

**AQUATIC SITE ASSESSMENT FOR THE  
MINE SITE C EXPANSION PROJECT—2014**

Prepared for

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## **INTRODUCTION**

ConocoPhillips Alaska, Inc., (CPAI) is proposing to expand Mine Site C, in the Kuparuk River Unit (KRU) oilfield on the North Slope of Alaska (Figure 1). The mine site is located adjacent to CPAI's Kuparuk Operations Center (KOC) and Central Processing Facility 1 (CPF1). This aquatic site assessment has been prepared to provide information on wetlands in the area in support of a Section 404 wetland permit and mitigation plan. The study area was developed by buffering the proposed expansion footprint by 200 meters to encompass potential areas of indirect impact. The proposed project study area for wetlands is 300 acres in size.

## **METHODS**

### **WETLAND CLASSIFICATION AND MAPPING**

The existing U.S. Fish and Wildlife (USFWS) National Wetlands Inventory (NWI) map of the area is at too small a scale to be useful for evaluating the wetland functions in the study area. Instead, we used Ecological Land Survey (ELS) maps and associated data for the Colville River Delta and Central Kuparuk region (Jorgenson et. al. 1997, Roth et. al. 2007) to support the creation of a wetlands map to serve as the basis of the ASA. The ELS maps (mapped at a scale of 1:10,000) present ecotypes, or local-scale ecosystems that describe the geomorphology, surface form, and vegetation in the study area. These data can then be used to derive a number of map products, including terrain sensitivity, and wildlife habitat maps. In this study the additional information provided by the ELS ITU codes is used to refine NWI wetland types into functional wetland groups suitable for evaluation with respect to a list of standard wetland functions.

Geomorphic (terrain) units incorporate landform-soil characteristics developed for Alaska by Kreig and Reger (1982) and the Alaska Division of Geological and Geophysical Survey (1983). Surficial deposits were emphasized, as they have the most influence on ecological processes. Geomorphic units incorporate physiography, slope and watershed position, and connections to adjacent waters. Surface forms (macrotopography) are based on a system modified by Schoenberger et al. (1998) and microtopography follows Washburn's (1973) periglacial classification. Vegetation classes are modified from the system developed by Viereck et al. (1992).

The ELS ecotypes and derived vegetation types (Roth et. al. 2007) were crosswalked to Cowardin et al. (1979) wetland types (Table 1), using standard NWI annotation (Dahl et al. 2009). Some NWI classes include multiple ELS ecotypes and vegetation types. For example, Permanently Flooded Emergent Marsh includes both persistent Sedge Marsh and non-persistent Grass Marsh, because these wetlands are not consistently distinguishable on the available imagery. This crosswalk was applied to the central Kuparuk ELS GIS data, and linework was refined as necessary to provide a fine-scale (1:2,000) map for wetlands permitting. A minimum map unit size of 0.1 acre was applied for permanently to seasonally flooded/saturated wetlands, and 0.5 acre for saturated to seasonally flooded wetlands and non-wetlands.

## **ASSESSMENT OF WETLANDS AND WATERS FUNCTIONS**

Defining and evaluating wetland functions in Alaska is challenging, in part because the areas of interest are often large, data are limited, and no consistent assessment method has been developed. For this study, a qualitative, best professional judgment (BPJ) method, based on hydrogeomorphic (HGM) principles and available data, were used to evaluate the functions performed by wetlands and their functional capacity. This approach has several advantages: it allows the ASA to be performed as a desk-top exercise using available GIS data and imagery; it has the flexibility to be modified to suit individual regions; and it evaluates standard, widely accepted wetland functions, allowing comparison to other wetlands. Specific field data will be collected during the 2014 summer growing season to support the findings of this report should they be required during the permitting process.

A qualitative, rapid, functional assessment was performed for each NWI type using an assessment procedure provided in the U.S. Army Corps of Engineers (USACE) *Regulatory Guidance Letter RGL-09-01* (USACE 2009). The RGL-09-01 was recently rescinded (pers. comm. Phone request to the Alaska Regulatory Headquarters, 11 June 2014) and currently, there is no standard or recommended method to assess wetlands on the Arctic Coastal Plain or elsewhere in Alaska. Therefore, the framework of the RGL-09-01 document was used, but substantial revisions to the functional criteria were made to address the common concerns expressed in agency reviews for similar areas. The *Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for the North Slope, Alaska* data forms were completed for each NWI type, and are presented in Appendix A.

Functions performed by wetlands and waters in the study area were assessed through a combination of interpreting aerial photography, reviewing existing maps and data, and examining local topography. These sources were used to define the environmental conditions and characteristics for each NWI type. Each function was then rated as low, moderate, or high, depending on both the capability and opportunity for a given function to be performed. The general classification scheme for the wetland types followed Cowardin et al. (1979) using map notation guidelines outlined in Dahl et al. (2009). Special attention was paid to individual NWI types that occur in more than one hydrogeomorphic system. For example, a Saturated Emergent Persistent/Broadleaf Deciduous type (PEM1/SS1B) may occur in both lowland and upland settings, and thus may need to be evaluated separately for wetland function.

To be consistent with previous functional evaluations for the region, the list of 8 functions recommended in the recently rescinded regulatory guidance letter (RGL-09-01) was used. To tailor the forms more specifically to ACP wetlands, and allow available data to be used, the evaluation questions and rating criteria for individual functions were revised where appropriate. The most substantive changes were made in evaluating flood flow regulation and general habitat suitability criteria. For example, in this site specific BPJ evaluation the PEM1/SS1E wetland type is considered high value for flood flow regulation using only flood flow regulation characteristics relevant to the ACP. While PEM1/SS1E wetlands provide for some storage of floodwater, they do not detain even a fraction of the total water discharged during peak flow and consequently, only rank high relative to the other wetlands that occur in the study area. Because wetlands in the ACP are part of a continuous permafrost system and are dormant with soils frozen to the surface during the annual peak flood event, typical flood storage functions attributed to many wetlands are limited. In addition, cold soils and shallow active layers result in slow decomposition of organic matter and low primary productivity. The physically (vs. biologically) constrained ecosystem that typifies the North Slope also results in low plant species diversity. With these factors in mind, a description of each evaluated function and the changes made to the evaluation criteria are presented below.

**Flood flow regulation** assesses the ability of the wetland to control surface water flow, consequently moderating downstream flooding. The dominant flood events in arctic watersheds are snowmelt generated (McNamara et al. 1998), particularly in the low-gradient rivers and

streams found on the Arctic Coastal Plain (ACP). Bowling et al. (2003) summarize the coastal plain. For example, the Putuligayuk River on the ACP undergoes a significant runoff event each spring, which peaks 7–10 days after snowmelt (Bowling et al. 2003). Wetlands and waters on the ACP are near their annual maximum for surface wetness just after snowmelt and gradually lose water over the summer, as evapotranspiration greatly exceeds precipitation (Mendez et al. 1998). Thus, flood flow regulation was assessed from the standpoint of snowmelt-generated floods, which 1) affect most communities outside the active floodplains on the ACP as sheetflow, 2) were assumed to fill any available spring storage, and 3) occur outside the growing season. Because the largest seasonal floods occur at snowmelt, when the wetlands affected by sheet flow are largely dormant, capacity for floodwater storage is largely determined by the presence of depressions that can store floodwater. To assess storage in wetlands outside the active riverine channels, the role of polygonal features was considered, specifically the difference between low center polygons (large depressions with raised rims) and high-and low-center polygons (a mixture of mounds and inundated depressions) (Liljedahl et al. 2012), were considered in assessing storage. Surface roughness provided by live vegetation was only considered when seasonal flooding from rainfall events was likely to occur.

**Sediment, nutrient, and toxicant removal** assesses the ability of the wetlands to retain suspended sediment and associated toxicants, and the detention and transformation of nitrogen and phosphorous. For this function to occur, water must enter the system and be retained in slow moving pools allowing for settlement. The water source for all ACP wetlands in the Mine Site C Expansion Study area is considered to be snowmelt and indicators of floodwater storage include periglacial depressional features as described for flood flow regulation. Other wetland characteristics evaluated for this function include a thick soil organic horizon that can filter sediments and provide the opportunity for biochemical transformation, and dense vegetation layers that also can filter and trap sediments. Wetlands downstream of active development projects are considered to have a higher probability of performing this function.

**Erosion control and shoreline stabilization** assesses the degree to which the wetland reduces erosion at the edges of relatively permanent waters. Existing ELS mapping (Jorgenson et al. 1997, Roth et. al. 2007) was used in conjunction with aerial imagery from 2008 and 2012 to assess bank erosion of lakes, ponds, rivers, and streams.

**Organic matter production and export** assesses the ability of the wetland to make organic matter contributions (through primary production) to the food web. ELS data (Jorgenson et al. 1997, Roth et. al. 2007) were used to assess production of organic matter by herbaceous and deciduous woody vegetation in wetlands and the degree to which these wetlands are connected to surface water or are exposed to flood flow.

**General habitat suitability** was assessed from a regional perspective, relying on work by Johnson et al. (2010, and 2013 and Phillips Alaska Inc. 2001) to evaluate habitat use, habitat preference, and habitat rarity. The Colville River Unit, Alpine Satellite Development Project Environmental Evaluation (Phillips Alaska, Inc. 2001) assessed habitat use by 12 species of mammals and 55 species of birds in the vicinity of the Alpine satellite development. For this ASA, a wetland type was considered to be used by a high diversity of species if it was used by at least half of these species, i.e. 6 mammals and 27 birds. The habitat preferences of threatened and endangered birds and candidate species were based on Johnson et al. (2013). Habitat preference of polar bears was not assessed in this ASA. Any potential polar bear use of the study area would occur during the winter, and would depend on terrain features independent of wetlands and waters (e.g., snowdrift depth).

**Fish habitat** quality was evaluated by assessing the degree to which a wetland or water directly supports fish. Due to the extensive surface water connections early in the growing season, all waters and permanently flooded wetlands may support at seasonal populations of fish (BLM 2012). According to the Alaska Department of Fish and Game (ADF&G), *Anadromous Waters Catalog* (ADF&G, 2014) the east fork of the Ugnuravik River does not support an anadromous fish population, and Pothole Lake is too shallow to provide overwintering habitat (pers. comm. E-mail to Steve Brashears from ADF&G, 6 September 2013), thus, we assume that no fish are present in any of the permanent waters in the Mine Site C Expansion study area. Waters were still considered to be potential fish habitat and aerial imagery was used to assess the size and depth of surface water, presence and type of vegetation, and likely presence of spawning or rest areas.

**Educational, scientific, recreational, or subsistence use** reflects the degree to which a wetland provides direct support of hunting and gathering activities, local travel, and/or education. Subsistence use was evaluated based on information compiled in the *NE NPR-A*



*Environmental Impact Statement* (BLM 2012), but is considered low due to proximity to oil industry infrastructure and controlled access. No long-term research sites or permanent sample plots have been established in the Mine Site C study area and thus, it is not considered important for education. The existence of active summer access trails was assessed by air photo interpretation.

**Uniqueness and special status** addresses whether a wetland supports threatened or endangered (T&E) species through documented occurrence or designated critical habitat, contains rare features, or provides ecological services scarce for the area. None of the wetlands within the study area are considered special aquatic sites, nor are any special conservation areas or formally recognized or protected wetland types present.

## **CATEGORICAL RANKINGS OF WETLAND FUNCTION**

As part of the permitting process, wetlands are typically categorized using a four tiered system based on the level of overall wetland function. Both the USACE and U.S. Fish and Wildlife Service (USFWS) have specific definitions in the RGL-09-01 (USACE 2009) and the USFWS Part 501 FW 2 Mitigation Policy and Appendix 2 (1993a, b). The standard definitions are presented below, augmented with the site-specific criteria used to place individual wetlands into 1 of 4 resource categories.

**Category I: High functioning wetlands** — Uncommon wetlands that: 1) provide a documented life support function for threatened or endangered species; 2) represent a high quality example of a rare wetland type; 3) are rare within a given region; or, 4) are undisturbed and contain ecological attributes that are impossible or difficult to replace within a generation, if at all. Wetlands were given a Category I status if the following criteria were met in the BPJ assessment: 1) documented observations of applicable threatened, endangered or candidate wildlife species (TES) were found within the project study bounds, 2) a wetland was within an established critical habitat or 3) the wetland rated as high value for all of the 8 evaluated functions.

**Category II: High to moderate functioning wetlands** — Wetlands that: 1) provide habitat for very sensitive or important wildlife or plants; 2) are difficult to replace (such as bogs); or 3)

provide very high functions, particularly for wildlife habitat. Habitat is relatively scarce or becoming scarce on a national scale or within the region. Wetlands were given a Category II status if the following specific criteria were met in the BPJ assessment: 1) the wetland was documented as preferred habitat for TES species based on available studies or 2) the wetland was rated as high value for at least 1 of the 8 evaluated functions

**Category III: Moderate to low functioning wetlands** —Wetlands that are important for a variety of wildlife species and can provide watershed protection functions depending on where they are located. Generally these wetlands will be smaller and/or less diverse in the landscape than Category II wetlands. These wetlands may have experienced some form of degradation, but to a lesser degree than Category IV wetlands. Habitat is of high to moderate value. Wetlands were given a Category III status if the following criteria were met in the BPJ assessment 1) the wetland was rated as low or moderate value for all 8 evaluated functions or 2) if disturbed, the wetland was not degraded to the point of substantially altering original functions.

**Category IV: Degraded or low functioning wetlands** —The smallest, most isolated and least diverse wetlands, which likely have been degraded by human activities. Habitat in these wetlands is of medium to low value. Wetlands were given a Category IV status if the following criteria were met in the BPJ assessment 1) the wetland was entirely surrounded by development or 2) functional capacity was reduced in all 8 evaluated functions.

## RESULTS

Six NWI wetlands (4) and waters (2) classes were derived from the ELS mapping of the Mine Site C study area (Roth et al. 2007). The NWI codes and corresponding ecotypes, vegetation types and wildlife habitats derived from the ELS mapping are presented in Table 1. Descriptions of the wetland and waters types, as well as for 1 upland type found in the study area, are presented in Table 2.

### WETLAND AND WATER TYPES

The Ugnuravik River is a Lower Perennial Stream (R2UBH, 3.39 acres, 1.13% of the study area, Table 3) mapped along the west edge of the Mine Site C study area. The river is a low gradient, low velocity permanently flooded stream channel. The permanently flooded channel

was partitioned from the original mapping, which included both vegetated banks and waters in a riverine complex type (Table 1).

Permanently Flooded Ponds (PUBH, PUBHh; 83.21 acres, 27.76% of the study area) include Pothole Lake immediately south of the existing mine site (a natural lake partially filled by the current mine footprint), 4 moderate-sized natural ponds, and several smaller ponds formed in thermokarst pits. Ponds are components of the overall drained lake basin wetland complex immediately to the south of the active mine site (Figure 2).

Seasonally Flooded Saturated Emergent-Deciduous Shrub Meadow (PEM1/SS1E) is the most abundant wetland type in the study area (99.38 acres, 33.15% of the study area; Table 3). It occurs around the edges of Pothole Lake and 4 other large ponds (Figure 2). These wetlands include high-centered, low relief polygons and low-centered polygons, and are typically associated with the margins of drained lake basins (Table 2). Cover of surface water ranges from 5 to 20% early in the growing season, but is minimal by late summer.

Saturated Emergent Deciduous Shrub Meadow (PEM1/SS1B) is the second most abundant wetland type within the Mine Site C study area (65.53 acres, 21.86% of the study area, Table 3). PEM1/SS1B is primarily tussock tundra dominated by sedges and dwarf and ericaceous shrubs (Table 2). PEM1/SS1B occurs on convex terrain or slightly raised ridges on the margins of the PEM1/SS1E wetlands around Pothole Lake and surrounding the riparian area on the Ugnuravik (Figure 2).

Permanently Flooded Emergent Marsh (PEM1H) is an aquatic community that typically occurs in small discrete patches, usually in association with a lacustrine fringe or an infilling pond. It occurs along the margins of Pothole Lake and a small thaw pond on the east side of the study area (Figure 2, Table 2) and may comprise either sedges or grasses.

Seasonally Flooded Saturated Emergent Meadow (PEM1E) occurs immediately adjacent to the permanently flooded portions of the Ugnuravik (Figure 2, Table 2). The vegetation is dominated by emergent sedges. The overbank flooding is due to high water following breakup and rainstorms during the growing season.

Uplands (Us, Figure 2) are restricted to dry gravel fill used for roads and pads or excavation and pumping associated with the active mine site.

## AQUATIC SITE ASSESSMENT

Wetlands and waters in the Mine Site C Expansion study area were placed into 2 of the 4 functional categories (Table 4). No Category IV, degraded or low functioning wetlands, or Category I, high functioning wetlands, were identified within the study area (Table 4). While some of the individual wetlands (e.g., Pothole Lake) have been disturbed, they are still mostly intact and perform the ecosystem functions typically associated with natural waterbodies in the area. No critical habitat for threatened, endangered (TES) or candidate species occurs within the study area and no observations of TES species have been recorded; thus none of the wetlands warranted a Category I designation.

PEM1/SS1B wetlands within the study area were given a Category III status (Table 4). These wetlands are considered to have low to moderate rankings for each of the 8 evaluated functions (Appendix A). Relatively few birds and mammals use this community (Appendix A, Johnson et al. 2010) and it is not preferred habitat for any threatened or endangered species (Appendix A, Johnson et al. 2013). This wetland type has limited flood flow regulation potential; plays no role in erosion control and shoreline stabilization; does not provide fish habitat; and is widely distributed across the North Slope.

All other wetlands and waters within Mine Site C Expansion study area (Table 3) were given a Category II status for function, with mostly moderate to high functioning rankings (Table 4). The wetlands were rated high for at least one wetland function and/or considered preferred habitat for at least one threatened or endangered species (Appendix A).

PEM1H wetlands were given a Category II status for function because they are preferred habitat for both Spectacled Eiders and Yellow-billed Loons (Appendix A, Johnson et al. 2013).

PEM1E is a productive wetland type that scores high for sediment nutrient and toxicant removal, erosion control and shoreline stabilization, and organic matter production and export. This wetland type comprises persistent emergent sedges interspersed with quiet-water areas that in addition to snowmelt runoff, are subject to seasonal flood events. The dense emergent vegetation has the capacity to trap fluvial sediments and airborne dust (from nearby road traffic), as well as regulate water flow during high-precipitation events. The proximity of this wetland

type to the Ugnuravik River also allows for the export of dissolved organic matter downstream during high-water events (production is expected to be high for this wetland type).

PEM1/SS1E wetlands were rated high for flood flow regulation and organic matter production and export (Table 4). This wetland type contains numerous small depressions between raised polygons, which contribute to flood flow regulation. The vegetation is co-dominated by deciduous shrubs, which provides fine particulate litter that contributes organic matter to the system. Leaf litter from the previous year may be transported downstream during spring flooding.

The permanently flooded waters (R2UBH, PUBH, and PEM1H) types were rated moderate for fish habitat, based on the presence of overhanging bank vegetation and aquatic vegetation that could provide cover and potential spawning habitat. However, neither the waters nor the permanently flooded wetland within the Mine Site C Expansion study area support anadromous or resident fish because they are not deep enough to provide overwintering habitat.

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Table 1. Crosswalk table of NWI codes, ecotypes, vegetation types, and wildlife habitat types found within the proposed Mine Site C Expansion study area, Kuparuk River Unit oilfield, Alaska.

NWI Code	Ecotype	Vegetation	Habitat
Waters			
PUBH	Lowland Lake Human Modified Waterbody	Fresh Water	Deep Open Water with Islands or Polygonized Margins Deep Open Water without Islands Shallow Open Water with Islands or Polygonized Margins Shallow Open Water without Islands
R2UBH	Riverine Complex	Riverine Complex	Riverine Complex
Wetlands			
PEM1H	Lowland Sedge Marsh	Fresh Sedge Marsh	Sedge Marsh
PEM1E	Riverine Complex	Riverine Complex	Riverine Complex
PEM1/SS1E	Lowland Basin Complex	Old Basin Wetland Complex	Old Basin Wetland Complex
	Lowland Moist Sedge-Shrub Meadow	Moist Sedge Shrub Tundra	Moist Sedge-Shrub Meadow
PEM1/SS1B	Lowland Moist Sedge-Shrub Meadow	Moist Sedge Shrub Tundra	Moist Sedge-Shrub Meadow
	Upland Moist Tussock Meadow	Tussock Tundra	Moist Tussock Tundra
Uplands			
Us	Human Modified Barrens	Barren	Human Modified

Table 2. NWI code descriptions for the Mine Site C Expansion study area, Kuparuk River Unit oilfield, Alaska.

NWI Code	Description
<b>Waters</b>	
Pond (PUBH) (<20 acres)	Shallow thaw ponds <20 acres in size and <2m in depth freezing to the bottom during winter months. Form primarily in drained lake basins. Small inlets and outlets may be visible but the ponds in the Mine Site C study area were primarily considered depressional features fed mainly by surface water inputs (primarily runoff at breakup).
Lower Perennial Stream (R2UBH)	The east fork of the Ugnuravik River flows north along the west edge of the Mine Site C study area. The channel is sinuous with low gradients and low water velocities.
<b>Wetlands</b>	
Seasonally Flooded Saturated Emergent Meadow (PEM1E)	Nonpatterned wet sedge meadows occurring at the edges of the Ugnuravik River. Dominated by robust growth of sedges such as <i>Carex aquatilis</i> and <i>Eriophorum angustifolium</i> . Low and dwarf willows ( <i>Salix richardsonii</i> , <i>S. reticulata</i> and <i>S. pulchra</i> ) may also be present.
Permanently Flooded Emergent Marsh (PEM1H)	An emergent plant community occurring at the edges or center of permanently flooded thaw ponds. These communities are a component of the drained lake basin wetland complex and function primarily as depressional wetlands similar in function to thaw ponds. Species composition is primarily pendant grass ( <i>Arctophila fulva</i> ) or water sedge ( <i>Carex aquatilis</i> ).
Seasonally Flooded/Saturated Emergent-Deciduous Shrub Meadow (PEM1/SS1E)	A mixture of high centered, low relief polygons and low centered polygons on gentle slopes at the margins of drained lake basins or rarely on inactive floodplain surfaces. Surface water is present in low lying troughs and accounts for 5 to 20% areal cover in the early season, drying out by fall. Vegetation is dominated by <i>Carex bigelowii</i> and <i>Dryas integrifolia</i> . Active layers are relatively shallow.
Saturated Emergent-Deciduous Shrub Meadow (PEM1/SS1B)	Moist tussock tundra occupying convex topography and gently rolling slopes between drained lake basins. Patterned ground features are limited and when present consist of high center polygons with <5% areal cover of inundated depressions. Dominated by a variety of sedges including <i>Eriophorum vaginatum</i> , <i>E. angustifolium</i> and <i>Carex aquatilis</i> . Dwarf and low ericaceous shrubs are also common.
<b>Uplands</b>	
Human Disturbed Barrens (Us)	Unvegetated barrens from placement of fill material for roads and pads.

Table 3. Area (acreage, % of footprint) of wetlands and non-wetlands for the Mine Site C Expansion study area, Kuparuk River Unit oilfield, Alaska. The study area includes the mine expansion footprint and a 200 meter buffer around the perimeter.

NWI Code <sup>1</sup>	NWI Description	Total Acres	% of Total	Functional Category
<b>Waters</b>				
PUBH, PUBHh	Pond	83.21	27.76	II
R2UBH	Lower Perennial Stream	3.39	1.13	II
	<b>Waters Total</b>	<b>86.60</b>	<b>28.89</b>	
<b>Wetlands</b>				
PEM1E	Seasonally Flooded Saturated Emergent Meadow	4.60	1.53	II
PEM1H	Permanently Flooded Emergent Marsh	3.72	1.24	II
PEM1/SS1E	Seasonally Flooded/Saturated Emergent-Deciduous Shrub Meadow	99.38	33.15	II
PEM1/SS1B	Saturated Emergent-Deciduous Shrub Meadow	65.53	21.86	III
	<b>Wetlands Total</b>	<b>173.23</b>	<b>57.78</b>	
<b>Uplands</b>				
Us	Human Disturbed Barrens	39.99	13.33	
	<b>Uplands Total</b>	<b>39.99</b>	<b>13.33</b>	
	<b>Grand Total</b>	<b>299.82</b>	<b>100.00</b>	

<sup>1</sup> Cowardin et al. (1979).

Table 4. Relative functional rankings and overall functional categories for NWI codes occurring in Mine Site C Expansion study area, Kuparuk River Unit oilfield, Alaska.

NWI Code	Overall Functional Category	Flood Flow Regulation	Sediment, Nutrient, & Toxicant Removal	Erosion Control and Shoreline Stabilization	Organic Matter Production & Export	General Habitat Suitability	Fish Habitat	Subsistence/Recreational/Educational Value	Uniqueness & Special Status
PUBH	II	MODERATE	MODERATE	N/A	N/A	MODERATE	HIGH	LOW	LOW
R2UBH	II	N/A	MODERATE	N/A	N/A	LOW	HIGH	LOW	LOW
PEM1E	II	LOW	HIGH	HIGH	HIGH	MODERATE	LOW	LOW	LOW
PEM1H	II	MODERATE	MODERATE	HIGH	MODERATE	HIGH	HIGH	LOW	LOW
PEM1/SS1E	II	HIGH	MODERATE	N/A	HIGH	MODERATE	N/A	LOW	LOW
PEM1/SS1B	III	LOW	MODERATE	N/A	MODERATE	LOW	N/A	LOW	LOW

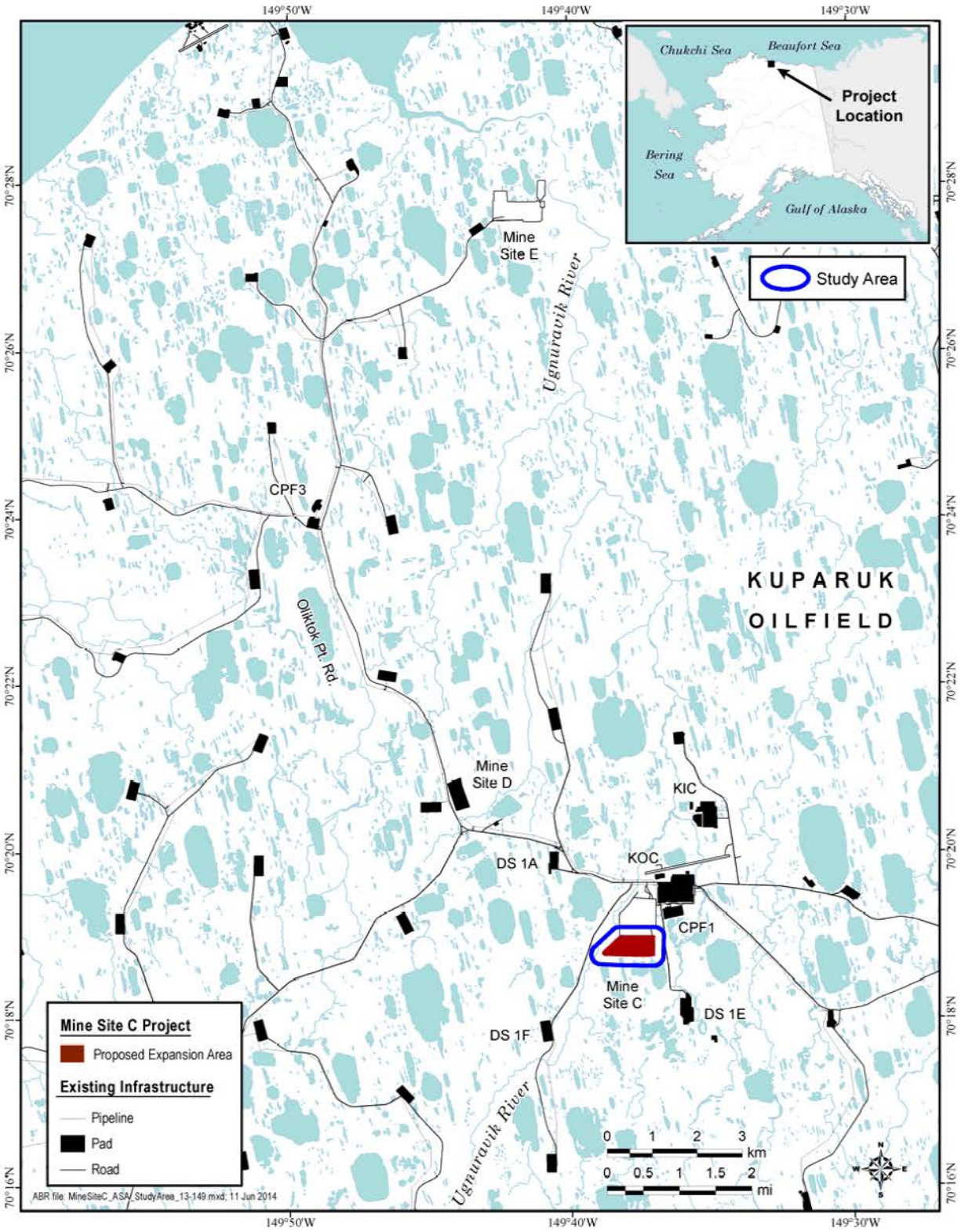
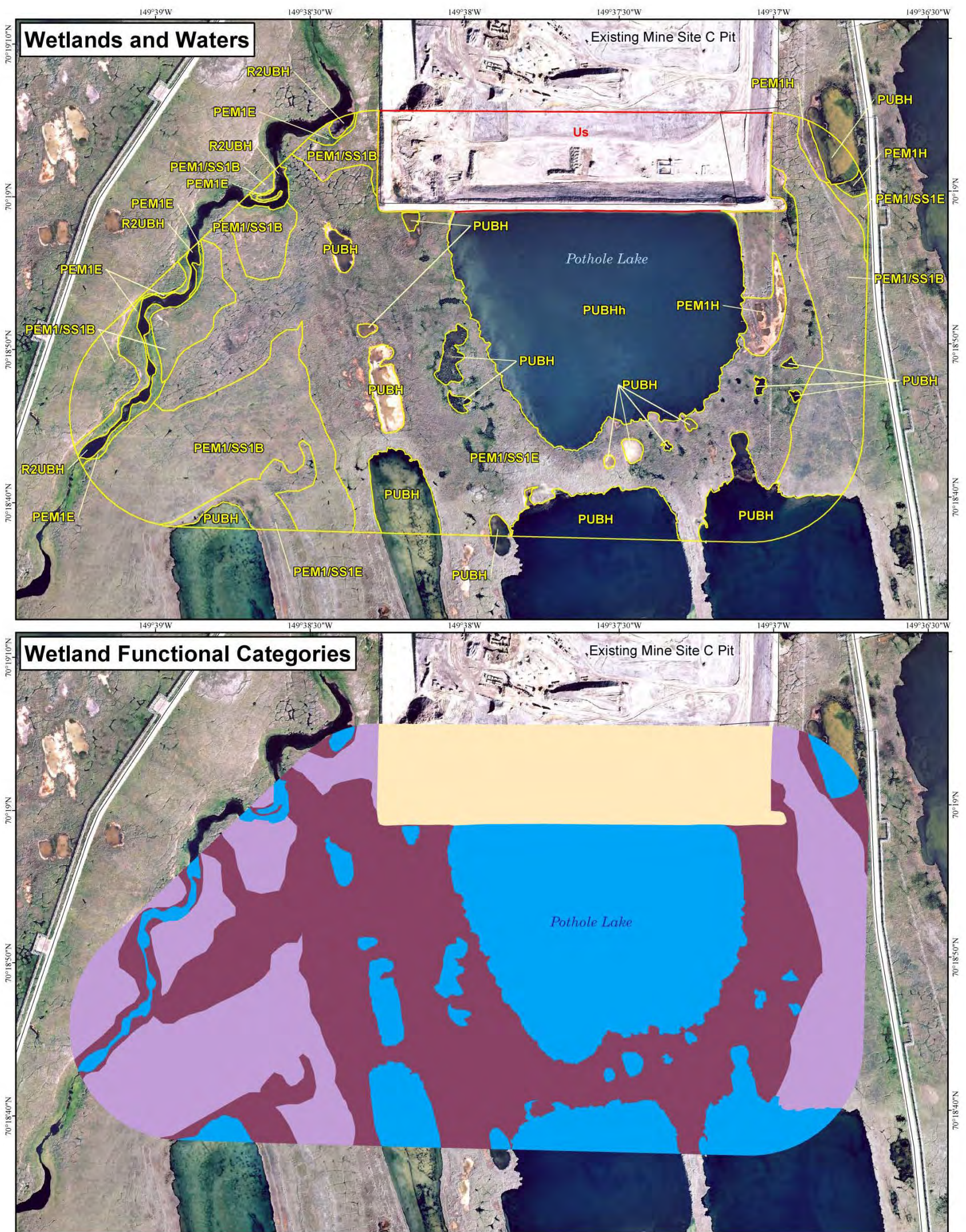


Figure 1. Mine Site C Expansion study area location.





**Waters of the U.S.<sup>1</sup>**

- PUBH Pond
- PUBHh Impounded or Excavated Pond
- R2UBH Lower Perennial Stream

**Wetlands<sup>1</sup>**

- PEM1H Permanently Flooded Emergent Marsh
- PEM1E Seasonally Flooded Saturated Emergent Meadow
- PEM1/SS1E Seasonally Flooded Saturated Emergent-Deciduous Shrub Meadow
- PEM1/SS1B Saturated Emergent-Deciduous Shrub Meadow

**Uplands**

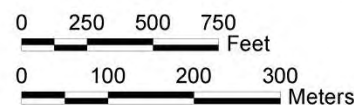
- Us Human Disturbed Barrens

<sup>1</sup> Follows National Wetlands Inventory (NWI) map conventions and Cowardin et al. (1979) classification system.

**Wetland Functional Categories**

- II
- III
- Waters (II)
- Upland

Notes: Background imagery acquired by Quantum Spatial, Inc. July 25, 2012 at 1-ft resolution. Map scale 1:8,000 when printed at 11x17. Map projection: Alaska State Plane 4, NAD83, ft.



ABR file: MineSiteC\_ASA\_Portrait\_13-149.mxd; 11 Jun 2014

Figure 2. Wetland and waters types and categorical rankings for the Mine Site C Expansion study area.



Appendix A. Best Professional Judgment Characterization for North Slope, Alaska, Mine Site C Aquatic Site Assessment.

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

<b>Pond (&lt;20 acres) (PUBH)</b>		
<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>A. Flood Flow Regulation (Storage)</b>		
1. Dense persistent vegetation or raised polygonal rims present. (N/A if assessing waters)	1. N/A	The dominant flood event on the Arctic Coastal Plain (ACP) is snowmelt, which occurs in spring when wetlands are frozen at the surface and vegetation is still dormant. Flood flow storage is primarily provided by depressed topographical features. The ponds in the Mine Site C study area were all considered to be depressional; they receive floodwaters from snowmelt regardless of the distance from a flowing waterbody or the presence of active inlets and outlets.
2. Wetland or water is a depressional system capable of storage.	2. Y	
3. Wetland or water shows signs of storage (i.e. fluctuating water levels, algal mats, and/or lodged debris).	3. Y	
4. Wetland or water receives floodwater at least once every 10 years.	4. Y	
5. Floodwaters enter and flow through wetland predominantly as sheet flow rather than channel flow. (N/A if assessing riverine waters)	5. Y	
Rating Criteria: 5 (Y) = High, 3-4 (Y) = Moderate, 0-2 (Y) = Low		<b>Moderate</b>
<b>B. Sediment, Nutrient (N and P), Toxicant Removal</b>		
1. Sediment, nutrients and/or toxicants (from tillage, mining, construction or other sources of pollution) appear to be or are likely to be entering the wetland or water.	1. Y	There are 4 large naturally occurring ponds in the Mine Site C study area. All of the ponds are within 1/3 mile from the active Mine Site C pit and are bordered on each side by active roads. Pollutants in the form of fugitive dust are likely to be entering the system. The ponds perform a sediment (dust) retention function, resulting in a moderate ranking for this function.
2. Slow-moving or still water is present or occurs during flooding that happens at least once every 10 years.	2. Y	
3. Dense (>50% cover) persistent herbaceous and/or woody vegetation is present. (N/A if assessing waters)	3. N/A	
4. At least moderate interspersed vegetation and water is present or occurs during flooding that happens at least once every 10 years. Surface water patches should account for >10 areal coverage. (N/A if assessing waters)	4. N/A	
5. Sediment deposits are present (evidence of deposition during natural flood events).	5. Y	
6. Thick surface organic horizon and/or abundant fine organic litter is present. (N/A if assessing waters)	6. N/A	
Rating Criteria: 4-6 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low		<b>Moderate</b>



**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

<b>Pond (&lt;20 acres) (PUBH)</b>		
<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>C. Erosion Control and Shoreline Stabilization</b>		
Only applicable to wetlands directly abutting permanent or relatively permanent waters		
Function not applicable to unvegetated waters.		
1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion.	1. N/A	
2. Historical aerial photography (if available) indicates stable shoreline features.	2. N/A	
Rating Criteria: 1–2 (Y) = High, 0 (Y) = Low		<b>N/A</b>
<b>D. Organic Matter Production and Export</b>		
Only applicable to vegetated wetlands that are flooded at least once every 10 years.		
Function not applicable to unvegetated waters		
1. Wetland is flooded at least once every 10 years. If no, proceed no further, wetland is low functioning.	1. N/A	
2. Wetland has at least 30% cover of herbaceous vegetation.	2. N/A	
3. Woody plants in wetland are mostly deciduous.	3. N/A	
4. High degree of plant community structure, vegetation density, and species richness present.	4. N/A	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for over 10% areal cover).	5. N/A	
Rating Criteria: 4–5 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>N/A</b>
<b>E. General Habitat Suitability</b>		
1. Wetland or water is undisturbed by human habitation or development	1. Y	With the exception of the large impounded pond immediately south of the active mine site, most of the ponds are not directly fragmented by disturbance. They are bordered, however, on 3 sides by active roads, drill pads and gravel extraction. Data from Johnson 2002 indicate that 0 mammals and 33 birds use PUBH wetlands in similar areas and PUBH is a preferred habitat for Spectacled Eider (Johnson et al. 2013).
2. Wetland or water is used by a high diversity of mammal species.	2. N	
3. Wetland or water is used by a high diversity of avian species.	3. Y	
4. Wetland or water is a known preferred habitat for applicable TES and candidate species	4. Y	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for 5 to 10% areal cover or is a continuous cover of surface water with a well-developed emergent component).	5. N	
6. Wetland or water is considered rare at a regional scale.	6. N	
Rating Criteria: 4-6 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>Moderate</b>

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

<b>Pond (&lt;20 acres) (PUBH)</b>		
<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>F. Fish Habitat</b>		
Applicable to waters, and wetlands with perennial or intermittent surface water connection to a fish bearing water.		We assume that ponds within the Mine Site C study area have the potential to support at least a seasonal population of fish because we suspect that all waters are potentially connected to permanently flooded flowing waterbodies (Ugnuravik River) during snowmelt. Ponds are shallow but are often bordered by other vegetated wetland types that provide cover, food sources and spawning habitat.
1. Wetland or water has sufficient size and depth of open water so as not to freeze completely during winter.	1. N	
2. Fish are present.	2. N	
3. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter.	3. Y	
4. Spawning areas are present (aquatic vegetation and/or gravel beds).	4. Y	
5. Juvenile rest areas present (e.g. pools with organic debris or overhanging vegetation).	5. Y	
Rating Criteria: 4-5 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>Moderate</b>	
<b>G. Educational, Scientific, Recreational, or Subsistence Use</b>		
1. Site has documented scientific or educational use.	1. N	Mine Site C study area is located in an area with restricted access and is not near any North Slope villages. Thus, the area is not likely to support subsistence activities. The land in question is designated for development and there are no established summer subsistence access trails in the area.
2. Wetland or water is in public ownership.	2. N	
3. Accessible trails are available.	3. N	
4. Wetland or water supports subsistence activities (e.g., hunting, fishing, berry picking).	4. N	
Rating Criteria: 3-4 (Y) = High, 1-2 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	
<b>H. Uniqueness and Special Status</b>		
1. Wetland or water contains documented occurrence of a state or federally listed threatened or endangered species. <i>If yes, wetland is high functioning.</i>	1. N	Not designated as critical habitat; no documented occurrences of TES species in the study area.
2. Wetland or water contains documented critical habitat, high quality ecosystems, or priority species, respectively designated by the U.S. Fish and Wildlife Service	2. N	
3. Wetland or water has biological, geological, or other features that are determined to be rare.	3. N	No World Heritage Site or similar conservation area designation.
4. Wetland or water has been determined significant because it provides functions scarce for the area.	4. N	
Rating Criteria: 2-5 (Y) = High, 1 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

<b>Lower Perennial Stream (R2UBH)</b>		
<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>A. Flood Flow Regulation (Storage)</b>		
1. Dense persistent vegetation or raised polygonal rims present. (N/A if assessing waters)	1. N/A	Permanently flooded portions of flowing waters are not considered to perform flood flow regulation.
2. Wetland or water is a depressional system capable of storage.	2. N/A	
3. Wetland or water shows signs of storage (i.e. fluctuating water levels, algal mats, and/or lodged debris).	3. N/A	
4. Wetland or water receives floodwater at least once every 10 years.	4. N/A	
5. Floodwaters enter and flow through wetland predominantly as sheet flow rather than channel flow. (N/A if assessing riverine waters)	5. N/A	
Rating Criteria: 5 (Y) = High, 3-4 (Y) = Moderate, 0-2 (Y) = Low		<b>N/A</b>
<b>B. Sediment, Nutrient (N and P), Toxicant Removal</b>		
1. Sediment, nutrients and/or toxicants (from tillage, mining, construction or other sources of pollution) appear to be or are likely to be entering the wetland or water.	1. Y	The Ugnuravik River is a lower perennial stream. The water course is sinuous, low gradient and low velocity and there are numerous areas of slow moving or still water along the reach within the Mine Site C study area. Pollutants that may be entering the system from upstream roads and pad can settle out in the slow moving waters.
2. Slow-moving or still water is present or occurs during flooding that happens at least once every 10 years.	2. Y	
3. Dense (>50% cover) persistent herbaceous and/or woody vegetation is present. (N/A if assessing waters)	3. N/A	
4. At least moderate interspersed vegetation and water is present or occurs during flooding that happens at least once every 10 years. Surface water patches should account for >10 areal coverage. (N/A if assessing waters)	4. N/A	
5. Sediment deposits are present (evidence of deposition during natural flood events).	5. N/A	
6. Thick surface organic horizon and/or abundant fine organic litter is present. (N/A if assessing waters)	6. N/A	
Rating Criteria: 4-6 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low		<b>Moderate</b>

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

<b>Lower Perennial Stream (R2UBH) (continued)</b>		
<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>C. Erosion Control and Shoreline Stabilization</b>		
Only applicable to wetlands directly abutting permanent or relatively permanent waters		
1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion.	1. N/A	This function is not applicable to unvegetated waters.
2. Historical aerial photography (if available) indicates stable shoreline features.	2. N/A	
Rating Criteria: 1–2 (Y) = High, 0 (Y) = Low		<b>N/A</b>
<b>D. Organic Matter Production and Export</b>		
Only applicable to vegetated wetlands that are flooded at least once every 10 years.		
1. Wetland is flooded at least once every 10 years. If no, proceed no further, wetland is low functioning.	1. N/A	This function is not applicable to unvegetated waters.
2. Wetland has at least 30% cover of herbaceous vegetation.	2. N/A	
3. Woody plants in wetland are mostly deciduous.	3. N/A	
4. High degree of plant community structure, vegetation density, and species richness present.	4. N/A	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for over 10% areal cover).	5. N/A	
Rating Criteria: 4–5 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>N/A</b>
<b>E. General Habitat Suitability</b>		
1. Wetland or water is undisturbed by human habitation or development	1. Y	The Ugnuravik River is in close proximity to human disturbances through the entire reach within the Mine C study area, but is not bordered by development. Data from Phillips Alaska, Inc. 2001 indicate that 0 mammals and 41 birds use R2UBH wetlands in similar areas in NE NPR-A. R2UBH is not a preferred habitat for any TES species that may occur in the area (Johnson et al. 2013).
2. Wetland or water is used by a high diversity of mammal species.	2. N	
3. Wetland or water is used by a high diversity of avian species.	3. Y	
4. Wetland or water is a known preferred habitat for applicable TES and candidate species	4. N	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for 5 to 10% areal cover or is a continuous cover of surface water with a well-developed emergent component).	5. N	
6. Wetland or water is considered rare at a regional scale.	6. N	
Rating Criteria: 4-6 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>Low</b>

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

<b>Lower Perennial Stream (R2UBH) (continued)</b>		
<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>F. Fish Habitat</b>		
Applicable to waters, and wetlands with perennial or intermittent surface water connection to a fish bearing water.		According to the Alaska Anadromous Waters Catalog (ADF&G 2014), the East fork of the Ugnuravik River is not considered to be an anadromous water. Nevertheless, at least a seasonal population of fish is assumed to be present and spawning; shelter and rest areas could be provided by undisturbed bank vegetation.
1. Wetland or water has sufficient size and depth of open water so as not to freeze completely during winter.	1. N	
2. Fish are present.	2. N	
3. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter.	3. Y	
4. Spawning areas are present (aquatic vegetation and/or gravel beds).	4. Y	
5. Juvenile rest areas present (e.g. pools with organic debris or overhanging vegetation).	5. Y	
Rating Criteria: 4-5 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>Moderate</b>	
<b>G. Educational, Scientific, Recreational, or Subsistence Use</b>		
1. Site has documented scientific or educational use.	1. N	Mine Site C study area is located in an area with restricted access and is not near any North Slope villages. Thus, the area is not likely to support subsistence activities. The land in question is designated for development and there are no established summer subsistence access trails in the area.
2. Wetland or water is in public ownership.	2. N	
3. Accessible trails are available.	3. N	
4. Wetland or water supports subsistence activities (e.g., hunting, fishing, berry picking).	4. N	
Rating Criteria: 3-4 (Y) = High, 1-2 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	
<b>H. Uniqueness and Special Status</b>		
1. Wetland or water contains documented occurrence of a state or federally listed threatened or endangered species. <i>If yes, wetland is high functioning.</i>	1. N	Not designated as critical habitat; no documented occurrences of TES species in the study area.
2. Wetland or water contains documented critical habitat, high quality ecosystems, or priority species, respectively designated by the U.S. Fish and Wildlife Service	2. N	
3. Wetland or water has biological, geological, or other features that are determined to be rare.	3. N	No World Heritage Site or similar conservation area designation.
4. Wetland or water has been determined significant because it provides functions scarce for the area.	4. N	
Rating Criteria: 2-5 (Y) = High, 1 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Seasonally Flooded Saturated Emergent Meadow (PEM1E)**

Function	Rating	Rationale
<b>A. Flood Flow Regulation (Storage)</b>		
1. Dense persistent vegetation or raised polygonal rims present. (N/A if assessing waters)	1. Y	This wetland type is located adjacent to the Ugnuravik River and functions as part of a riparian corridor. PEM1E is primarily composed of non-patterned wet sedge meadow and has a relatively dense herbaceous layer composed of obligate wetland sedge species. The vegetation on the bank can provide some surface roughness to slow overbank flooding but the sloping banks do not provide any storage capacity.
2. Wetland or water is a depressional system capable of storage.	2. N	
3. Wetland or water shows signs of storage (i.e. fluctuating water levels, algal mats, and/or lodged debris).	3. N	
4. Wetland or water receives floodwater at least once every 10 years.	4. Y	
5. Floodwaters enter and flow through wetland predominantly as sheet flow rather than channel flow. (N/A if assessing riverine waters)	5. N	
Rating Criteria: 5 (Y) = High, 3-4 (Y) = Moderate, 0-2 (Y) = Low	<b>Low</b>	
<b>B. Sediment, Nutrient (N and P), Toxicant Removal</b>		
1. Sediment, nutrients and/or toxicants (from tillage, mining, construction or other sources of pollution) appear to be or are likely to be entering the wetland or water.	1. Y	Pollutants such as road dust would be expected to enter the system; thus, the structural characteristics of this wetland type give it a high rating for this function. Sediment, nutrient and toxicant removal probably mainly occurs, however, during high rainfall events as opposed to the peak flow of water during spring break-up. Nonetheless, the dense herbaceous layer of these wetlands provides a significant filtering capacity.
2. Slow-moving or still water is present or occurs during flooding that happens at least once every 10 years.	2. Y	
3. Dense (>50% cover) persistent herbaceous and/or woody vegetation is present. (N/A if assessing waters)	3. Y	
4. At least moderate interspersed vegetation and water is present or occurs during flooding that happens at least once every 10 years. Surface water patches should account for >10 areal coverage. (N/A if assessing waters)	4. Y	
5. Sediment deposits are present (evidence of deposition during natural flood events).	5. Y	
6. Thick surface organic horizon and/or abundant fine organic litter is present. (N/A if assessing waters)	6. Y	
Rating Criteria: 4-6 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>High</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Seasonally Flooded Saturated Emergent Meadow (PEM1E) (continued)**

Function	Rating	Rationale
<b>C. Erosion Control and Shoreline Stabilization</b>		
Only applicable to wetlands directly abutting permanent or relatively permanent waters		
1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion.	1. Y	PEM1E wetlands bordering the Ugnuravik River is composed of dense herbaceous vegetation. When comparing imagery from 2012 and 2008, very little change in overall stream morphology was noted.
2. Historical aerial photography (if available) indicates stable shoreline features.	2. Y	
Rating Criteria: 1–2 (Y) = High, 0 (Y) = Low		<b>High</b>
<b>D. Organic Matter Production and Export</b>		
Only applicable to vegetated wetlands that are flooded at least once every 10 years.		
1. Wetland is flooded at least once every 10 years. If no, proceed no further, wetland is low functioning.	1. Y	This wetland type is within the active floodplain of the Ugnuravik River and receives floodwaters both from snowmelt and seasonal precipitation events. Organic matter production and export is mostly likely to occur during seasonal rainfall events when the wetlands are active. The vegetation type has a dense herbaceous cover and if low or dwarf shrubs occur they are typically deciduous willow species. Typical of most wet meadow communities in the Arctic this wetland type does not have high plant species diversity.
2. Wetland has at least 30% cover of herbaceous vegetation.	2. Y	
3. Woody plants in wetland are mostly deciduous.	3. Y	
4. High degree of plant community structure, vegetation density, and species richness present.	4. N	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for over 10% areal cover).	5. Y	
Rating Criteria: 4–5 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>High</b>
<b>E. General Habitat Suitability</b>		
1. Wetland or water is undisturbed by human habitation or development	1. Y	Data from Phillips Alaska, Inc. (2001) indicate that 0 mammals and 41 birds use PEM1E wetlands as a part of the larger riverine complex group mapped in the ELS (Jorgenson 1997, Roth et al. 2007). PEM1E is not a preferred habitat for any TES species that occur in the region (Johnson et al. 2013).
2. Wetland or water is used by a high diversity of mammal species.	2. N	
3. Wetland or water is used by a high diversity of avian species.	3. Y	
4. Wetland or water is a known preferred habitat for applicable TES and candidate species	4. N	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for 5 to 10% areal cover or is a continuous cover of surface water with a well-developed emergent component).	5. Y	
6. Wetland or water is considered rare at a regional scale.	6. N	
Rating Criteria: 4-6 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>Moderate</b>

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Seasonally Flooded Saturated Emergent Meadow (PEM1E) (continued)**

<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>F. Fish Habitat</b>		
Applicable to waters, and wetlands with perennial or intermittent surface water connection to a fish bearing water.		PEM1E wetlands provide low fish habitat support as open water areas within the wetland are lacking (i.e., continuous, dense vegetation layer) and wetland freezes to the bottom in winter.
1. Wetland or water has sufficient size and depth of open water so as not to freeze completely during winter.	1. N	
2. Fish are present.	2. N	
3. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter.	3. Y	
4. Spawning areas are present (aquatic vegetation and/or gravel beds).	4. N	
5. Juvenile rest areas present (e.g. pools with organic debris or overhanging vegetation).	5. N	
Rating Criteria: 4-5 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>Low</b>	
<b>G. Educational, Scientific, Recreational, or Subsistence Use</b>		
1. Site has documented scientific or educational use.	1. N	The Mine Site C study area is located in an area with restricted access and is not near any North Slope villages. Thus, the area is not likely to support subsistence activities. The land in question is designated for development and there are no established summer subsistence access trails in the area.
2. Wetland or water is in public ownership.	2. Y	
3. Accessible trails are available.	3. N	
4. Wetland or water supports subsistence activities (e.g., hunting, fishing, berry picking).	4. Y	
Rating Criteria: 3-4 (Y) = High, 1-2 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	
<b>H. Uniqueness and Special Status</b>		
1. Wetland or water contains documented occurrence of a state or federally listed threatened or endangered species. <i>If yes, wetland is high functioning.</i>	1. N	Not designated as critical habitat; no documented occurrences of TES species in the study area.
2. Wetland or water contains documented critical habitat, high quality ecosystems, or priority species, respectively designated by the U.S. Fish and Wildlife Service	2. N	No World Heritage Site or similar conservation area designation.
3. Wetland or water has biological, geological, or other features that are determined to be rare.	3. N	
4. Wetland or water has been determined significant because it provides functions scarce for the area.	4. N	
Rating Criteria: 2-5 (Y) = High, 1 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	



**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

<b>Permanently Flooded Emergent Marsh (PEM1H)</b>		
<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>A. Flood Flow Regulation (Storage)</b>		
1. Dense persistent vegetation or raised polygonal rims present. (N/A if assessing waters)	1. N	Ablation (snowmelt) is the dominant flood event on the Arctic Coastal Plain (ACP). PEM1H wetlands have virtually no surface roughness during ablation, as these are non-patterned communities with aquatic sedges and grasses with a vegetation cover of < 50%.  PEM1H wetlands are typically located in basin wetland complexes, which receive sheet flow during ablation.  Indicators of variable surface water levels were not directly observed, but are assumed present due to documented evidence in other studies (Mendez et al. 1998 and Liljedahl et al. 2012).
2. Wetland or water is a depressional system capable of storage.	2. Y	
3. Wetland or water shows signs of storage (i.e. fluctuating water levels, algal mats, and/or lodged debris).	3. Y	
4. Wetland or water receives floodwater at least once every 10 years.	4. Y	
5. Floodwaters enter and flow through wetland predominantly as sheet flow rather than channel flow. (N/A if assessing riverine waters)	5. Y	
Rating Criteria: 5 (Y) = High, 3-4 (Y) = Moderate, 0-2 (Y) = Low	<b>Moderate</b>	
<b>B. Sediment, Nutrient (N and P), Toxicant Removal</b>		
1. Sediment, nutrients and/or toxicants (from tillage, mining, construction or other sources of pollution) appear to be or are likely to be entering the wetland or water.	1. Y	Jorgenson et al. (2003) recorded 3 out of 5 plots with mineral soils dominating the top 40 cm. Fine organic litter is not present due to the dominance of standing dead graminoid litter that persists over multiple years and the absence of deciduous shrubs.  Herbaceous vegetation cover is <50% (Jorgenson et al. 2003) and dormant during peak flooding, thus providing limited surface roughness to slow water velocity and promote settling of suspended sediments. Few to no woody species in PEM1H wetlands.
2. Slow-moving or still water is present or occurs during flooding that happens at least once every 10 years.	2. Y	
3. Dense (>50% cover) persistent herbaceous and/or woody vegetation is present. (N/A if assessing waters)	3. N	
4. At least moderate interspersions of vegetation and water is present or occurs during flooding that happens at least once every 10 years. Surface water patches should account for >10 areal coverage.(N/A if assessing waters)	4. Y	
5. Sediment deposits are present (evidence of deposition during natural flood events).	5. N	
6. Thick surface organic horizon and/or abundant fine organic litter are present. (N/A if assessing waters)	6. N	
Rating Criteria: 4-6 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>Moderate</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Permanently Flooded Emergent Marsh (PEM1H) (continued)**

Function	Rating	Rationale
<b>C. Erosion Control and Shoreline Stabilization</b>		
Only applicable to wetlands directly abutting permanent or relatively permanent waters		
1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion.	1. Y	PEM1H wetlands are typically in flooded margins of thaw basins that are relatively stable in comparison to riverine features. Areas of overlapping aerial imagery from 2008, and 2012 were reviewed at 1:5,000; no indications of bank erosion along pond margins were observed.
2. Historical aerial photography (if available) indicates stable shoreline features.	2. Y	
Rating Criteria: 1–2 (Y) = High, 0 (Y) = Low		<b>High</b>
<b>D. Organic Matter Production and Export</b>		
Only applicable to vegetated wetlands that are flooded at least once every 10 years.		
1. Wetland is flooded at least once every 10 years. If no, proceed no further, wetland is low functioning.	1. Y	Aquatic emergent plant community dominated primarily by the aquatic sedge <i>Carex aquatilis</i> and rarely the emergent grass, <i>Arctophila fulva</i> ; thus, species richness is low.
2. Wetland has at least 30% cover of herbaceous vegetation.	2. Y	
3. Woody plants in wetland are mostly deciduous.	3. N	The communities are relatively productive (> 30% but < 50% cover), but no woody plants are present.
4. High degree of plant community structure, vegetation density, and species richness present.	4. N	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for over 10% areal cover).	5. Y	
Rating Criteria: 4–5 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>Moderate</b>
<b>E. General Habitat Suitability</b>		
1. Wetland or water is undisturbed by human habitation or development	1. Y	PEM1H wetlands are preferred habitat for Spectacled Eiders and Yellow-billed Loons (Johnson et al. 2013). Habitat is used by 0 mammals and 52 birds (Phillips Alaska, Inc. 2001). PEM1H wetlands include <i>Arctophila fulva</i> -dominated Aquatic Grass Marsh communities (PEM2H, < 1% of mapped area) but it is difficult to reliably distinguish Aquatic Grass Marsh from Aquatic Sedge Marsh using aerial photography. Thus, we assume that aquatic graminoid wetlands in the study area are the more common Aquatic Sedge Marsh.
2. Wetland or water is used by a high diversity of mammal species.	2. N	
3. Wetland or water is used by a high diversity of avian species.	3. Y	
4. Wetland or water is a known preferred habitat for applicable TES and candidate species	4. Y	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for 5 to 10% areal cover or is a continuous cover of surface water with a well-developed emergent component).	5. Y	
6. Wetland or water is considered rare at a regional scale.	6. N	
Rating Criteria: 4-6 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low		<b>High</b>

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Permanently Flooded Emergent Marsh (PEM1H) (continued)**

<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>F. Fish Habitat</b>		
Applicable to waters, and wetlands with perennial or intermittent surface water connection to a fish bearing water.		PEM1H wetlands and adjacent small shallow thaw ponds have not been surveyed for fish populations, but likely have a seasonal connection to area streams and fish are likely seasonally present. PEM1H wetlands are very shallow and freeze to the bottom during winter months.
1. Wetland or water has sufficient size and depth of open water so as not to freeze completely during winter.	1. N	
2. Fish are present.	2. N	
3. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter.	3. Y	
4. Spawning areas are present (aquatic vegetation and/or gravel beds).	4. Y	Aquatic vegetation could provide spawning habitat.
5. Juvenile rest areas present (e.g. pools with organic debris or overhanging vegetation).	5. Y	
Rating Criteria: 4-5 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>Moderate</b>	
<b>G. Educational, Scientific, Recreational, or Subsistence Use</b>		
1. Site has documented scientific or educational use.	1. N	Mine Site C study area is located in an area with restricted access and is not near any North Slope villages. Thus, the area is not likely to support subsistence activities. The land in question is designated for development and there are no established summer subsistence access trails in the area.
2. Wetland or water is in public ownership.	2. N	
3. Accessible trails are available.	3. N	
4. Wetland or water supports subsistence activities (e.g., hunting, fishing, berry picking).	4. N	
Rating Criteria: 3-4 (Y) = High, 1-2 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	
<b>H. Uniqueness and Special Status</b>		
1. Wetland or water contains documented occurrence of a state or federally listed threatened or endangered species. <i>If yes, wetland is high functioning.</i>	1. N	Not designated as critical habitat; no documented occurrences of TES species in the study area.
2. Wetland or water contains documented critical habitat, high quality ecosystems, or priority species, respectively designated by the U.S. Fish and Wildlife Service	2. N	No World Heritage Site or similar conservation area designation.
3. Wetland or water has biological, geological, or other features that are determined to be rare.	3. N	
4. Wetland or water has been determined significant because it provides functions scarce for the area.	4. N	
Rating Criteria: 2-4 (Y) = High, 1 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Seasonally Flooded Saturated Emergent / Deciduous Shrub Meadow (PEM1/SS1E)**

Function	Rating	Rationale
<b>A. Flood Flow Regulation (Storage)</b>		
1. Dense persistent vegetation or raised polygonal rims present. (N/A if assessing waters)	1. Y	These wetlands include low-center polygonal features in basin wetland complexes, which receive sheet flow during ablation.  Indicators of variable surface water levels were not directly observed, but are assumed present due to documented evidence in other studies (Mendez et al. 1998 and Liljedahl et al. 2012).
2. Wetland or water is a depressional system capable of storage.	2. Y	
3. Wetland or water shows signs of storage (i.e. fluctuating water levels, algal mats, and/or lodged debris).	3. Y	
4. Wetland or water receives floodwater at least once every 10 years.	4. Y	
5. Floodwaters enter and flow through wetland predominantly as sheet flow rather than channel flow. (N/A if assessing riverine waters)	5. Y	
Rating Criteria: 5 (Y) = High, 3-4 (Y) = Moderate, 0-2 (Y) = Low	<b>High</b>	
<b>B. Sediment, Nutrient (N and P), Toxicant Removal</b>		
1. Sediment, nutrients and/or toxicants (from tillage, mining, construction or other sources of pollution) appear to be or are likely to be entering the wetland or water.	1. N	Jorgenson et al. (2003) recorded only 7 out of 24 plots with organic soils dominating the top 40 cm.
2. Slow-moving or still water is present or occurs during flooding that happens at least once every 10 years.	2. Y	PEM1/SS1E wetlands typically have at least 10% surface water present after ablation.
3. Dense (>50% cover) persistent herbaceous and/or woody vegetation is present. (N/A if assessing waters)	3. Y	Vegetation cover is >50% (Jorgenson et al. 2003). Although vegetation is dormant during peak flooding, persistent woody stems provide surface roughness to slow flood flow, thereby promoting the settling of waterborne sediments.
4. At least moderate interspersion of vegetation and water is present or occurs during flooding that happens at least once every 10 years. Surface water patches should account for >10 areal coverage.(N/A if assessing waters)	4. N	
5. Sediment deposits are present (evidence of deposition during natural flood events).	5. N	
6. Thick surface organic horizon and/or abundant fine organic litter is present. (N/A if assessing waters)	6. N	
Rating Criteria: 4-6 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>Moderate</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Seasonally Flooded Saturated Emergent / Deciduous Shrub Meadow (PEM1/SS1E) (continued)**

Function	Rating	Rationale
<b>C. Erosion Control and Shoreline Stabilization</b>		
Only applicable to wetlands directly abutting permanent or relatively permanent waters		
1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion.	1. N/A	PEM1/SS1E wetlands in the study area do not directly abut rivers or streams so function is not applicable.
2. Historical aerial photography (if available) indicates stable shoreline features.	2. N/A	
Rating Criteria: 1–2 (Y) = High, 0 (Y) = Low	<b>N/A</b>	
<b>D. Organic Matter Production and Export</b>		
Only applicable to vegetated wetlands that are flooded at least once every 10 years.		
1. Wetland is flooded at least once every 10 years. If no, proceed no further, wetland is low functioning.	1. Y	PEM1/SS1E wetlands flood annually. Jorgenson et al. (2003a) data for this type shows ≥ 30% herbaceous vegetation and deciduous woody species.
2. Wetland has at least 30% cover of herbaceous vegetation.	2. Y	
3. Woody plants in wetland are mostly deciduous.	3. Y	
4. High degree of plant community structure, vegetation density, and species richness present.	4. N	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for over 10% areal cover).	5. Y	
Rating Criteria: 4–5 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low	<b>High</b>	
<b>E. General Habitat Suitability</b>		
1. Wetland or water is undisturbed by human habitation or development	1. Y	No documented evidence of preferred habitat for TES (Johnson et al. 2013), but wetland type is used by 10 mammals and 54 birds (Phillips Alaska, Inc. 2001).
2. Wetland or water is used by a high diversity of mammal species.	2. Y	
3. Wetland or water is used by a high diversity of avian species.	3. Y	
4. Wetland or water is a known preferred habitat for applicable TES and candidate species	4. N	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for 5 to 10% areal cover or is a continuous cover of surface water with a well-developed emergent component).	5. Y	
6. Wetland or water is considered rare at a regional scale.	6. N	
Rating Criteria: 4-6 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low	<b>High</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Seasonally Flooded Saturated Emergent / Deciduous Shrub Meadow (PEM1/SS1E) (continued)**

<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>F. Fish Habitat</b>		
Applicable to waters, and wetlands with perennial or intermittent surface water connection to a fish bearing water.		This function was determined N/A because PEM1/SS1E wetlands are typically located in basin wetland complexes with PEM1F and PEM1H wetlands. Although there may be seasonal connections to fish-bearing waters, the small, scattered pools in this community are not sufficiently large enough to support fish.
1. Wetland or water has sufficient size and depth of open water so as not to freeze completely during winter.	1. N/A	
2. Fish are present.	2. N/A	
3. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter.	3. N/A	
4. Spawning areas are present (aquatic vegetation and/or gravel beds).	4. N/A	
5. Juvenile rest areas present (e.g. pools with organic debris or overhanging vegetation).	5. N/A	
Rating Criteria: 4-5 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>N/A</b>	
<b>G. Educational, Scientific, Recreational, or Subsistence Use</b>		
1. Site has documented scientific or educational use.	1. N	Mine Site C study area is located in an area with restricted access and is not near any North Slope villages. Thus, the area is not likely to support subsistence activities. The land in question is designated for development and there are no established summer subsistence access trails in the area.
2. Wetland or water is in public ownership.	2. N	
3. Accessible trails are available.	3. N	
4. Wetland or water supports subsistence activities (e.g., hunting, fishing, berry picking).	4. N	
Rating Criteria: 3-4 (Y) = High, 1-2 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	
<b>H. Uniqueness and Special Status</b>		
1. Wetland or water contains documented occurrence of a state or federally listed threatened or endangered species. <i>If yes, wetland is high functioning.</i>	1. N	Not designated as critical habitat and no documented occurrence of TES species. No World Heritage Site or similar conservation area designation.
2. Wetland or water contains documented critical habitat, high quality ecosystems, or priority species, respectively designated by the U.S. Fish and Wildlife Service	2. N	
3. Wetland or water has biological, geological, or other features that are determined to be rare.	3. N	
4. Wetland or water has been determined significant because it provides functions scarce for the area.	4. N	
Rating Criteria: 2-4 (Y) = High, 1 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Saturated Emergent / Deciduous Shrub Meadow (PEM1/SS1B)**

Function	Rating	Rationale
<b>A. Flood Flow Regulation (Storage)</b>		
1. Dense persistent vegetation or raised polygonal rims present. (N/A if assessing waters)	1. N	PEM1/SS1B wetlands comprise predominantly tussock tundra; polygonal rims area generally absent. Vegetation cover > 50% (Jorgenson et al. 2003) but is dormant during peak flooding, thus, wetland provides limited surface roughness during peak flooding. Some ablation may be provided by raised tussock growth form but not by vegetation.
2. Wetland or water is a depressional system capable of storage.	2. N	
3. Wetland or water shows signs of storage (i.e. fluctuating water levels, algal mats, and/or lodged debris).	3. N	
4. Wetland or water receives floodwater at least once every 10 years.	4. Y	
5. Floodwaters enter and flow through wetland predominantly as sheet flow rather than channel flow. (N/A if assessing riverine waters)	5. Y	
Rating Criteria: 5 (Y) = High, 3-4 (Y) = Moderate, 0-2 (Y) = Low	<b>Low</b>	PEM1/SS1B wetlands receive sheet flow during ablation.
<b>B. Sediment, Nutrient (N and P), Toxicant Removal</b>		
1. Sediment, nutrients and/or toxicants (from tillage, mining, construction or other sources of pollution) appear to be or are likely to be entering the wetland or water.	1. N	Jorgenson et al. (2003) recorded only 2 out of 40 plots with organic soils dominating the top 40 cm.
2. Slow-moving or still water is present or occurs during flooding that happens at least once every 10 years.	2. Y	PEM1/SS1B wetlands have little to no interspersions of vegetation and water after ablation.
3. Dense (>50% cover) persistent herbaceous and/or woody vegetation is present. (N/A if assessing waters)	3. Y	Vegetation cover >50% (Jorgenson et al. 2003). Although vegetation is dormant during peak flooding, persistent woody stems provide surface roughness to slow water and allow settling.
4. At least moderate interspersions of vegetation and water is present or occurs during flooding that happens at least once every 10 years. Surface water patches should account for >10 areal coverage. (N/A if assessing waters)	4. N	
5. Sediment deposits are present (evidence of deposition during natural flood events).	5. N	
6. Thick surface organic horizon and/or abundant fine organic litter is present. (N/A if assessing waters)	6. N	
Rating Criteria: 4-6 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>Moderate</b>	

**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Saturated Emergent / Deciduous Shrub Meadow (PEM1/SS1B) (continued)**

Function	Rating	Rationale
<b>C. Erosion Control and Shoreline Stabilization</b>		
Only applicable to wetlands directly abutting permanent or relatively permanent waters		
1. Wetland has dense, energy absorbing vegetation bordering the water course and no evidence of erosion.	1. N/A	PEM1/SS1B wetlands in the study area do not directly abut waters, function is not applicable.
2. Historical aerial photography (if available) indicates stable shoreline features.	2. N/A	
Rating Criteria: 1–2 (Y) = High, 0 (Y) = Low	<b>N/A</b>	
<b>D. Organic Matter Production and Export</b>		
Only applicable to vegetated wetlands that are flooded at least once every 10 years.		
1. Wetland is flooded at least once every 10 years. If no, proceed no further, wetland is low functioning.	1. Y	PEM1/SS1B wetlands flood annually during ablation, but surface water is not present during the growing season. Jorgenson et al. (2003a) records >30% cover by herbaceous vegetation, but most woody vegetation is evergreen (e.g., <i>Vaccinium vitis-idaea</i> , <i>Ledum palustre decumbens</i> , <i>Dryas integrifolia</i> , and <i>Cassiope tetragona</i> ).  Jorgenson et al. (2003a) recorded 16 commonly occurring vascular plant species; and a community structure including tussocks, low and dwarf shrubs, forbs, and graminoids.
2. Wetland has at least 30% cover of herbaceous vegetation.	2. Y	
3. Woody plants in wetland are mostly deciduous.	3. N	
4. High degree of plant community structure, vegetation density, and species richness present.	4. Y	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for over 10% areal cover).	5. N	
Rating Criteria: 4–5 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low	<b>Moderate</b>	
<b>E. General Habitat Suitability</b>		
1. Wetland or water is undisturbed by human habitation or development	1. Y	Preferred habitat for no TES (Johnson et al. 2013a).  Habitat used by 3 mammal species (Phillips Alaska, Inc. 2001).  Habitat used by 23 bird species (Phillips Alaska, Inc. 2001). See Methods section of report for discussion of rationale.
2. Wetland or water is used by a high diversity of mammal species.	2. N	
3. Wetland or water is used by a high diversity of avian species.	3. N	
4. Wetland or water is a known preferred habitat for applicable TES and candidate species	4. N	
5. Interspersion of vegetation and water is at least moderate (surface water patches accounting for 5 to 10% areal cover or is a continuous cover of surface water with a well-developed emergent component).	5. N	
6. Wetland or water is considered rare at a regional scale.	6. N	
Rating Criteria: 4-6 (Y) = High, 2–3 (Y) = Moderate, 0–1 (Y) = Low	<b>Low</b>	



**Mine Site C Aquatic Site Assessment: Best Professional Judgment Characterization for North Slope, Alaska**

**Saturated Emergent / Deciduous Shrub Meadow (PEM1/SS1B) (continued)**

<b>Function</b>	<b>Rating</b>	<b>Rationale</b>
<b>F. Fish Habitat</b>		
Applicable to waters, and wetlands with perennial or intermittent surface water connection to a fish bearing water.		PEM1/SS1B wetlands may have seasonal connections to fish-bearing waters, but lack surface water outside of ablation. Thus, this function is considered not applicable to this wetland type.
1. Wetland or water has sufficient size and depth of open water so as not to freeze completely during winter.	1. N/A	
2. Fish are present.	2. N/A	
3. Herbaceous and/or woody vegetation is present in wetland and/or buffer to provide cover, shade, and/or detrital matter.	3. N/A	
4. Spawning areas are present (aquatic vegetation and/or gravel beds).	4. N/A	
5. Juvenile rest areas present (e.g. pools with organic debris or overhanging vegetation).	5. N/A	
Rating Criteria: 4-5 (Y) = High, 2-3 (Y) = Moderate, 0-1 (Y) = Low	<b>N/A</b>	
<b>G. Educational, Scientific, Recreational, or Subsistence Use</b>		
1. Site has documented scientific or educational use.	1. N	Mine Site C study area is located in an area with restricted access and is not near any North Slope villages. Thus, the area is not likely to support subsistence activities. The land in question is designated for development and there are no established summer subsistence access trails in the area.
2. Wetland or water is in public ownership.	2. N	
3. Accessible trails are available.	3. N	
4. Wetland or water supports subsistence activities (e.g., hunting, fishing, berry picking).	4. N	
Rating Criteria: 3-4 (Y) = High, 1-2 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	
<b>H. Uniqueness and Special Status</b>		
1. Wetland or water contains documented occurrence of a state or federally listed threatened or endangered species. <i>If yes, wetland is high functioning.</i>	1. N	Not designated as critical habitat, no documented occurrences of TES species.  No World Heritage Site or similar conservation area designation.
2. Wetland or water contains documented critical habitat, high quality ecosystems, or priority species, respectively designated by the U.S. Fish and Wildlife Service	2. N	
3. Wetland or water has biological, geological, or other features that are determined to be rare.	3. N	
4. Wetland or water has been determined significant because it provides functions scarce for the area.	4. N	
Rating Criteria: 2-4 (Y) = High, 1 (Y) = Moderate, 0 (Y) = Low	<b>Low</b>	