Appendix K

Wetland Functional Assessment

Appendix K – Wetland Functional Assessment

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Chapter 1. Introduction

The proposed Point Thomson Project (project) could affect wetlands through the placement of gravel fill for roads, pads, and an airstrip, gravel extraction, pipeline construction, ice road and pad construction, and operations and maintenance through the life of the project. Federal regulations and policies require projects to avoid adverse effects to wetlands where possible and minimize those effects to wetlands if there is no practicable alternative with fewer adverse environmental impacts. Environmental baseline studies (Noel and Schick 1995; Noel and Funk 1999, 2001; OASIS 2009, 2010; HDR 2011) have mapped and classified vegetation types within the project area according to a standard vegetation classification system used in northern Alaska. For the Point Thomson project area, the status of a given area as wetland, waterbody, or upland (nonwater, nonwetland) can be inferred from the vegetation and land cover mapping accurately enough for evaluation in the Environmental Impact Statement (EIS). The vegetation mapping therefore allows the third-party EIS team to compare acreages of wetland impacts among project alternatives and to compare project alternatives' effects on different wetland types.

In addition to considering the project's potential effects on wetland types, the U.S. Army Corps of Engineers (Corps) needs to evaluate and compare the effects of project alternatives on wetland functions. It will use this information, in part, to help it define appropriate measures to mitigate potential adverse effects. The Corps has approved the use of a desktop wetland functional assessment for EIS purposes. This functional assessment report describes the choice of assessment method for this project, defines each of the functions analyzed, presents a brief rationale for the features that indicate presence of the function at a particular site, lists the indicators of each function, and explains the limitations of the assessment. The results of this assessment are presented as maps showing where each function occurs and as a tabular summary of the acreage of each function within the project area. The project's potential effects on wetland functions are described in Chapter 5 (Environmental Consequences) of the EIS.

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Chapter 2. Methods

2.1 TERMINOLOGY

Wetlands, in the strict regulatory sense, are "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions…" (33 CFR 328.3(b)). Note that this definition requires the presence of vegetation. Other wet areas such as ponds, streams, and the sea are not wetlands, and are referenced in this report as "waterbodies." The Corps has jurisdiction over tidal waterbodies shoreward to the high tide line and over nontidal waterbodies to the ordinary high water mark, which could be roughly thought of as the "bank." Based on these definitions, intertidal beaches, intertidal flats, and unvegetated stream gravel bars are parts of waterbodies. Throughout this report, the reader should interpret the term "wetlands" to encompass both wetlands and waterbodies.

For regulatory purposes, only the functions of wetlands (strictly defined) are evaluated in a typical functional assessment, not waterbody functions. Sometimes, however, waterbodies perform functions similar to those of wetlands or are integral to a wetland's performance of a function. This assessment describes the function for a waterbody in the same process as describing that function for the wetlands where the methodology allows such discussions. Consequently, sometimes the method described by this report ascribes functions to waterbodies. The Corps may or may not use the information on waterbody functions presented through this analysis. Again, when the term "wetland" is used with respect to functions or assessment, recognize that some waterbody functions may also be evaluated.

Strictly speaking, the terms "vegetation types" or "vegetation mapping" would not encompass areas without vegetation such as barrens or unvegetated waterbodies. Throughout this report, the terms "vegetation mapping" or "vegetation types" will be considered to encompass unvegetated land cover types as well.

The project vegetation mapping is essentially synonymous with "wetland and waterbody" mapping. As stated in the introduction, the investigators inferred the locations of wetlands and waterbodies from the project-area vegetation mapping. All of the mapped vegetation types, except three types (constituting less than one percent of the project area), are considered wetland or waterbody for the purpose of the EIS analysis. Several vegetation types could, in fact, encompass areas that are wetlands, waterbodies, and uplands (nonwetlands, nonwaters).

Wetland functions may be defined as "the activities that normally occur in wetland ecosystems…Wetland functions result from the interactions among the attributes of the wetland, its watershed, the surrounding landscape…, the structural components of the wetland ecosystem…, and the processes that link these structural components…" (Smith and Wakeley 2001). Sometimes, wetland assessments also address wetland "values" or "ecosystem services", or the benefit that human society derives from a particular wetland process. The functions that the Point Thomson functional assessment team selected to evaluate reflect the functions that resource professionals consider important, which is in part an indication of value. The project wetland assessment method does not otherwise directly address wetland values or services.

2.2 SELECTION OF THE ASSESSMENT METHOD

No standard method exists to assess wetland functions in Alaska or on the North Slope of Alaska. Approximately ten methods are known to have been used in the state; most often scientists employ their best professional judgment to qualitatively describe the functions.

Wetland scientists examined existing functional assessment methods, Corps guidance documents, and previous reports for useful concepts that could be adapted for use on this project (USFWS 2010; Corps 2009; BLM 2004; ADEC/Corps Waterways Experiment Station 1999; Magee and Hollands 1998; Shannon and Wilson, Inc. 1996; OASIS 2010). The following factors were pertinent to selecting an assessment approach for this project:

- It is an office-based, desk-top assessment effort.
- The area to be evaluated is approximately 64,000 acres and includes long, unconnected transportation corridors.
- Nearly the whole project area is wetland or waterbodies.
- Because most of the project area is wetland, evaluating the functions of individual wetlands (surrounded by uplands or separated at watershed boundaries) is not practical.
- The project area is nearly pristine.
- Site-specific information is limited.
- Aerial imagery and Geographic Information System (GIS)-based vegetation mapping are available for the immediate vicinity of each alternative.
- The vegetation classification system incorporates substantial information on landforms, site moisture, and microtopography (for example, tussocks).
- The first use of the assessment is to help describe effects of project alternatives, but the result must also be useful to help define appropriate types and level of impact mitigation.

Most wetland assessment methods evaluate each wetland individually using a series of questions about the wetland unit that consider information available both offsite and onsite. The answers to certain questions indicate either the degree to which a certain function occurs at the site, or the level of confidence with which the investigator can know that the function occurs at the site. Answers to different combinations of questions are used to rate each function. Each function is assigned a numerical score or a rating of low, medium, or high. .

EIS wetland scientists developed a project-specific assessment method that employs logic and indicators of wetland functions similar to those used in many other methods. However, rather than asking whether the indicators exist to rate a wetland function as high- moderate-low for each individual wetland, this methodology describes the indicators of a high level of function, then identifies those locations on the landscape that possess that set of indicators and rates those areas as “high” for that function. Indicators of function in this landscape-scale method include such information as locations of streams of different sizes, landforms, vegetation types, flooding regimes, and topographic contours. Simple logic models (described below) within a GIS tool determine the locations of individual functions in this method, and a GIS layer (similar to transparent map overlay) is created for each function that shows where the function occurs. Then, for any location of interest in the project area, a review of the GIS layers will identify which functions occur at that particular location.

This method assesses the performance for each wetland function using two categories. An area is rated as either performing the function, or not performing it[1]. The Corps may then combine the assessments for the various functions as appropriate to categorize each wetland area (for example, high-, moderate-, or low-value) for management purposes.

Similar to all other methods used in Alaska, this landscape approach to wetland functional assessment is based on basic ecological principles developed for nonArctic environments; draws from existing information within scientific literature on the Arctic and the project area; evaluates a standard suite of wetland functions; and uses indicators to rate the relative magnitude of functional performance rather than a quantitative measurement of the function. The landscape-scale method differs from other methods used in Alaska in that it does not evaluate functions of each wetland individually and rates the function without regard to the human benefit derived from the function. Additionally, because the area being evaluated is nearly undisturbed, this method does not consider the presence of human-derived stressors such as pollutants.

The following are some additional assets of the landscape approach being used for this project.

- This method is objective and replicable. It uses the same data sets for the analysis through the entire project area. Each data set has been developed by a limited number of individuals using clearly defined rules. The logic models are well documented and every person running the models will achieve the same results.
- The method is relatively simple and highly transparent. With limited study, any interested person will be able to see what information was used to develop the ratings for each function.
- The method is flexible. Because the ratings are performed in GIS-based models, the assessment may be updated if better input data becomes available or if the users wish to redefine the function.
- The method does not require separating the project-area wetlands into individual assessment units. In most assessment methods, how the limits of each assessed unit are defined may strongly affect the results, and it is difficult to define enough rules so each investigator would identify the same assessment unit boundaries.
- The results of this method, in the form of 12 maps showing locations of wetland functions, can be easily used in a variety of ways by the Corps to define management categories or strategies, such as might be used to develop compensatory mitigation levels.

2.3 SELECTION OF FUNCTIONS TO BE EVALUATED

When determining which functions to evaluate, and the indicators to use for each function, the EIS wetland scientists considered:

- The suites of functions evaluated in existing methods
- Agency guidance specific to this project

[1] The investigators recognize that ecological processes are not so clear cut and that even a wetland that this method rates as not performing any functions clearly is the site of many ecological processes that are important, at a minimum, to the organisms that use that site.

- Professional opinion of which functions are likely to occur in the project area based on widely accepted wetland function principles, coastal-plain-relevant literature, and other EIS Subject Matter Experts' (SMEs') analyses
- The relevance of commonly-evaluated functions to a relatively pristine environment
- The usefulness of prospective functions for differentiating among project-area wetlands (for use in analyzing avoidance and minimization of effects on higher-value wetlands)
- Written and spoken feedback from agency staff, primarily from the Environmental Protection Agency (EPA), on the selected functions, their definitions, and their indicators

This functional assessment includes the following functions:

Hydrologic Functions

- Flood Flow Moderation and Conveyance
- Shoreline and Bank Stabilization
- Maintenance of Natural Sediment Transport Processes

Biogeochemical Functions

- Production and Export of Organic Matter
- Maintenance of Soil Thermal Regime

Habitat and Faunal Community Support Functions

- Waterbird Support
- Terrestrial Mammal Support
- Resident and Diadromous Fish Support
- Threatened or Endangered Species Support
- Scarce and Valued Habitats

Some commonly-evaluated functions are not analyzed for the Point Thomson Project EIS:

- **Nutrient/toxicant retention and sediment retention.** Nutrient retention and transformation and sediment retention are often evaluated in agricultural and urban areas where nutrients and sediments may be excessive in runoff. For the Point Thomson Project EIS, investigators chose to analyze functions that the wetlands may currently perform, not those for which no opportunity yet exists. A similar function suggested by the EPA for evaluation is capture of human-generated wind-borne particulates (dust from roads and gravel pads). The functional assessment is being used to help the Corps select an alternative and mitigation measures that minimize potential adverse environmental effects from the project. Which wetlands might best treat pollutants is not pertinent to the Corps decision.
- **Groundwater recharge and groundwater discharge.** These processes do not occur, or occur in very limited circumstances, in regions of continuous permafrost which is present throughout the project area.
- **Floral biodiversity.** Project scientists considered where rare plant species are most likely to occur and determined that most of these sites are either (1) likely to be uplands or (2) river bars

and terraces that are borderline upland or below a river's ordinary high water mark. Relatively rare vegetation communities were also considered; these are also either likely to be uplands or are among the vegetation types selected for evaluation under Scarce and Valued Habitats.

Some wetland functions are not addressed by the project assessment method because they are performed by most of the project-area wetlands, and would not be useful for analyzing the differences between alternatives in terms of impacts to wetland functions. All of the project-area wetlands provide habitat to diverse native plant and animal species and communities that are uniquely adapted to thrive or survive in an arctic environment, in the particular landscape setting in which they occur. Wetland plants capture energy from the sun, storing it in chemicals formed in part from carbon the plant draws from the atmosphere. This energy is transferred to other organisms as plants are consumed or decomposed. Live and dead organic materials (plants and their consumers) are washed from many project-area wetlands during snowmelt, when surface water flows over much of the ground surface. The energy and nutrients in this material support organisms in aquatic ecosystems downstream. Some organic materials produced in wetlands also remain in the wetlands. As organisms die, they may accumulate in peat soil because decomposition is so slowed by the anaerobic environment of saturated, cold soil. In peat, the carbon incorporated into plants through photosynthesis remains until site conditions dry, allowing decomposition to proceed and carbon to be released back to the atmosphere. Where site conditions do not change, peat continues to accumulate. It insulates the soil and, over time, the lower layers of peat become part of the perennially-frozen ground. In wetlands where soils are not oxygen-poor, dead organisms may decompose, which releases their nutrient components. Nutrients are transformed in ways specific to the site's microbes and level of soil aeration. Some may be released as gases, some incorporated into plants, some bound in the soil, some moved elsewhere by water. Airborne particulates may settle in wetlands and be incorporated into the soils.

An important hydrologic function that is likely ubiquitous is wetlands' absorption of water, both at breakup and to a much greater degree after the soils have thawed. Coastal plain wetlands lose water through evaporation and by passage of water through the plants to the atmosphere. As soils dry and surface water is drawn down to lower levels, wetlands' capacity to absorb precipitation increases. Much of the rain that falls on the coastal plain during the summer is retained in the soils and on the surface of wetlands, never reaching streams. Organisms dependent on the streams, and the stream morphology itself, are adapted to the particular timing and volume of flow that result from the wetlands' flow moderating effects.

2.4 DATA SETS USED FOR INDICATORS

The indicators for each function are features that can be detected on aerial photographs, are incorporated in the existing vegetation mapping and limited topographic mapping, are part of other existing office-available information, or can be generated from these sources.

Data sets already available for use within a GIS included the following:

- Vegetation mapping for the full project area, prepared by various scientists using similar methods (Noel and Schick 1995; Noel and Funk 1999, 2001; OASIS 2009, 2010; HDR 2011). This mapping delineates and classifies vegetation to Level C of Walker's (1983) classification system developed for use in northern Alaska. The vegetation classes identified within the project area are listed in Table 1. This classification system incorporates information on physiognomy (e.g., tundra, shrublands, barren), plant growth form (e.g., tall/low/dwarf shrub, herb, lichen), hydrologic regime (e.g., tidal, aquatic, wet, moist, dry), site chemistry (e.g., saline, alkaline), landform (e.g., pingo, high-centered polygon, river terrace, beach), microrelief (tussocks, strangmoor, polygonal ground), interspersion of vegetation types and water regimes, and plant species. This information-rich classification system allowed many more indicators of function to be drawn from the vegetation mapping than would typically be possible. HDR expanded Walker's classification system by distinguishing among waterbody types (ocean, stream, lake, pond). The features of each vegetation type that serve as indicators of some wetland functions are listed in the last column of Table 1.

- Topographic contour mapping covering the project area at varying levels of detail. Mapping with one and two foot contours was available for parts of the proposed Point Thomson development area and for the coastal transportation corridors. Four-foot-contour mapping was used for the remainder of the study area.
- Digital Elevation Model (DEM) produced by HDR using 4-foot contours generated from Light Detection And Ranging (LIDAR) taken in 2006, received from the State of Alaska Department of Natural Resources
- Aerial imagery for the full project area. These included digital orthomosaics based on natural-color or color infrared aerial photography or satellite imagery, captured in 2001, 2006, or 2007, with pixel resolutions ranging from 0.75 foot to 2.0 feet.
- A map of suitable polar bear denning habitat produced by the U.S. Geological Survey (USGS)
- Polar Bear Sea Ice and Barrier Island Critical Habitat, and No Disturbance Zones defined by the USFWS in January 2011
- The anadromous fish stream catalog and fish sampling results

Scientists developed or augmented several additional data sets to draw indicators from them. The methods for developing these data sets are described in Appendix B. The new information developed within GIS for use in the functional assessment includes:

- Stream locations and size categories (Category 4 is the largest and Category 1 is the smallest)
- Streams known to support fish, based on existing data sets
- Streams that are directly connected to fish-bearing streams
- Stream origin (Brooks Range versus coastal plain)
- Initial floodplain mapping, called "stream buffers", that estimate an average floodplain width for each size category of stream, without considering backwaters and other low areas into which flood waters would spill
- Estimated stream floodplains
- Large topographic basins, each coded as a basin wetland complex or drained lake basin and coded for inlet and outlet presence; lakes with banks were also identified as large topographic basins
- Coastal gravels were separated from riverine gravels

Table 1: Walker (1983) Vegetation Classes Mapped in the Point Thomson Project Area				
Walker Level B Cover Units	Walker Level C Photo Interpreted Map Unit Types[1]		Wetland, Waterbody, or Upland?	Description and Associated Features Used as Indicators of Wetland Functions
Waterbodies[2]	Ia1	Bays, lagoons, inlets, subtidal rivers	Waterbody	Brackish marine waters. Accessible to marine mammals and fish. Water subject to wave action and tidal flow, some of it sheltered by barrier islands.
	Ia2	Rivers and streams	Waterbody	Streams upstream from ocean-derived salinity, including reaches subject to tides. Water volumes and velocities vary. Indicate possible presence of erosive energy. Vector for overbank and downstream movement of materials. Assumed to support fish if visibly connected to fish-bearing waters. Large streams indicate presence of a riparian corridor with features important for movement of large mammals as well as insect escapement areas.
	Ia3	Lakes	Waterbody	Freshwater lakes greater than 20 acres. Large enough for development of waves that may have erosive energy. Occupy topographic depressions assumed to detain overland flow in spring. Still waters promote settling of solids from inflowing waters. Assumed to support fish if visibly connected to fish-bearing waters. A habitat type identified by USFWS (2010) as high to medium value for wildlife species but relatively abundant.
	Ia4	Ponds	Waterbody	Freshwater ponds less than 20 acres. Assumed to not be large enough for generation of erosive waves. Still waters promote settling of solids from inflowing waters. Assumed to support fish if visibly connected to fish-bearing waters.
Water-Associated Barrens	Xa	River Gravels, Beaches	Waterbody	Unvegetated gravels in active river channels and on beaches. Coarse substrate and lack of vegetation indicate exposure to erosive force. Also indicate presence of breeze and lack of vegetation that provide insect escapement for large mammals. Assumed to support fish if adjacent to sea. This cover type is an indicator of barrier islands, in combination with proximity to the sea, and barrier islands were specifically identified by USFWS (2010) as scarce and high value both for sheltering nearshore waters and for providing nesting habitat.
	XIa	Wet Mud	Waterbody	Drained lake basins and ponds. Exposed mud is largely unvegetated. This vegetation type was assumed to occupy a low-lying position subject to flooding if contiguous with a stream, so was included in floodplain delineation.
	XIc	Bare Peat	Waterbody	Peat soils devoid of vegetation, usually barren coastal areas caused by storm surges or lake margins where erosion has scoured the peat.

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Very Wet Tundra	IIb	Aquatic Graminoid Tundra	Wetland	Permanently-flooded marshes supporting grasses and sedges extending above the water surface. Plant productivity is assumed to be high. Assumed to occupy a low-lying position subject to flooding if contiguous with a stream, so was included in floodplain delineation. Vegetation is assumed to be capable of dissipating wave energy. Flooded water regime implies mechanism for organic matter to flow off-site. This vegetation type includes pendant grass (*Arctophila fulva*) wetlands and may be a component of basin wetland complexes which were specifically identified by USFWS (2010) as scarce and high value for many waterfowl and shorebird species.
	IId	Water/Tundra Complex	Waterbody/ wetland complex	Dominated by open water interspersed with patches of emergent Aquatic Graminoid Tundra, Wet Sedge Tundra, and Moist Sedge, Dwarf Shrub Tundra. Plant productivity is assumed to be high. Assumed to occupy a low-lying position subject to flooding if contiguous with a stream, so was included in floodplain delineation. Flooded water regime implies mechanism for organic matter to flow off-site. Vegetation is assumed to be capable of dissipating wave energy. This vegetation type includes pendant grass (*Arctophila fulva*) wetlands and may be a component of basin wetland complexes, which were specifically identified by USFWS (2010) as scarce and high value for many waterfowl and shorebird species.
Wet Tundra	IIIa	Wet Sedge Tundra	Wetland	Saturated wet sedge meadows, some permanently or semi-permanently flooded. Assumed to occupy a low-lying position subject to flooding if contiguous with a stream, so was included in floodplain delineation. Flooded water regime implies flowing surface water may be able to carry organic matter off-site. Plant productivity is assumed to be high. Thick surface organic layer and moss and sedge mat are thought to insulate soils from summer thaw. A vegetation type identified by USFWS (2010) as high to medium value for wildlife species but relatively abundant.
	IIIb	Wet Graminoid Tundra	Wetland	Regularly and irregularly flooded salt marsh. Presence next to ocean implies exposure to wave action and tidal water flow. Vegetation assumed to bind substrate. Water flowing across the ground surface provides mechanism for entrainment and off-site transport of organic matter. Plant productivity is assumed to be high. Assumed to support fish because it is sometimes flooded by sea water. A vegetation type specifically identified by USFWS (2010) as scarce and high value for migratory birds.
	IIIc	Wet Sedge Tundra/Water Complex	Wetland/ waterbody complex	Complexes of Wet Sedge Tundra and open water, with tundra dominant. Assumed to occupy a low-lying position subject to flooding if contiguous with a stream, so was included in floodplain delineation. Plant productivity is assumed to be high. Flooded water regime implies flowing surface water may be able to carry organic matter off-site. This vegetation type may be indicative of basin wetland complexes, which were identified by USFWS (2010) as scarce and of high value for waterfowl, loons, and shorebirds.

Table 1: Walker (1983) Vegetation Classes Mapped in the Point Thomson Project Area				
Walker Level B Cover Units	Walker Level C Photo Interpreted Map Unit Types[1]		Wetland, Waterbody, or Upland?	Description and Associated Features Used as Indicators of Wetland Functions
Wet Tundra (cont.)	IIId	Wet Sedge/ Moist Sedge, Dwarf Shrub Tundra Complex	Wetland	Patterned ground complexes dominated by Wet Sedge Tundra in the basins of the low-centered polygons, in the troughs between high-centered polygons, and in the low areas between moist ridges of strangmoor. Moist Sedge, Dwarf Shrub Tundra occurs on low-center polygon rims, on the flat high-center polygon centers, and on the ridges of strangmoor. Assumed to occupy a low-lying position subject to flooding if contiguous with a stream, so was included in floodplain delineation. Plant productivity is assumed to be high. Thick surface organic layer and moss and sedge mat are thought to insulate soils from summer thaw. Wet Sedge Tundra component is flooded in spring and saturated throughout the growing season. Water is assumed to flow across the ground surface for part of summer. Flooded water regime implies flowing surface water may be able to carry organic matter off-site. This vegetation type is characteristic of patterned wet sedge/low-center polygon wetlands identified by USFWS (2010) as scarce and high value; its mosaic of habitats supports relatively diverse vegetation and avian communities.
	IIIe	Wet Sedge/ Moist Sedge, Dwarf Shrub Tundra/Barren Complex (frost-scar tundra complex)	Wetland	Wet Sedge and Moist Sedge Tundra are dominant but barren areas caused by frost scarring are extensive. Wetter areas are similar to Wet Sedge Tundra. Areas with better drainage are dominated by Moist Sedge, Dwarf Shrub Tundra. Plant productivity is assumed to be high. Assumed to have thinner surface moss layers than other wet sedge tundra types so not as effective at insulating the soil from summer warmth. Assumed to occupy a low-lying position subject to flooding if contiguous with a stream, so was included in floodplain delineation. Flooded water regime implies flowing surface water may be able to carry organic matter off-site.
	IXh	Wet Barren/ Wet Graminoid Tundra Complex	Waterbody/ wetland complex	Regularly and irregularly flooded salt marsh with large patches of unvegetated intertidal sediments. Presence next to ocean implies exposure to wave action and tidal water flow. Vegetation assumed to bind substrate. Water flowing across the ground surface provides mechanism for entrainment and off-site transport of organic matter. Assumed to support fish because it is sometimes flooded by sea water. A vegetation type specifically identified by USFWS (2010) as scarce and high value for migratory birds.
Moist/Wet Tundra Complex	IVa	Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex	Wetland	Mixed high-and low-centered polygons with thermokarst polygon troughs and numerous ponds supporting Moist Sedge, Dwarf Shrub Tundra and Wet Sedge Tundra, dominated by high, moist areas. Plant productivity is assumed to be high. Thick surface organic layer and moss and sedge mat are thought to insulate soils from summer thaw. High-centered polygons are vulnerable to damage from ice road construction because high microsites may extend above the ice surface.

Table 1: Walker (1983) Vegetation Classes Mapped in the Point Thomson Project Area

Walker Level B Cover Units	Walker Level C Photo Interpreted Map Unit Types[1]		Wetland, Waterbody, or Upland?	Description and Associated Features Used as Indicators of Wetland Functions
Moist or Dry Tundra	Va	Moist Sedge, Dwarf Shrub Tundra	Wetland	High-centered polygons with distinct polygon troughs, as well as flat-topped polygons. Wet microsites occur in troughs. Plant productivity is assumed to be high. Thick surface organic layer and moss and sedge mat are thought to insulate soils from summer thaw. High-centered polygons are vulnerable to damage from ice road construction because high microsites may extend above the ice surface.
	Vb	Moist Tussock Sedge, Dwarf Shrub Tundra	Wetland	Dominated by tussock cottongrass (*Eriophorum vaginatum*) with other sedges and dwarf shrubs. Plant productivity is assumed to be high. Thick surface organic layer and moss and sedge mat are thought to insulate soils from summer thaw. Tussock sedges are important caribou forage in early calving season. Tussocks are vulnerable to damage from ice road construction because they may extend above the ice surface.
	Ve	Moist Graminoid, Dwarf Shrub Tundra/Barren Complex	Wetland	Typical Moist Sedge, Dwarf Sedge Tundra with numerous frost boils or frost scars. Frost boils are barren or partially vegetated with dwarf shrubs and scattered herbs. Plant productivity is assumed to be high. Assumed to have thinner surface moss layers than moist sedge tundra types so not as effective at insulating the soil from summer warmth
	Vc	Dry Dwarf Shrub, Crustose Lichens	Upland, Wetland	Relatively well-drained sites (pingos, low ridgetops, high-centered polygons) dominated by *Dryas integrifolia* and a diverse assemblage of dwarf willows, sedges, and forbs. Exposed mineral and peat soils are covered with crustose lichens. Troughs between high-centered polygons are wetter communities.
	Vd	Dry Dwarf Shrub, Fruticose Lichens	Upland, Wetland	Relatively well-drained, high-centered polygons with narrow, well-developed polygon troughs. Vegetation on the high centers is similar to Dry Dwarf Shrub, Crustose Lichen, with additional shrubs, forbs, and grasses. Exposed peaty soil is covered with fruticose lichens High-centered polygons are vulnerable to damage from ice road construction because high microsites may extend above the ice surface. This vegetation type is characteristic of high-centered polygon wetlands identified by USFWS (2010) as scarce and high value; its mosaic of habitats supports relatively diverse vegetation and avian communities.
Partially Vegetated	IXb	Dry Barren/Dwarf Shrub, Forb-Grass Complex	Upland, Wetland	Diverse assemblage of shrubs (willows and *Dryas*), grasses, and forbs on moderately well-drained gravel substrate elevated slightly above active river channels.
	IXc	Dry Barren/Forb Complex	Upland, Waterbody	Seasonally flooded, well drained areas on river floodplains that are partially vegetated with a diversity of forbs.
	IXe	Dry Barren/Grass Complex	Upland	Coastal sand dunes partially vegetated with grass. These vegetation units are excluded from areas performing wetland or waterbody functions.

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Partially Vegetated (cont.)	IXf	Dry Barren/Dwarf Shrub, Grass Complex	Upland	Sand dunes partially vegetated with forbs, grasses, and dwarf shrubs. Areas with this vegetation type are excluded from performing wetland or waterbody functions.
	IXi	Dry Barren/Forb-Graminoid Complex	Wetland	Coastal vegetation intermittently flooded by saltwater resulting in death of salt intolerant vegetation. Colonizing plant species are typical of salt marsh species. Assumed to support fish because it is sometimes flooded by sea water. A vegetation type specifically identified by USFWS (2010) as scarce and high value for migratory birds.
Disturbed Barrens	Xc	Barren Gravel Outcrops	Disturbed wetland, Disturbed upland	Partially vegetated gravel spill areas with plant cover less than 30%. Includes washout zones next to exploratory pads.
	Xe	Gravel Roads and Pads	Upland	Gravel fill, including exploratory pads, roads, and airstrips. These vegetation units are excluded from areas performing wetland or waterbody functions.

Notes:
[a] Level C types are ordered roughly by site flooding or soil moisture.; subunits for water were developed by HDR Alaska, Inc. for use in the EIS.

2.5 LIMITATIONS

Whether explicitly stated or not, every wetland functional assessment method is a tool to evaluate the human-valued features of complex systems in a highly simplified way. Each is based on incomplete scientific knowledge and incomplete information about the sites being evaluated. The following are some of this method's limitations.

The functions evaluated for this project have been chosen subjectively based on the functions evaluated in other methods and the values of the investigators and other project evaluators. Many important ecological processes are not evaluated. All wetlands have intrinsic values and are critical at least to the organisms that live within them. Some widely-recognized wetland functions that are, no doubt, performed by project-area wetlands are not evaluated because they are assumed to occur ubiquitously, and analysis of them would not be useful for comparing among project alternatives.

While substantial scientific literature exists for the Arctic Coastal Plain (ACP) of Alaska, the logic and the selection of indicators of wetland functions are founded on basic ecological and hydrologic principles primarily developed in other environments, and on the professional judgment of the investigators.

Any field-collected data represents a snapshot in time at a distinct location. For some functions, long-term observations or controlled experiments would be needed to better evaluate performance of a function.

This method assesses the performance for each wetland function using two categories. An area is rated as either performing the function, or not performing it. The investigators recognize that the magnitudes of most ecological processes are better expressed as gradients. However, information to describe that gradient or define indicators for it is lacking, and attempts to quantify magnitudes of function may imply more accuracy than actually exists.

Some data sets used as indicators of wetland functions were developed subjectively by scientists using their judgment and information that could be gleaned from other data sets, such as aerial imagery. The methods used by scientists to develop the data sets used in the functional assessment are present in Appendix B. In general, each data set was developed by as few scientists as possible to maximize the consistency of the mapping across the project area. Much of the vegetation mapping was verified in the field and vegetation classified according to the Walker (1983) system. However, the mapping has not been field verified for some of the corridors along ice road routes being examined in the EIS.

Specific wetland mapping does not exist for the project area. As stated above, the vegetation mapping is used as a surrogate for wetland and waterbody mapping. Several vegetation types assumed to be wetlands or waterbodies for this analysis could, in fact, encompass areas that are uplands. These mapped vegetation types comprise less than 3 percent of the mapped project area. Thus, the total area assumed to be wetland or waterbody, and to perform wetland functions, is likely to be an overestimate.

2.6 WETLAND FUNCTIONS

The functions being assessed are described in detail below. For each, there is a detailed description of the function, the rationale for where on the landscape that function may be performed, and descriptions of the features used as indicators of that function. The GIS model is presented following a description of the indicators.

2.6.1 Hydrologic Functions

2.6.1.1 Flood Flow Moderation and Conveyance

Definition: A wetland’s capacity to reduce flood peak flows in streams by temporarily storing or slowing water passage en route to stream channels, or by retaining the water without later release downstream. This function does not include the absorption of snowmelt and precipitation in soil.

Rationale: Post (1990) reviewed the flow regulation functions of ACP wetlands. He differentiated between wetlands’ role at snowmelt and their role later in the summer. At peak snowmelt, water covers much of the coastal plain’s surface. Wetland soils are still frozen at this time and their capacity to absorb water is thus limited. Some water can be taken up by organic surface layers and mosses that entered the previous winter unsaturated, water migration into the overlying snow pack during the winter creates some absorption capacity, and some water flows into cracks and voids in the still-frozen soil (Slaughter and Kane 1979, Kane et al. 1981, Carter et al. 1987, Woo 1986 in Post 1990). Most of the sources that Post cited characterized the magnitude of absorption relative to runoff as small during the period of snowmelt. A wetlands’ absorption of water at snowmelt will not be ascribed the flood flow moderation function. However, with the majority of snowmelt funneled to stream systems, other mechanisms become responsible for affecting the magnitude and timing of break-up flows. These mechanisms, which primarily occur in the floodplains, are detention of flows in microtopographic and large depressions, depression storage, and surface roughness (particularly woody vegetation; Post 1990). The floodplains of all streams are ascribed with the flood flow moderation function.

As summer progresses and the soil thaws, wetlands’ capacity to absorb water grows. Several sources describe the active layer’s effective absorption of precipitation during periods when the permafrostperched water table is below the soil surface. That water may be dissipated through evapotranspiration. Logical consideration of this mechanism leads to the conclusion that all wetlands that experience a declining water table through the summer, including floodplain wetlands, would absorb rainfall and delay or prevent its runoff to streams. Since this occurs throughout the entire area, it is not accounted for in the floodflow moderation function.

Post makes an incomplete case for flow regulation by retention and detention in depressions including ponds both during breakup and later in the summer. Common logic supports a pond's ability to lessen or delay runoff if it begins the runoff event in a drawn down condition or if it has a constricted outlet. This logic extends to the ability of microtopographic depressions to retain water if they are not already full when they receive water. On the coastal plain, most of the year's runoff (except runoff originating in the foothills or Brooks Range, see below) occurs during the single short snowmelt period. Snowmelt is the primary time when depressions may receive substantial overland flow. The flood flow moderation function will be attributed to large depressions with restricted outlets, which are assumed to receive overland flow during snowmelt and detain it, as well as large depressions with no outlet which are responsible for retention of snowmelt. Lakes that have banks, indicating they are within a basin and have the capacity to draw down and recharge, are also attributed this function.

Finally, wetlands within floodplains of rivers that experience multiple peak flows throughout the spring and summer also reduce flood flows. They do so by the same mechanisms as during snowmelt, however this function occurs throughout spring and summer. The occurrence of multiple peak flows applies to the larger streams in the project area originating in the foothills and the Brooks Range. These streams have peak flows in the spring and later in summer because precipitation is much higher inland and in the mountains than along the coast. The wetlands on their floodplains with robust vegetation or strong microtopographic features slow the flows slightly by friction, retain surface water in depressions, and absorb water in moss and thawed soil if not already saturated. Although these areas have already been ascribed the flood flow moderation function due to runoff detention and retention during snowmelt, it is important to note that these particular areas perform the function throughout the summer.

Indicators:

- Floodplains of all streams
- Wetlands, ponds, and lakes in large topographic basins (basin wetland complexes, drained lake basins, and lakes with banks)

Model: Flood Flow Moderation and Conveyance = [Floodplain polygons] PLUS [Basin Wetland Complex + Drained Lake Basin + Lakes with Banks] MINUS [IXe, IXf, Xe]

2.6.1.2 Shoreline and Bank Stabilization

Definition: Wetland vegetation's role in binding substrates and dissipating erosive forces of moving water in the form of waves, tidal water flow, and stream bank overflow; also barrier islands' and coastal beaches' role in dissipation of wave force.

Rationale: Emergent vegetation rooted in standing water in lakes and along their shores may dissipate the energy of small wind-generated waves as well as bind the substrate of the active layer. Thresholds of fetch, wave size, and vegetated fringe widths associated with effective performance of this function are not well documented. Dimensions used as indicators of the lakeshore stabilization function are best professional estimates as determined by the wetlands scientists.

Coastal shoreline grasses and sedges form dense mats that are assumed to both shield sediments from small wave forces and bind the substrate against erosion. Unvegetated barrier islands and coastal beaches are also assumed to perform this function, although the gravel spits and barrier islands may be partly above high tide line and thus not waters of the U.S.

Stream banks with heights within the approximate sedge rooting depth may be effectively stabilized by vegetation during high summer flows. Based on field observations, streams originating in the coastal plain have bank heights in the approximate range of plant rooting depths. Vegetation is assumed to not effectively stabilize stream banks taller than the approximate rooting (and active layer) depth because those banks are susceptible to erosion by exposure of permafrost, which leads to its thawing. The rivers originating in the Brooks Range have bank heights much taller than the bank vegetation rooting depths. Although vegetation may not effectively stabilize stream banks along the active channel, it is assumed to slow the process of erosion elsewhere in the floodplain when these rivers top their banks.

Indicators:

- Areas of emergent vegetation (IIb and IId) in and adjacent to lakes >20 acres in area (Ia3)
- Well vegetated areas (IIIa, IIIc, IIId, IIIe, IVa, Va, Vb, Vd, Ve) completely within and adjacent (within a 30-foot-wide zone) to lakes >20 acres in area (Ia3)
- Well vegetated areas (IIb, IId, IIIa, IIIc, IIId, IIIe, IVa, Va, Vb, Vd, Ve) directly adjacent to stream channels
- Estuarine meadows and meadow/barren complexes (IIIb, IXh)
- Coastal beaches (coastal Xa)

Model: Shoreline and Bank Stabilization = [Ia3] PLUS [any IIb, IId in or adjacent to Ia3] PLUS [any IIIa, IIIc, IIId, IIIe, IVa, Va, Vb, Vd, Ve within a 30-foot-wide zone around above] MINUS [Ia3] PLUS [all IIIb and IXh] PLUS [any IIb, IId, IIIa, IIIc, IIId, IIIe, IVa, Va, Vb, Vd, Ve within stream buffers] PLUS [coastal Xa] MINUS [IXe, IXf, Xe]

2.6.1.3 Maintenance of Natural Sediment Transport Processes

Definition: The natural processes of entrainment of particulates by flowing water, transport of particulates to downstream and coastal areas, and deposition of suspended particulates generated at natural sources. This function does not include capture or retention of airborne particulates or coastal sediment transport processes.

Rationale: The only suspended sediments expected in the project area from natural sources would be in creeks and rivers. Therefore, only wetlands associated with channels potentially perform this function. The creeks and rivers themselves provide the vector for natural sediment transport which is an important fluvial process.

Some wetlands' effectiveness at capturing and retaining sediments may be more the result of their location, particularly for those on floodplains, than of any wetland-specific characteristics. Note that, in most of the situations described below, uplands at the same location would also retain sediments.

When sediment-laden rivers, such as those originating in the Brooks Range, flood and overflow their banks, some of the suspended sediments are deposited because the conveyance of water over the wider floodplain allows the water velocity to slow. Vegetation through which the water may flow may help capture and retain suspended sediment by further slowing the water velocity. Taller and stiffer (woody) vegetation is assumed to slow water more effectively than is prostrate vegetation such as *Dryas*. Tall, woody vegetation does not occur in the project area. Wetlands with strong microtopography, such as hummocky or tussocky vegetation or polygonal ground caused by ice wedges, are assumed to be more effective at slowing flows by friction than are uniformly flat wetlands. Depressions or ponds in floodplains that are not already full when the river overflows would fill with sediment-laden water and the sediments would be deposited as the flood recedes and movement of water in the pond ceases. Adamus et al. (1991) noted that riverine wetlands would have the shortest sediment retention times of any wetland type. However, wetlands associated with streams are the only ones in the project area with potential natural sediment sources.

The same principles as described above would apply to sediment retention on the floodplains of smaller streams. While these streams, originating on the coastal plain, have much lower sediment loads, scientists ground-truthing vegetation mapping for this project observed sediments moved and redeposited adjacent to small streams, as well as stratified sediments in soil pits on these narrow floodplains. While it has not been confirmed by scientific literature, it is assumed for now that beaded streams would retain sediments in their deep pools. In circumstances where creeks flow into ponds or wetlands, the water velocity would slow and sediments would drop from the water column, therefore ponds and wetlands in floodplains are also attributed this function.

Indicators:

- Floodplains of large and small streams

Model: Maintenance of Natural Sediment Transport Processes = [Floodplain polygons] MINUS [IXe, IXf, Xe]

2.6.2 Biogeochemical Functions

2.6.2.1 Production and Export of Organic Matter

Definition: A high-level of production of organic carbon via photosynthesis and consumption of that material by microbes, and subsequent flushing of this organic matter to downstream ecosystems where it may support various trophic pathways. This definition does not include transport of organic materials during the early snowmelt period of widespread sheetflow across the tundra.

Rationale: This function depends on (1) high rates of primary production and (2) a hydrologic linkage in the form of water flow to other parts of the aquatic ecosystem (Adamus et al. 1991). Many of the vegetation types on the Arctic Coastal Plain are highly productive. Herbaceous plants and deciduous shrubs are assumed to be more productive than evergreen plants, and to release more organic matter when leaves senesce each autumn. Wetlands with surface water for part of the snow-free period are assumed to have more opportunity for entrainment of particulate and dissolved organic matter than drier community types, and are more likely to have runoff that would carry that matter to downstream systems. However, at snowmelt, detritus (dead organic matter) could easily be picked up from any vegetated area and transported offsite. Wetlands adjacent to streams or with stream outlets demonstrate a pathway for export of the organic matter. Wetlands within floodplains and wetlands flooded by tides also demonstrate a means for entrainment and export of organic matter. Wrack deposited along floodplain and lake margins observed during 2010 field studies (HDR) demonstrates the abundance of material entrained at high water; more material is assumed to have been carried downstream than was deposited at the peak. Streams are attributed the production and export function as the vector for movement of material downstream. Large productive basins with surface water outlets also export organic matter to downstream systems.

Indicators:

- Vegetated wetlands with a surface water outlet connected to other wetlands or streams:
- Flooded productive wetlands (IIb, IId, IIIa, IIIc, IIId, IIIe) in or adjacent to stream floodplains
- Streams (Ia2) and vegetated wetlands (IIb, IId, IIIa, IIIb, IIIc, IIId, IIIe, IVa, Va, Ve, Vb, Vd) within floodplains
- Vegetated estuarine wetlands (IIIb, IXh)
- Large topographic basins with surface water outlets, excluding waterbodies (Ia3, Ia4)

Model: Production and Export of Organic Matter = [merged (IIIa + IIIc + IIId + IIIe + IIb + IId) within or adjacent to a floodplain] PLUS [,IIb, IId, IIIa, IIIb, IIIc, IIId, IIIe, IVa, Va, Ve, Vb, Vd within a floodplain landform] PLUS [Ia2] PLUS [IIIb + IXh] PLUS [(Basin Wetland Complex, Drained Lake Basins, Lakes with Banks with surface water outlets) MINUS (Ia3 and Ia4)] MINUS [IXe, IXf, Xe]

2.6.2.2 Maintenance of Soil Thermal Regime

Definition: The role of wetland soil and vegetation in maintaining a stable soil thermal regime, as indicated by presence of permafrost, surface topography, and soil moisture typical of the site’s plant community. Loss of this maintenance function would be indicated by development of thermokarst, or thaw of permafrost, ground subsidence, drainage into the thawed area, drainage of adjacent areas, and proliferation of thawing and collapse conditions.

Rationale: The presence of permafrost and the depth of the annual thawed layer have major influences on wetland ecosystems. The soil thermal regime regulates site drainage and soil moisture, determines the vegetation type, and affects ground stability. Because the permafrost is impermeable to water, sites with shallow permafrost and flat or gradual slopes (that is, no gradient for drainage) tend to be saturated at or near the surface. Thawing permafrost can cause thermokarst and ground surface subsidence, leading to inundation of the area that subsided (Beringer et al. 2001, Nicolskly et al. 2008).

While the depth of thaw is governed by the complex interaction of climate, microtopography, substrate texture, surface hydrology, and vegetation (Beringer et al. 2001), vegetation cover exerts the strongest influence (Raynolds et al. 2008). In general, the depth of summer thaw is directly correlated to the depth of surface biomass and organic soil horizon (Ping, et al. 2008, Walker et al. 2003). Daanen et al. (2008) found that mosses and graminoids have the greatest insulative value, followed by forbs, lichens, shrubs, and last, bare ground. Nicolsky et al. (2008) found that for approximately every inch of additional thickness of surface organic material the active layer thaw depth decreased by almost two inches. Mosses in particular form a thick, insulating layer that buffers the underlying soil and permafrost from solar heat radiation (Beringer et al. 2001). Moss carpets also shade the soil surface, resulting in shallower thaw depths (Kade and Walker 2008).

On the other hand, areas with high surface moisture have the greatest summer heat flux, transferring heat to the active layer and increasing the thaw depth. Wet sedge tundra where the soil surface is mainly composed of water have higher heat flux than areas with shrubs and a moss understory where soil moisture is low and thaw depth is less (McFadden et al. 1998). Bare ground with little or no live vegetation and thin soil organic mats have the greatest depth of active layer thaw when compared to sites of similar location and landscape position that have a thick organic layer (Kade et al. 2006; Walker, Epstein, et al. 2008). Where vegetation is disturbed, permafrost is most likely to experience dramatic warming and thawing events (Pavlov and Moskalenko 2002). Increases in thaw depth can lead to ground surface subsidence, inundation, and deeper thaw.

While areas with surface water transfer heat into the soil readily, wet sedge meadows also tend to have dense moss cover and thick organic soil horizons. The presence of mossy wet sedge tundra is considered to be an indicator of this function. Moist tundra types with dense vegetation also have thick moss mats, so they also are ascribed this function.

<u>Indicators</u>:

- Wet tundra types (IIIa, IIId) and moist tundra types (IVa, Va, Vb)

<u>Model</u>: Maintenance of Soil Thermal Regime = (IIIa + IIId + IVa + Va + Vb)

2.6.3 Habitat and Faunal Community Support Functions

2.6.3.1 Waterbird Support

<u>Definition</u>: Capacity of a wetland or waterbody to provide a high or moderate level of support to waterbird species.

<u>Rationale</u>: The USFWS has provided a draft guidance document (2010) that describes species-habitat associations of waterbirds. It identifies habitats in four categories based on abundance and value for evaluation species, with Category I being unique and having the highest value and Category IV being abundant and of medium to low value. For the wetland functional assessment, Walker Level C mapping types that correspond to Categories I, II, and III are ascribed the waterbird support function. Additionally, the shoreline, lagoons, barrier islands, and nearshore areas in the project area are located within the Eastern Beaufort Sea Lagoons and Barrier Islands Important Bird Area (IBA) which is designated for its global importance (Audubon Alaska 2010). These nearshore habitats provide sheltered foraging areas used by molting seaducks, especially long tailed ducks, and these habitats also provide breeding and staging areas for seaducks, seabirds, and shorebirds. Note that nearshore marine waters constitute 17.0 percent of the project area and this strongly affects the total acreage of this function. The habitat types described in the USFWS guidance and the Eastern Beaufort Sea Lagoons and Barrier Islands IBA that occur in the project area include:

- Beaufort Sea coastal marshes
- Beaufort Sea barrier islands and shoreline

- *Arctophila* wetlands (wetlands associated with lake and pond shorelines that are dominated by *Arctophila fulva*)
- Basin wetland complexes
- Patterned wet sedge/low-center polygon wetlands
- High-center polygon wetlands
- Nonpatterned wet sedge wetlands
- Shallow sedge (*Carex*) wetlands
- Deep open lakes
- Nearshore waters

Indicators:

- Coastal wet sedge-grass marshes (IIIb, IXh)
- Coastal barrens (IXi, coastal Xa)
- Emergent marshes (IIb, IId; includes *Arctophila* wetlands)
- Basin wetland complexes
- Patterned wet sedge/low-center polygon wetlands (IIId) and adjacent ponds (Ia4)
- Wet sedge wetlands (IIIa, IIIc, IIId) and adjacent ponds (Ia4)
- High-center polygon wetlands (Vd)
- Lakes (Ia3)
- Nearshore waters (Ia1)

<u>Model</u>: Waterbird Support = [Ia3 + IIb + IId + IIIa + IIIb + IIIc + IIId + Vd + IXh + IXi + Ia1 + coastal Xa] PLUS [Basin Wetland Complexes] PLUS [Ia4 adjacent to IIIa, IIIc, IIId] MINUS [IXe, IXf, Xe]

2.6.3.2 Terrestrial Mammal Support

<u>Definition</u>: The capacity to support denning, foraging, movement, and insect escapement behavior of terrestrial mammals of cultural or subsistence interest. Polar bears are not considered under this function but are considered in Threatened or Endangered Species Support.

<u>Rationale</u>: The terrestrial mammals identified as species of interest during the EIS scoping period include caribou, muskoxen, and brown bears. The indicators of this function are based on available information, as presented in the preliminary draft EIS or through interviews with EIS Subject Matter Experts, that can be correlated to specific vegetation types or landforms that support denning, foraging, movement, or insect escapement behaviors for these species. Correlations were identified for limited subsets of these behaviors for each species, because correlations could not be identified or are not applicable for every behavior for each species.

Brown Bear

As described in the preliminary draft EIS, both male and female brown bears hibernate during the winter, entering dens between late September and mid-November, with pregnant females entering earliest and adult males entering latest during this period (Shideler and Hechtel 2000). Dens are excavated during late fall in well-drained sand or silt permafrost soils; commonly used den habitats include stream banks, pingos, hillsides, and terraces (Shideler and Hechtel 2000). (Note that these may not be wetlands.) Brown bears emerge from their dens between March and May, with adult males emerging first and females with new cubs emerging last (Shideler and Hechtel 2000). No brown bear dens have been observed in the project area, but a few dens have been observed near the project area near the Saganavirktok River (Shideler unpublished data). ADF&G collaring and tracking effort was lower for brown bears east of the Kavik River; therefore, this area has likely been under-sampled for brown bear dens. Most brown bears were observed within or near riparian habitats associated with the Sagavanirktok and Canning rivers during June, July, and August, and survey observers documented brown bears within this region on 34 percent of surveys in 1995 and 1997 to 2003 (Shideler and Hechtel 2000). Currently there are no references documenting brown bears feeding on fish or fishing in rivers on the North Slope. Brown bears are opportunistic omnivores and may be able to exploit short term or accidental situations where fish may be taken, but there has been no confirmed predictable use of North Slope rivers for fishing by brown bears (Shideler 2011).

Habitat potentially suitable for brown bear dens is evaluated based on polar bear denning models by USGS (Durner et al. 2001, 2006) that include sloped habitats along drainages that are considered to approximate the availability of loose, well-drained soils which may be suitable for brown bears to dig dens for hibernation. The modeled denning habitats closely correspond to Shideler (1999) conclusions that there is minimal brown bear use in the project area because of its low topography and limited preferred riparian habitat. Suitable denning habitat increases east and west of the project area where topography increases and along major river drainages. Because no brown bear den sites have been recorded within a mile of the coast or on the barrier islands (ADF&G 2001), the polar bear denning habitat within a mile of the coast is not considered to be brown bear denning habitat.

Caribou

In general, the entire Arctic Coastal Plain provides foraging habitat for caribou. A correlation has not been drawn between forage amounts/values and mapped vegetation types due to annual variances in plant phenology which is directly affected by annual variances in snow pack; however, tussock tundra has been identified as important for caribou early in the calving season when the inflorescences are eaten before they open. Caribou demonstrate some preference for movement along river corridors or floodplains, and also seek gravel bars and barrens within these areas for insect escapement. Similarly, caribou will also congregate on coastal gravel spits for relief from insects (Noel 2010).

Muskoxen

Similar to caribou, the entire Arctic Coastal Plain provides foraging habitat for muskoxen, and a correlation between forage amounts/values and mapped vegetation types has not been drawn. Additionally, no correlation has been identified between preferential calving areas and mapped vegetation types (Noel 2010). Rather, muskoxen frequently use habitats along or adjacent to rivers. In studies compiled for the preliminary draft EIS, most muskoxen used riparian habitats between the Sagavanirktok and Canning rivers during June, July, and August and survey observers documented muskoxen within this region on 43 percent of surveys in 1995 and 1997 to 2003 (Pollard and Noel 1995; Noel 1998a, 1998b; Noel and Olson 1999a, 1999b; Noel and King 2000a, King 2000b; Noel and Olson 2001a, 2001b; Jensen and Noel 2002; Jensen, Noel, and Ballard 2003; Noel and Cunningham 2003).

<u>Indicators</u>:

- Brown bear denning habitat (polar bear denning habitat from USGS model, buffered by 50 feet on each side to convert line to an area, minus areas within a mile of the coast)
- Riparian corridors/floodplains of large rivers (Category 4) including gravel bars (Xa) and excluding streams (Ia2)
- Tussock tundra (Vb)
- Coastal spits and coastal barrens (coastal Xa)

Model: Terrestrial Mammal Support = [((polar bear denning habitat lines) MINUS (1-mile coastal buffer)), buffered by 50 feet] PLUS [Floodplain landform of Category 4 streams] PLUS Vb PLUS (coastal Xa)] MINUS [Ia2] MINUS [IXe, IXf, Xe]

2.6.3.3 Resident and Diadromous Fish Support

Definition: Wetlands and waterbodies known or suspected to directly support freshwater or diadromous fish by providing habitat at some life stage. Diadromous fish include both amphidromous and anadromous fishes, which migrate between freshwater and saltwater environments.

Rationale: The sources of information on fish presence and distribution are listed in Section 3.12 of the EIS. Estuarine and nearshore waters support both diadromous fish and freshwater fish that may seek refuge there from peak stream flows. The ranges of all five species of Pacific salmon extend into the project area (NMFS 2005). Marine and nearshore Essential Fish Habitat (EFH) has been designated for all five species. The Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes (Johnson and Blanche 2010) identifies 13 rivers and streams as anadromous within the project area, and five project-area streams have habitat designated for one or both of pink and chum salmon: the Canning/ Staines Rivers, Shaviovik River, Kavik River, Sagavanirktok River, and West Sagavanirktok River.

Fish sampling in the project area indicates that freshwater or diadromous fish species occur in many, if not most, streams and ponds. Freshwater fish habitat includes seasonally flooded wetlands and ponds less than 4 feet deep (BPXA 1995), rivers, and lakes.

Fish distribution data within the project area are limited and are a constraint in identifying fish-supporting habitat. For this functional assessment, streams, ponds, and lakes are considered to be fish-bearing, and are ascribed the fish support function, if sampling has documented presence of fish (Craig and McCart 1974; Fechhelm 1996, 2000; Hemming 1996; Ward and Craig 1974; Winters and Morris 2004; WCC and ABR 1983) or if they are cataloged as anadromous waters (Johnson and Blanche 2010). Streams, lakes, ponds, seasonally flooded wetlands, and river bars with a direct surface-water (channel) connection to fish-bearing streams are also considered to perform this function. Additionally, any waterbodies, wetlands, and gravel bars within the floodplains of, and directly connected to, fish-bearing streams are considered to perform this function. Estuaries, all intertidal wetlands and waters, and lakes and ponds directly adjacent to intertidal areas are considered to provide resident and diadromous fish support. Streams, lakes, and wetlands that do not meet any of the above conditions are not ascribed this function.

Indicators:

- Streams (Ia2), ponds (Ia4), lakes (Ia3), coastal and river gravel bars (Xa), and wetlands (all mapped types except IXe, IXf, and Xe) within the floodplains of either fish-bearing (coded as anadromous waters (AW) or as documented fish presence (DFP)) streams or streams with a direct surface water connection (DSW) to fish-bearing streams

- Marine and nearshore EFH and the adjacent intertidal areas, ponds, and lakes (Ia1, IIIb, IXh, IXi and adjacent Ia3, Ia4) and coastal beaches

Model: Resident and Diadromous Fish Support = [Floodplains of AW and DFP and DSW] PLUS [Ia1, IIIb, IXh, IXi and adjacent Ia3, Ia4] PLUS [coastal Xa] MINUS [IXe, IXf, Xe]

2.6.3.4 Threatened or Endangered Species Support

Definition: Wetlands and waterbodies known or suspected to provide important habitat to spectacled eiders, having the potential to provide polar bear denning habitat, or depicted by USFWS as Sea Ice or Barrier Island Critical Habitat of the Polar Bear in November 2010. Separate GIS layers depict this function for the two species.

Rationale: Threatened or endangered species that are expected to have important habitat in the project area are considered for the analysis of wetland functions. Candidate species, or listed species that are not expected to have important habitat in the project area are not considered. The following descriptions of important spectacled eider and polar bear habitat are gleaned from information presented in the development of the draft EIS.

The draft EIS description of spectacled eider habitat cites habitats used on the Arctic Coastal Plain (Johnson et al. 2000; Anderson and Cooper 1994; OASIS Environmental 2008). Nests and broods have been found in basin wetland complexes, lowland wet-moist patterned tundra complex, and shallow or deep water with islands or polygonized margins, and on salt-killed tundra. At fledging, spectacled eiders move to nearshore marine waters (65 FR 6114; USFWS 2001). Note that nearshore marine waters constitute 17.0 percent of the project area and this strongly affects the total acreage of this function.

Potential polar bear denning habitat within the area of this wetland function analysis is determined as follows. Denning habitat has been modeled by USGS (Durner et al. 2001, 2006) and this data set serves as an indicator of polar bear habitat for this assessment. Onshore, most maternal dens are located in drifts along the coastline and, to a lesser extent, along river or stream banks; a few have been found along lakeshores and even at the edge of an abandoned gravel pad (Durner et al. 2003). The common characteristic among suitable denning habitats is the presence of topographic features that catch and hold blowing snow in early winter.

The USFWS identified three types of critical habitat for the polar bear in January 2011 (75 FR 76086). These are terrestrial denning habitat, sea ice habitat, and barrier island habitat. The wetland assessment is using the specific model described above to represent denning habitat, rather than the more general terrestrial denning habitat depicted by the USFWS. The barrier island critical habitat and the sea ice habitat areas mapped by the USFWS are incorporated into this function, including the no-disturbance zone around the barrier islands.

Indicators:

Spectacled eider

- *Arctophila fulva* and *Carex aquatilis* wetlands (IIb, IId, IIIa, IIIc, IIId, IIIe)

- Basin wetland complexes
- Open water in complex with islands or patterned margins (Ia3 and Ia4 that abut IIId or IVa)
- Patterned wet sedge/low-center polygon wetlands (IIId)
- Deep open lakes (Ia3)
- Nearshore marine waters (Ia1)
- Salt-killed tundra (IXi)

Polar bear

- Polar bear denning habitat as depicted by the USGS (buffered by 50 ft on each side to convert a line to an area)
- USFWS Critical Habitat (sea ice, barrier island, and no-disturbance zones)

Model: Threatened or Endangered Species Support; Layer 1 (Spectacled Eider) = [IIb + IId + IIIa + IIIc + IIId + IIIe + 1a1 + Ia3 + IXi + (Ia4 that abut IIId or IVa)] PLUS [Basin Wetland Complexes]; Layer 2 (Polar Bear) = [USGS lines depicting polar bear denning habitat, buffered by 50 feet] PLUS [USFWS Critical Habitat, including Sea Ice, Barrier Islands, and No-Disturbance Zones] MINUS [IXe, IXf, Xe]

2.6.3.5 Scarce and Valued Habitats

Definition: Habitats that are widely recognized as highly valuable on the Arctic Coastal Plain: brackish meadows, and ponds supporting pendent grass, *Arctophila fulva*.

Rationale: The USFWS (2010) lists Beaufort Sea Coastal Marshes among the habitats of high value for the species it evaluated, and describes it as unique and irreplaceable on a national or ecoregional basis (Category I). This type – dominated by grasses and sedges and often in complex with ponds and mudflats – provides important brood-rearing and post-breeding habitat for migratory birds, including shorebirds, waterfowl, and Lapland longspurs. The plants are used heavily by grazing geese, and the habitats are cited as preferred by brood-rearing brant and snow geese.

The USFWS (2010) considers *Arctophila fulva* wetlands as high value habitat for the species it evaluated, and relatively scarce or becoming scarce on a national or ecoregional basis. *Arctophila* wetlands provide important food, cover, and nesting habitat for many waterfowl and shorebird species. Part of these wetlands' value is derived from their support of high densities of aquatic invertebrates.

The project area is assumed to be somewhat representative of habitat type availability in a wider portion of the Arctic Coastal Plain. Community types not widely represented in the project area are assumed to also not be widely represented across the Arctic Coastal Plain.

Indicators:

- *Arctophila fulva* wetlands (IIb, IId)
- Vegetated estuarine communities, and complexes of these with tide flats (IIIb, IXh, IXi)

Chapter 3. Results

3.1 MODEL OUTPUTS

Table 2 lists the acreage of each function within the project area, and the percentage it represents of the project area, which measures 64,356 acres. Any site may perform multiple functions, so the total functional acreage sums to much more than simply the project area acreage. The last row of the table lists the acreage within the project area that supports at least one function; only approximately five percent of the project area is not ascribed any function. Appendix A lists the acreage of each vegetation type mapped in the project area; this may help reviewers understand how inclusion or exclusion of certain vegetation types affects the results; for example, sea water constitutes 17.0 percent of the project area and this strongly affects the total acreage of the polar bear, spectacled eider, and fish support functions.

Figures 1 through 11, each comprised of six tiles, show the locations within the project area identified as performing each function. Figure 12 shows the area that performs at least one function. Figures showing wetland functions are included as a separate mapbook entitled Wetland Functional Assessment Figures.

Table 2: Acreages of Wetlands and Waterbodies Performing Each Evaluated Function in the Project Area

Wetland or Waterbody Function	Function Definition	Acreage Performing Function in Project Area	Percent of Project Area
	Hydrologic Functions		
Flood Flow Moderation and Conveyance	A wetland's reduction of peak flows in streams by temporarily storing or slowing water passage en route to stream channels or by retaining the water without later release downstream. This function does not include the absorption of snowmelt and precipitation in soil.	18,187	28
Shoreline and Bank Stabilization	Wetland vegetation's role in binding substrates and dissipating erosive forces of moving water in the form of waves, tidal water flow, and stream bank overflow.	4,672	7

Table 2: Acreages of Wetlands and Waterbodies Performing Each Evaluated Function in the Project Area			
Wetland or Waterbody Function	Function Definition	Acreage Performing Function in Project Area	Percent of Project Area
Maintenance of Natural Sediment Transport Processes	The natural processes of entrainment of particulates by flowing water, transport of particulates to downstream and coastal areas, and deposition of suspended particulates generated at natural sources. This function does not include capture or retention of airborne particulates.	14,171	22
Biogeochemical Functions			
Production and Export of Organic Matter	A high-level of production of organic carbon via photosynthesis and consumption of that material by microbes, and subsequent flushing of this organic matter to downstream ecosystems where it may support various trophic pathways. This definition does not include transport of organic materials during the early snowmelt period of widespread sheetflow across the tundra.	18,558	29
Maintenance of Soil Thermal Regime	The role of wetland soil and vegetation in maintaining a stable soil thermal regime, as indicated by presence of permafrost, surface topography, and soil moisture typical of the site's plant community.	39,641	62
Habitat and Faunal Community Support Functions			
Waterbird Support	Capacity of a wetland or waterbody to support the requirements of waterbird species.	36,103	56

Table 2: Acreages of Wetlands and Waterbodies Performing Each Evaluated Function in the Project Area			
Wetland or Waterbody Function	Function Definition	Acreage Performing Function in Project Area	Percent of Project Area
Terrestrial Mammal Support	The capacity to support denning, foraging, movement, and insect escapement behavior of terrestrial mammals of cultural or subsistence interest (brown bear, caribou, muskoxen).	4,398	7
Resident and Diadromous Fish Support	Wetlands and waterbodies known or suspected to directly support freshwater or diadromous fish by providing habitat at some life stage. Diadromous fish include both amphidromous and anadromous fishes, which migrate between freshwater and saltwater environments.	24,607	38
Habitat and Faunal Community Support Functions (Continued)			
Threatened or Endangered Species Support	Wetlands and waterbodies known or suspected to provide important habitat to spectacled eider or having the potential to provide polar bear denning habitat or sea ice critical habitat.		
• Spectacled Eider		33,158	52
• Polar Bear		21,942	34
Scarce and Valued Habitats	Habitats that are widely recognized as highly valuable on the Arctic Coastal Plain: brackish meadows, and ponds supporting pendent grass, *Arctophila fulva*.	1,999	3
All Functions Combined	The area performing any one or more of the functions.	62,382	97.2

3.2 SUGGESTED USE OF THE RESULTS

This method has not categorized wetlands for the purpose of their management or determining appropriate levels of compensatory mitigation. The GIS shapefiles, each one depicting the area in which one of the functions is performed, can be used in various ways to locate important wetlands. For example, the Corps may develop criteria for assignment of different types of wetlands into management categories using some or all of the functions. It may choose to weight some functions more heavily than others; for example, presence of a "red flag" function may suffice to place a wetland in high category regardless of whether it performs other functions. Other areas may be rated high because they perform multiple functions. Some wetlands may be rated low because they were not identified through this method as performing any of the evaluated functions, or because they perform only functions that the project reviewers consider to be less important. The Corps or its appointee may carry out such an analysis in GIS to develop a shapefile showing high-, moderate-, and low-rated wetlands.

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Appendix A

Vegetation and Land Cover Types and Acreages Mapped in the Point Thomson Project Area

Vegetation and Land Cover Types and Acreages Mapped in the Point Thomson Project Area			
Level C Map Unit		Total Mapped Acres	Percent of Project Area
Ia1	Bays, lagoons, inlets, subtidal rivers (saline)	10,935	17.0
Ia2	Rivers and streams	1,278	2.0
Ia3	Lakes	1,864	2.9
Ia4	Ponds	2,954	4.6
IIb	Aquatic Graminoid Tundra	369	0.6
IId	Water/Tundra Complex	235	0.4
IIIa	Wet Sedge Tundra	3,829	6.0
IIIb	Wet Graminoid Tundra (saline)	548	0.9
IIIc	Wet Sedge Tundra/Water Complex	691	1.1
IIId	Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex	12,339	19.2
IIIe	Wet Graminoid, Dwarf Shrub Tundra/Barren Complex	332	0.5
IVa	Moist Sedge, Dwarf Shrub/Wet Graminoid Tundra Complex	10,719	16.7
Va	Moist Sedge, Dwarf Shrub Tundra	12,494	19.4
Vb	Moist Tussock Sedge, Dwarf Shrub Tundra	260	0.4
Vc	Dry Dwarf Shrub, Crustose Lichens	741	1.2
Vd	Dry Dwarf Shrub, Fruiticose Lichens	567	0.9
Ve	Moist Graminoid, Dwarf Shrub Tundra/Barren Complex	1,406	2.2
IXb	Dry Barren/Dwarf Shrub, Forb-Grass Complex	363	0.6
IXc	Dry Barren/Forb Complex	52	0.1
IXe	Dry Barren/Grass Complex	10	<0.1
IXf	Dry Barren/Dwarf Shrub, Grass Complex	2	<0.1
IXh	Wet Barren/Wet Graminoid Tundra Complex (saline)	262	0.4
IXi	Dry Barren/Forb-Graminoid Complex (saline)	585	0.9
Xa	River Gravels/Beaches	984	1.5
Xc	Barren Gravel Outcrops	6	<0.1
Xe	Gravel Roads and Pads	193	0.3
XIa	Wet Mud	326	0.5
XIc	Bare Peat	14	<0.1
	Total	**64,356**	**100%**

Appendix B

Methods Used to Create Data Input Layers for Functional Assessment

Methods Used by the EIS Team to Create Data Input Layers for Functional Assessment

The following are methods that scientists and GIS technicians used to create data layers (GIS "feature classes") that would serve as input to wetland and waterbody function models. Unless it was developed using a simple GIS model, each of these data sets was hand-developed for the entire project area by one or two scientists.

Large Depressions

Scientists mapped large depressions in GIS using the following data sets:

- Topographic contour mapping (1-foot and 2-foot contours, ExxonMobil)
- Digital Elevation Model (DEM) produced by HDR Alaska, Inc. using 4 foot contours generated from Light Detection And Ranging (LIDAR) taken in 2006 received from the State of Alaska Department of Natural Resources
- Aerial photography (Bullen Point digital orthomosaic with 0.75-foot pixel resolution, July 2006; BPXA orthophotos with 1.0-ft pixel resolution, July 2006 and 2.0-ft pixel resolution, August 2001; Digital Globe color infrared IKONOS satellite imagery at 2.0 foot pixel resolution, September 2006 and August 2007)
- Baseline vegetation mapping (Noel and Schick 1995; Noel and Funk 1999; Noel and Funk 2001; OASIS 2009; OASIS 2010; HDR 2011)

They hand-mapped the depressions as follows. Using aerial imagery and topographic mapping, scientists sought contiguous areas with abundant surface water (flooded vegetation types and ponds) that contrasted with adjacent dry areas in a shape indicative of a large depression such as an oriented lake basin. They selected the wet vegetation units in the basin, which often shared a boundary with the margin of the basin, and merged those polygons. They then edited the merged polygon as appropriate to match the apparent basin boundary shown on the topographic mapping. Scientists coded each mapped depression according to whether an inlet or outlet was visible on the imagery or the topographic mapping. Each depression was coded as a drained lake basin or a basin wetland complex. Basin wetland complexes are a subset of drained lake basins, and were identified by the presence of a high degree of interspersion of open water, sedge and grass marsh, and wet and moist meadow habitats. Scientists visually estimated the degree of interspersion among the vegetated habitats listed above within the complex, or between the habitats listed above and open water within the complex, and those areas estimated as having between 25 and 75 percent interspersion were considered to have a high degree of interspersion and were coded as basin wetland complexes. Basins with a low degree of interspersion or composed of nonpatterned moist or wet sedge meadows were coded as drained lake basins. Lakes that had discernable banks, indicating they were within a basin or depressional landform, were also mapped as large depressions and were coded as lakes with banks.

Stream Locations and Attributes

Scientist digitized the centerline of each stream through on-screen aerial photo interpretation of high resolution (0.75 feet to 2.0 feet pixel resolution) imagery captured in 2001, 2006, or 2007, using the best resolution imagery available for each area. Channels within the mapped project area that were clearly visible on this imagery were traced. Where necessary to identify connections with other features or with stream segments in other parts of the mapping area, the stream lines were also drawn outside the project mapping area.

Stream origin. The origin of each stream was identified as either the Arctic Coastal Plain (ACP) or the Brooks Range (BR) based on whether or not the watershed extends into the Brooks Range.

Size categories and initial floodplain width estimates ("buffers"). Scientists classified the streams based on their approximate sizes. Streams originating in the Arctic Coastal Plain were assigned to Categories 1, 2, or 3, representing increasing average widths. Streams originating in the Brooks Range were assigned Category 4. Some streams originating in the Arctic Foothills were assigned to Category 4 as well, but most were assigned to Category 1, 2, or 3. Note that a stream might be divided into segments assigned to different categories.

Categories 1, 2, and 3 were generally comprised of streams originating in the ACP, and were assumed to have generally slow flow and no distinct flow peaks after spring breakup. Category 4 was made up of streams originating in the Brooks Range (some also in the Foothills), which possess hydrologic distinct from the ACP streams because they are subject to higher flows resulting from rainstorms later in the summer, as well.

Scientists estimated initial floodplain widths of Category 1 through 3 as follows. This width was termed the "stream buffer" to distinguish it from the floodplains mapped by the process further described below. During ground-truthing of part of the study area mapped by the EIS wetland team in 2010, the scientists had estimated the average floodplain widths of streams they crossed. This was based primarily on the width of the topographic depression the stream occupied and visible wrack lines. Within GIS, scientists mapping streams reviewed any of these field-collected data, the coarse topographic mapping available to them at that time, visible differences in vegetation between the areas adjacent to streams (generally greener) and that more distant from the streams, and visible wrack lines or other signs of deposition. On stream segments of different sizes, they estimated this buffer width in numerous locations to develop averages that would be applied to each of the first three categories. Each category was defined and assigned a buffer width as follows:

Category 1: Streams connecting wetlands or waterbodies that are too small to map as polygons but are expected to have constant flow. These were given an average buffer width of 20 feet (again, the "buffer" intended to represent an initial floodplain width estimate); that is, 10 feet to each side from the digitized centerline.

Category 2: Defined channels that were wide enough to be mapped as polygons during vegetation mapping. The stream channels in this category are generally not wider than 100 feet, except where channels flow through larger beaded pools, ponds, or lakes. The channels are generally narrow but well defined on aerial photos. Category

2 streams were assigned a buffer width of 100 feet (50 feet from each side of the stream centerline).

Category 3: Streams that originate in the Arctic Foothills or the ACP and are wider than Category 2 streams but narrower than Category 4 streams. Streams in this category are characterized by defined channels, and are wide enough to be mapped as polygons during vegetation mapping. The channels in this category are broad, generally 100 feet wide, and are expected to support greater flows than Category 2 streams. Category 3 streams were assigned a buffer width of 200 feet (100 feet from each side of the stream centerline).

Category 4 streams were relatively few. These streams originate in the BR (and some from the Foothills) and are substantially larger than ACP-originating streams. They are characterized by multiple high-flow events each year, attributable to precipitation events in their BR headwaters which may occur frequently in the mountains but not on the dry ACP (Hydrocon, 1982). The floodplain of each of these streams was hand-drawn in GIS based on interpretation of aerial imagery and the available topographic mapping. The boundaries were estimated to lie where there was a distinct topographic break between the corridor containing the stream and the more elevated adjacent tundra. Category 4 streams often form braided channels with floodplains that are more defined than Category 1 through 3 streams; therefore the hand-digitizing method of mapping was deemed more appropriate than applying average widths. Scientists compared the photo-interpreted widths of the Category 4 river floodplains to the widths cited in a previous hydrologic report produced for the Bullen Point Road Project (PND 2009c) and found them to be similar.

The end result of this hand-drawing streams and Category 4 floodplains, and interpreting multiple data sources to define and map buffers for each Category 1, 2, and 3 stream was a GIS layer showing polygons with initial approximations of each stream's floodplain, called the "stream buffer" layer. This layer was the starting point for the final floodplain mapping described below.

Limitations of this effort include lack of clearly defined channels for smaller streams, lack of hydrologic data for individual streams, relatively coarse topographic data for most of the project area, and limited onsite observation.

Floodplains

Final floodplain mapping combined the stream buffers, areas of very wet vegetation types and ponds that are assumed to occupy low-lying positions that would receive stream overflow, and mapped depressions. This was done within GIS, using information from the stream buffer layer, the vegetation and waterbody mapping, and the depressions mapping.

The following vegetation types were assumed to occupy low-lying positions that could be subject to flooding if connected to a stream:

IIb: Aquatic Graminoid Tundra
IId: Water/Tundra Complex (pond complex with emergent vegetation)
IIIa: Wet Sedge Tundra

IIIc: Wet Sedge Tundra/Water Complex (pond complex, no emergent vegetation)
IIId: Wet Sedge/Moist Sedge, Dwarf Shrub Tundra Complex (wet patterned-ground complex)
IIIe: Wet Sedge/Moist Sedge/Barren complex (wet frost-scar tundra complex)
XIa: Wet Mud (drained lakes and ponds)

A few areas of wet vegetation were removed from the floodplain layer because they were considered too disconnected from streams to be within a floodplain. A single large polygon of IIIa was removed from the eastern portion of the project area, as were the large expanses of IIId at the intersection of the southernmost transportation corridor and the main project area.

GIS analysts took the following steps, in order, to estimate all of the project area streams' floodplains. They created a layer combining all of the above vegetation types and dissolved the boundaries between them to represent a single flooded vegetation type. Any polygons of that flooded vegetation layer that touched a stream buffer layer were added to the stream buffer layer to create a working floodplains layer. They identified any mapped depressions that intersected the working floodplains and added them to the working floodplains layer. They queried the flooded vegetation layer for any additional polygons that intersected the updated working floodplains layer, and added them to that layer. Finally, any additional parts of the flooded vegetation layer that were completely surrounded by floodplains in the working layer were added to that working layer to produce the final floodplain mapping.

Fish Presence

Fish-related attributes were applied to all stream segments.

Fish presence in streams, ponds, and lakes is coded as: Cataloged Anadromous Waters (ANAD), Documented Fish Presence (PRES), Surface Water Connection (SWC), or No Documented Fish (NDF). The ANAD streams are based on the Alaska Department of Fish and Game's Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes (Johnson and Blanche 2010). The waterbodies coded as PRES have been shown to be used by fish according to studies described in the Point Thomson EIS (Craig and McCart 1974; Fechhelm 1996, 2000; Hemming 1996; Ward and Craig 1974; Winters and Morris 2004; WCC and ABR 1983). The waterbodies coded as SWC can be seen on aerial photography to have a surface water connection to streams categorized as either ANAD or PRES. Waterbodies coded as NDF have no documented fish presence. This may be because they are not cataloged as anadromous by ADF&G, have been evaluated by studies described in the Point Thomson EIS but have not been documented to support fish, or have not been evaluated.

Coastal Gravels (Xa)

The vegetation mapping for the project mapped barren gravels as Xa, which included coastal and riverine gravels. Coastal gravels were distinguished from riverine gravels by project scientists who considered the proximity and adjacency of the mapped unit to estuarine waters (Ia1), the upstream extent of saline influenced vegetation at the mouths of rivers or streams, and stream channel morphology indicating the upper limits of tidal influence.