WETLANDS DETERMINATION AND HABITAT ASSESSMENT FOR PROPOSED MATERIAL SITE, NOATAK, ALASKA

FINAL REPORT

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INTRODUCTION

The material site under investigation for this study is being evaluated as a potential material source to support airport relocation construction activities for the village of Noatak, Alaska. The material site is located approximately 7 miles northwest of Noatak and 1 mile east of the Noatak National Preserve, a national park that also is part of the International Biosphere Reserve program. Access to the material site will be from Noatak, via a winter (ice) road. Location coordinates for the material site are 67°36.0072' N latitude, 163°13.8265' W longitude (Township 25N, Range 20W, Section 8, Kateel River Meridian). The study area is in a transitional landscape between boreal and tundra biomes, with vegetation consisting predominantly of sedge tussock-shrub, low shrub, and mixed broadleaf and ericaceous shrub communities. Patches of dwarf shrub, tall scrub, and woodland needleleaf forest can be found on upland slopes. Average summer temperatures range from 40 to 60°F, with the average winter temperature ranging from 15 to -21°F. Annual temperature extremes range from -59 to 75°F. Annual precipitation is 10–13 inches, including 48 inches of snowfall (ADCA 2005).

To support environmental permitting needs for development of the material site by the Alaska Department of Transportation & Public Facilities (DOT&PF), an assessment was conducted of the wetlands and habitats within the proposed material site boundaries, including a 1,000 ft buffer (total area = 3,378 acres). The wetlands and habitat assessment included classification and mapping of wetlands, vegetation, and wildlife habitats using aerial photo-interpretation; a functional assessment of wetland types; and an evaluation of habitat values for selected wildlife species.

METHODS

CLASSIFICATION AND MAPPING

Wetland and vegetation types were classified and mapped in the study area using a QuickBird satellite panchromatic image and a true-color image with 2-ft and 8-ft resolution, respectively. The photography was acquired 22 July 2005 (DigitalGlobe, Longmont, CO) and provided by DOT&PF. Wetland, vegetation, and habitat boundaries were delineated based on color signature, plant canopy, and surface relief, along with hydrological indicators such as drainage

patterns and surface water connections. No field survey was conducted to verify map boundaries, but field data collected for an ecological land survey east of the Noatak River were reviewed to assist the mapping effort (ABR, unpublished data). Mapping codes used for each wetland type followed *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 79). Wetlands with similar functions were grouped into wetland types to simplify mapping display. Vegetation types were identified using the Level III classifications outlined in *The Alaska Vegetation Classification* (Viereck et al. 1992). Similarly, habitat types were assigned based on vegetation communities and physiographic landscape position (riverine, lowland, upland). Similar habitat types were grouped based on Level III vegetation classifications for mapping and reporting. No existing wetland maps from the National Wetlands Inventory (NWI) were available for the study area.

Maps were produced by digitizing polygons of each wetland, vegetation, or habitat type using *ArcMap GIS 9.2* software (ESRI, Redlands, CA). Maps were produced in the same spatial coordinate system as the aerial photography (Alaska State Plane, NAD83). Wetland types are presented in standard NWI map annotation; Alaska vegetation classes are presented according to Viereck et al. (1992). A tabular key to these annotations is provided with the map.

WETLAND FUNCTIONAL ASSESSMENT

The functional importance of wetlands in the study area was evaluated using criteria outlined in the *Literature Review and Evaluation Rationale* of the Wetland Evaluation Technique (Adamus et al. 1991). Because no field verification surveys were performed for this project, wetland functions were inferred from aerial photographic interpretation (open water connections, vegetation community types, landscape position), and our experience from surveys in similar areas of northwestern Alaska (Koyuk Airport, Rock Creek Mine, Glacier Creek Road).

The procedure to evaluate wetland functions is based on the Hydrogeomorphic (HGM) Classification System (Brinson 1993), but was a modified approach to account for the lack of a field survey and the absence of HGM models for all of the wetlands found in study area. The relative importance of ten processes or attributes, encompassing hydrological, water quality, ecological, and social functions of wetlands in the project area were qualitatively ranked into

categories of low, medium, and high importance. Many of these attributes are not exclusive to wetlands in the area. Most wetland functional assessment rankings were based on landscape position, wetland size, relative abundance, and current knowledge of the study area. Additional information used in the evaluation included local topography, available information on animal use (ADF&G reports), and plant community structure.

HYDROLOGY

Hydrology functions were determined from the topographic relation of the wetland surface to the local water table. For basins, the presence of an inlet or outlet (or both) was determined from aerial photography. Three specific processes were considered.

- Ground water discharge—Movement (vertical or lateral) of water from the subsurface to the surface.
- Ground water recharge—Downward movement of water from a wetland into the subsurface.
- Erosion control and flow regulation— Various mechanisms that slow or impede the movement of water downslope and thus reduce its erosive force and moderate local stream flows.

WATER QUALITY

Water quality functions are wetland processes that can remove sediments, nutrients, and anthropogenic contaminants from the water while contributing important material to the invertebrate food web. Three general processes were considered.

- Sediment/toxicant retention—A combination of physical and biological processes that result in the reduction of suspended sediment of water moving across or through a wetland.
- Nutrient retention—Biological processes that result in the incorporation of dissolved nutrients (mainly N and P) into plant tissue and organic sediments. Also includes the process of denitrification in wetland soils.

- Production export—The movement of relatively large amounts of organic material derived from primary production to adjacent areas. This process can include a wide range of secondary production exports such as insect emergence.

ECOLOGY

Ecological values are based on the relative ability of a wetland to support animal populations and provide local habitat diversity. Three general characteristics of a wetland were considered.

- Aquatic habitat—The potential of a wetland to support a viable fish or invertebrate population.
- Wildlife habitat—The potential of a wetland to support wetland-dependent birds; other locally abundant animals such as moose will be considered.
- Regional ecological diversity—An index to how much a given wetland contributes to the overall landscape diversity of the watershed within which it is located. Wetland types that are regionally rare receive higher scores.

SOCIAL

Social values considered for this analysis include subsistence and recreational uses. These values include the importance of a wetland for hunting and gathering activities (e.g., fishing, waterfowl and mammal hunting, berry picking, firewood, and edible plant gathering), and transportation (boating or winter travel). Rankings for this value were made on the potential of a wetland to support subsistence activities. Subsistence use of wetlands in the project area were assessed based on an archaeological survey conducted in fall 2006 (Mobley 2007).

No data, previous study, or ranking systems were available to evaluate the intangible social values of open space and aesthetics. While certain ranking systems for such values exist (for example, see U.S. Forest Service 2002), these systems are specific to the areas for which they were developed and may not be applicable to the current study area. In general, the study area and surrounding landscape are not influenced by human use and appear continuous with the regional wilderness outside the immediate boundaries of the village. These subjective measures

can not be evaluated without input from local residents and other interested parties; therefore, they were not considered in the context of wetland functional values.

HABITAT EVALUATION

Habitat types in the study area were derived by integrating information from NWI classifications (Cowardin et al. 1979), Alaska vegetation classifications (Viereck et al. 1992), and landscape characteristics considered important to wildlife, such as availability of food, security (or escape), and shelter. These factors may be directly related to the quantity and quality of vegetation, soils, hydrology, microtopography, and/or microclimate. In practice, multiple related NWI types and Alaska vegetation classes often comprise a single habitat type.

Typical wildlife use of habitats was determined from the wetland and vegetation classifications, the derived wildlife habitat classes, and a review of available literature on wildlife-habitat relationships in the region (Platte and Butler 2002, Dau 2003 and 2005; Cook and MacDonald 2006, Tibbitts et al. 2006). Habitat value is a function of several factors including availability of cover, availability of food, availability of any special habitat needs, and the spatial and temporal arrangement of habitat (Adamus et al. 1991). Pertinent wildlife values include important foraging habitats, nesting or denning habitats, and habitats providing other important behavioral or life-history functions (e.g., escape cover from predators, seasonal food sources) (U.S. Fish and Wildlife Service 1980, Alaska Department of Fish and Game [ADF&G] 1986).

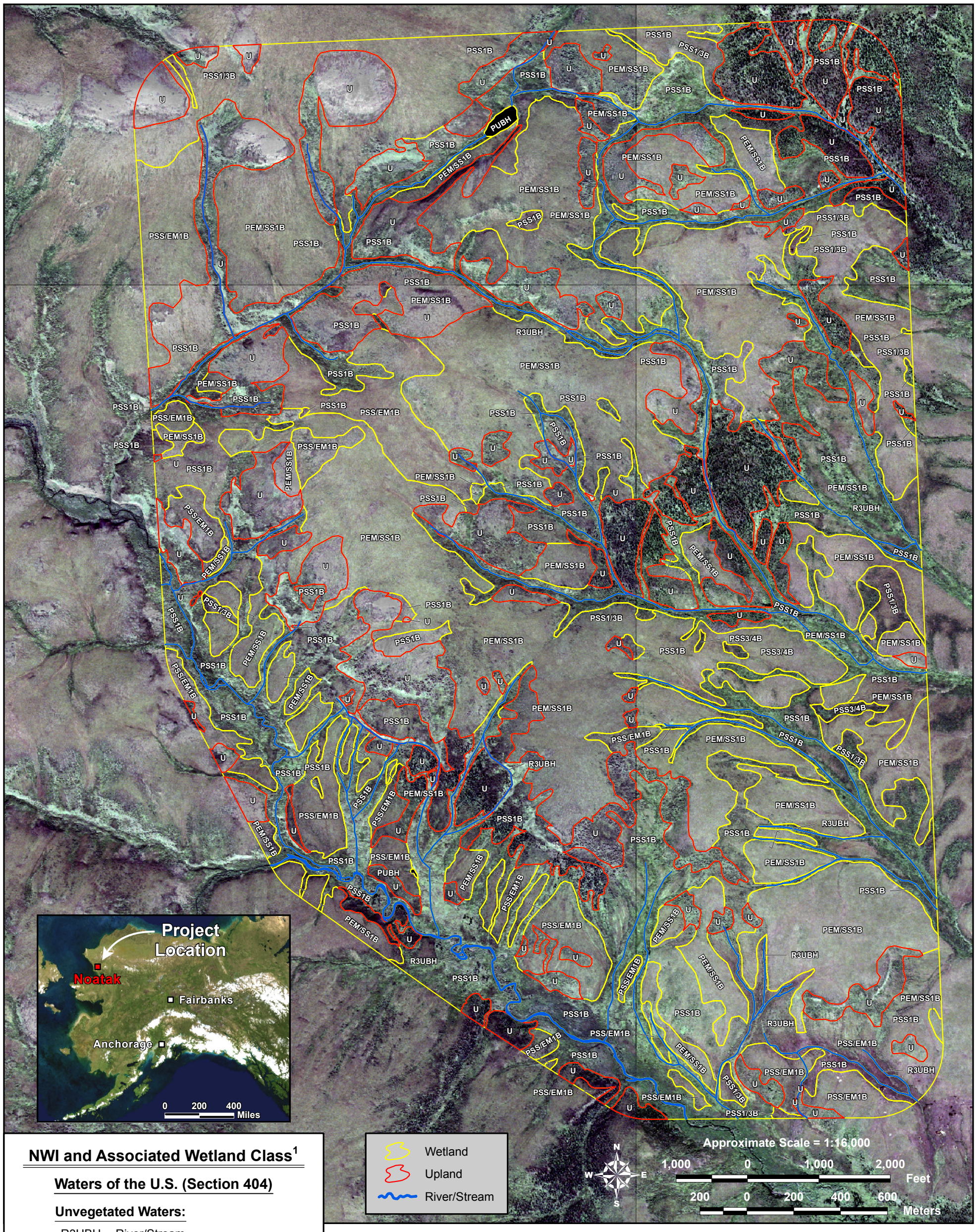
RESULTS AND DISCUSSION

WETLANDS AND VEGETATION

Waters of the US were identified in the study area, including non-vegetated waters and wetlands (Figure 1; Table 1). Non-vegetated waters (36 acres) included several small streams (R3UBH; 1 %) and two ponds (PUBH) (0.1%). None of the streams are navigable. Wetlands (2528.7 acres; 75%) are dominated by Tussock-Shrub Meadow (1256.9 acres; 37%), which occurs primarily on gentle slopes throughout the study area. This wetland type consists of primarily cottongrass tussocks (*Eriophorum vaginatum*), willow (*Salix* spp.), and a variety of dwarf ericaceous shrubs, such as blueberry and cranberry (*Vaccinium* spp.), and Labrador tea

Table 1. Acreages and percentages of Waters of the US (Section 404) summarized by NWI class, and of uplands for the material site proposed to support airport improvements, Noatak, Alaska, 2007. All Waters are considered jurisdictional due to their downstream connection with the Noatak River.

	NWI Class	Description	Acres	Percent of Total Area
Waters of the U. S.				
Unvegetated Waters	R3UBH	River/Stream	33.4	1.0
	PUBH	Pond	2.6	0.1
		Total Unvegetated Waters	**36.0**	**1.1**
Wetlands	PEM/SS1B	Tussock-Shrub Meadow	1256.9	37.2
	PSS/EM1B	Shrub-Sedge Tundra	250.6	7.4
	PSS1B	Shrub Birch-Willow Tundra	978.0	28.9
	PSS1/3B	Birch-Ericaceous Shrub Tundra	38.1	1.1
	PSS3/4B	Ericaceous Shrub-Dwarf Spruce	5.0	0.1
		Total Wetlands	2528.7	**74.8**
		Total Waters of the US	**2564.7**	**75.9**
Uplands				
	U	Upland	**813.7**	**24.1**
		Total Area	**3378.4**	**100.0**



NWI and Associated Wetland Class[1]

Waters of the U.S. (Section 404)

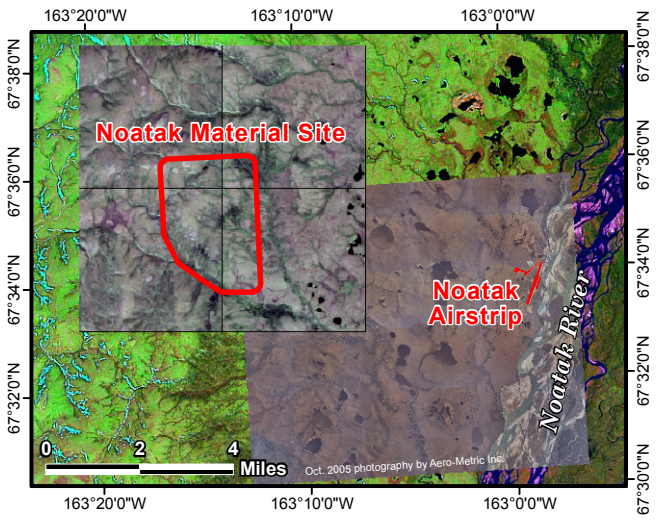
Unvegetated Waters:

R3UBH	River/Stream
PUBH	Pond

Wetlands:

PEM/SS1B	Tussock-Shrub Meadow
PSS/EM1B	Shrub-Sedge Tundra
PSS1B	Shrub Birch-Willow Tundra
PSS1/3B	Birch-Ericaceous Shrub Tundra
PSS3/4B	Ericaceous Shrub-Dwarf Spruce
U	Upland

[1]Follows the National Wetlands Inventory (NWI) classification system of Cowardin et al. (1979). **Jurisdictional Wetland:** All wetlands in this study area have a downstream connection to navigable waters of the Noatak River and are considered jurisdictional.



Notes: Quickbird imagery acquired July 22, 2005 by Digital Globe. Resolution: 2-ft panchromatic and 8-ft color.
Projection: ASP Zone 8, NAD83, US foot
AK inset imagery: Blue Marble Next Generation, NASA.

Wetlands Determination and Habitat Assessment, Material Site, Noatak, Alaska

Figure 1. Wetland Types

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16 Feb. 2007 | ABR File: Noatak_Material_Site_Wetlands_07-225.mxd

(*Ledum palustre*). Shrub Birch-Willow Tundra also covers a notable proportion of the study area (978 acres; 29%), and is primarily associated with the numerous drainages that occur within the project area.

Uplands (813.7 acres; 24%) occur mainly on the upper slopes of drainages and in association with partially vegetated outcrops and colluvial slopes (Figures 1 and 2; Table 2). The vegetation is predominantly Open Low and Tall Shrub (11%) composed of willow and shrub birch (*Betula glandulosa*); Woodland and Open Needleleaf Forest (6%) composed of white spruce (*Picea glauca*); and Dwarf Ericaceous Shrub (4%). The Dwarf Ericaceous Shrub includes species such as eight-petal mountain-avens (*Dryas octopetala*), alpine azalea (*Loiseleuria procumbens*), and alpine bearberry (*Arctostaphylos alpina*). Less exposed areas may include mountain heather (*Cassiope tetragona*), Lapland rosebay (*Rhododendron lapponicum*), and dwarf birch (*Betula nana*). Small patches of Dry Graminoid Herbaceous tundra (1%) also occur on the relatively steep upper slopes of some drainages.

WETLAND FUNCTIONAL ASSESSMENT

The functional values of wetlands in the study area (Table 3) are influenced by a short growing season, the presence of continuous permafrost across the study area, wildlife use, remoteness from large population centers, and limited urban or industrial development. Because soils are underlain by permafrost, hydrological functions are somewhat limited. All other ecological, and water quality functions of wetlands in the study area are difficult to evaluate without ground survey data. In terms of the social/cultural value of wetlands in the project area, the archaeological survey conducted by Mobley (2007) found that the area is not extensively used by local residents, although a modern hunting camp and airstrip were documented in the northwest corner of the project area. This evidence of repeated human use suggests the area supports wildlife important to subsistence users. The area is part of the migration corridor for the Western Arctic Caribou Herd and several collared animals were observed in the general region in July 2002–June 2003 (Dau 2005). Moose also have been observed in the area (Dau 2004), although they are not abundant; a finding attributed to the absence of well-developed spruce forest. Wolves and brown bears appear to be abundant in the area, however, perhaps as a result of good berry and small mammal habitat. The project area probably also supports a variety of passerine species, based on studies conducted elsewhere in the state in comparable habitats (Kessel 1998).

Vegetation Type[1]

- River/Stream/Pond
- Moist Graminoid Herbaceous
- Dry Graminoid Herbaceous
- Dwarf Ericaceous Shrub
- Open Low Shrub
- Closed Low Shrub
- Open Tall Shrub
- Woodland Dwarf Tree Scrub
- Open Dwarf Tree Scrub
- Woodland Needleleaf Forest
- Open Needleleaf Forest
- Partially Vegetated Barren

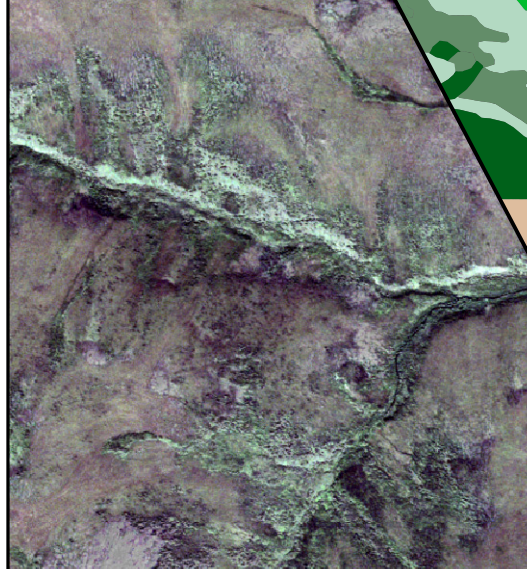
[1]Level III Vegetation Class of the Alaska Vegetation Classification (Viereck et. al. 1992).

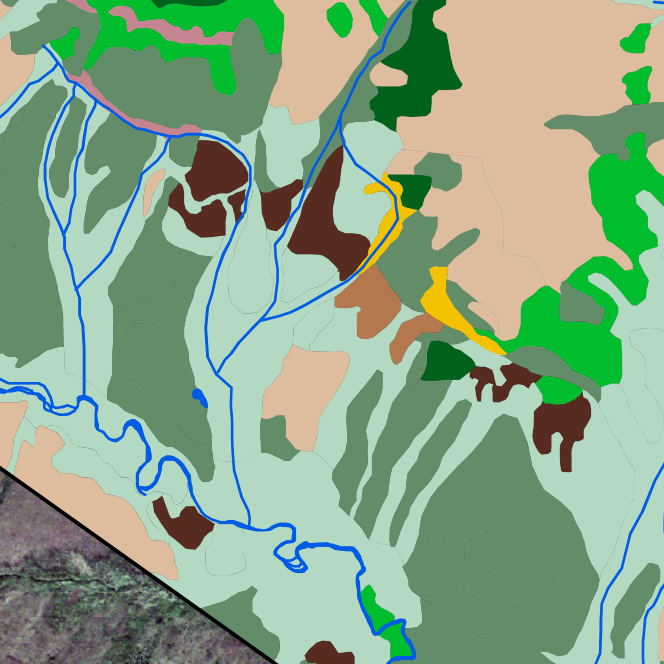
N W E S

Approximate Scale = 1:16,000

1,000 0 1,000 2,000 Feet

200 0 200 400 600 Meters





Notes: Quickbird imagery acquired July 22, 2005 by Digital Globe. Resolution: 2-ft panchromatic and 8-ft color.
Projection: ASP Zone 8, NAD83, US foot
AK inset imagery: Blue Marble Next Generation, NASA.

Wetlands Determination and Habitat Assessment, Material Site, Noatak, Alaska

Figure 2. Vegetation Types

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Table 2. Acreages of vegetation types found in the material site proposed to support airport improvements, Noatak, Alaska, 2007.

	Proposed Material Site	
Vegetation Type Description	Acres	Percent of Total Area
River/Stream/Pond	36.0	1.1
Dry Graminoid Herbaceous	31.7	0.9
Moist Graminoid Herbaceous	1256.9	37.2
Dwarf Ericaceous Shrub	143.9	4.3
Open Low Shrub	910.5	27.0
Closed Low Shrub	625.0	18.5
Open Tall Shrub	138.0	4.1
Woodland Dwarf Tree Scrub	5.0	0.1
Open Dwarf Tree Scrub	5.0	0.1
Woodland Needleleaf Forest	104.0	3.1
Open Needleleaf Forest	88.8	2.6
Partially Vegetated Barren	33.5	1.0
Total	3378.4	100.0

Table 3. Ranking of functions and values of wetland types found in the material site proposed to support airport improvements, Noatak, Alaska, 2007. Scores are relative to the other wetlands in the project area. Wetlands with a total area <0.5 acres (<0.2%) were excluded from the assessment.

	Habitat Type (NWI Class)		
Functions and Values	Lowland Moist Meadow (PEM/SS1B)	Lowland Open Scrub (PSS1B, PSS/EM1B, PSS1/3B)	Lowland Closed Scrub (PSS1B)
Groundwater Discharge	Low	Moderate	Moderate
Groundwater Recharge	Low	Low	Moderate
Erosion Control and Flow Regulation	Moderate	Low	High
Sediment/Toxicant Retention	High	Low	High
Nutrient Retention	Moderate	Low	High
Production Export	Low	Moderate	High
Aquatic Habitat	Low	Low	Low
Wildlife Habitat	Moderate	Low	High
Regional Ecological Diversity	Low	Low	Low
Subsistence/Recreation Use	Low	Low	Low

HABITAT EVALUATION

Nineteen wetland habitat types were identified in the study area (Figure 3, Table 4), although three habitats make up 70% of the total area: Lowland Moist Tundra (37%), Lowland Open Low Shrub (18.6%), and Lowland Closed Low Shrub (14.3%). The remaining habitat types covered 7% or less of the study area. Overall, habitat use of the area by waterbirds is probably relatively low, as ponds are rare (no marshes or lakes are present). The area has moderate value for upland birds, such as Willow Ptarmigan (*Lagopus lagopus*) and American Golden-Plover (*Pluvialus dominica*), which would forage in the Lowland Meadows and Upland Dwarf Scrub. Passerines (songbirds) also would find the Riverine and Lowland Closed Low Shrub habitats attractive as feeding and nesting areas. Although field data are not available, it is unlikely that any threatened or endangered species are present in the study area, based on the habitats present and the known distributions of these species. A summary of the characteristics of the habitats found in the study area and their wildlife use is presented below. Habitats that encompass ≤1% of the total area (and are not considered regionally important) are not summarized here, as their limited availability reduces their habitat value.

Rivers and Streams: The only major river occurs along the southern margin of the study area (Seeksingnachaek River); the remaining drainages are small tributaries of the Seeksingnachaek River that drain the wetlands occurring on the hillsides that dominate the project area. No anadromous fish have been documented in the Seeksingnachaek River (ADF&G 2007), nor was it mentioned as a source of fish by Noatak residents in the archaeological assessment (Mobley 2007). The main value of the river/stream network is in the support of adjacent shrub habitats.

Riverine Open and Closed Low Shrub: These habitats (4% of the study area) were confined to the floodplains of the Seeksingnachaek River and were composed primarily of low (<5 ft tall) willow. As a result of the low canopy height, they have less habitat value than Tall Shrub habitats, but still may be used by a few passerine species for feeding and nesting, primarily sparrows (Kessel 1998) and the Arctic Warbler (*Phylloscopus borealis*) (Lowther 2001). This habitat also would be attractive to moose, but as previously stated, moose are uncommon in the area. Microtines such as voles (*Microtus* spp.), and insectivores such as shrews (*Sorex* spp.) also likely use Riverine Open and Low Shrub habitats for cover and forage.

Table 4. Acreages of habitat types found in the material site proposed to support airport improvements, Noatak, Alaska, 2007.

	Proposed Material Site	
Habitat Description	Acres	Percent of Total Area
Pond	2.6	0.1
River/Stream	33.4	1.0
Riverine Open Low Shrub	51.1	1.5
Riverine Closed Low Shrub	94.4	2.8
Riverine Open Tall Shrub	10.1	0.3
Riverine Woodland Needleleaf Forest	4.4	0.1
Lowland Moist Tundra	1256.9	37.2
Lowland Open Low Shrub	628.6	18.6
Lowland Closed Low Shrub	482.6	14.3
Lowland Open Dwarf Tree Forest	5.0	0.1
Upland Dry Tundra	31.7	0.9
Upland Dwarf Scrub	143.9	4.3
Upland Open Low Shrub	230.8	6.8
Upland Closed Low Shrub	48.0	1.4
Upland Open Tall Shrub	128.0	3.8
Upland Woodland Dwarf Tree Forest	5.0	0.1
Upland Woodland Needleleaf Forest	99.6	2.9
Upland Open Needleleaf Forest	88.8	2.6
Partially Vegetated Bluff	33.5	1.0
Total	**3378.4**	**100.0**

Lowland Moist Tundra: This habitat is the most abundant in the study area (37%) and typically consists of sedges such as cottongrass tussock and Bigelow sedge (*Carex bigelowii*) and low to dwarf shrubs (generally less than 0.25–2 ft tall) such as cranberry, dwarf birch, willows, Labrador tea, and blueberry. This habitat type is predominantly used by Willow Ptarmigan for feeding and nesting and American Golden-Plover for feeding. Brown bears (*Ursus arctos*) also likely use the areas for feeding on berries in the fall.

Lowland Open Low Shrub: This habitat is closely associated with Lowland Moist Meadow habitats and is mainly differentiated by a higher percentage of shrub cover (35–75%). Typical stands are characterized by an open canopy of dwarf birch and/or willow, blueberry, with water sedge, and bigelow sedge. Herbaceous species such as coldsfoot (*Petasites frigidus*), lousewort (*Pedicularis* spp.), and wintergreen (Pyrola spp.) also may be present. Lowland Low Shrub is of value to a few passerine species, such as White-crowned (*Zonotrichia leucophrys*) and Savannah (*Passerculus sandwichensis*) sparrows. Microtines, such as voles, and insectivores, such as shrews, use Lowland Open Low Scrub habitats for cover and forage (Cook and MacDonald 2006).

Habitat Type

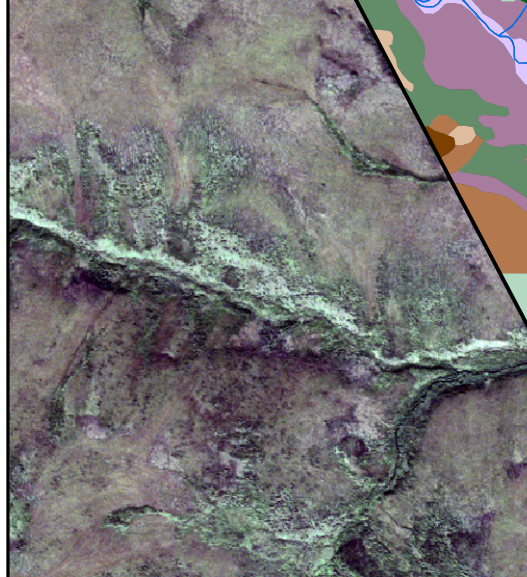
- Pond
- River/Stream
- Riverine Open Low Shrub
- Riverine Closed Low Shrub
- Riverine Open Tall Shrub
- Riverine Woodland Needleleaf Forest
- Lowland Moist Tundra
- Lowland Open Low Shrub
- Lowland Closed Low Shrub
- Lowland Open Dwarf Tree Forest
- Upand Dry Tundra
- Upland Dwarf Scrub
- Upland Open Low Shrub
- Upland Closed Low Shrub
- Upland Open Tall Shrub
- Upland Woodland Dwarf Tree Forest
- Upland Woodland Needleleaf Forest
- Upland Open Needleleaf Forest
- Partially Vegetated Bluff

N W E S

Approximate Scale = 1:16,000

1,000 0 1,000 2,000 Feet

200 0 200 400 600 Meters



Notes: Quickbird imagery acquired July 22, 2005 by Digital Globe. Resolution: 2-ft panchromatic and 8-ft color.
Projection: ASP Zone 8, NAD83, US foot
AK inset imagery: Blue Marble Next Generation, NASA.

Wetlands Determination and Habitat Assessment, Material Site, Noatak, Alaska

Figure 3. Habitat Types

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18 Feb. 2007 | ABR File: Noatak_Material_Site_Hab_07-225.mxd

Lowland Closed Low Shrub: This type (14% of study area) was confined primarily to the small drainages that dissect Lowland Moist Tundra and Open Shrub areas and probably is functionally similar in terms of habitat use as Riverine Low Shrub habitats. The canopy is closed (>75% cover) and the shrubs are <5 ft in height. Taller shrubs may be present, but account for <25% cover. Typical stands are characterized by willow and blueberry, with an understory shrub layer of ericaceous species such as Labrador tea, leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda polifolia*), and cranberry. Shrub birch also may be present. Lowland Closed Low Shrub is of value to a few passerine species for nesting, primarily sparrows (Kessel 1998), but the habitat also may be used by the Arctic Warbler, which tends to select low shrub habitats for feeding and nesting (Lowther 2001). Voles and shrews use Lowland Closed Low Shrub habitats for cover and forage.

Upland Dwarf Scrub: This habitat type was found on well-drained colluvial slopes. Vegetation consists of dwarf shrubs (<10 inches height), such as net-leaf willow (*Salix reticulata*), eight-petal mountain-avens (*Dryas octopetala*), and Lapland rosebay (*Rhododendron lapponicum*). Graminoids such as alpine sweetgrass (*Hierochlöe alpina*) and spike trisetum (*Trisetum spicatum*) also may be present. Arctic ground squirrels (*Spermophilus parryii*) might use this habitat for denning and if lichens are present, caribou (*Rangifer tarandus*) may forage in these areas, but probably has limited habitat value for other species. Rock Ptarmigan (*Lagopus mutus*) would likely occur in this habitat as would some shorebirds (e.g., American Golden-Plover) and passerines (e.g., Lapland Longspur *Calcarius lapponicus*) that prefer low vegetation and open habitats (Tibbitts et al. 2006).

Upland Open and Closed Low Shrub: These habitats occur downslope of Upland Dwarf Scrub, where conditions are less exposed and the soil is better developed, but still moderately well-drained. Plant species include shrub birch, Labrador tea, Lapland rosebay, and blueberry and cranberry. In areas where snow persists into early summer, mountain heather (*Cassiope tetragona*), crowberry (*Empetrum nigrum*), and mountain-avens (*Dryas* spp.) are more prevalent. Some bird species that used the Upland Dwarf Scrub type also would occur in this habitat as well, but Willow Ptarmigan would be more likely than Rock Ptarmigan, and more sparrows and warblers would occur with the greater cover of shrubs (Tibbitts et al. 2006).

Upland Open Tall Shrub: Although not completely discernible on the aerial photography, these areas were likely composed of an open canopy (25–75%) of tall (>5 ft) alder shrub (*Alnus crispa*). These habitats were typically on moderately steep slopes above drainages or in association with partially vegetated outcrops and colluvial slopes. Associated plant species may include bluejoint (*Calamagrostis canadensis*), beauverd spirea (*Spiraea beauverdiana*), and Altai fescue (*Festuca altaica*). Habitat use is dominated by songbirds (Kessel 1998, Tibbitts et al. 2006), which may include the Hermit (*Catharus guttatus*) and Varied (*Ixoreus naevius*) Thrush, Wilson's Warbler (*Wilsonia pusilla*), sparrows, and the Dark-eyed Junco (*Junco hyemalis*).

Upland Woodland and Open Needleleaf Forest: This habitat is characterized by a woodland (10–25%) or open (25–60%) cover of white spruce (*Picea glauca*) with an understory of willow, birch, and ericaceous shrubs. These forests were rare (only 4% combined) and occurred primarily in the eastern half of the study area (Figure 3). Wildlife values are moderate-to-high primarily because of the mixture of both tree and shrub cover, which provides habitats for some species not found in habitats dominated only by shrubs. For example, in the Upper Tanana River Valley, bird densities in upland needleleaf forests are intermediate between those of shrub and forested habitats (Spindler and Kessel 1978, 1980). Common birds using this habitat include Ruby-crowned Kinglet (*Regulus calendula*), thrushes (*Catharus* spp.), Yellow-rumped Warbler (*Dendroica petechia*), and Dark-eyed Junco (*Junco hyemalis*) (Tibbitts et al. 2006). Berry-producing species, such as cranberry and blueberry provide a seasonal food source for small mammals (voles, squirrels), birds, and bears.

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