3.11 WETLANDS

This section summarizes the nature and extent of wetlands that would potentially be affected by the Mine Site, the Transportation Corridor that would provide access and supply materials to the mine, and the Pipeline component that would supply energy for the mine. It also addresses the expected impacts of the project and alternatives on wetlands.

SYNOPSIS

This section describes current conditions and evaluates potential impacts to wetlands from the proposed action and alternatives. Each alternative is examined by major project component: Mine Site; Transportation Corridor; and Pipeline. These components are evaluated as defined wetlands study areas determined through wetland mapping, titled mine site wetland study area, transportation wetland study area, and pipeline wetland study area.

EXISTING CONDITION SUMMARY

Mine Site Wetland Study Area - The mine site wetland study area is a 33 square mile (mi^2) (21,050 acre) area comprised of a mosaic of wetland, upland, and transitional areas that have been influenced by recent and past wildland fires (Michael Baker 2016, 2017). Thirty-five percent of this study area is wetland or water, comprised predominately of evergreen scrub shrub and forested wetlands in flat or slope hydrogeomorphic classes. Rivers and streams within the Mine Site wetland study area total 72 miles, with 56 miles of perennial streams and rivers and 16 miles of intermittent streams (Michael Baker 2016, 2017).

Transportation Wetland Study Area - The Transportation Corridor wetlands study area is a 20 mi^2 (12,839 acre) area comprised of a mosaic of upland, wetland, and transitional areas. Fifty-two percent of this study area is wetland or water; wetlands are predominately evergreen scrub shrub and forested wetlands in flat or slope hydrogeomorphic classes (Michael Baker 2016, 2017). Wetland distribution and extent are influenced by discontinuous permafrost. Rivers and streams within the mine transportation wetland study area total 33 miles, with 28 miles of perennial streams and rivers and 5 miles of intermittent streams (Michael Baker 2016, 2017).

Pipeline Wetland Study Area - Twenty-eight percent of the 125 mi^2 (79,799 acre) pipeline wetland study area is wetlands or water. Wetlands throughout the pipeline route are predominately deciduous scrub shrub wetlands and evergreen forested and scrub shrub wetlands in slope or flat hydrogeomorphic classes. Rivers and streams within the pipeline route study corridor total 165 miles, with 128 miles of perennial streams and rivers and 37 miles of intermittent streams (Michael Baker 2016, 2017a).

North Option Wetland Study Area – Nearly thirteen percent, or 920 acres, of the 7,230 acres, 26.5-mile North Option route is wetlands. Wetlands along this route are primarily deciduous shrub and deciduous shrub/herbaceous wetlands, with a lower percentage in coniferous forests in slope or riverine hydrogeomorphic classes. Rivers and streams within the north option wetland study area total 27.3 miles (Michael Baker 2017b).

EXPECTED EFFECTS SUMMARY

Alternative 1 - No Action

This alternative would not have any new effects on wetland resources.

Alternative 2 - Donlin Gold's Proposed Action

Direct impacts from the Mine Site component would disturb 2,728 acres of wetlands and waters during the Construction and Operations phases. Indirect impacts would disturb 635 and 432 acres from dust, and potential dewatering, respectively. Of the 2,728 acres of wetland impacts, 814 acres total (all categories) would be affected by vegetation clearing only and may be restorable to wetland conditions at or before the Closure Phase. Direct impacts from the Transportation Corridor component would disturb 224 acres of wetlands during the Construction and Operations Phases. Indirect impacts would disturb 627 acres of wetlands from dust. Direct Transportation Corridor impacts would occur through the Closure Phase because the mine access road and airstrip would not be reclaimed. Direct impacts from the Pipeline component would disturb 1,337 acres of wetlands during the Construction Phase and 525 acres of wetlands during the Operations Phase. Impacts for the North Option are similar (1,331 acres). Indirect effects from the Pipeline component would generally occur within the permanent right-of-way (ROW) and would include changes in soil temperature, blockage of subsurface shallow groundwater flow, and potential aufeis formation.

OTHER ALTERNATIVES - This section discusses differences of note between Alternative 2 and the following alternatives, but does not include a comprehensive discussion of each alternative's impacts if they are the same as or similar to Alternative 2 impacts.

Alternative 3A - LNG-Powered Haul Trucks

In the Transportation Corridor, reducing the number of new river barge trips from 122 to 83 trips during the Operations Phase would reduce potential wetland erosion from barge wakes, although wake erosion impacts are not likely to be discernable from natural shoreline erosion on the Kuskokwim River.

Alternative 3B - Diesel Pipeline

Alternative 3B Pipeline Construction impacts on wetlands would be similar to Alternative 2, although impacts would be increased by 153 acres of primarily scrub shrub wetlands. In addition, the dock at Tyonek would also impact a small area of estuarine waters. Three new airstrips would be constructed for the diesel pipeline alternatives, and access roads and airstrips would be retained for spill response during Pipeline Operations. For the Port MacKenzie Option, Pipeline Construction impacts would increase by 144 acres in similar type wetlands. The Collocated Pipeline Option construction impacts on wetlands would be similar to Alternative 2, although wetland impacts would be increased by 200 acres of primarily scrub shrub wetlands. If the Collocated Pipeline Option were configured with Port MacKenzie, an additional 237 acres would be impacted. In the Operations Phase, an additional 112 acres would be impacted in Alternative 3B; an additional 98 under the Port MacKenzie Option; an additional 127 under the Collocated Option; and an additional 133 acres if the Collocated Pipeline Option were configured with Port MacKenzie.

Alternative 4 - Birch Tree Crossing Port

The longer port to mine road would affect more wetlands than Alternative 2. Potential Alternative 4 Transportation Corridor Construction and Operations direct effects on wetlands would be increased by 340 acres over the Alternative 2 Transportation Corridor. Potential indirect effects from dust would be increased by 1,379 acres.

Alternative 5A - Dry Stack Tailings

Fugitive dust impacts on wetland vegetation would be expected to increase by the use of Dry Stack Tailings (DST) and would be expected to affect a larger area than the Alternative 2 Mine Site component. There may, however, be a potential for successful reestablishment of a larger area as wetlands after the Closure Phase of the TSF/operating pond facilities, but the overall direct and indirect effects on wetlands would be similar to Alternative 2.

Alternative 6A - Dalzell Gorge Route

Alternative 6A Pipeline Construction would potentially affect an estimated 100 more acres of wetlands than the proposed Alternative 2 Pipeline Construction between MP 106.5 and MP 152.7.

3.11.1 REGULATORY FRAMEWORK

3.11.1.1 SECTION 404 OF THE CLEAN WATER ACT (CWA)

Section 404 of the Clean Water Act (CWA; 33 USC 1344) and Section 10 of the Rivers and Harbors Act (RHA; 33 USC 403) establish programs to regulate the discharge of dredged or fill material into waters of the U.S., including wetlands; Section 10 also regulates work/structures placed in and over navigable waters. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a Department of the Army permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation.

Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions (33 Code of Federal Regulations [CFR] 328.3(b)). Wetlands support hydrophytic vegetation, have wetland hydrology, and contain hydric soils. Jurisdictional wetlands, regulated through permitting by the U.S. Army Corps of Engineers (Corps) under Section 404, must possess wetland indicators for hydrology, vegetation, and soils.

3.11.1.1.1 SECTION 404(B)(1) OF THE CWA

Section 404(b)(1) of the CWA requires that the Corps permit only the least environmentally damaging practicable alternative (LEDPA). In addition, under Section 404, the Corps conducts a public interest review and weighs various environmental, economic, and social concerns before deciding whether to grant a permit. Protection of wetlands during permit review focuses first on avoidance of impacts, followed by minimization of impacts, and finally requires compensatory mitigation for unavoidable impacts to wetlands and waters. Protection of wetlands is defined as the avoidance, to the extent possible, of the long- and short-term adverse impacts associated with the destruction or modification of wetlands and the avoidance of direct or indirect support of new construction in wetlands wherever there is a practicable alternative (Executive Order 11990).

The Corps will complete the 404(b)(1) evaluation for compliance with the CWA prior to issuance of the Corps' Record of Decision (ROD). These decision documents will be available after publication of the Final EIS. The 404(b)(1) evaluation is not required by the Corps to complete the NEPA process. The Permit Application for the Department of the Army Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, December 2017, is included as Appendix J.

3.11.1.1.2 COMPENSATORY MITIGATION

Regulatory standards and criteria for the use of compensatory mitigation to offset unavoidable impacts to waters of the U.S., including wetlands, authorized under the CWA, were established on April 10, 2008, under 33 CFR 332 (Corps) and 40 CFR Part 230 (U.S. Environmental Protection Agency [EPA]). Compensatory mitigation for unavoidable impacts may be required to ensure that activities requiring a permit comply with Section 404(b)(1) Guidelines. Compensatory mitigation is the restoration (reestablishment or rehabilitation), establishment (creation), enhancement, and / or in certain circumstances preservation of aquatic resources to offset unavoidable adverse impacts. Compensatory mitigation may be achieved by purchasing credits through mitigation banks or in-lieu fee programs, by permittee-responsible mitigation, or by a combination of the three.

Donlin Gold has developed a Compensatory Mitigation Plan (CMP) in coordination with federal, state, and local governments and landowners (Appendix M). The CMP explains how Donlin Gold proposes to compensate for the unavoidable losses of waters of the United States (WOUS) including wetlands, streams, ponds, and creeks in the Donlin Gold Project Area. The development of the project will require the placement of fill material into WOUS. The calculated project wetlands disturbance and fill activities (impacts) are described in the Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899 permit application. The Permit Application for the Department of the Army Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, December 2017, is included as Appendix J.

The CMP provides measures taken to avoid and minimize impacts to WOUS, to include wetlands, in the project designs. Some of the proposed project activities in wetland areas include vegetation clearing, winter roads, and work areas where no placement of fill is proposed. Wetland impact minimization activities include restoring wetlands following placement of fill by removing the fill at the end of the mine life and returning the areas to functioning wetlands similar to pre-mining conditions. No compensatory mitigation is being proposed for vegetation clearing, winter roads, or work areas that do not involve placement of fill into wetlands. The remaining impacts to wetlands in the Project Area are defined as permanent for the purposes of the CMP.

In 2008, the USACE and the United States Environmental Protection Agency (EPA) published regulations (33 Code of Federal Regulations (CFR) Parts 325 and 332; 40 CFR Part 230) entitled, "Compensatory Mitigation for Losses of Aquatic Resources" (Mitigation Rule). The Mitigation

Rule emphasized the selection of compensatory mitigation sites on a watershed basis, and established operating standards for the mitigation providers and mechanisms. These include mitigation banks, In-Lieu Fee (ILF) programs, and Permittee-Responsible Mitigation (PRM) Projects. For the Crooked Creek watershed (Hydrologic Unit Code [HUC] 10 definition), there are no approved mitigation banks that can provide credits currently or in the timeframe of the Project permitting process. There are no statewide ILF providers in Alaska. Hence, the project is proposing all compensatory mitigation through PRM Projects. Donlin Gold has evaluated all available and practicable options to assure compliance with the provisions of the 2008 Mitigation Rule and the 1994 Alaska Wetland Initiative (EPA et. al 1994) through PRM.

Mitigation has been considered throughout the NEPA process and will be considered throughout the permitting processes. Specific mitigation conditions would be determined following review of the permit application, and will be included in the ROD for any permit that may be issued.

3.11.2 ANALYSIS METHODOLOGY

The EIS Analysis Area was delineated and mapped consistent with the current Alaska regional supplement to the Corps Wetlands Delineation Manual (Corps 2007; Michael Baker 2016, 2017a, 2017b). The Corps issued a Preliminary Jurisdictional Determination (PJD) to Donlin Gold on February 27, 2017 for a parcel of land identified as Donlin Gold PJD Study Area; and on October 12, 2017, for a parcel of land identified as Donlin Gold North Route Addendum (analyzed as the North Option in this document), on which all tributary, wetland, and other waters calculations in this EIS are based. Information supporting the PJD included four components: 1) evaluation of existing data, 2) field data collection, 3) aerial photo interpretation and mapping, and 4) database quality control (3PPI et al. 2014; Michael Baker 2016, 2017a, 2017b). Open water features were mapped at 1:400 scale (1 inch = 33 feet), and all other features were mapped at 1:1,200 scale (1 in = 100 ft) or 1:1,500 scale (1 in = 125 ft). When stream boundaries were not visible due to overhanging vegetation, streams were mapped as polylines (3PPI et al. 2014; Michael Baker 2016, 2017a, 2017b).

During mapping, three classification systems were assigned to each wetland polygon: 1) vegetation community classification based on the Alaska Vegetation Classification System (AVCS) (Viereck et al. 1992), 2) National Wetlands Inventory (NWI) classification (Cowardin et al. 1979), and 3) hydrogeomorphic (HGM) classification (Brinson 1993; Smith et al. 1995).

Wetland classification systems carried forward in this analysis include the NWI classification for wetland type and HGM classification to characterize wetland landscape positions and functions (Michael Baker 2016; Brinson 1993; Smith et al. 1995). Descriptions of the affected environment for wetlands for the three project components use subsets of the wetland mapping (Michael Baker 2016, 2017a, 2017b) to quantify the affected environment within defined wetland study areas surrounding the Mine Site, Transportation Corridor, and the Pipeline.

Mine Site Wetland Study Area. The mine site wetland study area includes wetlands mapped within the Crooked Creek drainage in subbasins that contain either mine infrastructure or Crooked Creek. These Crooked Creek subbasins were combined and then buffered by 1,000 feet to capture the ridges surrounding the combined subbasins to create the mine site wetland study area. Approximately 62 percent of this mine site wetland study area, including areas covered by all project footprints, has been delineated for wetlands (Michael Baker 2017a).

Transportation Wetland Study Areas. Transportation wetland study areas were evaluated along the roads and ports to access the Mine Site, along the barge route on the Kuskokwim River, and at port facilities in Bethel. Any actions that would occur at Dutch Harbor or the Port of Bethel at the Bethel Yard Dock are not part of the proposed action, and are considered connected actions (see Section 1.2.1, Connected Actions, in Chapter 1, Project Introduction and Purpose and Need). Although Bethel Yard Dock actions are a connected action, not part of the proposed action, impacts are included as they were part of the study area for wetlands.

- Mine Transportation Wetland Study Area. The mine transportation wetland study area includes areas within 0.5 mile of the proposed and alternative Mine Site access road, airstrip, material sites, and port site. Approximately 17 percent of the mine transportation wetland study area, including all proposed footprint areas, has been mapped for wetlands (Michael Baker 2017a).
- Kuskokwim River Wetland Study Area. Detailed wetland mapping has not been completed for the barge route along the Kuskokwim River. Land cover data (Homer et al. 2004) were used to describe wetlands within an approximated Kuskokwim River floodplain for the Kuskokwim River wetland study area, and NWI data (USFWS 2014a) were used to evaluate shoreline erosion along segments of the river.
- Bethel Wetland Study Area. An area was evaluated around the Bethel Port to describe any potential impacts to wetlands from expansion at this facility to support equipment, cargo, and fuel storage and transfer (a connected action, not part of the proposed action for the project). Detailed wetland mapping was not available. Wetland information was evaluated based on a Section 404 CWA permit application and statewide vegetation mapping (Boggs et al. 2012).

Pipeline Wetland Study Area. The pipeline wetland study area includes wetlands within 1,000 feet on either side of the proposed and alternative alignments; and within 500 feet around proposed and alternative camp locations, airstrips, temporary work spaces, and access roads. The proposed pipeline route and an alternative route through Dalzell Gorge have been mapped for wetlands (3PPI et al 2014; Michael Baker 2016, 2017a). Approximately 53 percent of this pipeline wetland study area has been delineated for wetlands (Michael Baker 2017a).

- North Option Wetland Study Area. The north option wetland study area covers the area in the North Option, MP 84.8 to 112. The north option wetland study area includes wetlands within 1000 feet on either side of the North Option's route alignment, and within 500 feet around proposed camp locations, airstrips, temporary work spaces, and access roads. Methodology was the same as for the pipeline wetland study area (Michael Baker 2017b).

3.11.2.1 WETLAND CATEGORIES

NWI classes and subclasses found within the EIS Analysis Area (Appendix K, Table K-1) were combined into general groups based on vegetation type and structure (Table 3.11-1; Michael Baker 2017a). Evergreen forested and scrub shrub wetlands are predominant in the region around the Donlin Gold mine, with a shift toward evergreen forested and deciduous scrub shrub wetlands in the pipeline corridor (Table 3.11-1). Evergreen forested and scrub shrub wetlands are primarily black spruce (*Picea mariana*) wetlands that contain varying degrees of canopy cover (closed, open, woodland) and canopy heights ranging from trees (≥ 20 feet) to shrubs (< 20 feet) where black spruce are stunted (Post 1996; 3PPI et al. 2014). Bog and fen wetlands are generally a mixture of deciduous scrub shrub and herbaceous wetlands within the deciduous scrub shrub category (3PPI et al. 2014). Where present, bogs and fens are separated and listed outside of the deciduous scrub shrub category in Affected Environment, Section 3.11.3. Bogs are indicated by the Low Shrub Bog (LSB) wetland category, and fens are indicated by the Ericaceous Shrub Bog-String Bog (ESB-SB) wetland category (Michael Baker 2016, 2017a, 2017b).

Table 3.11-1: Wetland Categories for Mine Site, Mine Transportation, Kuskokwim River, Bethel, Pipeline, and North Option Wetland Study Areas

Wetland/Water Category	NWI Class	NWI Description	Study Area Relative Abundance[1]					
			M	T	K	B	P	N
Evergreen Forested Wetlands	PFO4	Forested, Needle-leaved Evergreen	a	a	+	uk	+	+
Deciduous Forested Wetlands	PFO1	Forested, Broad-leaved Deciduous	-	-	+	uk	+	-
Mixed Forested Wetlands	PFO1/4	Forested, Broad-leaved Deciduous/ Needle-leaved Evergreen	+	+	+	uk	+	-
Evergreen Scrub Shrub Wetlands	PSS4	Scrub Shrub, Needle-leaved Evergreen	a	a	+	+	+	+
Deciduous Scrub Shrub Wetlands	PSS1	Scrub Shrub, Broad-leaved Deciduous	+	a	+	+	a	a
Herbaceous Wetlands	PEM1	Emergent, Persistent	+	+	+	+	+	+
Ponds	PUB	Unconsolidated Bottom	-	-	+	+	+	+
Lakes	L1, L2	Limnetic, Littoral	np	np	np	uk	-	-
Rivers	R1, R2, R3, R4	Tidal, Lower Perennial, Upper Perennial, Intermittent	+	+	+	+	+	+

Notes:

1 Relative abundance of Wetland Category within mapped portion of Study Area.
a = abundant (≥ 20% by area)
+ = present (1 to 19% by area)
- = trace (<1% by area)
np = not present
uk = unknown
B = Bethel Wetland Study Area (proportions unknown, presence only)
K = Kuskokwim River Wetland Study Area
M = Mine Site Wetland Study Area
P = Pipeline Wetland Study Area
N = North Option Wetland Study Area
T = Mine Transportation Wetland Study Area

Source: Homer et al. 2004; Boggs et al. 2012; Michael Baker 2016, 2017a, 2017b

3.11.2.2 HYDROGEOMORPHIC CLASSES

Wetlands were classified by HGM classes to characterize their functions (Michael Baker 2016, 2017a, 2017b). HGM classes include coastal fringe, depression, flat, slope, riverine, riverine (river) channel, lacustrine, and lacustrine (lake) fringe types based on landscape position, dominant water source, and hydrology (Table 3.11-2).

3.11.2.3 WETLAND FUNCTIONS AND VALUES

Wetlands provide services or functions that are considered valuable to society (EPA 2001a). Wetland functions are considered in this document, although a Functional Assessment was not prepared. All wetlands are not considered of equal value or conservation concern. The position and function of high-value wetlands in the landscape plays an integral role in overall watershed health.

Wetlands that are considered high-value are those that:

- Provide habitat for threatened or endangered species (see Section 3.14, Threatened and Endangered Species (TES), for information on TES species in the EIS Analysis Area), or provide habitat for sensitive or important fish, wildlife, birds, or plant species;
- Are regionally scarce, or rare and high quality, within a given region (for example, willow scrub shrub wetlands, often found near streams and ponds, are considered relatively rare and valuable for wildlife for forage, cover, and nesting; herbaceous wetlands and open water ponds are regionally scarce within the wetlands study areas); or
- Are undisturbed and that are difficult or impossible to replace within a lifetime such as mature productive forested wetlands and certain bogs and fens with their unique plant communities that may take centuries to develop.

Typical functions performed by wetlands include: 1) modification of groundwater discharge, 2) modification of groundwater recharge, 3) storm and floodwater storage, 4) modification of stream flow, 5) modification of water quality, 6) export of detritus, 7) contribution to abundance and diversity of wetland flora, and 8) contribution to abundance and diversity of wetland fauna (3PPI et al. 2012, 2014). The functions likely performed by depression, slope, flat, riverine, and lake fringe HGM classes throughout the EIS Analysis Area are presented in Table 3.11-3.

Table 3.11-2: Hydrogeomorphic (HGM) Class Descriptions for Donlin Gold Mine Project Wetlands

HGM Class Description	Examples	
Coastal (Estuarine) Fringe Waters occur along ocean or sea coastlines and in estuaries. The dominant water source is ebb and flow from tides either through flooding or groundwater. Additional inputs can come from precipitation. Water loss is through tidal exchange, overland flow, or evapotranspiration. Organic matter can accumulate in the absence of erosive forces. In the EIS Analysis Area, coastal fringe waters occur along Cook Inlet shorelines.	 Open water coastal fringe wetland, Old Tyonek Creek, Frontal cook Inlet watershed	
Depressional (Depression) Wetlands occur in topographic depressions (closed elevation contours). The direction of water flow from surrounding areas is toward the center of the depression where surface waters accumulate. Water sources include precipitation, groundwater discharge, and surface flow often with seasonal vertical fluctuations. Water loss is through intermittent or perennial outflow, evapotranspiration or seepage to groundwater. In the EIS Analysis Area, depressional wetlands occur as abandoned river features on terraces (oxbows) above active floodplains or as kettles on moraine landforms. Depressional wetlands are often embedded within other HGM wetland classes.	 Depressional wetland in abandoned channel on terrace Crooked Creek floodplain	 Depressional wetlands, Cook Inlet Basin Ecoregion
Flat (Organic Soil) Wetlands occur where shallow permafrost tables perch precipitation at or near the surface on ridgetops, hillsides, or broad glacial outwash terraces in valley bottoms. Surface flow is low and lateral. Water source is primarily precipitation with water loss from evapotranspiration, overland flow, and seepage to groundwater. In the EIS Analysis Area, flat wetlands may occur on either mineral soil or accreted organic matter similar to extensive peatlands. Flat wetlands are common within the EIS Analysis Area and are often closely associated with slope wetlands.	 Flat wetland on a hillside	 Flat bordered by slope wetland drainways

Table 3.11-2: Hydrogeomorphic (HGM) Class Descriptions for Donlin Gold Mine Project Wetlands

HGM Class Description	Examples	
Slope Wetlands occur on sloping land from steep hillslopes to nearly level terrain. Surface flow is downslope. Water sources are primarily groundwater discharge, surface flow from surrounding areas, and precipitation; with water loss by subsurface and surface outflow and evapotranspiration. Slope wetlands in the EIS Analysis Area commonly occur as seeps on footslopes and as drainage ways in steep to rolling terrain where stream channels have not yet formed. Slope wetlands also occur as fens and string bogs in the EIS Analysis Area.	 Slope wetland as a high gradient drainway	 Slope wetland as a string bog, Cook Inlet Basin ecoregion
Riverine Wetlands occur in active flood plains and riparian corridors associated with stream channels. Water sources are overbank flow from the channel and subsurface hyporheic flow; but may also include groundwater discharge and overland flow from adjacent uplands, tributaries and precipitation. Water loss is through flow returning to the channel, subsurface discharge to the channel, seepage to groundwater, and evapotranspiration. Riverine wetlands range from broad floodplains along large meandering rivers to narrow zones along higher gradient rivers and streams. Riverine wetlands are often modified by beaver activity. **Riverine (River) Channel** wetlands and waters occur within the active channel of an intermittent or perennial stream or river. Water source and loss are the same as riverine wetlands This class includes vegetated or bare sand and gravel bars and channel areas with water or aquatic vegetation.	 Riverine wetlands bordering Shell Creek	 Riverine channel, Field Plot 3PP13967

Table 3.11-2: Hydrogeomorphic (HGM) Class Descriptions for Donlin Gold Mine Project Wetlands

HGM Class Description	Examples
Lacustrine includes the water in lakes that are greater than 20 acres in size or at least 6.6 feet deep. Water sources are precipitation, surrounding wetlands, and groundwater. Water loss may be through an outflow, evapotranspiration, or seepage into groundwater. **Lacustrine (Lake) Fringe Wetlands** occur next to lakes which maintain the water table in these wetlands. Surface flow is bi-directional. Water sources are precipitation and groundwater discharge. Water loss is through flow returning to the lake and by evapotranspiration. Lacustrine and lake fringe classes occur at Charlie Lake, Rainy Pass Lake and at other lakes between Rainy Pass and the Skwentna River in the eastern portion of the EIS Analysis Area.	 Lacustrine and lacustrine (lake) fringe wetlands at Charlie Lake

Sources: 3PPI et al. 2012; Michael Baker 2016

Table 3.11-3: Typical Wetland Functions by HGM Class for Donlin Gold Project Wetlands

Function	Depression	Flat	Slope	Riverine	Lake Fringe
Modification of Groundwater Discharge	Yes	Yes	Yes	Yes	No
Modification of Groundwater Recharge	Yes	Yes	No	Yes	Yes
Storm and Floodwater Storage	Yes	Yes	Yes	Yes	Yes
Modification of Stream Flow	Yes	Yes	Yes	Yes	Yes
Modification of Water Quality	Yes	Yes	Yes	Yes	Yes
Export of Detritus	Yes	Yes	Yes	Yes	Yes
Contribute to Abundance and Diversity of Wetland Flora	Yes	Yes	Yes	Yes	Yes
Contribute to Abundance and Diversity of Wetland Fauna	Yes	Yes	Yes	Yes	Yes

Source: Magee and Hollands 1998; 3PPI et al. 2012; 3PPI 2014b

3.11.2.4 IMPACT ASSESSMENT BOUNDARIES

Quantitative impacts to wetlands in the discussion of environmental consequences were assessed based on the spatial overlay of proposed and alternative project footprints on wetland delineation maps (Michael Baker 2017a, 2017b). The wetland delineation dataset used to preliminarily determine acreage of wetland impacts was available as polygons. Waters, including intermittent and perennial streams, too narrow to be mapped as polygons were mapped as polylines; these are reported in miles (Michael Baker 2016). Both quantities are provided in summary tables.Footprints were used to quantify the wetland area potentially directly lost or altered by the project. Footprints were available for all proposed and alternative mine impact areas. Where linear features did not contain footprint information, assumptions were made that included: 150-foot wide construction ROW for the pipeline, 50- or 51-foot wide operational ROW for the pipeline, 30-foot wide transmission line construction and operational ROW, and 24-foot wide construction access roads. Wetland areas permanently or temporarily affected by the project and previous wetland areas that would be available for reclamation over the life of the project were quantified where these were identified within the footprint data (Michael Baker 2017).

Potential indirect effects on wetlands that were analyzed in the consequences include:

1. Areas of altered groundwater hydrology within the modeled maximum draw down groundwater surface due to the excavated and dewatered pit that may potentially alter wetland status, or function (ADEC 1999; BGC 2015b);
2. Areas where wetland restoration may be delayed or unsuccessful due to permafrost degradation (ADEC 1999);
3. Areas within 328 feet (100 m) of the mine access road and airstrip where air-borne dust, snow removal, snow drifting, and interruption of surface water sheet flow may

potentially alter wetland status, productivity, and community composition (Walker and Everett 1987; Auerbach et al. 1997; Hasselbach et al. 2005); and

4. Areas where barge wake energy may cause increased Kuskokwim River shoreline erosion effects based on NWI from circa 1980s imagery (USFWS 2014a), deposition and erosion areas identified by shoreline changes between 1988 and 2006 (ARCADIS 2007a), and projected increases in seasonal wave energy (BGC 2007c, 2016a, 2017g).

3.11.3 AFFECTED ENVIRONMENT

An estimated 43 percent of Alaska's surface area is wetlands (Hall et al. 1994). Proposed project activities that range from barging through the Kuskokwim River delta to the origin of the natural gas pipeline in Cook Inlet would encompass three physical subdivisions of Alaska – Arctic and Western Alaska, Interior Alaska, and Southern Alaska (Hall et al. 1994). The wetland study areas developed and used for comparative purposes represent about 0.1 percent of the surface and wetland areas within the ecoregions that would be crossed by the project (Hall et al. 1994) (Table 3.11-4). As a result, direct and indirect impacts to wetlands described in the environmental consequences would then affect even smaller percentages of wetlands within these ecoregions. The proportion of wetlands within these wetland study areas ranges both above and below the ecoregion and division wetland proportions (Table 3.11-4). The largest differences are for the pipeline and mine site wetland study areas through the Kuskokwim Mountains Ecoregion where lower proportions of the study areas are wetlands compared to the Ecoregion as a whole.

Table 3.11-4: Physical Subdivisions, Ecoregion, and Study Area Wetland Comparisons

Physical Subdivisions/Ecoregions/ Study Areas	Wetland (1,000 acres)	Total (1,000 acres)	Wetland[1] (%)
Southern Alaska Subdivision	9,051.2	69,718.6	13%
Cook Inlet Ecoregion	2,644.5	9,442.0	28%
Pipeline Wetland Study Area	9.3	34.2	27%
Interior Alaska Subdivision	70,665.7	160,701.1	44%
Alaska Range Ecoregion	1,339.5	18,197.4	7%
Pipeline Wetland Study Area	2.9	18.9	15%
Tanana – Kuskokwim Lowlands Ecoregion	8,256.1	13,550.9	61%
Pipeline Wetland Study Area	6.0	9.6	62%
Kuskokwim Mountains Ecoregion	24,462.4	44,182.5	55%
Pipeline Wetland Study Area	2.0	17.2	12%
Mine Site Wetland Study Area	7.2	21.0	34%
Mine Transportation Wetland Study Area[2]	6.4	12.8	50%

Notes:

1 Proportion of wetlands with subdivision, ecoregion, or wetland study area by ecoregion; water categories excluded.

2 The mine transportation wetland study area includes only the access roads, airstrip, and ports; the Kuskokwim River barge route is not included.

Source: Adapted from Hall et al. 1994; Nowacki et al. 2001, Michael Baker 2017a

3.11.3.1 MINE SITE WETLAND STUDY AREA

Thirty-five percent of the mine site wetland study area is wetland and waters, comprised predominately of evergreen forested and scrub shrub wetlands in flat or slope geomorphic settings (Table 3.11-5, Figure 3.11-1). This area is a mosaic of wetland, upland, and transitional areas that have been influenced by recent and past wildland fires (3PPI et al. 2014). Wetland distribution and extent are influenced by discontinuous permafrost; which prevents infiltration of surface waters and maintains saturated ground, especially on north-facing hillsides and toe slopes (Figure 3.11-1, Post 1996). Permafrost maintained wetlands may be converted to non-wetlands following fires that remove the insulating organic mat that protects permafrost from receding and creating better drainage conditions (Post 1996). Wetland conditions may return over the span of 40 to 60 years or more as the insulating organic mat recovers allowing the permafrost to reestablish to shallower depths (Post 1996). Common wetland communities within the mine site wetland study area include: black spruce forested wetlands on north-facing hillsides and toe slopes; willow-dominated shrub wetlands in creek drainages; moist tundra dominated by tussock cotton grass typically underlain by permafrost on hillsides, toe slopes, or valley bottoms; and shrub bogs and sedge marshes in valley bottoms (Figure 3.11-2; ARCADIS 2013a).

Rivers and streams within the mine site wetland study area total 72 miles with 78 percent perennial streams and rivers (56 miles), and 22 percent intermittent streams (16 miles) (Table 3.11-5, Michael Baker 2017a).

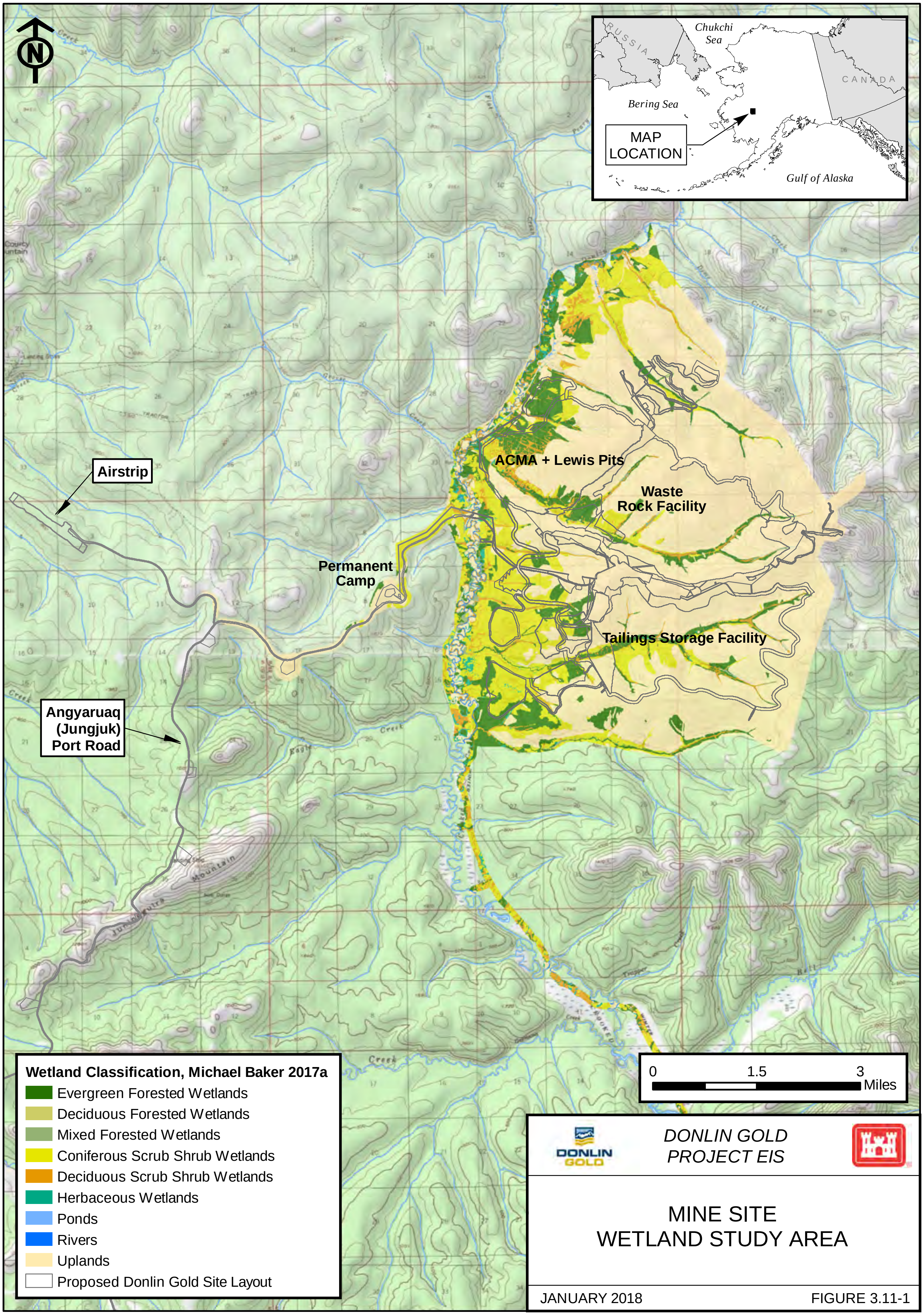
Previous disturbances to wetlands and uplands within the Mine Site area have been caused by a variety of current human activities including: ongoing placer mining; Donlin Gold's exploration drill roads and pads, all-terrain vehicle trails, roads; as well as historic human activities such as winter trails and the Crooked Creek village site (Figure 3.11-3). There have also been natural causes, such as landslides (3PPI et al. 2014). Drill roads and pads and placer mining account for 82 percent of the existing disturbances to wetlands and 50 percent of disturbance to uplands in the mine site wetland study area (3PPI et al. 2014; Figure 3.11-4). Previously disturbed wetland habitats represent disproportionate amounts of deciduous scrub shrub and herbaceous wetlands (Figure 3.11-5), potentially in response to post-disturbance revegetation or succession.

Regionally scarce wetlands in the mine site wetland study area include herbaceous wetlands and open water ponds (3PPI 2014b, Michael Baker 2016, Michael Baker 2017b).

Table 3.11-5: Mine Site Wetland Study Area Preliminary Calculation of Wetland Categories by HGM Classes

Wetland Category	HGM Class (Acres)					Area[1] (Acres)	Area[2] (%)
	Depression	Flat	Slope	Riverine	River Channel		
Evergreen Forested Wetlands	0.4	1,319.2	753.5	218.4	0	2,291.5	11%
Deciduous Forested Wetlands	0	0	0.0	2.4	0	2.4	<1%
Mixed Forested Wetlands	0	0	32.8	39.5	0	72.3	<1%
Evergreen Scrub Shrub Wetlands	1.6	2,860.2	693.3	33.2	0	3,588.3	17%
Deciduous Scrub Shrub Wetlands	5.3	287.9	458.5	300.7	0	1,052.4	5%
Herbaceous Wetlands	25.0	3.0	97.2	55.9	0	181.1	1%
Ponds	11.2	0	0	6.5	0	17.7	<1%
Lakes	0	0	0	0	0	0	NA
Rivers	0	0	0	0	122.6	122.6	1%
Uplands	NA	NA	NA	NA	NA	13,721.5	65%
Total Area	43.5	4,470.3	2,035.3	656.6	122.6	21,049.8	NA
Wetland/Water Totals	<1%	61%	28%	9%	2%	7,328.3	35%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	15.7	22%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	56.5	78%

Notes:
1 Surface area is provided in acres unless otherwise noted in the wetland category descriptions.
2 Proportion of total study area by wetland category. Note that percentages for intermittent streams and perennial streams represent the percent of river miles that make up the rivers category within the study area.
NA = Not Applicable
0 = None
0.0 = < 0.1
Source: Michael Baker 2017a



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MINE SITE
WETLAND STUDY AREA

JANUARY 2018

FIGURE 3.11-1

Figure 3.11-2: Common Wetland Types in the Mine Site Wetland Study Area

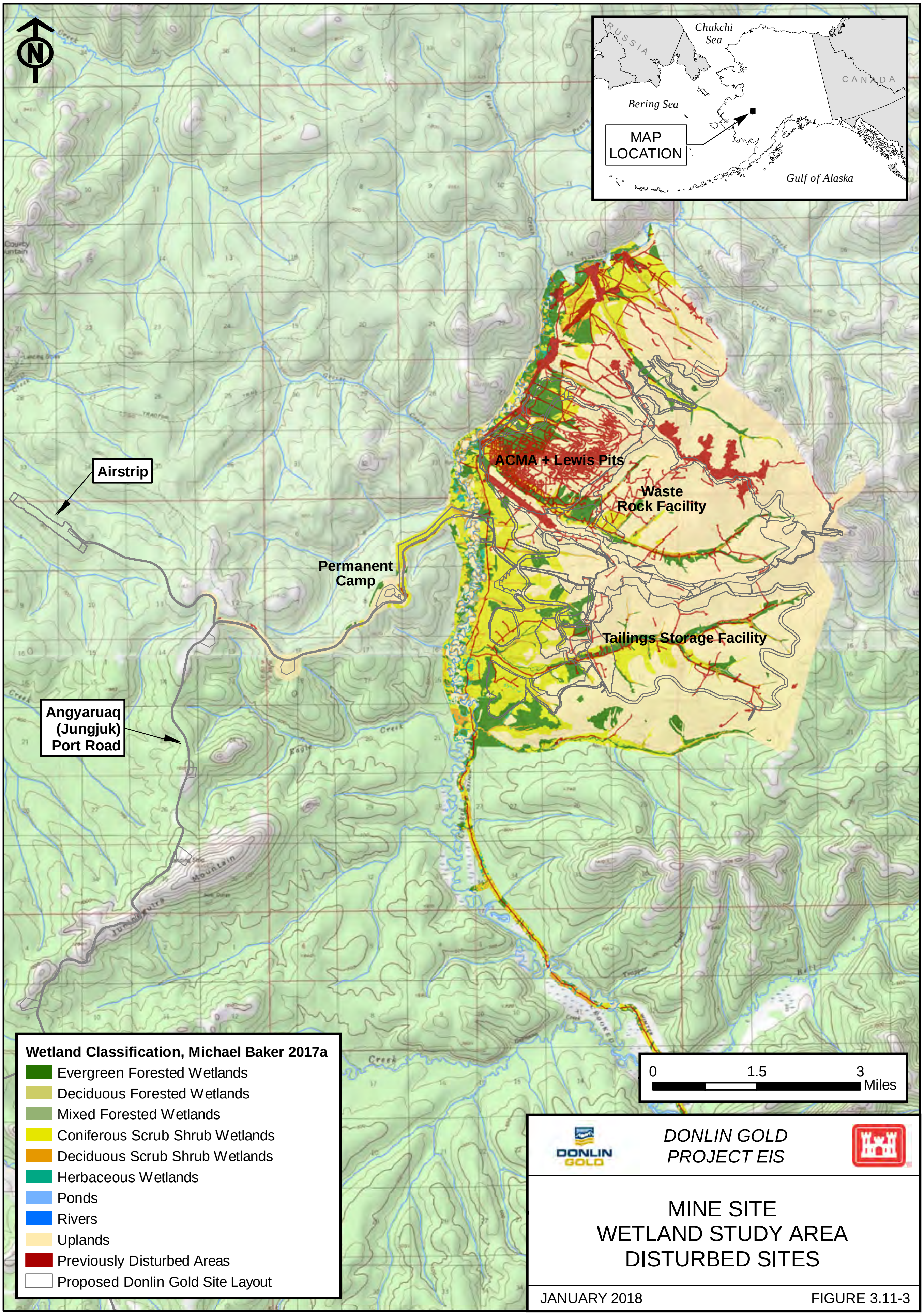
Evergreen Forested Wetland, PF04B, Closed Black Spruce Forest, American Creek Watershed

Evergreen Scrub Shrub Wetland, PSS4B, Open Black Spruce Forest-Shrub, Crooked Creek Watershed

Deciduous Scrub Shrub Wetland, PSS1C, Open Alder Willow Shrub, American Creek Watershed

Herbaceous Wetland, PEM1C, Emergent Aquatic, Crooked Creek Watershed

Source: 3PPI et al. 2012; 3PPI 2014a



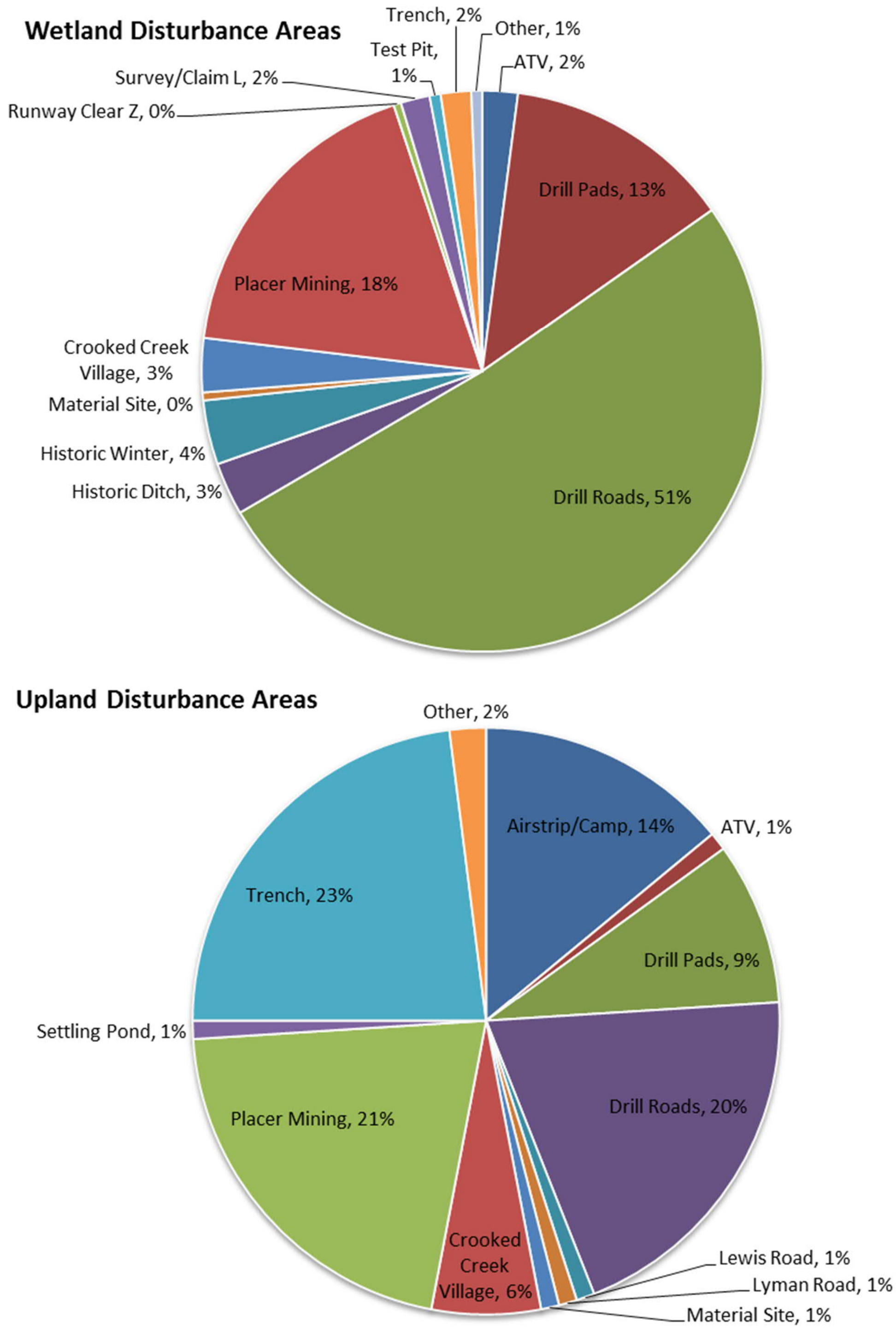
DONLIN GOLD PROJECT EIS

MINE SITE
WETLAND STUDY AREA
DISTURBED SITES

JANUARY 2018

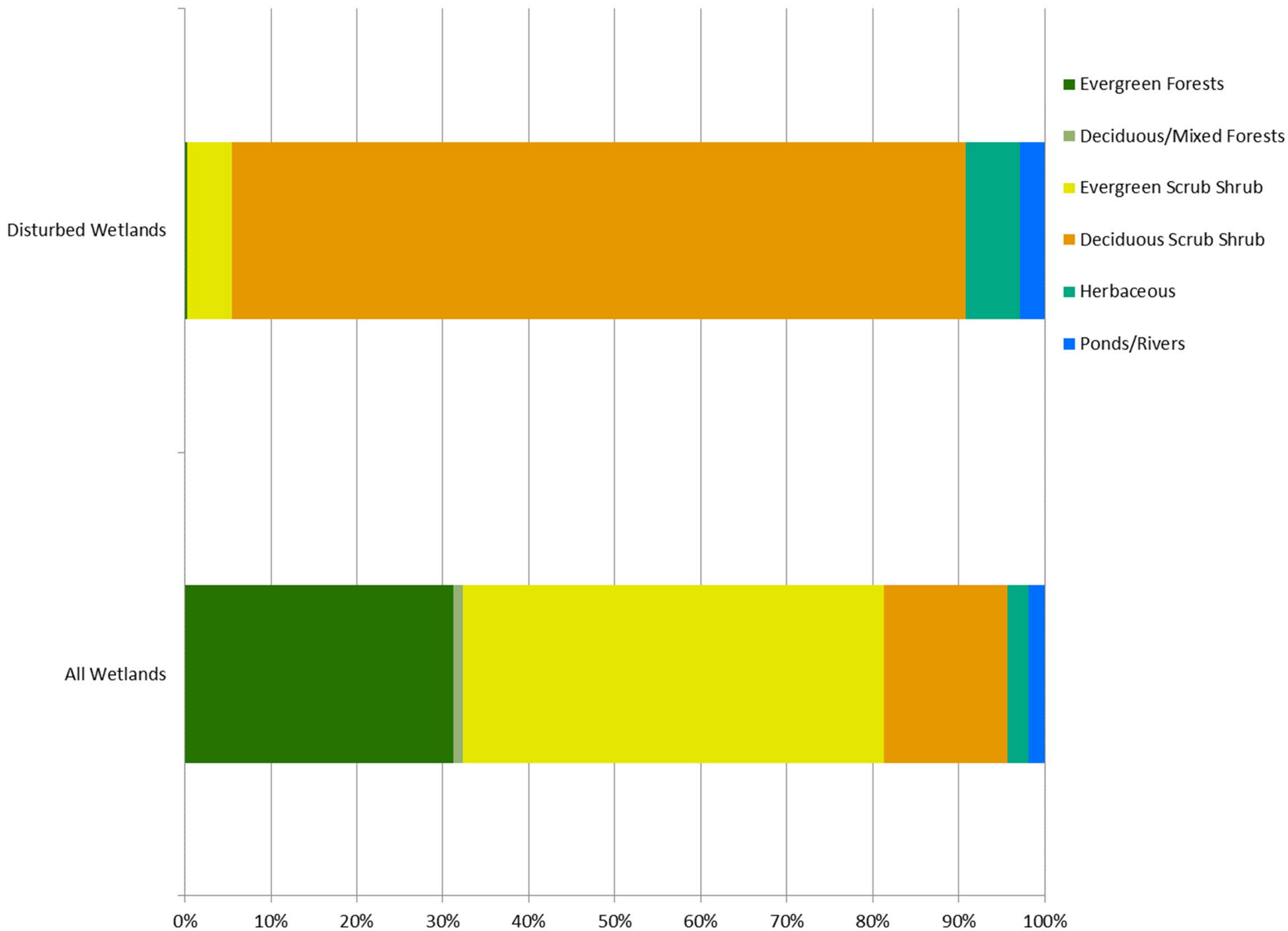
FIGURE 3.11-3

Figure 3.11-4: Wetland and Upland Disturbance Types in the Mine Site Wetland Study Area



Source: 3PPI et al. 2014b

Figure 3.11-5: Mine Site Wetland Study Area Wetland Composition – Disturbed and All Wetlands



Source: Michael Baker 2017a

3.11.3.2 TRANSPORTATION CORRIDOR

3.11.3.2.1 MINE TRANSPORTATION WETLAND STUDY AREA

Fifty-two percent of the mine transportation wetland study area is wetland and waters; wetlands are predominately evergreen forested, and evergreen and deciduous scrub shrub wetlands in flat or slope geomorphic settings (Table 3.11-6). The mine transportation wetland study area is a mosaic of upland, wetland, and transitional areas (3PPI et al. 2014). Wetland distribution and extent are influenced by discontinuous permafrost. Common wetland communities along the access road and airstrip include: black spruce forested wetlands on north-facing hillsides and toe slopes; willow-dominated shrub wetlands in creek drainages; moist tundra dominated tussock cotton grass on hillsides, slopes, or valley bottoms; and shrub bogs and sedge marshes in valley bottoms (Table 3.11-6, ARCADIS 2013a). Wetlands near the Angyaruaq (Jungjuk) and BTC port sites and along the Kuskokwim River include wetlands influenced by the river including floodplain forests, shrub and emergent wetlands. Figure 3.11-6 depicts common wetland types, and Figure 3.11-7 shows wetlands mapped in the mine transportation wetland study area.

Rivers and streams within the mine transportation wetland study area total 33 miles with 84 percent perennial streams and rivers (28 miles), and 16 percent intermittent streams (5 miles) (Table 3.11-6; Michael Baker 2017a).

Previous disturbances in the mine transportation wetland study area were to 48 percent wetlands and 52 percent uplands, and have been caused by recent wildland fires (62 percent) and a variety of ongoing human activities including: Donlin Gold's exploration drill roads and pads (12 percent), as well as historic human activities such as use of winter trails and the Crooked Creek village site (25 percent; 3PPI et al. 2014b). As in the mine site wetland study area, disturbed areas represent a disproportionate amount (96 percent) of deciduous scrub shrub wetlands, possibly reflecting succession or revegetation within disturbed areas. Note that due to overlap of the mine site and mine transportation wetland study areas, 36 percent of the disturbed wetland areas noted in the mine transportation wetland study area also occur in the mine site wetland study area.

Regionally scarce wetlands in the mine transportation wetland study area include deciduous and mixed forested wetlands, herbaceous wetlands, and open water ponds (Michael Baker 2017a).

Table 3.11-6: Mine Transportation Wetland Study Area Wetland Categories by HGM Classes

Wetland Category	HGM Class (Acres)					Area[1] (Acres)	Area[2] (%)
	Depression	Flat	Slope	Riverine	River Channel		
Evergreen Forested Wetlands	0.4	956.0	335.4	91.9	0	1,383.7	11%
Deciduous Forested Wetlands	0	1.2	1.4	13.6	0	16.2	<1%
Mixed Forested Wetlands	0	0.1	13.4	41.0	0	54.5	<1%
Evergreen Scrub Shrub Wetlands	1.1	2,271.4	467.9	9.4	0	2,749.8	21%
Deciduous Scrub Shrub Wetlands	3.5	720.9	377.7	228.6	0	1,330.7	10%
Bogs (LSB)	0.7	68.8	33.8	3.7	0	107.0	1%
Herbaceous Wetlands	22.7	599.7	212.1	63.8	0	898.3	7%
Ponds	4.0	0	0	4.7	0	8.7	<1%
Rivers	0	0	0	0	171.9	171.9	1%
Uplands	NA	NA	NA	NA	NA	6,225.5	48%
Total Area	31.7	4,549.3	1,407.9	453.0	171.9	12,839.3	NA
Wetland/Water Totals	<1%	69%	21%	7%	3%	6,613.8	52%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	5.4	16%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	27.6	84%

Notes:
1 Surface area is provided in acres unless otherwise noted in the wetland category descriptions.
2 Proportion of total study area by wetland category. Note that percentages for intermittent streams and perennial streams represent the percent of river miles that make up the rivers category within the study area.
NA = Not Applicable
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
Source: Michael Baker 2017a

Figure 3.11-6: Common Wetland Types in the Mine Transportation Wetland Study Area

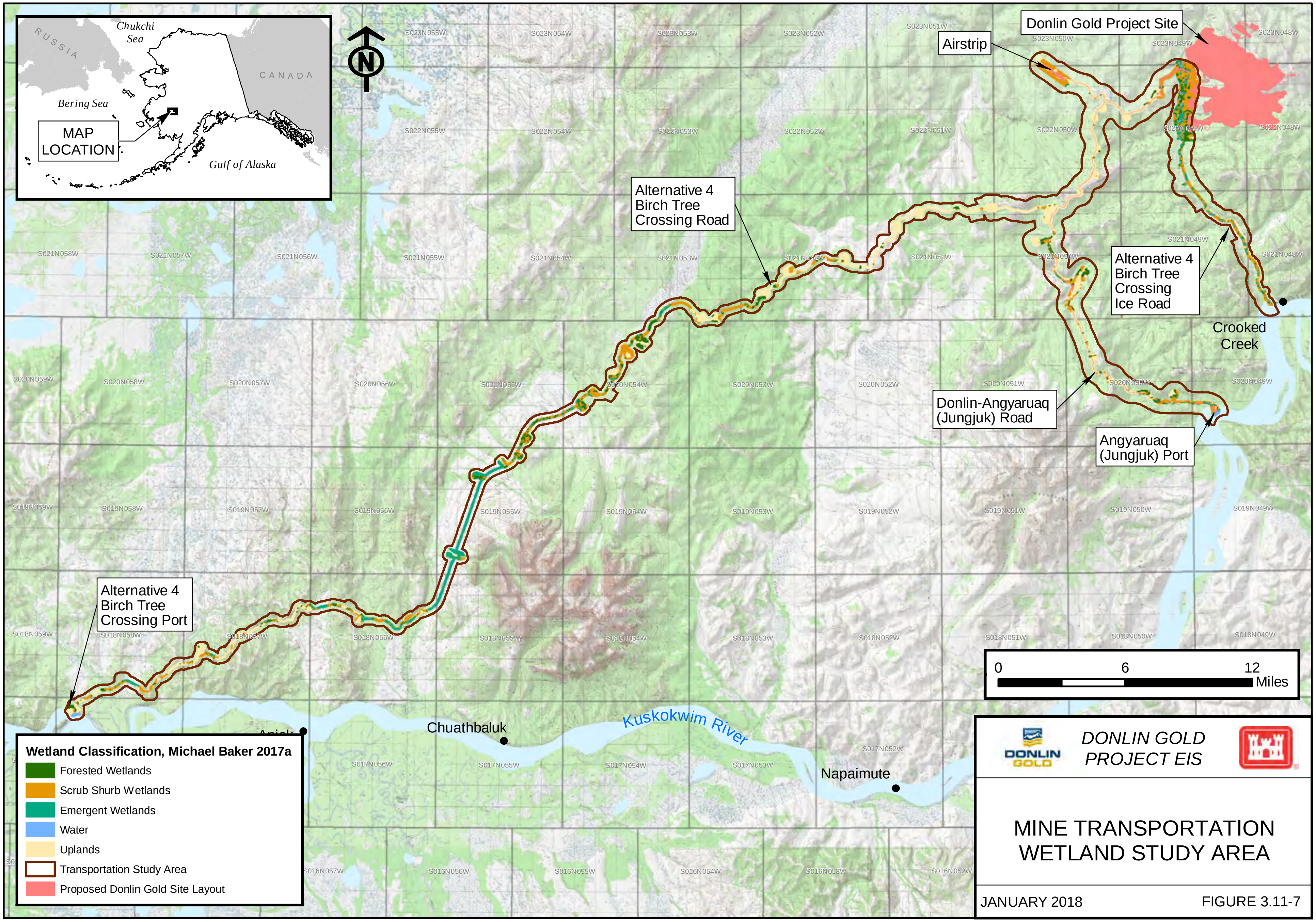
Evergreen Forested Wetland, PF04B, Open Spruce Forest-Moss Lichen Understory, Return Creek Watershed

Evergreen Forested Wetland, PF04B, Open Black Spruce Forest-Shrub, Getmuna Creek Watershed

Deciduous Scrub Shrub Wetland, PSS1C, Closed Alder Willow Shrub, Getmuna Creek Watershed

Herbaceous Wetland, PEM1B, Bluejoint Tall Grass, Getmuna Creek Watershed

Source: 3PPI et al. 2012; 3PPI 2014a



MINE TRANSPORTATION WETLAND STUDY AREA

JANUARY 2018

FIGURE 3.11-7

3.11.3.2.2 KUSKOKWIM RIVER WETLAND STUDY AREA

Twenty-eight percent of the Kuskokwim River wetland study area is wetland, 12 percent is water, and 60 percent is upland. Wetlands include woody wetlands with either forest or shrubland vegetation and soils that are periodically saturated or covered with water, or are emergent herbaceous wetlands with perennial herbaceous vegetation (Table 3.11-7, Figure 3.11-8; Homer et al. 2004). Riparian wetland habitats and vegetation are reshaped by flooding, and by flooding with melting followed by subsequent collapse of permafrost-supported shorelines (thermoerosional niching; BGC 2007c). Permafrost is generally absent within the river channel, although permafrost may develop within floodplains in mixed stands of 200-year old white and black spruce because of accumulated thick insulating layers of moss and organics (Post 1996).

Table 3.11-7: Kuskokwim River Wetland Study Area Wetland Categories

Wetland Category	Area (acres)	Area (%)
Woody Wetlands	138,976	13%
Emergent Herbaceous Wetlands	164,479	15%
Water	125,634	12%
Uplands	634,801	60%
Total Area	1,063,890	NA

Notes:
NA = Not Applicable
Source: Homer et al. 2004

Overlay of available digital NWI data covering 195 miles of the Kuskokwim River mapped from circa 1980s imagery (USFWS 2014a) with deposition and erosion areas identified by shoreline changes between 1988 and 2006 (ARCADIS 2007a; Figure 3.11-9A and Figure 3.11-9B) indicates:

- Deposition rates (acres/mile) were less than 25 percent of erosion rates (the river is actively moving and eroding banks);
- Wetland erosion rates decreased substantially from downstream to upstream;
- Upland erosion occurred in river segments upstream from Tuluksak; and
- Overall erosion rates decreased 10-fold within segments from downstream of Bethel to upstream of Aniak (Table 3.11-8: Kuskokwim River Segment Wetland Deposition and Erosion Rates (acres/mile) between 1988 and 2006 and Figure 3.11-10).

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KUSKOKWIM RIVER WETLAND STUDY AREA

MAY 2017

FIGURE 3-11.8

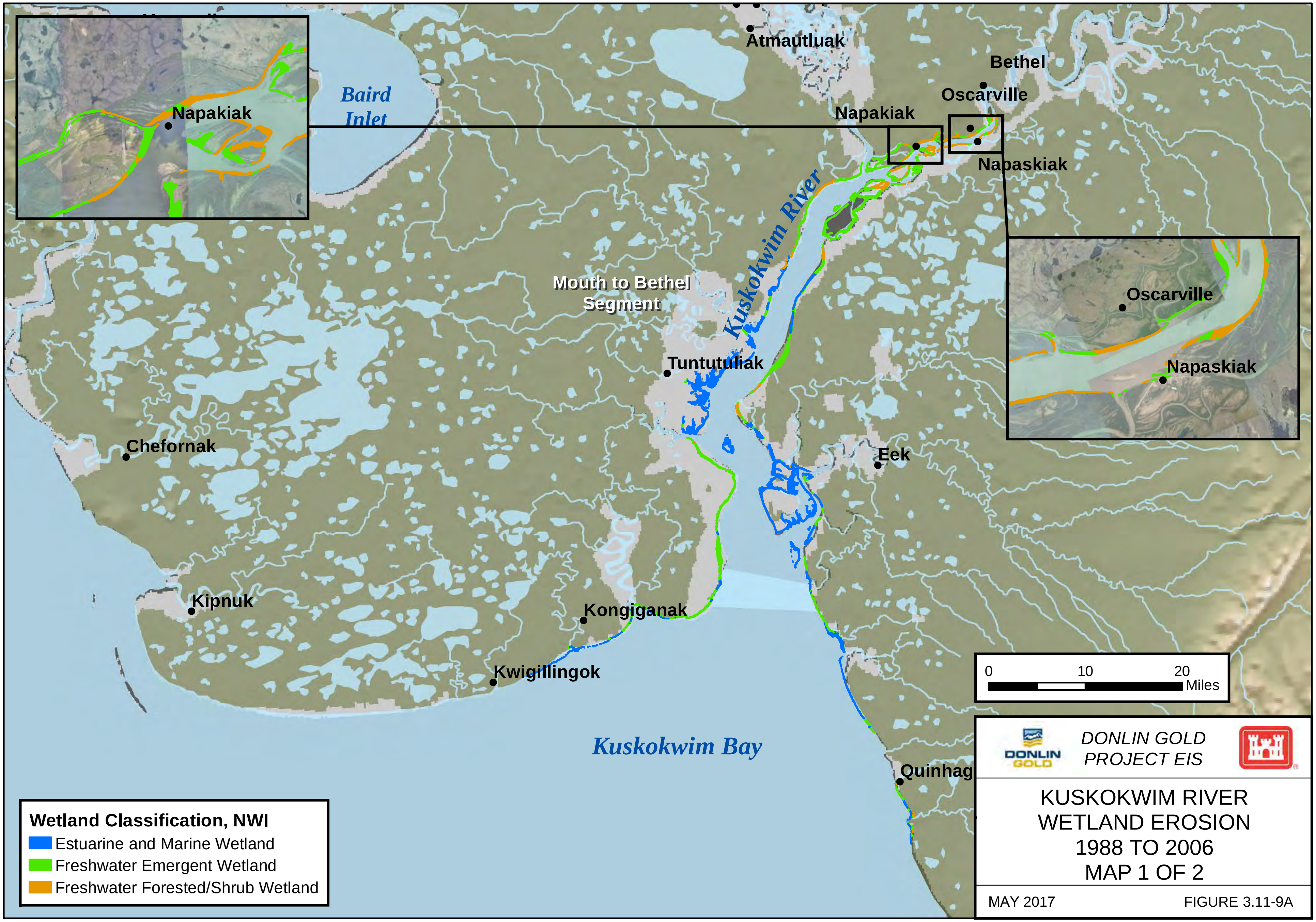
Table 3.11-8: Kuskokwim River Segment Wetland Deposition and Erosion Rates (acres/mile) between 1988 and 2006

Wetland Type		Kuskokwim River Segments[1]				
		Mouth to Bethel	Tuluksak	Kalskag	Aniak to Napaimute	Combined Segments
Estuarine and Marine Wetland	Deposition	11.88	0.00	0.00	0.00	5.17
	Erosion	88.64	0.00	0.00	0.00	38.57
Freshwater Emergent Wetland	Deposition	1.23	0.00	0.00	0.00	0.54
	Erosion	65.44	0.47	1.56	0.04	29.00
Freshwater Forested/ Shrub Wetland	Deposition	0.17	1.47	0.62	0.73	0.50
	Erosion	9.18	31.75	6.62	3.06	8.56
Wetlands	Deposition	13.28	1.47	0.63	0.73	6.20
	Erosion	163.26	32.22	8.18	3.09	76.13
Uplands	Deposition	0.00	0.00	0.99	2.15	0.72
	Erosion	0.00	0.00	36.63	13.46	13.98
Total	Deposition	13.28	1.47	1.62	2.88	6.93
	Erosion	163.26	32.22	44.80	16.56	90.12
Deposition to Erosion (%)		8%	5%	8%	23%	8%

Notes:

1 River Segment Lengths: Mouth to Bethel – 84.9 miles; Tuluksak – 11.8 miles; Kalskag – 60.6 miles; Aniak to Napaimute – 37.8 miles; Combined Segments – 195.1.

Source: Analysis based on ARCADIS 2007a; USFWS 2014a, Styles and Gailani 2016



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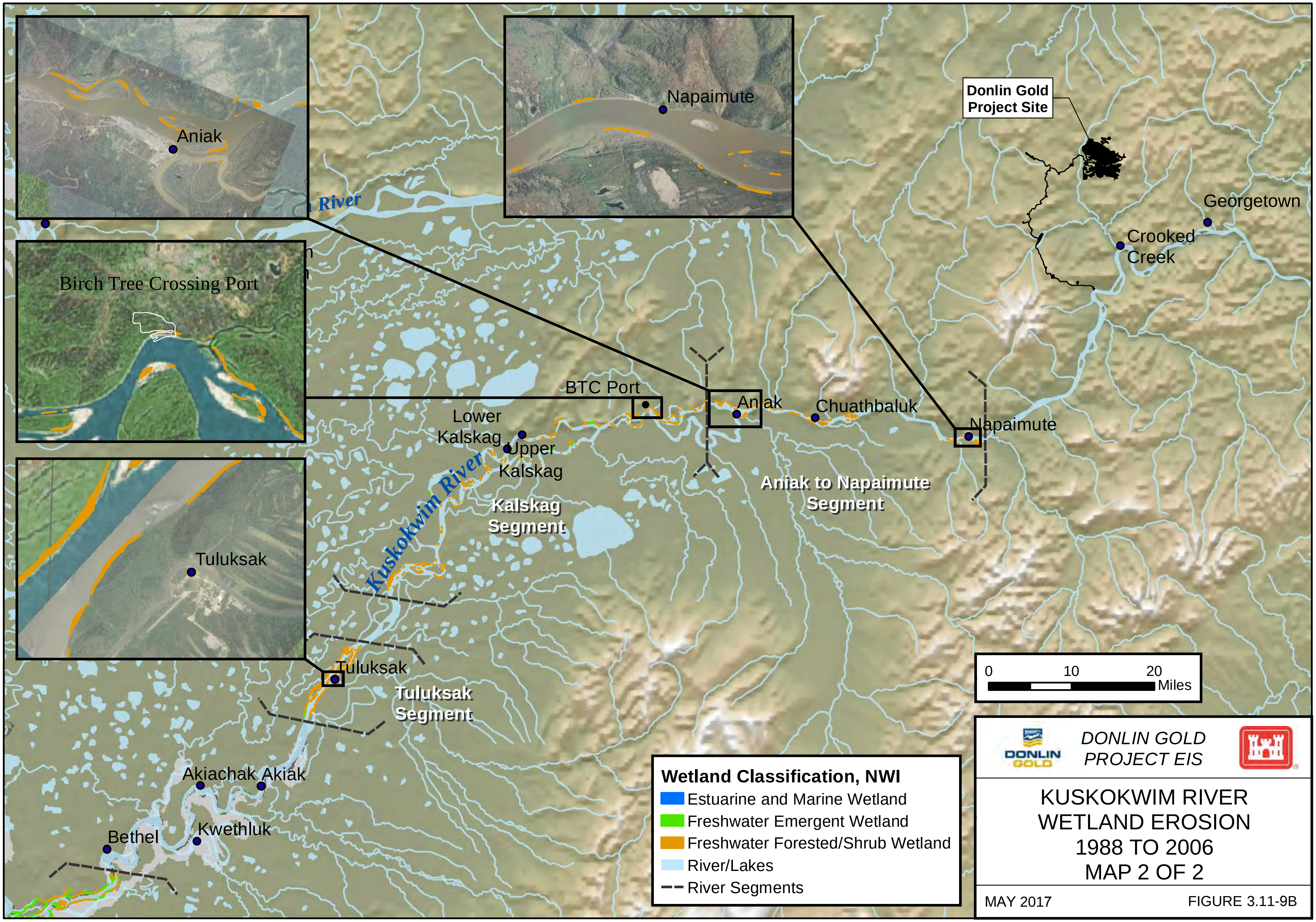
KUSKOKWIM RIVER WETLAND EROSION 1988 TO 2006 MAP 1 OF 2

MAY 2017

FIGURE 3.11-9A



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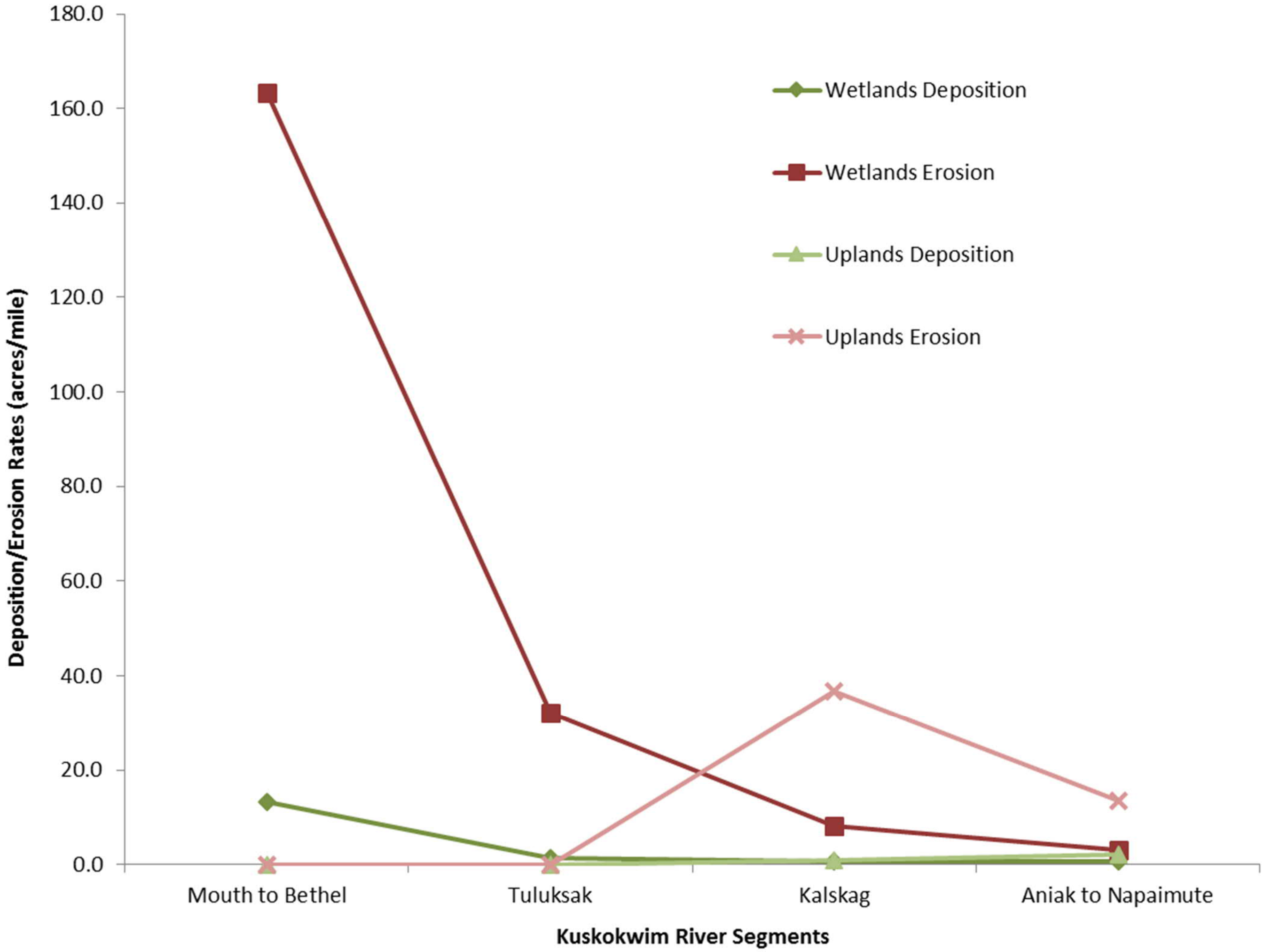
KUSKOKWIM RIVER WETLAND EROSION 1988 TO 2006 MAP 2 OF 2

MAY 2017

FIGURE 3.11-9B

Figure 3.11-10: Kuskokwim River Wetland Deposition and Erosion Rates by River Segment 1988 to 2006



Source: ARCADIS 2007a; USFWS 2014a

3.11.3.2.3 BETHEL WETLAND STUDY AREA

Wetlands along the Kuskokwim River were analyzed. Wetlands in the vicinity of the 16-acre Bethel Cargo Terminal include wet graminoid, dwarf shrub-sphagnum moss peatlands, and tall alder-willow shrub habitats and shoreline and riverine habitats (Boggs et al. 2012). The Bethel fuel terminal and tank farm would be constructed within existing facilities in primarily upland habitats. Any actions that would occur at Dutch Harbor or the Port of Bethel at the Bethel Yard Dock are not part of the proposed action, and are considered connected actions (see Section 1.2.1, Connected Actions, in Chapter 1, Project Introduction and Purpose and Need).

3.11.3.3 PIPELINE

3.11.3.3.1 PIPELINE WETLAND STUDY AREA

Twenty-eight percent of the pipeline wetland study area is wetland and waters. Wetlands throughout the pipeline route are predominately deciduous scrub shrub wetlands, and evergreen forested and scrub shrub wetlands in flat or slope geomorphic settings (Table 3.11-9, depicted in Figure 3.11-11, and mapped in Figure 3.11-12A through Figure 3.11-12H). The pipeline ROW crosses four ecoregions, each with differing wetland abundance and type (Figure 3.11-13 and Table 3.11-9). Wetlands across the Kuskokwim Mountains region, from MP 221 to MP 315 of the pipeline, include alpine wetlands scattered along the route that are dominated by dwarf and low shrubs, and are sometimes underlain by permafrost or seasonally persistent frost (ARCADIS 2013a). Wetlands across the Tanana-Kuskokwim Lowlands ecoregion from MP 156 to MP 221 are dominated by scrub black spruce forested wetland in the western portion, much of which is underlain by permafrost, and drainages are dominated by willows. In the eastern portion, the wetlands are dominated by tussock grass tundra (ARCADIS 2013a). Wetlands across the Alaska Range region from MP 82 to MP 156 include: black spruce-dominated forested wetlands; scattered bogs and fens; riparian willow-dominated wetlands that have been modified by beavers; and shrub-dominated moist tundra (ARCADIS 2013a). Wetlands across the Cook Inlet Basin region from MP 0 to MP 82 include: patterned bogs; black spruce forested wetlands; and willow-dominated wetlands on river and stream floodplains (ARCADIS 2013a). Most wetlands fall within flat and slope HGM classes, although the area of each varies within ecoregions (Figure 3.11-14).

Rivers and streams within the pipeline wetland study area total 165 miles with 78 percent of these perennial streams and rivers (128 miles), and 22 percent intermittent streams (37 miles) (Table 3.11-9; Michael Baker 2017a). Within the pipeline wetland study area, the Cook Inlet Basin Ecoregion has the greatest length of streams with 74 miles, followed by the Alaska Range with 38 miles, then the Kuskokwim Mountains with 32 miles, and finally the Tanana-Kuskokwim Lowlands with 21 miles (Table 3.11-9; Michael Baker 2017a).

Disturbances in the pipeline wetland study area have been primarily to uplands, affecting 91 percent uplands and 9 percent wetlands (Michael Baker 2017a). Most disturbed wetland habitats (99 percent) were within the Cook Inlet Basin (96 percent) and Kuskokwim Mountains (3 percent) ecoregions. When they were identified, wetland disturbances included: roads (56 percent), vegetation clearing (28 percent), burned areas (14 percent), and trails (3 percent) (3PPI et al. 2014). Previously disturbed wetland areas occurred within deciduous scrub shrub wetlands (78 percent), herbaceous wetlands (14 percent), and deciduous and mixed forested wetlands (8 percent; Michael Baker 2017a).

Table 3.11-9: Pipeline Wetland Study Area Wetland Categories by Ecoregion

Wetland Category	Ecoregion (Acres)				Area (Acres)	Area (%)
	Kuskokwim Mountains	Tanana-Kuskokwim Lowlands	Alaska Range[1]	Cook Inlet Basin[1]		
Evergreen Forested Wetlands	559.0	1,032.6	373.4	2,126.9	4,091.9	5%
Deciduous Forested Wetlands	1.2	3.4	7.8	131.9	144.3	<1%
Mixed Forested Wetlands	40.9	4.8	4.0	357.2	406.9	1%
Evergreen Scrub Shrub Wetlands	564.1	1,320.0	294.6	1,420.7	3,599.4	5%
Deciduous Scrub Shrub Wetlands	764.1	3,272.9	2,046.3	4,766.1	10,849.4	14%
Bogs (LSB)	319.8	2,241.4	388.7	1,708.4	4,658.3	6%
Fens (ESB-SB)	9.9	3.7	0	997.3	1,010.9	1%
Herbaceous Wetlands	71.8	323.6	166.6	484.9	1,046.9	1%
Ponds	2.1	35.7	71.7	113.0	222.5	<1%
Lakes	0.0	3.0	41.4	88.1	132.5	<1%
Rivers	187.8	204.5	629.0	541.0	1,562.3	2%
Wetland/Water Totals	2,191.0	6,200.5	3,634.8	10,029.8	22,056.1	28%
Uplands	15,000.1	3,365.4	15,217.7	24,159.7	57,742.9	72%
Total Area	17,191.1	9,565.9	18,852.5	34,189.5	79,799.0	NA
Intermittent Streams (Miles)	5.1	4.6	12.8	14.2	36.7	22%
Perennial Streams (Miles)	26.9	16.4	25.5	59.5	128.3	78%

Notes:
1 Missing detailed wetland mapping for Alternative 3B – Port MacKenzie Option, as field work was not conducted in this area.
NA = Not Applicable
0 = None
LSB = Low Shrub Bog Wetland Subcategory
ESB-SB = Ericaceous Shrub Bog – String Bog Wetland Subcategory
Source: Michael Baker 2017a, 2017a

Figure 3.11-11: Common Wetland Types in the Pipeline Wetland Study Area

Evergreen Forest Wetland, PF04B, Open Black Spruce Forest, Unnamed Tributary #2 Headwaters Tatlawiksuk River

Deciduous Forest Wetland, PF01B, Open Deciduous Forest, Deep Creek Watershed

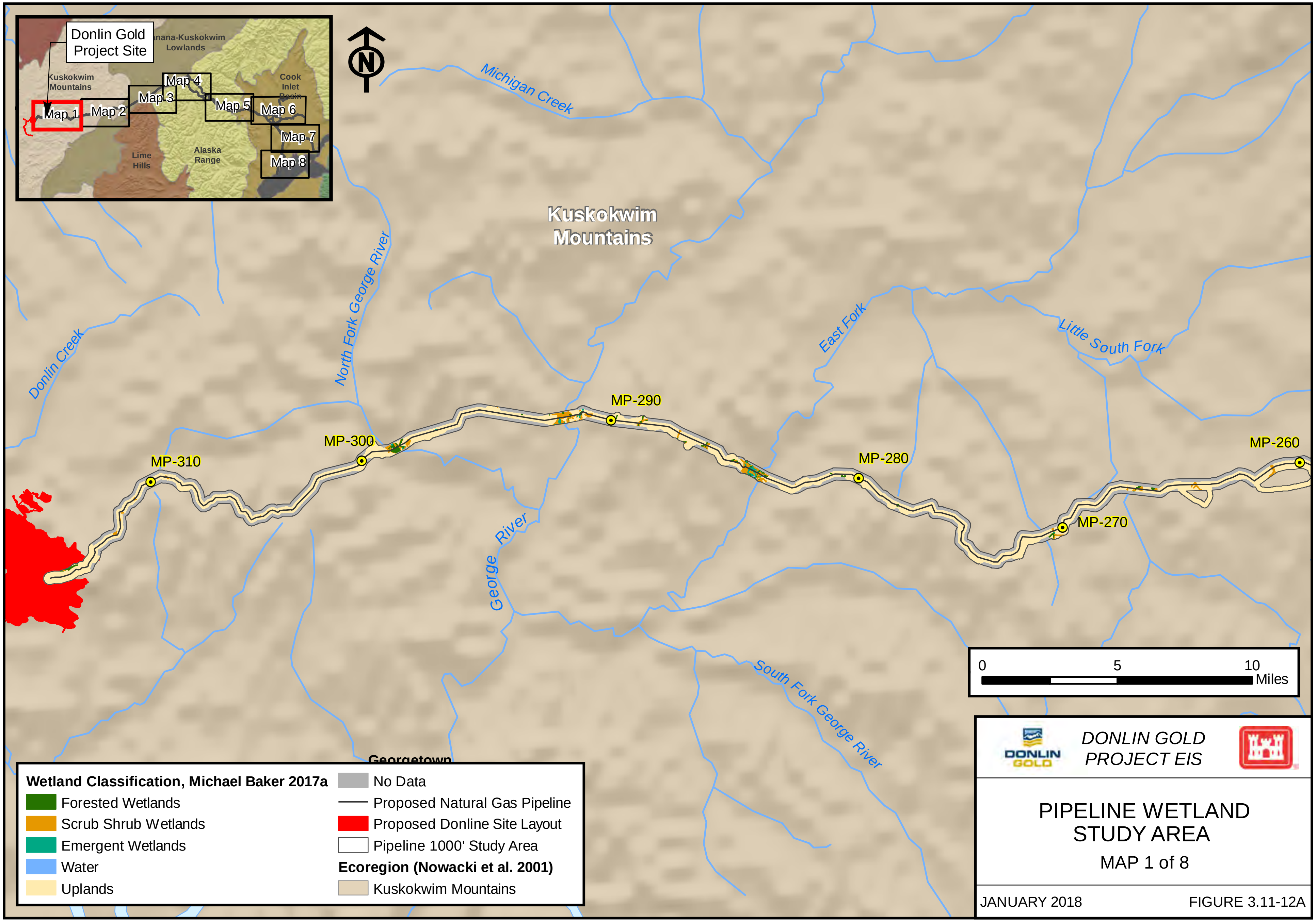
Evergreen Scrub Shrub Wetland, PSS4B, Open Black Spruce Forest, Middle Big River Watershed

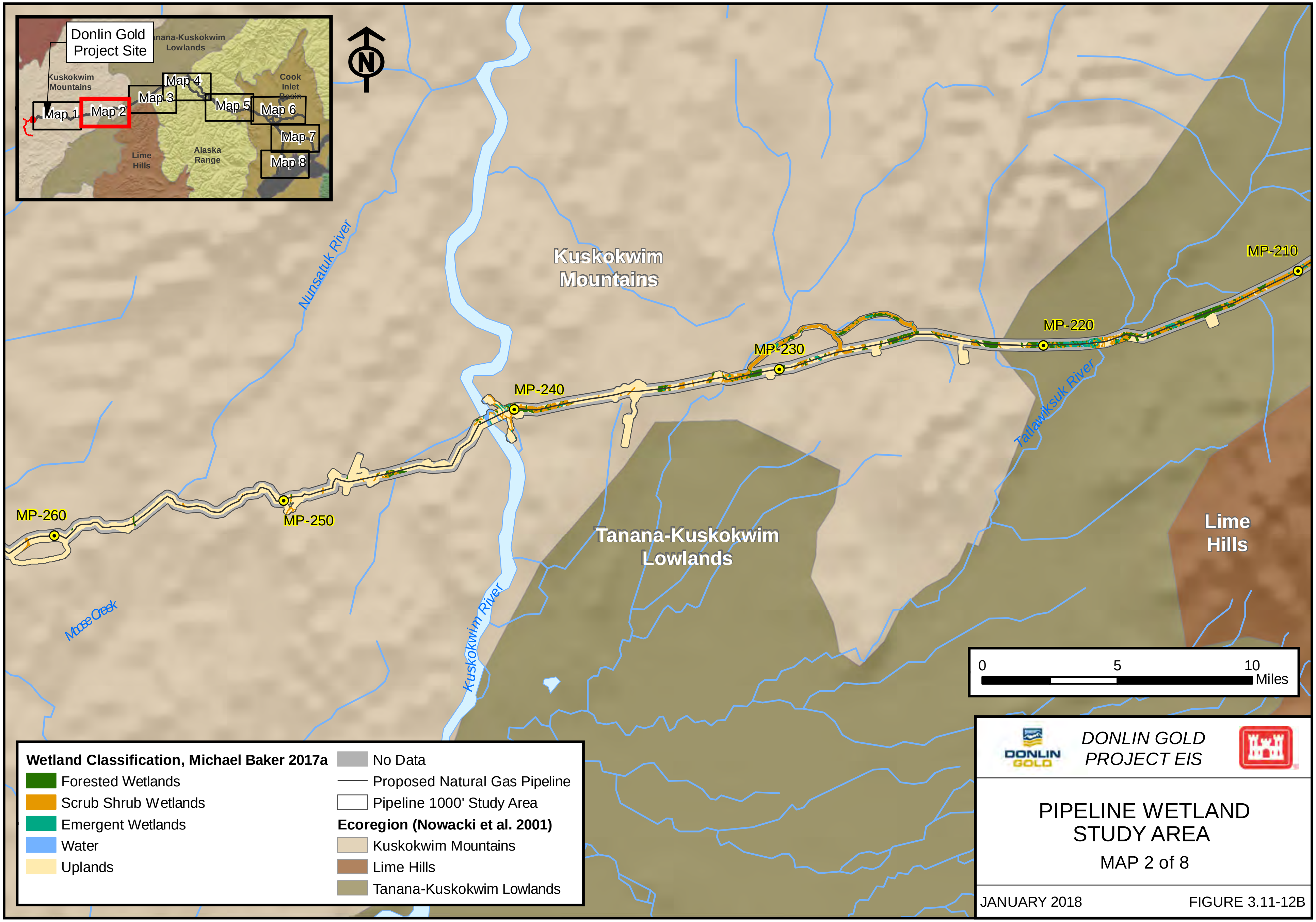
Deciduous Scrub Shrub Wetland, PSS1B, Low Shrub Bog, Canyon Lake-Skwentna River Watershed;

Deciduous Scrub Shrub Wetland, PSS1C, Open Alder Willow Shrub, American Creek Watershed

Herbaceous Wetland, PEM1C, Emergent Aquatic, Canyon Creek Watershed

Source: 3PPI et al. 2012; 3PPI 2014a.


Donlin Gold Project Site
Kuskokwim Mountains
Lowlands
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
Cook Inlet
Lime Hills
Alaska Range
N
Michigan Creek
Kuskokwim Mountains
Donlin Creek
North Fork George River
East Fork
Little South Fork
MP-290
MP-300
MP-310
MP-280
MP-260
MP-270
George River
South Fork George River
Georgetown
0 5 10 Miles
Wetland Classification, Michael Baker 2017a
Forested Wetlands
Scrub Shrub Wetlands
Emergent Wetlands
Water
Uplands
No Data
Proposed Natural Gas Pipeline
Proposed Donline Site Layout
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Kuskokwim Mountains
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE WETLAND STUDY AREA
MAP 1 of 8
JANUARY 2018
FIGURE 3.11-12A



DONLIN GOLD PROJECT EIS

PIPELINE WETLAND STUDY AREA

MAP 2 of 8

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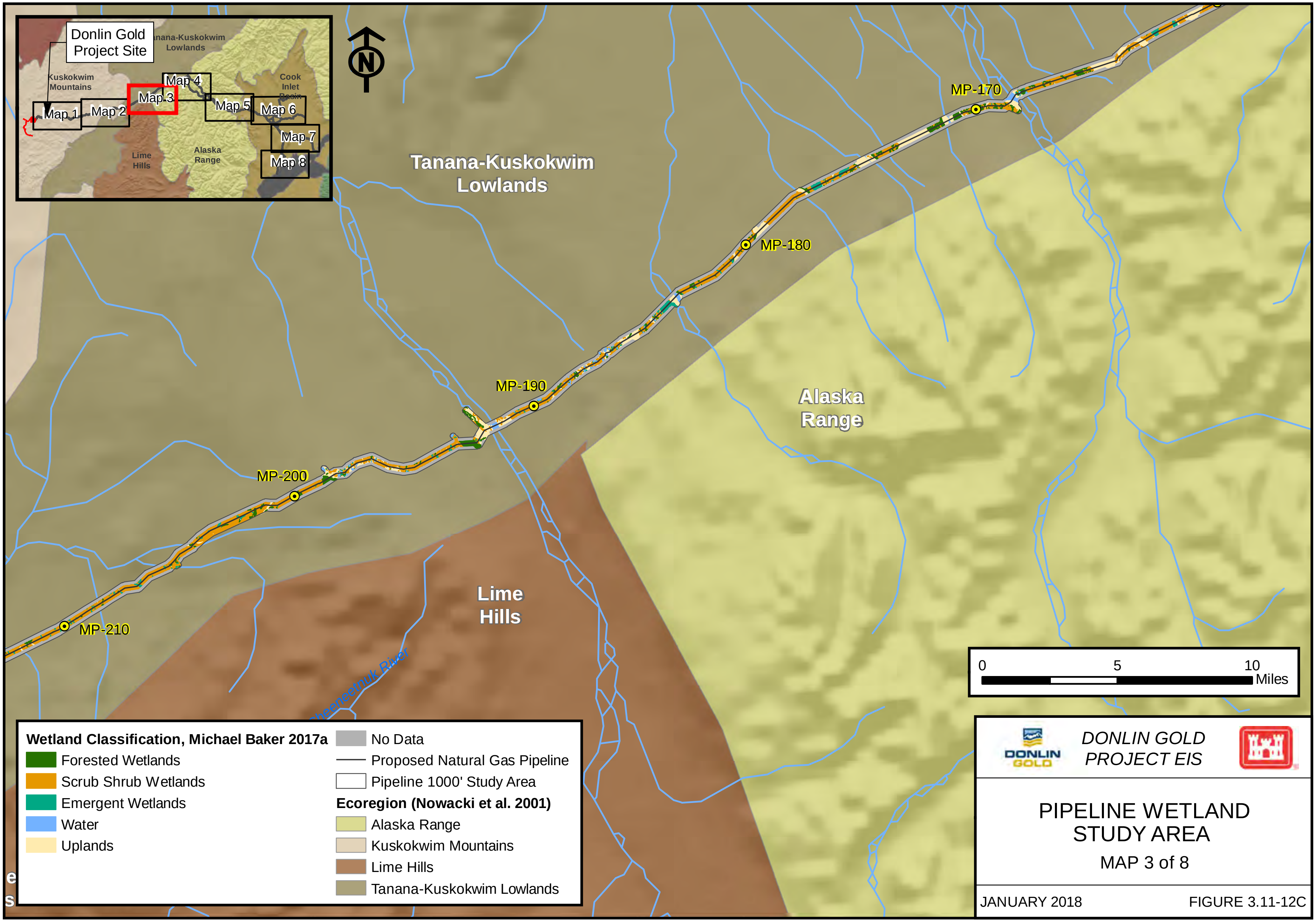
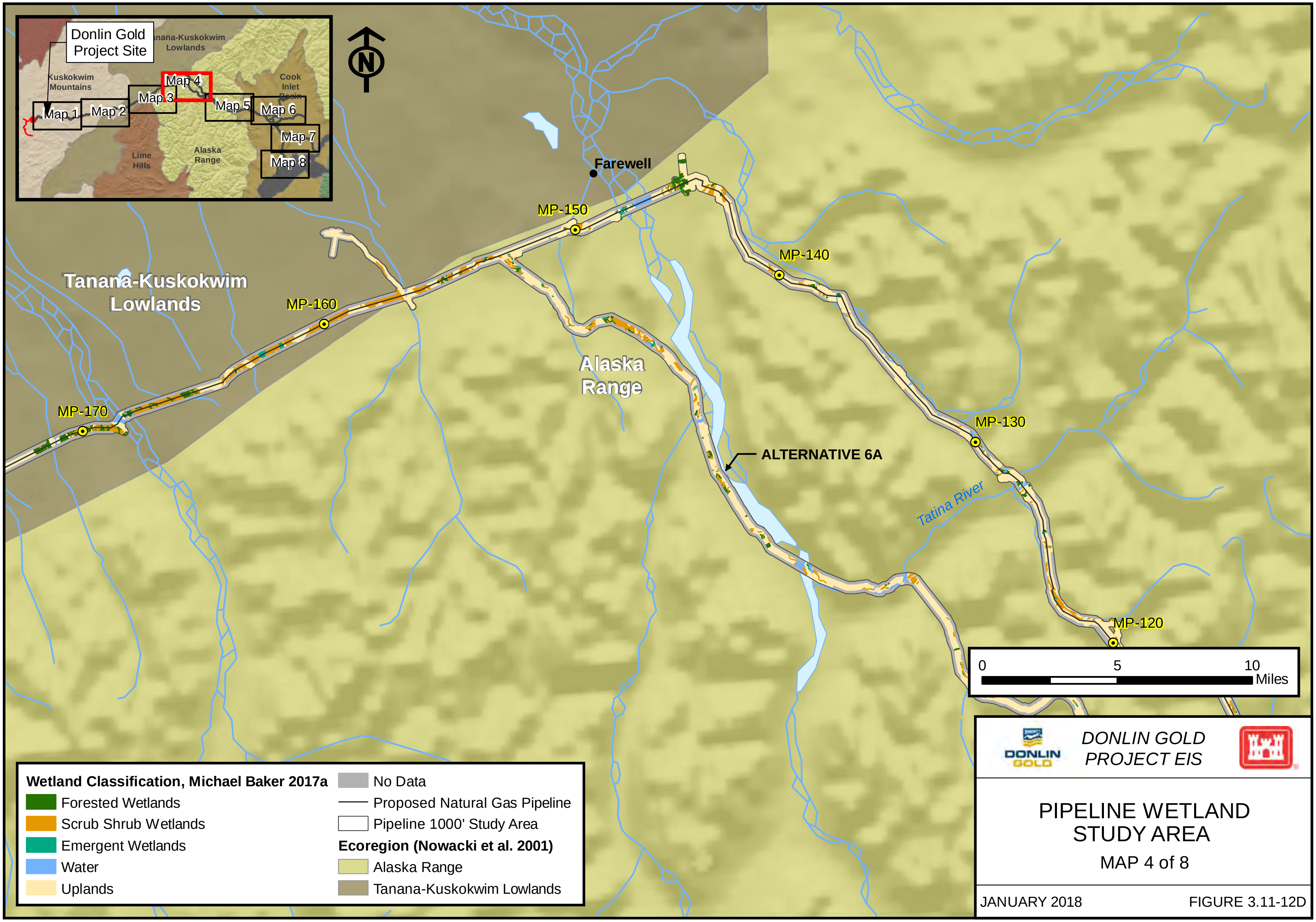
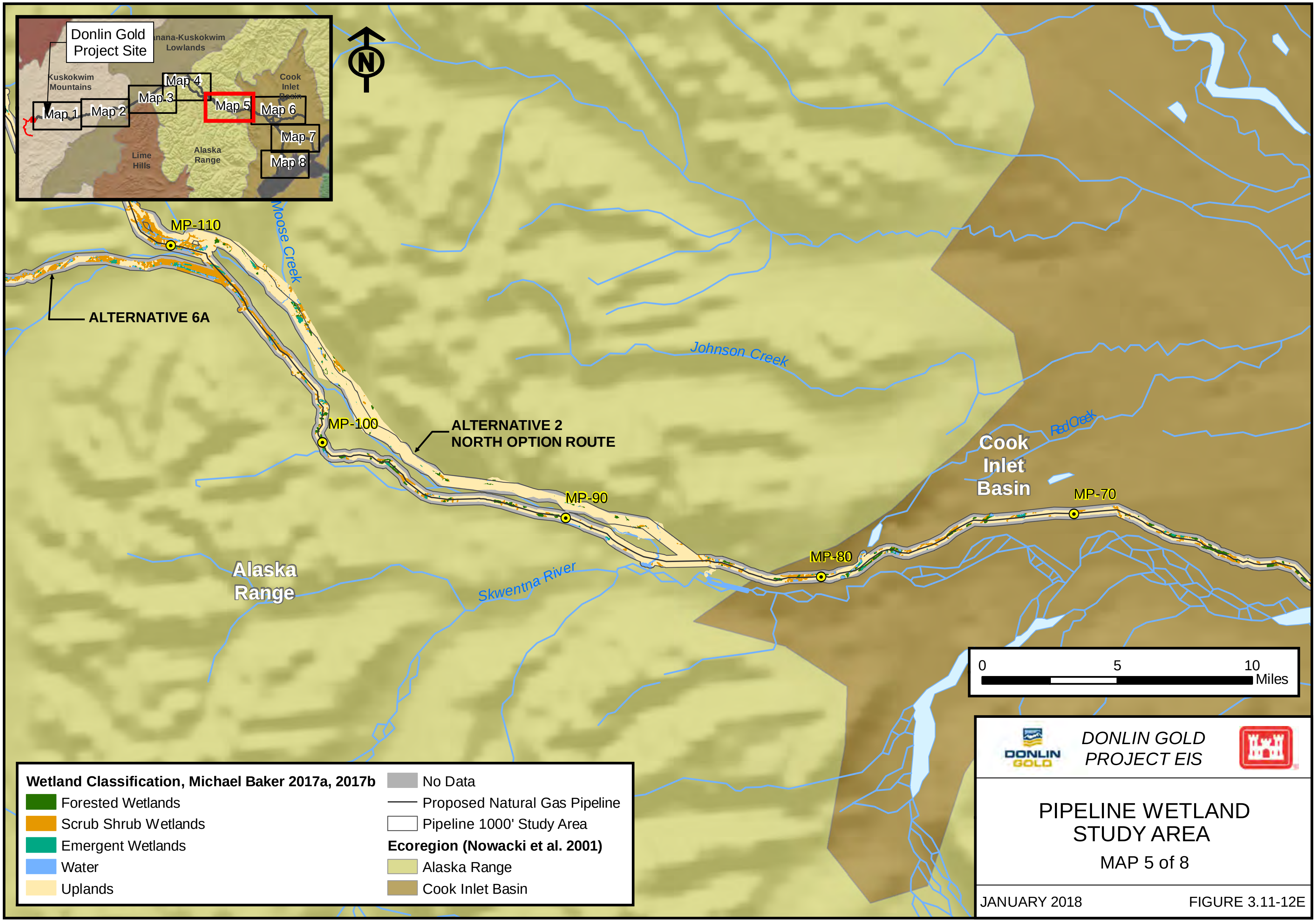
FIGURE 3.11-12B


Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
Cook Inlet
Lime Hills
Alaska Range
N
Tanana-Kuskokwim Lowlands
MP-170
MP-180
MP-190
MP-200
MP-210
Alaska Range
Lime Hills
0
5
10
Miles
Wetland Classification, Michael Baker 2017a
Forested Wetlands
Scrub Shrub Wetlands
Emergent Wetlands
Water
Uplands
No Data
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Alaska Range
Kuskokwim Mountains
Lime Hills
Tanana-Kuskokwim Lowlands
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE WETLAND STUDY AREA
MAP 3 of 8
JANUARY 2018
FIGURE 3.11-12C


Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
N
Farewell
MP-150
MP-140
MP-160
MP-170
MP-130
MP-120
Tanana-Kuskokwim Lowlands
Alaska Range
ALTERNATIVE 6A
Tatina River
0
5
10
Miles
Wetland Classification, Michael Baker 2017a
Forested Wetlands
Scrub Shrub Wetlands
Emergent Wetlands
Water
Uplands
No Data
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Alaska Range
Tanana-Kuskokwim Lowlands
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE WETLAND STUDY AREA
MAP 4 of 8
JANUARY 2018
FIGURE 3.11-12D



Donlin Gold Project Site
anana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
Lime Hills
Alaska Range
N
MP-110
Moose Creek
ALTERNATIVE 6A
Johnson Creek
MP-100
ALTERNATIVE 2
NORTH OPTION ROUTE
MP-90
Cook Inlet Basin
Red Creek
MP-70
MP-80
Alaska Range
Skwentna River
0
5
10
Miles
Wetland Classification, Michael Baker 2017a, 2017b
Forested Wetlands
Scrub Shrub Wetlands
Emergent Wetlands
Water
Uplands
No Data
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Alaska Range
Cook Inlet Basin
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE WETLAND STUDY AREA
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FIGURE 3.11-12E

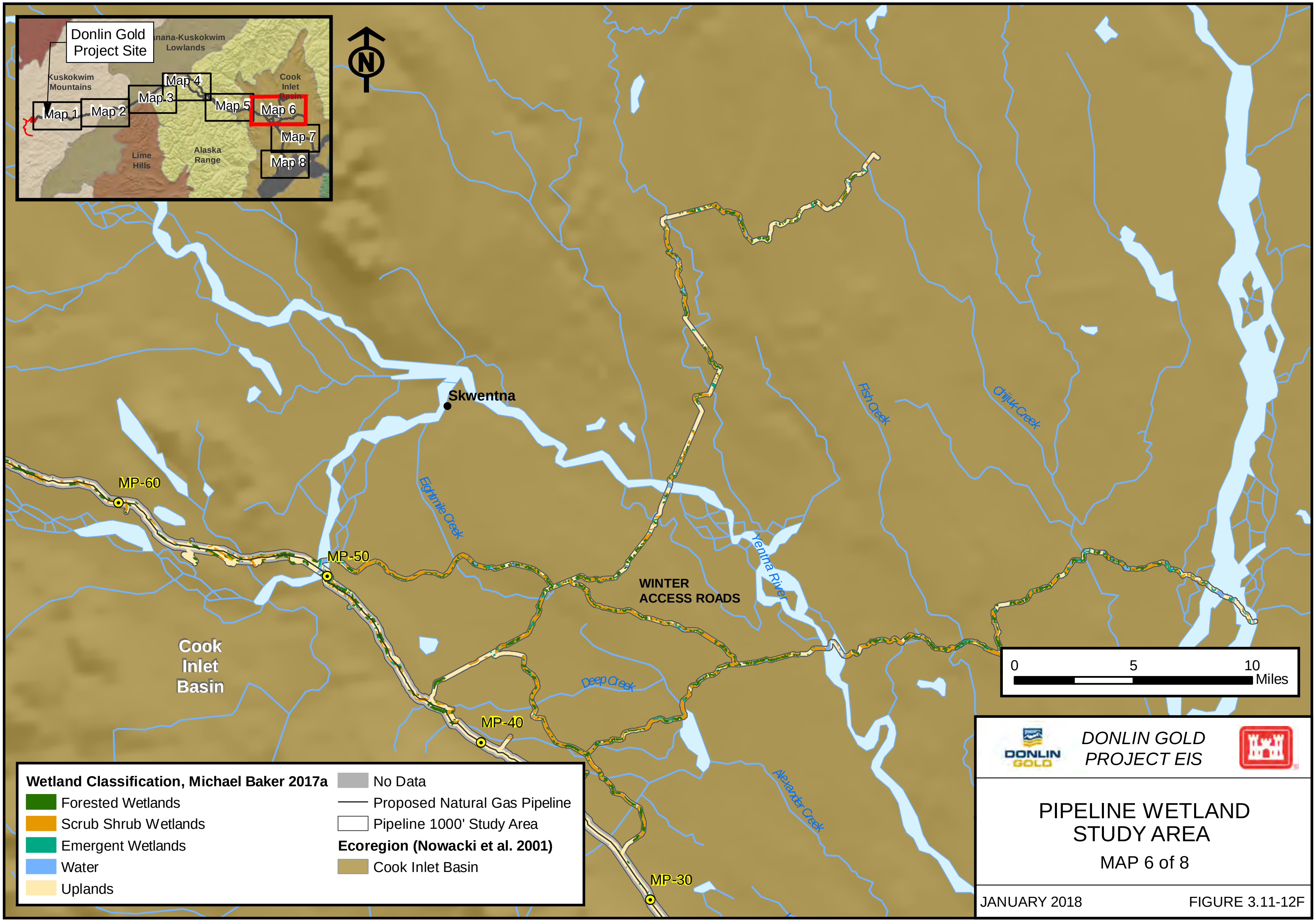
Donlin Gold Project Site
anana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
N
Skwentna
MP-60
MP-50
MP-40
MP-30
Eightmile Creek
Fish Creek
Chijuk Creek
Yentna River
Deep Creek
Alexander Creek
WINTER ACCESS ROADS
Cook Inlet Basin
0
5
10
Miles
Wetland Classification, Michael Baker 2017a
Forested Wetlands
Scrub Shrub Wetlands
Emergent Wetlands
Water
Uplands
No Data
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Cook Inlet Basin
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE WETLAND STUDY AREA
MAP 6 of 8
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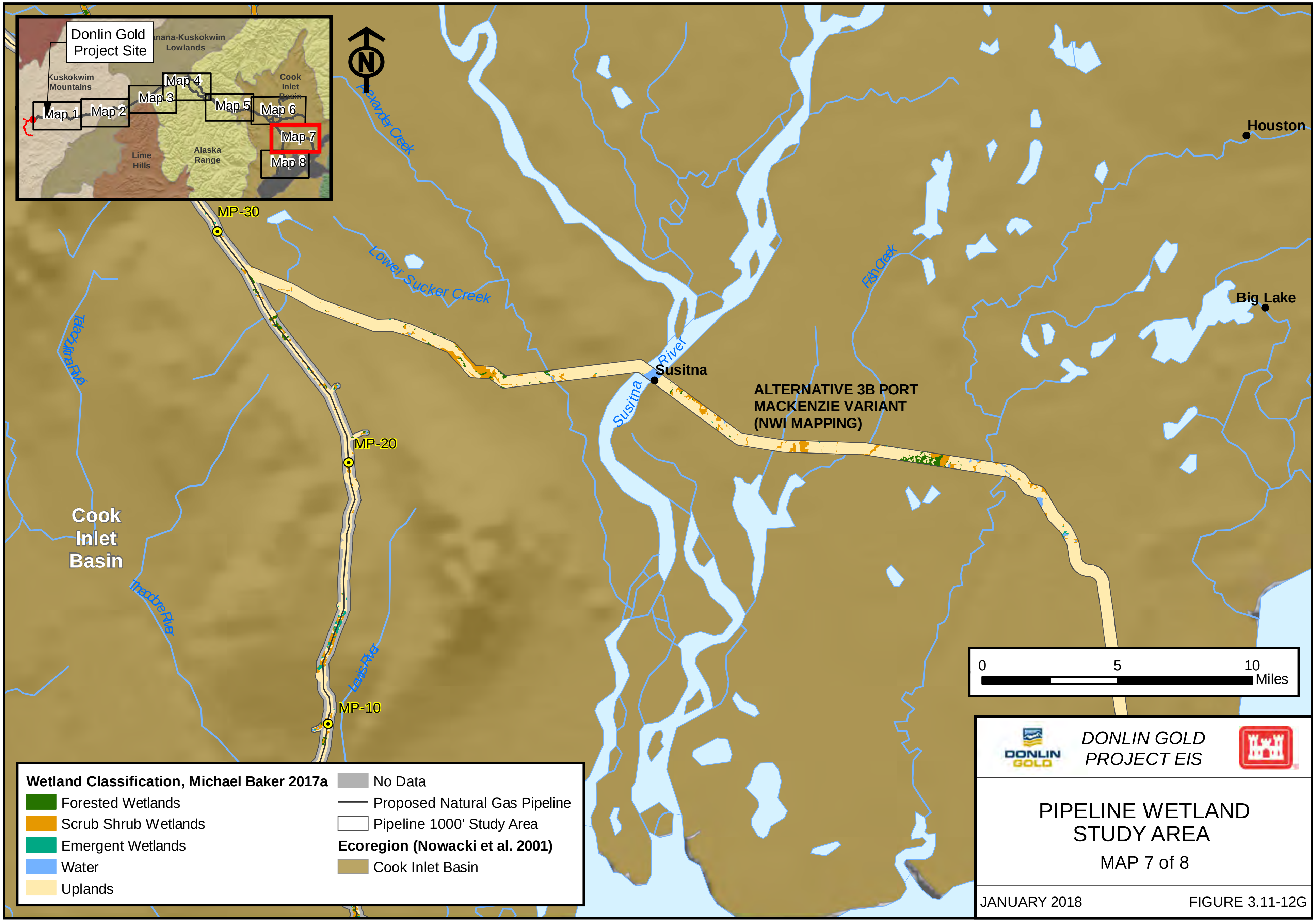
FIGURE 3.11-12F



DONLIN GOLD PROJECT EIS

PIPELINE WETLAND STUDY AREA

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FIGURE 3.11-12G

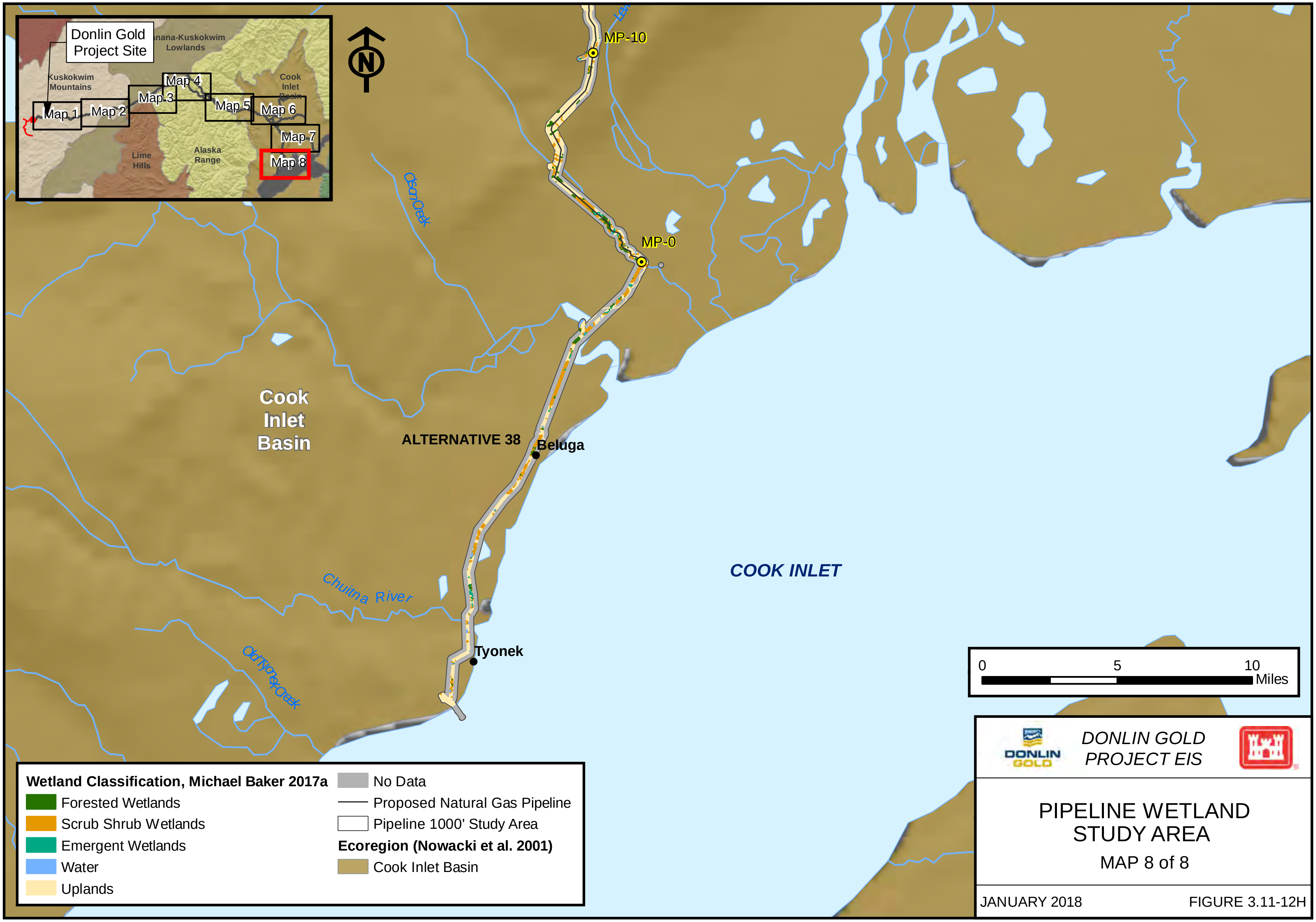
Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
N
MP-10
MP-0
Olson Creek
Cook Inlet Basin
ALTERNATIVE 38
Beluga
Chuitna River
Tyonek
Old Tyonek Creek
COOK INLET
0
5
10
Miles
Wetland Classification, Michael Baker 2017a
Forested Wetlands
Scrub Shrub Wetlands
Emergent Wetlands
Water
Uplands
No Data
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Cook Inlet Basin
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE WETLAND STUDY AREA
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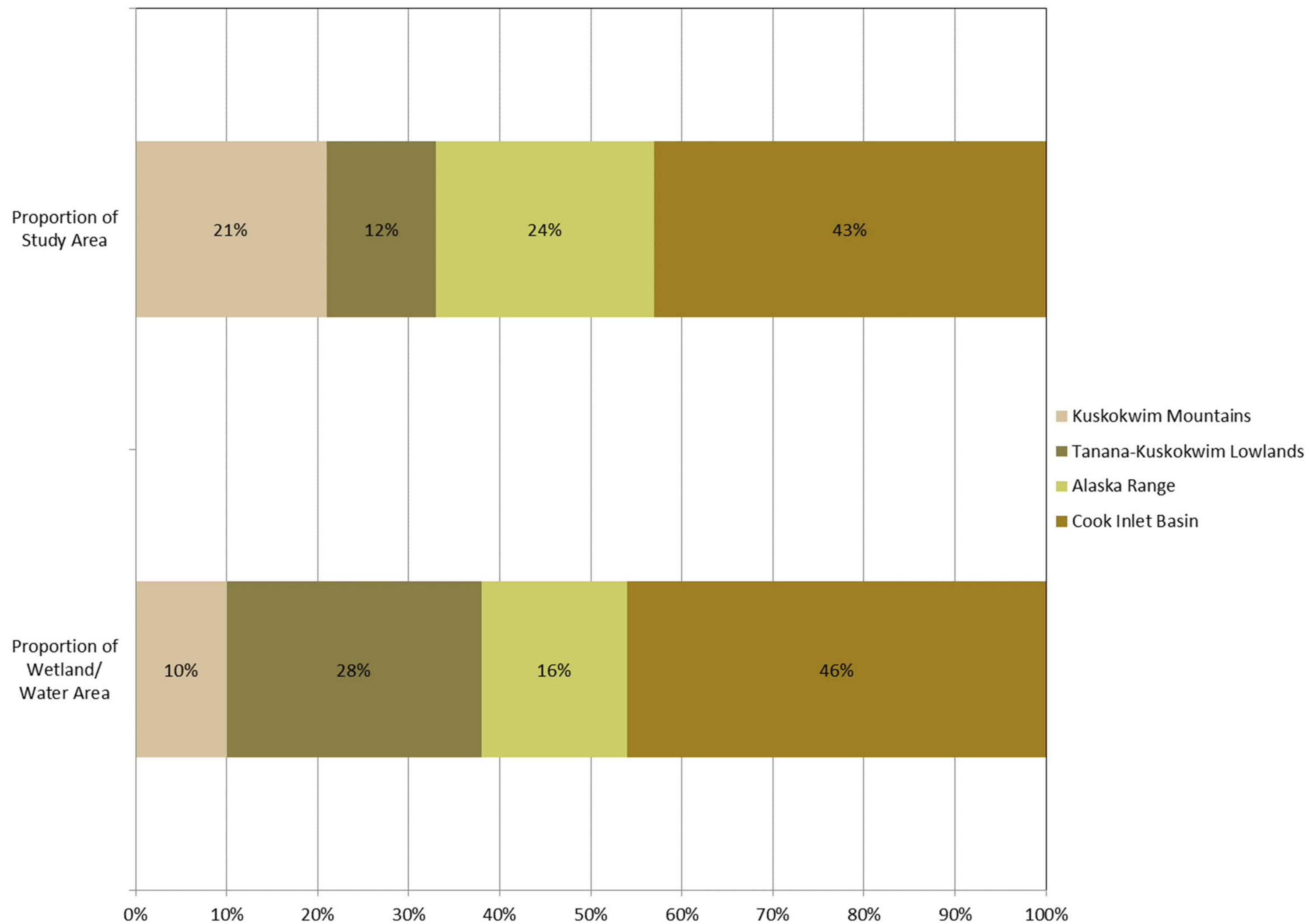
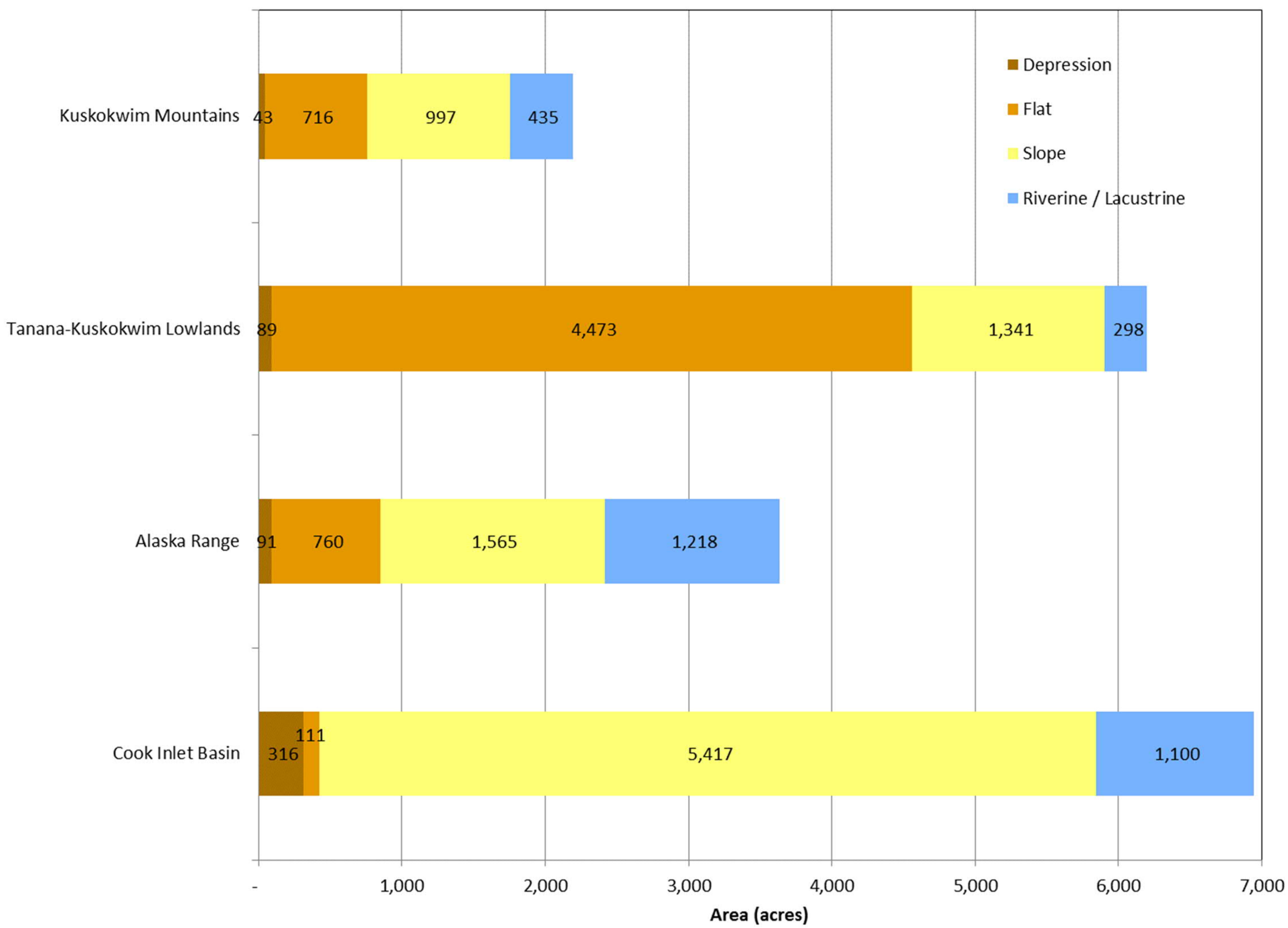
FIGURE 3.11-12H

Figure 3.11-13: Pipeline Wetland Study Area and Wetland Proportions by Ecoregion



Source: Michael Baker 2017a

Figure 3.11-14: Pipeline Wetland Study Area Hydrogeomorphic Classes by Ecoregion



Source: Michael Baker 2017a

3.11.3.3.2 NORTH OPTION WETLAND STUDY AREA

The 7,320 acre north option study area is on the east side of the Alaska Range, mostly in the Happy River watershed. The study area drains to the Happy River, which flows into the Skwentna River, into the Yentna River, which drains into the Susitna River, and finally into Cook Inlet. Figure 3.11-12E depicts the wetlands in the north option study area, which is entirely within the Alaska Range ecoregion with the exception of one small location in a river area in the Cook Inlet Basin ecoregion; wetlands include: black spruce-dominated forested wetlands; scattered bogs and fens; riparian willow-dominated wetlands that have been modified by beavers; and shrub-dominated moist tundra (ARCADIS 2013a). The National Hydrography Dataset (NHD) shows 15 perennial streams crossing or within the north option wetland study area and flowing into Happy River (Michael Baker 2017b).

In the north option wetland study area, 1,232.6 acres (16.8 percent) were determined to be Waters of the U.S. and 6,087.3 acres (83.2 percent) were determined to be uplands (Table 3.11-10). Wetlands account for 12.6 percent (920.0 acres) of the study area. Coniferous forests types comprise 34.7 percent of the study area. They are 9.1 percent wetlands, and 25.2 percent of the study area wetlands. Open white spruce forests and white spruce woodlands comprised the majority of coniferous forested wetlands (209.4 acres), though both types were more likely to be uplands. Black spruce forests and woodlands made up a small portion of coniferous forest area (22.1 acres), but were determined to be 100 percent wetlands. Scrub shrub types comprise 29.6 percent of the study area. They are 26.5 percent wetlands which is 62.4 percent of the study area wetlands. The low shrub bog vegetation type is 100 percent wetlands. Open Willow Shrub was determined to be 55.2 percent wetlands, totaling 310.8 acres or 54 percent of the scrub shrub wetlands. Herbaceous types are 11.5 percent of the study area wetlands. The aquatic herbaceous and wet herbaceous vegetation types are each determined to be 100 percent wetlands. The mesic herbaceous vegetation type is 100 percent uplands (Michael Baker 2017b).

3.11.3.4 CLIMATE CHANGE

Climate change is affecting resources in the EIS Analysis area and trends associated with climate change are projected to continue into the future. Section 3.26, Climate Change, discusses climate change trends and impacts to key resources in the physical and biological environments including atmosphere, water resources, permafrost, and vegetation. Current and future effects on wetlands are tied to changes in physical resources and vegetation.

Table 3.11-10: North Option Wetland Study Area Wetland Categories by Ecoregion

Wetland Category	Alaska Range Ecoregion (Acres)	Cook Inlet Basin Ecoregion (Acres)	Area (Acres)	Area (%)
Evergreen Forested Wetlands	136.6	0	136.6	2%
Deciduous Forested Wetlands	2.8	0	2.8	<1%
Mixed Forested Wetlands	2.8	0	2.8	<1%
Evergreen Scrub Shrub Wetlands	94.8	0	94.8	1%
Deciduous Scrub Shrub Wetlands	537.9	0	537.9	7%
Bogs (LSB)	38.8	0	38.8	<1%
Herbaceous Wetlands	106.2	0	106.2	2%
Ponds	91.7	0	91.7	1%
Lakes	8.0	0	8.0	<1%
Rivers	179.0	33.9	213.0	3%
Wetland/Water Totals	1,198.7	33.9	1,232.6	17%
Uplands Totals	6,087.3	0	6,087.3	83%
Total Area	7,286.0	33.9	7,319.9	NA
Intermittent Streams (Miles)	2.8	0	2.8	10%
Perennial Streams (Miles)	24.1	0.4	24.5	90%

Notes:
NA = Not Applicable
0 = None
LSB = Low Shrub Bog Wetland Subcategory
Source: Michael Baker 2017b

3.11.4 ENVIRONMENTAL CONSEQUENCES

This section describes potential impacts to wetlands as a result of the Mine Site, Transportation Corridor, and Pipeline. Summaries of potential impacts on wetlands, both direct and indirect, follow the methodology listed in Table 3.11-11.

In evaluating negative and positive impacts to wetlands, direct project footprint impacts are more clearly defined than indirect impacts to ground and surface water distribution from diversions and dewatering or impacts to wetland vegetation and soils from fugitive dust deposition or erosion and sedimentation. Relevant factors for this project include:

- The location and total area of project footprints within wetland habitats. Project footprints located within wetland habitats would change or eliminate large areas of wetlands.
- The type and value of wetlands that are covered by project footprints. Project footprints within potentially rare or high-value wetlands may be of greater consequence than project footprints within abundant or potentially low-value wetlands.

- Changes to ground and surface water distribution. Project-related activities which change ground or surface water distribution may inundate or dry wetlands leading to conversion of wetlands to water or upland.
- Changes to wetland vegetation cover and soils. Project-related activities that generate fugitive dust may result in deposition within wetlands which would alter wetland vegetation cover and reduce wetland functions. Project-related activities that increase erosion or sedimentation may alter wetland vegetation cover and reduce wetland functions.

Table 3.11-11: Impact Methodology for Effects on Wetlands

Impact Factor	Assessment Criteria		
Magnitude or Intensity	Impacts to <5% by acreage of high-value wetlands or greater proportions of low value wetlands in the study area[1].	Impacts to 5 to 25% by acreage of high-value wetlands in the study area[1].	Impacts to >25% by acreage of high-value or in the study area[1].
Duration	Wetland functions may be reduced during construction but would be expected to return to near pre-activity level within several growing seasons after reclamation.	Wetland functions would be reduced during construction but would be expected to return to near pre-activity functions after the action ceased within several decades after reclamation.	Wetland functions would be eliminated and would not be anticipated to return to previous functions after the action that caused the impacts ceased; or within more than several decades after reclamation.
Extent or Scope	Affects wetland systems within one or a few watersheds[2].	Affects wetland systems across multiple watersheds[2].	Affects extensive wetland systems across many watersheds[2].
Context	Affects wetlands that are widespread and typical of the region.	Affects wetlands that support important local or regional subsistence resources.	Affects wetlands that are rare or of very high quality.

Notes:
1 Proportions are based on percentages used in the Point Thomson EIS (Section 5.8; Table 5.8-1; Corps 2012).The wetland study areas defined in Section 3.11.3 are assumed to be generally representative of affected watersheds and the surrounding area.
2 Watersheds are defined as the National Hydrography Database Hydrologic Unit Code (HUC) 10-digit watershed boundary data (HUC 10 WBD).

3.11.4.1 ALTERNATIVE 1 – NO ACTION

Under the No Action alternative the Donlin Gold Project would not be constructed, therefore it would not have any effects on wetlands.

3.11.4.2 ALTERNATIVE 2 – DONLIN GOLD'S PROPOSED ACTION

Potential wetland impacts specific to the Mine Site, Transportation Corridor, and Pipeline are described in the following sections.

Based on comments on the Draft EIS from agencies and the public, one route option has been included in Alternative 2 to address concerns due to pipeline crossings of the Iditarod National Historic Trail (INHT):

- The MP 84.8 to 112 North Option would realign this segment of the natural gas pipeline crossing to the north of the INHT before the Happy River crossing and remain on the north side of the Happy River Valley before rejoining the alignment near MP-112 where it enters the Three Mile Valley. The North Option alignment would be 26.5 miles in length, compared to the 27.2 mile length of the mainline Alternative 2 alignment it would replace, with one crossing of the INHT and only 0.1 mile that would be physically located in the INHT right-of-way (ROW). The average separation distance from the INHT would be 1 mile.

3.11.4.2.1 MINE SITE

Construction and Operations Phases

Primary direct and indirect construction-related effects on wetlands would include:

- Clearing and removal of wetland vegetation;
- Placement of fill in wetlands;
- Excavation that eliminates wetlands;
- Compaction, rutting, and mixing of wetland soils; and
- Disruption of wetland hydrology through:
  - Blocking surface water flow and creating impoundments that flood wetlands;
  - Blocking or diverting surface water flow and drying wetlands;
  - Breaching impervious substrates causing drainage of perched water tables and drying wetlands;
  - Degrading permafrost causing drainage and drying wetlands;
  - Degrading permafrost causing subsidence that converts wetlands to waters; and
  - Removing, blocking, or diverting subsurface water causing drying of wetlands.

Most project-related direct and indirect effects on wetlands would be initiated during the Construction Phase and may result in temporary or permanent loss of wetlands or alteration in wetland functions. Operations-related direct and indirect effects on wetlands would include:

- Degradation of wetland vegetation and soils due to:
  - Fugitive dust and gravel thrown from pads or roads by vehicles or snow clearing;
  - Introduction and spread of nonnative invasive species (NNIS);
  - Riparian wetland erosion from unstable slopes or water diversions,
  - Sediment deposition from slope erosion; and
  - Chemical and fuel spills and leaks.
- Alteration of surface water quantity or distribution due to:
  - Creation of freshwater impoundments;

    - Redirection of drainage through artificial drainage channels;
    - Interruption of surface flow by roadways; and
    - Stream diversions, snow fences, and freshwater use.
- Alteration of subsurface water quantity and distribution due to:
    - Excavation and dewatering wells for the open pit; and
    - Creation of freshwater impoundments that intercept groundwater or increase infiltration.

Excavation of the open pit and filling within the Waste Rock and Tailings Storage Facilities (WRF and TSF) would occur throughout the active life of the mine. The maximum extents of all surface disturbance impacts were used to evaluate direct wetland impacts for the Mine Site. Some wetland reclamation would begin shortly after the start of the Construction Phase and would continue throughout Operations and Closure. A total of 2,728 acres of wetlands and waters would be directly affected by Donlin Gold's proposed mine (Table 3.11-12). Mine Site wetland impacts would affect primarily flat and slope HGM classes of wetlands (Table 3.11-12 and Figure 3.11-15).

Of the 2,728 acres of wetlands that would be affected by the proposed mining activities, several hundred acres have been previously disturbed by historic and ongoing exploration and placer mining activities (3PPI et al. 2014). Over half of the 353 acres of deciduous scrub shrub wetlands that would be affected by the mine have been previously disturbed (Michael Baker 2017a). Facilities have been sited to avoid and minimize wetland impacts and allow for efficient reclamation of disturbed areas.

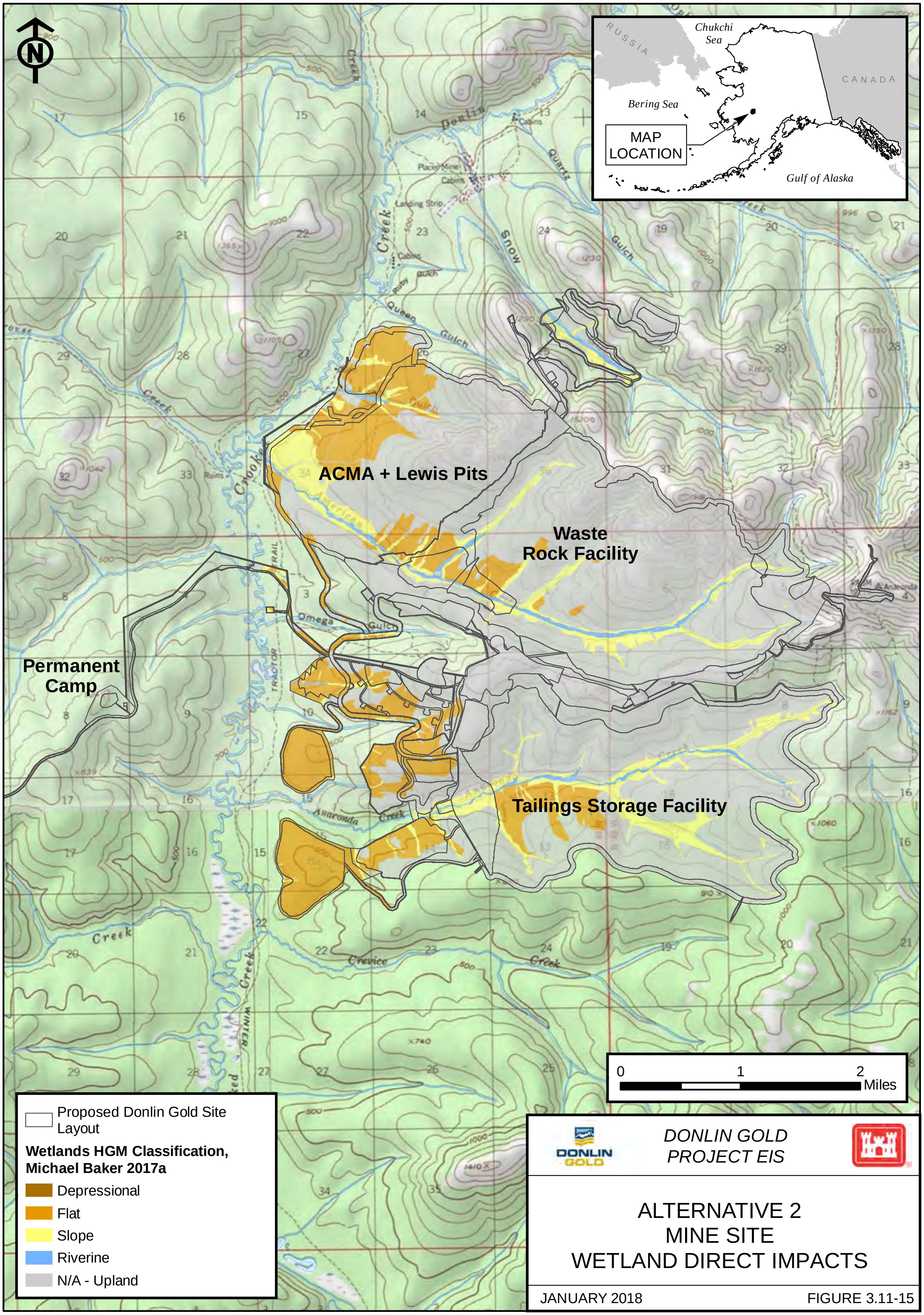
Excavation, filling, and clearing of wetlands and waters in the American Creek, Snow Gulch, Omega Gulch, Anaconda Creek, and Crooked Creek watersheds would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions. Construction-related disturbances may alter wetland modification of groundwater functions (recharge and discharge), and would decrease storm and floodwater storage and modification of stream flow functions by decreasing the wetlands' potential to dissipate energy and reduce peak flows. These altered hydrologic functions would extend to the streams connected to or downstream from the affected wetlands. A total of 34 miles of streams would be directly affected by construction, including 26 miles of perennial streams and 8 miles of intermittent streams (Table 3.11-12; Michael Baker 2017a), see Section 3.5, Surface Water Hydrology, for a discussion of surface water hydrology impacts.

Construction on or through wetlands would decrease or remove the wetlands' potential to improve water quality by preventing erosion and by settling sediments. Sediment barriers and erosion control planning would mitigate for loss of this wetland function. Clearing with no ground disturbance reduces the wetlands' ability to modify water quality and its contribution to the abundance and diversity of wetland fauna; but may not reduce the export of detritus or contribution to the abundance and diversity of wetland flora functions.

Table 3.11-12: Alternative 2 Mine Site Wetland Direct Impacts from Construction and Operations

Wetland Category	HGM Class (Acres)					Area (Acres)	Study Area (Acres)	Area[1] (%)
	Depression	Flat	Slope	Riverine	River Channel			
Evergreen Forested Wetlands	0	625.2	370.1	76.9	0	1,072.2	2,291.5	47%
Deciduous Forested Wetlands	0	0	0	0	0	0	2.4	0%
Mixed Forested Wetlands	0	0	16.5	0.4	0	16.9	72.3	23%
Evergreen Scrub Shrub Wetlands	0	971.2	272.3	22.6	0.0	1,266.1	3,588.3	35%
Deciduous Scrub Shrub Wetlands	0.5	87.3	208.8	56.5	0.0	353.1	1,052.4	34%
Herbaceous Wetlands	2.5	0.4	9.4	6.1	0	18.4	181.1	10%
Ponds	0.2	0	0	0.6	0	0.8	17.7	5%
Rivers	0	0	0	0	0.8	0.8	122.6	1%
Uplands	NA	NA	NA	NA	NA	7,091.0	13,721.5	52%
Total Area	3.2	1,684.1	877.1	163.1	0.8	9,819.3	21,049.8	47%
Wetland/ Water Totals	<1%	62%	32%	6%	<1%	2,728.3	7,328.3	37%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	8.0	15.7	51%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	25.7	56.5	45%

Notes:
1 Proportion of impact area within mine site wetland study area by wetland category.
NA = Not Applicable
0 = None
Source: Michael Baker 2017a



ALTERNATIVE 2
MINE SITE
WETLAND DIRECT IMPACTS

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FIGURE 3.11-15

Dust emissions generated by drilling and blasting, waste rock and ore loading and unloading, traffic on roads, wind erosion of exposed surfaces and ore processing (Environ 2014a) would be deposited primarily downwind from sources on nearby vegetation and wetlands. Most dust would be produced by the pit and Waste Rock Facility (WRF) (Environ 2014a). Operations contributing to total site dust at mineral extraction sites include: drilling and blasting, loading and dumping, draglines, crushing and preparation, conveyors, haulage roads, and storage piles (Petavratzi et al. 2005). Most dust generated during minerals operations is over 30 µm in size and most dust of this size would be deposited within 328 feet or 100 m (Petavratzi et al. 2005).

Prevailing winds from the southeast or north (Air Sciences, Inc. 2014a) would likely transport most fugitive dust created during Mine Site Construction and Operations to the northwest or south. Section 3.2 Soils estimates the amount of dust that is predicted to be deposited on soils at the Mine Site on a watershed basis, and discusses the potential for dust deposition to alter soil pH. The wetland area potentially affected by dust deposition sufficient to cause changes in wetland vegetation may extend as far as 328 feet (100 m), with the heaviest unmitigated deposition expected to occur within 33 feet (10 m) for traffic on gravel roads (Walker and Everett 1987; Hasselbach et al. 2005). Areas most likely to be affected by dust generated during Mine Site Construction and Operations include uplands and wetlands northwest of the pit and WRF, near the ore storage area, and along haul routes between the pit, storage, and processing areas. An estimated wetland area of 635 acres within 328 feet of the mine footprint would be expected to be exposed to fugitive dust during mine Operations (Table 3.11-13). Wetland areas exposed to dust deposition can experience vegetation community changes, reduced productivity from dust coating vegetation surfaces, mineralization of wetland soils, and potential alteration of pH (Walker and Everett 1987, Auerbach et al. 1997, Myers-Smith et al. 2006). Dust deposition reduces wetland biogeochemical and biological functions by reducing overall plant productivity, abundance, and diversity (Auerbach et al. 1997); wetland plants and mosses may continue to assist with modification of water quality by adsorption and absorption of heavy metals (Hasselbach et al. 2005). Dust control measures would include use of water trucks to spray roads and work areas, dust baghouses at ore transfer points, and containment of the course ore stockpile.

Comments received on the Draft EIS questioned the extent of the area identified as impacted by deposition of fugitive dust. Multiple additional references conclude that factors influencing the generation of dust from unpaved roads include: road bed source material, vehicle type, traffic levels, traffic speeds, precipitation, and winds (AECOM 2015g). Most dust generated during minerals operations is over 30 µm in size and most dust of this size would be deposited within 328 feet or 100 m (Petavratzi et al. 2005). As the composition of materials that would be used to build access roads and on mine roads are unknown, there is confusion between equating modeled with measured dust deposition rates. Also, the traffic levels on mine roads are expected to be less than many studies of fugitive dust impacts on Alaska wetlands. As a result, the 328 foot distance for evaluating potential fugitive dust impacts was retained but is considered to be a conservative estimate of the wetland area potentially affected by dust. The potential effects of dust deposition on vegetation should not be interpreted as being un-mitigatable. While this analysis may be conservative, the effects of fugitive dust on vegetation and soils in Alaska are well documented (AECOM 2015g). Discussions of fugitive dust impacts, including contamination from dust components, and Donlin Gold's Dust Control Plan are included in Section 3.5, Surface Water, Section 3.2, Soils, and Section 3.10, Vegetation and Nonnative Invasive Species.

Table 3.11-13: Alternative 2 Mine Site Wetland Potential Indirect Impacts from Fugitive Dust

Wetland Category	Indirect Fugitive Dust Impacts[1] – HGM Class (Acres)						Study Area (Acres)	Area[2] (%)
	Depression	Flat	Slope	Riverine	River Channel	Total		
Evergreen Forested Wetlands	0	133.0	36.4	7.6	0	177.0	2,291.5	8%
Deciduous Forested Wetlands	0	0	0	0	0	0	2.4	0%
Mixed Forested Wetlands	0	0	0.2	1.1	0	1.3	72.3	2%
Evergreen Scrub Shrub Wetlands	0	308.6	59.8	3.8	0	372.2	3,588.3	10%
Deciduous Scrub Shrub Wetlands	0	9.3	30.3	26.7	0	66.3	1,052.4	6%
Herbaceous Wetlands	1.0	0	7.6	3.0	0	11.6	181.1	6%
Ponds	0.1	0	0	0.3	0	0.4	17.7	2%
Rivers	0	0	0	0	6.1	6.1	122.6	5%
Uplands	NA	NA	NA	NA	NA	1,270.5	13,721.5	9%
Total Area	1.1	450.9	134.3	42.5	6.1	1,905.4	21,049.8	9%
Wetland/Water Totals	<1%	71%	21%	7%	1%	634.9	7,328.3	9%
Intermittent Streams Miles)	NA	NA	NA	NA	NA	1.6	15.7	10%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	5.1	56.5	9%

Notes:
1 Potential indirect impact area within 328 feet (100 meters) around Mine Site footprints impact areas due to fugitive dust deposition on vegetation. These areas would overlap with areas also affected by dewatering. Excludes overlapping indirect impact area for the mine access road.
2 Proportion of indirect impact area within mine site wetland study area by wetland category.
NA = Not Applicable
0 = None
Source: Michael Baker 2017a

During the Construction and Operations phases surface waters would be used, stored, and diverted within the Snow Gulch, American Creek, and Anaconda Creek watersheds as described in Section 3.5, Surface Water Hydrology. Diversion dams would reduce available surface water for wetlands downslope from the dams. During Construction, all three watersheds would have reduced discharge to Crooked Creek. During Operations, surface waters would be used in the processing plant and various other uses, and there would be an overall reduction in stream flow with the exception of Omega Gulch. Little to no flow from the American Creek watershed would reach Crooked Creek. The Tailings Storage Facility (TSF) would occupy most of the Anaconda Creek watershed, which would contain most surface water within the facility. The Snow Gulch dam would reduce available surface water by about

14 percent (see Section 3.5, Surface Water Hydrology). These changes in surface water distribution and abundance would result in some wetlands potentially drying while others would be inundated or become wetter. Drying of wetlands tends to favor development of shrubs and trees, while increased wetness tends to favor sedges and herbaceous plants (ADEC 1999; Murphy et al. 2009; Churchill 2011).

Dewatering the pit during mining would create a drawdown cone that would potentially lower the water table from 0.1 foot around the periphery to over 1,500 feet near the center of the pit over an area of about 16 square miles (ARCADIS 2013a; BGC 2015b; Figure 3.11-16). Changes in surface and subsurface water levels, due to excavation of the pit and subsequent dewatering during active mining operations, would potentially alter wetlands in the area surrounding the mine. To identify wetlands potentially affected by changes in groundwater, the maximum drawdown area was used to predict indirect impacts that may occur after multiple years of mining and pit dewatering. As discussed in Section 3.5, Surface Water Hydrology, the expression of the drawdown in Crooked Creek stream flow at American Creek would primarily be during the winter months of January, February or March. Average annual Crooked Creek stream flows would be reduced by 7 to 31 percent at the maximum extent of drawdown after 20 years of active mining under average flow conditions dependent. The amount of stream flow reduction would depend on both precipitation conditions (wet versus dry years) and bedrock hydraulic conductivity, and would be much less downstream of Crevice Creek due to the addition of tributary flows. Wetlands are primarily defined by soil moisture during the growing season, when the drawdown effects are likely to be moderated by precipitation. The analysis does not incorporate the contribution to wetland hydrology from snow melt, precipitation, and the redistribution of surface water flows. Although growing season conditions may be drier, near-surface groundwater from spring runoff and precipitation may continue to support wetlands such that the overall long-term effect of the drawdown on surrounding wetlands are difficult to accurately predict.

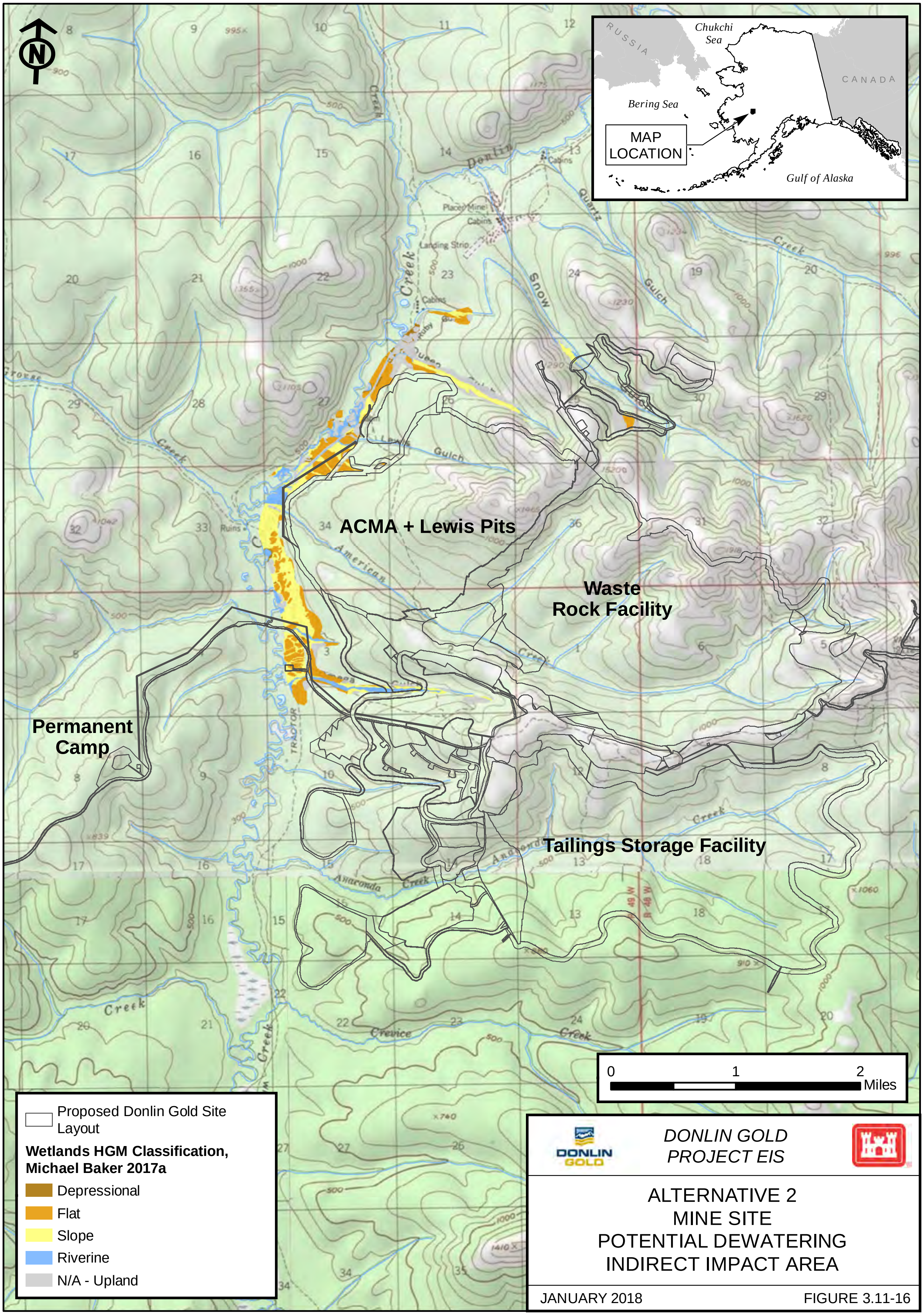
Outside of the impacts in the direct mine footprint, a total of 432 acres of wetlands fall within and may be affected by the maximum lowered groundwater level that would occur near the end of mine operations (Table 3.11-14 and Figure 3.11-16). All wetlands within this drawdown area are unlikely to be permanently altered; however, the level of this potential alteration is unclear due to the complexity of natural variability and unknowns associated with the groundwater modeling. After active mining ceases, pit dewatering would be discontinued, the pit would fill with water, and a new equilibrium subsurface water level would become established.

Wetland response to water level fluctuations may include both short- (5 years) and long- (45 years) term changes in vegetation communities and shifts between above and below ground productivity (Weltzin et al. 2000; Murphy et al. 2009; Churchill 2011). Woody plants have been shown to increase and sedges decrease with drying conditions in boreal wetlands (Churchill 2011), while flooding increased bryophyte and decreased shrub production in bogs, and increased graminoid and forb production in fens (Weltzin et al. 2000; Murphy et al. 2009; Churchill 2011). Areas where the water table is at or near the ground surface occur beneath intermittent and perennial stream drainages at the Mine Site (Figure 3.11-17). Potential lowering of the water table in these areas may favor development of trees and shrubs at the expense of wetland sedges, forbs, and species richness (ADEC 1999; Murphy et al. 2009; Churchill 2011).

Table 3.11-14: Alternative 2 Mine Site Potential Dewatering Wetland Indirect Impacts

Wetland Category	Drawdown HGM Classes (Acres)						Study Area (Acres)	Area[1] (%)
	Depression	Flat	Slope	Riverine	River Channel	Total		
Evergreen Forested Wetlands	0	63.0	63.9	10.3	0	137.2	2,291.5	6%
Deciduous Forested Wetlands	0	0	0	0	0	0	2.4	0%
Mixed Forested Wetlands	0	0	1.8	0.4	0	2.2	72.3	3%
Evergreen Scrub Shrub Wetlands	0	99.3	77.4	0.2	0	176.9	3,588.3	5%
Deciduous Scrub Shrub Wetlands	1.7	11.1	38.4	34.8	0	86.0	1,052.4	8%
Herbaceous Wetlands	3.6	1.1	6.1	5.5	0	16.3	181.1	9%
Ponds	3.7	0	0	0.5	0	4.2	17.7	24%
Rivers	0	0	0	0	9.6	9.6	122.6	8%
Uplands	NA	NA	NA	NA	NA	168.3	13,721.5	1%
Total Area	9.0	174.5	187.6	51.7	9.6	600.7	21,049.8	3%
Wetland/Water Totals	2%	40%	44%	12%	2%	432.4	7,328.3	6%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	1.0	15.7	6%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	5.6	56.5	10%

Notes:
1 Proportion of drawdown area within mine site wetland study area by wetland category.
NA = Not Applicable
0 = None
Source: Analysis based on drawdown data by BGC (2015b) and wetland data by Michael Baker 2017a

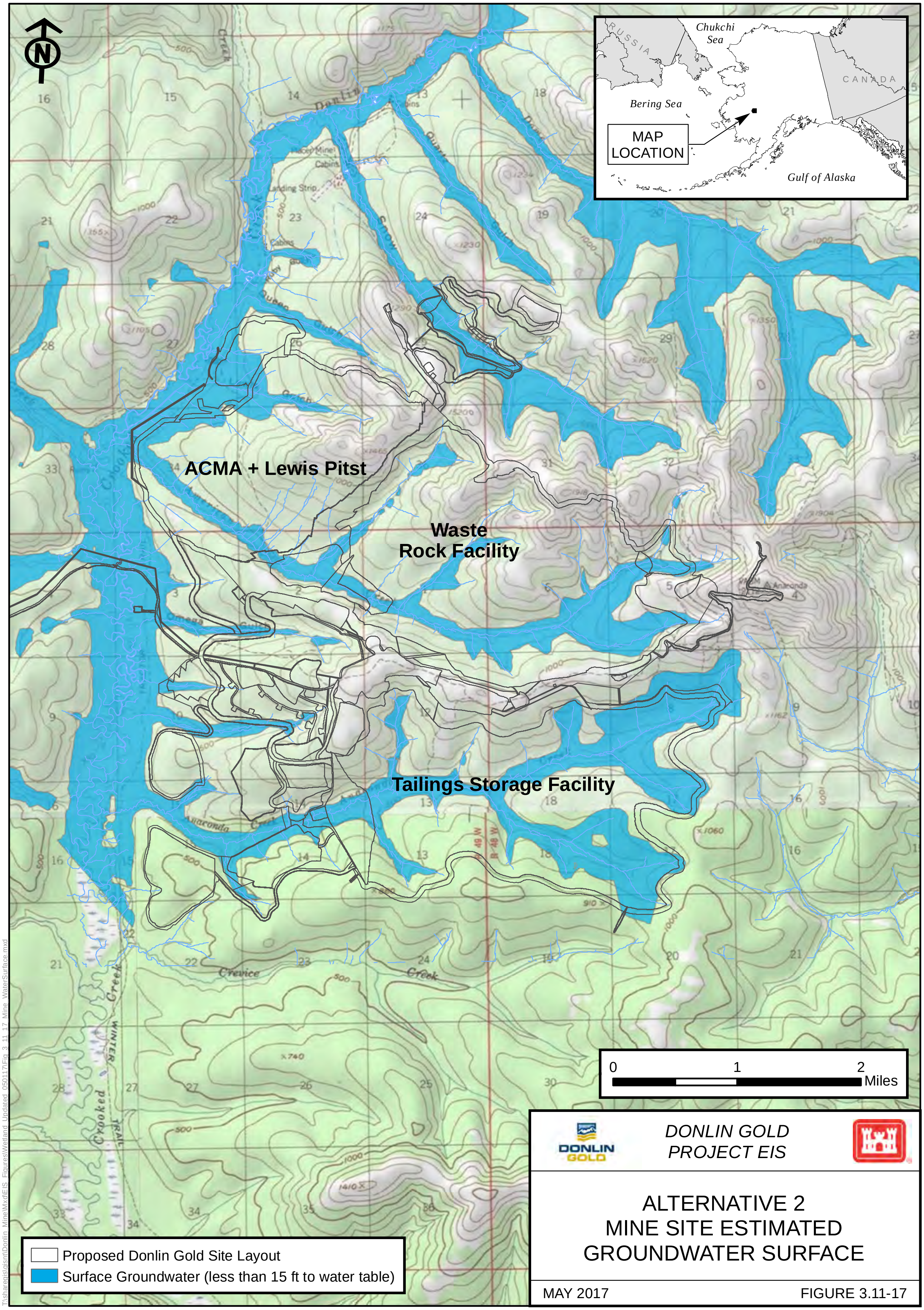


DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
MINE SITE
POTENTIAL DEWATERING
INDIRECT IMPACT AREA

JANUARY 2018

FIGURE 3.11-16



DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
MINE SITE ESTIMATED
GROUNDWATER SURFACE

MAY 2017

FIGURE 3.11-17

Lowering the subsurface water table within permafrost-based wetlands may have little effect on surface moisture, especially in flat HGM classes where moisture is primarily received as precipitation, unless there is also an associated collapse in the permafrost from thermal degradation. Collapse scars in bogs create moister conditions that result in losses of evergreen and deciduous trees and gains in sedges with increased moss productivity in newly formed collapse scars (Churchill 2011).

Closure Phase

During the Closure Phase, flat to gently sloping wetland areas would generally be reclaimed by removal of fill and grading to recreate original contours and hydrologic regimes. Depression areas would be reclaimed to emergent wetlands where the hydrology permits. Culverts and fill would be removed from channels and active floodplains. Steam embankments would be revegetated with native riparian plants such as willows and erosion-controlling grasses such as Calamagrostis canadensis. Material sites constructed in valley bottoms, lowland sites, or in black spruce permafrost wetlands are candidates to be reclaimed to create new ponds with emergent wetlands where sufficient water quality and hydrology are available. Final contouring around created ponds could focus on providing water's edge habitat and a complex interspersion between wetland and upland vegetation. Moderate to steeply sloping wetland or upland mosaics with wetland inclusions would be less feasible to restore to wetlands because of the marginal hydrology and some fills may not be removed in these areas. Marginal wetland hydrology would be expected in areas where the permafrost has melted from clearing and excavation, and in areas where excavations and road cuts through colluvium and rock have reduced overland sheet flow.

Closure and post-Closure project-related ground disturbing reclamation effects on wetlands would be similar to construction-related effects, although on a reduced scale. Disturbance to surrounding wetlands may occur during the removal of existing facilities, grading to recreate surface contours, and general ground disturbance that may result in sediment release, soil erosion, and spread of NNIS. NNIS can be introduced or spread by contaminated construction equipment or in contaminated seed mixes or mulch. NNIS are discussed in more detail in Section 3.10, Vegetation and Nonnative Invasive Species. Sedimentation would likely be of greater consequence in alpine herbaceous wetlands than in lowland wetlands and would result in decreased shoot density and species diversity (van der Valk et al. 1983).

Interior boreal forest wetland successional processes, generally initiated by natural disturbances such as wildland fires, gradually reestablish typical vegetation and permafrost and eventually hydrologic characteristics. When construction disturbs interior wetlands, successional processes may be prolonged or may not occur (ADEC 1999). Construction disturbances differ from natural disturbance in that the organic mat and organic soil horizons are often removed completely, which facilitates melting of permafrost, drains supra-permafrost groundwater, removes seedbeds, and reduces surface and subsurface water storage capacity (ADEC 1999). Timing and extent of recovery likely depend on the intensity, extent, and duration of the disturbance; the time required for wetlands to return to pre-disturbance depth of permafrost, soil moisture, and original vegetation cover has not been well documented in interior Alaska (ADEC 1999).

Most reclamation actions focus on establishing plant cover to provide insulation, stop erosion processes, and improve site appearance (Forbes and Jefferies 1999). Active post-construction and Closure Phase wetland revegetation would include seeding of prepared seedbeds with native grass varieties including: 'Egan' American sloughgrass (*Beckmannia syzigachne*), 'Norcoast' Bering hairgrass (*Deschampsia beringensis*), 'Arctared' red fescue (*Festuca rubra*), and 'Alyeska' polargrass (*Arctagrostis latifolia*) (Wright 2008; Czapla and Wright 2012; SRK 2012f). Some native grasses such as red fescue, when heavily seeded and fertilized, may exclude reestablishment of native forbs and shrubs (Czapla and Wright 2012). Addition of fertilizer favors graminoids and can substantially alter abundance and plant community composition (Forbes and Jefferies 1999). Development of self-sustaining wetland plant communities on previously disturbed Alaska wetlands may occur within 10 to 30 years, but may be slowed in gravel or sandy soils and by years with failed seedling establishment or seed production (Forbes and Jefferies 1999). Effects of treatments and seed mixtures are likely to only be evident after 20 to 25 years because of the slow rates of vegetation development in Alaska (McKendrick 1997).

Donlin Gold's previous experience with revegetation associated with exploration activities at the Mine Site has found that careful planning and management; minimizing disturbance; segregating and protecting materials to be used during reclamation; using the appropriate seed mixture and seeding rates; continuing monitoring for erosion and revegetation success; and limiting or avoiding the use of fertilizer, especially in hydric soils, are important for successful revegetation. The grass mix that has been used successfully for revegetation in hydric soils seeded at a rate of 15 pounds per acre included: 'Egan' American sloughgrass (45 percent), 'Norcoast' Bering hairgrass (40 percent), 'Arctared' red fescue (10 percent), and 'Alyeska' polargrass (5 percent).

Reclamation of wetland conditions would be complicated in areas where permafrost has degraded because insulating surface vegetation and vegetative mats have been removed, or where clay layers that prevented surface water percolation have been breached or removed. Both conditions would alter surface hydrology causing previous wetland areas to drain and dry. Successful reclamation of native wetland vegetation cover and function would depend upon many factors; the most basic and difficult of which may be successful restoration of site hydrology (Ford and Bedford 1987; Post 1996; Graph 2009). Restored wetlands are likely to differ in type and functional capacity from the original wetlands for decades to centuries.

During Closure, the pit would be filling with water and the TSF area would be reclaimed, and surface waters available to wetlands would continue to be affected by diversion and storage. Water from the pit would be treated and discharged to Crooked Creek after the pit level reaches 33 feet below the low point of the pit crest. A spillway would be constructed between the TSF pond and Crevice Creek that would divert surface water to this drainage after it has been determined to be of suitable water quality for discharge. The pit lake, TSF and contact water impoundment would be designed to prevent contaminated water from entering Waters of the U.S., and as such these artificial waters would not be required to meet water quality standards and would never qualify as Waters of the U.S. Surface water resources available to wetlands would continue to be altered in distribution and abundance with an estimated return to within 4 percent of Crooked Creek pre-development stream flows at the downstream end of the mine development (see Section 3.5, Surface Water Hydrology). These changes in surface water distribution and abundance would result in some wetlands potentially drying while others would be inundated or become wetter.

After the pit fills with water, a new equilibrium groundwater level would become established. Because the pit lake level would be below the elevation of Crooked Creek, the section of the creek that runs along the pit lake would lose groundwater to the cone of depression created by the pit lake. This may result in long-term wetland and stream flow effects. The drawdown analysis presented for operations represents the greatest levels for potential wetland dewatering and identifies those wetlands and functions that are likely to be affected. These same wetland areas are likely to be effected to a lesser extent by the long-term impacts to stream flow resulting from the new equilibrium groundwater surface. There is insufficient detail for the equilibrium groundwater level to quantify potential long-term impacts to wetlands.

Of the 2,728 acres of wetlands that would be directly affected by the mine footprint, approximately 157 acres would be affected by vegetation clearing and may be restorable to wetland conditions at or before Closure (Table 3.11-15). Wetland areas affected by excavation or filling may not be restorable to wetland condition. Restoration of wetland hydrology in areas where permafrost has melted, especially areas subject to subsidence and draining in slope or riverine HGM classes, may be difficult or unsuccessful. Of the 157 acres of wetlands areas that would be cleared of vegetation and may be restorable to wetland conditions, 98 acres are potentially supported by permafrost, based on modelled permafrost distribution (Figure 3.11-18, Table 3.11-16). Permafrost-based wetlands in the vegetation clearing areas are primarily (89 percent) flat HGM wetlands, 8 percent are slope, and 3 percent are riverine HGM classes (Figure 3.11-18, Table 3.11-16).

Table 3.11-15: Alternative 2 Mine Site Wetland Direct Impacts for Cut or Fill and Vegetation Clearing Areas

Wetland Category	Total Impact Area (Acres)	Cut or Fill Impacts		Vegetation Clearing Impacts	
		Area (Acres)	Area[1] (%)	Area (Acres)	Area[1] (%)
Evergreen Forested Wetlands	1,072.2	1,012.4	94%	59.8	6%
Deciduous Forested Wetlands	0	0	0%	0	0%
Mixed Forested Wetlands	16.9	16.8	100%	0.1	<1%
Evergreen Scrub Shrub Wetlands	1,266.1	1,178.8	93%	87.3	7%
Deciduous Scrub Shrub Wetlands	353.1	347.4	98%	5.7	2%
Herbaceous Wetlands	18.4	14.9	81%	3.5	19%
Ponds	0.8	0.6	69%	0.2	31%
Rivers	0.8	0.7	93%	0.1	7%
Uplands	7,091.0	6,433.3	91%	657.7	9%
Total Area	9,819.3	9,004.9	92%	814.4	8%
Wetland/Water Totals	2,728.3	2,571.6	94%	156.7	6%

Notes:

1 Proportion of impact area identified by wetland category. Note cut/fill included freshwater pond and vegetation clearing included work area.

NA = Not Applicable

0 = None

Source: Michael Baker 2017a

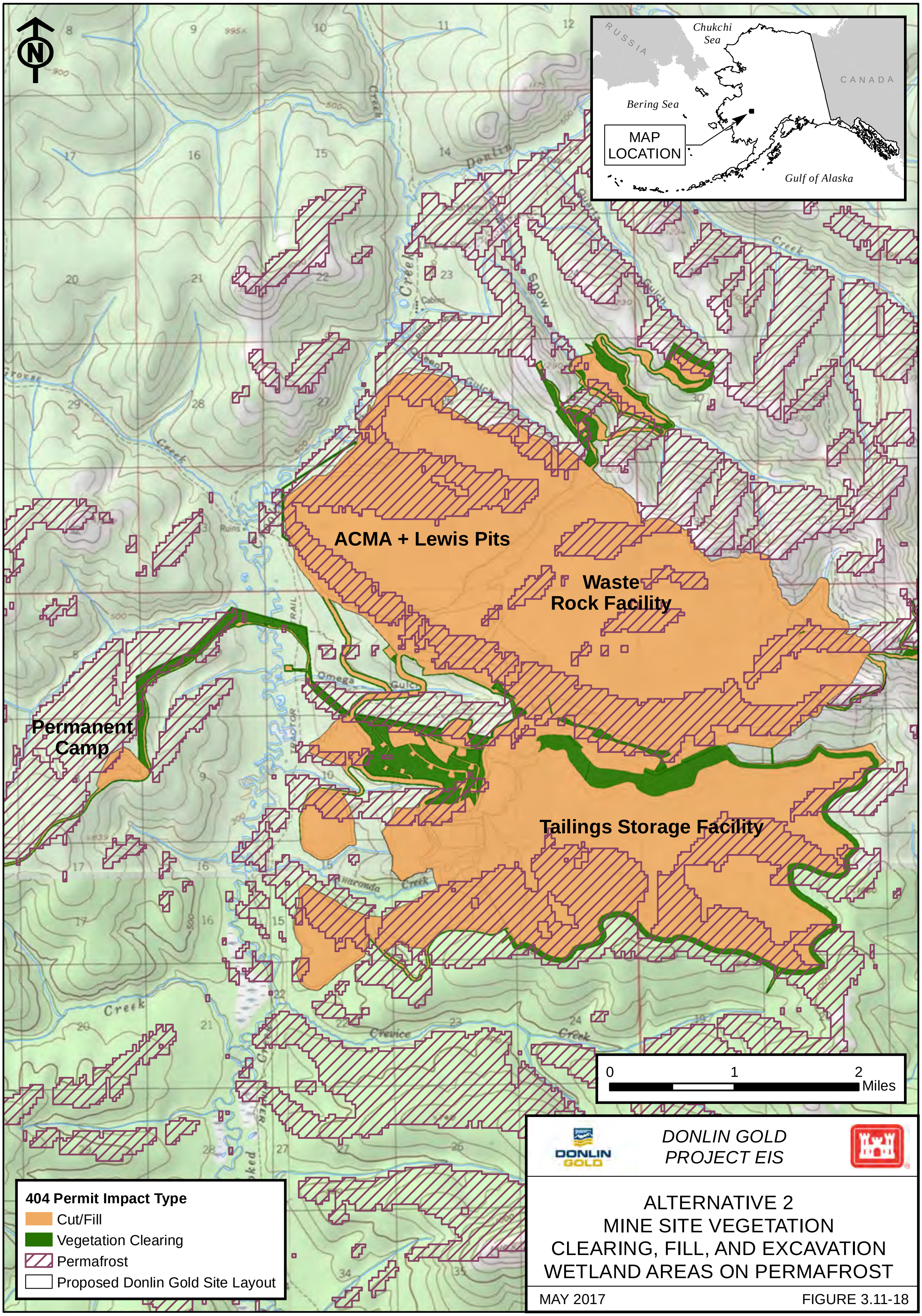
Table 3.11-16: Alternative 2 Mine Site Wetland Vegetation Clearing Impact Areas Located on Permafrost

Wetland Category	Permafrost – HGM Class (Acres)					Study Area (Acres)	Area[1] (%)
	Depression	Flat	Slope	Riverine	Total		
Evergreen Forested Wetlands	0	18.0	1.7	0.7	20.4	2,291.5	1%
Deciduous Forested Wetlands	0	0	0	0	0	2.4	0%
Mixed Forested Wetlands	0	0	0	0	0	72.3	0%
Evergreen Scrub Shrub Wetlands	0	68.5	4.9	0.0	73.4	3,588.3	2%
Deciduous Scrub Shrub Wetlands	0	0.6	0.9	1.8	3.3	1,052.4	<1%
Herbaceous Wetlands	0.1	0	0.7	0.5	1.3	181.1	1%
Ponds	0.0	0	0	0.0	0.0	17.7	<1%
Rivers	0	0	0	0.0	0.0	122.6	<1%
Uplands	NA	NA	NA	NA	238.2	13,721.5	2%
Total Area[1]	0.1	87.1	8.2	3.0	336.6	21,049.8	2%
Wetland/Water Totals	<1%	89%	8%	3%	98.4	7,328.3	1%

Notes:
1 Proportion of vegetation clearing area located on permafrost by wetland category.
NA = Not Applicable
0 = None
0.0 = < 0.1
Source: Analysis based on modeled permafrost distribution and wetland data Michael Baker 2017a

Summary of Impacts for Mine Site

Anticipated Alternative 2 Mine Site effects on wetlands would include direct impacts to 2,728 acres of wetlands (Table 3.11-12). during Construction and Operations; siting and design features have been used to avoid and minimize wetland impacts. Effects would continue throughout Construction and Operations; during Closure or at the conclusion of mine-related activities in a specific area, wetlands would be reestablished wherever practicable. The geographic extent of direct and indirect effects would affect several sub-drainages within the Crooked Creek drainage; mine design focused on minimizing the number of drainages that would be disturbed. Most impacts (86 percent) would be to black spruce dominated wetlands (evergreen forested and scrub shrub wetlands) that are common throughout the region (Table 3.11-17). There would be a few impacts to wetlands that support anadromous fish streams and regionally scarce wetland categories including herbaceous wetlands and open water ponds (Table 3.11-17).



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
MINE SITE VEGETATION
CLEARING, FILL, AND EXCAVATION
WETLAND AREAS ON PERMAFROST

MAY 2017

FIGURE 3.11-18

Table 3.11-17: Alternative 2 Mine Site Summary of Wetland Direct and Indirect Impacts

Wetland Category	Construction and Operations Direct Impact Area[1] (Acres)	Potential Fugitive Dust Indirect Impact Area[2] (Acres)	Potential Dewatering Indirect Impact Area[3] (Acres)	Vegetation Clearing Area with Permafrost[4] (Acres)
Evergreen Forested Wetlands	1,072.2	177.0	137.2	20.4
Deciduous Forested Wetlands	0	0	0	0
Mixed Forested Wetlands	16.9	1.3	2.2	0
Evergreen Scrub Shrub Wetlands	1,266.1	372.2	176.9	73.4
Deciduous Scrub Shrub Wetlands	353.1	66.3	86.0	3.3
Herbaceous Wetlands	18.4	11.6	16.3	1.3
Ponds	0.8	0.4	4.2	0.0
Rivers	0.8	6.1	9.6	0.0
Wetland/Water Totals	2,728.3	634.9	432.4	98.4
Intermittent Streams (Miles)	8.0	1.6	1.0	NE
Perennial Streams (Miles)	25.7	5.1	5.6	NE

Notes:
NE = Not Evaluated
1 Mine Site footprint impact areas – see Table 3.11-12 for breakdown by HGM class.
2 Mine Site potential indirect fugitive dust impact areas – see Table 3.11-13 for breakdown by HGM class.
3 Wetlands potentially affected by reduced groundwater within modeled maximum drawdown areas – see Table 3.11-14 for breakdown by HGM class.
4 Mine site footprint impact areas identified as "vegetation clearing" located on modeled permafrost distribution – see Table 3.11-16 for breakdown by HGM class. Cleared wetlands supported by permafrost may not be restorable if the permafrost has been degraded.

3.11.4.2.2 TRANSPORTATION CORRIDOR

Construction and Operations Phases

Angyaruaq (Jungjuk) Port, Mine Access Road, and Airstrip

Construction of the Angyaruaq (Jungjuk) Port, mine access road, and the mine airstrip and access road would disturb 224 acres of primarily flat and slope HGM class evergreen forested and scrub shrub wetlands (Table 3.11-18, Figure 3.11-19). Some of these impacts would be permanent as it is likely that the road would remain to facilitate closure monitoring at the Mine Site. A total of 1.4 miles of streams would be affected by construction, including 1.1 miles of perennial streams and 0.3 miles of intermittent streams (Table 3.11-18; Michael Baker 2017a).

Excavation, filling, and clearing of wetlands and waters for construction of the access road, port, and airstrip would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions. Construction-related disturbances may alter wetland modification of groundwater functions (recharge and discharge), would be expected to decrease storm and floodwater storage, and modify stream flow functions by decreasing the wetlands' potential to dissipate energy and reduce peak flows. These altered hydrologic functions would extend to the streams connected to or downstream from the affected wetlands.

Construction on or through wetlands would decrease or remove the wetlands' potential to improve water quality by preventing erosion and by retaining sediments. Clearing with no ground disturbance would reduce the modification of water quality and the contribution to the abundance and diversity of wetland fauna functions. Wetland vegetation clearing that includes ground disturbance and compaction would reduce the modification of water quality function, the contribution to the abundance and diversity of wetland fauna, and all hydrologic functions.

Table 3.11-18: Alternative 2 Transportation Corridor Wetland Direct Impacts from Construction and Operations

Wetland Category	Impact Area – HGM Class (Acres)						Study Area (Acres)	Area[1] (%)
	Depression	Flat	Slope	Riverine	River Channel	Total		
Evergreen Forested Wetlands	0	28.7	21.1	1.5	0	51.3	1,383.7	4%
Deciduous Forested Wetlands	0	0	0.2	0	0	0.2	16.2	1%
Mixed Forested Wetlands	0	0	0.7	0.8	0	1.5	54.5	3%
Evergreen Scrub Shrub Wetlands	0	121.1	22.6	0.4	0	144.1	2,749.8	5%
Deciduous Scrub Shrub Wetlands	0	4.4	6.7	9.0	0	20.1	1,330.7	2%
Herbaceous Wetlands	0.1	0	1.7	2.2	0	4.0	898.3	<1%
Ponds	0	0	0	0	0	0	8.7	0%
Rivers	0	0	0	0	2.9	2.9	171.9	2%
Uplands	NA	NA	NA	NA	NA	869.3	6,225.5	14%
Total Area	0.1	154.2	53.0	13.9	2.9	1,093.4	12,839.3	9%
Wetland/Water Totals	<1%	69%	24%	6%	1%	224.1	6,613.8	3%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	0.3	5.4	6%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	1.1	27.6	4%

Notes:
1 Proportion of impact area within transportation wetland study area by wetland category.
NA = Not Applicable
0 = None
Source: Michael Baker 2017a

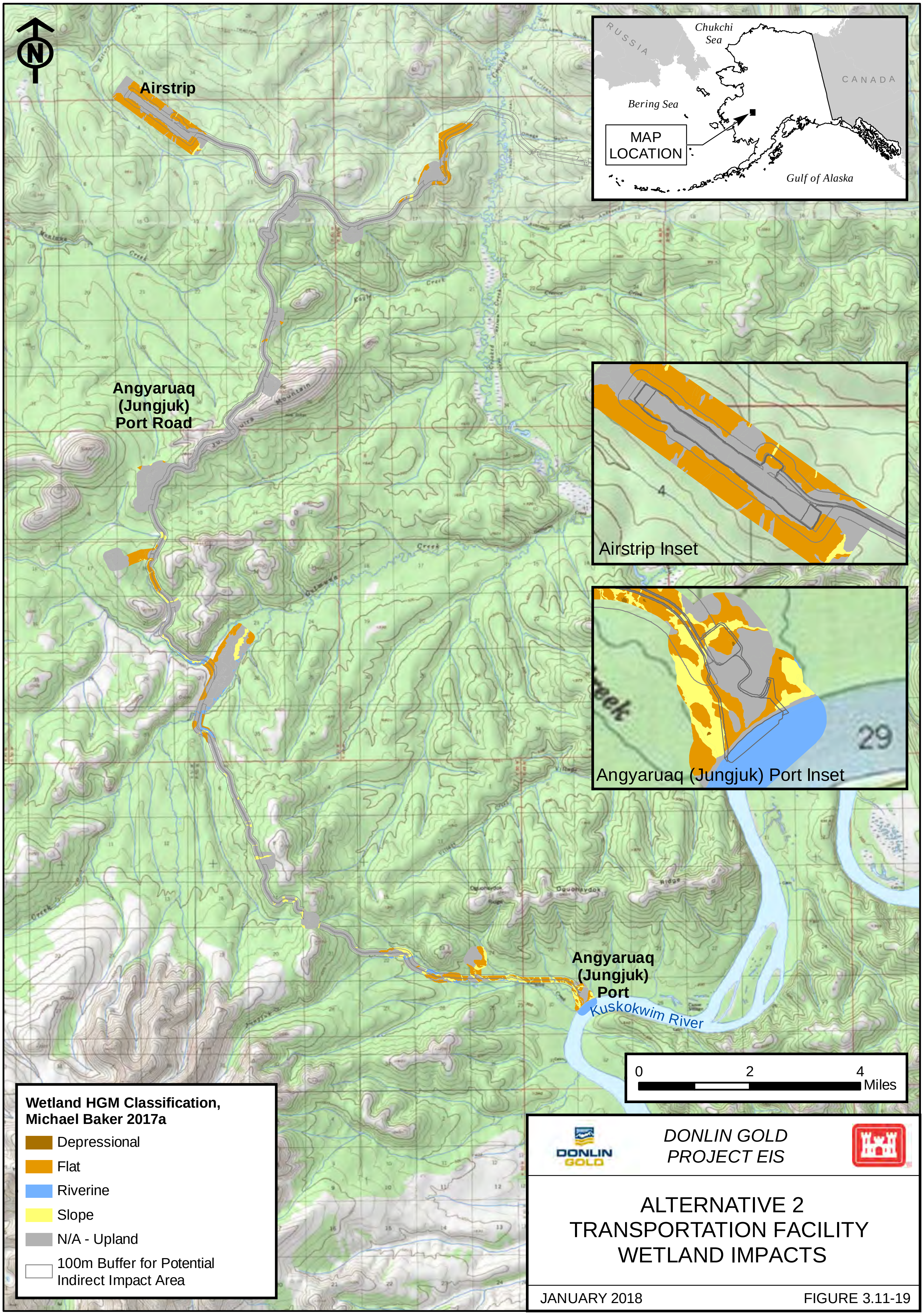
Dust generated by traffic on gravel roads and deposited on adjacent vegetation can change soil pH and bulk density, and raised road beds cause drifting and dust deposition on snow that results in early spring melt and deeper active layers next to the road in areas underlain by permafrost (Auerbach et al. 1997). Dust deposition would be heaviest within about 33 feet (10 meters) of the most heavily trafficked road (the mine access road), but may influence vegetation and soils within about 328 feet (100 meters) (Auerbach et al. 1997; Ford and Hasselbach 2001; Hasselbach et al. 2005). Alteration of wetlands near the airstrip and access road due to dust, snow removal and drifting may include altered nutrient distribution, changes in soil pH and bulk density, reduced vegetation biomass, changes in plant community composition and diversity, and potential long-term changes in permafrost active layer depth and site hydrology (Auerbach et al. 1997). Roads may also interrupt sheet flow, leading to upslope impoundment and downslope drying of wetlands. Indirect effects from the Jungjuk Road and airstrip may result in alteration or degradation of an estimated 627 acres of wetlands (Table 3.11-19). Dust suppression using road watering, and proper culvert sizing and placement would reduce these indirect impacts on wetlands and wetland functions.

The road would cross an estimated 6.5 miles of permafrost-supported wetlands including: the Crooked Creek crossing and the ascent for about 2 miles; segments between Two Bull Creek Valley and Getmuna Creek; the lower slopes of Basalt Pass; and from the lower crossing of Jungjuk Creek to the dock location. Geotextile and moderate fill would be used for road segments over permafrost to prevent thermokarst and subsidence (RECON 2011a).

Table 3.11-19: Alternative 2 Mine Access Road and Airstrip Wetland Potential Indirect Impacts from Fugitive Dust

Wetland Category	Indirect Impacts[1] – HGM Class (Acres)						Study Area (Acres)	Area[2] (%)
	Depression	Flat	Slope	Riverine	River Channel	Total		
Evergreen Forested Wetlands	0	108.1	30.0	20.8	0	158.9	1,383.7	11%
Deciduous Forested Wetlands	0	1.1	0.4	0	0	1.5	16.2	9%
Mixed Forested Wetlands	0	0	2.0	0.5	0	2.5	54.5	5%
Evergreen Scrub Shrub Wetlands	0	293.9	59.2	1.8	0	354.9	2,749.8	13%
Deciduous Scrub Shrub Wetlands	0.4	22.9	30.8	22.4	0	76.5	1,330.7	6%
Herbaceous Wetlands	0.5	0	7.0	5.1	0	12.6	898.3	1%
Ponds	0.1	0	0	0.2	0	0.3	8.7	3%
Rivers	0	0	0	0	19.7	19.7	171.9	11%
Uplands	NA	NA	NA	NA	NA	1,508.7	6,225.5	24%
Total Area	1.0	426.0	129.4	50.8	19.7	2,135.6	12,839.3	17%
Wetland/Water Totals	<1%	68%	21%	8%	3%	626.9	6,613.8	9%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	1.2	5.4	23%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	4.5	27.6	16%

Notes:
1 Potential indirect impact area within 328 feet (100 meters) around mine access road, airstrip and airstrip access road from dust deposition. Material sites and road footprints were excluded. Mapping covers approximately 75 percent of the road indirect area and 77 percent of the airstrip indirect area (extending approximately 250 feet).
2 Proportion of indirect impact area in the mine transportation wetland study area by wetland category.
NA = Not Applicable
0 = None
Source: Michael Baker 2017a



N
Airstrip
Angyaruaq
(Jungjuk)
Port Road
Angyaruaq
(Jungjuk)
Port
Kuskokwim River
Chukchi
Sea
RUSSIA
CANADA
Bering Sea
MAP
LOCATION
Gulf of Alaska
Airstrip Inset
Angyaruaq (Jungjuk) Port Inset
0
2
4
Miles
Wetland HGM Classification,
Michael Baker 2017a
Depressional
Flat
Riverine
Slope
N/A - Upland
100m Buffer for Potential
Indirect Impact Area
DONLIN GOLD
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PROJECT EIS
ALTERNATIVE 2
TRANSPORTATION FACILITY
WETLAND IMPACTS
JANUARY 2018
FIGURE 3.11-19

Snow drifts and interruption of sheet flow may alter wetland modification of groundwater functions (recharge and discharge), and may decrease storm and floodwater storage and modification of stream flow functions by decreasing the wetlands' potential to dissipate energy and reduce peak flows. These altered hydrologic functions may extend to the streams connected to or downstream from the affected wetlands. Changes in soils, pH and vegetation productivity may reduce the modification of water quality biogeochemical and export of detritus functions, which may then also reduce the wetlands contribution to the abundance and diversity of wetland flora and fauna.

Barging

No additional facilities would be constructed along the barge route through the Kuskokwim River wetland study area between Bethel and Angyaruaq (Jungjuk) Port. Barge traffic supporting mine operations would produce wakes that may increase shoreline erosion, potentially degrading shoreline wetlands. Erosion may lead to loss or conversion of wetland types, while sediments deposited in lowland wetlands may result in decreased shoot density and species diversity (van der Valk et al. 1983). Studies of the wave height and energy generated from barge traffic indicate that the increase of bank erosion above natural erosion rates due to project barge traffic is likely to be small and is not possible to calculate (BGC 2007c, 2016a, 2017g).

An analysis of wave energy produced by a projected 116 barge trips (58 fuel and 58 cargo barge round trips per year) indicated that barges impart the greatest wave energy on the return trips when they are unloaded and travel at higher rates of speed (BGC 2007c, 2016a, 2017g). Seasonal wave energy generated by barge traffic generally increases in relation to seasonal river tractive energy from downstream to upstream with about 0.7 percent near Akiak to about 2.3 percent near Aniak (BGC 2017g). In the lower river where multiple smaller channels distribute the river tractive energy, however, the seasonal wave energy is a higher proportion of the tractive energy within the individual channel (BGC 2017g). The results would be proportionately less for the Construction Phase of the project (89 trips/season) than the Operations Phase.

An estimated 58 fuel barge and 64 cargo barge train trips would be required per year to supply the mine in Alternative 2 during operations; fewer barge train trips would be required during construction. Applying these seasonal operations increases in wave energy to measured wetland erosion rates indicates that the largest increase in wetland erosion rates would occur in the lower segments of the river, even though in general the highest proportional increase in wave energy would occur in the upper segments of the river (Table 3.11-20). An estimated increase of 0.00 to 0.11 acre per mile per year (acre/mile/year) of shoreline wetland erosion, upstream to downstream, would be expected to be attributable to the increase in wave energy from project-related barge traffic.

This estimate is considered conservative, as it does not distinguish wind-generated waves, other vessel and skiff generated waves, or thermoerosional niching (BGC 2007c, 2016a, 2017g). The BGC estimates are based on the maximum vessel speeds, although for some reaches tugs would slow when close to shore and through river bends, reducing wave height and energy (BGC 2017g). Because thermoerosional niching, the process of undercutting of frozen banks by concomitant thawing and erosion and the primary process for bank erosion on the lower Kuskokwim River, is associated with spring and summer flood stage flows, waves induced by wind or barges were not considered to substantially affect bank erosion rates (BGC 2007c). Over the course of the 27 years of the life of the mine, the projected increase in wetland erosion rates would extrapolate to a total of about 4 acres across the barge transit route. This level of potential barge induced erosion would not be distinguishable from natural bank erosion on the Kuskokwim River.

BGC (2007c, 2016a) calculations of wave height and river energy were reviewed by the Corps' Engineer Research and Development Center (ERDC) to evaluate the modeling methodologies and assumptions used in the analyses (Styles and Gailani 2016). Overall, the methodologies used were found to be consistent with those in the literature, and the predictions of wave height and energy were considered reasonable order-of-magnitude estimates, recognizing that uncertainties in channel widths and depths can increase or decrease the results depending on vessel speed and route.

Table 3.11-20: Wetland Erosion Rates from the 1988 to 2006 by River Segment with Alternative 2 Projected Barge-Related Increases

Wetland Type	Kuskokwim River Segments			
	Mouth to Bethel	Tuluksak	Kalskag	Aniak to Napaimute
Wetland Erosion Rates 1988 to 2006 (acres/mile)				
Estuarine and Marine Wetland	88.64	0	0	0
Freshwater Emergent Wetland	65.44	0.47	1.56	0.04
Freshwater Forested/Shrub Wetland	9.18	31.75	6.62	3.06
All Wetlands	163.26	32.22	8.18	3.09
Annual Erosion Rates (acres/mile/year)				
Estuarine and Marine Wetland	4.92	0	0	0
Freshwater Emergent Wetland	3.64	0.03	0.09	0.00
Freshwater Forested/Shrub Wetland	0.51	1.76	0.37	0.17
All Wetlands	9.07	1.79	0.45	0.17
Projected Annual Wetland Erosion Rate Increase (acres/mile/year)[1]				
Seasonal Wake Energy/River Tractive Energy	1.2%	2.0%	1.5%	2.1%
Estuarine and Marine Wetland	0.059	0	0	0
Freshwater Emergent Wetland	0.044	0.001	0.001	0.000
Freshwater Forested/Shrub Wetland	0.006	0.035	0.006	0.004
All Wetlands	0.109	0.036	0.007	0.004

Notes:

1 Seasonal erosion rate calculated from 18-year erosion measure divided by 18 years to give an annual erosion rate; increase in wave energy based on 58 fuel and 58 cargo barge trips per year applied as an annual increase in erosion rate.

Source: Analysis based on data from ARCADIS 2007a, BGC 2007c, 2016a, 2017g, USFWS 2014a

Anticipated expansion at Dutch Harbor would result in 4 to 6 acres of impacts; diesel storage tanks would most likely be sited on uplands.

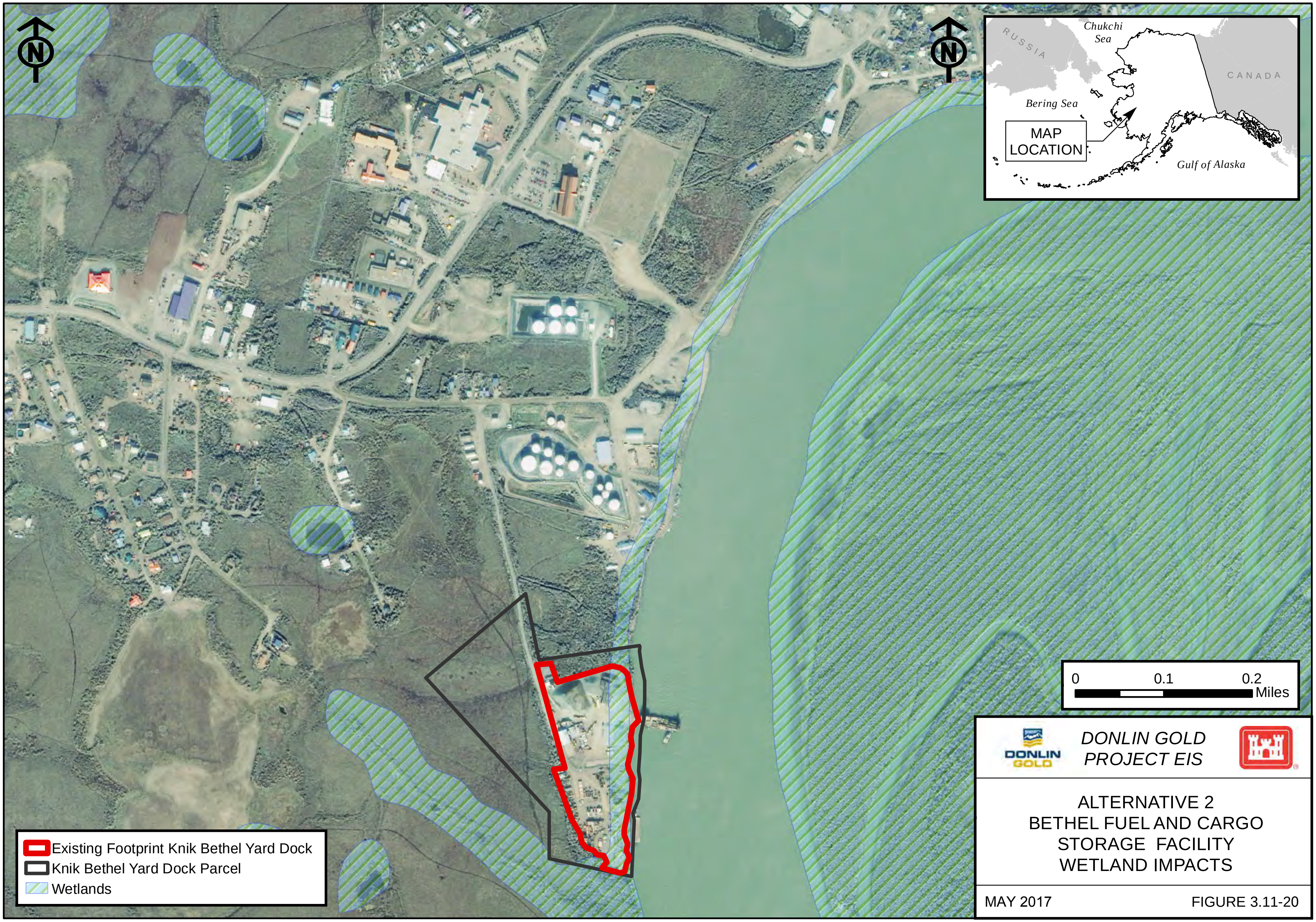
The connected action at the Bethel Yard Dock would result in direct loss of 2.9 acres of shoreline and riverine wetlands (Corps 2014a); this is not part of the proposed action (see Chapter 1, Purpose and Need, Section 1.2.1). A 16-acre area would also likely be required for additional diesel storage tanks and cargo storage (Figure 3.11-20); diesel storage tanks and cargo storage would most likely be sited on uplands. Some wetlands would be lost by placement of fill during dock construction, and losses would likely persist beyond the life of the Donlin Gold mine. Additional fuel storage tanks and cargo facilities installed at Dutch Harbor and Bethel ports would not likely be sited on wetlands and would not likely be removed with closure of the mine.

Closure Phase

The Angyaruaq (Jungjuk) Port facilities would be partially reclaimed. A barge landing, the mine access road and the airstrip would remain to facilitate access to the site for post-Closure monitoring. Reclamation of the port facility would include removal of all facilities, sheet piles, foundations, and drainage control structures. The port area would be regraded to approximate original contours or acceptable slopes, decompacted, covered with growth media if necessary, and seeded to promote vegetative growth. When the road is no longer required, road culverts would be removed, natural drainage areas would be restored or stabilized, erosion control structures would be installed, and road beds would be graded where necessary to provide drainage. Most flat to gently sloping wetlands would be reclaimed by removal of fill. Fill would not likely be removed in areas where marginal hydrology makes restoration of wetlands not feasible.

Summary of Impacts for Transportation Corridor

Anticipated Alternative 2 transportation facility effects on wetlands would include direct impacts to 224 acres of wetlands and potential indirect effects from dust to 627 acres of wetlands during Construction and Operations (Table 3.11-18). Some direct effects would occur through Closure because the mine access road and airstrip would not be reclaimed. The geographic extent of transportation effects on wetlands would primarily affect wetlands in the vicinity of the mine access road, port, and airstrip within the Crooked Creek watershed. Most facility-related impacts (75 percent) would be to black spruce dominated wetlands (evergreen scrub shrub and forested wetlands) that are common throughout the region; however, there would be some impacts to riverine wetlands that support anadromous fish streams and to regionally scarce herbaceous wetlands and open water ponds (Table 3.11-21). Projected potential increases in wetland erosion rates resulting from barge wake energy represent an increase of 1.2 to 2.1 percent of river tractive energy along Kuskokwim River shorelines. Projected erosion rates, based on the assumed relationship between river tractive energy and shoreline erosion rates, are conservative and would likely not be distinguishable from natural shoreline erosion on the Kuskokwim River.



Chukchi
Sea
RUSSIA
CANADA
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MAP
LOCATION
Gulf of Alaska
0
0.1
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Miles
Existing Footprint Knik Bethel Yard Dock
Knik Bethel Yard Dock Parcel
Wetlands
DONLIN GOLD
DONLIN GOLD
PROJECT EIS
ALTERNATIVE 2
BETHEL FUEL AND CARGO
STORAGE FACILITY
WETLAND IMPACTS
MAY 2017
FIGURE 3.11-20

Table 3.11-21: Alternative 2 Transportation Corridor Summary of Wetland Direct and Indirect Impacts

Wetland Category	Construction and Operations Direct Impact Area[1] (Acres)	Potential Indirect Fugitive Dust Impact Area[2] (Acres)
Evergreen Forested Wetlands	51.3	158.9
Deciduous Forested Wetlands	0.2	1.5
Mixed Forested Wetlands	1.5	2.5
Evergreen Scrub Shrub Wetlands	144.1	354.9
Deciduous Scrub Shrub Wetlands	20.1	76.5
Herbaceous Wetlands	4.0	12.6
Ponds	0	0.3
Rivers	2.9	19.7
Total Wetland/Water Area	224.1	626.9
Intermittent Streams (Miles)	0.3	1.2
Perennial Streams (Miles)	1.1	4.5

Notes:
1 Transportation footprint impact areas – see Table 3.11-19 for breakdown by HGM class.
2 Potential indirect transportation indirect impact area from dust based on 328-foot (100-meter) buffer around roads and airstrip – see Table 3.11-19 for breakdown by HGM class. Approximately 75 to 77 percent of estimated dust impact area mapped for wetlands.
0 = None

3.11.4.2.3 PIPELINE

Much of the pipeline construction through wetlands, about 91 percent by area, would occur during winter with reduced disturbance to wetlands and wetland soils. Donlin Gold proposes to use three methods for pipeline construction across wetlands:

- Ice or snow pads would be used to support equipment during winter construction through wetlands on permafrost soils;
- Frost-packing would be used to support equipment during winter construction through wetlands on non-permafrost soils, with additional support from timber corduroy or mats in wetlands with organic mat thickness of 3 or more feet; or
- Temporary work pads made from imported fill and / or trench soil or timber mats would be used to support equipment during summer construction through wetlands on non-permafrost soils.

Geotextile or mats would be used to separate fill and spoils from vegetation during summer construction through wetlands. If summer construction would be required for wetlands on permafrost, a granular fill work pad would be used to support equipment.

Construction of the pipeline would affect wetlands and their functions primarily during and immediately following construction activities before vegetation becomes reestablished, but permanent changes also are possible (FERC 2004).

Potential construction- and operations-related effects include:

- Conversion of wetlands to uplands due to filling;
- Conversion of wetlands to uplands due to draining;
- Conversion of wetlands to open water due to disturbance of floating bogs;
- Modification of wetland productivity due to modification of surface and subsurface flow patterns;
- Temporary and permanent modification of wetland vegetation community composition and structure from clearing and operational maintenance (clearing temporarily affects the wetland's capacity to buffer flood flows and/or control erosion);
- Wetland soil disturbance (mixing of topsoil with subsoil with altered biological activity and chemical conditions that may affect reestablishment and natural recruitment of native wetland vegetation);
- Compaction and rutting of wetland soils from movement of heavy machinery and transport of pipe sections, altering natural hydrologic patterns, inhibiting seed germination, or increasing siltation;
- Temporary increase in turbidity and changes in wetland hydrology and water quality;
- Permanent alteration in water-holding capacity due to alteration or breaching of water-retaining substrates (volcanic ash or loess deposited clay layers) or degradation of permafrost;
- Alteration in vegetation productivity and life stage timing due to altered soil temperatures associated with heat or cold exchange from the pipeline; and
- Alteration in freeze-thaw timing due to increased water temperatures associated with heat or cold exchange from the pipeline.

Construction Phase

The acreage of herbaceous wetlands disturbed during the Construction Phase of the Pipeline would be small (65 acres), forested wetlands would be moderate (304 acres), as would the acreage of scrub shrub wetlands (932 acres, Table 3.11-22). The preponderance of deciduous scrub shrub wetlands affected during the Construction Phase reflects the ubiquity of these wetlands throughout the EIS Analysis Area. Construction would affect a total of 11.9 miles of streams of which 9.5 miles are perennial streams and 2.4 miles are intermittent streams (Table 3.11-21, Michael Baker 2017a, 2017b). The distribution of HGM wetlands that would be affected by construction varies by ecoregion with a preponderance of flat HGM wetlands in the Tanana-Kuskokwim Lowlands ecoregion and a preponderance of slope HGM wetlands in the Cook Inlet Basin and Kuskokwim Mountains ecoregions (Figure 3.11-21). Riverine and lacustrine HMG wetlands are crossed more in the Cook Inlet Basin and Alaska Range ecoregions (Figure 3.11-21).

Wetlands disturbed during the Construction Phase would be reclaimed shortly after installation of the pipeline. The type of disturbances include excavation and/or filling, vegetation clearing with minor grading, or vegetation clearing with no ground disturbance (Figure 3.11-22). Following reclamation and revegetation, few long-term effects on emergent wetland vegetation would be expected. Removal of trees and shrubs from wetlands may result in long-term to permanent conversion of forested and scrub shrub wetlands to herbaceous wetlands. Wetland vegetation communities would eventually transition back into a community functionally similar to the wetland prior to construction if pre-construction conditions such as elevation, grade, and soil structure are successfully restored (FERC 2004). Tree species that typically dominate forested wetlands in the EIS Analysis Area (black spruce, balsam poplar) have regeneration periods of 30 to 100 years or longer (ADEC 1999). Herbaceous wetland vegetation would regenerate more quickly (typically within 3 to 5 years) than shrub or forest communities (typically within 5 to 100 years), although wetland status in areas maintained by permafrost may not return until permafrost aggrades to pre-disturbance levels (typically within 30 to 100 years or more, ADEC 1999). The proposed Alternative 2 route would cross primarily deciduous scrub shrub wetlands within slope and organic soil flat HGM classes.

Excavation, filling, and clearing of wetlands and waters for construction of the buried pipeline, transmission line, construction camps, storage yards, workspaces and access roads would be expected to alter or remove the wetlands capacity to provide hydrologic, biogeochemical, and biological functions. Trench plugs are measures typically installed during construction to prevent drainage of wetlands. Altered hydrologic functions may extend effects to the streams connected to or downstream from the affected wetlands. Construction on or through wetlands would decrease or remove the wetlands' potential to improve water quality by preventing erosion and by retaining sediments. Clearing with no ground disturbance would reduce the modification of water quality biogeochemical function and the contribution to the abundance and diversity of wetland flora and fauna functions. Wetland vegetation clearing that includes some ground disturbance and compaction would reduce the modification of water quality function, the contribution to the abundance and diversity of wetland flora and fauna functions, and all hydrologic functions. Post-construction restoration of some forested and scrub shrub wetlands may be possible; however, long-term effects are likely to remain.

Bog and Fen Wetlands

An estimated 415 acres of the 681 acres of deciduous scrub shrub wetlands impacted by pipeline construction are identified as bog or fen habitats. Construction impacts to 209 acres of bog and fen habitats would be cut/fill, while the remaining 206 acres of bog and fen construction impacts would be vegetation clearing, ice bridge or winter trail construction. Pipeline Construction through certain bogs and fens react similarly when a pipeline installation cuts through these wetlands during either winter or summer construction. The backfilled portion of the trench becomes an open water area; there may be no practicable effective mitigation measure to avoid this conversion. Besides avoidance through routing, other potential mitigation measures include, where practicable, avoidance of surface vegetation impacts by using either horizontal boring or horizontal directional drilling (HDD) techniques. However, the abundance of bogs in central Alaska and the typical crossing lengths for these areas generally prohibit using simple HDD installations. Effective restoration of floating mat bog and fen areas may not be possible, leaving compensation through mitigation banks as the only mitigation option.

Permafrost

Restoration along the pipeline corridor in areas where wetland hydrology is supported by permafrost would be difficult, especially in slope and riverine HGM classes. An estimated 215 acres of wetlands within the pipeline construction right-of-way (ROW) are supported by permafrost with about 124 acres on thaw stable permafrost and 91 acres on thaw unstable permafrost (Table 3.11-23). Most permafrost-based wetlands are located within the Tanana-Kuskokwim Lowlands ecoregion and support deciduous scrub-shrub wetlands (Table 3.11-23). Thaw stable permafrost-based wetlands occurred in flat (88 percent) and slope (12 percent) HGM classes, and thaw unstable permafrost-based wetlands also occurred in flat (86 percent) and slope (14 percent) wetlands (Michael Baker 2017a).

Winter Access Routes

During Construction of the Pipeline, winter access routes would be developed in the Kuskokwim Mountains and Cook Inlet Basin ecoregions to transport equipment and supplies over the 3-year construction period. Routes would be cleared of trees and shrubs with no ground disturbance. Winter access routes would be maintained by packing, watering, and grading the snow and ice surface. While portions of the routes are collocated with existing winter trails, some additional vegetation clearing would be required in areas where no trail exists and to widen existing trails from 10 or 15 feet to 30 feet. Estimates of wetland vegetation clearing by wetland type are listed in Table 3.11-24, and shown in Figure 3.11-23.

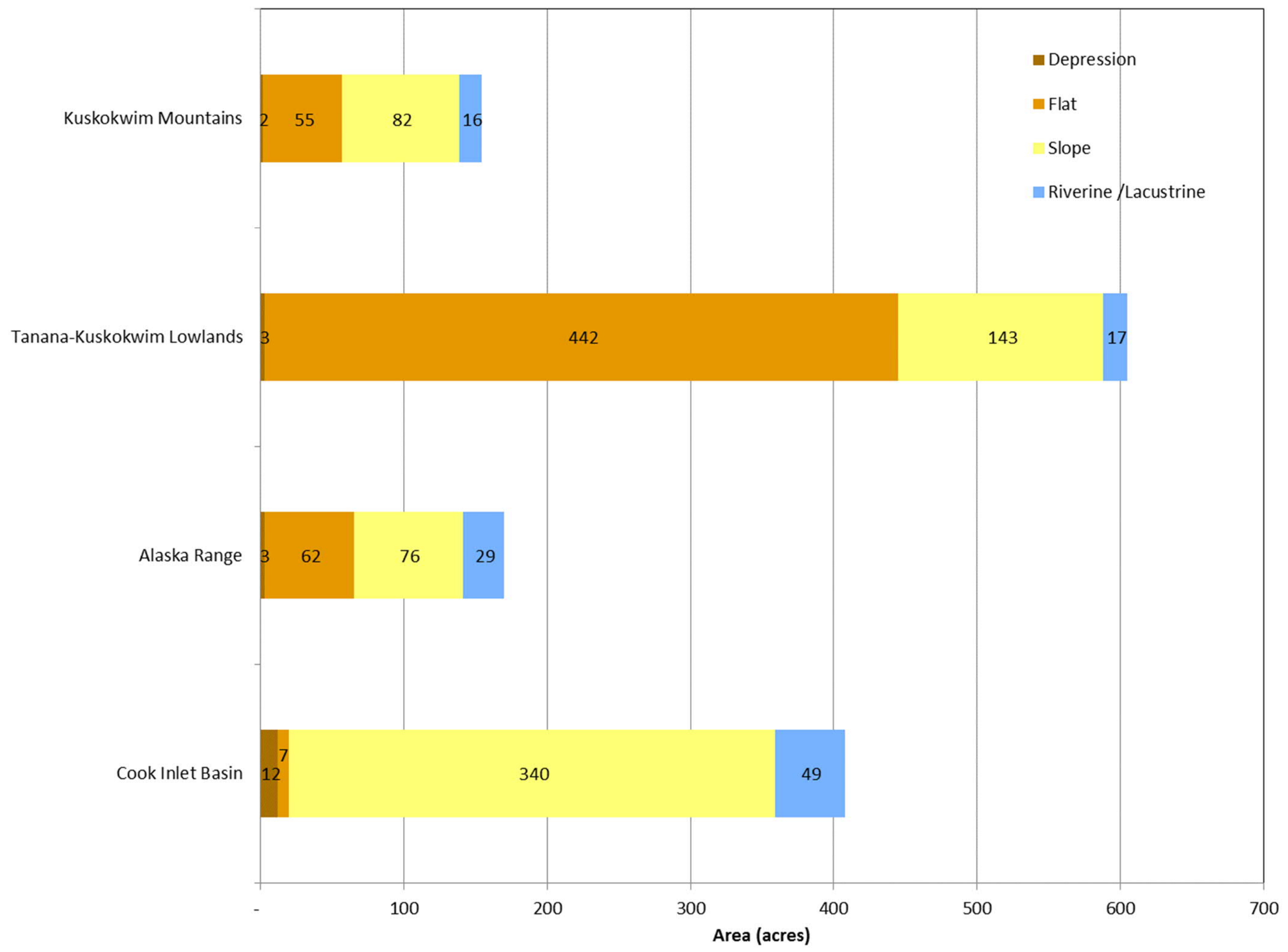
Winter ice road routes generally follow existing trails. The routes selected are not likely to cross floating mat bogs and fens because these areas lack sufficient stability for larger vehicles. Crossing floating mat bogs or fens with large vehicles would require freezing the water beneath the vegetation mat or rerouting to safely transit vehicles. Long term impacts to these habitats from winter access routes would be similar to pipeline construction impacts described above if the vegetation mat is breached or otherwise damaged.

Table 3.11-22: Alternative 2 Pipeline Construction Wetland Direct Impacts by Ecoregion

Wetland Category	Ecoregion (Acres)				Impact Area[1] (Acres)	Study Area (Acres)	Area[2] (%)
	Kuskokwim Mountains	Tanana-Kuskokwim Lowlands	Alaska Range	Cook Inlet Basin			
Evergreen Forested Wetlands	43.2	103.4	48.3	63.1	258.0	4,091.90	6%
Deciduous Forested Wetlands	0	0.1	2.6	10.2	12.9	144.3	9%
Mixed Forested Wetlands	2.0	0.2	0.0	30.8	33.0	406.9	8%
Evergreen Scrub Shrub Wetlands	43.2	138.4	13.3	55.5	250.4	3,599.4	7%
Deciduous Scrub Shrub Wetlands	59.6	323.9	85.2	212.4	681.1	10,849.4	6%
Bogs (LSB)	22.8	212.3	10.9	110.6	356.6	4,658.3	8%
Fens (ESB–SB)	0.7	0	0	57.7	58.4	1,010.9	6%
Herbaceous Wetlands	4.0	28.2	5.5	27.3	65.0	1,046.9	6%
Ponds	0.1	0.2	0.0	0.7	1.0	222.5	<1%
Lakes	0	0	0	0	0	132.5	0%
Rivers	2.3	10.4	15.1	7.8	35.6	1,562.3	2%
Uplands	1,928.0	665.1	1,575.3	1,476.5	5,644.9	5,7742.9	10%
Total Area	2,082.4	1,269.9	1,745.3	1,884.3	6,981.9	79,799.0	9%
Wetland/Water Totals	154.4	604.8	170.0	407.8	1,337.0	22,056.1	6%
Intermittent Streams (Miles)	0.2	0.4	0.6	1.3	2.5	36.7	7%
Perennial Streams (Miles)	1.7	2.2	1.2	4.4	9.5	128.3	7%

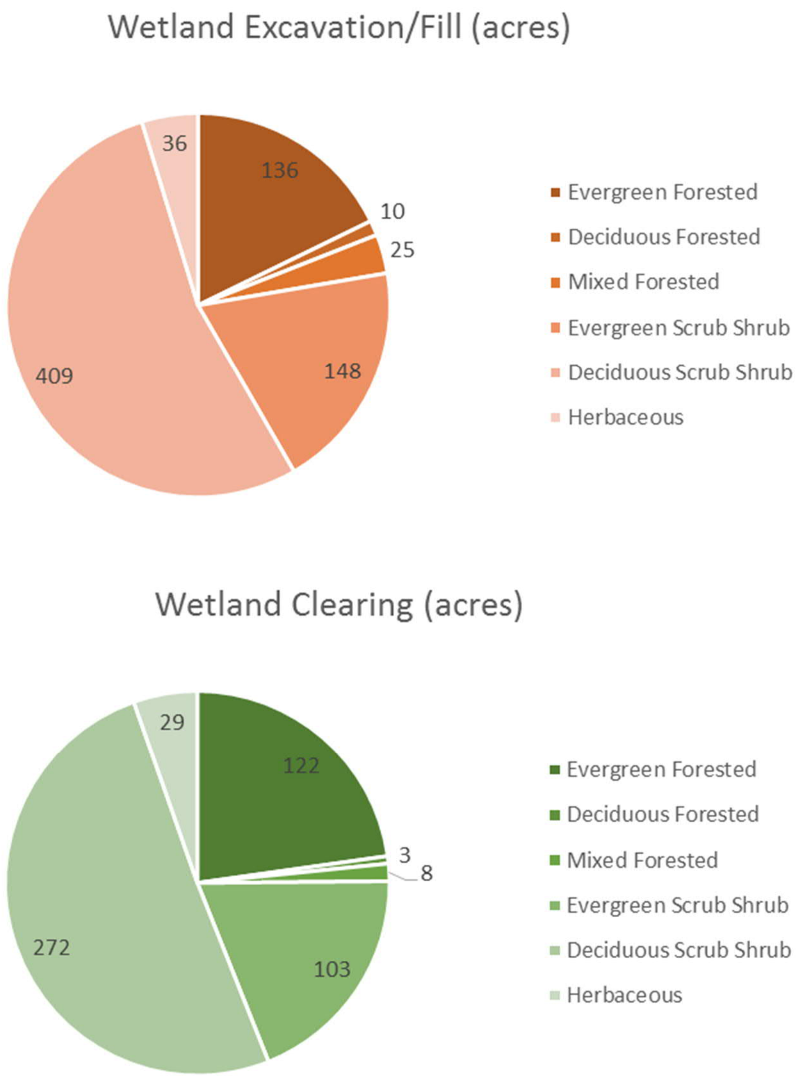
Notes:
1 Includes all impact areas, including winter access routes.
2 Proportion of impact area in pipeline wetland study area by wetland category.
0 = None
0.0 = < 1
LSB = Low Shrub Bog Wetland Subcategory
ESB – SB = Ericaceous Shrub Bog–String Bog Wetland Subcategory
Source: Michael Baker 2017a

Figure 3.11-21: Alternative 2 Pipeline Construction Wetland Impacts for Hydrogeomorphic Classes by Ecoregion



Source: Michael Baker 2017a

Figure 3.11-22: Alternative 2 Pipeline Construction Wetland Impacts by Disturbance Type



Source: Michael Baker 2017a

Table 3.11-23: Alternative 2 Pipeline Construction Calculation of Wetland Direct Impacts Located on Permafrost

Wetland Category	Ecoregion (Acres)						Permafrost Area (Acres)	Impact ROW Area[1] (Acres)	Area[2] (%)
	Kuskokwim Mountains		Tanana-Kuskokwim Lowlands		Alaska Range				
	Stable	Unstable	Stable	Unstable	Stable	Unstable			
Evergreen Forested Wetlands	0	0	12.0	2.6	0.6	0.4	15.6	150.3	10%
Deciduous Forested Wetlands	0	0	0.0	0	0	0	0.0	2.7	<1%
Mixed Forested Wetlands	0	0	0	0	0	0	0	2.0	0%
Evergreen Scrub Shrub Wetlands	0.3	0	8.9	15.5	3.7	0	28.4	175.5	16%
Deciduous Scrub Shrub Wetlands	0.4	0	78.0	62.2	15.4	4.3	160.3	433.5	37%
Bogs (LSB)	0	0	53.1	37.0	2.2	0	92.3	232.8	40%
Herbaceous Wetlands	0	0	4.0	5.4	0.3	0.3	10.0	35.3	28%
Ponds	0	0	0	0.0	0	0	0.0	0.3	15%
Rivers	0	0	0	0.0	0.2	0.1	0.3	24.2	1%
Uplands	0.7	0	20.3	9.9	90.4	17.2	138.5	2,178.4	6%
Total Area	1.4	0	123.2	95.6	110.6	22.3	353.1	3,002.3	12%
Wetland/Water Totals	0.7	0	102.9	85.7	20.2	5.1	214.6	823.8	26%

Notes:

1 Impact area for construction ROW footprint in Kuskokwim Mountains, Tanana-Kuskokwim Lowlands, and Alaska Range Ecoregions. No permafrost was mapped in the Cook Inlet Basin.

2 Proportion of Permafrost Area within ROW Impact Area by Wetland Category.

0 = None

0.0 = < 0.1

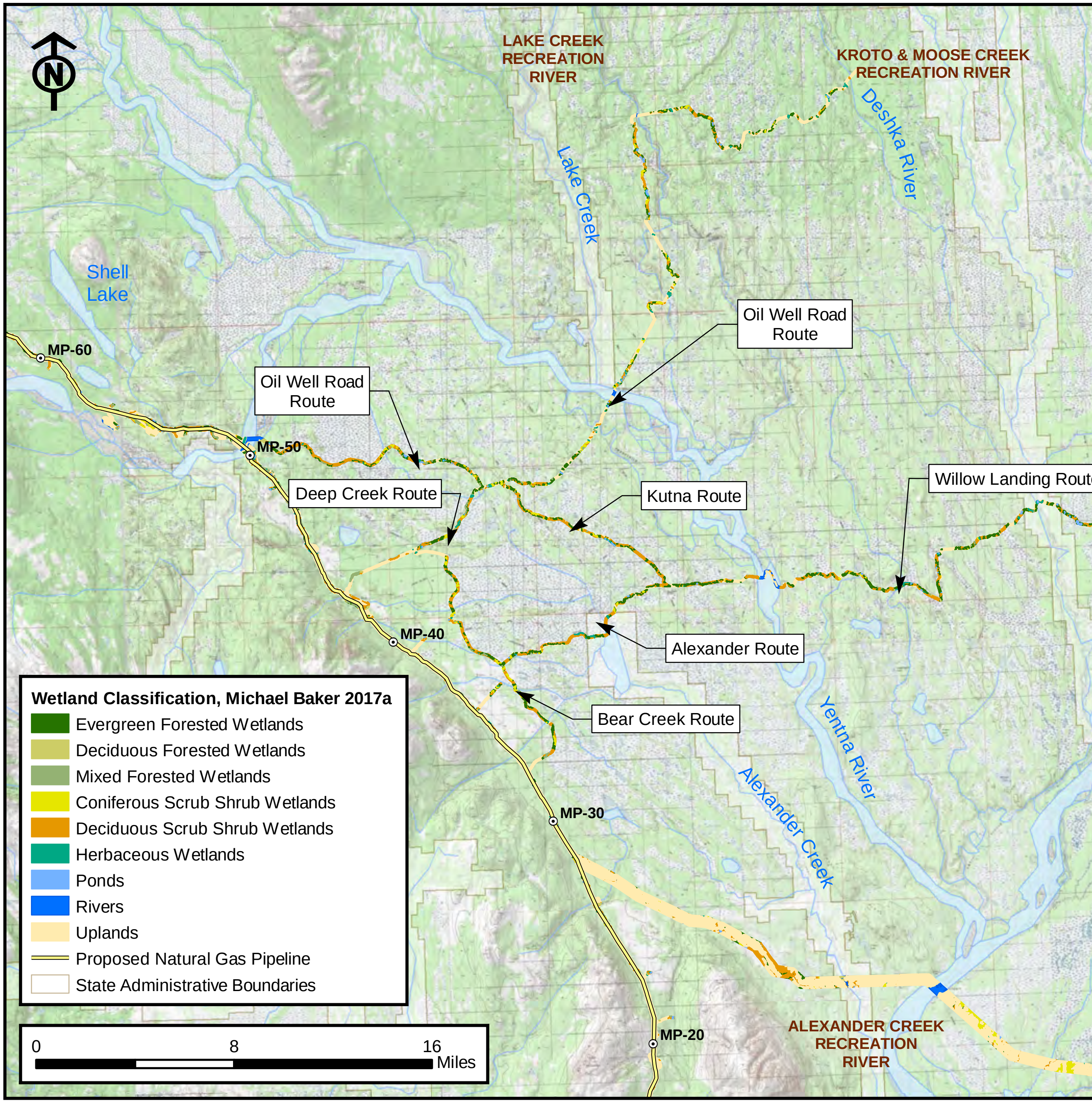
LSB = Low Shrub Bog Wetland Subcategory

Source: Michael Baker 2017a; see Section 3.2, Soils, for description of Permafrost Analysis

Table 3.11-24: Alternative 2 Winter Access Corridor Wetland Impacts from Winter Access Route Vegetation Clearing

Wetland Category	Route (Acres)							Total Area[1] (Acres)
	Tatlawiksuk	Alexander	Bear Creek	Deep Creek	Kutna	Oil Well Road	Willow Landing	
Evergreen Forested Wetlands	6.1	7.7	7.4	2.3	4.6	16.0	10.5	54.6
Deciduous Forested Wetlands	0	0	0	0	0	0.4	0.2	0.6
Mixed Forested Wetlands	0	0	0.8	1.4	0	1.2	0.3	3.7
Evergreen Scrub Shrub Wetlands	9.7	4.2	7.7	1.5	7.8	13.7	10.2	54.8
Deciduous Scrub Shrub Wetlands	8.2	14.2	22.3	8.5	16.0	54.8	44.1	168.1
Bogs (LSB)	5.3	7.8	16.2	3.1	9.7	22.8	32.3	97.2
Fens (ESB–SB)	0.7	6.0	4.4	4.2	6.0	28.0	7.8	57.1
Herbaceous Wetlands	0.8	0.4	0.3	1.3	0	6.7	7.1	16.6
Ponds	0	0	0	0	0	0.3	0.1	0.4
Rivers	0	0	0	0	0	2.3	4.1	6.4
Uplands	0.4	5.0	9.3	13.4	2.7	68.2	23.9	122.9
Total Area	25.2	31.5	47.8	28.4	31.1	163.6	100.5	428.1
Total Wetland/Water Area	24.8	26.5	38.5	15.0	28.4	95.4	76.6	305.2
Wetland Clearing Area (forested and shrub acres)	24.0	26.1	38.2	13.7	28.4	86.1	65.3	281.8
Wetland Clearing Proportion (%)	95%	83%	80%	48%	91%	53%	65%	66%

Notes:
1 Estimated clearing impacts for 30-foot wide access road; clearing applies to forested and scrub shrub wetlands.
NA = Not Applicable
UK = Unknown
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
ESB – SB = Ericaceous Shrub Bog – String Bog Wetland Subcategory
Source: Michael Baker 2017a



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
WINTER ACCESS ROUTES
POTENTIAL WETLAND IMPACTS

JANUARY 2018

FIGURE 3.11-23

North Option Impacts

Table 3.11-25 compares the wetland category acres that would be affected during Construction between Alternative 2 and Alternative 2-North Option route. The total number of wetlands acres impacted is similar between Alternative 2 and Alternative 2-North Option (1,337 acres compared to 1,331 acres).

Acres impacted during Operations would be similar to Alternative 2.

Table 3.11-25: Alternative 2 and North Option Impacts Comparison

Wetland Category	Alternative 2 Construction Impact Area[1] (Acres)	North Option Construction Impact Area[1] (Acres)	Difference
Evergreen Forested Wetlands	243.7	247.4	3.7
Deciduous Forested Wetlands	8.0	42.4	34.5
Mixed Forested Wetlands	41.8	6.8	-35.0
Evergreen Scrub Shrub Wetlands	260.8	247.1	-13.7
Deciduous Scrub Shrub Wetlands	236.1	253.1	17.0
Bogs (LSB)	356.6	349.0	-7.6
Fens (ESB-SB)	58.4	58.4	0.0
Herbaceous Wetlands	95.1	90.6	-4.5
Ponds	1.0	1.1	0.1
Rivers	35.6	35.3	-0.3
Uplands	5644.8	5,588.3	-56.5
Total Area	6981.9	6,919.5	-62.4
Total Wetlands/Water Area	1,337.1	1,331.2	-5.9
Intermittent Streams (Miles)	9.6	10.2	0.6
Perennial Streams (Miles)	2.4	2.5	0.1

Notes:
1 Includes all impact areas, including winter access routes.
LSB = Low Shrub Bog Wetland Subcategory
ESB-SB = Ericaceous Shrub Bog-String Bog Wetland Subcategory
Source: Michael Baker 2017a, 2017b

Operations Phase

During Pipeline Operations, vegetation maintenance may remove shrub and sapling trees from an area over the pipeline to protect pipeline integrity and to facilitate visual observation of the pipeline ROW. Above-ground facilities would continue to impact wetlands. Materials sites would be reclaimed. Areas exhibiting erosion along the ROW identified during twice-yearly inspections would be remediated. The total acreage of wetlands potentially affected during Operations (Table 3.11-26) would occur within areas that were initially disturbed during Construction and would be reduced from construction-related impacts. The deciduous scrub shrub, and evergreen forested and scrub shrub wetlands affected during Pipeline Operations reflects the ubiquity of these wetland communities throughout the component (Table 3.11-26).

Deciduous scrub shrub wetlands that would be affected by operations include 52 percent low shrub bog, 18 percent low shrub tundra, 7 percent open alder willow (*Alnus* spp. and *Salix* spp.) shrub, and 7 percent open willow shrub (Michael Baker 2017a). Evergreen forested wetlands that would be affected are 63 percent black spruce forests and woodlands, and 35 percent white spruce (*Picea glauca*) forests and woodlands; evergreen scrub shrub wetlands are 93 percent black spruce and 6 percent white spruce forests and woodlands. Pipeline Operations would affect a total of 5.5 miles of streams within the 50 or 51 foot ROW of which 4.5 miles are perennial streams and 1.0 miles are intermittent streams (Table 3.11-25, Michael Baker 2017). Most operational impacts (88 percent) would be to flat and slope HGM classes (Table 3.11-27; Michael Baker 2017a).

The temperature of the natural gas at the compressor station at 100°F would equilibrate and remain near ambient soil temperatures as it travels along most of the pipeline route (Donlin Gold 2013a). Operation of the natural gas pipeline at the designed 50 MMSCFD would cause increases in soil temperatures above the ambient 50°F soil temperatures in late summer within a zone of about 20 miles from the compressor station; and would cause changes in the ambient 32°F soil temperatures within zones of about 10 to 15 miles where the pipeline temperature would be either above the soil temperature near MP 84.2 or below the soil temperature near MP 243 as the pipeline crosses into and out of permafrost soils. (Donlin Gold 2013a). Pipeline Operations would cause increases in soil temperatures above the ambient 30°F soil temperatures in late winter within a zone of about 10 miles from the compressor station, and would cause an increase in the ambient 20°F soil temperature within a zone of a few miles near MP 50 where soils become colder (Donlin Gold 2013a).

In general, increased soil temperatures during early spring would be expected to result in earlier germination and emergence in wetland plant species while decreased soil temperatures would be expected to result in delayed germination and emergence. Experimental effects of increased soil temperature on prairie wetland plants and seed banks found that stem density, biomass, and species richness for annual plants increased with increasing soil temperatures while species richness for perennial plants showed a small positive increase (Seabloom et al. 1998). Twenty years after installation of a natural gas pipeline through a boreal forest in Wisconsin, Zimmerman et al. (1993) found: adjacent wetland areas were not altered in type; sheet flow restriction had been reversed naturally; no non-native plants had invaded the natural area; 75 percent of the ROW area was wetland; and the ROW increased overall vegetation diversity. The pipeline may also cause slight increases in water temperatures where the pipeline crosses through wetlands near the compressor station. Effects would be most pronounced in small ponds and wetlands, as excess heat would dissipate in larger water bodies and flowing waters. Small ponded wetlands over the pipeline may freeze later and thaw sooner than surrounding wetlands. Potential pipeline operation impacts on streams may include the potential for localized chilled pipeline sections that may result in the formation of ice dams and aufeis, which are discussed in Section 3.5, Surface Water Quality. Ground surface disturbances can also create conditions that lead to aufeis formation. Bedding materials, construction materials such as liners, or the pipeline can create a subsurface blockage of shallow groundwater flow causing the ground water to seep from the ground. In most cases adverse aufeis conditions generated by the pipeline would be corrected to ensure the structural integrity of the pipeline and would result in little if any impact to wetland vegetation as discussed in Section 3.5, Surface Water Quality.

Although in general a smaller area of wetlands would be affected during Operations, potential effects within the operational ROW would be longer term. Altered wetland hydrologic functions may extend effects to the streams connected to or downstream from the affected wetlands. Maintenance vegetation clearing with no ground disturbance may reduce wetlands' capacity for modification of water quality and export of detritus biogeochemical functions, especially for riverine deciduous forested or scrub shrub wetlands.

Table 3.11-26: Alternative 2 Pipeline Operations Wetland Direct Impacts by Ecoregion

Wetland Category	Ecoregion (Acres)				Operations Area[1] (Acres)
	Kuskokwim Mountains	Tanana-Kuskokwim Lowlands	Alaska Range	Cook Inlet Basin	
Evergreen Forested Wetlands	17.8	53.1	36.4	6.7	114.0
Deciduous Forested Wetlands	0	0.0	1.6	4.8	6.4
Mixed Forested Wetlands	1.3	0.1	0	13.2	14.6
Evergreen Scrub Shrub Wetlands	18.5	66.5	6.2	6.5	97.7
Deciduous Scrub Shrub Wetlands	27.3	152.8	40.2	27.2	247.5
Bogs (LSB)	10.6	101.2	5.2	10.9	127.9
Fens (ESB–SB)	0	0	0	1.0	1.0
Herbaceous Wetlands	2.3	13.7	2.3	5.8	24.1
Ponds	0.2	0.1	0.0	0.5	0.8
Lakes	0	0	0	0	0
Rivers	2.4	6.7	9.3	1.7	20.1
Uplands	755.5	328.5	636.7	610.6	2,331.3
Total Area	825.3	621.5	732.7	677.0	2,856.5
Total Wetland Area	69.8	293.0	96.0	66.4	525.2
Intermittent Streams (Miles)	0.1	0.2	0.2	0.5	1.0
Perennial Streams (Miles)	0.8	1.5	0.5	1.7	4.5

Notes:
1 Operations impact area defined as the 50-foot or 51-foot ROW, access roads to airstrips and facilities, airstrips, compressor station, fault crossings, distribution station, pig launcher, and metering station; assumes all construction-related disturbances (camps, material sources, work pads, storage yards and associated access roads) would reclaimed.
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
ESB – SB = Ericaceous Shrub Bog – String Bog Wetland Subcategory
Source: Michael Baker 2017a

Closure

Reclamation of the pipeline construction corridor would begin immediately following Construction, per Donlin Gold's Reclamation and Closure Plan. All roads, new airstrips, and barge landings used for Pipeline Construction would be reclaimed post-construction. Road culverts would be removed, natural drainage areas would be restored or stabilized, erosion control structures would be installed, and road beds would be graded where necessary to provide drainage. Most flat to gently sloping wetlands would be reclaimed by removal of fill. Fill would not likely be removed in areas where marginal hydrology makes restoration of wetlands not feasible. The pipeline would be decommissioned in place with removal of all above-ground facilities. All above-ground pipeline components and the transmission line would be removed and the sites would be reclaimed. The buried pipeline and fiber optic cable would be abandoned in place. Removal and reclamation of the pipeline components and transmission line would include some minor land disturbance activities which would be reclaimed as described for Construction.

Summary of Impacts for the Pipeline

Anticipated Alternative 2 Pipeline Construction effects on wetlands would include direct impacts to 1,337 acres of wetlands (1,331 acres, North Option). Many construction-related effects on wetlands would be offset by reclamation beginning soon after the Construction Phase. While many wetlands would be restored, functions may be reduced for extended periods. The pipeline ROW would cross 215 acres of permafrost-based wetlands; 91 acres of which are on unstable permafrost soils which may be difficult to restore as wetlands (Table 3.11-24). Most permafrost-based wetlands would be crossed during winter to minimize disturbance from trenching. The geographic extent of wetland impacts from the pipeline would affect small areas of wetlands across multiple watersheds. Much of the wetland area impacted by the pipeline construction and operations contains wetlands that likely contribute to storm and floodwater storage, modification of water quality, and contribution to the abundance and diversity of wetland flora and fauna functions. High-value wetlands crossed include wetlands that support anadromous fish streams, fen and bog wetlands, and regionally scarce open water lakes and ponds.

3.11.4.2.4 CLIMATE CHANGE SUMMARY FOR ALTERNATIVE 2

Predicted overall increases in temperatures and precipitation and changes in the patterns of their distribution (McGuire 2015; Chapin et al. 2006, 2010; Walsh et al. 2005) have the potential to influence the projected effects of the Donlin Gold Project on vegetation and wetlands. An overall warming/drying trend would tend to convert some wetlands to uplands and tend to increase the cover of shrubs and trees in previously open areas. Warming may also increase the thawing of permafrost over time. In project locations such as the pipeline route, increased thawing might lead to more open water areas. Permafrost thaw may cause ground subsidence leading to water-filled depressions. Adjacent areas may then drain, causing a shift from a wetland type or mosaic to an upland type. Higher transpiration, less available water, and a lower albedo caused by woody vegetation increase contributes to a drier landscape with fewer or smaller waterbodies compared to current conditions. Large scale hydrological changes may occur throughout the landscape. See Section 3.26 (Climate Change) for further details on climate change and resources.

Table 3.11-27: Alternative 2 Pipeline Operations Wetland Direct Impacts by HGM Class

Wetland Category	HGM Class (Acres)					Impact Area[1] (Acres)	Study Area (Acres)	Area[2] (%)
	Depression	Flat	Slope	Riverine	River Channel			
Evergreen Forested Wetlands	1.0	72.3	38.0	2.7	0	114.0	4,091.9	3%
Deciduous Forested Wetlands	0.2	0	6.1	0.2	0	6.5	144.3	5%
Mixed Forested Wetlands	0.8	1.2	12.1	0.5	0	14.6	406.9	4%
Evergreen Scrub Shrub Wetlands	1.0	65.0	30.7	1.0	0	97.7	3,599.4	3%
Deciduous Scrub Shrub Wetlands	3.3	134.4	87.3	22.5	0	247.5	10,849.4	2%
Bogs (LSB)	1.6	88.6	34.9	2.8	0	127.9	4,658.3	3%
Fens (ESB–SB)	0.5	0	0.5	0	0	1.0	1,010.9	<1 %
Herbaceous Wetlands	2.8	7.6	10.1	3.5	0	24.0	1,046.9	2%
Ponds	0.2	0	0	0.6	0	0.8	222.5	<1 %
Lakes	0	0	0	0	0	0	132.5	0%
Rivers	0	0	0	0	20.1	20.1	1,562.3	1%
Uplands	NA	NA	NA	NA	NA	2,331.3	57,742.9	4%
Total Area	9.3	280.5	184.3	31.0	20.1	2,856.5	79,799.0	4%
Wetland/Water Totals	2%	53%	35%	6%	4%	525.2	22,056.1	2%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	1.0	36.7	3%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	4.5	128.3	4%

Notes:

1 Operations impact area defined as the 50-foot or 51-foot ROW, access roads to airstrips and facilities, airstrips, compressor station, fault crossings, distribution station, pig launcher, and metering station; assumes all construction-related disturbances (camps, material sources, work pads, storage yards and associated access roads) would reclaimed.

2 Proportion of impact area in pipeline wetland study area by wetland category.

NA = Not applicable
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
ESB – SB = Ericaceous Shrub Bog – String Bog Wetland Subcategory
Source: Michael Baker 2017a

3.11.4.2.5 SUMMARY OF IMPACTS FOR ALTERNATIVE 2

Direct impacts from the Mine Site component would disturb 2,728 acres of wetlands and waters during the Construction and Operations phases. Indirect impacts would disturb 635 and 432 acres from dust and dewatering, respectively. Effects would continue throughout Construction and Operations; during Closure or at the conclusion of mine-related activities in a specific area, wetlands would be reestablished wherever practicable. Most excavation and fill impacts would eliminate wetland functions and would not be anticipated to return to previous functions after the impact causing the action has ceased or within more than several decades after reclamation. The geographical extent of these impacts would affect several sub-drainages within the Crooked Creek drainage. A total of 2,338 of the 2,728 acres are black spruce dominated wetlands (evergreen forested and scrub shrub wetlands) that are common throughout the region. Approximately 20 acres contain wetlands that may support anadromous fish streams and/or regionally scarce wetland categories such as herbaceous wetlands and open water ponds.

Direct impacts from the Transportation Corridor component would disturb 224 acres of wetlands during the Construction and Operations phases. Indirect impacts would disturb 627 acres of wetlands from dust. Some direct impacts would occur through the Closure Phase because the mine access road and airstrip would not be reclaimed. Direct excavation and fill impacts would eliminate wetland functions and would not be anticipated to return to previous functions after the impact causing action has ceased or within more than several decades after reclamation. The geographical extent of these impacts would affect wetlands in the vicinity of the mine access road, port, and airstrip within the Crooked Creek watershed. A total of 195 of the 224 wetland acre impacts would be to black spruce dominated wetlands that are common throughout the region. Approximately 7 acres contain wetlands that may support anadromous fish streams and/or regionally scarce herbaceous wetlands.

Direct impacts from the Pipeline component would disturb 1,337 acres (1,331 for the North Option) of wetlands during Construction and 525 acres of wetlands during Operations (expected to be the same for the North Option). Indirect effects would include thermal effects from pipeline alteration that would occur within portions of the permanent ROW. Many construction-related effects on wetlands would last only for the duration of the Construction Phase until vegetation cover is reestablished, because reclamation would begin immediately after Pipeline Construction. However, due to the extended recovery time for boreal forest wetlands, effects may cause permanent change in the resource that would last beyond the life of the project. The pipeline ROW would cross 215 acres of permafrost-based wetlands, 91 acres of which are on unstable permafrost soils which may be difficult to restore as wetlands. The geographical extent of these impacts would extend beyond the area of the pipeline and into small areas of wetlands across multiple watersheds. Much of the wetland area impacted during the Construction and Operations phases contains wetlands that likely contribute to storm and floodwater storage, modification of water quality, and contribution to the abundance and diversity of wetland flora and fauna functions. Approximately 452 acres within the Pipeline Construction area contain high-value wetlands that may support anadromous fish streams, bog and fen wetlands, and open water lakes and ponds. A summary of impacts to wetlands by assessment criteria is provided in Table 3.11-28.

Table 3.11-28: Summary of Impacts to Wetlands for Alternative 2 by Project Component

Impacts	Assessment Criteria			
	Magnitude or Intensity	**Duration**	**Geographic Extent**	**Context**
Mine Site				
Direct Wetland Impacts (excavation, fill, vegetation clearing)	Changes to wetlands would be measurable, and an alteration to the wetlands function in the ecosystem would be clearly and consistently observable.	Impacts to wetlands would extend from the end of the Construction Phase through the life of the mine and beyond where wetlands are permanently converted to uplands or water.	Impacts to wetlands would be limited to a geographically discrete area limited to several sub-drainages within the Crooked Creek drainage.	Most impacts would be to black spruce dominated wetlands that are common throughout the region. Approximately 20 acres contain wetlands that may support anadromous fish streams and/or regionally scarce wetland categories such as herbaceous wetlands and open water ponds.
Potential Indirect Wetland Impacts (dust deposition, dewatering, permafrost degradation)	Changes to wetlands may be measurable, although an alteration to the wetlands function in the ecosystem may not be clearly and consistently observable.	Impacts to wetlands would extend from the end of the Construction Phase through the life of the mine and beyond.	Impacts to wetlands would be limited to a geographically discrete area limited to several sub-drainages within the Crooked Creek drainage.	Most impacts would be to black spruce dominated wetlands that are common throughout the region. Approximately 30 acres contain wetlands that may support anadromous fish streams and/or regionally scarce wetland categories such as herbaceous wetlands and open water ponds.
Transportation Corridor				
Direct Wetland Impacts (excavation, fill, vegetation clearing)	Changes to wetlands would be measurable, although alteration to the wetlands function in the ecosystem may not be clearly and consistently observable.	Impacts to wetlands would extend from the end of the Construction Phase through the life of the mine and beyond where wetlands are permanently converted to uplands or water.	Impacts to wetlands would be limited to a geographically discrete area limited to several sub-drainages within the Crooked Creek drainage.	Most impacts would be to black spruce dominated wetlands that are common throughout the region. Approximately 7 acres contain wetlands that may support anadromous fish streams and/or regionally scarce wetland categories such as herbaceous wetlands and open water ponds.

Table 3.11-28: Summary of Impacts to Wetlands for Alternative 2 by Project Component

Impacts	Assessment Criteria			
	Magnitude or Intensity	**Duration**	**Geographic Extent**	**Context**
Potential Indirect Wetland Impacts (dust deposition)	Changes to wetlands may be measurable, although an alteration to the wetlands function in the ecosystem may not be clearly and consistently observable.	Impacts to wetlands would extend from the end of the Construction Phase through the life of the mine and beyond.	Impacts to wetlands would be limited to a geographically discrete area limited to several sub-drainages within the Crooked Creek drainage.	Most impacts would be to black spruce dominated wetlands that are common throughout the region. Approximately 33 acres contain wetlands that may support anadromous fish streams and/or regionally scarce wetland categories such as herbaceous wetlands and open water ponds.
Potential Indirect Barge Wake Erosion Impacts (increase shoreline wetland erosion rates)	The estimated increase of 0.00 to 0.11 acre/mile/year of shoreline wetland erosion would not likely be distinguishable from naturally occurring erosion occurring along Kuskokwim River shorelines.	Impacts to Kuskokwim River shoreline wetlands would extend from the end of the Construction Phase through the life of the mine and beyond.	Impacts to wetlands would extend beyond the local area, potentially affecting wetlands throughout the Kuskokwim River watershed.	Shoreline wetland erosion impacts are unlikely to affect areas that support anadromous fish.
Pipeline				
Direct Construction Wetland Impacts (excavation, fill, vegetation clearing)	Changes to wetlands would be measurable, although alteration to the wetlands function in the ecosystem may not be clearly and consistently observable.	Most impacts to wetlands would extend from the end of the Construction Phase through the reestablishment of vegetation cover past Closure.	Impacts to individual wetlands would local but the pipeline would affect wetlands throughout multiple watersheds across the EIS Analysis Area.	Most impacts would be to deciduous scrub shrub wetlands that are common throughout the region. Approximately 452 acres contain high-value wetlands that may support anadromous fish streams, bog and fen wetlands, and open water ponds.
Direct Operations Wetland Impacts (vegetation management)	Changes to wetlands may be measurable, although changes may not noticeably alter the wetlands function in the ecosystem.	Impacts to previously forested and scrub shrub wetlands would extend from the end of the Construction Phase through the life of the mine and beyond.	Impacts to individual wetlands would be local but the pipeline would affect wetlands throughout multiple watersheds across the EIS Analysis Area.	Most impacts would be to previously forested and scrub shrub wetlands. Approximately 129 acres contain deciduous scrub shrub wetlands that support bogs and fens.

3.11.4.2.6 MITIGATION AND MONITORING FOR ALTERNATIVE 2

Donlin Gold has incorporated facility siting and transportation facility construction, operations, and closure procedures to avoid and minimize adverse impacts to wetlands and has committed to provide compensation for unavoidable wetland impacts. Wetland impact minimization was incorporated into the project design by reducing the construction footprint in areas near wetlands where avoidance was not practicable. Construction minimization measures would also include incorporation of slope stabilization to prevent sediments from entering wetlands, limiting use of earth moving equipment to upland areas during Construction, and use of large surface area / low impact tires for equipment operating on or near wetlands.

During final pipeline project design Donlin Gold would develop project-specific stabilization, rehabilitation, and reclamation. Applicable measures for avoidance and minimization of potential wetland impacts are outlined in the Natural Gas Pipeline Plan of Development (SRK 2013b). Stabilization of the construction trench would be a multi-year process in some locations, especially in areas with fine grained ice-rich soils and in wetland areas. Site-specific best management practices would be identified and applied.

Effects determinations take into account impact reducing design features (Table 5.2-1 in Chapter 5, Impact Avoidance, Minimization, and Mitigation) proposed by Donlin Gold and also the Standard Permit Conditions and BMPs (Section 5.3) that would be implemented.

Design features important in reducing impacts to wetlands include:

- Temporary ice roads instead of gravel roads would be used for pipeline construction in many places to minimize disturbance to wetlands;
- The project design includes (when practicable) crossing drainages at right angles and use of bridges to reduce impacts and minimize footprint in riparian areas;
- The project design includes routing transmission lines in proximity to roads, where possible, to reduce additional vegetation impacts;
- Areas of disturbed bedrock and surficial deposits along the pipeline ROW, roads, and material sites would be contoured to match existing landforms as feasible, ripped to mitigate compaction effects, covered with growth media as needed and revegetated, and would support the overall drainage of the site, the long-term geotechnical stability, and post-mining land use;
- Where feasible and practicable, valley bottom and lowland material sites will be reclaimed to create new wetland areas with ponds and emergent vegetation or black spruce wetlands;
- Where practicable, large surface area / low impact tires / tracks would be used on or near wetlands to help reduce equipment impacts;
- In final design, site infrastructure, material sites, and roads would avoid ground-disturbing activity in wetland areas whenever practicable. Details would be developed as design and permitting progress. Those details will not be finalized at the Final EIS stage;
- The project design includes developing multiple use facilities – using the same piece of ground for more than one purpose over the life of the mine as well as using existing disturbed areas for temporary construction activities to minimize impacts;

- Siting and design of material sites would include site assessments for the potential for conversion of the sites to wetlands or restoration of the sites to create high(er) functioning wetlands;
- Numerous locations and combinations of locations were analyzed for TSF and WRF layouts during the alternatives development process. These are summarized in Appendix C. The layout of major mine facilities was designed to minimize wetland impacts and limit effects on water quality to the American and Anaconda Creek watersheds. The 404(b)(1) analysis will document the steps taken to minimize wetlands impacts;
- Geosynthetic liner would be used over permafrost in wetland areas to minimize thawing or degradation that could lead to requirements of excessive amounts of fill to avoid shoulder sloughing (i.e., collapse or sliding of shoulder material);
- The mine plan incorporates the concept of design for closure. This incorporates methods for safe and efficient closure of the mine as an integral part of the planned mine design and operations. Implementing design for closure can have the effect of minimizing disturbance and the re-handling of materials;
- Mine transportation facilities, access routes, airstrips and other transportation infrastructure would be sited along ridge tops whenever possible to minimize wetlands and stream impacts;
- Helicopters would be available for logistics to support activities such as monitoring/surveillance or special projects on the transportation corridor; which would reduce the need for overland travel and associated roads/trails;
- Specific siting of the new airstrip was conducted to minimize the amount of cut and fill required for runway construction;
- Approximately 68 percent of the total pipeline length would be constructed during frozen winter conditions to minimize wetland and soil disturbances from support equipment. Areas selected for summer or fall construction would be based on geotechnical, terrain, safety, and continuity considerations; and
- The project design includes installation of pipeline components (temporary roads and pipelines) at most water bodies and wetlands primarily in the winter months when frozen ground and snow are present, flows are lowest, and disturbance of the river, stream banks, and local groundwater would be minimized, or by using horizontal directional drilling (HDD) technology to avoid flow impacts at major pipeline river crossings.

Standard Permit Conditions and BMPs important in reducing impacts to wetlands include:

- Using secondary containment for the storage of all fuel and hazardous or dangerous materials at the shipping terminals, Mine Site area, and gas pipeline alignment during all phases of the proposed project to prevent potential releases from fuel handling, tank failures, or contaminated stormwater from reaching the aquatic environment;
- Implementation of Stormwater Pollution Prevention Plans (SWPPPs) and/or Erosion and Sediment Control Plans (ESCPs) and use of industry standard BMPs for sediment and erosion control;

- Development and maintenance of Oil Discharge Prevention and Contingency Plans (ODPCPs), Spill Prevention, Control and Countermeasure (SPCC) Plans, and Facility Response Plans (FRPs);
- Use of BMPs such as revegetation planning, watering and use of dust suppressants to control fugitive dust;
- Preparation and implementation of a Reclamation and Closure Plan (SRK 2017f); and
- Development of Invasive Species Prevention and Management Plan (ISPMP) and application of industry-standard BMPs relating to nonnative invasive species (NNIS) prevention and management.

Additional measures are being considered by the Corps and cooperating agencies and are further assessed in Chapter 5, Impact Avoidance, Minimization, and Mitigation (Section 5.5 and Section 5.7). Examples of additional measures being considered that are applicable to this resource include:

- Train site construction managers to oversee work of specialists in wetland recognition, permit stipulations, and BMPs;
- Mark wetland boundaries and vegetation clearing limits with flagging or other markers to prevent crews from damaging more vegetation than needed during construction;
- Where practicable, for winter pipeline construction access roads, frost pack muskegs and wetlands (the combination of covering with snow and driving on it causes freezing at depth and provides a slightly elevated running surface) to minimize impacts to vegetative ground cover and wetlands;
- Restore wetlands instead of simply reclaiming the mine and Jungjuk port facilities (e.g., Lower CWD, ore stockpile berm / sump, SOB, and barge landing).
- Evaluate use of slope breakers and trench breakers at wetlands boundaries to prevent trenches from draining wetlands;
- To the extent practicable, avoid wetlands in the positioning of temporary construction facilities, including camps;
- Segregate wetlands soil for use in wetland mitigation to the maximum amount practicable;
- During construction of the pipeline, avoid wetlands impacts by placing above ground appurtenances away from floating bogs and fens;
- Restore flat-to-gently sloping wetlands by removal of fill at project closure where practicable. Removed fill would be transported to approved upland areas for disposition;
- Specific plans for borrow site reclamation would be completed in a later phase of the project. In addition to standard BMPs for contouring, drainage, and erosion controls (Section 3.2, Soils), reclamation should create ponds and / or stream connections for fish and wildlife habitat at borrow sites in low lying areas (e.g., at Getmuna Creek) in accordance with ADEC and ADF&G guidance (McClean 1993; Shannon & Wilson 2012; Owl Ridge 2017c);

- Include additional erosion and sediment control measures such as settling ponds, silt fences, or sediment barriers to minimize the amount of sedimentation from snowmelt;
- Conduct a baseline survey and regular monitoring for nonnative invasive species (NNIS) of all taxa on all disturbed lands on all project components; and
- Implement additional long-term hydrologic monitoring of functioning wetlands.

Compensatory Mitigation

Compensatory mitigation is being considered to offset unavoidable impacts, specified in Donlin Gold's CMP (Appendix M). Where losses would be permanent with no possibility for restoration, compensatory mitigation would be developed where practicable collaboratively with the Corps and other federal, state and local agencies and landowners. Wetland impact minimization activities include restoring wetlands following placement of fill by removing the fill at the end of the mine life and returning the areas to functioning wetlands similar to pre-mining conditions. No compensatory mitigation is being proposed for vegetation clearing, winter roads, or work areas that do not involve placement of fill into wetlands. All compensatory mitigation is proposed through PRM Projects within the Upper Crooked Creek watershed and the Chuitna watershed. No compensatory mitigation is being proposed for the Pipeline component; the primary compensation for wetland damage caused by the pipeline construction would be reclamation of the ROW to reestablish wetlands and wetland functions.

3.11.4.3 ALTERNATIVE 3A – REDUCED DIESEL BARGING: LNG-POWERED HAUL TRUCKS

Alternative 3A would replace diesel fuel with LNG to power the mine haul trucks. Alternative 3A would require construction of an LNG plant and storage tanks near the ore processing plant. It would result in reduced diesel consumption, reduced barge trips, and reduced onsite diesel storage. It would increase natural gas usage, but would not increase the size of the pipeline.

3.11.4.3.1 MINE SITE

The LNG plant, storage containers, and distribution infrastructure footprint would occur within an area that would be disturbed under Alternative 2; therefore, no new impacts to wetlands are anticipated during Construction and Operations. Mine Site Closure would be the same as for Alternative 2.

3.11.4.3.2 TRANSPORTATION CORRIDOR

After the end of the Construction Phase and during Operations, there would be a reduction in the amount of diesel required for the project and hence, the number of fuel barge trips compared to Alternative 2. There would also be a reduction in the number of truck trips between the port and the Mine Site, which may lessen but would not eliminate indirect effects on wetlands from dust and gravel spray along the road. Potential indirect effects on wetlands from construction of diesel storage tanks at Dutch Harbor and Bethel would be reduced or eliminated with the reduced need to transfer and store diesel fuel at these ports. Any actions that would occur at Dutch Harbor or the Port of Bethel at the Bethel Yard Dock are not part of the proposed action, and are considered connected actions (see Section 1.2.1, Connected Actions, in Chapter 1, Project Introduction and Purpose and Need).

The estimated barge traffic on the Kuskokwim River during Operations would be reduced from 122 to 83 round trips, which would reduce seasonal wake energy (Table 3.11-29 and Table 3.11-20) and would also reduce the potential for spills. Projected increases in wetland erosion rates resulting from barge wake energy may be less under Alternative 3A than under Alternative 2.

Table 3.11-29: Alternative 3A Projected Barge-Related Wetland Erosion Rates

Wetland Type	Kuskokwim River Segments			
	Mouth to Bethel	Tuluksak	Kalskag	Aniak to Napaimute
Annual Erosion Rates (acres/mile/year)				
Estuarine and Marine Wetland	4.92	0	0	0
Freshwater Emergent Wetland	3.64	0.03	0.09	0.00
Freshwater Forested/Shrub Wetland	0.51	1.76	0.37	0.17
All Wetlands	9.07	1.79	0.45	0.17
Projected Annual Wetland Erosion Rate Increase (acres/mile/year)[1]				
Seasonal Wake Energy/River Tractive Energy	0.8%	1.3%	1.0%	1.4%
Estuarine and Marine Wetland	0.039	0	0	0
Freshwater Emergent Wetland	0.029	0.000	0.001	0.000
Freshwater Forested/Shrub Wetland	0.004	0.023	0.004	0.002
All Wetlands	0.073	0.023	0.005	0.002

Notes:

1 Seasonal erosion rate calculated from 18-year erosion measure divided by 18 years to give an annual erosion rate (ARCADIS 2007a); increase in wave energy based on 19 fuel and 58 cargo river barge trips per season based on BGC (2007c, 2016a, 2017g).

Source: Analysis based on ARCADIS 2007a; BGC 2007c, 2016a, 2017g; USFWS 2014a

3.11.4.3.3 PIPELINE

The Pipeline component for Alternative 3A would be essentially the same as Alternative 2; therefore, potential impacts to wetlands would be the same between these two alternatives.

3.11.4.3.4 SUMMARY OF IMPACTS FOR ALTERNATIVE 3A

Alternative 3A would result in Mine Site and Pipeline wetland impacts that would be essentially the same as Alternative 2. The overall impact of the Mine Site and Pipeline components on wetlands would be the same as described for Alternative 2.

The overall impact of the Construction and Operations of the Transportation Corridor for Alternative 3A would be similar to Alternative 2, with a potential for elimination of indirect effects from port expansions under Alternative 3A. Many direct effects on wetlands would last beyond the life of the project because the access road and airstrip would be retained to access the Mine Site post-Closure for monitoring. Reduced fuel barging under Alternative 3A would be expected to reduce potential wetland erosion increases from barge wakes. Projected potential increases in wetland erosion rates resulting from barge wake energy represent an increase of 0.8 to 1.4 percent of river tractive energy along Kuskokwim River shorelines. Projected erosion rates, based on the assumed relationship between river tractive energy and shoreline erosion rates, are conservative and would likely not be distinguishable from natural shoreline erosion on the Kuskokwim River. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

3.11.4.4 ALTERNATIVE 3B – REDUCED DIESEL BARGING: DIESEL PIPELINE

Alternative 3B would supply diesel fuel for Mine Site Operations through an 18-inch diameter pipeline from Tyonek in Cook Inlet to the Mine Site. Reduction in barge traffic on the Kuskokwim River would be expected to reduce potential project-related impacts to wetlands as wave energy-related impacts on wetland erosion would be reduced. Reduced fuel barge traffic on the Kuskokwim River would also result in a reduced risk of fuel spills and potential spill-related impacts on wetland and riparian habitats. The diesel fuel pipeline would increase the total area of wetlands impacts with additional access roads and airstrips for spill response and would shift much of the risk of potential diesel spill impacts on wetlands from the Kuskokwim River barge route to the diesel pipeline corridor. This alternative would require a dock in Cook Inlet near Tyonek, a barge landing, staging for spill response equipment, and tanks sufficient to store 10 million gallons of diesel fuel. The diesel pipeline would include a new 19-mile segment from the Tyonek dock to MP 0 (Figure 3.11-24). At MP 0 the diesel pipeline would follow the same 316-mile long route that was evaluated for the natural gas pipeline in Alternative 2.

Alternative 3B:

Two options to Alternative 3B have been added based on Draft EIS comments from agencies and the public:

- Port MacKenzie Option: The Port MacKenzie Option would utilize the existing Port MacKenzie facility to receive and unload diesel tankers instead of the Tyonek facility considered under Alternative 3B. A pumping station and tank farm of similar size to the Tyonek conceptual design would be provided at Port MacKenzie. A pipeline would extend northwest from Port MacKenzie, route around the Susitna Flats State Game Refuge, cross the Little Susitna and Susitna rivers, and connect with the Alternative 3B alignment at approximately MP 28. In this option, there would be no improvements to the existing Tyonek dock; a pumping station and tank farm would not be constructed near Tyonek; and the pipeline from the Tyonek tank farm considered under Alternative 3B to MP 28 would not be constructed.
- Collocated Natural Gas and Diesel Pipeline Option: The Collocated Natural Gas and Diesel Pipeline Option (Collocated Pipeline Option) would add the 14-inch-diameter natural gas pipeline proposed under Alternative 2 to Alternative 3B. Under this option, the power plant would operate primarily on natural gas instead of diesel as proposed under Alternative 3B. The diesel pipeline would deliver the diesel that would be supplied using river barges under Alternative 2 and because it would not be supplying the power plant, could be reduced to an 8-inch-diameter pipeline. The two pipelines would be constructed in a single trench that would be slightly wider than proposed under either Alternative 2 or Alternative 3B and the work space would be five feet

wider. The permanent pipeline ROW would be approximately two feet wider. This option could be configured with either the Tyonek or Port MacKenzie dock options.

3.11.4.4.1 MINE SITE

Infrastructure at the Mine Site would be essentially the same as Alternative 2, with a reduction in the number of fuel storage tanks required. Storage tanks are not likely to be located on wetlands. Potential Alternative 3B impacts to wetlands for the Mine Site are anticipated to be the same as described in Alternative 2.

3.11.4.4.2 TRANSPORTATION CORRIDOR

Infrastructure at the Transportation Corridor, including Angyaruaq (Jungjuk) Port, and the mine access road would be similar to Alternative 2. The requirement for fuel storage at Bethel and Dutch Harbor would be eliminated. A dock extension, storage tanks, operations center and pumping station would be required near the existing Tyonek Dock (Figure 3.11-24). Fuel shipments would be by tanker to Cook Inlet instead of by barge on the Kuskokwim River. An estimated 4.6 acres of estuarine wetlands or waters would potentially be altered by construction of the dock extension (Figure 3.11-24). The tanks and operations center would be constructed on uplands (Figure 3.11-24).

Barge traffic-induced wetland erosion rates would be reduced by elimination of the need for fuel barges during the Operation Phase; barge traffic for cargo would remain the same as Alternative 2. Estimated barge traffic would be reduced from 122 to 64 round trips, which may reduce seasonal wake energy in Alternative 3B (Table 3.11-30) and would also reduce the potential for spills.

3.11.4.4.3 PIPELINE

An 18-inch diesel pipeline would be constructed instead of the natural gas pipeline along the same alignment proposed in Alternative 2, except that the pipeline would begin near Tyonek and would extend 19 miles before joining the proposed Alternative 2 pipeline route at MP 0 (Figure 3.11-24). There would also be additional requirements for block valves, long-term access roads and airstrips for spill response equipment staging for a diesel versus a natural gas pipeline. Construction of the diesel pipeline from Tyonek would affect an estimated 1,491 acres of wetlands, with 54 percent of impacts on deciduous scrub shrub wetlands (Table 3.11-31). The additional 19 miles of ROW would impact an estimated 83 acres of primarily slope (81 percent) wetlands in the Cook Inlet Ecoregion, and an additional 4.6 acres of estuarine habitat for the dock (Table 3.11-32). Construction of the diesel pipeline from Port MacKenzie would affect an estimated 1,481 acres of wetlands, with 52 percent of impacts on deciduous scrub shrub wetlands (Table 3.11-32). The 48 miles of ROW would impact an estimated 120 acres of wetlands in the Cook Inlet Ecoregion, with 38 percent of impacts on forested wetlands (Figure 3.11-25).

Construction of the collocated pipelines would affect an estimated 1,537 and 1,574 acres of wetlands with the diesel pipelines originating at either Tyonek or Port MacKenzie, respectively (Table 3.11-31).

Table 3.11-30: Alternative 3B Projected Barge-Related Wetland Erosion Rates

Wetland Type	Kuskokwim River Segments			
	Mouth to Bethel	Tuluksak	Kalskag	Aniak to Napaimute
Annual Erosion Rates (acres/mile/year)				
Estuarine and Marine Wetland	4.92	0	0	0
Freshwater Emergent Wetland	3.64	0.03	0.09	0.00
Freshwater Forested/Shrub Wetland	0.51	1.76	0.37	0.17
All Wetlands	9.07	1.79	0.45	0.17
Projected Annual Wetland Erosion Rate Increase (acres/mile/year)[1]				
Seasonal Wake Energy/River Tractive Energy	0.6%	0.9%	0.7%	1.1%
Estuarine and Marine Wetland	0.030	0	0	0
Freshwater Emergent Wetland	0.022	0.000	0.001	0.000
Freshwater Forested/Shrub Wetland	0.003	0.016	0.003	0.002
All Wetlands	0.055	0.016	0.004	0.002

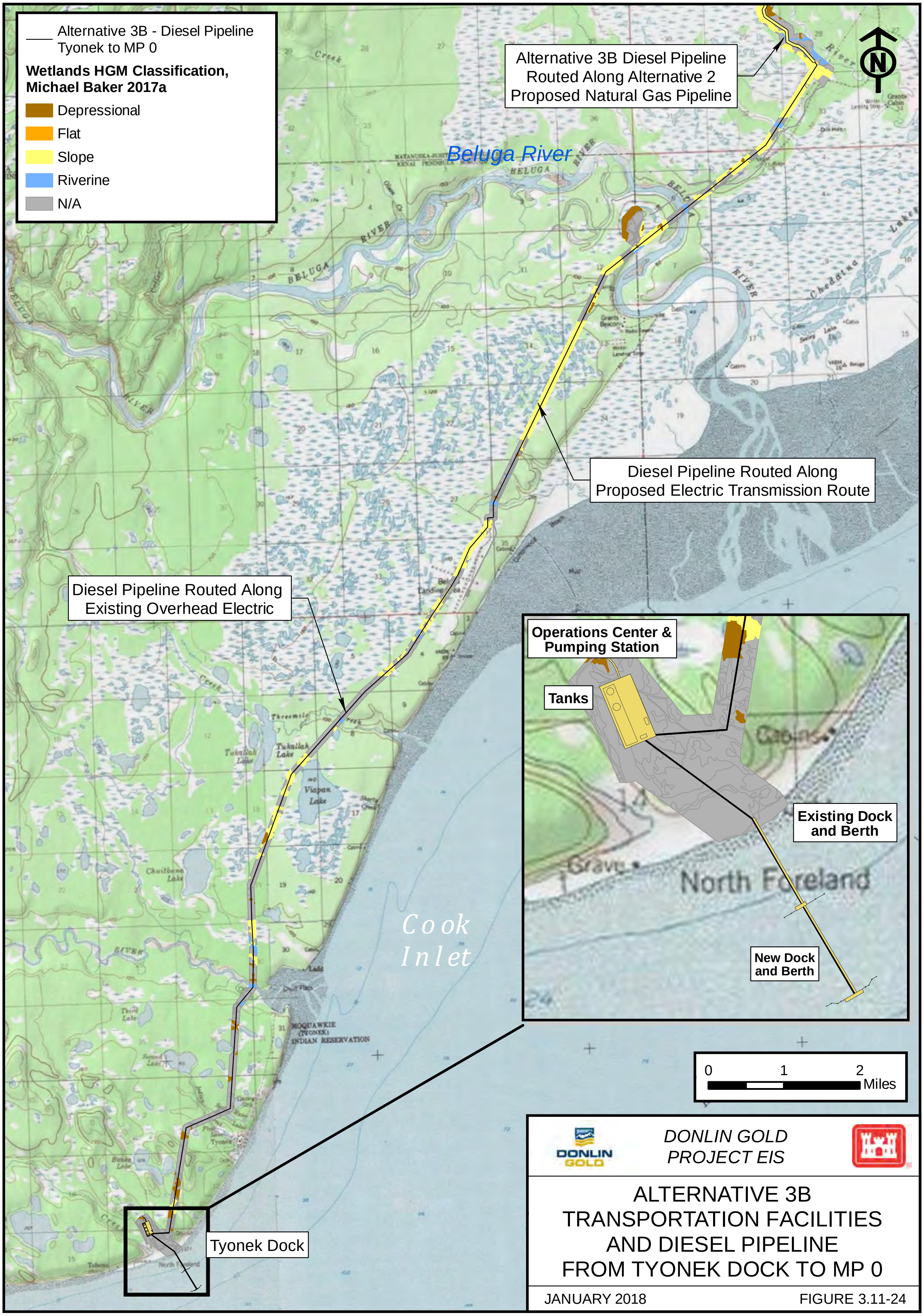
Notes:

1 Seasonal erosion rate calculated from 18-year erosion measure divided by 18 years to give an annual erosion rate (ARCADIS 2007a); increase in wave energy based on 58 cargo river barge trips per season based on BGC (2007c, 2016a, 2017g).

Source: Analysis based on ARCADIS 2007a; BGC 2007c, 2016a, 2017g; USFWS 2014a

During the Operations Phase, all access improvements (roads and airstrips) would be maintained for spill response for the diesel pipeline rather than most being removed and reclaimed after the Construction Phase is completed as in the case of the natural gas pipeline. Periodic vegetation maintenance would be required to prevent trees and large shrubs from growing within the maintained pipeline ROW as described for Alternative 2. The pipeline would operate at ambient temperatures and would be unlikely to increase or decrease soil temperatures as it crosses into and out of permafrost soils. Termination of the diesel pipeline would presumably be similar to Alternative 2 with any above ground facilities removed and the pipeline left buried in place. There would be an additional effort to flush any remaining diesel fuel from the pipeline prior to abandonment, which may lead to an increased potential for spills during termination over the natural gas pipeline.

Operations impacts from the diesel pipeline on wetlands would include retention of all airstrips and access roads for spill response and the 50-foot or 51-foot operational ROW (Table 3.11-32). The Collocated Pipeline Option would require a 52-foot operational ROW (Table 3.11-32).



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ALTERNATIVE 3B TRANSPORTATION FACILITIES AND DIESEL PIPELINE FROM TYONEK DOCK TO MP 0

JANUARY 2018

FIGURE 3.11-24

Table 3.11-31: Alternative 3B and Options Comparison of Wetland Direct Impacts from Construction

Wetland Category	Alternative 3B Diesel Pipeline Impacts Comparison (Acres)[1]		Collocated Pipeline Impacts Comparison (Acres)[2]	
	Alternative 3B[3]	Port MacKenzie Option[4]	Collocated Pipeline Option[5]	Collocated Pipeline Configured with Port MacKenzie[6]
Evergreen Forested Wetlands	262.9	282.7	271.0	293.3
Deciduous Forested Wetlands	13.1	28.4	13.7	32.0
Mixed Forested Wetlands	33.7	24.5	35.1	33.9
Evergreen Scrub Shrub Wetlands	258.7	262.5	267.9	277.5
Deciduous Scrub Shrub Wetlands	810.0	772.5	833.9	816.6
Bogs (LSB)	394.8	370.1	407.4	389.9
Fens (ESB–SB)	67.8	66.6	67.8	66.6
Herbaceous Wetlands	72.9	63.5	75.1	70.5
Ponds	1.8	1.0	1.9	1.1
Lakes	0.0	1.4	0.0	1.4
Rivers	37.5	44.6	38.7	45.9
Uplands	5,878.6	5,871.9	6,043.1	6,429.3
Total Area	7,369.1	7,353.1	7,580.3	8,001.5
Total Wetland/Water Area	1,490.5	1,481.1	1,537.2	1,574.2
Intermittent Streams (Miles)	2.4	1.7	2.5	2.5
Perennial Streams (Miles)	9.8	7.8	10.2	9.9

Notes:

1 Construction impacts were based on a 100 foot wide construction ROW for the diesel pipeline. Pumping facilities and tank farm are included for the options. Alternative 3B would include 3 additional airstrips: Tatlawiksuk Airstrip (wetland mapping not available), Puntilla Airstrip (100% mapped for wetlands – 70.2 acres), and George River Airstrip (NWI indicates this is an upland site – 72.9 acres).These impacts are added to Alternative 2 impacts.

2 Construction impacts were based on a 100 foot wide construction ROW for the diesel pipeline. Pumping facilities and tank farm are included for the option. Alternative 3B would include 3 additional airstrips. These impacts are added to Alternative 2 impacts which were increased by 5 percent for the pipeline construction ROW and 8 percent for pipe storage yards for the collocated pipelines.

3 Alternative 3B impacts plus Alternative 2 from MP 0 to MP 315 construction impacts. Estuarine impacts excluded.

4 Port MacKenzie Option impacts plus Alternative 2 from MP 28 to MP 315 construction impacts.

5 Alternative 3B impacts plus Alternative 2 increased by 5 to 8 percent from MP 0 to MP 315 construction impacts. Estuarine impacts excluded.

6 Collocated Pipeline Option configured with Port MacKenzie impacts plus Alternative 2 impacts increased by 5 to 8 percent from MP 0 to MP 315 construction impacts.

See Figure 3.11-21 for illustration of HGM classes.
NA = Not Applicable
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
ESB–SB = Ericaceous Shrub Bog – String Bog Wetland Subcategory
Source: Michael Baker 2017a; Michael Baker 2017b, USFWS 2014a

Table 3.11-32: Alternative 3B and Options Comparison of Wetland Direct Impacts from Operations

Wetland Category	Impacts Comparison (Acres)[1]		Impacts Comparison (Acres)[2]	
	Alternative 3B[3]	Port MacKenzie Option[4]	Alternative 3B with Collocated Pipeline Option [5]	Alternative 3B with Collocated Pipeline Option configured with Port MacKenzie [3]
Evergreen Forested Wetlands	115.6	126.5	118.2	130.2
Deciduous Forested Wetlands	6.5	4.5	6.7	6.6
Mixed Forested Wetlands	15.0	10.4	15.4	14.8
Evergreen Scrub Shrub Wetlands	101.9	103.7	104.6	109.5
Deciduous Scrub Shrub Wetlands	347.1	328.9	354.7	343.9
Bogs (LSB)	146.9	145.7	150.8	152.7
Fens (ESB–SB)	5.8	9.2	5.8	9.2
Herbaceous Wetlands	28.8	24.0	29.5	26.5
Ponds	1.2	0.8	1.2	0.8
Lakes	0	0.7	0	0.7
Rivers	21.1	23.7	21.8	24.5
Uplands	2,494.0	2,525.2	2,542.7	2,717.6
Total Area	3,112.0	3,129.2	3,175.6	3,355.9
Total Wetland/Water Area	637.2	623.2	652.1	657.5
Intermittent Streams (Miles)	2.4	1.7	2.5	2.4
Perennial Streams (Miles)	9.8	7.8	10.2	9.6

Notes:

1 Operations impacts were based on a 50 foot wide permanent ROW for the diesel pipeline from the operations facility at Tyonek to MP 0 of the Alternative 2 pipeline or from Port MacKenzie to MP 28 of the Alternative 2 pipeline. These impacts are added to Alternative 2 operation impacts. A footprint for the pumping facilities and tank farm are included for the options. Alternative 3B would include 3 additional airstrips: Tatlawiksuk Airstrip (wetland mapping not available), Puntilla Airstrip (100% mapped for wetlands – 70.2 acres), and George River Airstrip (NWI indicates this is an upland site – 72.9 acres).

2 Operations impacts were based on a 50 foot wide permanent ROW for the diesel pipeline from the operations facility at Tyonek to MP 0 of the Alternative 2 pipeline or from Port MacKenzie to MP 28 of the Alternative 2 pipeline. These impacts are added to Alternative 2 operations impacts which are increased from a 50 to 51 foot wide permanent ROW to a 52 foot wide permanent ROW. A footprint for the pumping facilities and tank farm are included for the options. Alternative 3B would include 3 additional airstrips: Tatlawiksuk Airstrip (wetland mapping not available), Puntilla Airstrip (100% mapped for wetlands – 70.2 acres), and George River Airstrip (NWI indicates this is an upland site – 72.9 acres).

3 Alternative 3B impacts plus Alternative 2 from MP 0 to MP 315 operation impacts. A footprint for the pumping facilities and tank farm are included for the Tyonek Option.

4 Port MacKenzie Option added impacts plus Alternative 2 from MP 28 to MP 315 operation impacts.

5 Collocated Pipeline impacts plus Alternative 2 from MP 0 to MP 315 operation impacts. A footprint for the pumping facilities and tank farm are included for Alternative 3B.

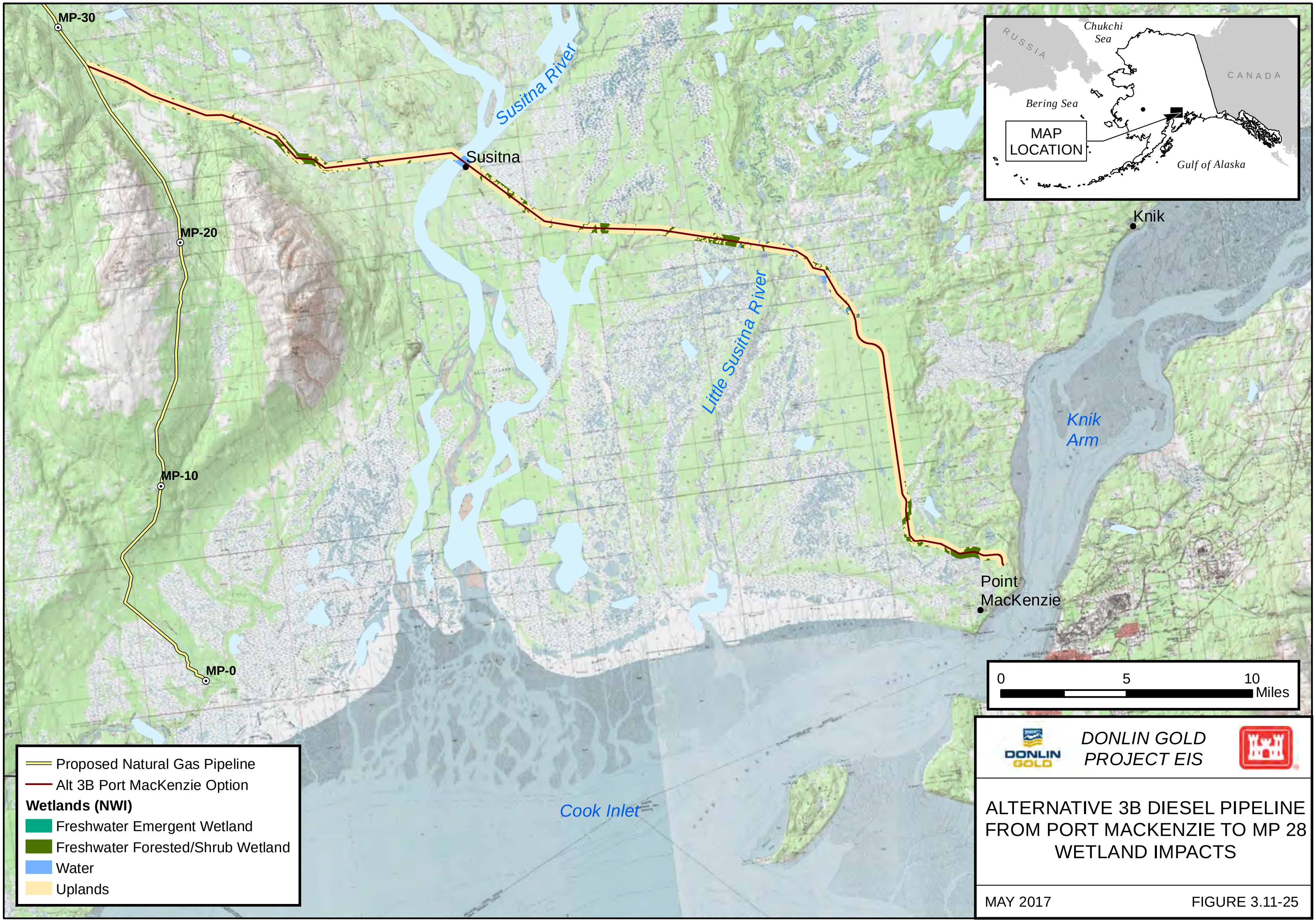
6 Collocated Pipeline configured with the Port MacKenzie Option added impacts plus Alternative 2 from MP 0 to MP 315 operation impacts.

See Figure 3.11-21 for illustration of HGM classes.
NA = Not Applicable
0 = None
LSB = Low Shrub Bog Wetland Subcategory
ESB – SB = Ericaceous Shrub Bog – String Bog Wetland Subcategory
Source: Michael Baker 2017a, USFWS 2014a

3.11.4.4.4 SUMMARY OF IMPACTS FOR ALTERNATIVE 3B

The overall impact of the Mine Site on wetlands would be the same for both Alternative 3B and Alternative 2, as described for Alternative 2. The overall impact of the Construction and Operations of the Transportation Corridor for Alternative 3B would be similar to Alternative 2; with an elimination of indirect effects from port expansions at Dutch Harbor and Bethel (connected actions), diesel storage at Angyaruaq (Jungjuk) Port, and addition of a new dock extension and diesel storage facility at Tyonek. Some wetland impacts would last beyond the life of the project; for example, the road and airstrip would be retained for access post-Closure for monitoring. Elimination of fuel barges under Alternative 3B may reduce wetland erosion rates from barge wake energy with an estimated increase of 0.6 to 1.1 percent of river tractive energy along Kuskokwim River shorelines. Projected erosion rates, based on the assumed relationship between river tractive energy and shoreline erosion rates, are conservative and would likely not be distinguishable from natural shoreline erosion on the Kuskokwim River.

Alternative 3B Pipeline Construction impacts on wetlands would be similar to Alternative 2, although impacts would be increased by 154 acres (144 acres for the Port MacKenzie Option) of wetlands. In addition, the dock at Tyonek would also impact a small area of estuarine wetlands and waters. The Collocated Pipelines Option would increase impacts over Alternative 2 by 200 (237 acres if configured with Port MacKenzie) of wetlands. Alternative 3B diesel pipeline operations effects on wetlands would be similar to Alternative 2. The diesel pipeline wetland impact duration, extent, and context would be similar to the Alternative 2 natural gas pipeline, although areas for access roads and airstrips would not be reclaimed prior to termination of pipeline operations. Impacts associated with climate change would also be the same as those discussed for Alternative 2. The overall direct and indirect effects of the Construction, Operations, and Closure for Alternative 3B on wetlands would be the same as for Alternative 2.



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ALTERNATIVE 3B DIESEL PIPELINE FROM PORT MACKENZIE TO MP 28 WETLAND IMPACTS

MAY 2017

FIGURE 3.11-25

3.11.4.5 ALTERNATIVE 4 – BIRCH TREE CROSSING (BTC) PORT

This alternative would move the port facility 75 miles downriver from Angyaruaq (Jungjuk) (Alternative 2) to BTC. This would reduce barge distances for freight and diesel but would increase the mine access road distance from 30 miles in Alternative 2, to 76 miles in Alternative 4.

3.11.4.5.1 MINE SITE

The Mine Site activities and wetland impacts for Alternative 4 would be the same as Alternative 2.

3.11.4.5.2 TRANSPORTATION CORRIDOR

Transportation Corridor facilities would move the port site from Angyaruaq (Jungjuk) to BTC; the access road from the port site to the Mine Site would increase in length by 46 miles; and the airstrip and access road for the Mine Site would remain the same between Alternative 4 and Alternative 2. A temporary winter ice road from the vicinity of the Village of Crooked Creek to the Mine Site would be required to access material sites and begin construction of the BTC Road from the Mine Site. Construction and Operations activities at Bethel and Dutch Harbor Ports (connected actions) would be the same as for Alternative 2.

Construction of the BTC road, BTC port, and the mine airstrip and access road would disturb 564 acres of primarily flat HGM class wetlands (Table 3.11-33, Figure 3.11-26). Some of these impacts would last beyond the life of the project as it is likely that the road and airstrip would remain to facilitate closure monitoring at the Mine Site.

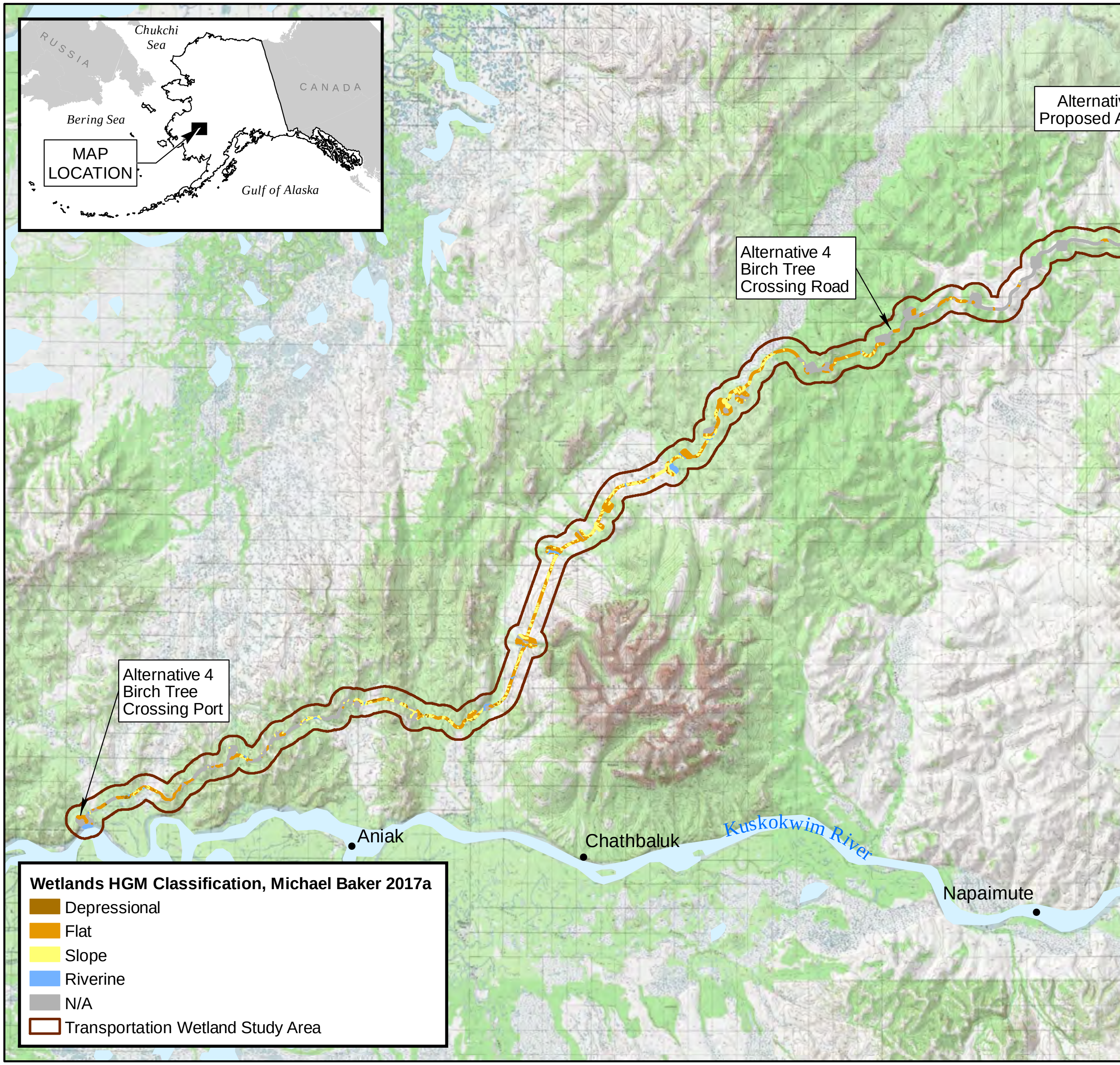
Roads and dust generated by traffic can change soil pH and bulk density and cause drifting and dust deposition on snow that result in early spring melt and deeper active layers in areas with permafrost (Auerbach et al. 1997). Dust deposition likely would be heaviest within about 33 feet (10 meters) of the most heavily trafficked road, the BTC Road, but may influence vegetation and soils within about 328 feet (100 meters) (Auerbach et al. 1997; Ford and Hasselbach 2001; Hasselbach et al. 2005). Water trucks would be used to reduce fugitive dust from traffic on the road, and culverts would be placed to maintain hydrologic connections. Over half (52 percent) of the 564 acres of wetlands impacted by road construction and materials sites are likely supported by permafrost based on reconnaissance surveys and road borings summarized by RECON (2007a, 2007c and DMA 2007a). Geotextile and road fill would be used to insulate the permafrost and prevent thermokarst. Indirect effects from the BTC Road may result in some degradation or alteration of an estimated 2,006 acres of wetlands (Table 3.11-34).

Construction of the Crooked Creek winter trail for building the BTC Road would result in temporary impacts to waters and herbaceous wetlands and long-term to permanent impacts to scrub shrub and forested wetlands (Table 3.11-35). Winter trail construction would likely require some clearing and compaction which may result in conversion of scrub shrub and forested wetlands to herbaceous wetlands. Any areas with soil disturbance would be revegetated as required. Converted wetlands would be expected to eventually transition back to scrub shrub or forested wetlands over periods of several years to decades.

Table 3.11-33: Alternative 4 Birch Tree Crossing Transportation Corridor Wetland Direct Impacts during Construction and Operations Phases

Wetland Category	HGM Class (Acres)					Impact Area (Acres)	Study Area (Acres)	Area[1] (%)
	Depression	Flat	Slope	Riverine	River Channel			
Evergreen Forested Wetlands	0	97.0	24.7	4.8	0	126.5	1,383.7	9%
Deciduous Forested Wetlands	0	0	0	3.3	0	3.3	16.2	20%
Mixed Forested Wetlands	0	0	0.1	2.1	0	2.2	54.5	4%
Evergreen Scrub Shrub Wetlands	0	116.8	26.2	0	0	143.0	2,749.8	5%
Deciduous Scrub Shrub Wetlands	0.1	133.3	22.2	14.2	0	169.8	1,330.7	13%
Bogs (LSB)	0	19.3	0	0	0	19.3	107.0	18%
Herbaceous Wetlands	0.6	82.3	23.0	2.0	0	107.9	898.3	12%
Ponds	0.0	0	0	0	0	0.0	8.7	<1%
Rivers	0	0	0	0	11.4	11.4	171.9	7%
Uplands	NA	NA	NA	NA	NA	1,142.2	6,225.5	18%
Total Area	0.7	429.4	96.2	26.4	11.4	1,706.3	12,839.3	13%
Wetland/Water Totals	<1%	76%	17%	5%	2%	564.1	6,613.8	9%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	0.4	4.0	10%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	1.1	22.2	5%

Notes:
1 Proportion of impact area in mine transportation wetland study area by wetland category.
NA = Not Applicable
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
Source: Michael Baker 2017a



DONLIN GOLD PROJECT EIS

ALTERNATIVE 4
BIRCH TREE CROSSING
WETLAND IMPACTS

JANUARY 2018

FIGURE 3.11-26

Table 3.11-34: Alternative 4 Birch Tree Crossing Road Calculation of Wetland Potential Fugitive Dust Indirect Impacts

Wetland Category	HGM Class (Acres)					Impact Area[1] (Acres)	Study Area (Acres)	Area[2] (%)
	Depression	Flat	Slope	Riverine	River Channel			
Evergreen Forested Wetlands	0	262.5	84.8	7.2	0	354.5	1,383.7	26%
Deciduous Forested Wetlands	0	0	0.7	0	0	0.7	16.2	4%
Mixed Forested Wetlands	0	0.1	0.5	2.0	0	2.6	54.5	5%
Evergreen Scrub Shrub Wetlands	0	492.7	105.9	0.3	0	598.9	2,749.8	22%
Deciduous Scrub Shrub Wetlands	1.3	344.2	117.4	47.5	0	510.4	1,330.7	38%
Bogs (LSB)	0	2.5	0.2	0	0	2.7	107.0	3%
Herbaceous Wetlands	7.8	414.5	97.8	11.8	0	531.9	898.3	59%
Ponds	0.4	0	0	0.1	0	0.5	8.7	6%
Rivers	0	0	0	0	6.6	6.6	171.9	4%
Uplands	NA	NA	NA	NA	NA	2,002.9	6,225.5	32%
Total Area	9.5	1,514.0	407.1	68.9	6.6	4,009.0	12,839.3	31%
Wetland/Water Totals	1%	76%	20%	3%	<1%	2,006.1	6,613.8	30%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	1.3	4.0	32%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	6.6	22.2	30%

Notes:

1 Indirect impact area from dust within 328 feet (100 meter) around Birch Tree Crossing road; material sites, and road footprint excluded. Wetland mapping covers about 72 percent of the potential impact area.

2 Proportion of impact area in mine transportation wetland study area by wetland category.

NA = Not Applicable

0 = None

LSB = Low Shrub Bog Wetland Subcategory

Source: Michael Baker 2017a

No facilities would be constructed along the barge route through the Kuskokwim River wetland study area. Barge traffic would be the same level as Alternative 2, but the stretch of the river traveled by barges would be shortened by 75 river miles, eliminating the potential for wake-energy induced increases in wetland erosion rates of 0.004 acre/mile/year for this segment from Aniak to Napaimute in Alternative 2 (Table 3.11-20). The projected erosion rate would likely not be distinguishable from natural shoreline erosion on the Kuskokwim River. The shortened route would also reduce the potential for grounding and fuel or chemical spills upriver from the BTC Port.

During Closure, the BTC port facilities would be removed and the site would be reclaimed similar to the Angyaruaq (Jungjuk) port facilities, but the BTC Road and the airstrip would remain to facilitate access to the site for post-Closure monitoring. Reclamation of the port facility would include removal of all facilities, sheet piles, foundations, and drainage control structures. The port area would be regraded to approximate original contours or acceptable slopes, decompacted, covered with growth media if necessary, and seeded to promote vegetative growth. Most flat to gently sloping wetlands would be reclaimed by removal of fill.

Fill would not likely be removed in areas where marginal hydrology of wetlands or upland mosaics with wetland inclusions makes restoration of wetlands not feasible.

Table 3.11-35: Alternative 4 Wetland Direct Impacts from Crooked Creek Winter Trail Construction

Wetland Category	HGM Class (Acres)					Impact Area (Acres)	Study Area (Acres)	Area[1] (%)
	Depression	Flat	Slope	Riverine	River Channel			
Evergreen Forested Wetlands	0	4.8	2.5	0.1	0	7.4	1,383.7	1%
Deciduous Forested Wetlands	0	0	0	0	0	0	16.2	0%
Mixed Forested Wetlands	0	0	0.0	0.1	0	0.1	54.5	<1%
Evergreen Scrub Shrub Wetlands	0.3	20.2	4.3	0.0	0	24.8	2,749.8	1%
Deciduous Scrub Shrub Wetlands	0.2	19.1	18.7	1.9	0	39.9	1,330.7	3%
Bogs (LSB)	0	6.2	1.1	0	0	7.3	107.0	7%
Herbaceous Wetlands	1.0	0.2	4.0	0.4	0	5.6	898.3	1%
Ponds	0.0	0	0	0	0	0.0	8.7	<1%
Rivers	0	0	0	0	0.8	0.8	171.9	<1%
Uplands	NA	NA	NA	NA	NA	6.3	6,225.5	<1%
Total Area	1.5	44.3	29.5	2.5	0.8	84.9	12,839.3	1%
Wetland/Water Totals	2%	56%	38%	3%	1%	78.6	6,613.8	1%
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	0.2	4.0	4%
Perennial Streams (Miles)	NA	NA	NA	NA	NA	0.3	22.2	1%

Notes:
1 Proportion of impact area in mine transportation wetland study area by wetland category.
NA = Not Applicable
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
Source: Michael Baker 2017a

3.11.4.5.3 PIPELINE

The Pipeline component under Alternative 4 would be identical to Alternative 2.

3.11.4.5.4 SUMMARY OF IMPACTS FOR ALTERNATIVE 4

Alternative 4 Mine Site and Pipeline Construction and Operations would be the same as Alternative 2. The Alternative 4 Transportation Corridor Construction and Operations would directly affect 564 acres of wetlands and may potentially indirectly affect an additional 2,006 acres of wetlands through dust deposition (Table 3.11-36). Most direct effects would last beyond the life of the project because the road and airstrip would not be reclaimed. Some wetlands and their associated functions may be reestablished at the port site at Closure. The BTC road would affect wetlands in the vicinity of the road, ice road, and airstrip across multiple watersheds. Many impacts (48 percent) would be to black spruce dominated wetlands (evergreen scrub shrub and forested wetlands) and deciduous scrub shrub wetlands that are common throughout the region. High-value wetlands crossed include wetlands that support anadromous fish streams, and bog wetlands. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

Table 3.11-36: Alternative 4 Birch Tree Crossing Summary of Wetland Direct and Indirect Impacts in the Transportation Corridor

Wetland Category	Construction, and Direct Impact Area[1] (Acres)	Potential Indirect BTC Road Fugitive Dust Impact Area[2] (Acres)	Crooked Creek Winter Trail Direct Impact Area[3] (Acres)
Evergreen Forested Wetlands	126.5	354.5	7.4
Deciduous Forested Wetlands	3.3	0.7	0
Mixed Forested Wetlands	2.2	2.6	0.1
Evergreen Scrub Shrub Wetlands	143.0	598.9	24.8
Deciduous Scrub Shrub Wetlands	169.8	510.4	39.9
Bogs (LSB)	19.3	2.7	7.3
Herbaceous Wetlands	107.9	531.9	5.6
Ponds	0.0	0.5	0.0
Rivers	11.4	6.6	0.8
Total Wetland/Water Area	564.1	2,006.1	78.6
Intermittent Streams (Miles)	0.4	1.3	0.2
Perennial Streams (Miles)	1.1	6.6	0.3

Notes:
1 Based on 55-foot wide road, material sites, airstrip, access roads, and port site.
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory

3.11.4.6 ALTERNATIVE 5A – DRY STACK TAILINGS

Alternative 5A evaluates alternate methods for handling tailings.

This alternative includes two options:

- Unlined Option: The TSF would not be lined with an LLDPE liner. The area would be cleared and grubbed and an underdrain system placed in the major tributaries under the TSF and operating pond to intercept groundwater base flows and infiltration through the DST and convey it to a Seepage Recovery System (SRS). Water collecting in the SRS pond would be pumped to the operating pond, lower CWD, or directly to the processing plant for use in process.

- Lined Option: The DST would be underlain by a pumped overdrain layer throughout the footprint, with an impermeable LLDPE liner below. The rock underdrain and foundation preparation would be completed in the same manner as the Unlined Option.

Both Options of Alternative 5A would use the same Transportation Corridor and Pipeline facilities as Alternative 2. For the two Alternative 5A Options, the differences for direct wetland impacts would be limited to the footprint of the TSF (Figure 3.11-27).

3.11.4.6.1 MINE SITE

Compared to Alternative 2, Alternative 5A Unlined Option would directly affect an estimated 15 fewer acres of wetlands (Table 3.11-38).

Compared to Alternative 2, Alternative 5A Lined Option would directly affect an estimated 7 fewer acres of wetlands (Table 3.11-37).

Potential indirect effects from fugitive dust would be increased during Operations under Alternative 5A compared to Alternative 2 because the tailings would be dewatered prior to transfer to the TSF. The upper and lower Contact Water ponds, and American and Snow Gulch reservoirs, would remain the same under both alternatives. At closure, the pond and dam liners would be removed and the area would be reclaimed. Because the Operating Pond area for Alternative 5A Unlined and Lined Options (about 40 percent of the TSF footprint) would not be filled with tailings, reclamation to previous contours, wetland types and function may be more successful. Overall, the effects of Alternative 5A Unlined and Lined Options on wetlands would be similar to those of Alternative 2.

3.11.4.6.2 TRANSPORTATION CORRIDOR

An increase in the amount of cargo required for the filter plant infrastructure and consumables would occur during Operations (after the end of the Construction Phase). Also, additional earth moving equipment will be required to transport and compact the tailings; there would be an increase from 64 to 71 cargo barge trips during Operations. The number of cargo barge trips is similar to Alternative 2 and would be expected to have similar impacts

The estimated barge traffic on the Kuskokwim River during operations would be increased from 122 to 129 round trips, which would increase seasonal wake energy (Table 3.11-30 and Table 3.11-20). The potential for spills would be the same as Alternative 2. Projected increases in wetland erosion rates of 1.3 to 2.2 percent of river tractive energy along Kuskokwim River shorelines would be similar to Alternative 2 (Table 3.11-38). Projected erosion rates, based on the assumed relationship between river tractive energy and shoreline erosion rates, are conservative and would likely not be distinguishable from natural shoreline erosion on the Kuskokwim River.

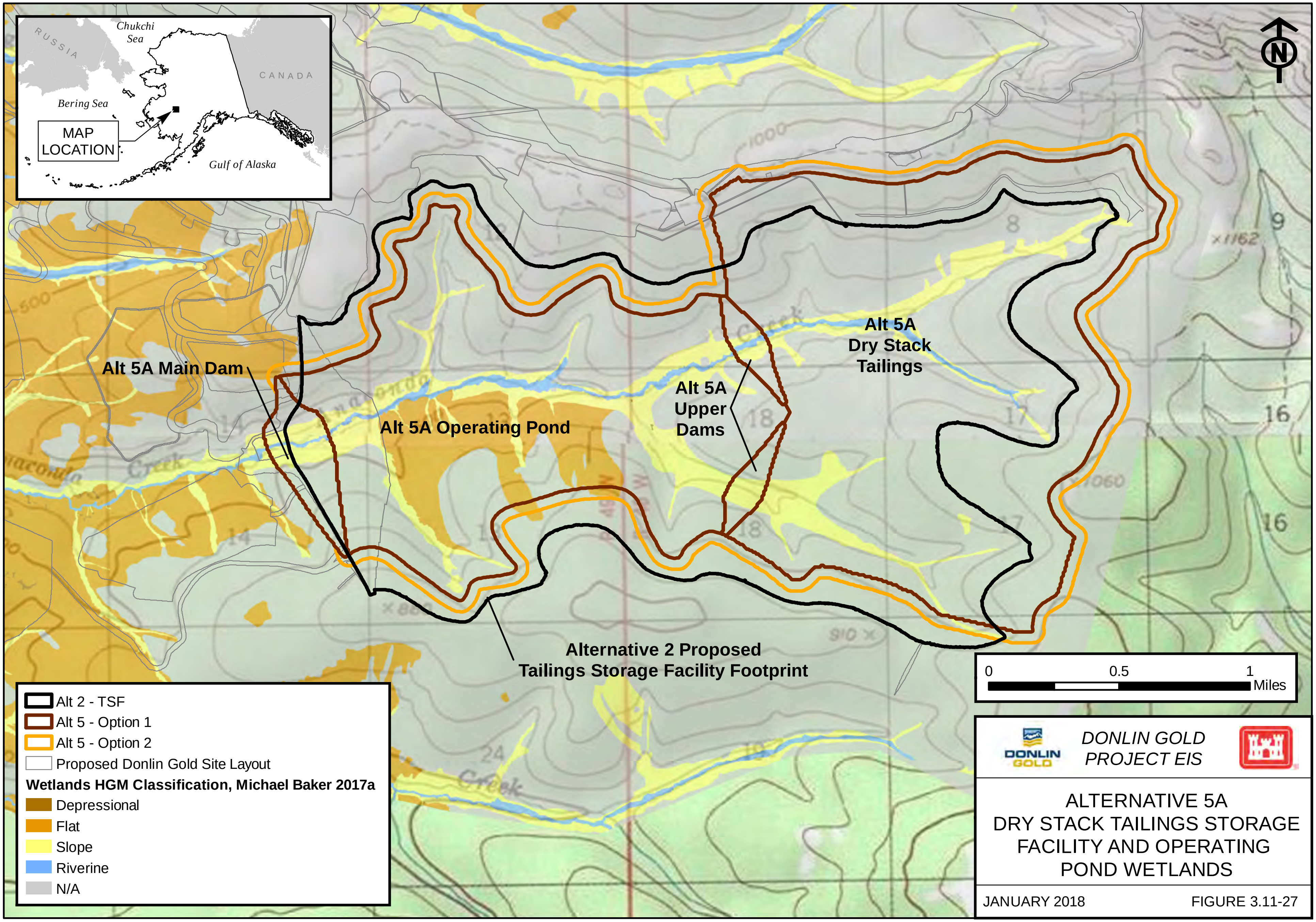

Chukchi Sea
RUSSIA
CANADA
Bering Sea
MAP LOCATION
Gulf of Alaska
Alt 5A Main Dam
Alt 5A Operating Pond
Alt 5A Upper Dams
Alt 5A Dry Stack Tailings
Alternative 2 Proposed Tailings Storage Facility Footprint
Alt 2 - TSF
Alt 5 - Option 1
Alt 5 - Option 2
Proposed Donlin Gold Site Layout
Wetlands HGM Classification, Michael Baker 2017a
Depressional
Flat
Slope
Riverine
N/A
0
0.5
1
Miles
N
DONLIN GOLD PROJECT EIS
ALTERNATIVE 5A DRY STACK TAILINGS STORAGE FACILITY AND OPERATING POND WETLANDS
JANUARY 2018
FIGURE 3.11-27

Table 3.11-37: Alternative 5A Tailings Storage Facility/Operating Pond Comparison of Calculation of Wetland Direct Impacts

Wetland Category	Alternative 5A, Unlined Option Dry Tailings[1] (Acres)	Alternative 5A, Lined Option Dry Tailings[1] (Acres)	Alternative 2 Wet Tailings[1] (Acres)
Evergreen Forested Wetlands	192.8	196.1	196.6
Deciduous Forested Wetlands	0	0	0
Mixed Forested Wetlands	4.6	4.6	4.6
Evergreen Scrub Shrub Wetlands	231.8	236.6	240.4
Deciduous Scrub Shrub Wetlands	77.8	77.9	80.2
Herbaceous Wetlands	3.8	3.8	3.8
Ponds	0.2	0.2	0.2
Rivers	0.3	0.3	0.3
Uplands	1,951.7	2,234.0	1,865.3
Total Area	2,463.0	2,753.5	2,391.4
Total Wetland/Water Area	511.3	519.5	526.1

Notes:
1 See Figure 3.11-27 for distribution of HGM classes within the TSF configurations for Alternative 5A, Unlined and Lined Options, and Alternative 2.
0 = None
0.0 = < 0.1
Source: Michael Baker 2017a

3.11.4.6.3 SUMMARY OF IMPACTS FOR ALTERNATIVE 5A

Potential Alternative 5A Mine Site TSF/Operating Pond effects on wetlands would result in an observable reduction in wetland abundance and alteration of function encompassing much of the local Anaconda Creek watershed. Effects would extend from the end of Construction through the life of the mine, and may last beyond the life of the mine. Overall impacts to wetlands would be decreased by about 15 and 7 acres during construction and operations for Alternative 5A Unlined and Lined Options, respectively, compared to Alternative 2. A primary difference between Alternative 5A with dry stack tailings and Alternative 2 with wet tailings may be in the potential for successful reestablishment of a larger area as wetlands after closure of the TSF/Operating Pond facilities. Reestablishment of wetlands within the operating pond area may be more successful for Alternative 5A because only process water and non-filterable tailings would be placed in the operating pond and original contours would not likely be substantially changed. Most impacts (425 or 433 acres) for Alternative 5A would be to black spruce dominated wetlands (evergreen scrub shrub and forested wetlands) that are common throughout the region. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

Table 3.11-38: Alternative 5A Projected Barge-Related Wetland Erosion Rates

Wetland Type	Kuskokwim River Segments			
	Mouth to Bethel	Tuluksak	Kalskag	Aniak to Napaimute
Annual Erosion Rates (acres/mile/year)				
Estuarine and Marine Wetland	4.92	0	0	0
Freshwater Emergent Wetland	3.64	0.03	0.09	0.00
Freshwater Forested/Shrub Wetland	0.51	1.76	0.37	0.17
All Wetlands	9.07	1.79	0.45	0.17
Projected Annual Wetland Erosion Rate Increase (acres/mile/year)[1]				
Seasonal Wake Energy/River Tractive Energy	1.3%	2.1%	1.6%	2.2%
Estuarine and Marine Wetland	0.064	0	0	0
Freshwater Emergent Wetland	0.047	0.001	0.001	0.000
Freshwater Forested/Shrub Wetland	0.007	0.037	0.006	0.004
All Wetlands	0.118	0.038	0.007	0.004

Notes:

1 Seasonal erosion rate calculated from 18-year erosion measure divided by 18 years to give an annual erosion rate (ARCADIS 2007a); increase in wave energy based on 58 fuel and 65 cargo river barge trips per season based on BGC (2007c, 2016a, 2017g).

Source: Analysis based on ARCADIS 2007a; BGC 2007c, 2016a, 2017g; USFWS 2014a

3.11.4.7 ALTERNATIVE 6A – MODIFIED NATURAL GAS PIPELINE ALIGNMENT: DALZELL GORGE ROUTE

Alternative 6A evaluates realignment for sections of the Pipeline component. Under Alternative 6A, Mine Site and Transportation Corridor impacts would be the same as for Alternative 2.

3.11.4.7.1 PIPELINE

The Dalzell Gorge Route alternative would re-route the 46.2-mile section of pipeline between MP 106.5 and MP 152.7 to the west through the Dalzell Gorge (Figure 3.11-28). The revised route would be 45.4 miles, or 0.8 mile shorter than the corresponding Alternative 2 route. Wetland mapping has been completed for both routes, although siting for camps, access roads, airstrips, and material sites was not available for evaluation. Direct construction-related impacts to wetlands within the 150-foot wide construction ROW for Alternative 6A would affect about 100 more acres of wetlands than the corresponding ROW segment of the route for Alternative 2 (Table 3.11-39). Most of the additional wetland area crossed by Alternative 6A (91 percent) would be impacted by construction during winter (Figure 3.11-28). Alternative 6A would cross about 24 more acres of bogs than Alternative 2 (Table 3.11-39, note that this table differs from the format of prior tables that specify information from specific wetland study areas; difference from the Alternative 2 route is given).

Operations and Closure phases of the Pipeline would be the same as described for Alternative 2. Permafrost distribution data for the Alternative 6A route indicates that 24 percent of the route crosses stable permafrost soils, and 8 percent crosses unstable permafrost soils. Wetlands on thaw unstable permafrost soils may be difficult to restore. Permafrost distribution data for the corresponding Alternative 2 route indicates that 11 percent of the route crosses stable permafrost soils, and 25 percent crosses unstable permafrost soils.

Table 3.11-39: Alternative 6A – Dalzell Gorge Route Pipeline Calculation of Wetland Direct Impacts from Construction

Wetland Category	HGM[1] Class (Acres)					Alternative 6A Impact Area[2] (Acres)	Difference from Alternative 2 Area[2] (Acres)
	Depression	Flat	Slope	Lacustrine	Riverine		
Evergreen Forested Wetlands	0	2.7	10.5	0	1.3	14.5	2.9
Deciduous Forested Wetlands	0	0	0	0	0.5	0.5	0.5
Mixed Forested Wetlands	0	0	0	0	0	0	None
Evergreen Scrub Shrub Wetlands	0	3.7	21.7	0	0.2	25.6	16.7
Deciduous Scrub Shrub Wetlands	0.8	42.8	69.5	0.0	27.5	140.6	83.6
Bogs (LSB)	0.3	6.3	21.1	0	0	27.7	24.3
Herbaceous Wetlands	0.8	0	2.1	0.1	2.2	5.2	-0.6
Ponds	0.1	0	0	0	0.4	0.5	0.5
Lakes	0	0	0	0.0	0	0.0	None
Rivers	0	0	0	0	21.8	21.8	-3.3
Uplands	NA	NA	NA	NA	NA	610.9	-112.7
Total Area	1.7	49.2	103.8	0.1	53.9	819.6	-12.4
Wetland/Water Totals(%, Acres)	1%	23%	50%	<1%	26%	208.7	100.3
Intermittent Streams (Miles)	NA	NA	NA	NA	NA	1.0	0.6
Perennial Streams (Miles)	NA	NA	NA	NA	NA	1.1	0.1

Notes:
1 Lacustrine contains both lacustrine and lacustrine fringe classes and riverine contains both riverine and river channel classes.
2 Comparison based on 150 foot-wide construction ROW for route segments between MP 106.5 and 152.7.
NA = Not Applicable
0 = None
0.0 = < 0.1
LSB = Low Shrub Bog Wetland Subcategory
Source: Michael Baker 2017a

3.11.4.7.2 SUMMARY OF IMPACTS FOR ALTERNATIVE 6A

Both Construction Phase and Operations Phase effects on wetlands would result in a reduction in wetland abundance or alteration of function along the routes. Most construction-related effects would be intermittent, infrequent, or last only for the duration of the Construction Phase, as reclamation would begin soon after Construction. However, because of the extended recovery time for boreal forest wetlands, effects may extend from the end of construction through the life of the mine, and may last beyond the life of the project. Most wetlands would be restored, although functions would likely be reduced or altered for extended periods. A smaller proportion of unstable permafrost would be crossed by the Alternative 6A segment compared to the Alternative 2 segment. Wetlands on unstable permafrost soils may be difficult to restore as wetlands. Alternative 6A would potentially affect about 100 more acres of wetlands than the proposed Alternative 2 route segment. High-value wetlands crossed include wetlands that may support anadromous fish streams, and bog wetlands. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

3.11.4.8 ALTERNATIVES IMPACT COMPARISON

A comparison of the impacts on wetlands by alternative is presented in Table 3.11-40. Although there are differences among alternatives within project components that would affect wetlands such as longer or shorter access road and pipeline, different activities at the Mine Site, and more or fewer barge trips, the overall changes among the alternatives would result in relatively small changes compared to the overall impacts.

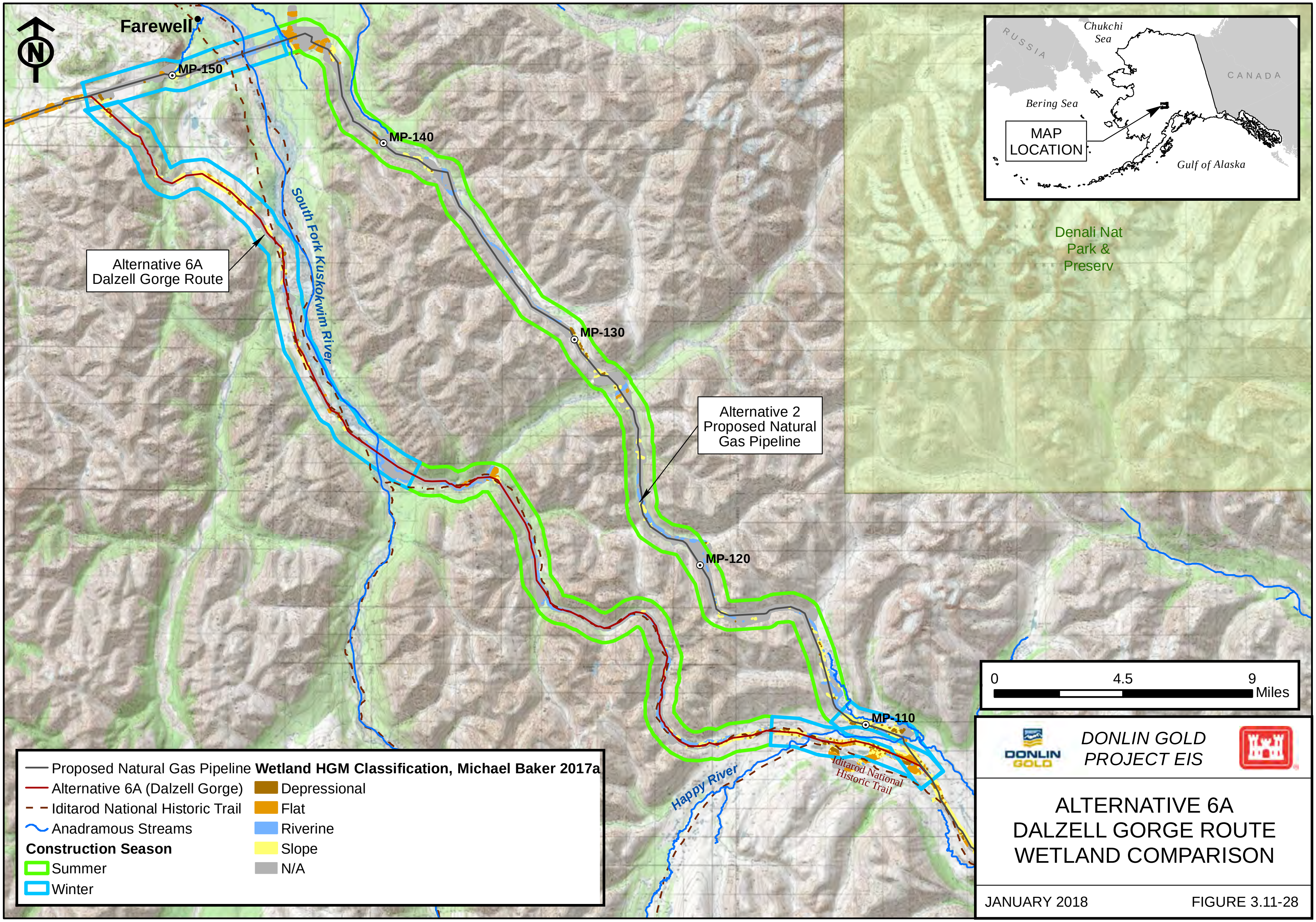

Farewell
MP-150
MP-140
MP-130
MP-120
MP-110
South Fork Kuskokwim River
Happy River
Iditarod National Historic Trail
Alternative 6A Dalzell Gorge Route
Alternative 2 Proposed Natural Gas Pipeline
Denali Nat Park & Preserv
Chukchi Sea
RUSSIA
CANADA
Bering Sea
Gulf of Alaska
MAP LOCATION
0
4.5
9
Miles
Proposed Natural Gas Pipeline
Alternative 6A (Dalzell Gorge)
Iditarod National Historic Trail
Anadramous Streams
Construction Season
Summer
Winter
Wetland HGM Classification, Michael Baker 2017a
Depressional
Flat
Riverine
Slope
N/A
DONLIN GOLD
DONLIN GOLD PROJECT EIS
ALTERNATIVE 6A DALZELL GORGE ROUTE WETLAND COMPARISON
JANUARY 2018
FIGURE 3.11-28

Table 3.11-40: Comparison by Alternative* for Wetlands

Impact-Causing Project Component	Alternative 2 - Proposed Action		Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline				Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings		Alternative 6A – Dalzell Gorge Route
	Alternative 2	Alternative 2-North Option		Alternative 3B	Alternative 3B-Port MacKenzie Option	Alternative 3B-Collocated Pipeline Option	Alternative 3B-Collocated Pipeline configured with Port MacKenzie		Alternative 5A-Unlined Option	Alternative 5A-Lined Option	
Mine Site – Direct Wetland Impacts	2,728 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	2,713 acres	2,721 acres	Same as Alternative 2.
Mine Site – Potential Dust Indirect Wetland Impacts	635 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	>635 acres	>635 acres	Same as Alternative 2.
Mine Site – Potential Dewatering Indirect Wetland Impacts	432 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Direct Wetland Impacts	224 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	564 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor Potential Dust Indirect Wetland Impacts	627 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	2,006 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Potential Barge Wake Erosion	Indistinguishable from naturally occurring erosion	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Route 75 miles shorter than Alternative 2	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline – Construction Wetland Impacts	1,337 acres	1,331 acres	Same as Alternative 2.	1,490 acres	1,481 acres	1,537 acres	1,574 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	1,437 acres
Pipeline – Operations Wetland Impacts	525 acres	519 acres	Same as Alternative 2.	637 acres	623 acres	652 acres	658 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	558 acres
Total Direct Wetland Impacts (excavation, fill, vegetation clearing)[1]	4,289 acres	4,283 acres	Same as Alternative 2.	4,442 acres Slightly greater impacts than Alternative 2.	4,433 acres Slightly greater impacts than Alternative 2.	4,489 acres Slightly greater impacts than Alternative 2.	4,526 acres Slightly greater impacts than Alternative 2.	4,629 acres Greater impacts than Alternative 2.	4,274 acres Similar impacts to Alternative 2.	4,282 acres Similar impacts to Alternative 2.	4,389 acres Slightly greater impacts than Alternative 2.
Potential Indirect Wetland Impacts (dust, dewatering)[2]	1,262 acres	Expected to be the same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	2,641 acres Greater impacts that Alternative 2.	>1,262 acres Slightly greater impacts than Alternative 2.	>1,262 acres Slightly greater impacts than Alternative 2.	Same as Alternative 2.

Notes:
* The No Action Alternative would have no new impacts on wetlands.
1 Total includes only pipeline direct construction impacts; all pipeline operation wetland impacts areas are also included within construction impact areas.
2 Total includes only potential Mine Site and Transportation Corridor indirect impacts from dust; many of the Mine Site drawdown indirect impact areas would also be affected by dust generated at the Mine Site.