Fisheries and wildlife sensitivity mapping layers were reviewed in place of a Landscape Analysis Tool (LAT) report which can only be requested for surface activity applications to the Crown through the Enhanced Approval Process.

(i.e., 2019) were reviewed and successive photos were acquired based on clarity and to show changes over approximately 10 year intervals, as available. Historical climatic data obtained from the AgroClimatic Information Service (Alberta Agriculture and Forestry 2017) was also used to help select the best available years for the historical aerial photograph review. Seven photos (from 1952, 1962, 1976, 1982, 1986, 1993 and 2001) were selected for review. Historical photographs and associated historical wetland boundary delineations are included in Appendix A.

2.2 Wetland Field Survey

Sheelah Griffith and Andrea Ortega, Golder Professional Biologists with the Alberta Society of Professional Biologists, surveyed the LSA on June 9 and 10, 2017, to assess, classify and delineate the wetland. It was not feasible to delineate the full extent of the wetland because it is large (i.e., covering parts of at least 16 quarter sections) and land access was not granted west of the assessment area (Figure 1). Classification of the wetland was based on the Alberta Wetland Classification System (AWCS) (GOA 2015c) (Appendix B). Wetland soils were characterized during the survey, and conductivity and pH were documented where possible (i.e., where standing water was present at the time of the survey). Plants were identified to species, if possible, and distinct vegetation zones were noted by the presence of dominant plant species or communities. Weed, listed plant and wildlife species observations were also recorded if encountered. Detailed notes were taken on the topography, surficial connectivity and surrounding land use. Additional surveys were completed on May 28, 2020 to collect additional data, using similar protocols (Golder 2022a).

Photographs were taken during the field survey, and are provided in Appendix C. A track file was recorded using a Global Positioning System (GPS) to refine the wetland boundary created remotely prior to the field survey, and a Geographical Information System (GIS) was used to generate wetland area summaries.

2.3 Wetland Post-Field Desktop Assessment

Following the field survey, the wetland was delineated based on current and historical imagery, field verification notes, and topographic maps. It was not feasible to delineate the full extent of the wetland due to its large size and lack of permission to access land beyond the LSA.

The wetland catchment area was delineated based on a GIS analysis of available 1:20,000 Digital Elevation Model (DEM) data (AltaLIS 2016) and available watercourse data (AltaLIS 2014). The resulting catchment area does not consider anthropogenic alterations to natural drainage patterns, which may prevent or increase runoff to the wetland. The delineated area may be considered a conservative estimate of the wetland catchment area.

2.3.1 Wetland Relative Value Assessment

Although the LSA falls within the White Area of the province, the Alberta Wetland Rapid Evaluation Tool – Actual (ABWRET-A) for the Boreal and Foothills Natural Regions (GOA 2016a) was completed because the LSA wetland is a peatland (Wilson, pers. comm. 2017). The ABWRET-A form was completed based on the desktop analysis and field survey, and was submitted to AEP for computation of the relative value of the wetland. Wetland classification was based on information from both desktop and field-based studies, including vegetation species present, topographical position, soil conditions and comparison of historical aerial photographs (Appendix A).

3.0 ASSESSMENT RESULTS

3.1 Desktop Review

3.1.1 Desktop Searches

The LSA is located in the Clearwater sub-watershed of the Headwaters Region of the North Saskatchewan Watershed (North Saskatchewan Watershed Alliance 2012). The North Saskatchewan Watershed is a component of the North Saskatchewan River Basin, which covers about 80,000 km^2 of the province and includes the Brazeau, Nordegg, Ram, Clearwater, Sturgeon and Vermilion Rivers (AEP 2014). The North Saskatchewan River Basin has a mean annual discharge from Alberta into Saskatchewan of over seven billion cubic metres (AEP 2014).

The LSA is located in the Lower Foothills Natural Subregion of the Foothills Natural Region of Alberta, where the landscape is undulating to strongly rolling (Natural Regions Committee 2006). The LSA is located within a depression with upland areas to the north, east and south. The wetland has two outlets, Mud Creek and Prairie Creek.

The LSA is not included in the *Listing of Historic Resources* under the Alberta *Historical Resources Act* (Alberta Culture and Tourism 2017), and has low potential for the presence of archaeological, paleontological, historical, natural or cultural resources. Four existing *Water Act* authorizations were identified with the AER Authorization Viewer (Table 1); no EPEA approvals were listed (AER 2017). Seventeen dispositions, including Premier Tech's Surface Material Lease (SML090026), were identified within the LSA using the Disposition Spatial Processing Tool (Table 2) (GOA 2017b).

Table 1: Existing Water Act Authorizations

Legal Land Location	Document Number	Type	Owner	Issue Date	Expiry Date
1-37-7-W5M	00137373-00-00 ROCKY MOUNTAIN HOUSE/REGISTRATION/DANIEL & CHARLES ARCHIBALD – F00137373	Registration	D. and C. Archibald	April 29, 2003	Does not expire
1-37-7-W5M	00185437-00-00 ROCKY/STOCK/MCNUTT BRAD – F00185437	Licence	B. McNutt	September 29, 2009	September 28, 2034
1-37-7-W5M	00259246-00-00 CROWN LAND/REGISTRATION/ASRD/GRL 40235	Registration	Public Land Management	May 29, 2009	Does not expire
3-37-7-W5M	00259206-00-00 CROWN LAND/REGISTRATION/ASRD/GRL 38956	Registration	Public Land Management	May 29, 2009	Does not expire

Table 2: Existing Dispositions within Sections 1, 2 and 3 of 37-7-W5M

Disposition Type	Disposition Number	Area (ha)	Purpose Code	Company/Individual
Consultative Notation	CNT090060	187,254.6	Buffer	Department of Sustainable Resource Development, Rocky Mountain House Office - Forestry
	CNT950022	0	Surface Mineral Exploration	Department of Sustainable Resource Development, Edmonton Office - Operations Division
	CNT960225	42,979.4	Multiple Resource Concerns	Department of Sustainable Resource Development, Rocky East Office - Rangeland District Lands Division
Grazing Lease	GRL39488	191.8	-	C.E. Archibald
	GRL38956	64.8	-	J.N. Radau
License of Occupation	LOC941288	2.5	Access Road	Pengrowth Energy Corporation
Mineral Surface Lease	MSL941483	1.4	Well Site	Pengrowth Energy Corporation
	MSL941855	1.4	Well Site	Pengrowth Energy Corporation
	MSL001993	1.2	Well Site	ConocoPhillips Canada Operations ULC
Pipeline Agreement	PLA950554	1.9	Pipeline	Pengrowth Energy Corporation
	PLA013920	2.5	Pipeline	ConocoPhillips Canada Operations ULC
	PLA013920	2.5	Pipeline	ConocoPhillips Canada Operations ULC
	PLA941008	2.1	Pipeline	Pengrowth Energy Corporation
Protective Notation	PNT742685	376.4	Ungulate Habitat Protection Area	Department of Sustainable Resource Development, Rocky Mountain House Office - Fish and Wildlife
	PNT753813	194.2	Organic/Poorly Drained Soils	Department of Sustainable Resource Development, Rocky East Office - Rangeland District Lands Division
	PNT790758	322.9	Organic/Poorly Drained Soils	Department of Sustainable Resource Development, Rocky East Office - Rangeland District Lands Division
Surface Material Lease	SML090026	319.6	Peat	Premier Horticulture Ltd.

An ACIMS database search was completed initially on May 12, 2017 and a follow up search was completed on May 15, 2020 (ACIMS 2017) to help determine the potential for listed plant species at the LSA. The query boundaries were defined as sections 1, 2 and 3 of 37-7-W5M. Both ACIMS queries returned one non-sensitive element occurrence, pepper spore lichen (*Rinodina metaboliza*). Pepper spore lichen mainly occurs on living trees, including black spruce (*Picea mariana*) and larch (*Larix laricina*) (Sheard 2010), both of which occur in fens. The results of the ACIMS search do not preclude the potential for other listed plant species to be present at the LSA.

A search of the FWMIS database was completed initially on June 26, 2017 (AEP 2017b) and a follow up search was completed in June 2020 (AEP 2020a) to identify recorded historical occurrences of wildlife species within the LSA. No listed species were found within 5 km of the centre of 2-37-7-W5M; however, Key Wildlife Biodiversity areas were identified along riparian corridors south (approximately 2 km away) and east (approximately 3 km away) of the LSA, and a Grizzly Bear Zone was identified approximately 3 km west of the LSA. Secondary grizzly bear range intersects with the western portion of the wildlife regional study area defined by Golder (2020a) (AEP 2020b). The LSA does not appear to be located in high quality/effective grizzly bear habitat (Golder 2022a). It is important to note that the absence of listed species observations within the LSA does not indicate listed species are not present in this area, but may be an indication that very few inventories have been completed.

Confirmation of the Surface Material Lease (SML) for the LSA is included in Appendix D.

3.1.2 Desktop Delineation

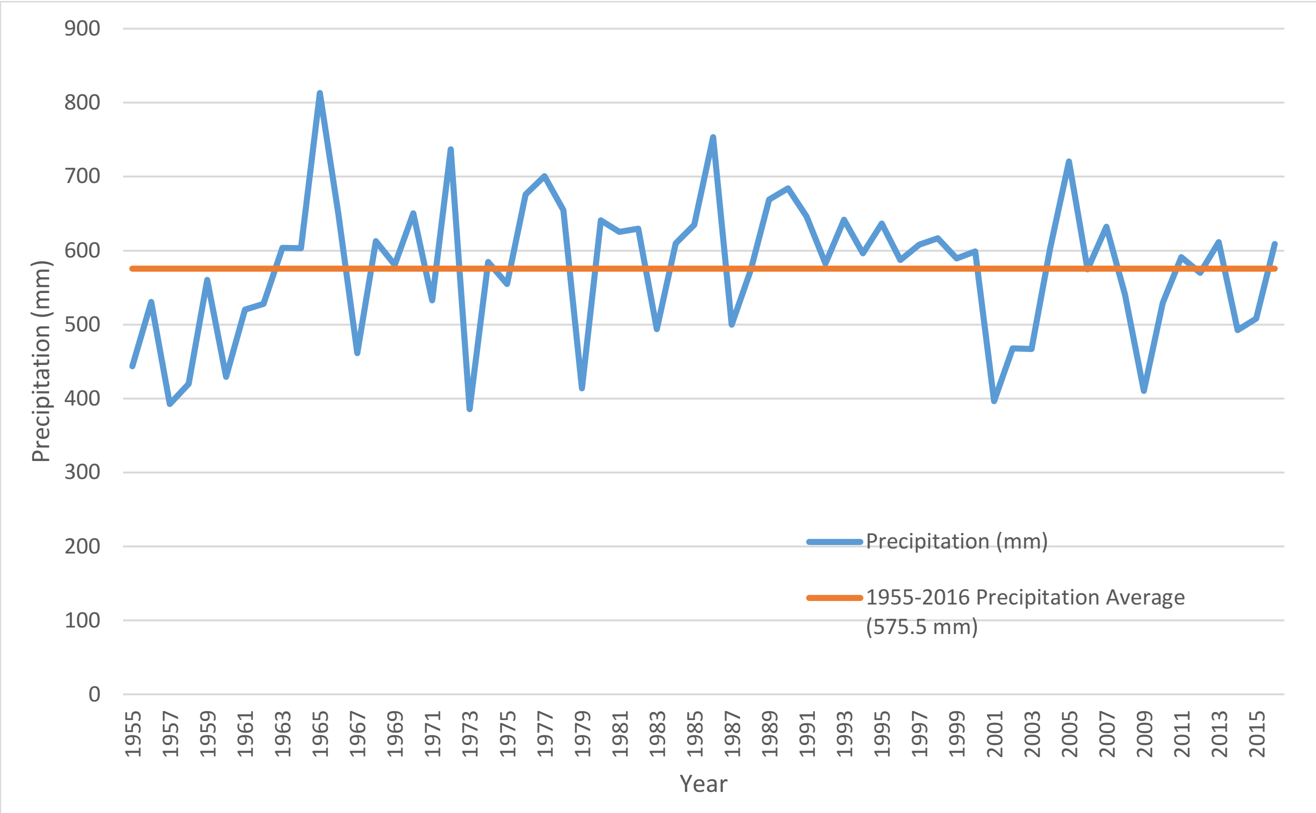
3.1.2.1 Historical Aerial Photograph Review

Seven historical aerial photographs from 1952, 1962, 1976, 1982, 1986, 1993 and 2001 were reviewed to assess changes to the wetland on the LSA over time (Appendix A). The historical aerial photographs, dating back to 1952, indicate that a wetland has been present on the LSA for over 65 years. The wetland, W01, is classified as a wooded fen (F-Wc), and it is hydrologically linked to a larger wetland complex that includes a permanent watercourse (Mud Creek), which drains into the Clearwater River to the east (Figure 1). Historical wetland delineations were restricted to a 500 m buffer around the LSA due to the large size of the wetland complex and limitations in coverage for some years of historical aerial photographs.

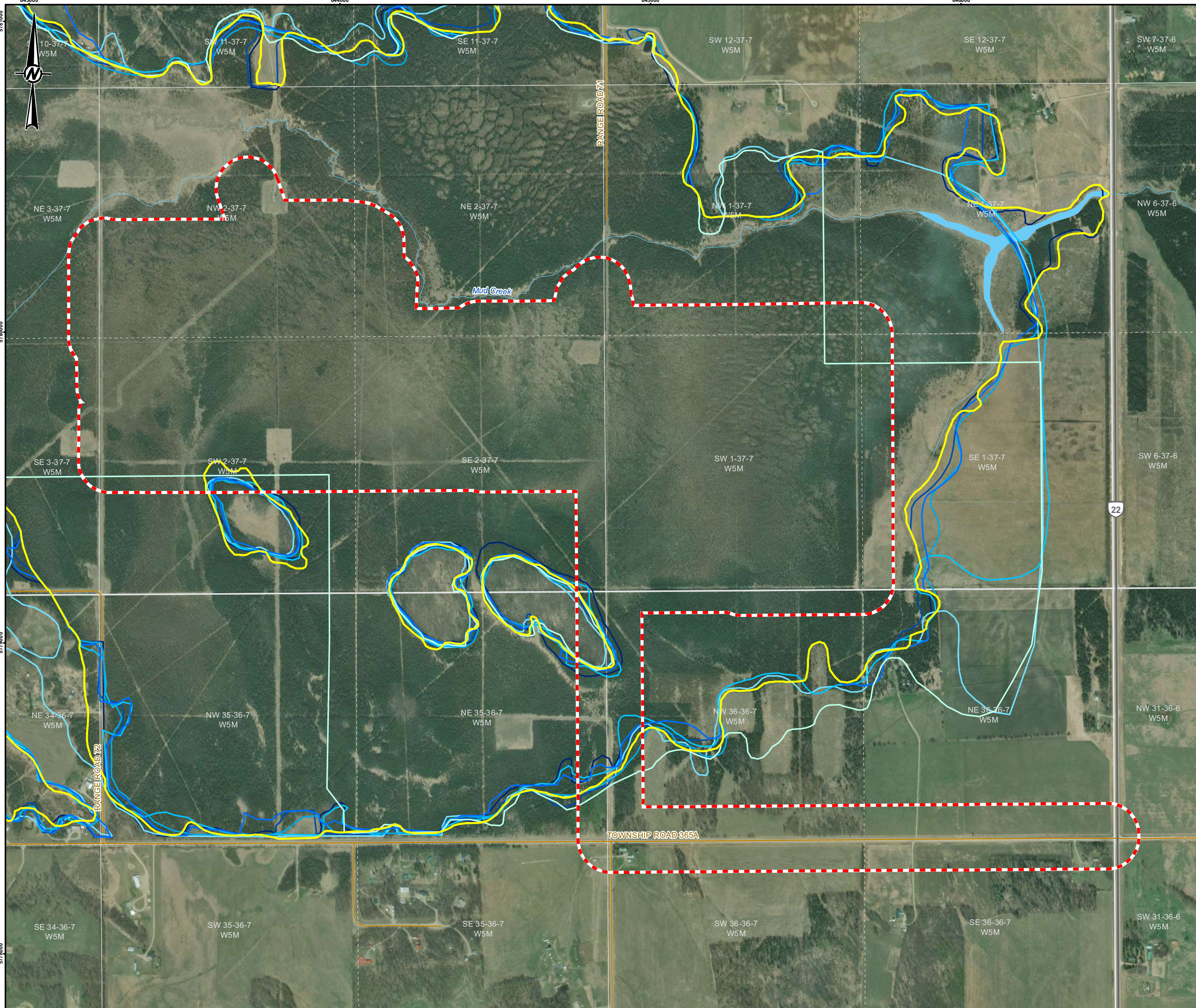
Wetland W01 is well defined in all the historical images. Patterning in the vegetation in the northeast and northwest corners of the fen is prominent in many of the images, and Mud Creek is visible traversing the wetland from west to east. Prior to 1976, vegetation clearing was limited to upland areas outside the wetland boundary. Between 1962 and 1976, vegetation was cleared for agriculture in the southeast corner of the wetland, and wetland area was lost. During the same time period, cut-lines were established across the wetland in at least five locations. Between 1976 and 2001, cut-lines became more frequent and prominent within the wetland. The first vegetation clearing for a well pad was noted in 1993, and by 2001, eight well pad clearings were visible within the wetland boundary. The wetland appears to be a shrubby fen in the first three photos (i.e., 1952, 1962, 1976), and a wooded, coniferous fen in subsequent photos. The change in wetland classification is related to vegetation re-establishment following a fire that burned parts of the wetland in 1941. A detailed description of the wetland features visible in each photograph is presented in Table 3.

Climate analysis of local precipitation data for years corresponding with historical aerial photographs shows that below-average precipitation occurred in 1962 and 2001 (with 527.8 and 396.4 mm of precipitation, respectively, compared with a long-term average precipitation of 575.5 mm [Figure 2]), and above-average precipitation occurred in 1976, 1982, 1986 and 1993 (with 676.1, 629.6, 753.2 and 642.0 mm, respectively) (Alberta Agriculture and Forestry 2017). The boundary of wetland W01 did not change much between 1952 and 2017 (Figure 3), and the boundary appears not to be strongly correlated with precipitation patterns and time of year, as the fen is permanently saturated.

Figure 2: Mean and Annual Precipitation between 1955 and 2016 for 37-7-W5M



Source: Alberta Agriculture and Forestry 2017.



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 1952 WETLAND BOUNDARY
- 1962 WETLAND BOUNDARY
- 1976 WETLAND BOUNDARY
- 1982 WETLAND BOUNDARY
- 1986 WETLAND BOUNDARY
- 1993 WETLAND BOUNDARY
- 2001 WETLAND BOUNDARY
- CURRENT WETLAND BOUNDARY
- TERRESTRIAL LOCAL STUDY AREA - PROJECT FOOTPRINT + 100 M BUFFER

0 250 500

1:12,500 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
WETLAND DELINEATION FROM 1952 TO PRESENT

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	KS
PREPARED	LMS
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	3

Table 3: Documentation of Imagery Sources used to Identify and Delineate Wetland Boundaries

Wetland ID	Photo Date [dd-mmm-yy]	Photo ID [Roll AS#-Photo#]	Resolution	Season[(a)]	AWCS Wetland Class[(b)]	Precipitation				Open Water Visible or Consistent Wetland Vegetation Signature[(d)]	Assessment of Permanence[(e)]	Wetland Area within the Local Study Area [ha]	Photo Notes
						Year[(c)]	Month[(c)]	Day [mm]	Precipitation in 2 weeks prior [mm]				
W01	15-Sep-52	AS0532-41, 130	1:15,840	Sum	F-S	-	-	-	-	DV	n/a	253.9[(f)]	Precipitation data are not available for 1952, and 1952 photo coverage is restricted. The wetland is well defined, and appears undisturbed within the wetland boundary, although some vegetation clearing is evident in the upland area north of the wetland. Patterning is prominent in the northeast and northwest corners of the fen, and Mud Creek is well-defined traversing the wetland from west to east. The fen appears to have higher cover of shrubs than trees in 1952, likely because the area was burned in 1941 and trees are regenerating; therefore, the wetland is classified as a shrubby fen in 1952.
	09-Jul-62	AS0826-134	1:31,680	Sum	F-S	D	D	8.5	49.2	DV	n/a	261.0	Precipitation data indicate that while 1962 was a dry year and July of 1962 was a dry month, 49.2 mm of precipitation fell in the two weeks prior to the photograph. The wetland is well defined. Disturbance within the wetland is not visible, but vegetation clearing occurred between 1952 and 1962, and is apparent northeast and southeast of the wetland boundary. Patterning is visible in the northeast and northwest corners of the fen, and Mud Creek is visible traversing the wetland from west to east. The wetland appears to be a shrubby fen in the 1962 photo.
	16-Sep-76; 17-Sep-76	AS1533-130, 157	1:31,680	Sum	F-S	W	W	0	27.6	DV	n/a	258.8	Precipitation data indicate that 1976 was wetter than average, and the wetland, particularly the northern boundary, is well defined. Vegetation clearing for agriculture in the southeast corner of the wetland has resulted in a loss of wetland area compared to 1962. Cut-lines are also visible traversing the fen in at least five locations. Patterning is prominent in the northeast and northwest corners of the fen, while Mud Creek is less visible than in previous photos. The wetland appears to be a shrubby fen in the 1976 photo.
	17-Sep-82	AS2583-153	1:30,000	Sum	F-Wc	W	D	0	25.2	DV	n/a	261.1	Precipitation data indicate that 1982 was a wetter than average year, although the month preceding the photo was drier than average. The wetland is well defined in the photo. Additional vegetation clearing between 1976 and 1982 has resulted in further loss of wetland area in the southeast corner and along the southern boundary of the wetland, and additional cut-lines are also visible. Patterning is again prominent in the northeast corner of the wetland, but is less distinct in the northwest corner than in previous photos. The contrast between graminoid vegetation immediately adjacent to Mud Creek and the woody vegetation farther away from the creek is clear. In the 1982 photo, trees appear to have regenerated sufficiently for the wetland to be considered a wooded, coniferous fen.
	20-Apr-86	AS3301-58	1:30,000	S	F-Wc	W	D	0	11.9	DV	n/a	259.6	As in 1982, precipitation data indicate that 1986 was a wetter than average year with a drier than average month preceding the April 1986 photo. The wetland is well defined, and additional cut-lines within the wetland boundary are visible. Patterning is prominent in both the northeast and northwest corners of the fen. Pools of water, possibly associated with beaver activity, are visible along Mud Creek. Pools of water are also visible along the north and east boundaries of the fen. The wetland appears to be a wooded, coniferous fen.
	22-Sep-93	AS4471-131	1:30,000	F	F-Wc	W	W	0	27.6	DV	n/a	260.8	Precipitation data indicate that 1993 was a wetter than average year, and the photo was preceded by a wetter than average month. The wetland is well defined, and numerous cut-lines are visible crossing the fen. A new clearing, likely a well pad, is visible near the north boundary of the wetland. Patterning is prominent in the northeast corner of the fen. The pools of water along Mud Creek noted in the 1982 photo appear to have receded, although darker soil and vegetation in these locations suggest that somewhat wetter conditions have persisted. The wetland appears to be a wooded, coniferous fen.
	28-Oct-01	TRSG0104-72	1:30,000	F	F-Wc	D	D	1.3	12.3	DV	n/a	258.3	Precipitation data indicate that 2001 was a drier than average year, and the month preceding the October 2001 photo was also drier than average. The wetland is well defined. Vegetation clearing, likely for well pads, is visible in eight locations within the wetland boundary. Patterning is well defined in the northeast and northwest corners of the fen, and Mud Creek is visible traversing the wetland from west to east. The wetland appears to be a wooded, coniferous fen.

(a) S = Spring (April to June); Sum = Mid-late Summer (June to September); F = Fall (September to November).
(b) F-S = Fen – Shrubby; F-Wc = Fen – Wooded, coniferous (Appendix B).
(c) D = Drier; W = Wetter (Alberta Agriculture and Forestry 2017).
(d) W = Water present/inundated; D = Dry; DV = Dry, vegetated (consistent with wetland class); DVI – Dry, vegetated (indistinguishable from surrounding uplands).
(e) Y = Yes (Reasonably Permanent, a Sec. 3 *Public Lands Act* [Province of Alberta 2001] body of water); N = No (Not permanent, a wetland regulated under *Water Act*).
(f) 1952 photo coverage limited and full extent of wetland not delineated.
n/a = not applicable.

3.2 Wetland Field Survey

3.2.1 Wetland Identification and Delineation

The field survey was completed on June 9 and 10, 2017. At numerous locations within the wetland, soils, surface water and vegetation communities were surveyed in accordance with the Alberta Wetland Identification and Delineation Directive (GOA 2015a). Detailed vegetation surveys were completed at three locations within the wetland: W01A, W01B and W01C, and wetland class and vegetation characteristics were confirmed at 25 additional locations (Figure 1). The soil, hydrology and vegetation characteristics used for wetland classification are included in Tables 4 and 5. Surveys were completed at four additional locations on May 28, 2020; wetland classifications and plant community compositions were consistent with the 2017 survey results (Golder 2022a).

Overall, the wetland is classified as a wooded coniferous fen, with graminoid fen and shrubby fen components (Appendix C). Plot W01A was situated within a graminoid fen community, and was dominated by water sedge (*Carex aquatilis*) and bog willow (*Salix pedicellaris*). Cloudberry (*Rubus chamaemorus*), purple avens (*Geum rivale*), tamarack (*Larix laricina*) and wild mint (*Mentha arvensis*) were also present, but with low cover (i.e., less than 2%) (Table 5). Plot W01B was situated within a shrubby fen community, and was dominated by black spruce (*Picea mariana*), bog willow, dwarf birch (*Betula pumila*), tamarack and tufted moss (*Aulacomnium palustre*) (Table 5). Plot W01C was situated within a wooded, coniferous fen community, and was dominated by black spruce, bog cranberry (*Vaccinium vitis-idaea*), common Labrador tea (*Rhododendron groenlandicum*) and dwarf birch (Table 5).

3.2.1.1 Wetland Hydrology

The LSA is located within a depression with upland areas to the north, east and south. The wetland has two outlets, Mud Creek and Prairie Creek. The majority of the wetland drains into Mud Creek, with the northwestern portion draining into Prairie Creek. Based on the surface water, the inferred direction of shallow groundwater flow within the LSA is towards the southeast (Figure 4).

3.2.2 Invasive and Listed Species

One noxious weed species listed under the Weed Control Regulation (Province of Alberta 2010) of the *Weed Control Act* (Province of Alberta 2011), creeping thistle (*Cirsium arvense*), was observed during the 2017 wetland survey. No listed wildlife or plant species were observed during the 2017 survey. In addition, no listed wildlife or plant species were documented during surveys conducted in 2005 and 2006 (Stantec 2006). One wildlife species listed federally as a species of special concern (GOC 2019), western toad (*Anaxyrus boreas*), was detected during the 2020 surveys (Golder 2022a).

Table 4: Information and Evidence Used to Classify Wetland

Wetland Plot ID	Overall Wetland Classification Code	Soil								Hydrology		Vegetation Characteristics	Indicator Species/Communities[c]
		Organic Matter Type[a]	Organic Matter Depth [cm]	B horizon texture	B horizon depth [cm]	Drainage[b]	Mottles present (Yes/No)	Conductivity [µs/cm]	pH	Surface Water Inflows or Outflows [Yes/No]	Catchment Area [ha]		
W01A	F-Wc	Om	>30	n/a	n/a	p	n/a	106	7.49	Yes	5,288 ha	Evidence of fen vegetation indicative of moderate-rich freshwater conditions.	*Carex aquatilis*
W01B		Of	>30	n/a	n/a	p	n/a	69	6.5	Yes		Evidence of fen vegetation indicative of moderate-rich freshwater conditions.	*Aulacomnium palustre*, *Carex diandra*, *Comarum palustre*, *Maianthemum trifolium*, *Menyanthes trifoliata*, *Triglochin maritima*
W01C		Oh	>30	n/a	n/a	p	n/a	-	6.5	Yes		Evidence of fen vegetation indicative of moderate-rich freshwater conditions.	*Aulacomnium palustre*, *Maianthemum trifolium*, *Triglochin maritima*

(a) Of = Fibric organic material; Oh = Humic organic material; Om = Mesic organic material.
(b) p = poorly drained.
(c) Based on characteristic species of moderate-rich fens described in AWCS (GOA 2015c).
- = no data.
n/a = not applicable.

Table 5: Field Information and Indicators Used to Identify and Delineate Wetland

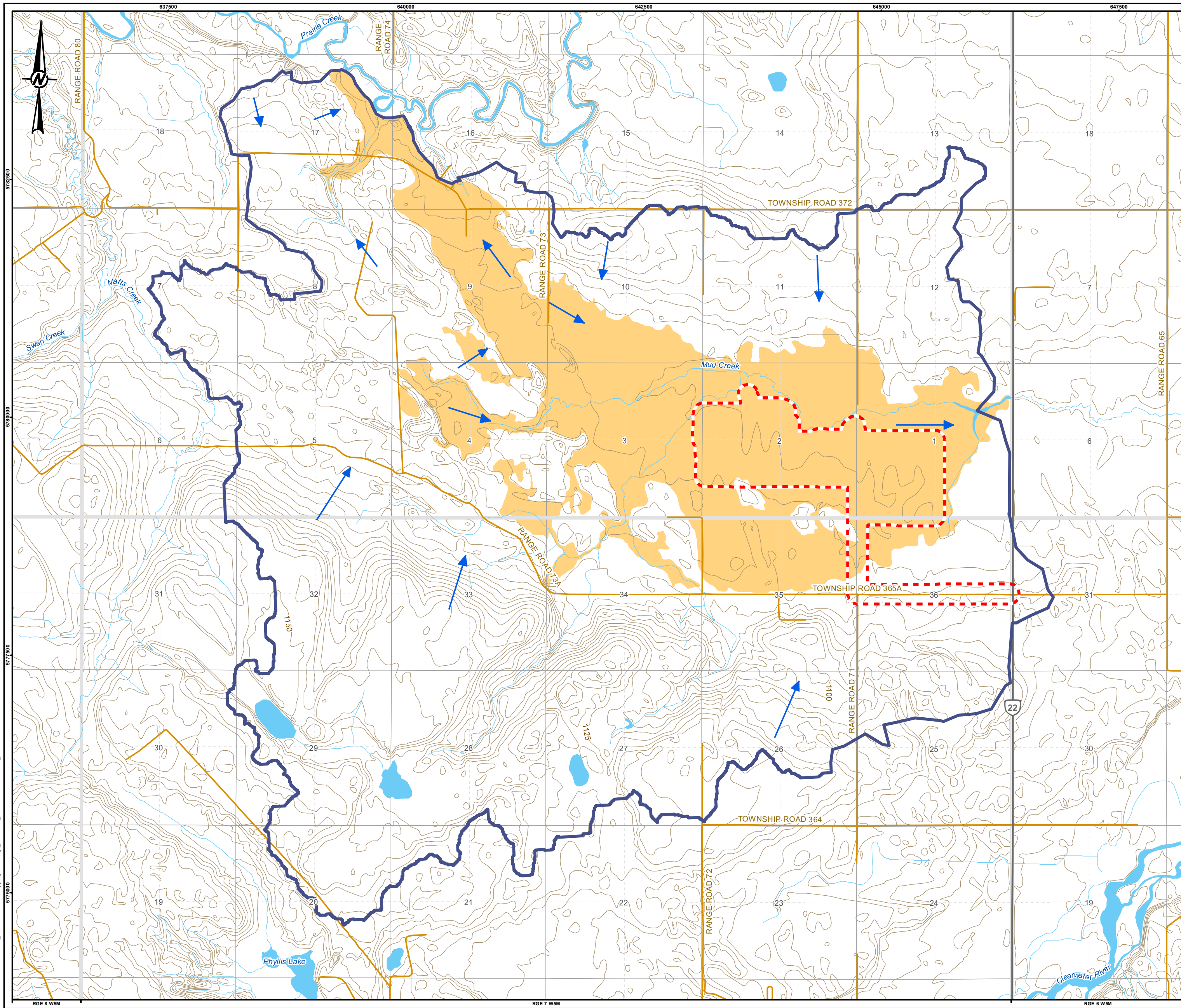
Wetland Plot ID	Classification Code[a]	Plot Size [1 x 1 m, 5 x 5 m, 10 x 10 m, none]	Plot Location [UTM]			Scientific Name of Species	Common Name of Species	Species Stratum	Facultative Wetland or Obligate Wetland Species[b] [Yes or No]	Percent Relative Cover of Abundant Species
			Zone	Easting	Northing					
W01A	F-Wc	none	11 U	643743	5780700	*Larix laricina*	tamarack	tree	yes	1
						Larix laricina	tamarack	shrub	yes	1
						Salix pedicellaris	bog willow	shrub	yes	2
						Salix sp.	willow sp.	shrub	yes	1
						Carex aquatilis	water sedge	graminoid	yes	80
						Achillea millefolium	common yarrow	forb	no	1
						Cirsium arvense	creeping thistle[c]	forb	yes	0.5
						Comarum palustre	marsh cinquefoil	forb	yes	1
						Geum rivale	purple avens	forb	yes	1
						Mentha arvensis	wild mint	forb	yes	1
						Rubus chamaemorus	cloudberry	forb	yes	1
						Wet/Non-Wet Species Ratio				89.5:1
W01B	F-Wc	none	11 U	644458	5780731	*Picea mariana*	black spruce	tree	yes	8
						Betula pumila	dwarf birch	shrub	yes	8
						Larix laricina	tamarack	shrub	yes	20
						Picea mariana	black spruce	shrub	yes	2
						Rhododendron groenlandicum	common Labrador tea	shrub	yes	1
						Salix pedicellaris	bog willow	shrub	yes	10
						Carex diandra	two-stamened sedge	graminoid	yes	1
						Comarum palustre	marsh cinquefoil	forb	yes	3
						Equisetum fluviatile	swamp horsetail	forb	yes	1
						Galium trifidum	sweet-scented bedstraw	forb	yes	0.5
						Maianthemum trifolium	three-leaved Solomon's-seal	forb	yes	3
						Menyanthes trifoliata	buck-bean	forb	yes	5
						Rubus chamaemorus	cloudberry	forb	yes	1
						Triglochin maritima	seaside arrow-grass	forb	yes	1
						Aulacomnium palustre	tufted moss	bryophyte	yes	20
						Wet/Non-Wet Species Ratio				84.5:0
W01C	F-Wc	none	11 U	644825	5780226	*Picea mariana*	black spruce	tree	yes	40
						Betula pumila	dwarf birch	shrub	yes	5
						Linnaea borealis	twinflower	shrub	no	1
						Picea mariana	black spruce	shrub	yes	8
						Rhododendron groenlandicum	common Labrador tea	shrub	yes	25
						Vaccinium vitis-idaea	bog cranberry	shrub	yes	5
						Carex sp.	sedge sp.	graminoid	n/a	2
						Maianthemum trifolium	three-leaved Solomon's-seal	forb	yes	1
						Mitella nuda	bishop's-cap	forb	yes	2
						Pyrola sp.	wintergreen sp.	forb	no	0.5
						Aulacomnium palustre	tufted moss	bryophyte	yes	5
						Wet/Non-Wet Species Ratio				91:3.5

(a) Wetland classes following AWCS (GOA 2015c); Appendix B.

(b) Based on *Preliminary Provincial List of Plant Species Found in Wetlands* in AWCS (GOA 2015c) and wetland status in the United States Department of Agriculture Plants Database (USDA 2017).

(c) Denotes Noxious or Prohibited Noxious weed species (Province of Alberta 2010).

n/a = not applicable.



LEGEND

- ELEVATION CONTOUR (5 m)
- FLOW DIRECTION
- WATERCOURSE
- WATERBODY
- CURRENT WETLAND BOUNDARY
- TERRESTRIAL LOCAL STUDY AREA - PROJECT FOOTPRINT + 100 M BUFFER
- WETLAND CATCHMENT

0 800 1,600

1:40,000 METRES

REFERENCE(S)

1. ALBERTA DIGITAL BASE DATA MAY BE OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED, ALTALIS LTD.© GOVERNMENT OF ALBERTA 2016. ALL RIGHTS RESERVED. OR IHS ENERGY INC.

PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT

PREMIER TECH HORTICULTURE

PROJECT

CLEARWATER PEAT HARVEST PROJECT

TITLE

WETLAND CATCHMENT AREA

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2022-01-28
DESIGNED	SC
PREPARED	LMS
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	4

3.3 Wetland Post-Field Desktop Assessment

Wetland W01 was delineated based on field notes, GPS tracks, and aerial photographs. Wetland and catchment areas were calculated using GIS. Wetland W01 covers a total area of 1,237.8 ha, with 244.2 ha occurring within the LSA and 153.4 ha within the footprint (Figure 1). Based on the interpretation of the DEM, combined with the results of the field survey, the catchment area for wetland W01 is 5,288.1 ha (Figure 4). Land cover surrounding the LSA includes natural vegetation, agricultural land, and areas cleared for oil and gas exploration and extraction.

3.3.1 Wetland Relative Value Assessment

ABWRET-A was used to calculate the relative value of wetland W01 (GOA 2016a), and results of the ABWRET-A are provided in Appendix E. The LSA is located in Relative Wetland Value Assessment Unit 10. The ABWRET-A assessment determined that the Final Relative Value for wetland W01 was category “A”.

3.3.2 Wetland Functions

Wetland function was assessed based on ABWRET-A scores for the highest scoring metrics of W01, which likely contributed to the high overall Final Relative Value. Normalized Function ABWRET-A Scores were above 0.9 for five wetland function metrics: water cooling (0.91), stream flow support (0.94), phosphorus retention (1.00), native plant and pollinator habitat (1.00), and fire break (1.00) (Appendix E).

Water Cooling

The effectiveness of a wetland at maintaining or reducing temperatures of downslope waters is evaluated by considering the predominant wetland type, as well as parameters describing surface water and outflow/groundwater discharge (GOA 2016a). W01 had a very high score for the water cooling metric (i.e., 0.91).

Of the wetland attributes that contribute to the water cooling metric as per ABWRET-A scores, W01 had a relatively high score in the following fields (Appendix E): OF3 (presence of a channel connection), OF16 (presence of a groundwater discharge area or spring), OF33 (presence of riparian or floodway location), F1 (predominant wetland type), F22 (percentage of wetland never with surface water), F31 (percentage of ponded versus flowing water), and F48 (channel connection and outflow duration).

Relatively high values for the presence of a channel connection and outflow duration are important because wetlands with no outflow typically have minimal effects on the temperature of downslope waterbodies (GOA 2016a), and thus, are unlikely to maintain or reduce temperatures downslope. The high value for the predominant wetland type reflects the presence (or high likelihood) of groundwater discharge, which is often cooler than surface waters and is useful to help maintain or reduce surface water temperature (GOA 2016a). Particularly during the summer, water remains cooler if it remains entirely belowground, rather than being exposed aboveground (Mellina et al. 2002); thus, wetlands with groundwater discharge areas and limited surface water are better able to maintain cooler water temperatures. Ponded water is especially likely to be heated by the sun, and thus, the presence of channels and underground water help maintain lower water temperatures (GOA 2016a). Additionally, wetlands that are connected to waters downslope, including via a riparian or floodway area, have a greater impact on the temperature of those downslope water bodies (GOA 2016a); discharge of cooler water may have cooling effects on downstream water from 50 m to 4 km (Caldwell et al. 1991; Lewis et al. 2000). A combination of these factors likely contributed to a relatively high water cooling score for W01.

Stream Flow Support

The potential for a wetland to contribute water to streams during the driest part of a growing season is evaluated by considering the predominant wetland type, as well as parameters describing soil texture, the predominant surface water depth class, the percentage of open ponded water, and both surface water and groundwater connectivity (GOA 2016a). W01 had a very high score for the stream flow support metric (i.e., 0.94).

Of the wetland attributes that contribute to the stream flow support metric as per ABWRET-A scores, W01 had a relatively high score in the following fields (Appendix E): OF16 (presence of a groundwater discharge area or spring), OF33 (presence of riparian or floodway location), OF47 (wetland as a percentage of its watershed [hydrologic unit code 8]), F1 (predominant wetland type), F14 (soil texture), and F48 (channel connection & outflow duration).

Relatively high values for the presence of a groundwater discharge area or spring is important because discharge areas in wetlands often help sustain water flow in streams (GOA 2016a). The larger the proportion of a watershed a wetland covers, the more likely the wetland is to be a ground discharge area (Schmidt et al. 2010); groundwater discharge tends to be more seasonally stable and continues to contribute to stream flow downstream through the late season (McEachern et al. 2000; GOA 2016a). In contrast, open water is more susceptible to water loss from evaporation and thus, can have less water to contribute to downstream water bodies. Additionally, high values for the presence of a riparian or floodway location is important as wetlands in these locations tend to have greater impacts on the volume of flow reaching downstream water bodies (GOA 2016a). Fens, such as W01, are not only typically ground discharge areas (Boelter and Verry 1977), but also store near-surface moisture in organic soils, even during extended dry periods (Silins and Rothwell 1998), which allows them to continue to contribute water even during low flow conditions. Gracz et al. (2015) found that over half of the stream flow came from the near-surface layers of peatlands during a dry period in Alaska. A combination of these factors likely contributed to a relatively high stream flow support score for W01.

Phosphorus Retention

The potential for a wetland to retain phosphorus for more than one growing season is evaluated by considering the predominant wetland type, as well as the ground structure, the hydrologic environment, vegetation, chemical parameters, and soil or sediment alterations (GOA 2016a). W01 had a very high score for the phosphorus retention metric (i.e., 1.00).

Of the wetland attributes that contribute to the phosphorus retention metric as per ABWRET-A scores, W01 had a relatively high score in the following fields (Appendix E): F1 (predominant wetland type), F11 (percentage of bare ground and thatch), F12 (amount of ground irregularity), F14 (soil texture), F22 (percentage of wetland never with surface water), F23 (percentage with persistent surface water), F28 (annual water fluctuation range), F49 (surface water outflow confinement), F51 (wetland internal gradient), and F69 (wetland as a percentage of its catchment area).

Relatively high values for the predominant wetland type were driven by W01 being a fen. Peatlands have high potential for retaining phosphorus due to high *Sphagnum* moss cover, which contributes to a high cation exchange capacity (Prepas et al. 2001; Rippy and Nelson 2007). High levels of organic soil can result in restricted nutrient availability for plants, and thus, reduce their ability to take up and retain phosphorus (Prescott et al. 2000). In fens, phosphorus tends to be retained in the soil, rather than in plants (Bayley and Mewhort 2004). Dense vegetation, topographical features, and flat to minimal slopes slow runoff, which increases the deposition of suspended sediments that contain phosphorus, and reduces erosion. This in turn stimulates phosphorus retention as phosphorus adsorbs to soil particles (GOA 2016a). Additionally, areas that are continually moist, but not flooded, are more likely to retain phosphorus (Aldous et al. 2007). Areas that remain covered with water for prolonged periods of time, or soils that reflood after being dry for prolonged periods of time, can become anaerobic and release phosphorus (Burley et al. 2001; GOA 2016a); thus, wetlands that contain mainly groundwater, rather than persistent surface water, may retain more phosphorus (GOA 2016a). Furthermore, wetlands that comprise a large portion of their catchment area tend to have relatively more space to retain phosphorus while receiving less phosphorus, and are thus able to store more soil-bound phosphorus (GOA 2016a). A combination of these factors likely contributed to a relatively high phosphorus retention score for W01.

Native Plant & Pollinator Habitat

The potential for a wetland to support a diversity of native vascular and non-vascular plants and communities, and associated pollinating insects, is evaluated by considering the diversity of the wetland class within the surrounding landscape; vegetation form, cover, and distribution; the presence of any plant species listed by ACIMS; whether the wetland falls within the range of a tracked rare plant species; as well as wetland productivity, habitat substrate, offsite habitat influences, and stressors (GOA 2016a). W01 had a very high score for the native plant and pollinator habitat metric (i.e., 1.00).

Of the wetland attributes that contribute to the native plant and pollinator metric as per ABWRET-A scores, W01 had a relatively high score in the following fields (Appendix E): OF8 (distance to nearest well-settled area), OF33 (presence of riparian or floodway location), F7 (dominance of most abundant shrub species), F12 (amount of ground irregularity), F14 (soil texture), F19 (dominance of most abundant herbaceous species), F20 (invasive plant cover), F21 (weed source along wetland edge), F23 (percentage with persistent surface water), F29 (predominant wetland depth class), F52 (percentage of buffer with perennial vegetation), F53 (type of cover in surrounding buffer), F55 (new or expanded wetland), and F60 (unvisited core area).

Relatively high values for dominant vegetation attributes are important as overall plant species richness is generally lower when a few common species are dominant (GOA 2016a). The presence of some woody cover at intermediate levels tends to support more understory plant species (e.g., Halpern and Spies 1995; Chipman & Johnson 2002; Chavez and Macdonald 2010), although trees tend to shade and compete with the understory for nutrients, reducing plant diversity (Hanley & Brady 1997). Furthermore, short (i.e., <1 m tall) evergreen shrub species typically have the most flowers, and therefore, attract more pollinating insects (GOA 2016a). Different plant species have different moisture preferences, which correlate to different microsites (Šamonil et al. 2010); thus, increased diversity in ground topography supports more diversity of plant species (Pollack et al. 1998; Benscoter and Vitt 2008). Wetlands that are saturated, but with limited persistent surface water, tend to have higher plant species richness as both submersed aquatic plants, and other wetland plants that require more light and sediment oxygen, can thrive (GOA 2016a). Additionally, organic wetland soils support more plant species than wetland soils with lower organic content (Alsfeld et al. 2009), especially fens which are not too acidic (GOA 2016a). Wetlands with inflowing streams and riparian or floodway areas tend to have greater external nutrient inputs, which are concentrated by evaporation as seasonal connections disappear and water levels drop (Lesack et al. 1998), and encourage plant growth and diversification (Ogbebo et al. 2009). Additionally, areas farther from population centres tend to have fewer non-native plants (Reichard and White 2001a,b); non-native plant seeds are often carried by humans and their pets and are therefore more common in areas frequently visited by people (GOA 2016a). Higher levels of non-native species generally result in lower native plant species richness (Reichard and White 2001a,b; Vujnovik et al. 2002); few noxious weed species were observed in W01 (Golder 2022a). Wetlands that are surrounded by natural land cover generally have more diverse plant communities

(Rooney and Bayley 2011a,b, 2012a,b; Raab and Bayley 2012; Wilson et al. 2013). A combination of these factors likely contributed to a relatively high native plant and pollinator habitat score for W01.

Fire Break

The potential to limit wildfire spread by resisting ignition by wildfire is evaluated by considering the amount of wetland that contains persistent surface water and the burn history of the wetland (GOA 2016a). W01 had a very high score for the fire break metric (i.e., 1.00).

Of the wetland attributes that contribute to the fire break metric as per ABWRET-A scores, W01 had a relatively high score in the following field (Appendix E): OF55 (fire barrier).

A relatively high value for fire barrier is important as this indicates that based on wildfire risk maps, W01 has a low susceptibility to maintaining wildfire (Tymstra et al. 2010). This may be in part due to the nature of peatlands, which store near-surface moisture in organic soils, even during extended dry periods (Silins and Rothwell 1998), which may help reduce the wetland's ability to support fire combustion and dispersion.

4.0 DISCUSSION

4.1 Proposed Impacts to Wetlands

4.1.1 Potential Impacts

Construction of the proposed Project footprint will result in disturbance to 151.5 ha of wetland area, with an additional 1.9 ha of previously developed, cleared fen for a total wetland disturbance area of 153.4 ha (Table 6). Construction and operations are proposed to begin as early as 2022, following Project approval from the regulator.

Table 6: Wetland Area to be Impacted by Phase 1 Project Components

Project Component	Wetland Area [ha]
Access Road	1.2
Drainage Ditches	7.1
Harvest Road	6.3
Harvest Section – Year 1	43.6
Harvest Section – Year 2	27.8
Harvest Section – Year 3	29.3
Harvest Section – Year 4	23.3
Harvest Section – Year 5	10.9
Sedimentation Pond	0.3
Yard	0.1
Maintenance Access	1.4
Subtotal	151.5
Developed – Cleared Fen	1.9
Total	**153.4**

Construction and operations may disrupt groundwater flow and discharge of the wetland, which can impact the five previously mentioned wetland function metrics of concern: water cooling, stream flow support, phosphorus retention, native plant and pollinator habitat, and fire break (Section 3.3.2). The unlikely, but potential, disruption of groundwater discharge could result in increased surface water flow, which does not tend to stay as cool as groundwater and may reduce the wetland's ability to maintain or reduce water temperatures downstream. Surface water is not as seasonally stable as groundwater and may be lost to evaporation, which, combined with the loss of near-surface moisture held in organic soils, could result in reduced water supply during low flow conditions. The majority of phosphorus in fens is retained in the upper soil layers where it forms complexes with soil organic matter; thus, the removal of soil, vegetation, and a saturated environment could hinder the wetland's ability to retain phosphorus. Construction and operational activities will result in the removal of plant species and native plant and pollinator habitat, while increasing the risk of introduction of non-native species, which can further reduce native plant species richness. Prior to construction, one listed or tracked species, western toad, was detected (Golder 2022a); this species remains widespread and may be expanding its range but may be vulnerable to changes from human development (ECCC 2016). No other listed or tracked species, including plants, fish, or wildlife, were detected in W01 (Golder 2022a). Wildfire risk maps currently indicate that this wetland has a low fire risk, however, peat dust suspended in the air may increase the fire risk at the LSA (Golder 2022a).

4.1.2 Proposed Mitigation to Reduce Impacts

Two hydrology assessments have been completed to determine the impacts of construction and operations on wetland W01 (Premier Tech 2010; Appendix C in Stantec 2013). These assessments concluded that parameters and methods used for surface runoff analysis were conservative; short-term changes in flow will not negatively impact downstream users; once the Project is developed, the runoff will have the same characteristics as the pre-development natural runoff; and ditches will not accelerate the drainage of the harvesting area (Golder 2022a). The proposed harvesting operation is predicted to result in negligible impacts to the regional groundwater system (Golder 2022a). The maximum total harvest area that will contribute runoff to Mud Creek is less than 5% of the drainage area of the Mud Creek and less than 12% for the Tributary of Mud Creek. The estimated flow increase during open water season varies from zero in most winter months to a maximum monthly increase of 2.1% in October for the unnamed tributary of Mud Creek (Golder 2022a). The proposed harvesting operation is predicted to result in small increases in local flows in Mud Creek and its unnamed tributary. The potential changes to flows in the receiving environment (i.e., Mud Creek and its unnamed tributary) are predicted to be negligible, because the closure drainage system will be properly designed and implemented and the area of reclaimed fen is much less than the drainage area of Mud Creek and its tributary at the Project location. Additionally, operations are expected to result in negligible impacts in terms of water quality, and fish and wildlife habitat (Golder 2022a). With mitigation, impacts to water cooling are expected to be minimal as groundwater systems will not be disturbed and temperatures of open water in sedimentation pond discharge stations will be monitored and water will only be released downstream if temperatures meet release criteria (Golder 2022a).

Runoff from the fen is expected to continue to drain towards Mud Creek (Golder 20202a). The construction of drainage ditches and sedimentation ponds will manage and control water stored in the fen, while culverts will be installed to maintain drainage pathways within the fen. Combined, these mitigations are expected to prevent negative impacts to overall stream water flow and water quality, and contribute to phosphorus retention (Golder 2022a).

Baseline water quality data from the Project footprint and Mud Creek, the receiving watercourse, were collected from March 2016 to April 2019 and indicated high concentrations of phosphorus within the Project footprint compared to the receiving waters. Continued monitoring will ensure phosphorus retention is maintained within the fen (Golder 2022a).

Not only is native plant and pollinator habitat important to wetland functions, but wildlife and aquatic ecology can also impact wetland health, function and value, particularly invasive and tracked species. Impacts to native plant and pollinator habitat are unavoidable; however, the appropriate protocols will be in place to prevent the introduction of aquatic invasive species by following AEP decontamination requirements (Golder 2022a, Appendix G) and care will be taken not to introduce non-native plant species that can outcompete native plant species. Removal of western toad habitat is expected to be within the adaptability and resilience limits for this population and suitable western toad habitat will remain adjacent to the Project and may be created (e.g., drainage ditches, outflow ditches, sedimentation ponds).

A Fire Prevention and Procedure program has been developed to reduce the increased wildfire risk (Appendix F in Golder 2022a).

4.2 Wetland Mitigation Plan

An Approval under the *Water Act* is required prior to any wetland impact in Alberta (GOA 2013). Avoidance or minimization of wetland impacts can eliminate or reduce the need for wetland compensation. However, unavoidable and authorized impacts will require wetland compensation as per the Alberta Wetland Mitigation Directive (GOA 2018a), as outlined in the Government of Alberta's Wetland Regulatory Requirements Guide (GOA 2015b). Approval applicants are expected to demonstrate adherence to the mitigation hierarchy for wetlands, beginning with avoidance, followed by minimization (which includes reclamation), and finally compensation/replacement, as described in the Alberta Wetland Policy (GOA 2013).

Premier Tech plans to reclaim the 153.4 ha of wetland associated with Harvest Sections, Roads, Ditches, Sedimentation Ponds and Yard to peatland (Premier Tech 2018; Golder 2022b). A Reclamation Proposal for the 153.4 ha of land to be reclaimed to wetland is provided in Section 4.2.3.

4.2.1 Avoidance

Evidence of wetland avoidance can include options considered for relocating the activity, alternative activities considered at the proposed location, modifications considered to the proposed activity, and a comparative analysis of options (GOA 2018a). Alternate peat harvesting locations were considered by Premier Tech during early Project planning phases; however, the advantages of Clearwater outweighed the other options under consideration (Table 7). Alternate activities to minimize impacts temporally, including a phased approach to both peat harvest and reclamation, are incorporated into the current Peat Development and Operations Plan (Golder 2022a) and Conservation and Reclamation Plan (Golder 2022b).

Within the wetland, the Project footprint was sited to avoid as much as possible the patterned components of the fen on the north side of the Mud Creek and along the eastern wetland boundary, which have the potential for higher species richness. In addition, the overall footprint within the wetland was minimized, and existing disturbances were incorporated into design plans where possible.

Table 7: A Comparative Analysis of Options Considered to Avoid the Wetland

Advantages	Disadvantages
Option A: Harvest Peat from Clearwater	
■ 93 km from Olds processing plant and 150 km from Balzac processing plant. Transportation costs are expensive and would be 44%, 66%, and 90% more expensive (yearly) to operate in Drayton Valley, Athabasca, and Valleyview regions, respectively, compared to the Clearwater region. ■ Better employment opportunities. It is increasingly difficult to hire operators in northern Alberta where Premier Tech currently operates. ■ The peat is mostly retail grade quality but has some peat that is suitable for blending into professional mixes. ■ The peatland is large and deep, and can therefore maintain a supply for a long period of time. ■ The consistency of the peat reserves from Clearwater will help secure sufficient product and therefore prolong the operation life on other operations in Alberta.	■ The Clearwater peatland has a high ecological value (i.e., ABWRET-A value of "A").
Option B: Harvest More Decomposed Peat from Older Peatlands Currently Approved for Operation	
■ Continue to use already existing infrastructure and equipment.	■ This would compromise the restoration of this wetland. As harvesting goes deeper in the peatland, the minerotrophic layers of peat that have higher pH and Von Post scale values will become exposed. If the remaining peat deposit is too shallow, water retention will be compromised and may contribute to high fluctuations of the water table. These outcomes will make it more difficult to restore the peat harvest fields to the reference ecosystem. ■ This is a short term option. The peatlands will deplete entirely within the next few years, which would render it impossible to restore the site to a peat accumulating system. ■ Transportation costs for this option are more costly than for Option A.
Option C: Harvest Peat from Another Peatland of a Lower Estimated ABWRET Value (52.151093, -114.494568)	
■ This peatland has an estimated ABWRET value of C and D (Geodiscover online tool). ■ Similar to Option A, it is in close proximity to the Olds and Balzac processing plants which would significantly reduce transportation costs.	■ This peatland is much shallower and approximately half the size of the Clearwater peatland. On average, the peat barely reaches two meters deep. The peat reserves would be depleted in approximately 10 years, which is half the lifespan of Option A. ■ The peat is of lower quality from the surface (Von Post H7) all the way through to the bottom (H9).

In an effort to avoid negative impacts to the water quality, quantity, and biodiversity of the Mud Creek watershed, surveys were completed to determine the baseline function of this wetland, and potential linkages to Mud Creek and its tributaries, and potential impacts due to construction and operations of the Project (Premier Tech 2010; Appendix C in Stantec 2013; Golder 2022a). Expected impacts following mitigation have been highlighted in Section 4.1, which outlines efforts to avoid negative impacts to the hydrology and ecology of the connections between this fen and Mud Creek. The surface water monitoring plan that has been developed to ensure negative impacts are minimized includes water quality monitoring and aligns with the recommendations for locations, sampling frequency, and parameters in the Guide to Surface Materials Lease Information Requirements for Peat Operations and additional guidance provided by AEP (GOA 2017c, 2018b). Appropriate vegetation buffers (100 m) will be maintained around Mud Creek to avoid negative impacts to bank stability, water quality, and biodiversity, and the majority of the Project footprint is designed to avoid the 100-year floodplain extent (Golder 2022a).

4.2.2 Minimization Proposal

Premier Tech intends to minimize impacts to the wetland area adjacent to the Project footprint. Specifically, to maintain natural conditions and functions of adjacent wetland area, Premier Tech will implement mitigation measures including, but not limited to, the following:

- Confining disturbance associated with development and operation of the Project to the Project footprint to minimize effects on adjacent wetland area
- Situating the Yard within an existing wellsite disturbance to minimize wetland impacts
- Implementing effective erosion and sediment control measures (e.g., appropriately scaled Sedimentation Ponds) before and during construction and operations to prevent sediment from entering adjacent wetland areas or watercourses
- Implementing a Wildlife Mitigation and Monitoring Plan, which may include pre-clearing nest sweeps for migratory birds in accordance with the Migratory Birds Convention Act (GOC 1994) and pre-clearing amphibian sweeps with possible relocation of individuals when operations occur during the general nesting period for this region (April 17 to August 24; ECCC 2018).
- Following best practices to minimize the spread of weed species by ensuring all equipment arriving at the LSA is clean and free of soil or vegetation debris.

Premier Tech is committed to applying the best science, technology, and ecological principles during construction, operation, closure, and reclamation of the Project. In addition, Premier Tech will follow guidelines within applicable Best Management Practices and Standard Operating Procedures.

4.2.3 Reclamation Proposal

The Project footprint will be reclaimed following the principles and techniques outlined in Quinty and Rochefort's Peatland Restoration Guide (2003) and best practices for peatland and peatland road restoration at the time of restoration (Golder 2022b), and will meet the requirements included in Requirements for Conservation and Reclamation Plans for Peat Operations (AEP 2016b). Reclamation to peatland following peat harvesting operations has been completed successfully by Premier Tech at sites in other provinces, and best practices gleaned from these sites will be applied to the Project footprint. In addition, Premier Tech will apply successful reclamation techniques from other sites in Alberta once closure and reclamation have occurred at these sites.

Premier Tech plans to reclaim the 153.4 ha of land associated with Harvest Sections, Ditches, Sedimentation Ponds, Roads, and the Yard (Figure 1) to fen upon completion of peat harvesting activities, as outlined below.

Surface Preparation

Upon closure, a leveller will be used to re-profile the harvested areas by moving peat from the top and centre of the fields toward the edges, ditches will be filled with peat collected from adjacent surfaces, and berms will be established up to a height of 40 to 50 cm (Golder 2022b). Loose surface peat will be scraped to reveal the underlying undisturbed peat layer, and loose peat will be used for berm construction and ditch filling.

Hydrology

Water levels will be close to the surface of the wetland after decommissioning of the drainage network, and the post-reclamation area is expected to drain into Mud Creek. Effective surface preparation will increase water availability throughout the reclamation area, while avoiding flooding. Water drained from the fen area will not be from the regional groundwater system, and this water system is expected to continue to function as it did prior to disturbance. Reclamation of the wetland is expected to render the hydrological connections between the wetland and Mud Creek, its tributaries, and Prairie Creek similar to pre-disturbance. More details can be found in the Conservation and Reclamation Plan (Golder 2022b).

Revegetation

Donor plant material will be supplied from within the SML. Quinty and Rochefort (2003) recommend that the size of the donor site to reclamation site be a ratio of 1:12 to 1:10, and Premier Tech has identified enough area within the SML to meet the 1:10 ratio. A figure of the proposed donor areas are provided in the Conservation and Reclamation Plan (Golder 2022b). Approximately 1 ha of donor surface area is required for every 10 ha of restoration area, and the top 10 cm of peat will be collected and shredded into approximately 1 to 3 cm fragments. Plant fragments will be applied in a thin, continuous layer between 1 cm and 5 cm thick, and a protective layer of straw mulch will be applied soon after spreading the plant fragments (Golder 2022b). Up to 15.3 ha of donor area will be required to reclaim the 153.4 ha of wetland that will be disturbed.

Reclamation Timeline

Progressive reclamation will be initiated in the Harvest Sections from Year 18 to Year 22 of the harvesting operation (Table 8). Reclamation will start directly east and west of the Yard (i.e., Harvest Section 1), including associated Sedimentation Ponds, followed by the eastern-most Harvest Section (i.e., Harvest Section 2), the central/southwest Harvest Section (i.e., Harvest Section 3), the southwestern-most Harvest Section and the adjacent northeastern-most Harvest Section and associated Sedimentation Pond (i.e., Harvest Section 4), and finally the northwestern-most Harvest Section and associated Sedimentation Pond (i.e., Harvest Section 5) (Golder 2022b). Premier Tech is proposing to start extraction as early as 2022 (Year 1). Five years after commencement of reclamation of the final Harvest Section, and once reclamation within all Harvest Sections is self-sustaining, the area associated with the Harvest Roads, Yard (which includes the office and maintenance garage), and Main Access Road will be reclaimed. Reclamation is expected to be ready for certification 10-12 years after initiation.

Table 8: Phase 1 Clearwater Project Reclamation Schedule

Harvest Section	Active Peat Removal	Ready for Reclamation	Reclamation Initiated	Ready for Reclamation Certification (Projected)
Harvest Section 1	Year 2 to 17	Year 18	Year 18 to 20	Year 28 to 30
Harvest Section 2	Year 3 to 18	Year 19	Year 19 to 21	Year 29 to 31
Sedimentation Pond (Harvest Section 1 & 2)	N/A	Year 21	Year 21	Year 29 to 31
Harvest Section 3	Year 4 to 19	Year 20	Year 20 to 22	Year 30 to 32
Sedimentation Pond (Harvest Section 3)	N/A	Year 20	Year 22	Year 32
Harvest Section 4	Year 5 to 20	Year 21	Year 21 to 23	Year 31 to 33
Sedimentation Pond (Harvest Section 4)	N/A	Year 21	Year 23	Year 33
Harvest Section 5	Year 6 to 21	Year 22	Year 22 to 24	Year 32 to 34
Sedimentation Pond (Harvest Section 5)	N/A	Year 22	Year 24	Year 34
Harvest Roads	N/A	Year 29	Year 29	Year 35
Yard Site	N/A	Year 30	Year 30	Year 35
Access Road	N/A	Year 30	Year 30	Year 35

Monitoring and Contingency Planning

Monitoring of post-reclamation vegetation and hydrology will be carried out during the second, third, and fifth years following initiation of reclamation, with basic maintenance inspections occurring annually, beginning in the first year following reclamation. Post-reclamation vegetation monitoring will occur at the site level, and also within permanent 5 x 5 m vegetation plots (for coarse scale vegetation sampling) and 25 x 25 cm ground level plots (for detailed bryophyte sampling). Water table fluctuations will be monitored using 2.5 cm diameter polyvinyl chloride (PVC) water wells, with measurements taken in conjunction with vegetation monitoring site visits. Corrective actions that can be taken to manage water levels, if required, include inspecting dams for defects, or recontouring and adding berms to redistribute water. The monitoring program will be used to support an adaptive management approach to reclamation by identifying areas for mitigation and improvement in reclamation design. Results may highlight areas for improvement or indicate aspects of the design that are working well and may be implemented elsewhere on the landscape. To meet wetland restoration requirements associated with the Alberta Wetland Policy (GOA 2013), a wetland restoration verification assessment and associated report will be completed following the requirements as stated in Section 6 of the Alberta Wetland Restoration Directive (GOA 2016b). Further details can be found in the Conservation and Reclamation Plan created for the Clearwater Project (Golder 2022b).

4.2.4 Replacement Proposal

Permanent, unavoidable and authorized impacts to wetlands will require wetland compensation as per the Alberta Wetland Mitigation Directive (GOA 2018a), as outlined in the Government of Alberta's Wetland Regulatory Requirements Guide (GOA 2015b). Based on the Conservation and Reclamation Plan – Phase 1 – Clearwater

Project (Golder 2022b), Premier Tech proposes to reclaim all wetland area back to wetland. For any unanticipated permanent losses of wetland area, in-lieu replacement fees will be paid as per Section 5 of the Alberta Wetland Mitigation Directive (GOA 2018a).

Based on the ABWRET-A results (Appendix E), the Final Relative Value for wetland W01 is “A”. Based on the Alberta Wetland Mitigation Directive (GOA 2018a), the appropriate wetland replacement ratio and compensation requirements are provided in Table 9.

Should unanticipated permanent wetland losses occur, Premier Tech will either undertake a wetland replacement project to restore a previously drained wetland or construct a new wetland (i.e., permittee-responsible replacement), or pay a wetland replacement fee for the permanent loss of wetland area and relative wetland value (GOA 2019).

Table 9: Wetland Replacement Proposal for Unavoidable, Permanent Wetland Impacts

Wetland ID	Wetland Class	Relative Wetland Value	Replacement Ratio[a]
W01	Wooded Coniferous Fen	A	8:1

(a) Applied to permanent wetland losses at a cost of $19,100 per hectare of wetland to be lost for Relative Wetland Value Assessment Unit 10.

5.0 SUMMARY AND RECOMMENDATIONS

Implementation of the proposed peat harvesting operation will result in disturbance to 153.4 ha of wetland area. Premier Tech plans to reclaim the 153.4ha of disturbed wetland associated with Harvest Sections, Ditches, Roads, Sedimentation Ponds, Yard and Access Road within the LSA to peatland. Progressive reclamation will commence for the first Harvest Section in Year 18, and reclamation is expected to be complete for the final Harvest Section by Year 35.

6.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

Golder Associates Ltd.

<Original signed by>

<Original signed by>

Jasmin Parker, BA&Sc
Environmental Scientist

Valerie Coenen, B.Sc., RT(Ag)
Senior Terrestrial Ecologis

JP/VC

https://golderassociates.sharepoint.com/sites/153472/project files/6 deliverables/05. wair/final/21496738_pth_clearwater_wair_rev0.docx

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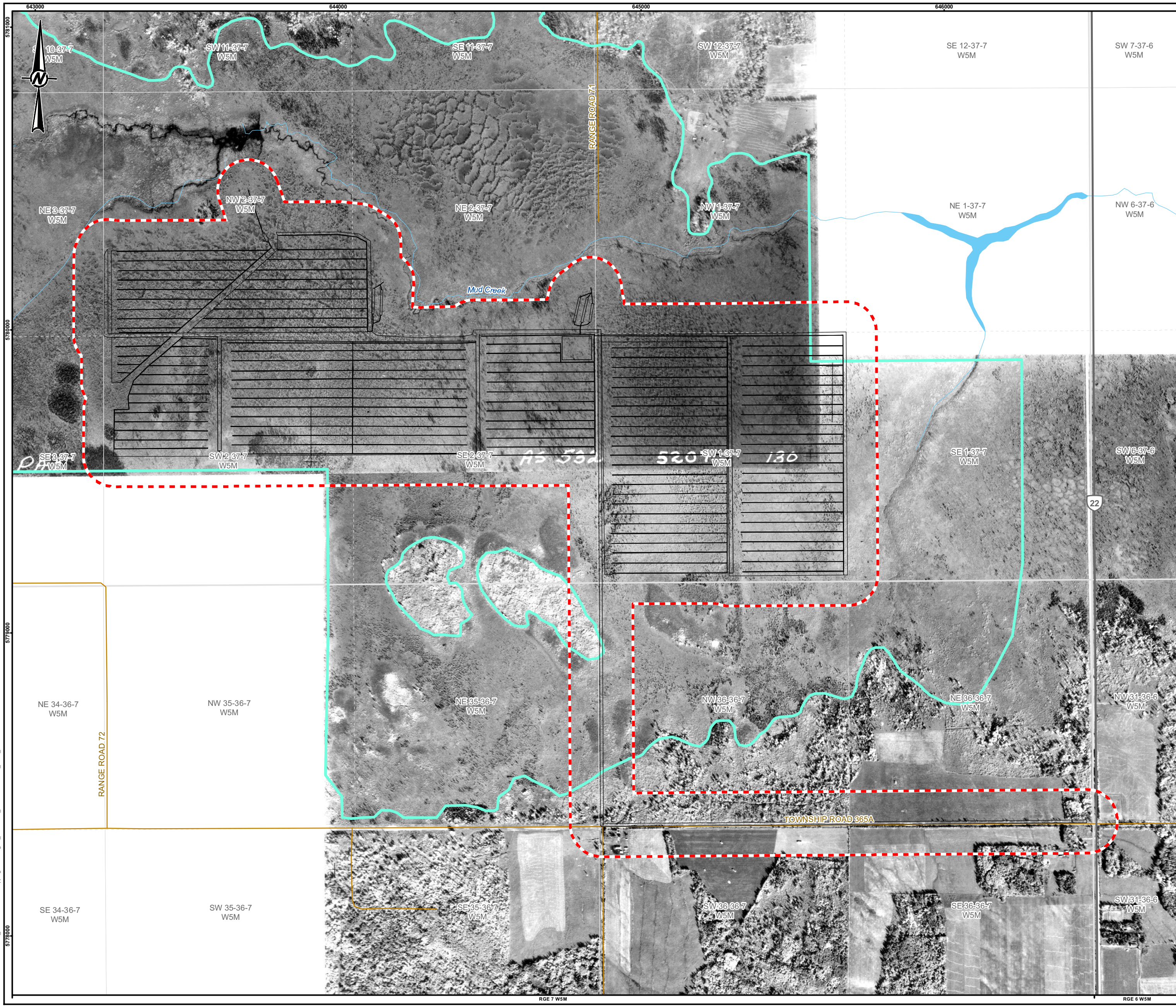
APPENDIX A

Historical Aerial Photographs



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 1952 WETLAND BOUNDARY
- PROJECT FOOTPRINT - PHASE 1
- LOCAL STUDY AREA

0 250 500

1:12,500 METRES

REFERENCE(S)

1. AIR PHOTOS (0532 130-EP AND 0532 041-EP) OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS.
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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

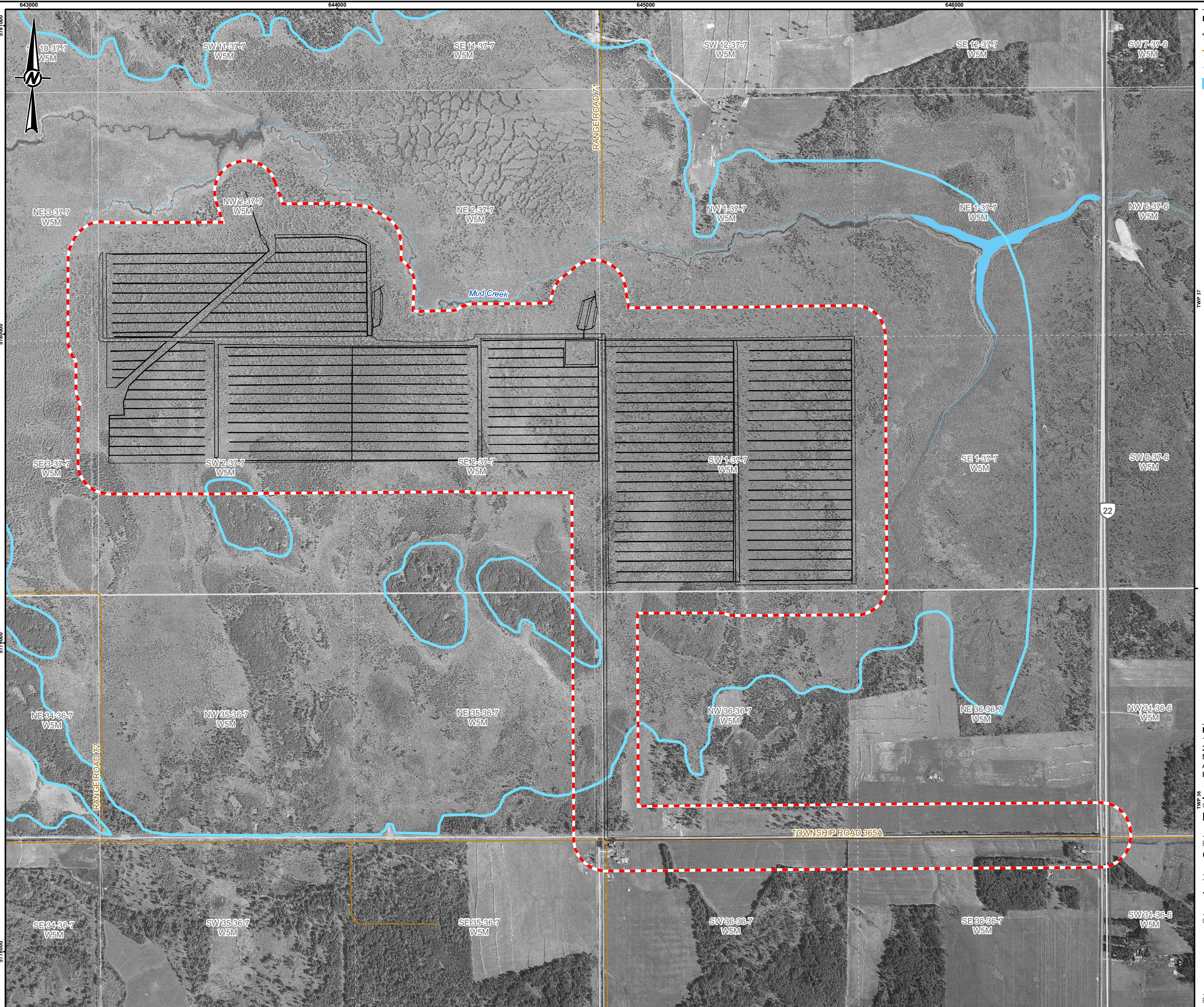
TITLE
1952 WETLAND BOUNDARY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	LMS/ANK
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	A-1



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 1962 WETLAND BOUNDARY
- PROJECT FOOTPRINT - PHASE 1
- LOCAL STUDY AREA

REFERENCE(S)

1. AIR PHOTO (0826 134-PS) OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS.
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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
1962 WETLAND BOUNDARY

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	LMS/ANK
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	A-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm

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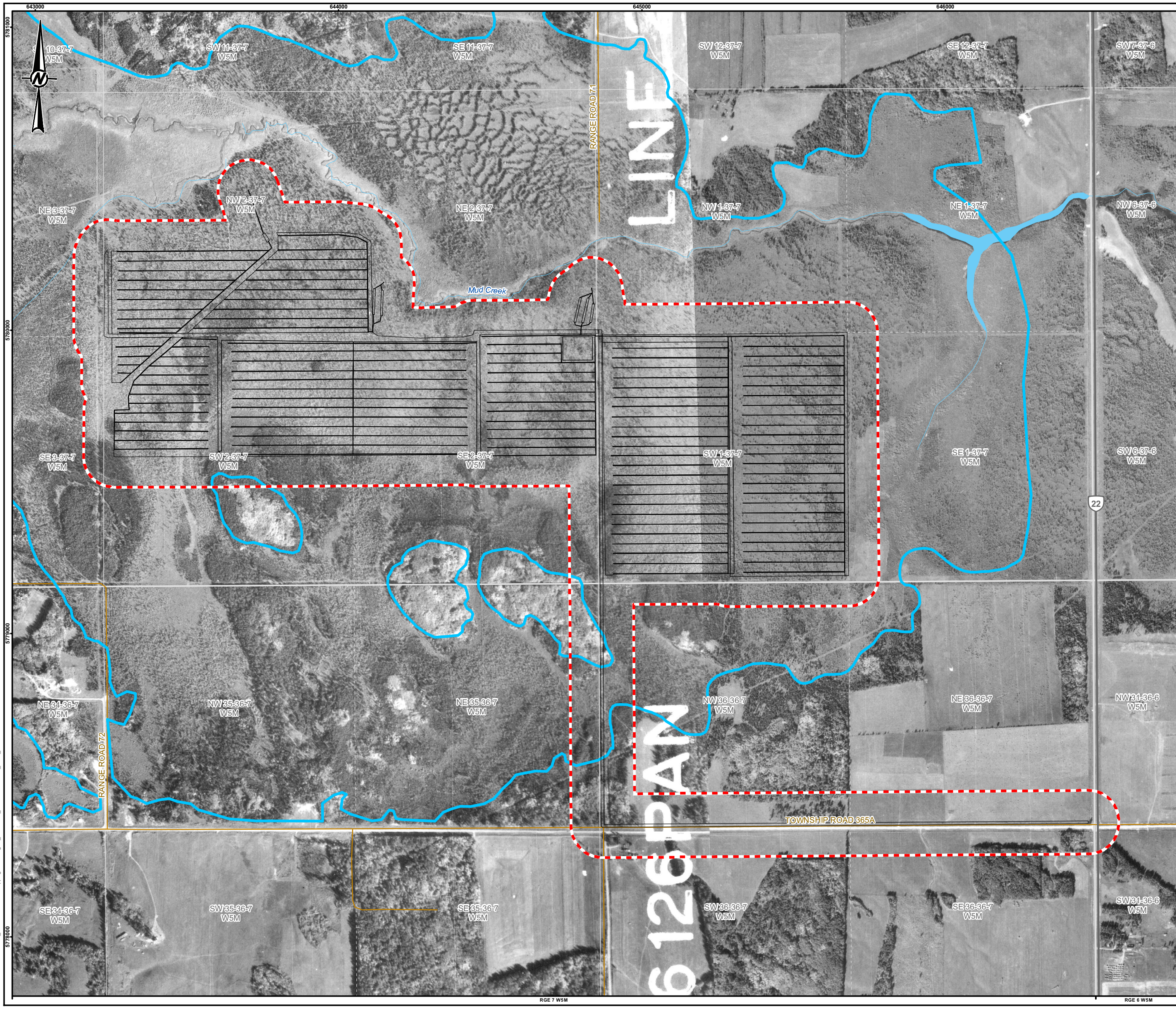

LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 1976 WETLAND BOUNDARY
- PROJECT FOOTPRINT - PHASE 1
- LOCAL STUDY AREA

0 250 500

1:12,500 METRES

REFERENCE(S)

1. AIR PHOTO (1533 130-EP AND 1533 157-EP) OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS.
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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
1976 WETLAND BOUNDARY

CONSULTANT

GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	LMS/ANK
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	A-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25mm

LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 1982 WETLAND BOUNDARY
- PROJECT FOOTPRINT - PHASE 1
- LOCAL STUDY AREA

0 250 500

1:12,500 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
1982 WETLAND BOUNDARY

CONSULTANT

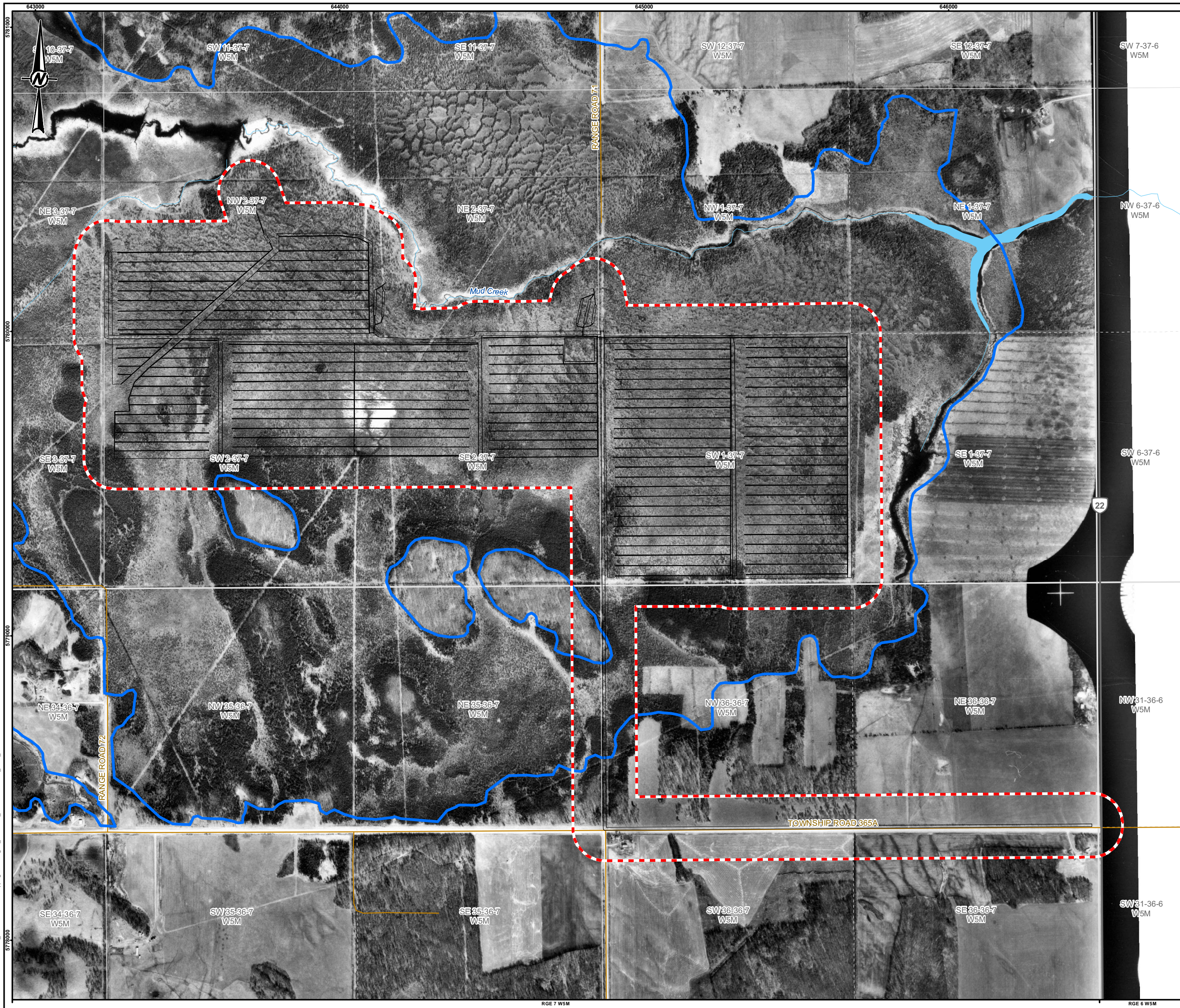
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	LMS/ANK
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	A-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 1986 WETLAND BOUNDARY
- PROJECT FOOTPRINT - PHASE 1
- LOCAL STUDY AREA

0 250 500

1:12,500 METRES

REFERENCE(S)

1. AIR PHOTO (3301 058-EP) OBTAINED FROM ALBERTA ENVIRONMENT AND PARKS.
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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
1986 WETLAND BOUNDARY

CONSULTANT

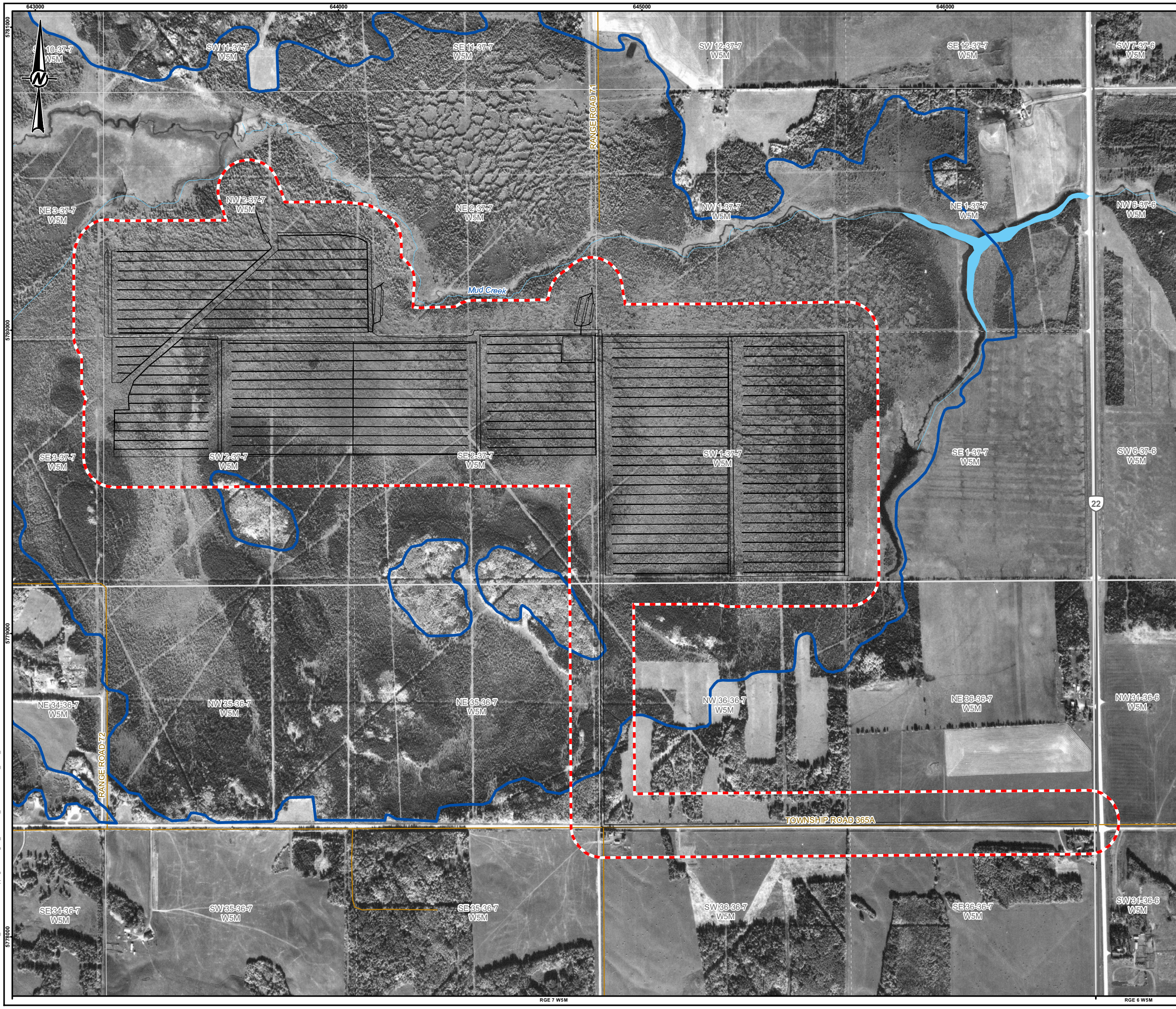
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	LMS/ANK
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	A-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 1993 WETLAND BOUNDARY
- PROJECT FOOTPRINT - PHASE 1
- LOCAL STUDY AREA

0 250 500

1:12,500 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
1993 WETLAND BOUNDARY

CONSULTANT

GOLDER
MEMBER OF WSP

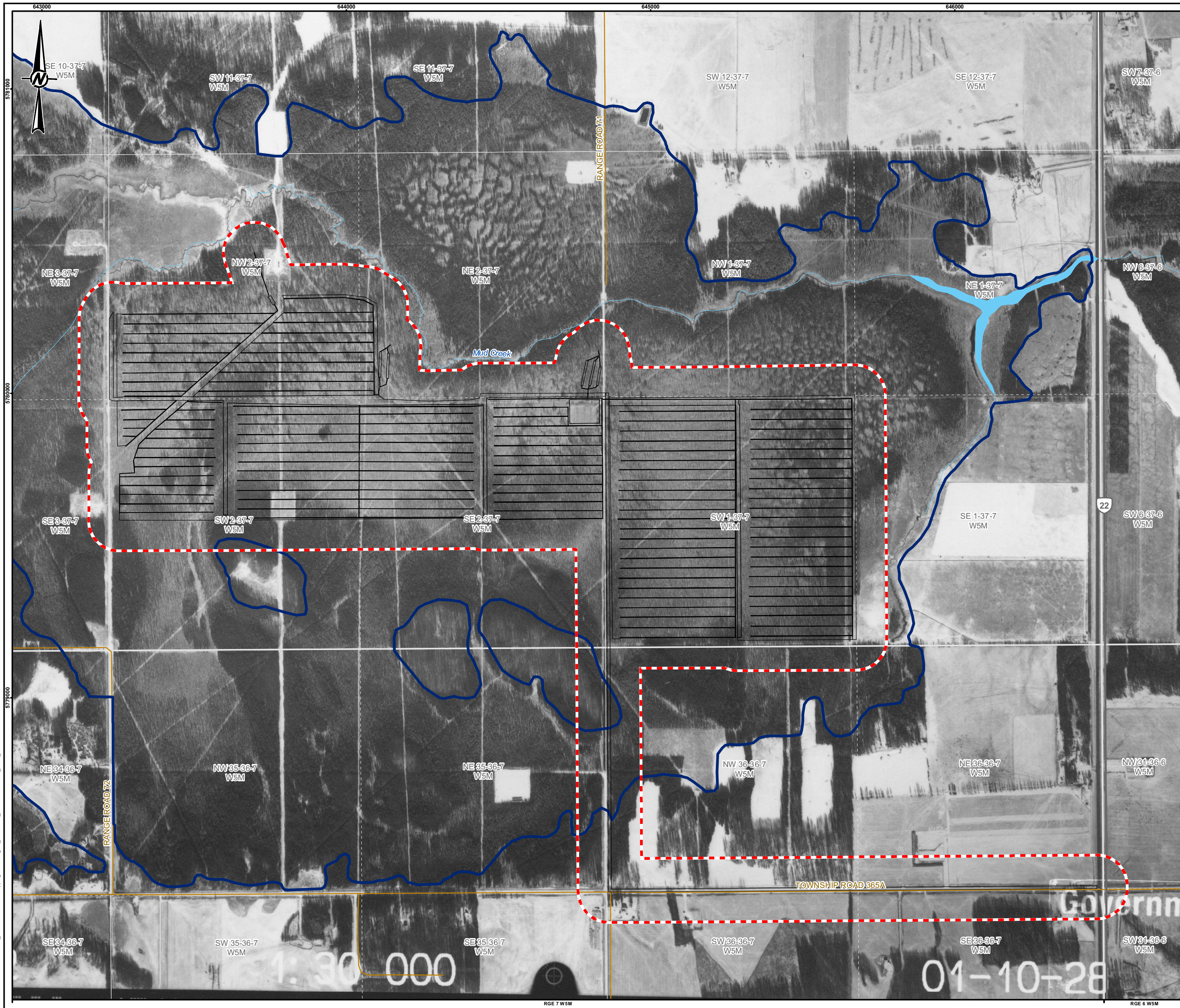
YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	LMS/ANK
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	A-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

PATH: I:\CLIENTS\PREMIER_TECH\21496738\Mapping\WAIR\FigA6_21496738_HistoricalWetland_1993_Rev0.mxd PRINTED ON: 2022-01-31 AT: 11:57:45 AM



LEGEND

- PRIMARY HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- 2001 WETLAND BOUNDARY
- PROJECT FOOTPRINT - PHASE 1
- LOCAL STUDY AREA

0 250 500

1:12,500 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD 83

CLIENT
PREMIER TECH HORTICULTURE

PROJECT
CLEARWATER PEAT HARVEST PROJECT

TITLE
2001 WETLAND BOUNDARY

CONSULTANT
GOLDER MEMBER OF WSP

YYYY-MM-DD	2022-01-31
DESIGNED	KS
PREPARED	LMS/ANK
REVIEWED	JP
APPROVED	VC

PROJECT NO.	PHASE	REV.	FIGURE
21496738	2000	0	A-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

APPENDIX B

Alberta Wetland Classification System

Table 1: Wetland Classes, Forms and Types in the Alberta Wetland Classification System (AWCS) (adapted from GOA 2015c)

Class	Form	Types			AWCS Full Code	AWCS Class-Form Mapcode
		Water Permanence [(a)]	Salinity [(b)]	Acidity-alkalinity		
Bog (B)	Wooded, coniferous (Wc)	--	Freshwater (f)	Acidic (a)	B-Wc-f-a	B-Wc
	Shrubby (S)	--	Freshwater (f)	Acidic (a)	B-S-f-a	B-S
	Graminoid (G)	--	Freshwater (f)	Acidic (a)	B-G-f-a	B-G
Fen (F)	Wooded, coniferous (Wc)	--	Freshwater (f)	Poor (p)	F-Wc-f-p	F-Wc
				Moderate-rich (mr)	F-Wc-f-mr	
	Shrubby (S)	--	Freshwater (f)	Poor (p)	F-S-f-p	F-S
				Moderate-rich (mr)	F-S-f-mr	
				Extreme-rich (er)	F-S-f-er	
			Slightly-brackish (sb)	Extreme-rich (er)	F-S-sb-er	
	Graminoid (G)	--	Freshwater (f)	Poor (p)	F-G-f-p	F-G
				Moderate-rich (mr)	F-G-f-mr	
				Extreme-rich (er)	F-G-f-er	
		--	Slightly-brackish (sb)	Extreme-rich (er)	F-G-sb-er	
Marsh (M)	Graminoid (G)	Temporary (II)	Freshwater (f)	--	M-G(II)f	M-G(II)
			Slightly-brackish (sb)	--	M-G(II)sb	
		Seasonal (III)	Freshwater (f)	--	M-G(III)f	M-G(III)
			Slightly-brackish (sb)	--	M-G(III)sb	
			Moderately-brackish (mb)	--	M-G(III)mb	
		Semi-permanent (IV)	Freshwater (f)	--	M-G(IV)f	M-G(IV)
			Slightly-brackish (sb)	--	M-G(IV)sb	
			Moderately-brackish (mb)	--	M-G(IV)mb	
			Brackish (b)	--	M-G(IV)b	
Shallow Open Water (W)	Submersed and/or floating aquatic vegetation (A)	Seasonal (III)	Freshwater (f)	--	W-A(III)f	W-A(III)
			Slightly-brackish (sb)	--	W-A(III)sb	
			Moderately-brackish (mb)	--	W-A(III)mb	
		Semi-permanent (IV)	Freshwater (f)	--	W-A(IV)f	W-A(IV)
			Slightly-brackish (sb)	--	W-A(IV)sb	
			Moderately-brackish (mb)	--	W-A(IV)mb	
			Brackish (b)	--	W-A(IV)b	
			Sub-saline (ss)	--	W-A(IV)ss	
		Permanent (V)	Slightly-brackish (sb)	--	W-A(V)sb	W-A(V)
			Moderately-brackish (mb)	--	W-A(V)mb	
			Brackish (b)	--	W-A(V)b	
			Sub-saline (ss)	--	W-A(V)ss	
		Intermittent (VI)	Saline (s)	--	W-A(VI)s	W-A(VI)

Table 1: Wetland Classes, Forms and Types in the Alberta Wetland Classification System (AWCS) (adapted from GOA 2015c)

Class	Form	Types			AWCS Full Code	AWCS Class-Form Mapcode
		Water Permanence [a]	Salinity [b]	Acidity-alkalinity		
Shallow Open Water (W)	Bare (B)	Seasonal (III)	Freshwater (f)	--	W-B(III)f	W-B(III)
			Slightly-brackish (sb)	--	W-B(III)sb	
			Moderately-brackish (mb)	--	W-B-III-mb	
		Semi-permanent (IV)	Freshwater (f)	--	W-B(IV)f	W-B(IV)
			Slightly-brackish (sb)	--	W-B(IV)sb	
			Moderately-brackish (mb)	--	W-B(IV)mb	
			Brackish (b)	--	W-B(IV)b	
			Sub-saline (ss)	--	W-B(IV)ss	
		Permanent (V)	Slightly-brackish (sb)	--	W-B(V)sb	W-B(V)
			Moderately-brackish (mb)	--	W-B(V)mb	
			Brackish (b)	--	W-B(V)b	
			Sub-saline (ss)	--	W-B(V)ss	
Swamp (S)	Wooded, coniferous (Wc)	--	--	--	S-Wc	S-Wc
	Wooded, mixedwood (Wm)	--	--	--	S-Wm	S-Wm
	Wooded, deciduous (Wd)	--	--	--	S-Wd	S-Wd
	Shrubby (S)	Temporary (II)	Freshwater (f)	--	S-S-II-f	S-S(II)
			Slightly-brackish (sb)	--	S-S-II-sb	
		Seasonal (III)	Freshwater (f)	--	S-S-III-f	S-S(III)
			Slightly-brackish (sb)	--	S-S-III-sb	
			Moderately-brackish (mb)	--	S-S-III-mb	
			Brackish (b)	--	S-S-III-b	
			Sub-saline (ss)	--	S-S-III-ss	

(a) Water permanence and plant community zones described in Table 2.

(b) Salinity types defined in Table 3.

Table 2: Plant Community Zones for Marshes and Shallow Open Water Wetlands

Wetland Type (permanence)	Hydroperiod	Plant Community Zone
Temporary (II)	Surface water is present for a short period of time after snowmelt or a heavy rainfall	Wet Meadow
Seasonal (III)	Surface water is present throughout the majority of the growing season, but is typically dry by the end of the summer	Shallow Wetland
Semi-permanent (IV)	Surface water is present for most or all of the year, except in periods of drought	Deep Wetland
Permanent (V)	Surface water is present throughout the year	Open Water
Intermittent (VI)	Alternates between saline open water and exposed bottom	Alkaline

Table 3: Salinity Types and Corresponding Conductivity Ranges (adapted from Stewart and Kantrud, 1971)

Wetland Type	Conductivity (µS/cm)
Freshwater	<500
Slightly brackish	500 – 2000
Moderately brackish	2000 – 5000
Brackish	5000 – 15000
Sub-saline	15000 – 45000
Saline	>45000

APPENDIX C

LSA Photographs

Photo 1: Looking south within plot W01A (Graminoid Fen component of Wooded Coniferous Fen) (Latitude: 52.155594, Longitude: -114.906044)

Photo 2: Looking north within plot W01A (Graminoid Fen component of Wooded Coniferous Fen) (Latitude: 52.155558, Longitude: -114.906069)

Photo 3: Looking west towards plot W01B (Shrubby Fen component of Wooded Coniferous Fen) (Latitude: 52.151731, Longitude: -114.879411)

Photo 4: Looking north within plot W01B (Shrubby Fen component of Wooded Coniferous Fen) (Latitude: 52.151756, Longitude: -114.885456)

Photo 5: Looking west towards plot W01C (Wooded Coniferous Fen) (Latitude: 52.151606, Longitude: -114.905083)

Photo 6: Looking north-west within plot W01C (Wooded Coniferous Fen) (Latitude: 52.152656, Longitude: -114.900961)

Photo 7: Looking north-west within plot W01C (Wooded Coniferous Fen) (Latitude: 52.160689, Longitude: -114.888519)

APPENDIX D

Confirmation of Surface Material Lease

EDS: Main Menu - Windows Internet Explorer

https://securexnet.env.gov.ab.ca/eds/econtrol

Page Tools

ELECTRONIC DISPOSITION SYSTEM

- Contact Us
- EDS Website
- Help
- Logout

Alberta Government

Location: Alberta Government > Sustainable Resource Development > Electronic Disposition System

Amendment

Your submission has been accepted. Click the Finish button to return to the main menu.

Your Reference # is: 86294

Amendment for SML090026

Display and Print Form (PDF Format, open with Adobe Acrobat)

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Finish

Oct 14, 2010, 11:56AM

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Alberta Government

Done Internet 100%

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APPENDIX E

Alberta Wetland Rapid Evaluation Tool – Actual

Scores will appear below after all data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Results for this Wetland Assessment Area (AA):	
Specific Functions:	**ABWRET-a Score**
Surface Water Storage (WS)	0.56
Stream Flow Support (SFS)	10.00
Water Cooling (WC)	0.00
Sediment Retention & Stabilization (SR)	0.76
Phosphorus Retention (PR)	0.28
Nitrate Removal & Retention (NR)	1.40
Organic Nutrient Export (OE)	0.00
Fish Habitat (FH)	0.95
Aquatic Invertebrate Habitat (INV)	0.96
Amphibian Habitat (AM)	1.40
Waterbird Habitat (WB)	0.42
Songbird, Raptor, & Mammal Habitat (SBM)	1.67
Native Plant & Pollinator Habitat (PH)	0.43
Fire Break (FB)	0.00
Human Use & Recognition (HU)	2.25

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