3.10 VEGETATION AND NONNATIVE INVASIVE SPECIES

SYNOPSIS

This section describes existing conditions and evaluates potential impacts to vegetation from the proposed action and alternatives, and potential impacts from all taxa of nonnative invasive species (NNIS). Each alternative is examined by project component (Mine Site; Transportation Corridor; and Pipeline) by project phase (Construction, Operations; and Closure). Analysis includes acres of ecoregions impacted by vegetation removal, potential impacts to vegetation from other project activities, potential impacts to rare and sensitive plants, and potential impacts from NNIS. Analysis is based within the Project Area unless otherwise noted.

EXISTING CONDITION SUMMARY

Ecoregions - Vegetation is described by ecoregion, or ecosystem of regional extent. The EIS Analysis Area lies within five ecoregions: Yukon-Kuskokwim (Y-K) Delta, Kuskokwim Mountains, Tanana-Kuskokwim Lowlands, Alaska Range, and Cook Inlet Basin. The Transportation Corridor occurs in the Y-K Delta and Kuskokwim Mountains ecoregions. The Mine Site occurs entirely in the Kuskokwim Mountains ecoregion. The Pipeline component crosses this ecoregion, then the Tanana-Kuskokwim Lowlands, the Alaska Range, and the Cook Inlet Basin ecoregions. One Ecosystem of Conservation Concern (spruce floodplain-old growth forest) has been identified as having habitat located within the Project Area.

Vegetation Types - Several surveys were conducted to identify and map vegetation types within the wetland/vegetation study area within the Project Area. Thirty-two vegetation types were identified and grouped into broader structural types (aggregated vegetation types), which were analyzed by acres impacted per ecoregion.

Rare and Sensitive Plants - The only federally Endangered Species Act (ESA) listed plant species in Alaska is the Aleutian shield fern, a small fern known to occur only at two locations in the Aleutian Islands. It is not documented nor expected to occur within the Project Area.

There are several confirmed or reported populations for species on the BLM Sensitive Plant List and on the Alaska Center for Conservation Science (ACCS) rare vascular plant species list within the Project Area. In the Mine Site, an unconfirmed population of fowl mannagrass was recorded during project surveys. No additional populations of any rare or sensitive plant species have been confirmed in this component. In the Transportation Corridor, no rare or sensitive plants have been confirmed. In the Pipeline component, five species of concern have been confirmed, including bristleleaf sedge, little prickly sedge, fragile rockbrake, elephanthead lousewort, and pearfruit smelowskia. Unconfirmed populations were recorded during project surveys for both sedge species.

Nonnative Invasive Species - In the Project Area, a total of 27 nonnative invasive terrestrial plant species have been recorded. In the Mine Site, 12 nonnative invasive terrestrial plant species have been recorded in project or prior surveys. In the Transportation Corridor, 21 nonnative invasive terrestrial plant species have been recorded in project or prior Alaska Association of Conservation District (AACD) surveys in communities along the Kuskokwim River (documented in the Alaska Exotic Plant Information Clearinghouse [AKEPIC]). In the Pipeline component, 15 nonnative invasive terrestrial plant species have been recorded in project and prior surveys.

There are no known reproducing populations of nonnative invasive marine or freshwater aquatic plants, fish, or animals; or terrestrial birds, amphibians, or mammals, within the Project Area. Species within these taxa that have been recorded in Alaska are identified in this analysis.

EXPECTED EFFECTS SUMMARY

Alternative 1 - No Action

There would be no new effects on vegetation resources.

Alternative 2 - Donlin Gold's Proposed Action

Vegetation: Direct and indirect impacts to vegetation include direct vegetation removal in the project footprint; potential accidental physical damage to vegetation due to project activities; potential accidental fire that could damage vegetation; presence of fugitive dust that could affect vegetation; changes in water availability that could affect vegetation; or potential environmental contamination that could damage vegetation. In all three components, during Construction and Operations, 9,819.3 acres of vegetation would be removed at the Mine Site; 1,093.4 acres removed in the Transportation Corridor, and 6,981.9 acres removed in the Pipeline component (6,919.5 in the North Option), for a total of 17,894.6 acres removed (17,832.2 in the North Option). In some locations, removal would be permanent (such as the pit lake area). In some locations, removal would be temporary as reclamation activities would start during Operations; or natural revegetation would be expected to occur.

Rare and Sensitive Plants: Direct and indirect impacts to rare and sensitive plants in all three components during Construction and Operations include the potential removal of known or potentially discovered populations, or changes in habitats that may support these species, due to vegetation removal or other vegetation-impacting project activities. There are no special protections for any vegetation within the Project Area; however, there are confirmed locations in the Project Area for species on the Alaska Center for Conservation Science (ACCS) rare vascular plant species list or on BLM's Sensitive Species list. The Project Area also contains habitat that may support the presence of species on these lists.

Nonnative Invasive Species: Potential impacts from project activities in all three components during all project phases include risk of introduction or spread of new or existing populations of all taxa of NNIS, which may affect ecosystem integrity. Project activities in all phases have the potential to serve as vectors for NNIS introduction and spread, including Mine Site infrastructure, Transportation Corridor road and barge corridors and facilities, and Pipeline infrastructure. Barge traffic in the Transportation Corridor includes 30 total ocean cargo and fuel barge round trips to Bethel during Construction (16 cargo and 14 fuel) and 26 during Operations (12 cargo and 14 fuel). River barges include 89 total round trips during Construction (50 cargo, 19 fuel, and 20 pipe and equipment during the first two years of Construction) from Bethel and 122 during Operations (64 cargo and 58 fuel). In the Pipeline component, there would be 20 ocean pipe and equipment barge round trips during the first year of Construction.

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 Trucks – In the Transportation Corridor, reducing the number of ocean barge trips from 26 to 17 round trips (Operations Phase), river barge trips from 122 to 83 round trips (Operations Phase), and eliminating barge trips in the Pipeline component (Construction Phase), reduces but does not eliminate the risk of introduction or spread of NNIS by vessel vectors. There would be no difference in acres of vegetation removal.

Alternative 3B - Diesel Pipeline - In the Transportation Corridor, reducing the number of river barge trips from 122 to 64 (Operations Phase), reduces but does not eliminate the risk of introduction or spread of NNIS by vessel vectors. There would also be 12 ocean barge round trips in the Pipeline component during Operations. In the Pipeline component, an additional 19 miles of pipeline and clearing in the vicinity of the Tyonek dock would result in an additional 473.5 acres of vegetation removal (18,368.1 total) compared to Alternative 2 during Construction, which would increase the risk of introduction or spread of NNIS by terrestrial vectors because of both the additional acres of vegetation removal and the known occurrences of nonnative invasive plant species in the vicinity of the Tyonek dock. The Port MacKenzie Option would include similar construction infrastructure with an additional 452.8 acres of vegetation removed (18,342.4 total) compared to Alternative 2. The Collocated Pipeline Option would require a wider pipeline construction footprint; an additional 684.6 acres of vegetation would be removed (18,579.2 total) compared to Alternative 2.

Alternative 4 - Birch Tree Crossing (BTC) Port – There would be no difference in barging compared to Alternative 2. The longer mine access road would remove 1,791.1 acres of vegetation, 697.7 more acres than Alternative 2 (18,592.3 total), which would increase risk of introduction or spread of NNIS by terrestrial vectors. Eliminating barging upstream of BTC reduces but does not eliminate the risk of introduction or spread of NNIS by vessel vectors.

Alternative 5A - Dry Stack Tailings – There would be an additional 7 river barge round trips during the Operations Phase compared to Alternative 2. The change in tailings disposal method would increase vegetation removal at the Mine Site by 71.6 acres for the Unlined Option (17,966.2 total) or by 362.1 acres for the Lined Option (18,256.7 total) compared to Alternative 2, increasing the risk of introduction or spread of NNIS by terrestrial vectors. Production of fugitive dust would also be expected to increase which may impact vegetation adversely.

Alternative 6A - Dalzell Gorge Route – There would be no difference in barging compared to Alternative 2. In the Pipeline component, there would be 12.4 less acres of vegetation removed (17,882.2 total), which reduces but does not eliminate the risk of introduction or spread of NNIS by terrestrial vectors.

3.10.1 REGULATORY FRAMEWORK

Within the EIS Analysis Area, various regulations and management guidance apply and are discussed below.

3.10.1.1 VEGETATION

The BLM Alaska Land Health Standards and Guidelines (BLM-AK IM 2004-23) provide general guidance for managing healthy ecosystems, focusing on retaining natural populations consistent with potential and capability of the landscape. The BLM National Vegetation Classification and Associated Mapping (BLM-AK IM 2013-11) provides a standard, hierarchical classification system for existing vegetation consistent with the 2008 National Vegetation Classification Standard (NVCS).

The Alaska Forest Resources & Practices Act of 2013 (AS 41.17) amends the original Act adopted in 1978 by the ADNR Division of Forestry. The Act governs how timber harvesting, reforestation, and timber access occur on state, private, and municipal land. Forest management standards on federal land must meet or exceed the standards for state land established by the Act. The Alaska administrative codes that govern timber management are summarized in the 2013 Alaska Forest Resource and Practices Regulation document (11 AAC 95). ADNR Division of Forestry also includes the Wildland Fire and Aviation Program, which manages firefighting crews and resources, Community Wildfire Protection Plans, and the Alaska Interagency Wildland Fire Management Plan. BLM Alaska Fire Service implements actions documented and directed by the Alaska Interagency Wildland Fire Management Plan.

The ADNR Plant Materials Center (ADNR-PMC) provides reclamation, erosion control, research, technology and knowledge transfer, nonnative invasive plant management, and revegetation services for the state of Alaska. Their programs include research in developing cultivars and plantings suitable for restoration and reclamation sites, and growing materials (such as seeds, cuttings, or transplants) suitable for these activities.

3.10.1.2 RARE AND SENSITIVE PLANTS

There is only one federally ESA-listed plant species in Alaska, the Aleutian shield fern (*Polystichum aleuticum*), a small fern known to occur only at two locations in the Aleutians. It is not known from or expected to occur in the Project Area.

The BLM maintains a Sensitive Species List and a Watch List (BLM 2010a, BLM 2010b). The Watch List does not confer sensitive status, but identifies species that may benefit from additional study. Habitat exists within the Project Area for several species on the Sensitive Plant List.

The State of Alaska does not have any regulatory framework regarding sensitive or rare plants.

The Alaska Center for Conservation Science (ACCS, formerly the Alaska Natural Heritage Program) maintains a rare plant list for Alaska, tracking occurrence of over 300 rare plant species (ACCS 2017a, 2017f; Nawrocki et al. 2013; Lipkin and Murray 1997), some of which occur in the Project Area; no special state-wide protections are afforded species on this list. ACCS has also developed an Alaska Ecosystems of Conservation Concern list, assessed with respect to conservation need and current level of protection (Boggs et al. 2016b); no special protections are afforded these ecosystems.

3.10.1.3 NONNATIVE INVASIVE SPECIES

Executive Order 13112, Invasive Species (1999) provides guidelines to prevent the introduction of invasive species and provide for their control and to minimize economic, ecological and human health impacts that invasive species cause. This EO established the National Invasive Species Council which regularly updates National Invasive Species Council Management Plans (2001-2018). The Carlson-Foley Act of 1968 (PL 90-583) provides authorization for federal agency or department heads to control noxious plants on federal lands in compliance with approved agency or department plans. The Plant Protection Act (Title IV of the Agricultural Risk Protection Act of 2000) consolidates and modernizes statutes pertaining to plant protection, importation, transport, and quarantine that were previously addressed in various statutes, including the Federal Noxious Weed Act of 1974, the Federal Plant Pest Act, and the Plant Quarantine Act. The act also provides authorization for such entities as Animal and Plant Health Inspection Service to enforce transportation and quarantine practices to prevent NNIS spread.

The National Invasive Species Act (NISA) of 1996 provides policy guidance to prevent NNIS from entering inland waters through ballast water carried by ships, and directs the US Coast Guard (USCG), under the Department of Homeland Security, to establish regulations and guidelines to prevent aquatic nuisance species. This act also reauthorized and amended the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990. The Environmental Protection Agency (EPA) and US Coast Guard (USCG) have regulatory authority over ballast discharge. USCG provides guidance through their Ballast Water Management Program policy. The EPA Vessel General Permit (VGP) outlines permissions for discharge actions through the National Pollutant Discharge Elimination System (NPDES); in Alaska, the Alaska Department of Environmental Conservation (ADEC) has jurisdictional authority over ballast discharge from vessels (AS 46.03.750) and administers the Alaska Pollutant Discharge Elimination System (APDES) program. Ballast water discharge is prohibited within the state of Alaska except in cases where it is necessary for the safety of a tank vessel and no alternative action is feasible to ensure safety. In Alaska, the EPA VGP is required for barges.

The EPA VGP also outlines Best Management Practices (BMPs) for hull fouling prevention and management, but has no regulatory authority. USCG provides information about voluntary anti-fouling practices through its Anti-Founding System (AFS) policy, guided by the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (ratified 2012).

BLM policy and practices guide management of NNIS on lands managed by the BLM. The BLM Alaska Land Health Standards and Guidelines (BLM 2004) provide general guidance for managing healthy ecosystems, focusing on retaining natural populations consistent with potential and capability of the landscape. The guidelines state that seeding and planting nonnative vegetation should only be used in cases where native species are not available in sufficient quantities; where native species are incapable of maintaining or achieving standards; or where nonnative species are essential to the functional integrity of the site. The 2010 BLM IM AK-2011-001 formally establishes a BLM-Alaska policy regarding a noxious weed management program (BLM 2010b. The 2010 BLM Alaska State Invasive Species Policy (IM AK-2011-001a, revised 2017 version in draft) provides statewide guidance for NNIS management (BLM 2010c), and incorporates principles outlined in the 2004 National Strategy and Implementation Plan for Invasive Species Management (USFS 2004); the 2016 Safeguarding America's Lands and Waters from Invasive Species: a National Framework for Early Detection and Rapid Response (DOI 2016); and the 2016 Arctic Invasive Alien Species (ARIAS) Action Plan (CAFF 2016). The BLM Manual has three sections that apply specifically to NNIS management. These include 9220 – Integrated Pest Management (1981), 9015 – Integrated Weed Management (1992), and 9011 – Chemical Pest Control (1992). The 2007 Record of Decision for Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (September 2007) guides actions regarding application of 11 herbicides. The 2016 ROD for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States Programmatic EIS guides actions regarding these three herbicides for application control options for NNIS on BLM lands in Alaska (BLM 2016d). The Federal Insecticide, Fungicide, and Rodenticide Act of 1975 (7 USC 136 et seq.) establishes an extensive regulatory system for controlling the sale, distribution, and application of pesticides.

Existing State of Alaska regulations intended to reduce the introduction of NNIS in Alaska include the ADF&G prohibition on sport angler use of felt soles in fresh waters of Alaska, effective January 1, 2012 (ADF&G 2012); the Alaska Board of Game's prohibition of footgear with absorbent, fibrous material soles for hunters in fresh water effective January 1, 2013 (ADF&G 2013d); the State of Alaska regulations and statutes concerning permitted conditions and prohibitions for importing, harboring, possessing, transporting, or releasing fish and animals into Alaska (AS 03.05.010, AS 03.05.040, AS 44.37.030, AS 03.05.090, 5 AAC 92.141, 11 AAC 34.130, 11 AAC 34.140, 11 AAC 34.160, 11 AAC 34.170, AAC 34.115); State of Alaska Statutes on noxious weed, invasive plant, and agricultural pest management and education (AS 03.05.027); and the ADNR quarantine of five aquatic invasive plants, effective March 5, 2014 (ADNR 2014). Regulations are enforced by ADEC, ADNR and the Alaska Department of Public Safety, Alaska Wildlife Troopers. There are also State of Alaska regulations concerning prohibited and restricted noxious weeds in agricultural seeds (11 AAC 34.020), and restrictions on the sale, transport, or planting of agricultural seeds that may contain listed prohibited or restricted noxious weed seeds (11 AAC 34.075).

The ACCS also tracks NNIS in the region through its Invasive and Harmful Species program, including the Alaska Exotic Plant Information Clearinghouse (AKEPIC) database and the Nonnative and Invasive Animals in Alaska program (ACCS 2017c).

3.10.2 AFFECTED ENVIRONMENT

The affected environment for vegetation includes vegetation that may be directly or indirectly affected by the project. Vegetation is described in terms of ecoregions, vegetation types, rare and sensitive plants, and nonnative invasive plants (terrestrial and aquatic).

Invasive nonnative species are also described for all taxa (nonnative invasive marine and freshwater aquatic species are also discussed where appropriate in Section 3.13, Fish and Aquatic Resources; terrestrial nonnative invasive mammal species are also discussed where appropriate in Section 3.12, Wildlife).

The areas of potential effects include the Project Area, as well as regional pathways for NNIS introduction and spread. Vectors for NNIS introduction and spread include wind, water, wildlife, humans, and transportation (such as floatplanes, wheeled planes, helicopters, boats, barges, other vessels, vehicles, off-highway vehicles [OHVs], or construction equipment). Areas with disturbed, open, or recently burned organic or bare soil surfaces are known to be vulnerable to nonnative invasive plant species infestation.

The following sections describe:

- Ecoregions, vegetation types, and Ecosystems of Conservation Concern within the EIS Analysis Area;
- Field wetland and vegetation surveys that were conducted to identify, classify, and map existing wetlands and vegetation types (including incidental identification of rare or sensitive plant species);
- Wetland and vegetation survey results for each project component;
- Rare and sensitive plant status, information, and survey results;
- NNIS status and information for all taxa; and
- Results of nonnative invasive plant surveys that were conducted for the project.

Figure 3.10-1 illustrates the vegetation affected areas in the Transportation Corridor, Mine Site, and Pipeline components. The area covered by wetland and vegetation surveys included the Mine Site, potential port locations and their associated mine access roads (Angyaruaq [Jungjuk] or Birch Tree Crossing [BTC] Ports) in the Transportation Corridor, and the Pipeline component. Wetland survey details are discussed in Section 3.11, Wetlands.

3.10.2.1 ECOREGIONS

Southwest Alaska vegetation in the Mine Site and Transportation Corridor includes the Bristol Bay area, Kuskokwim Bay, and the extensive Y-K Delta region. Much of this region is low and poorly drained, with wetland vegetation community types common (Viereck et al. 1992). Vegetation inventory and classification work in this region, including rare plant and general species surveys, is extensive (Carlson et al. 2003, 2005, 2013; Boggs et al. 2003; Lipkin 1996, 2002; Viereck et al. 1992; Tande and Jennings 1986; Talbot et al. 1986; Byrd and Ronsee 1983; Wibbenmeyer et al. 1982; Hultén 1968).

Southcentral Alaska vegetation in the Pipeline Component includes a diverse area from the peaks of the Alaska Range to the coastal marshes of Cook Inlet. This area has had several comprehensive surveys to determine vegetation composition, species, and community types (DeVelice et al. 1999; Viereck et al. 1992; Viereck and Dyrness 1980; Hultén 1968).

Ecoregions that include broad vegetation descriptions and general regional characteristics, including general soil type, have been mapped and described in several publications (Boggs et al. 2016a, Boggs et al. 2016b; NatureServe 2008; Moore et al. 2004; Nowacki et al. 2001; Nowacki and Brock 1995; Gallant et al. 1995). In this document, ecoregion descriptions are taken from Nowacki et al. 2001. Vegetation affected area occurs primarily within four ecoregions: the Kuskokwim Mountains, Tanana-Kuskokwim Lowlands, Alaska Range, and Cook Inlet Basin (Figure 3.10-2). The affected area also includes a fifth ecoregion, the Y-K Delta; as there is no proposed vegetation removal within this ecoregion, it was excluded from the wetlands/vegetation study area and not included in tables that show acres of vegetation removal. The rest of the Transportation Corridor and all of the Mine Site occurs within the Kuskokwim Mountains ecoregion. This ecoregion also covers the westernmost portion (MP 219 to the Mine Site) of the Pipeline component. The proposed pipeline route in the Pipeline component crosses the Tanana-Kuskokwim Lowlands, the Alaska Range, and the Cook Inlet Basin ecoregions.

The Yukon-Kuskokwim Delta ecoregion was formed from a combination of heavy sediment load carried by glacial runoff and from stabilization of sea levels after an initial rapid rise during deglaciation. The unconsolidated sediments are comprised principally of marine tidal flats, beach deposits, and alluvium. Isolated basalt hills and volcanic cinder cones jut up in places. Permafrost is discontinuous, moderately thick to thin, and relatively warm. Impeded subsurface drainage caused by the permafrost contributes to shallow organic soils. Coastal vegetation is dominated by highly productive brackish marshes and wet meadows. Inland, permafrost-dominated landscapes support low birch-ericaceous shrubs and sedge-tussock and sedge-moss bogs. Willow (*Salix* spp.) thickets occur along rivers and on better-drained slopes. The part of the Transportation Corridor that does not have any proposed vegetation removal occurs in this ecoregion.

The Kuskokwim Mountains ecoregion is comprised of old, low rolling mountains that have eroded largely without the aid of recent past glaciations. A continental climate prevails with seasonal moisture provided by the Bering Sea during the summer. Mountains are composed of eroded bedrock and rubble, whereas intervening valleys and lowlands are composed of undifferentiated sediments. Thin to moderately thick permafrost underlies most of the area. Boreal forests dominate grading from white spruce (*Picea glauca*), paper birch (*Betula papyrifera*), and quaking aspen (*Populus tremuloides*) on uplands to black spruce (*Picea mariana*) and tamarack (*Larix* spp.) in lowlands. Tall willow, birch, and alder (*Alnus* spp.) shrub communities are scattered throughout, particularly where wildland fires burned in the recent past. Rivers meander through this undulating landscape following fault lines and highly eroded bedrock seams. The Transportation Corridor north of the Kuskokwim River and upstream of Napaimute, all of the Mine Site, and the eastern portion of the Pipeline component are within this ecoregion.

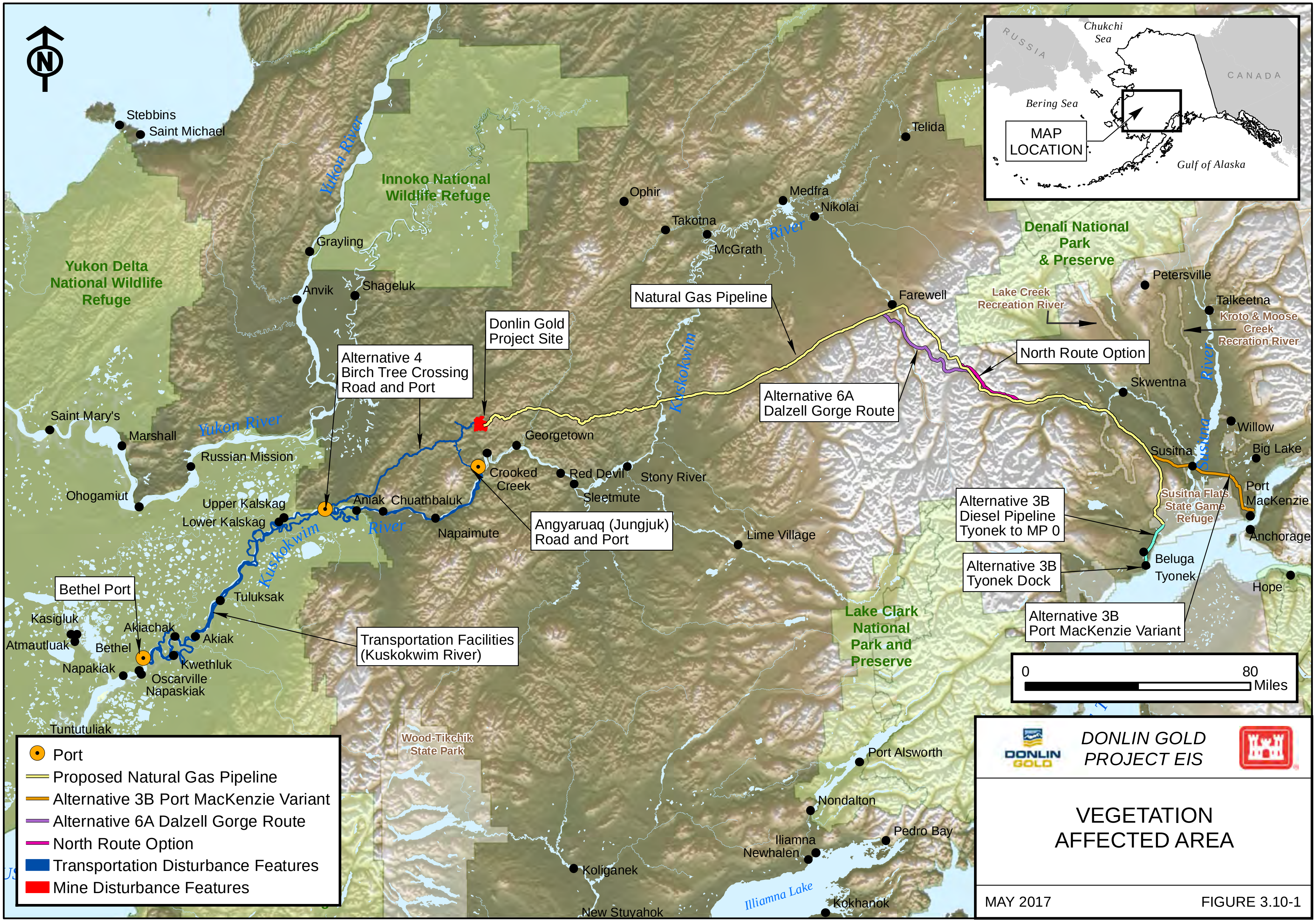
The Tanana-Kuskokwim Lowlands alluvial plain falls in the rain-shadow of the Alaska Range and has a dry, Interior Alaska continental climate. Permafrost is thin and discontinuous and creates local conditions of poor soil drainage. Collapsing permafrost creates bogs and fens comprised of ericaceous shrubs (heath family) and sedges. Boreal forests dominate the landscape. Black spruce is found throughout the poorly drained flats. White spruce, paper birch, and quaking aspen occur along the drier river banks and steep, drier south-facing hills. Alder and willow shrubs are found in small drainages and elsewhere. The proposed pipeline route crosses the southern border of the Tanana-Kuskokwim Lowlands ecoregion along the northwest-facing toe slope of the Alaska Range Mountains.

The Alaska Range ecoregion is comprised of the Alaska Range Mountains. A cold continental climate predominates in the ecoregion and the mountains are tall, steep, with highest areas generally barren of vegetation. The ecoregion is dominated by low shrubs and alpine scree; forests are generally limited to lower elevation footslopes and riverine valleys. Forests, interspersed with low shrub bogs and patches of dense alders, dominate the EIS Analysis Area between the western border of the Cook Inlet Basin ecoregion and the Lower Happy River watershed. Shrublands transition to forests near Puntilla Lake (Squaw Creek watershed). Shrublands dominate where the proposed pipeline route crosses over the Teocalli Mountains at elevations over 2,000 feet. The proposed pipeline route traverses the lower elevation open forests of the South Fork of the Tatina River and Kuskokwim River basins. The proposed pipeline route intersects the western border of the 2010 Turquoise Lake burn, near the junction of the Post River and the South Fork of the Kuskokwim River. Photointerpretation of pre-burn imagery indicates that much of the burn was previously spruce forest.

The Cook Inlet Basin ecoregion includes numerous lakes, ponds, and wetlands. The basin is generally free of permafrost. A mix of maritime and continental climates prevails with moderate fluctuations of seasonal temperature and abundant precipitation. This climate, coupled with the flat to gently sloping, fine-texture surfaces give rise to wet, organic soils that support black spruce forests and woodlands. Ericaceous shrubs are dominant in open bogs. Mixed forests of white and Sitka spruce (*Picea sitchensis*), aspen and birch grow on better-drained sites and grade into tall shrub communities of willow and alder on slopes along the periphery of the basin. The proposed pipeline route traverses several miles of lowland string bogs as it extends north and west. Then the route passes through upslope areas dominated by drier forests interspersed with tall shrubs (primarily alder).

3.10.2.2 ECOSYSTEMS OF CONSERVATION CONCERN

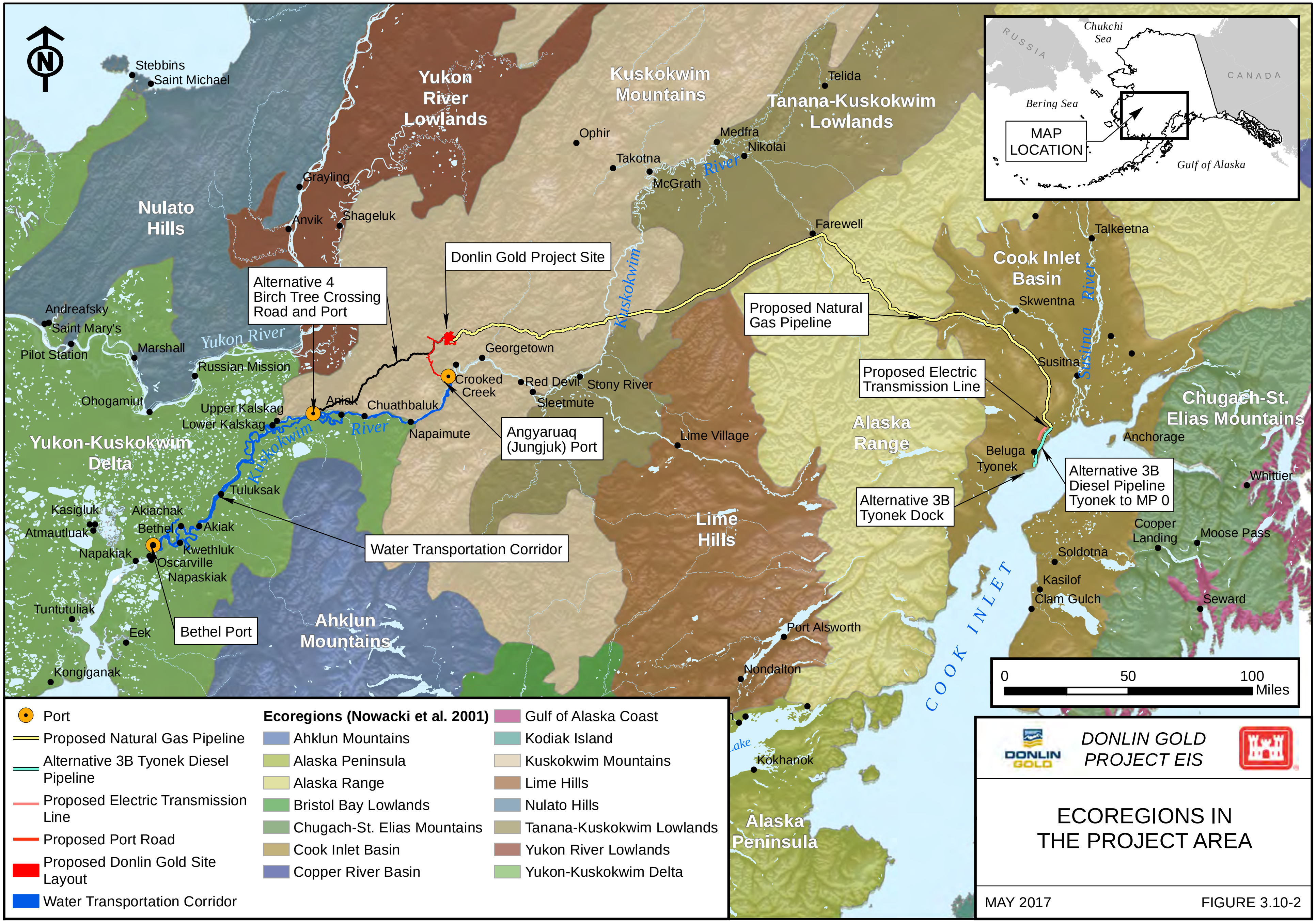
Range for spruce floodplain-old growth forest, an Ecosystem of Conservation Concern, has been mapped as occurring within the EIS Analysis Area (Boggs et al. 2016b). There is no legal designation or protection for this ecosystem which is classified as S4 (apparently secure). This ecosystem is characterized by a closed canopy of mature white spruce, with an abundance of snags (standing dead trees) and downed wood in a floodplain environment. These ecosystems occur on moderate to large floodplains in interior Alaska along the Yukon, Kuskokwim, Koyukuk, and Tanana Rivers. The general range of where this ecosystem occurs has been mapped by creating a buffer around likely habitat along these river systems, informed by approximately 35 field plots (Boggs et al. 2016b). Within the EIS Analysis Area, suitable habitat for this ecosystem has been identified along the Kuskokwim River between Upper Kalskag and Chuathbaluk, along drainages adjacent to the proposed BTC road corridor, and in approximately seven drainages that cross the proposed natural gas pipeline corridor. Within the EIS Analysis Area, three field plots were recorded: one near Aniak on the Kuskokwim River, one at a location approximately halfway between Chuathbaluk and Crooked Creek on the Kuskokwim River, and one adjacent to a drainage approximately one quarter of the way along the proposed pipeline east of the proposed mine site location.



VEGETATION AFFECTED AREA

MAY 2017

FIGURE 3.10-1



ECOREGIONS IN THE PROJECT AREA

MAY 2017 FIGURE 3.10-2

3.10.2.3 VEGETATION TYPES

Vegetation types applied in vegetation analysis in this section are based on Boggs et al. (2016a). Vegetation types, also knowns as vegetation community types, were derived from the best-available data derived from 18 regional landcover maps that have been developed over the last 31 years. The classes are represented by a coarse-scale class, which is analogous to level III of the Alaska Vegetation Classification, and fine-scale classes, which nest within the coarse-scale classes and are analogous to level IV of the Alaska Vegetation Classification (Viereck et al. 1992). For the scale of analysis in this section, vegetation types are displayed in maps and in tables at level III coarse scale types which have been aggregated into five classes identical to those applied in analysis of wetlands in the Wetlands Section, Section 3.11 (see Tables 3.10-1 through 3.10-3 in this section). Thirty-two fine-scale vegetation types were defined in the study area (analogous to level IV in Viereck et al. 1992) and described in detail in a revised Preliminary Jurisdictional Wetland Determination (PJD) (Michael Baker 2016, 2017b).

Prior to the 2016 and 2017 surveys, past wetland and vegetation surveys have taken place in the Project Area between 1996 and 2014. Between 1996 and 2014, Three Parameters Plus, Inc. (3PPI) mapped approximately 330,000 acres of vegetation and wetlands in the Project Area and prepared a PJD (3PPI 2014b). In the Mine Site, Management and Solutions in Environmental Science (MSES) mapped approximately 60,887 acres of vegetation and wildlife habitat in 2004-2005 using field information and satellite imagery for the Mine Site, the Angyaruaq (Jungjuk) Port site, and mine access road (MSES 2006). In the Pipeline component, ARCADIS mapped over 1,000,000 acres of habitat along the 316-mile long proposed pipeline route using unsupervised satellite imagery with representative supervised on-the-ground field verification in 2010 (ARCADIS 2011a). The 2010 study area consisted of 5 km on either side of the proposed pipeline route and extended from sea level near Cook Inlet, to 3000' over Rainy Pass, then across tributaries of the Kuskokwim River to the Mine Site. The supervised (field verification component) vegetation classification survey was conducted in the height of the growing season, during the first two weeks of July 2010, for optimal plant identification. Additional surveys were conducted in August of 2010 to complete work that was delayed due to weather delays. Prior to conducting the field survey, an unsupervised landcover classification was produced using satellite Landsat™ imagery.

Field work was conducted in 2016 and 2017 by Michael Baker International, who prepared the PJD with data collected between 1996 through 2017 and National Wetland Inventory (NWI) data (Michael Baker 2016, 2017a, 2017b). The study area in the revised PJD included areas in the Mine Site, including the upper Crooked Creek watershed, the exploration camp, roads, winter trails, and airstrips. In the Transportation Corridor, the study area covered mine access roads from BTC Port site and Angyaruaq (Jungjuk) Port site to the mine, and winter trails. In the Pipeline component, the study area covered the 316-mile long, 1000' wide pipeline route from the mine site to Cook Inlet (including the North Option), plus winter trails.

In the PJD, 31,504.3 acres (31.5 percent) of the study area were mapped as waters of the U.S. and 68,584.2 acres (68.5 percent) were determined to be upland; a total of slightly over 100,000 acres was mapped. The project vegetation types were aggregated into broader structural types: Evergreen and Deciduous/Mixed Forest (approximately 58 percent of the study area); Scrub Shrub (approximately 38 percent); Herbaceous (approximately four percent); Barren and Snow (less than one percent); and Water (ponds, lakes, ocean/Cook Inlet, rivers, streams) (approximately two percent). The two most common forested types in the study area were open black spruce forests (approximately 20 percent) and open mixed forests (approximately 12 percent). The most common scrub shrub type was low shrub tundra, covering approximately 13 percent of the study area. The herbaceous types were minimal and scattered throughout the study area (Michael Baker 2016).

In the 2017 north option wetlands study area, approximately 17 percent was determined to be Waters of the U.S. and approximately 83 percent was determined to be uplands. Wetlands accounted for 12.6 percent (920.0 acres) of the north option wetlands study area. Coniferous forests types comprised 34.7 percent of the study area. Black spruce forests and woodlands made up a small portion of coniferous forest area (22.1 acres), and were determined to be 100 percent wetlands. Scrub shrub types comprised 29.6 percent of the study area. Further details on the wetland acres per type are described in Section 3.11, Wetlands.

The distribution of these types within the study area is described by project component below. Forested types were separated into "Forested-Evergreen" and "Forested-Deciduous and Mixed" types, and water and other non-vegetated types were grouped into an "Other Land Cover" type. The study area intersected 43 USGS Hydrologic Unit Code (HUC) level 10 watersheds. The revised PJD reports acres of wetlands and waters areas, as well as detailed information on NWI types by acres, per HUC per ecoregion. The revised PJD also reports the area of each HUC 10 watershed intersecting the study area, and the portion by percent within the study area. The study area mapping crosses 1.2 percent of the total basin area of the 43 watersheds. The greatest percentage is in or adjoining the Mine Site where 11.2 percent of the Crooked Creek watershed is within the study area (Michael Baker 2016, 2017a, 2017b). See Section 3.11, Wetlands, for further discussion of the PJD and wetlands.

Mine Site

The vegetation types mapped in the Mine Site area are listed and described in Table 3.10-1 and shown in Figure 3.10-3. The descriptions are abbreviated versions of complete descriptions found in the revised PJD and associated GIS data (Michael Baker 2016, 2017a, 2017b). All of the Mine Site occurs within the Kuskokwim Mountains ecoregion.

Spruce-dominated evergreen forests cover large portions of the Mine Site area. On north-facing slopes and other areas where drainage is restricted by the presence of permafrost, stunted black spruce forests predominate. Black spruce forests also extend into bottomlands and other wet areas. In better drained sites such as those on floodplain terraces, near timberline, and on warmer south-facing slopes, white spruce forests are more prevalent. Mixed evergreen/deciduous forests are also common on drier slopes and consist of white spruce and paper birch. These mixed wood forest communities are also found on floodplain terraces and may include balsam poplar (Populus balsamifera).

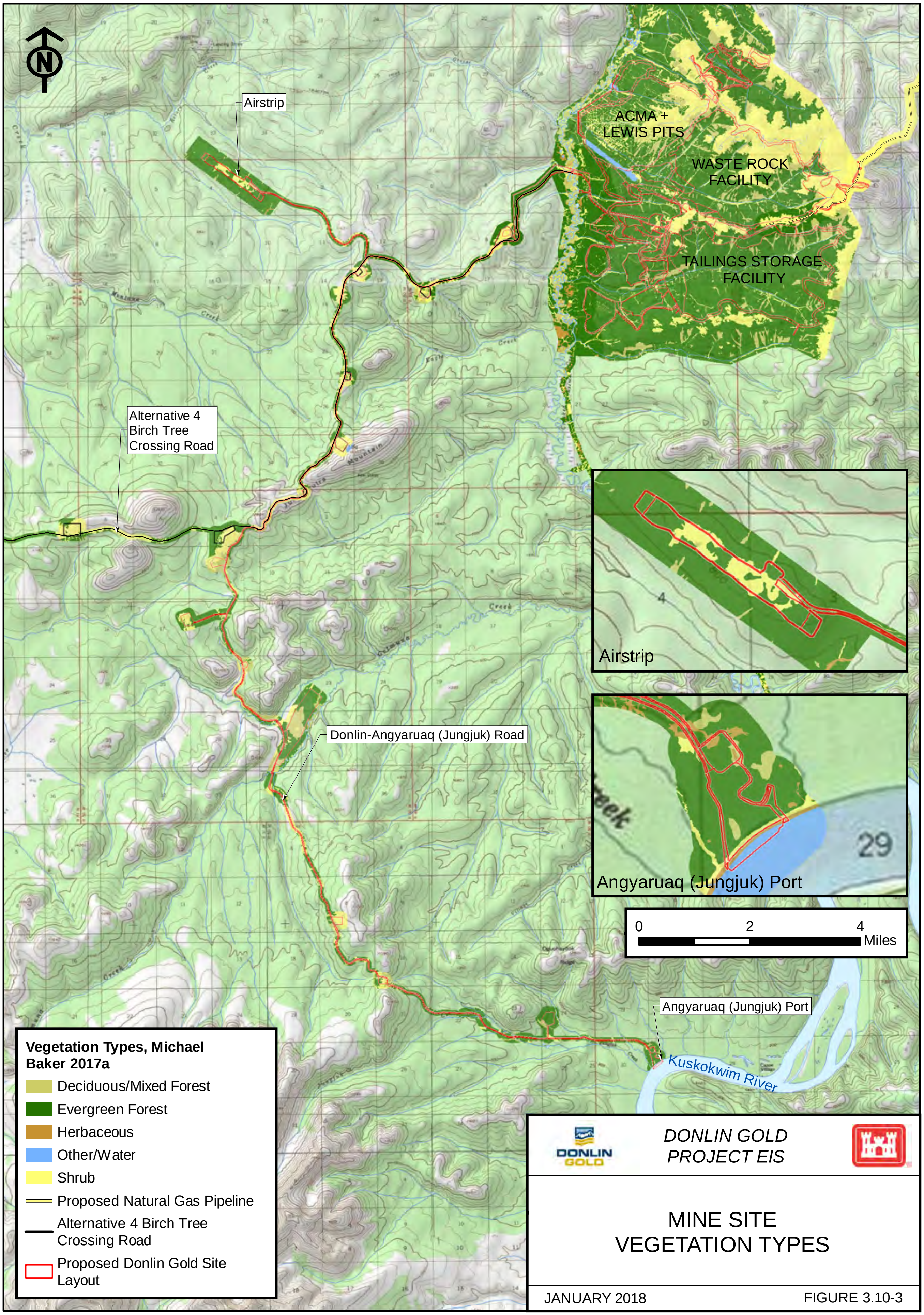
River meanders, such as those along Crooked Creek, support a continuous succession of early successional willow and alder, followed by balsam poplar, which is replaced by spruce. Recently disturbed sites, areas near timberline, north-facing slopes, and wetter areas support scrub communities dominated by willow, alder, and dwarf and shrub birch (Betula nana and B. glandulosa). Bottomland bogs and other extremely wet areas are occupied by scrub communities, including willow, dwarf birch, bog blueberry (Vaccinium uliginosum), Labrador-tea (Ledum palustre spp. decumbens), shrubby cinquefoil (Dasiphora fruticosa), cottongrasses (Eriophorum spp.), and sedges (Carex spp.).

At higher elevations above timberline, dwarf alpine shrub communities are common and are dominated by ericaceous (heath family) shrubs, dryas (*Dryas* spp.), and dwarf birch. These communities often have considerable lichen cover and some patches of bare ground.

Table 3.10-1: Study Area Mine Site Vegetation Types

Aggregated Type	Description	Vegetation Types	Acres Mapped	Percentage of Study Area
Forested - Evergreen	Tree/sapling cover greater than 10%	black spruce woodland, closed black spruce forest, closed white spruce forest, open black spruce forest, open white spruce forest, white spruce woodland	13,844.5	66%
Forested – Deciduous and Mixed	Tree/sapling cover greater than 10%	open deciduous forest, open mixed forest, closed deciduous forest, closed mixed forest, woodland deciduous forest, woodland mixed forest	1,711.4	8%
Scrub Shrub	Shrub cover greater than 25%	deciduous shrub sapling regrowth, closed willow shrub, open willow shrub, closed alder shrub, open alder shrub, closed alder willow shrub, open alder willow shrub, low shrub bog, ericaceous shrub bog-string bog, low shrub tundra, dwarf shrub tundra	4,975.90	24%
Herbaceous	Tree cover less than 10%, shrub cover less than 25%	mesic herb, wet herbaceous, aquatic herbaceous, tussock sedge tundra	227.7	1%
Other Land Cover	Less than 25% ground cover, vegetation cover less than 10%	alpine barrens, barren: disturbance related, open water: ponds/lakes, riverine systems: water/bars, snow	290.3	1%

Source: Michael Baker 2017a


Airstrip
ACMA +
LEWIS PITS
WASTE ROCK
FACILITY
TAILINGS STORAGE
FACILITY
Alternative 4
Birch Tree
Crossing Road
Donlin-Angyaruaq (Jungjuk) Road
Airstrip
Angyaruaq (Jungjuk) Port
0 2 4 Miles
Angyaruaq (Jungjuk) Port
Kuskokwim River
Vegetation Types, Michael Baker 2017a
Deciduous/Mixed Forest
Evergreen Forest
Herbaceous
Other/Water
Shrub
Proposed Natural Gas Pipeline
Alternative 4 Birch Tree Crossing Road
Proposed Donlin Gold Site Layout
DONLIN GOLD
PROJECT EIS
MINE SITE
VEGETATION TYPES
JANUARY 2018
FIGURE 3.10-3

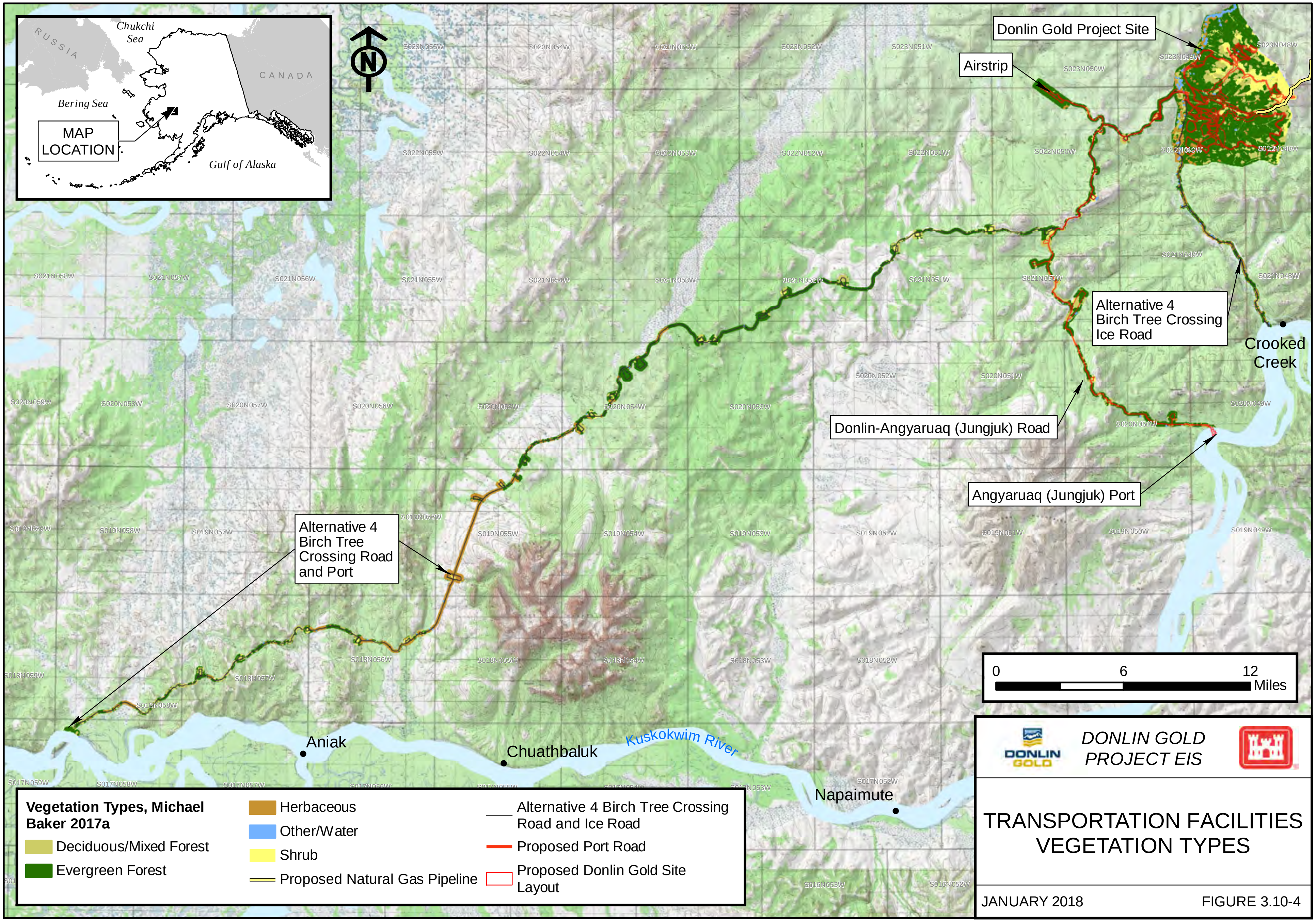
3.10.2.4 TRANSPORTATION CORRIDOR

The vegetation types mapped in the Transportation Corridor are listed and described in Table 3.10-2 and shown in Figure 3.10-4. The part of the Transportation Corridor with proposed vegetation removal occurs within the Kuskokwim Mountains ecoregion. The part of the Transportation Corridor that does not have any proposed vegetation removal occurs in the Y-K Delta ecoregion.

Table 3.10-2: Study Area Transportation Corridor Vegetation Types

Aggregated Type	Description	Vegetation Types	Acres Mapped	Percentage of Study Area
Forested - Evergreen	Tree/sapling cover greater than 10%	black spruce woodland, closed black spruce forest, closed white spruce forest, open black spruce forest, open white spruce forest, white spruce woodland	7,135.50	56%
Forested – Deciduous and Mixed	Tree/sapling cover greater than 10%	open deciduous forest, open mixed forest, closed deciduous forest, closed mixed forest, woodland deciduous forest, woodland mixed forest	1,241.20	10%
Scrub Shrub	Shrub cover greater than 25%	deciduous shrub sapling regrowth, closed willow shrub, open willow shrub, closed alder shrub, open alder shrub, closed alder willow shrub, open alder willow shrub, low shrub bog, ericaceous shrub bog-string bog, low shrub tundra, dwarf shrub tundra	3,274.00	25%
Herbaceous	Tree cover less than 10%, shrub cover less than 25%	mesic herb, wet herbaceous, aquatic herbaceous, tussock sedge tundra	988.8	8%
Other Land Cover	Less than 25% ground cover, vegetation cover less than 10%	alpine barrens, barren: disturbance related, open water: ponds/lakes, riverine systems: water/bars, snow	199.8	1%

Source: Michael Baker 2017a



TRANSPORTATION FACILITIES VEGETATION TYPES

JANUARY 2018

FIGURE 3.10-4

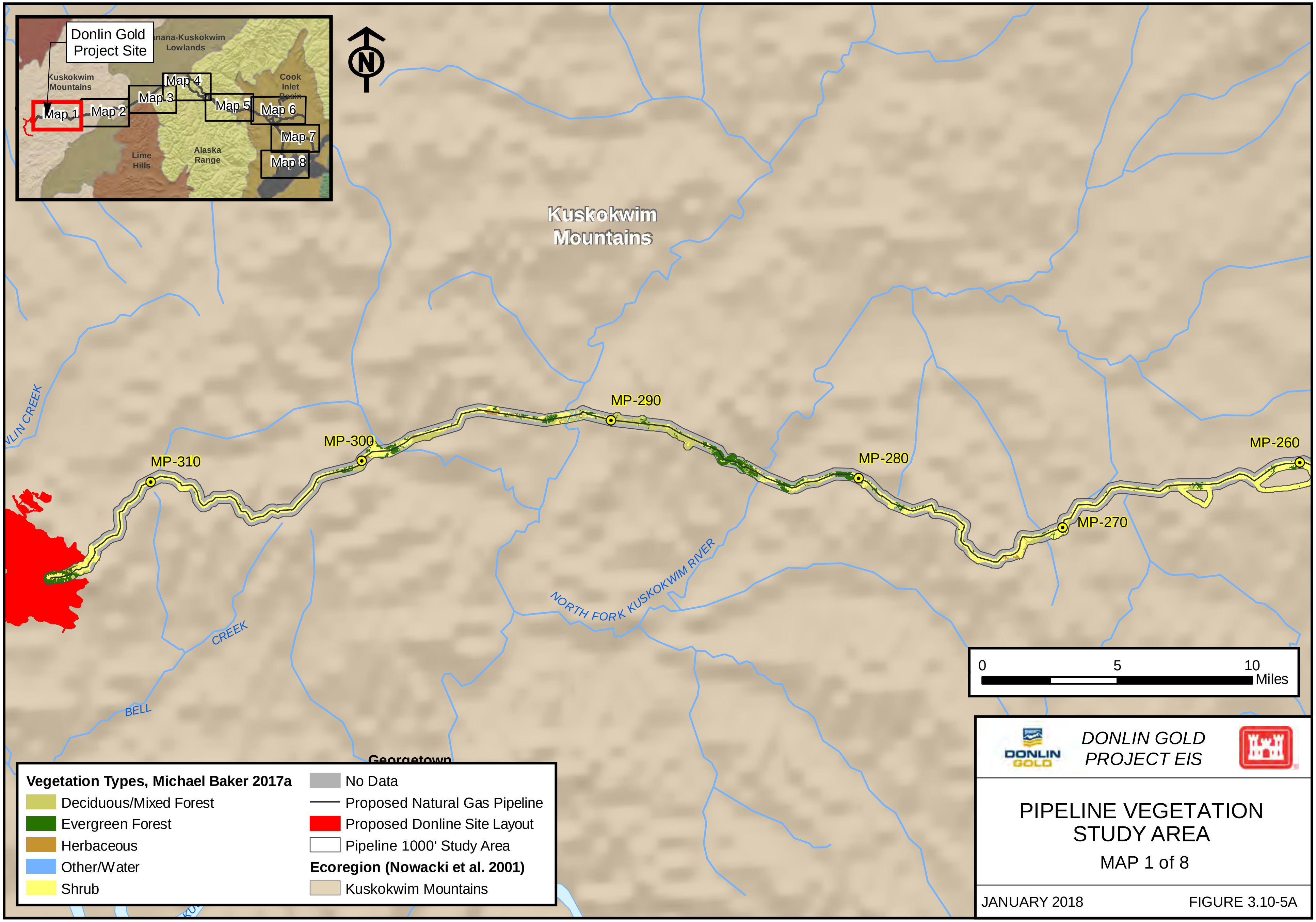
3.10.2.5 PIPELINE

The vegetation types mapped in the Pipeline component are listed and described in Table 3.10-3 and shown in Figure 3.10-5A through Figure 3.10-5H. The proposed pipeline route in the Pipeline component crosses the Tanana-Kuskokwim Lowlands, the Alaska Range, and the Cook Inlet Basin ecoregions. The eastern portion of the Pipeline, located within the Cook Inlet ecoregion, is generally characterized by mixed forest along the larger rivers of the region (i.e., the Susitna, Skwentna, Happy, and Hayes rivers and their tributaries). The portion of the Pipeline component west of the Alaska Range runs through the Kuskokwim Mountains and Kuskokwim lowlands ecoregions, and is largely black spruce forest in low-lying tundra habitat commonly associated with the larger Kuskokwim and Yukon rivers (ARCADIS 2011a).

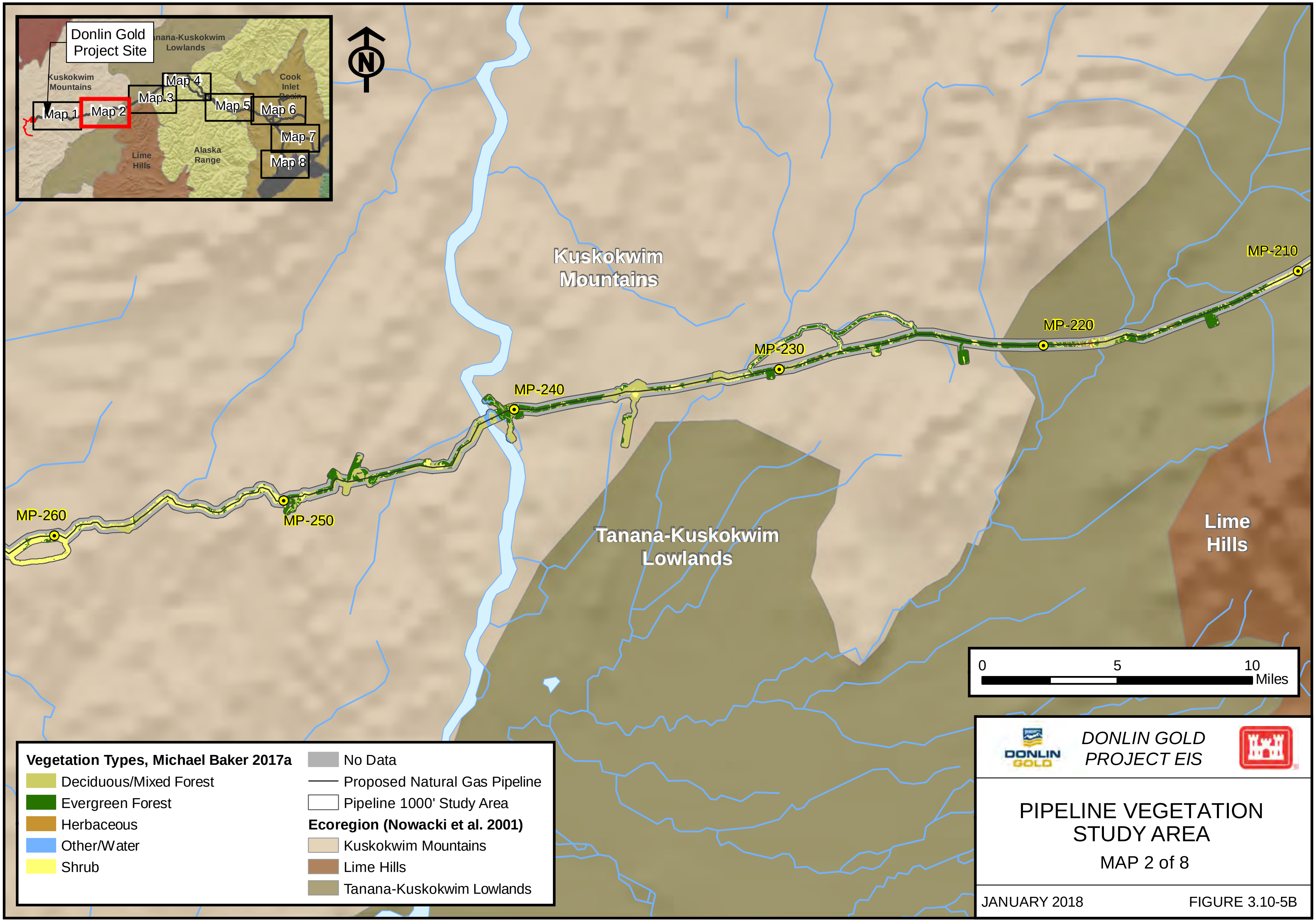
Table 3.10-3: Study Area Pipeline Component Vegetation Types

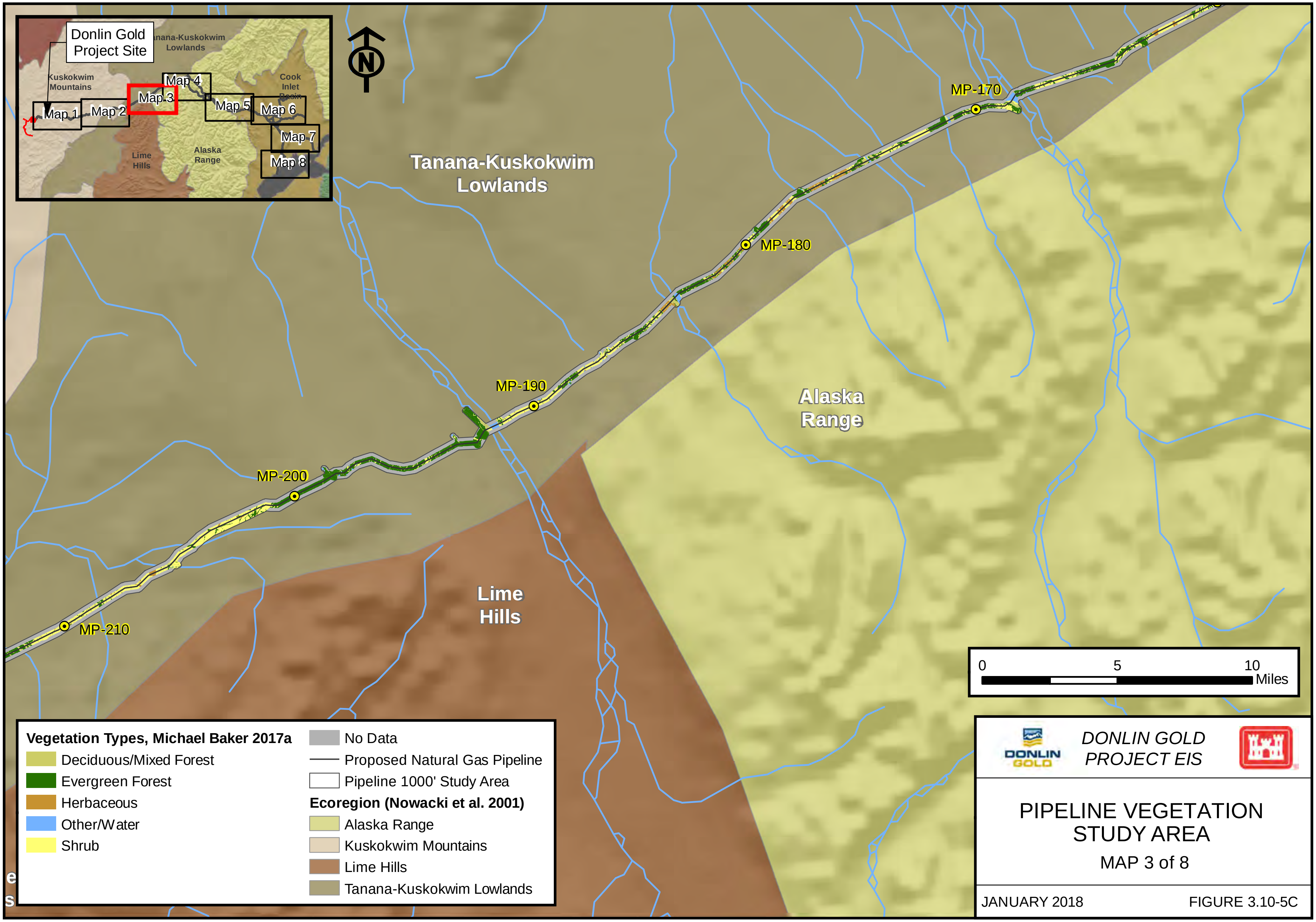
Aggregated Type	Description	Vegetation Types	Acres Mapped	Percentage of Study Area
Forested - Evergreen	Tree/sapling cover greater than 10%	black spruce woodland, closed black spruce forest, closed white spruce forest, open black spruce forest, open white spruce forest, white spruce woodland	17,776.30	22%
Forested – Deciduous and Mixed	Tree/sapling cover greater than 10%	open deciduous forest, open mixed forest, closed deciduous forest, closed mixed forest, woodland deciduous forest, woodland mixed forest	17,617.40	22%
Scrub Shrub	Shrub cover greater than 25%	deciduous shrub sapling regrowth, closed willow shrub, open willow shrub, closed alder shrub, open alder shrub, closed alder willow shrub, open alder willow shrub, low shrub bog, ericaceous shrub bog-string bog, low shrub tundra, dwarf shrub tundra	28,822.60	36%
Herbaceous	Tree cover less than 10%, shrub cover less than 25%	mesic herb, wet herbaceous, aquatic herbaceous, tussock sedge tundra	2,461.20	3%
Other Land Cover	Less than 25% ground cover, vegetation cover less than 10%	alpine barrens, barren: disturbance related, open water: ponds/lakes, riverine systems: water/bars, snow	13,123.30	17%

Source: Michael Baker 2017a, 2017b

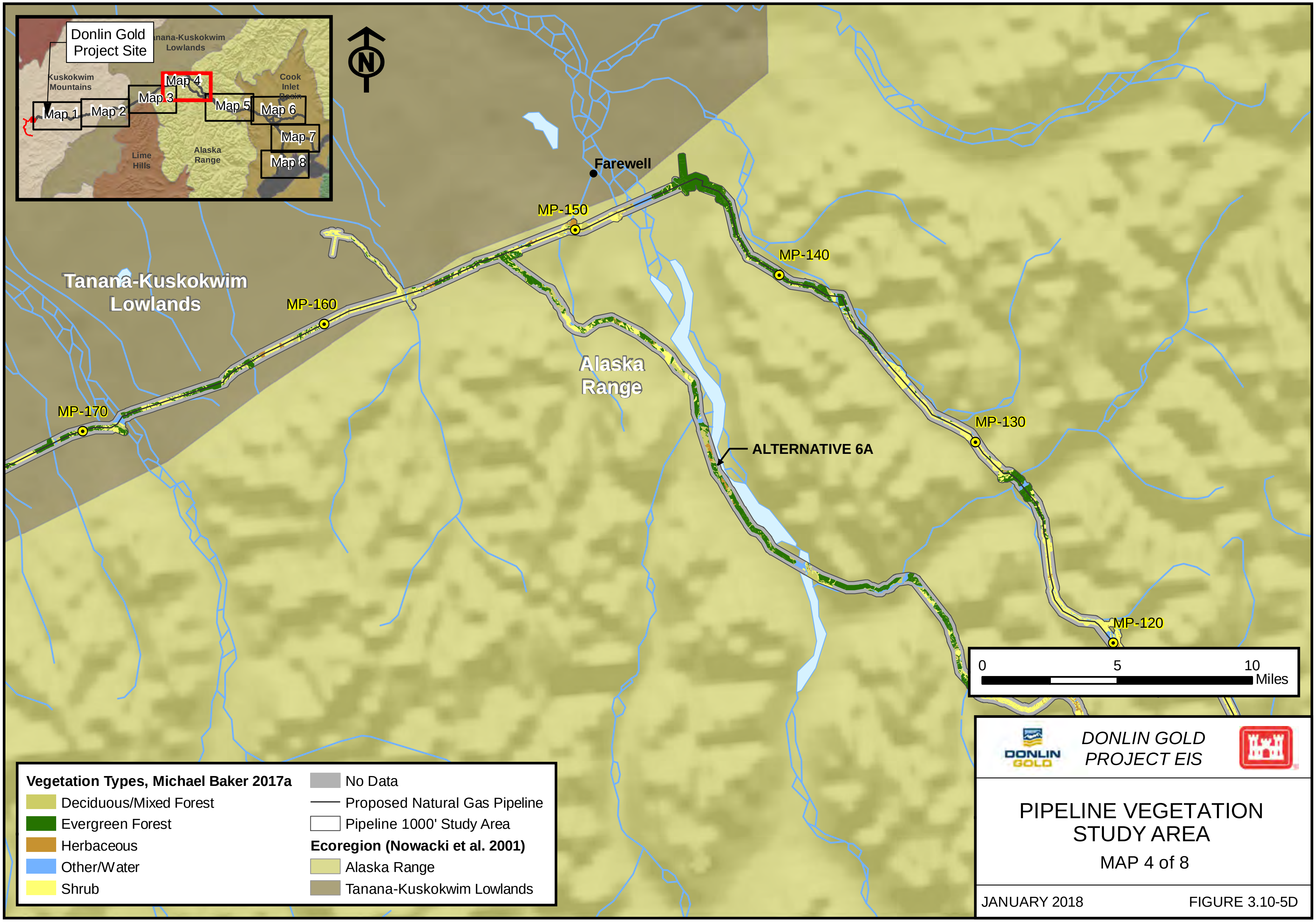


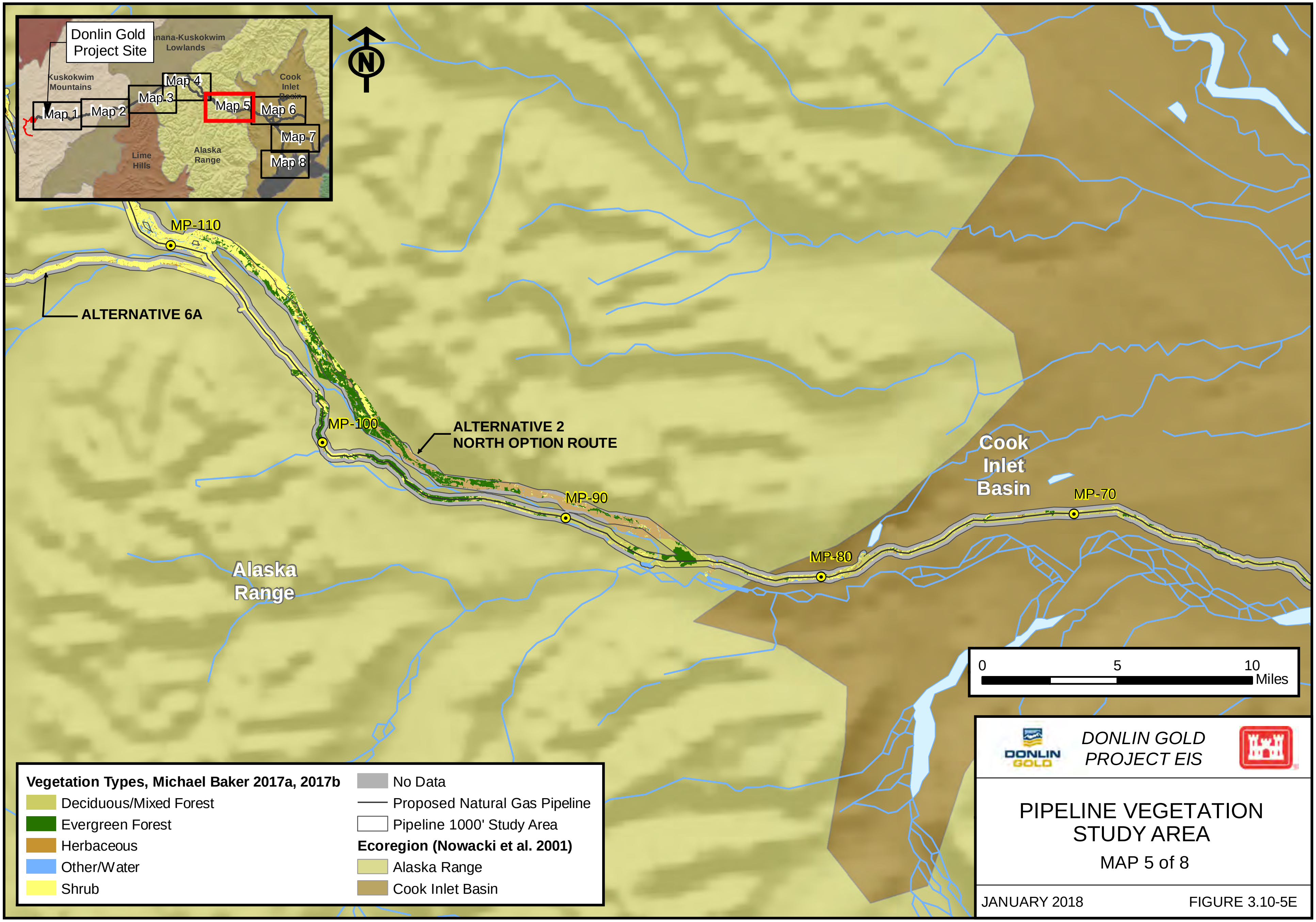
Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
N
Kuskokwim Mountains
MP-310
MP-300
MP-290
MP-280
MP-270
MP-260
NORTH FORK KUSKOKWIM RIVER
CREEK
BELL
Georgetown
0
5
10
Miles
Vegetation Types, Michael Baker 2017a
Deciduous/Mixed Forest
Evergreen Forest
Herbaceous
Other/Water
Shrub
No Data
Proposed Natural Gas Pipeline
Proposed Donlin Site Layout
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Kuskokwim Mountains
DONLIN GOLD
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 1 of 8
JANUARY 2018
FIGURE 3.10-5A


Donlin Gold Project Site
Tanana-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
Kuskokwim Mountains
Tanana-Kuskokwim Lowlands
Lime Hills
MP-210
MP-220
MP-230
MP-240
MP-250
MP-260
0
5
10
Miles
Vegetation Types, Michael Baker 2017a
Deciduous/Mixed Forest
Evergreen Forest
Herbaceous
Other/Water
Shrub
No Data
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Kuskokwim Mountains
Lime Hills
Tanana-Kuskokwim Lowlands
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 2 of 8
JANUARY 2018
FIGURE 3.10-5B

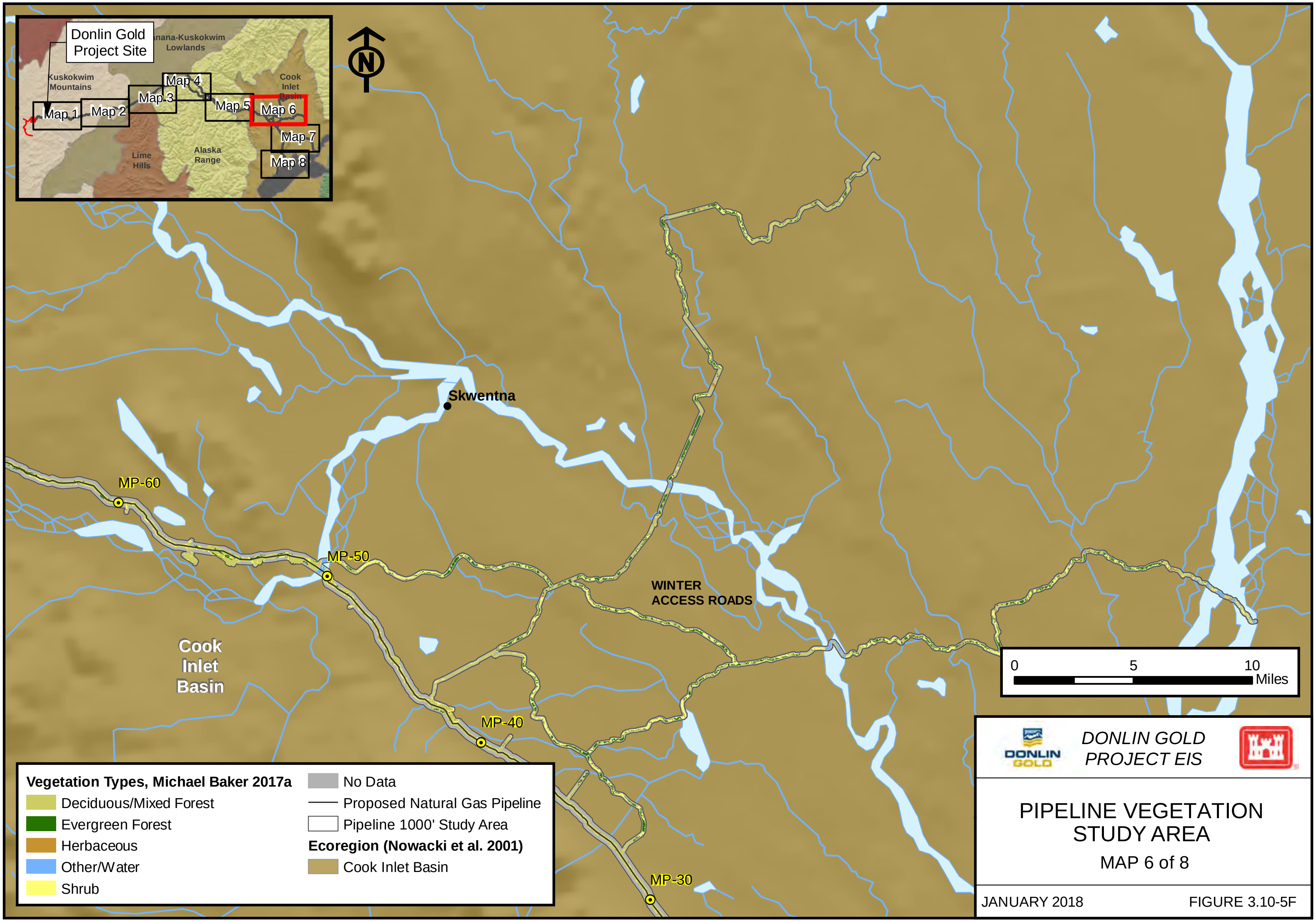


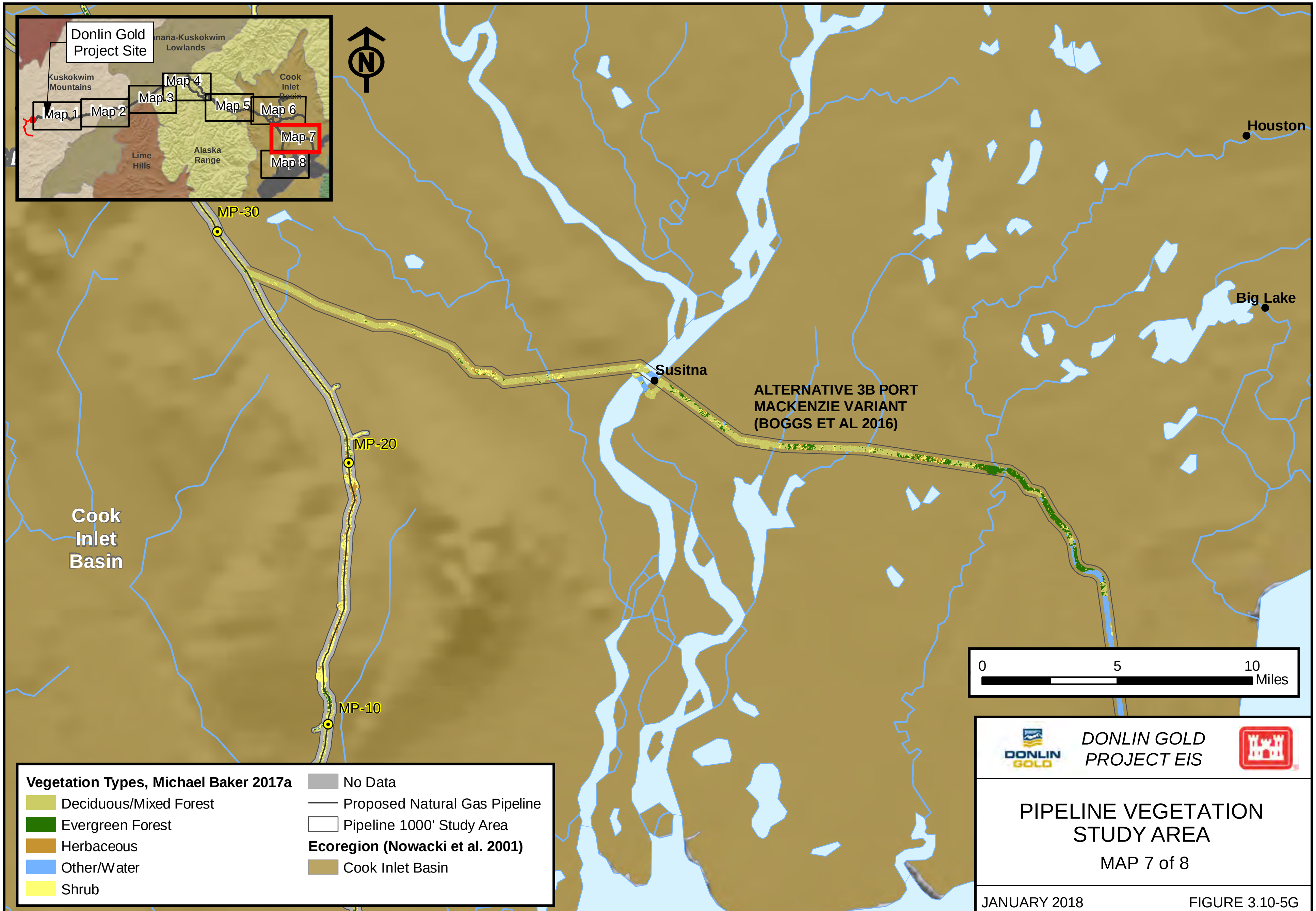
Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Lime Hills
Alaska Range
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
N
Tanana-Kuskokwim Lowlands
Alaska Range
Lime Hills
MP-170
MP-180
MP-190
MP-200
MP-210
0
5
10
Miles
Vegetation Types, Michael Baker 2017a
Deciduous/Mixed Forest
Evergreen Forest
Herbaceous
Other/Water
Shrub
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 VEGETATION STUDY AREA
MAP 3 of 8
JANUARY 2018
FIGURE 3.10-5C


Donlin Gold Project Site
Tanana-Kuskokwim Lowlands
Kuskokwim Mountains
Cook Inlet Basin
Alaska Range
Lime Hills
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
0
5
10
Miles
Vegetation Types, Michael Baker 2017a
Deciduous/Mixed Forest
Evergreen Forest
Herbaceous
Other/Water
Shrub
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 VEGETATION STUDY AREA
MAP 4 of 8
JANUARY 2018
FIGURE 3.10-5D



Donlin Gold Project Site
Kuskokwim Mountains
Lime Hills
Alaska Range
Cook Inlet Basin
Map 1
Map 2
Map 3
Map 4
Map 5
Map 6
Map 7
Map 8
N
MP-110
ALTERNATIVE 6A
MP-100
ALTERNATIVE 2
NORTH OPTION ROUTE
MP-90
MP-80
MP-70
Alaska Range
Cook Inlet Basin
0 5 10 Miles
Vegetation Types, Michael Baker 2017a, 2017b
Deciduous/Mixed Forest
Evergreen Forest
Herbaceous
Other/Water
Shrub
No Data
Proposed Natural Gas Pipeline
Pipeline 1000' Study Area
Ecoregion (Nowacki et al. 2001)
Alaska Range
Cook Inlet Basin
DONLIN GOLD PROJECT EIS
PIPELINE VEGETATION STUDY AREA
MAP 5 of 8
JANUARY 2018
FIGURE 3.10-5E


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
WINTER ACCESS ROADS
Cook Inlet Basin
0
5
10
Miles
Vegetation Types, Michael Baker 2017a
Deciduous/Mixed Forest
Evergreen Forest
Herbaceous
Other/Water
Shrub
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 VEGETATION STUDY AREA
MAP 6 of 8
JANUARY 2018
FIGURE 3.10-5F



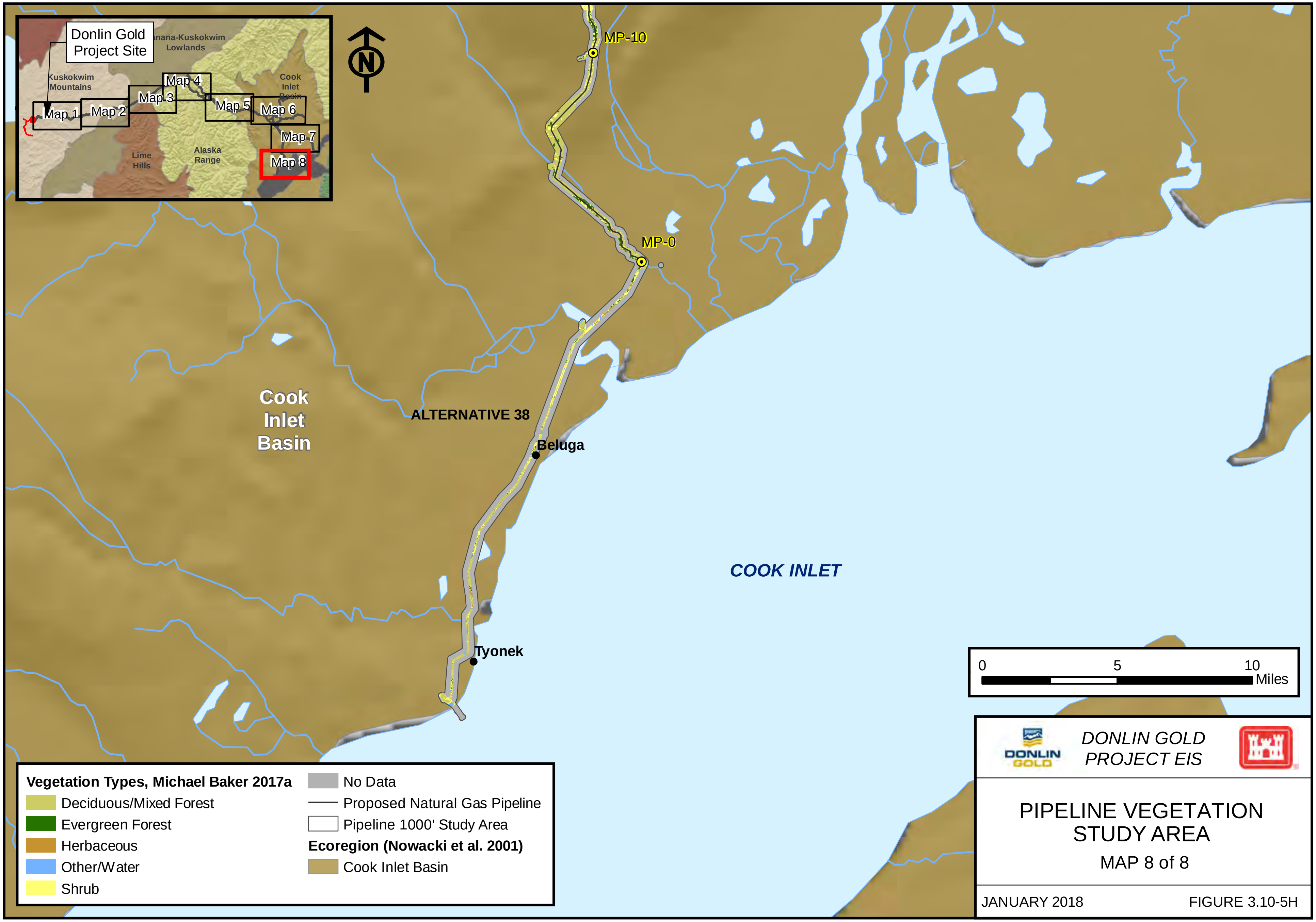
DONLIN GOLD PROJECT EIS

PIPELINE VEGETATION STUDY AREA

MAP 7 of 8

JANUARY 2018

FIGURE 3.10-5G



DONLIN GOLD PROJECT EIS

PIPELINE VEGETATION STUDY AREA

MAP 8 of 8

JANUARY 2018

FIGURE 3.10-5H

3.10.2.6 RARE AND SENSITIVE PLANTS

Rare or sensitive species are groups of organisms that are very uncommon, scarce, or infrequently encountered; they are essential components of ecosystems and natural processes. There is only one federally ESA-listed rare plant species in Alaska, the Aleutian shield fern (*Polystichum aleuticum*), a small fern known to occur only at two locations in the Andreanof Island group of the Aleutian Islands. There are no documented occurrences of this plant in the Project Area and it is not expected to occur here.

ACCS maintains a list of 318 rare vascular plant species in Alaska (ACCS 2017a; Nawrocki et al. 2013; Lipkin and Murray 1997). In addition, the BLM maintains a sensitive species list (BLM 2010a, BLM 2010b). Several incidental observations of listed species were recorded during project vegetation / wetland surveys. Surveys that have been conducted in the vicinity of the Project Area, but were not specifically conducted for the project, have also confirmed presence of listed species. All known locations of rare and sensitive plants known or suspected in the vicinity of the Project Area are listed in Table 3.10-4. Precise coordinates of rare or sensitive plants are not provided on the ACCS online database to protect the location of the plants, but general locations are described. Figure 3.10-6 depicts locations of rare or sensitive plants recorded during project surveys. In order to be confirmed and receive a state herbarium (ALA, University of Alaska Museum of the North Herbarium) accession number, voucher specimens must be collected or carefully photographed for review and approval by a qualified botany expert.

No rare or sensitive species have been confirmed in the Mine Site component. A fowl mannagrass (*Glyceria striata*) population was recorded along Anaconda Creek during project wetland / vegetation surveys. A voucher specimen was not collected and this observation remains unconfirmed. The closest documented population of fowl mannagrass is in the Yentna Watershed, near the Pipeline component but outside the Project Area (ACCS 2017a).

No rare or sensitive plants have been confirmed within the Transportation Corridor component inside the Project Area.

In the Pipeline component, a population of bristleleaf sedge (*Carex eburnea*) was reported in the utility corridor 20 miles southwest of Farewell during project vegetation / wetland surveys; a voucher specimen was not collected so this observation remains unconfirmed (Moody 2013). Voucher specimens were collected and confirmed for little prickly sedge (*Carex echinata* ssp. *echinata*) in the Lower Skwentna River basin and elephanthead lousewort (*Pedicularis groenlandica*) in the Alexander Creek basin. Specimens have been archived in the ALA herbarium (Moody 2013). These two species have been confirmed in prior surveys within the Project Area, along with fragile rockbrake (*Cryptogramma stelleri*) (ACCS 2017a). An unconfirmed population of little prickly sedge was reported in the Lower Skwentna River basin near Canyon Lake; a voucher specimen was not collected and this observation remains unconfirmed (Moody 2013). Little prickly sedge has been confirmed within the Project Area during prior surveys (ACCS 2017a). Pearfruit smelowskia (*Smelowskia pyriformis*) presence has also been confirmed in prior surveys within the Project Area (ACCS 2017a).

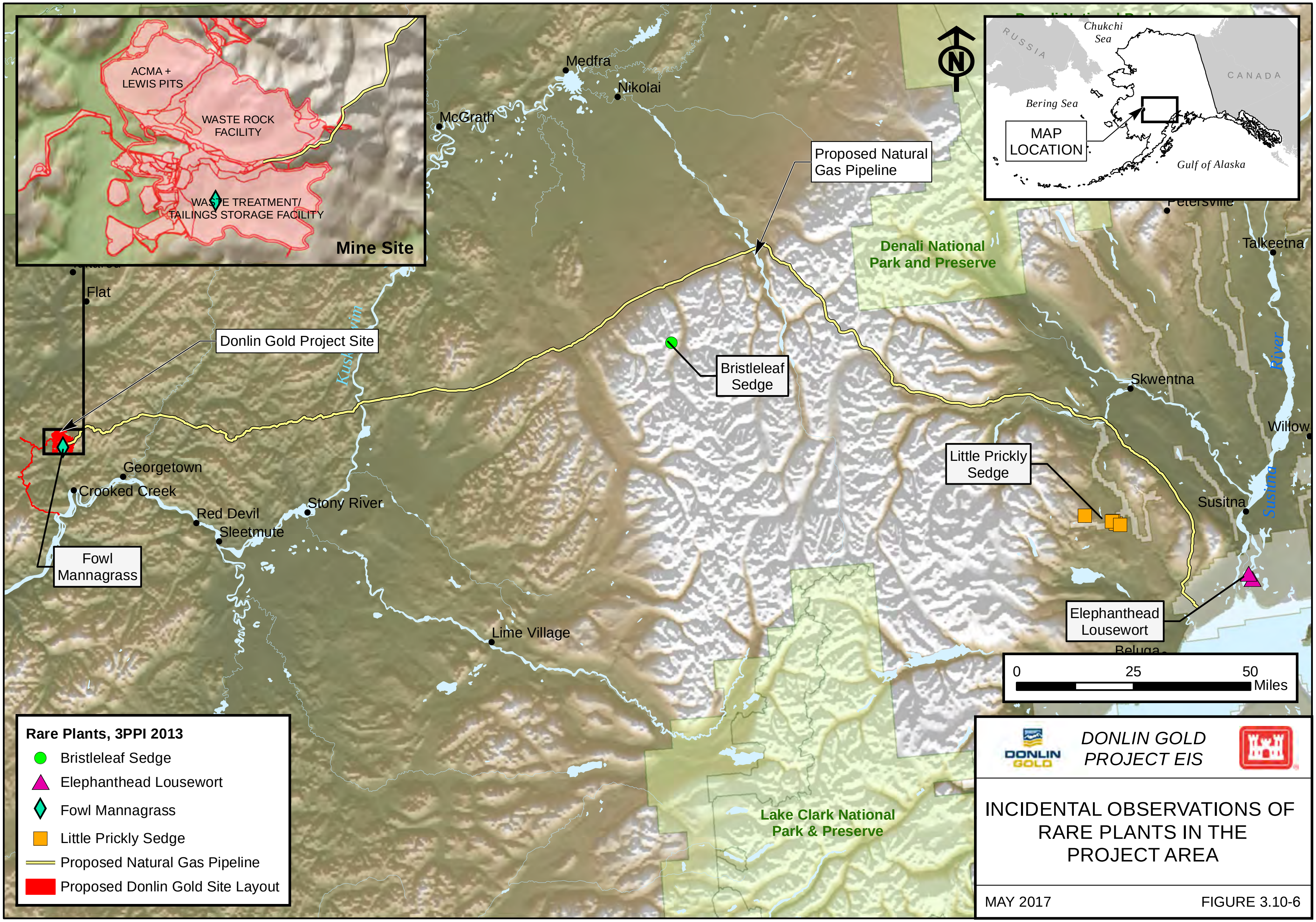
Table 3.10-4: Rare and Sensitive Plants Recorded in the Project Area

Number of Individuals	Common Name	Scientific Name	ACCS Ranking[1]	Ecoregion, Watershed and Basin
Mine Site				
1	fowl mannagrass	*Glyceria striata*	G5 S3	Kuskokwim Mountains Ecoregion, Crooked Creek, Anaconda Creek Basin (unconfirmed)
Pipeline				
1	bristleleaf sedge	*Carex eburnea*	G5 S3	Tanana-Kuskokwim Lowlands Ecoregion, Khuchaynik Basin, Khuchaynik Creek (unconfirmed)
3	little prickly sedge	*Carex echinata ssp. echinata*	G5T5 S1S2	Cook Inlet Ecoregion, Lower Skwentna River Basin, Unnamed Tributary #2 (**confirmed – ALA Accession Numbers V171549, V171548, V171551**)
1	little prickly sedge	*Carex echinata ssp. echinata*	G5T5 S1S2	Cook Inlet Ecoregion, Lower Skwentna River Basin, Skwentna River (**confirmed – ALA Accession Number V171550**)
1	little prickly sedge	*Carex echinata ssp. echinata*	G5T5 S1S2	Cook Inlet Ecoregion, Lower Skwentna River, Basin, Canyon Lake-Skwentna River (unconfirmed)
2	fragile rockbrake	*Cryptogramma stelleri*	G5 S3S4	Cook Inlet Ecoregion, West Fork Yenta River (**confirmed – ALA Accession Numbers V133685, V133686)**
1	elephanthead lousewort	*Pedicularis groenlandica*	G5 S2	Cook Inlet Ecoregion, Alexander Creek Basin, Wolverine Creek (**confirmed – ALA Accession Number V171547**)
1	elephanthead lousewort	*Pedicularis groenlandica*	G5 S2	Cook Inlet Ecoregion, Alexander Creek Basin, Lower Sucker Creek (**confirmed – ALA Accession Number V171546**)
1	pearfruit smelowskia	*Smelowskia pyriformis*	G2 S3	Cook Inlet Ecoregion, Happy R. drainage, vic. Rainy Pass **(confirmed – ALA Accession Number V103404)**
1	pearfruit smelowskia	*Smelowskia pyriformis*	G5 S2	Cook Inlet Ecoregion, Terra Cotta Mountains. 10 km NE of Post Lake (**confirmed – ALA Accession Number V77012**)
1	pearfruit smelowskia	*Smelowskia pyriformis*	G5 S2	Cook Inlet Ecoregion, Alaska Range, Upper Tin Creek (**confirmed – ALA Accession Number V76757**)

Notes:

1 Rankings use a scale of S for State, G for Global; 1 for critically imperiled populations to 5 for secure populations. The T rankings are for subspecies or varieties (ACCS 2017a).

Source: ACCS 2017a, Arctos 2017, Moody 2013



DONLIN GOLD PROJECT EIS

INCIDENTAL OBSERVATIONS OF RARE PLANTS IN THE PROJECT AREA

MAY 2017 FIGURE 3.10-6

3.10.2.7 NONNATIVE INVASIVE SPECIES

NNIS are a serious concern with potentially severe ecological and economic consequences. NNIS of all taxa (terrestrial plants, aquatic plants, marine plants and algae, marine animals, marine or freshwater fish, amphibians, terrestrial invertebrates, terrestrial mammals, or even pathogens) could be introduced and spread by a variety of vectors throughout the Project Area.

This section discusses all taxa of NNIS species that may be introduced or spread within the Project Area, including terrestrial plants (Section 3.10.2.7.1), aquatic (marine and freshwater) species (Section 3.10.2.7.2), and mammal species (Section 3.10.2.7.3).

3.10.2.7.1 NNIS VECTORS

Common introduction locations include ports, docks, river banks, road corridors, airstrips, material sites, pipe storage yards, construction areas, cleared areas, gravel pits, staging areas, lay down areas, drainages or moist areas, trails, trailsides, trailheads, parking areas, roadsides, recently burned locations, structures, and camps. Areas with disturbed soils, open soil surfaces, or recently burned organic or mineral surfaces are especially vulnerable to nonnative invasive plant species infestation.

NNIS vectors include:

- Existing populations: Water vessel traffic (e.g., barges, boats, floatplanes) and other water-transport related activities (e.g., cargo shipments, gear, equipment, clothing, footwear) have the potential to spread known infestations along the Kuskokwim River throughout the Transportation Corridor to the Project Area in all project phases. Plane or helicopter transport that occurs in known infestation areas could also transport populations throughout the Project Area to landing strips or landing zones. Mine Site activities in all three phases have the potential to spread known populations to larger areas or new locations. Pipeline activities have the potential to spread known infestations near Port MacKenzie, Tyonek, along the Iditarod National Historic Trail (INHT), and in the vicinity of Dalzell Gorge to more extensive areas in this component through construction equipment, non-certified gravel, soil transport, personal equipment, clothing, or footwear, primarily during the Construction Phase, but also during the Operations Phase during routine pipeline access or maintenance or during brushing activities. In all three project components, seeds or other propagules from existing populations could be dispersed by wind, water, waves, wildlife and bird movement, ocean currents, or by being attached to people, clothing, footwear, gear, materials, or equipment.
- Equipment: NNIS can be transported by construction equipment; field gear; imported materials including fill, gravel, pallets, packing materials, erosion control materials; clothing, footwear, field packs, and personal gear; fishing gear including nets, waders, and bait; and any other items brought into the Project Area, including within soil that is not properly washed off construction equipment, boots, clothes, or gear.
- Natural processes: NNIS could potentially be transported by natural processes such as wind, water movement, waves and ocean currents, and bird and wildlife transport. Marine NNIS such as cordgrasses or open-ocean species such as bryozoans may be transported by ocean currents to areas within the Project Area. Nonnative invasive

freshwater plant species such as elodea or waterweed (*Elodea canadensis*, *E. nuttallii*, and hybrids) have the potential to be transported by waterfowl or terrestrial mammals from other locations within Alaska.

- Vehicles: Roads contribute to the spread of NNIS in two ways. NNIS can grow in disturbed soil within the road corridor itself, usually at the edge. Typically, these species are adapted to disturbed areas and spread readily. In addition, roads are pathways for NNIS to be spread from other locations as people or vehicles incidentally move seeds or plant parts that are deposited along the road or are carried in/on equipment, supplies, or fill material.
- Float planes: Invasive plant fragments can be transported on float plane parts, including one particular species of concern, elodea. A 2014 U.S. Fish and Wildlife Service survey of a floatplane lake near Bethel revealed no elodea. However, there are many other water bodies used by floatplanes and boats in the vicinity of the Project Area that have not been surveyed for the presence or absence of aquatic NNIS, and planes may travel from known infestation areas to the Project Area.
- Freshwater vessels: Freshwater based boats can transport invasive plant seeds, invasive plant parts, and invasive animals that hitchhike in or on the vessel or gear used in the vessel. Docking sites and ports are especially vulnerable. Wind-dispersed species, which generally have a moderate to high invasiveness ranking (Nawrocki et al. 2011; Carlson et al. 2008), may be able to land on vessels and be transported more readily to new areas.
- Marine vessels: Marine vessels take on and discharge millions of tons of ballast water daily in ports and harbors around the world. The discharge of ballast water is considered a main pathway for aquatic introductions because ballast water can contain aquatic plants, animals, and pathogens. Ballast water could also transport estuarine or coastal terrestrial plant NNIS such as cordgrasses. Biofouling, or the accumulation of microorganisms, plants, algae, or animals on below-water surfaces, is considered one of the strongest vectors of invasion transport in marine environments.
- Vessel hotspot niches: All vessel types tend to have niche areas that act as "hotspots" for organism accumulation. Plant parts can also be easily transported in propellers, exterior engine parts, or on board the vessel. Barges move at slow speeds (<11 knots) and have variable duration in ports (generally >24 hours, from several days to several weeks), inviting potential invasion. Barges tend to have hotspots for invasion in ladder holes and dock block areas.

3.10.2.7.2 NNIS - TERRESTRIAL PLANTS

ACCS maintains data and tracks populations of nonnative invasive terrestrial and aquatic plant species found in Alaska through the AKEPIC database and determines invasiveness ranking for species (ACCS 2017c). Ranking is a score between 0 and 100 based on ecological impacts, biological characteristics and dispersal ability, distribution, and feasibility of control. Scores greater than 80 define the species as Extremely Invasive; 70 to 79 as Highly Invasive, considered a high level of ecological threat within Alaska; 60 to 69 as Moderately Invasive and 50 to 59 as Modestly Invasive, both posing substantial risks to ecosystems in Alaska; 40 to 49 as Weakly Invasive; and below 40 as Very Weakly Invasive (Nawrocki et al. 2011; Carlson et al. 2008).

Surveys for nonnative invasive plant species within the Project Area include:

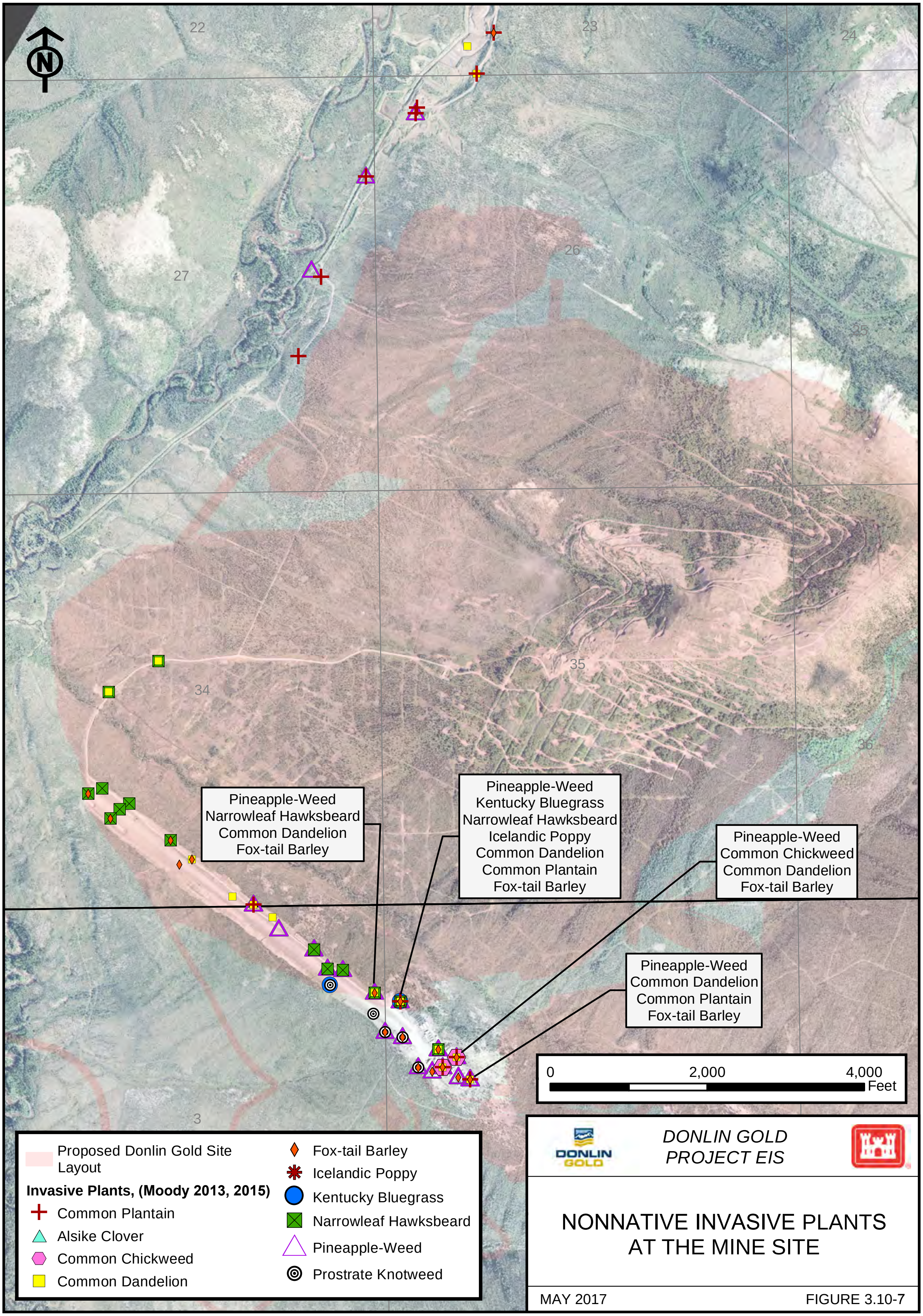
- In 2009, the ACCS conducted a nonnative invasive species survey for the BLM along the INHT (Flagstad and Cortés-Burns 2010). These data are included in AKEPIC (ACCS 2017c).
- A statewide Alaska Association of Conservation Districts (AACD) project in 2010 surveyed many locations within the Project Area for nonnative invasive plant species, including communities along the Kuskokwim River and Cook Inlet. These data are included in AKEPIC (ACCS 2017c).
- In July 2014, a project reconnaissance survey for nonnative invasive plant species was conducted within the Mine Site along existing features and roads (Moody 2015).

Within the Project Area, 27 nonnative invasive terrestrial plant species have been recorded with 496 individual occurrences, with invasiveness ranking scores between 76 and 32 (Table 3.10-5). Within the Mine Site, 12 invasive plant species have been recorded (Moody 2015, ACCS 2017c). In a project survey, three species that were previously not known from the Project Area (Icelandic poppy [*Papaver nudicaule*], Kentucky bluegrass [*Poa pratensis* spp. *pratensis*], and alsike clover [*Trifolium hybridum*]) were recorded (Moody 2015). Mine Site nonnative invasive plant locations are illustrated in Figure 3.10-7. Within the Transportation Corridor, 21 nonnative invasive plant species have been recorded during surveys along the Kuskokwim River in the vicinities of Bethel, Kwethluk, Upper and Lower Kalskag, Aniak, Chuathbaluk, Napaimute, and Crooked Creek (Moody 2015, ACCS 2017c). Locations are shown on Figure 3.10-8. Within the Pipeline component, 15 species have been recorded near Georgetown, Red Devil, Sleetmute, Stony River, and Tyonek; and along the Iditarod National Historic Trail (ACCS 2017c; Flagstad and Cortés-Burns 2010) (Figure 3.10-9). During preliminary wetland surveys, four invasive plant species were incidentally noted along Squaw Creek approximately three miles from the pipeline corridor footprint, outside the Project Area (Moody 2013). A habitat classification study in the Pipeline component noted that no nonnative invasive plant species were noted (ARCADIS 2011a). Details of numbers of species recorded and locations are given in Table 3.10-6.

Table 3.10-5: Nonnative Invasive Species within the Project Area

Common Name	Scientific Name	Invasiveness Ranking[1]	Number of Occurrences in Project Area
creeping thistle	*Cirsium arvense*	76	1
Siberian peashrub	*Caragana arborescens*	74	2
butter and eggs	*Linaria vulgaris*	69	6
foxtail barley	*Hordeum jubatum*	63	50
oxeye daisy	*Leucanthemum vulgare*	61	6
quackgrass	*Elymus repens*	59	1
white clover	*Trifolium repens*	59	12
common dandelion	*Taraxacum officinale*	58	43
alsike clover	*Trifolium hybridum*	57	4
narrowleaf hawksbeard	*Crepis tectorum*	56	91
creeping buttercup	*Ranunculus repens*	54	3
Kentucky bluegrass	*Poa pratensis* ssp. *pratensis*	52	11
fall dandelion	*Leontodon autumnalis*	51	7
sheep sorrel	*Rumex acetosella*	51	12
black bindweed	*Fallopia convolvulus*	50	1
splitlip hempnettle	*Galeopsis bifida*	50	14
curled dock	*Rumex crispus*	48	3
annual bluegrass	*Poa annua*	46	1
redroot pigweed	*Amaranthus retroflexus*	45	1
prostrate knotweed	*Polygonum aviculare*	45	30
common plantain	*Plantago major*	44	69
common chickweed	*Stellaria media*	42	19
shepherd's purse	*Capsella bursa-pastoris*	40	7
Icelandic poppy	*Papaver croceum (P. nudicaule)*	39	1
lambsquarters	*Chenopodium album var. album*	37	32
big chickweed	*Cerastium fontanum spp. vulgare*	36	5
pineappleweed	*Matricaria discoidea*	32	64
Totals	**27 Species**		**496**

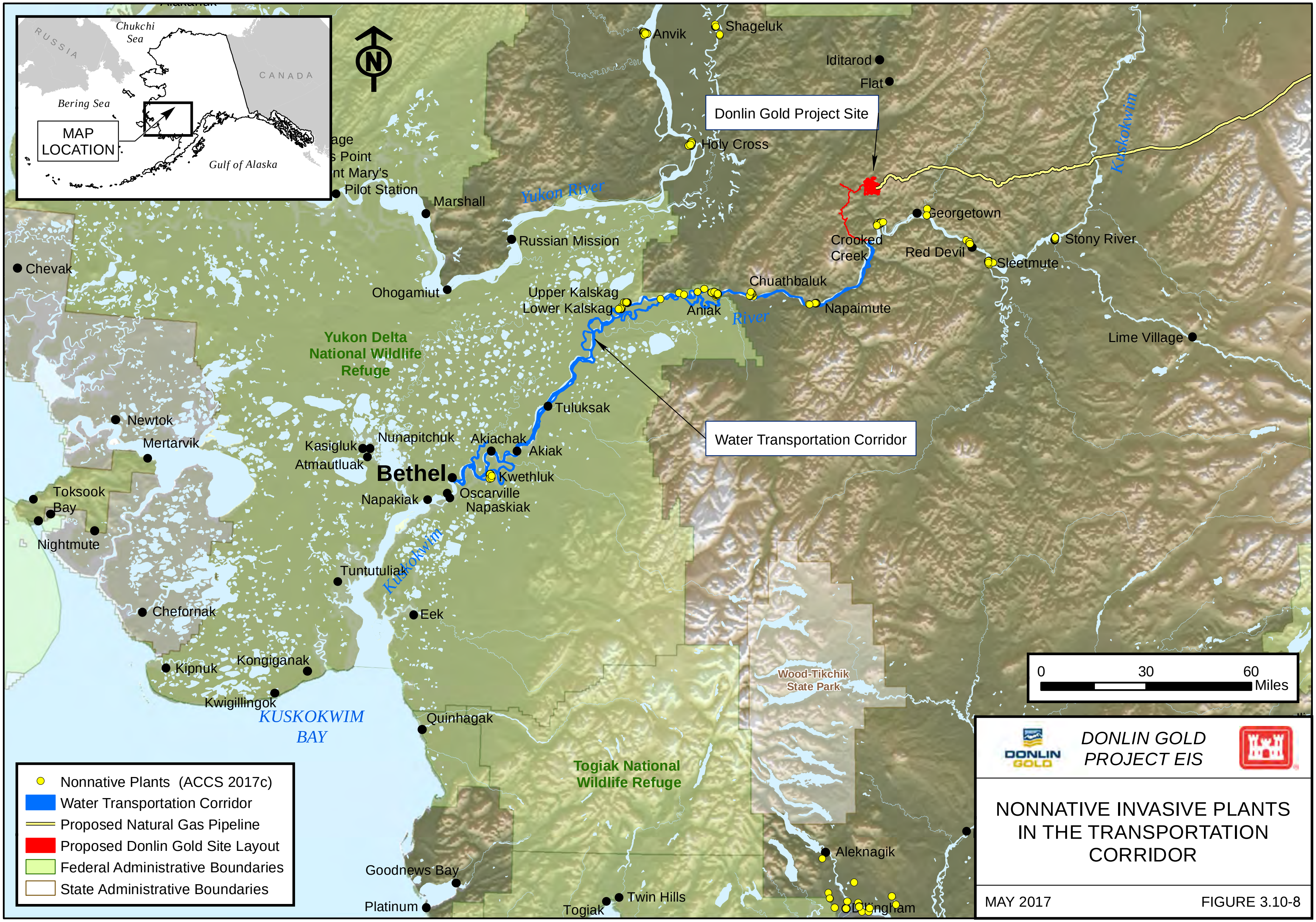
Source: 1 Nawrocki et al. 2011 and Carlson et al. 2008, ACCS 2017c, Moody 2015, Flagstad and Cortes-Burns 2010



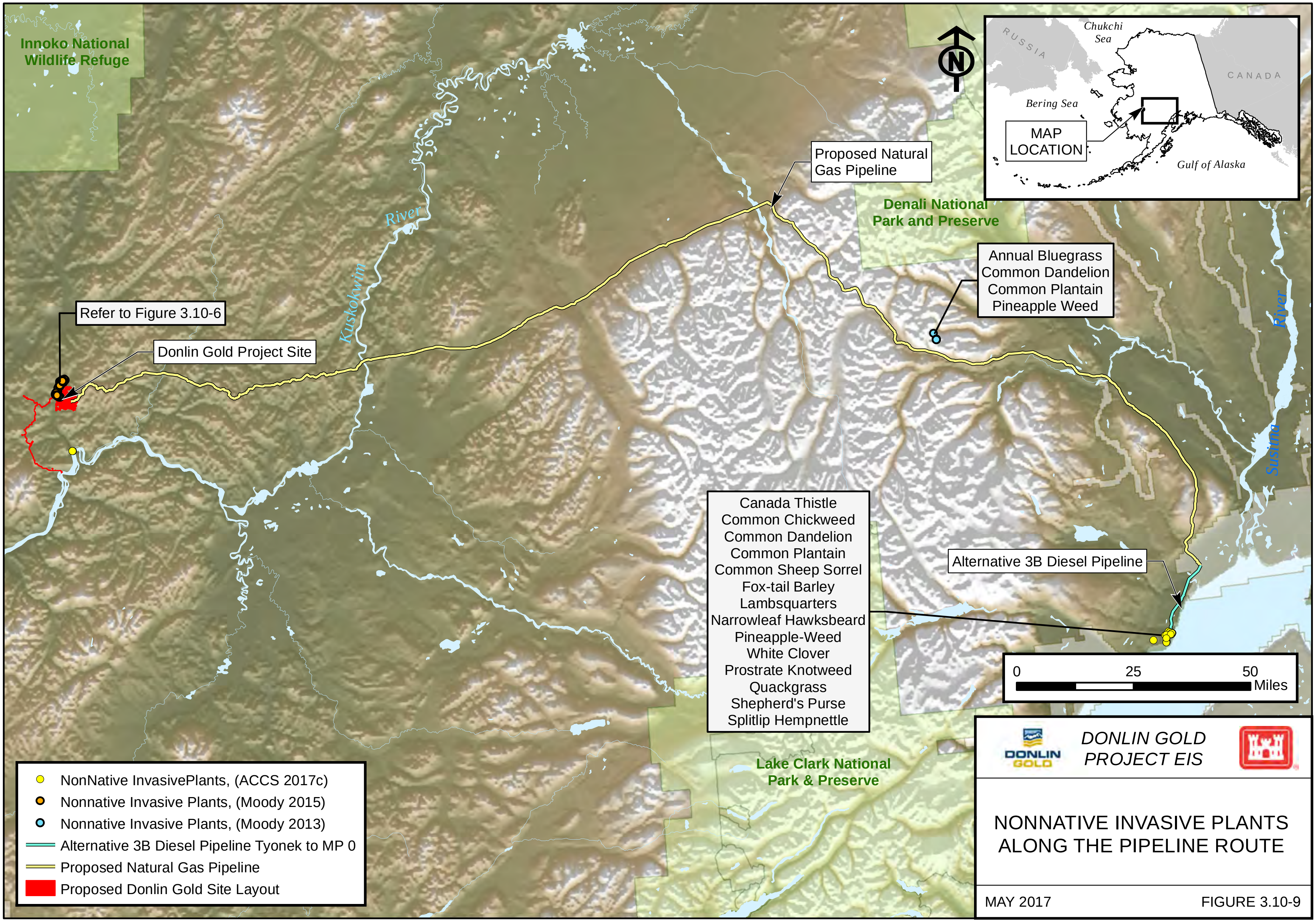
DONLIN GOLD PROJECT EIS

NONNATIVE INVASIVE PLANTS AT THE MINE SITE

MAY 2017 FIGURE 3.10-7



NONNATIVE INVASIVE PLANTS IN THE TRANSPORTATION CORRIDOR



DONLIN GOLD PROJECT EIS

NONNATIVE INVASIVE PLANTS ALONG THE PIPELINE ROUTE

MAY 2017 FIGURE 3.10-9

Table 3.10-6: Nonnative Invasive Species Occurrence by Component

Project Component	Location	Number of Species	Common Name	Number of Occurrences
Mine Site - 12 species total	Between Lyman and Donlin Camp	6	narrowleaf hawksbeard	2
			foxtail barley	7
			pineappleweed	6
			common plantain	14
			Kentucky bluegrass	5
			common dandelion	5
	Donlin Camp/Airstrip	9	narrowleaf hawksbeard	12
			foxtail barley	16
			pineappleweed	16
			Icelandic poppy	1
			common plantain	5
			Kentucky bluegrass	2
			prostrate knotweed	5
			common chickweed	2
			common dandelion	10
	Lyman Yard/Airstrip	8	foxtail barley	10
			oxeye daisy	1
			pineappleweed	6
			common plantain	11
			Kentucky bluegrass	4
			common chickweed	1
			common dandelion	10
			alsike clover	4
Transportation Corridor - 21 species total	Aniak	13	shepherd's purse	5
			Siberian peashrub	1
			big chickweed	1
			lambsquarters	4
			narrowleaf hawksbeard	34
			black bindweed	1
			splitlip hempnettle	7
			fall dandelion	1
			butter and eggs	1
			pineappleweed	2
			common plantain	2
			prostrate knotweed	5
			common chickweed	4
	Bethel	12	Siberian peashrub	1
			lambsquarters	3
			narrowleaf hawksbeard	3
			fall dandelion	3
			oxeye daisy	2
			pineappleweed	2
			common plantain	3
			prostrate knotweed	5
			creeping buttercup	3
			sheep sorrel	7
			curled dock	2
			common dandelion	1
	Chuathbaluk	4	lambsquarters	1
			narrowleaf hawksbeard	6
			pineappleweed	3
			white clover	1

Table 3.10-7: Nonnative Invasive Species Occurrence by Component

Project Component	Location	Number of Species	Common Name	Number of Occurrences
Transportation Corridor - 21 species total	Crooked Creek	8	lambsquarters	7
			narrowleaf hawksbeard	9
			foxtail barley	2
			butter and eggs	1
			pineappleweed	3
			common plantain	3
			prostrate knotweed	3
			common chickweed	1
	Kwethluk	7	redroot pigweed	1
			shepherd's purse	2
			big chickweed	2
			fall dandelion	3
			pineappleweed	1
			common plantain	1
			sheep sorrel	3
	Lower Kalskag	7	big chickweed	1
			lambsquarters	1
			narrowleaf hawksbeard	2
			butter and eggs	1
			pineappleweed	2
			common plantain	2
			sheep sorrel	1
	Napaimute	6	lambsquarters	1
			narrowleaf hawksbeard	2
			splitlip hempnettle	1
			oxeye daisy	1
			butter and eggs	1
			pineappleweed	1
	Upper Kalskag	11	big chickweed	1
			narrowleaf hawksbeard	9
			foxtail barley	1
			oxeye daisy	2
			pineappleweed	1
			common plantain	3
			prostrate knotweed	3
			curled dock	1
			common chickweed	1
			white clover	1
			lambsquarters	2
Pipeline Component - 15 total species	Alaska Range, Middle Happy River	1	pineappleweed	1
	Alaska Range, Squaw Creek	4	pineappleweed	1
			common plantain	1
			annual bluegrass	1
			common dandelion	1
	Georgetown	6	lambsquarters	1
			butter and eggs	1
			pineappleweed	3
			common plantain	2
			prostrate knotweed	1
			common chickweed	2
			common dandelion	1

Table 3.10-8: Nonnative Invasive Species Occurrence by Component

Project Component	Location	Number of Species	Common Name	Number of Occurrences
Pipeline Component - 15 total species	Red Devil	8	lambsquarters	3
			narrowleaf hawksbeard	4
			splitlip hempnettle	1
		8	foxtail barley	4
			pineappleweed	5
			common plantain	4
			prostrate knotweed	3
			common dandelion	1
	Sleetmute	10	lambsquarters	4
			narrowleaf hawksbeard	4
			splitlip hempnettle	1
			foxtail barley	2
			pineappleweed	3
			common plantain	5
			prostrate knotweed	1
			common chickweed	2
			common dandelion	2
			white clover	1
	Stony River	6	lambsquarters	3
			butter and eggs	1
			pineappleweed	1
			common plantain	1
			prostrate knotweed	1
			common chickweed	1
	Tyonek	13	lambsquarters	2
			bull thistle	1
			narrowleaf hawksbeard	2
			quackgrass	1
			splitlip hempnettle	4
			pineappleweed	7
			common plantain	12
			prostrate knotweed	3
			sheep sorrel	1
			common chickweed	5
			common dandelion	11
			foxtail barley	6
			white clover	9

Source: ACCS 2017c, Moody 2015, Flagstad and Cortes-Burns 2010

3.10.2.7.3 NNIS - AQUATIC (MARINE AND FRESHWATER) ANIMALS AND FISH

No nonnative invasive aquatic animal or fish species of any taxa have been documented in published literature at this time to have reproducing populations within the Project Area, but several species are considered high risk threats due to current known distribution in Alaska or in similar habitat in North America.

Table 3.10-7 lists high risk marine or freshwater animal and fish species. One reproducing population of nonnative invasive marine animal has been found in Alaska, the tunicate known as sea squirt (Didemnum vexillum), in Whiting Harbor near Sitka on abandoned oyster farm equipment and docks that had been imported to this location. One nonnative invasive aquatic freshwater plant species, elodea or waterweed (Elodea canadensis, E. nuttallii, and hybrids), is known to occur within the state of Alaska, in several locations and could survive in habitats within the Project Area. A 2014 USFWS survey of a lake near Bethel revealed no elodea.

Fourteen nonnative invasive fish species have been identified as occurring in Alaska, including Atlantic salmon (Salmo salar) and yellow perch (Perca flavescens) (ACCS 2017e, ADF&G 2017, McClory and Gotthardt 2008). Of these fourteen species, none are considered highest risk for this project. Some are considered native to other parts of the state, but have been noted in new parts of the state in which the species was not previously known to occur and was not considered native. None of the fish species described in the 2008 publication have been demonstrated to establish breeding populations in Alaska.

Northern pike (Esox lucius) is a freshwater fish that occurs naturally in most of Alaska, but is not considered native to parts of southcentral Alaska. Northern pike is a voracious, aggressive feeder that tends to out-compete other fish species in water bodies. The Project Area occurs in both native and nonnative habitats for this species. In the Pipeline component, the area around the shoreline of Cook Inlet, including areas near Port MacKenzie and the community of Tyonek, would be considered nonnative habitat, while the rest of the Project Area would be considered native habitat (ADF&G 2017). At this time, there are no documented reproducing population of northern pike in the locations within the Project Area where it would be considered nonnative, although presence has been noted; there has been a fishing derby in Tyonek to remove northern pike, and specific suppression projects have been undertaken by the State of Alaska in the Alexander Creek drainage.

Table 3.10-7: Potential High Risk NNIS - Aquatic Animals

Life Form	Common Name	Scientific Name	Vector	Habitat and Ecophysiology
Marine Animal				
Ascidian - colonial tunicate	sea squirt, marine vomit, d-vex	*Didemnum vexillum*	floating rafts, infested material, infested aquaculture stock	Forms colonies. Completely smothers seafloor, grows over all substrate and other organisms, destroys marine habitat.
Ascidian - colonial tunicate	star ascidian, golden star tunicate	*Botryllus schlosseri*	floating rafts, infested material, infested aquaculture stock, hull fouling	Forms colonies in flat sheets that often appear lobate. Adheres to docks, boat hulls, buoys, ropes, pilings, rocks, mussels, solitary sea squirts, seaweeds, and eelgrass. Filter feeder by water pump.
Ascidian - colonial tunicate	sea squirt	*Botrylloides violaceus*	floating rafts, infested material, infested aquaculture stock, hull fouling	Forms colonies arranged in columnar systems with a firm, clear matrix. Adheres to docks, boats hulls, buoys, ropes, pilings, rocks, eelgrass blades, and seaweeds. Overgrows mussels, barnacles, bryozoans, and solitary sea squirts. Filter feeder by water pump.
Ascidian - solitary tunicate	vase tunicate, sea squirt	*Ciona intestinalis*	hull fouling, infested materials, ballast water	Solitary form with vase-like shape. Grows on pilings, aquaculture gear, floats, boat hulls. Lower intertidal to

Table 3.10-7: Potential High Risk NNIS - Aquatic Animals

Life Form	Common Name	Scientific Name	Vector	Habitat and Ecophysiology
				tidal zone
Ascidian - solitary tunicate	transparent ciona, Pacific transparent sea squirt	*Ciona savignyi*	hull fouling, infested materials, ballast water	Solitary form with pillar-like shape up to 15 cm long. Forms dense patches on docks, pilings, marinas, harbors, and aquaculture structures.
Ascidian - solitary tunicate	club tunicate, stalked tunicate	*Styela clava*	hull fouling, infested materials, ballast water	Solitary form with club-like shape up to 20 cm long. Often covered with other organisms. Grows on rocks, floats, pilings, oyster and mussel shells, and seaweeds. Filter feeder by siphon.
Amphipod	no common name	*Monocorophium ascherusicum*	ballast water	Free marine species. Ecophysiology largely unknown.
Amphipod	no common name	*Elasmopus rapax*	ballast water	Free marine species, depth range from about 0 to 100 meters. Often among algae in shallow sub-tidal habitats.
Bryozoan	no common name	*Waterispora subtorquata*	hull fouling	Colonial growth on rocks, shells, docks, vessel hulls, pilings, debris, kelp holdfast, other bryozoans.
Bryozoan	spiral tufted bryozoa	*Bugula neritina*	hull fouling	Colonial growth in upright, bushy, branching tufts up to 15 cm, often mistaken for seaweed. Filter feeding by tentacles. Grows in intertidal to shallow subtidal zones on dock sides, buoys, pilings, rocks, shells, seaweeds, sea grasses, sea squirts, and other bryozoans.
Copepod	no common name	*Oithona davisae*	ballast water	Free marine species in temperate coastal waters. Ecophysiology largely unknown.
Crab	European green crab	*Carcinus maenas*	larval transport in ballast water	Estuarine environments. Voracious feeder on juvenile native crab and shellfish.
Snail	Eastern oyster drill, Atlantic oyster drill	*Urosalpinx cinera*	ballast water	Intertidal and shallow subtidal waters to a maximum depth of 15m. Common on rocks and oyster reefs. Feeds on oysters, barnacles, mussels, and snails.
Snail	Eastern mud snail	*Nassarius obsoletus (Ilyanassa obsoleta)*	larval transport in ballast water	Mud flats in intertidal and shallow subtidal zones, in sounds and inlets. Forms large herds. Feeds on diatoms, algal detritus, worms, dead fish, crabs, and other animal remains.
Snail	Japanese drill snail,	*Ceratostoma inornatum*	larval transport in ballast water	Estuarine and marine habitats in cool waters. Feeds voraciously on

Table 3.10-7: Potential High Risk NNIS - Aquatic Animals

Life Form	Common Name	Scientific Name	Vector	Habitat and Ecophysiology
	hornmouth snail			oysters.
Snail	New Zealand mudsnail	*Potamopyrgus antipodarum*	boat or equipment transport; larval transport in ballast water	Thrives in disturbed watersheds. Feeds on plant and animal detritus, epiphytic and periphytic algae, sediments and diatoms. Can alter primary productivity of streams.
Freshwater Animal				
Mussel	zebra mussel	*Dreissena polymorpha*	boat or vessel transport; larval transport in water	Builds colonies that clog infrastructure or on native species or habitats. Freshwater filter feeders that change habitats by allowing greater macrophyte growth, changing water quality and altering ecosystems.
Mussel	quagga mussel	*Dreissena rostriformis bugensis*	boat or vessel transport; larval transport in water	Builds colonies that clog infrastructure or on native species or habitats; similar impacts to zebra mussel.

Source**:** Davis 2015, Shaw 2015, NISC 2016a

3.10.2.7.4 NNIS - AQUATIC (MARINE AND FRESHWATER) PLANTS

No nonnative invasive aquatic plant species have been documented in surveys or published literature at this time within the Project Area, but several species have been identified as threats due to current known distribution in similar habitat within Alaska or in similar habitats in North America. Table 3.10-8 shows high risk marine or freshwater plant species by lifeform (submerged marine plants/algae, emergent marine/estuarine/coastal plant (a plant that generally grows above water surface but within coastal features), and submerged freshwater plant).

Elodea or waterweed (Elodea spp.) is a nonnative invasive freshwater submerged aquatic plant that has been found in several locations in southcentral Alaska. Elodea is currently the only such plant species known to have reproducing populations in the state of Alaska. Elodea has known impacts on native ecosystems, including degrading fish habitat, displacing native flora and fauna, restricting or impeding boat or floatplane travel, impeding recreational use of waterbodies, increasing sedimentation, and reducing waterfront property values (ADNR 2016). A 2014 USFWS survey of a floatplane lake near Bethel revealed no elodea. However, there are many other water bodies used by floatplanes and boats in and near the Project Area that have not been surveyed for the presence or absence of aquatic nonnative plants.

Table 3.10-8: Potential High Risk NNIS - Aquatic Plants

Life Form	Common Name	Scientific Name	Vector	Habitat and Ecophysiology
Submerged Marine Plant/Algae				
Algae	caulerpa, killer seaweed	*Caulerpa taxifolia*	aquarium dumps; larval transport in ballast water	Cold temperate marine environments. Common aquarium species. Grows voraciously on all surfaces in marine environments. Out-competes all other species.
Algae	Asian kelp, wakame	*Undaria pinnatifida*	larval transport in ballast water; hull fouling	Cold temperate marine environments. Cultivated food species. Out-competes other species and smothers marine surfaces.
Emergent Marine Plant				
Emergent Marine Plant	cordgrasses	*Spartina spp. (S. alterniflora, S. anglica, S. alternaflora x foliosa, S. densiflora, S. densiflora x foliosa, S. patens)*	floating plant parts	Mudflats. Fills and uplifts habitats. Alters fish nursery habitat structure and shoreline structure.
Submerged Freshwater Plant				
Submerged Aquatic Plant	elodea, waterweed	*Elodea spp. (E. nuttallii, E. canadensis,* hybrids)	plant parts, transport by float plane or boat, aquarium and science lab kit plant	Still or moving freshwater lakes, ponds, and streams. Tolerates freezing and very cold temperatures. Can reproduce from tiny fragments. Spreads rapidly. Out-competes native aquatic vegetation and chokes waterways.
Submerged Aquatic Plant	Eurasian watermilfoil	*Myriophyllum spicatum*	plant parts, transport by float plane or boat, movement by waterfowl	Easily reproduces from stem fragments and runners in still or moving cold water bodies. Chokes waterways with floating canopy.
Submerged Aquatic Plant	hydrilla	*Hydrilla verticillata*	plant parts, transport by float plane or boat, aquarium plant	Grows in canals, channelized streams, ponds, lakes, and impoundments; generally prefers warmer water bodies.
Submerged Aquatic Plant	egeria, Brazilian waterweed	*Egeria densa*	plant parts, transport by float plane or boat, aquarium plant	Grows in canals, channelized streams, ponds, lakes, and impoundments; generally prefers warmer water bodies.

Source**:** Davis 2015, Shaw 2015, ADNR 2016, NISC 2016a

3.10.2.7.5 NNIS - MAMMALS

Norway rats are a nonnative invasive terrestrial mammal species that have colonized numerous cities and islands in Alaska, including Dutch Harbor, Nome, and Fairbanks (ADF&G 2015c). Rats have a variety of adverse effects, including competition for food resources and the potential to spread parasites and diseases. Rats have had devastating effects on some islands, primarily by eating seabirds and disrupting their nesting efforts, as well as altering vegetation patterns and displacing other predators (USFWS 2007). Rat invasions typically occur when rats living on marine vessels escape while the vessels are in port, or during shipwrecks. Norway rats are not known to occur within the Project Area, but are present in the City of Dutch Harbor / Unalaska and on Unalaska Island.

3.10.2.7.6 OTHER NNIS - BIRDS, AMPHIBIANS, INVERTEBRATES, AND PATHOGENS

Nonnative invasive bird, amphibian, and invertebrate species (including insects) have been detected in Alaska, but are not known to have reproducing populations within the Project Area (ACCS 2017c, ADF&G 2017, McClory and Gotthardt 2008). Nonnative invasive insect species, including forests pests, are tracked by the Alaska Forest Health Protection Program of the Alaska Division of Forestry, ADNR, in cooperation with the U.S. Forest Service Forest Health Protection program. In the most recent year of published surveys (USFS 2016), alder, willow, mixed forest, and birch defoliation was detected within the Project Area in aerial insect and disease detection surveys which may indicate presence of the nonnative invasive birch leaf miner (Fenusa pusilla) or other potential nonnative invasive insects, but may also be attributed to native insects such as aphids. Other invertebrate insect species of concern include the Asian gypsy moth (Lymantria dispar dispar) and wood borers such as the emerald ash borer (Agrilus planipennis). In the summer of 2008, a vessel destined for Ketchikan that contained Asian gypsy moth egg masses was intercepted by Customs and Border Patrol (CBP) personnel; no other presence of this species has been detected on route to Alaska (USFS 2010).

Nonnative invasive pathogens include microscopic organisms such as viruses, bacteria, or single-celled organisms that can cause disease in trees, plants, birds, fish, or wildlife species. Pathogens can be transported by equipment, gear, birds, wildlife, or other vectors. Some diseases of concern to Alaska include avian influenza and West Nile virus (birds), chronic wasting disease (deer, elk, moose), chytrid fungus (amphibians), whirling disease (fish), and whitenose syndrome (bats) (ADF&G 2016). Currently, these pathogens are either not known to occur in Alaska or are not considered serious threats to public health within the state of Alaska, although monitoring programs are established for certain pathogens, such as avian influenza. Diagnostic testing is performed on wild and hatchery finfish and shellfish in the state of Alaska to detect a number of pathogens impacting these species (ADF&G 2016). A felt-sole wader ban has been established to prevent whirling disease in Alaska (ADF&G 2012).

3.10.2.8 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 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 vegetation are tied to changes in physical resources (discussed in Section 3.26, Climate Change).

3.10.3 ENVIRONMENTAL CONSEQUENCES

This section describes potential impacts to vegetation as a result of the Donlin Gold Project and its associated components. Each of the alternatives is addressed below. In evaluating negative and positive impacts to vegetation resources, relevant factors for this project include:

- The area of the impacts. The three project components cover varying areas of five ecoregions and vegetation types.
- The type of impacts per vegetation type. Some areas will be reclaimed, restored, or allowed to naturally revegetate. Some areas (e.g., maintained roads, buildings, the pit lake, and others) are not expected to be reclaimed or to revegetate. In areas of natural revegetation, typical successional vegetation pathways are expected to occur (see Viereck et al. 1992 for discussions of typical Alaska regional vegetation type succession).
- Permanent decrease in the quantity or volume of resources remaining. Certain vegetation types may not return to prior conditions.
- Increases in NNIS due to project activities, if mitigation measures and BMPs are not adequately applied.
- Modifications or reduction in rare or sensitive plant species or habitats. Project activities may result in the permanent removal of an unconfirmed rare plant in the Mine Site, or may result in impacts to habitat for rare or sensitive plants in the Pipeline component. Impacts to habitats that may potentially support rare or sensitive plant species may occur in all project components.

Table 3.10-9 provides the impact methodology framework applied to assessing direct or indirect impacts to vegetation based on four factors of magnitude or intensity, duration, extent or scope, and context (40 CFR 1508.27, described in Section 3.0, Approach and Methodology).

Key issues with potential direct and indirect effects impacting vegetation were identified during agency and public scoping. These include:

- Vegetation removal;
- Vegetation damage by accidental construction impacts, improper forestry practices, or accidental or wildland fire;
- Vegetation damage through contamination from fuel or chemical spills (addressed in Section 3.24, Spill Risk);
- Fugitive dust impacts;
- Impacts from changes in water availability;
- Impacts to rare and sensitive plants; and
- NNIS impacts (all taxa NNIS impacts are discussed in Section 3.10.3.2.6, in addition to terrestrial plants).

Impact assessments were considered, analyzed, and determined from the perspective of overall regional Alaskan vegetation affected. In terms of regional vegetation, the Mine Site, Transportation Corridor, and Pipeline vary in size and composition, but all are comprised of vegetation types typical of and common to the region, based on the project PJD survey and review of field-survey based publications from this region.

Table 3.10-9: Impact Methodology for Effects on Vegetation

Type of Effect	Impact Factor	Assessment Criteria		
Vegetation removal or vegetation damage (from accidental construction impacts, improper forestry practices, or accidental or wildland fire)[1]	Magnitude or Intensity	Impacts limited to removal of above-ground vegetation. Little or no soil disturbance.	Vegetation is removed both above and below ground, but the area is reclaimed.	Vegetation is removed both above and below ground and is not reclaimed.
	Duration	Vegetation would be affected briefly but not longer than the span of a few years and would be expected to return to pre-activity condition, such as areas cleared for construction purposes only and then reclaimed.	Vegetation would be affected for up to the life of the project and would return to a functional condition after the completion of the activity, although composition may not be the same as pre-disturbance conditions.	Vegetation would not be anticipated to return at all, such as the pit lake and areas of exposed rock.
	Extent or Scope	Impacts limited to areas of the project footprint in which vegetation would be removed.	Affects vegetation within the Project Area.	Affects vegetation at the ecoregion level.
	Context	Affects common or ordinary vegetation and species; plant species are not rare or sensitive; ecosystems are not those of conservation concern[2].	Affects rare or sensitive species or populations; affects ecosystems of conservation concern.	The portion of the vegetation affected results in extirpation of rare or sensitive plant species, or fills an irreplaceable ecosystem role within the locality or region.
Vegetation type (community) impacts (from fugitive dust, changes in water availability, or impacts to rare and sensitive plant populations).	Magnitude or Intensity	Changes in vegetation types may not be measurable or noticeable; limited to small areas or small number of species changed.	Noticeable compositional or structural changes in vegetation types.	Acute or obvious changes in vegetation types.
	Duration	Vegetation types would be affected briefly but not longer than the span of a few years and would be expected to return to pre-activity condition.	Vegetation types would be affected for up to the life of the project but be expected would return to conditions similar to those of pre-activity after completion of the activity.	Vegetation types would not be anticipated to return to pre-activity condition.
	Extent or Scope	Impacts limited to the Project Area.	Affects vegetation within the Project Area.	Affects vegetation at the ecoregion level.
	Context	Affects common or ordinary vegetation and species; plant species are not rare or sensitive; ecosystems are not those of conservation concern[2].	Affects rare or sensitive species or populations; affects ecosystems of conservation concern[2].	The portion of the vegetation affected fills an irreplaceable ecosystem role within the locality or region.

Table 3.10-9: Impact Methodology for Effects on Vegetation

Type of Effect	Impact Factor	Assessment Criteria		
NNIS impacts	Magnitude or Intensity	Any new NNIS introduced into the Project Area are controlled. Existing populations are not allowed to spread. Ecological damage does not occur.	Any new NNIS introduced into the Project Area are only partially controlled. Existing populations are controlled but spread. Ecological damage may be initiated.	Any new NNIS introduced into the Project Area are not controlled. Existing populations are allowed to spread. Ecological damage is likely to occur.
	Duration	Any new NNIS populations would be eradicated so the ecosystem would be restored to pre-activity condition.	NNIS persist in areas of continual disturbance such as roads, port, marine routes, airstrips, etc. but are eradicated by Closure.	NNIS are not controlled, resulting in permanent establishment of new population, or expansion of existing populations.
	Extent or Scope	Impacts limited to the Project Area.	Affects vegetation within the EIS Analysis Area.	Affects vegetation at the ecoregion level.
	Context	NNIS are not introduced, and all regulatory practices are followed, resulting in no new invasions.	NNIS are introduced accidentally despite regulatory practices being generally followed, resulting in new invasions that are subsequently controlled in accordance with regulations.	NNIS are introduced and not controlled, in violation of the regulatory framework governing them, or species are deliberately introduced.

Notes:

1 Vegetation damage through contamination from fuel or chemical spills is discussed in Section 3.24, Spills.

2 Source: Boggs et al. 2016b

3.10.3.1 ALTERNATIVE 1 – NO ACTION

Under the No Action alternative, the project would not be constructed. Further exploration activities would not be precluded. Therefore, it would not have any new direct or indirect effects on vegetation.

3.10.3.2 ALTERNATIVE 2 – DONLIN GOLD'S PROPOSED ACTION

The following is a general description of the sources or mechanisms of potential impacts to vegetation. Details, such as acres of aggregated vegetation types affected per ecoregion, are described below under each project component.

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 INHT:

- North Option: 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.

For each type of impact, the design features that would mitigate or reduce the impact are also described. The impacts assessed under each alternative are those that remain following implementation of the design features detailed in Chapter 2. Specific mitigation measures that agencies are considering to further reduce impacts, as reasonable and practicable, are also discussed in Chapter 5, along with an evaluation of their expected effectiveness.

3.10.3.2.1 VEGETATION REMOVAL

The most direct impact to vegetation would be caused by the removal of vegetation during the clearing and grading of the construction areas. The construction ROW and work areas would be cleared and graded where necessary. Shrubs, trees, understory vegetation, roots, and other obstructions such as large rocks and stumps would typically be cleared from construction work areas. Acres of vegetation removal were calculated by overlaying the project footprint over the aggregated vegetation types in ArcGIS, and calculating the area impacted for vegetation type within each ecoregion per component (data sources: Boggs et al 2016a, Michael Baker 2016, Michael Baker 2017a, 2017b, Nowacki et al. 2001). Tables for each project component list acres of aggregated vegetation type that would be removed, along with the total acres and percent impacted per ecoregion.

Vegetation types were analyzed by USGS HUC 10 watershed in the PJD (Michael Baker 2016, 2017b). The vegetation data in this section (and in the Wetlands Section 3.11) are based on analysis taken directly from the PJD (which is included as Appendix Y). Tables are available in the PJD which detail of impacted vegetation type by HUC 10 watershed for all three project components. Acres impacted are presented in this section by ecoregion rather than by individual HUC 10 watersheds due to the number of watersheds involved.

Vegetation removal can cause numerous changes in the surrounding environment, such as:

- Increased rate of soil erosion from wind or water;
- Changes in water drainage patterns (increased runoff volumes);
- Sediment deposition in downslope areas;
- Melting of permafrost;
- Changes in adjacent vegetation type composition;
- Changes in wildlife habitat; and
- Introduction or spread of NNIS.

Indirect effects could result from erosion of the exposed soil and sedimentation. Drainage and erosion control measures, both temporary and permanent, would be implemented at the Mine Site, Transportation Corridor, and along the Pipeline and at facilities such as camps, storage yards, material sites, and airstrips.

Mine Site

Table 3.10-10 lists acres of aggregated vegetation type that would be removed within each ecoregion, along with the total acreage for the ecoregion and percent of the vegetation type impacted per ecoregion. The majority of removal would be within the evergreen forested vegetation type (6950.8 acres), with the next amount of removal in the scrub shrub type (1991.5 acres). The percent of the ecoregion removed is below one percent for all vegetation types. Figure 3.10-3 shows a map of vegetation types for the Mine Site. The Mine Site occurs entirely within the Kuskokwim Mountains ecoregion.

Table 3.10-10: Alternative 2 Mine Site Vegetation Removal Impacts

Aggregated Vegetation Type	Impacted Acres	Ecoregion Acres	Percent of Ecoregion
Kuskokwim Mountains Ecoregion			
Forested – Evergreen	6,950.8	10,533,652.8	0.07%
Forested – Deciduous/Mixed	759.1	3,675,388.5	0.02%
Scrub Shrub	1,991.5	5,111,573.1	0.04%
Herbaceous	20.5	1,116,460.5	<0.01%
Other Land Cover	97.4	659,232.3	0.01%
TOTAL:	**9,819.3**	**21,096,307.2**	**0.05%**

Source: Michael Baker 2017a, Boggs et al. 2016a, Nowacki et al. 2001

Section 17(b) Easements

Section 17(b) of ANCSA reserves linear access easements to public land and water on lands that have been or will be conveyed to Alaska Native Village and Regional Corporations (ADNR 2013b). Access rights on easements crossing the Mine Site, including ANCSA Section 17(b) Easements, may result in impacts to vegetation depending on decisions regarding routes. Access rights would be administratively adjusted through agreements between affected land managers, and comparable access would be provided. Easements can take the form of 60-foot wide roads, 25- and 50-foot trails, or one-acre sites for short-term uses, and are reserved to allow the public to cross private property in order to reach public lands and waterways. There are five Section 17(b) Easements that are in the vicinity of the Mine Site. Donlin has proposed on behalf of TKC and Calista that certain easements east of FAS 231 within the core operating area be terminated by the BLM to protect the public from mine operations. In exchange, a new public easement would be acquired by BLM south of the core operating area which leads east to public lands.\The Omnibus Route (FAS 231) from Crooked Creek to Flat would also be affected by the Mine Site, and would likely need to be relocated to maintain the ROW. Further discussion of Section 17(b) Easements is found in the Land Ownership, Management, and Use Section, Section 3.15.

Transportation Corridor

Figure 3.10-4 shows the impacted Transportation Corridor vegetation types. Table 3.10-11 lists acres of vegetation by type that would be removed in the Transportation Corridor, mostly along the mine access road. The majority would be evergreen forested vegetation types (602. 4 acres). Small portions of habitat identified as potentially supporting an Ecosystem of Conservation Concern, spruce floodplain-old growth forest, occurs along the BTC mine access road, although this specifically defined habitat has not been quantified in this location (Boggs et al. 2016b).

Table 3.10-11: Alternative 2 Transportation Corridor Vegetation Removal Impacts

Aggregated Vegetation Type	Impacted Acres	Ecoregion Acres	Percent of Ecoregion
Kuskokwim Mountains Ecoregion			
Forested – Evergreen	602.4	10,533,652.8	0.01%
Forested – Deciduous/Mixed	164.6	3,675,388.5	<0.01%
Scrub Shrub	317.6	5,111,573.1	0.01%
Herbaceous	4.5	1,116,460.5	<0.01%
Other Land Cover	4.3	659,232.3	<0.01%
TOTAL:	**1,093.40**	**21,096,307.2**	**0.01%**

Source: Michael Baker 2017a, Boggs et al. 2016a, Nowacki et al. 2001

Pipeline

Vegetation within the Pipeline component would be directly affected by removal and reclamation, periodical brushing of revegetation in the pipeline corridor during Operations, and potential removal of rare or sensitive species. Indirect impacts would include increased risk of NNIS introduction and spread, fugitive dust during construction and operations, and changes in water availability. 3.10-5AError! Reference source not found. through 3.10-5HError! Reference source not found. show the Pipeline component footprint overlain on detailed mapped vegetation types. Table 3.10-12 lists acres of vegetation by type that would be removed in Alternative 2 in four ecoregions (the North Option only occurs in the Alaska Range ecoregion). Percent impacted is below one percent for all four ecoregions for all five vegetation types. In the Kuskokwim Mountains ecoregion, scrub shrub types would experience the most removal (885.1 acres). In the Tanana-Kuskokwim Lowlands ecoregion, evergreen forested types would experience the most removal (562.5 acres). In the Alaska Range ecoregion, scrub shrub types would again experience the most removal (856.6 acres; 760.2, North Option). In the Cook Inlet Basin ecoregion, evergreen forested types would again experience the most removal (1130.5 acres).

Small portions of habitat identified as potentially supporting an Ecosystem of Conservation Concern, spruce floodplain-old growth forest, occurs in approximately seven drainages that cross the pipeline corridor footprint, although this habitat has not been quantified in this location aside from one plot located approximately one-fourth of the distance along the pipeline corridor heading east from the Mine Site (Boggs et al. 2016b).

The Pipeline differs from the other project components in that a much larger area would be affected temporarily during the Construction phase than would be affected for the longer term during Operations. Once the Pipeline is buried after the Construction phase is completed, most of the disturbed area would be revegetated using native seeds, fertilizer, and mulch as required. Natural revegetation is likely along the length of the corridor after Closure, when periodic brushing to maintain the pipeline corridor is no longer required. Vegetative cover would be maintained during Operations to the extent permitted under PHMSA regulations, which requires brushing a 50-foot ROW. Natural revegetation would generally initially include early-successional species such as willow or alder shrubs, which would be brushed above ground. Burying the pipeline and blending the ROW with the natural setting would minimize the potential for pipeline to dominate the landscape and would decrease visual impacts. See Section 3.17, Visual Resources, for details on visual impacts and design features important for reducing visual impacts from the pipeline corridor.

Table 3.10-12: Alternative 2 Pipeline Component Vegetation Removal Impacts

Aggregated Vegetation Type	Alternative 2 Acres	Alternative 2 - North Option Acres	Ecoregion Acres	Percent of Ecoregion[1]
Kuskokwim Mountains Ecoregion				
Forested - Evergreen	555.2	555.2	10,533,652.8	0.01%
Forested - Deciduous/Mixed	604.7	604.7	3,675,388.5	0.02%
Scrub Shrub	885.1	885.1	5,111,573.1	0.02%
Herbaceous	30.5	30.5	1,116,460.5	<0.01%
Other Land Cover	6.9	6.9	659,232.3	<0.01%
Tanana-Kuskokwim Lowlands Ecoregion				
Forested - Evergreen	562.5	562.5	8,972,446.5	0.01%
Forested - Deciduous/Mixed	91.9	91.9	2,380,015.3	<0.01%
Scrub Shrub	536	536	2,127,158.9	0.03%
Herbaceous	52.9	52.9	1,069,386.2	<0.01%
Other Land Cover	26.6	26.6	1,280,274.1	<0.01%
Alaska Range Ecoregion				
Forested - Evergreen	577.2	629.12	2,028,558.7	0.03%
Forested - Deciduous/Mixed	241.3	246.54	1,164,726.2	0.02%
Scrub Shrub	865.6	760.22	9,709,936.5	0.01%
Herbaceous	36.1	31.31	2,385,039.6	<0.01%
Other Land Cover	25.1	24.42	10,260,014.6	<0.01%
Cook Inlet Basin Ecoregion				
Forested - Evergreen	133.1	133.1	1,299,479.3	0.01%
Forested - Deciduous/Mixed	1,130.5	1,130.5	2,817,995.6	0.04%
Shrub	507.3	507.3	1,665,304.9	0.03%
Herbaceous	87.2	87.2	805,479.4	0.01%
Other Land Cover	26.2	26.2	594,957.6	<0.01%
TOTAL:	**6,981.9**	**6,919.2**	**69,657,080.6**	**0.01%**

Notes:
1 Ecoregion percent is the same for both Alternative 2 and Alternative 2-North Option.
Source: Michael Baker 2017a, Michael Baker 2017b, Boggs et al. 2016a, Nowacki et al. 2001

Vegetation Removal Impacts Summary for Alternative 2

The intensity of vegetation removal impacts would include complete vegetation removal and no reclamation, at certain Mine Site facilities, the pit lake, permanent road corridors, and the water treatment plant. Other areas would be subject to the same intensity of impacts but would experience reclamation, such as temporary road and facility construction areas, the Pipeline corridor, or temporary buildings. In other areas, impacts intensity would be limited to short-term removal, including the Transportation Corridor dock or port site construction or improvement areas, Pipeline small shoofly roads, temporary staging areas, or access roads or areas requiring vegetation removal or trimming where reclamation would begin as soon as possible after Construction or Operations end. While some areas are expected to revegetate naturally, they are not likely to have the same plant composition or structure as they did prior to disturbance. Vegetation could also be adversely affected by stabilization, rehabilitation, or reclamation actions or by failure of reclamation. The magnitude would depend on the location and extent of damage. Impacts from reclamation failure are not expected to occur because the project's Reclamation and Closure Plan (SRK 2017f) would include monitoring to ensure reclamation success is achieved by taking adaptive action when needed. Nonnative invasive plant species could be introduced or spread from vegetation removal if mitigation measures are not adequately applied (see Section 3.10.3.2.6). The intensity would depend on the risk rating assigned to the species, along with many other factors including time of introduction; number of introductions; amount, location, and level of disturbance; and habitat parameters.

The duration of the effects would range from temporary (during Construction only) to long-term (for the duration of Operations) to permanent for some areas, such as the pit lake. Most removal activities would occur initially during Construction, although maintaining certain areas free of vegetation (such as roads and around structures) may require brushing or other vegetation removal maintenance. The pipeline corridor in the Pipeline component would be subject to disturbance from periodic brushing throughout Operations; vegetation may start to revegetate in between maintenance brushing, and then would be removed above the ground.

The extent of impacts would be confined to areas designated for vegetation removal for the purpose of constructing the mine and its components, the access roads, structures, and any ancillary infrastructure. Starting during Operations and continuing through Closure, designated areas would be reclaimed including re-contouring roadways and planting native vegetation and reseeding disturbed areas with native seeds.

There is no particular context of vegetation removal in that vegetation types impacted are geographically well represented throughout the region in the five ecoregions within the EIS Analysis area. There may be impacts to locations classified as an Ecosystem of Conservation Concern, the white spruce floodplain-old growth forest (Boggs et al. 2016b), although there is no legal designation or protection for this ecosystem which is classified as S4 (apparently secure). The general range of this ecosystem is indicated to occur within the EIS Analysis area primarily in drainages along the Kuskokwim River in the Transportation Corridor and in drainages within the Pipeline component.

3.10.3.2.2 RECLAMATION

Reclamation would begin immediately after the Construction Phase and continue through the Closure Phase. Reclamation and closure of the proposed Donlin Gold project for the falls under the jurisdiction of ADNR, Division of Mining, Land, and Water; and ADEC. Details of reclamation for the mine site and metering station and natural gas distribution systems at the Donlin Gold mine site are provided in Donlin Gold's Plan of Operations Reclamation and Closure Plan, July 2017 (SRK 2017f). The natural gas pipeline reclamation and abandonment falls under the jurisdiction of the BLM and SPCO, and will require Donlin Gold to comply with applicable federal and state statutes and regulations to be described in a separate plan. The Reclamation and Closure Plan describes reclamation and closure requirements, agency roles, applicant information, a project description, the implementation plan, an estimate of reclamation costs, the applicant statement of responsibility, and references. The implementation plan provides a general description of land use prior to and during mine operations, a detailed schedule of reclamation activities, the public safety plan, an assessment of post-reclamation topography, a closure social impact assessment, a description of general reclamation procedures, and details of area-specific reclamation (SRK 2017f).

Cleared or graded vegetation reestablishment time is variable. Trees and shrubs are expected to begin to reestablish almost immediately after construction and reclamation. Alders, willows, and birch are generally the first trees and shrubs to reestablish. Tundra habitat including the vegetative mat may take several years to recover; the general time frame for recovery of disturbed tundra vegetation is around 5 to 10 years (Vavrek et al. 1999; Gartner et al. 1983; Chapin and Chapin 1980). In general, the recovery of vegetation following disturbance is related to the intensity of the disturbance and the resulting changes in moisture regimes (Lawson 1986). Tundra habitat recovery speed is dependent on many factors including retention of the vegetative mat, reclamation methods, and microsite characteristics. Reversion to or recreation of the original plant community is sometimes possible only when the original site characteristics such as moisture and topography are maintained.

General reclamation and closure practices would include common, well-document, and proven practices to prevent unnecessary and undue degradation of land and water resources implemented by mining operations (SRK 2017f). Practices would be expected to include:

- Timber would be salvaged and un-merchantable organic materials would be stripped and stockpiled. Prior to initial growth media stripping for construction of facilities, timber that is greater than 6 inches (>15 cm) in diameter at breast height would be cut and decked.
- All other plant material would be hydro-axed (a hydro-ax, or hydraulic ax, is a piece of machinery that can "mow" a tree up to 12 inches (31 cm) in diameter, creating coarse mulch) and incorporated as a soil amendment in the growth media. In some cases, this hydro-axed material may be stockpiled for later use as mulch.
- Growth media (topsoil and overburden) would be stockpiled in anticipation of future use in reclamation. If the growth media becomes compacted while in the stockpile, it would be tilled prior to placement to regain pre-disturbance bulk densities. Before placement of the growth media, the subsoil surface would be roughened by ripping or disking to ensure good contact. The growth media would be dumped and spread using a minimum of passes to limit compaction. Controlled dozer tracking may be performed during placement of the growth media to roughen the surface, lightly compact the soil, increase water retention, and prevent erosion.

- Reclamation of exploration disturbances on the site and at other mine sites in Alaska (Czapla and Wright 2012) require a minimum of 6 inches (15 cm) of growth media to be applied to those sites requiring additional growth media to establish a vegetative cover by seeding or to promote natural re-invasion by native species. However, application depth may vary depending on the facility, existing growth media at the site, and if applicable, engineered cover design.
- Seedbed preparation would be conducted to prepare sites for plant germination and growth. Growth media (applied or in situ) and the underlying surface would be prepared in such a manner to retain moisture and allow adequate root development and penetration in those areas where infiltration and surface water retention are desired.
- It is not currently projected that fertilizer would be required or desirable for establishing a permanent perennial cover. It is assumed that some level of soil amendment would be required during reclamation. Specific soil amendment requirements would depend on the quality of growth media used for a particular area. Application of soil amendments would be managed carefully. Mine revegetation research and monitoring would be conducted in cooperation with ADNR-PMC (Wright 2008).
- General reclamation seed mixes proposed for use would include mixes of native species that have been used extensively in other Alaska reclamation activities. Wetland (hydric) and upland (mesic) mixes are proposed. As with any seed mix, actual mixes would depend on seed availability and site-specific condition that may result in modification of mixes. Mixes may change over time to include other species as new information or technologies become available. Seeding would be done via drill seeding, broadcast seeding via ground or aerial application, and hydro-seeding.
- If mulch application is necessary, it would be applied following seeding and soil amendment application. If necessary, the mulch would then be crimped into the seedbed using a culti-packer or shallow set disk harrow to prevent wind blow and increase microhabitat for seed germination. On those areas where a hydro-seeder may be used, hydro-mulch, if needed, would be incorporated into the seed and amendment mix for one-time application. The hydro-mulch would contain a tackifier, if necessary, to help hold the mulch mix in place.
- During vegetation establishment, NNIS control practices would be implemented to limit the growth and spread of noxious weeds and benefit the revegetation process. The control program would include the use of weed-free mulch in the reclamation program, and all seeds would be tested and certified "weed-free" before planting. The primary method of control would be to seed disturbed areas as soon as practicable after the seedbed has been prepared. Donlin Gold's Invasive Species Prevention and Management Plan (ISPMP) is available in Appendix U.
- A vegetative cover criterion of at least 70 percent used at other interior Alaska hard rock mines since 1994 would be achieved prior to requesting bond release (Alaska Reclamation Performance Standard (11 AAC 97.200) also defines successful re-vegetation as revegetation that occurs "within 5-years after reclamation is completed without the need for fertilization or reseeding"). Experience in Alaska has shown this goal would likely be reached within the first 5 years. Concurrent reclamation areas also would be required to meet the criteria prior to Donlin Gold requesting bond release.

- Other specific requirements for reclamation have been identified in Donlin Gold's Reclamation and Closure Plan (SRK 2017f).

3.10.3.2.3 VEGETATION DAMAGE

The primary incidents that could result in serious harm or damage to vegetation include mechanical damage from construction activities, damage from inappropriate forestry practices accidental or wildland fire, or accidental fuel or chemical spills (Spill scenarios and potential impacts are described in Section 3.24, Spill Risk). The effects of any of these incidents could be loss or damage from small to large areas of vegetation within the Project Area.

Accidental fire could spread beyond the Project Area, or wildland fire could impact any area of the Project Area. Fire prevention measures would be implemented for all three project components. At the Mine Site, all structures would be designed in compliance with State of Alaska Building Codes and approved by the State Fire Marshal's office. Fire control and suppression would be coordinated by an on-site fire brigade. In addition, all personnel would receive instruction in fire and emergency procedures during their Mine Safety and Health Administration (MSHA) training. In addition to an on-site fire truck, heavy mine equipment would be available for fire control and suppression. This equipment would include rubber-tired dozers, tracked dozers, graders, and loaders in addition to a 20,000 gallon water truck with pumps, water cannons, and hoses. A heated and insulated aboveground 237,800 gallon dedicated water storage tank would provide water for fire protection at the Angyaruaq (Jungjuk) Port. All heavy equipment would be equipped with automatic and/or manually activated fire suppression systems, and hand-held extinguishers would be installed in all heavy equipment and small vehicles. Automatic sprinklers would be installed in buildings and, where appropriate, fire extinguishers would be mounted on the walls of all buildings. Fire hydrants would be located near the mill/administration building complex and the conveyor drive tower. For the Pipeline, a Fire Prevention and Suppression Plan would be implemented. Donlin Gold would take all actions necessary or appropriate for the prevention and suppression of fires in accordance with applicable law and instructions from appropriate authorities.

To follow good forestry practices that minimize forest insect spread and reduce the risk of wildfire, Donlin Gold would apply the provisions of Alaska State Code Title 11, Chapter 95, Section 195, 11 AAC 95.195, Clearing of spruce trees, as applied to spruce trees other than black spruce. All work would be performed in accordance with relevant permit and lease stipulations consistent with Donlin Gold's Timber Utilization Plan.

The intensity of the impacts vary by the size of the potential damage; construction damage, minor forestry practice issues, or small fires would have less of an impact than severe fires that may affect below-ground vegetation and soil. Nonnative invasive plant species could be introduced or spread from vegetation damage, any cause, if mitigation measures are not adequately applied. The duration of impacts could occur during the life of the project and during Closure phase activities, and the extent of impacts could potentially be throughout all project activity areas to the entire Project Area or beyond in the case of a large fire. There is no specific context for vegetation damage in that vegetation types impacted are those found throughout the project area, although it is possible that a rare or sensitive plant species may be impacted.

3.10.3.2.4 FUGITIVE DUST

Fugitive dust emissions are an inevitable by-product of construction and operations activities. Dust would be caused by vehicle travel on the mine roads and access areas, the port road, pipeline ROW access roads, and other unpaved surfaces, as well as mining activities at the pit, which are also a potential source of dust emissions. This dust has the potential to collect on vegetation in the vicinity of the dust sources. Windblown dust could affect vegetation well beyond the source, but the effect diminishes with distance and is affected by prevailing winds and topography. The deposition of dust has been analyzed in Section 3.2, Soils, with information on impacts to wetlands included in Section 3.11, Wetlands, and impacts to wildlife in an ecotoxicity context included in Section 3.13, Wildlife.

Dust can have a number of impacts on vegetation, including:

- Elimination of vegetation in heavy dust area, early snowmelt and early green-up along roadsides with dust shadow, decrease in mosses and lichens, and decrease in contributions to thermokarst (Walker and Everett 1987);
- Reduction in biomass, increase in graminoids and decrease in soil nutrients (Auerbach et al. 1997);
- Reduction in the plants' photosynthetic abilities which then affects growth (Myers-Smith et al. 2006);
- Decreases in soil moisture, increases in thaw depths; and
- Increases in toxicity if the dust is chemically active (highly acidic or highly alkaline or high in certain metals).

The cumulative impact of dust loading is a reduction in the plants' photosynthetic abilities and therefore growth. While it is difficult to predict the cumulative effect of fugitive dust emissions on vegetation, it is likely that plant growth retardation and changes in plant communities could occur in some areas immediately bordering dust source areas.

Measures to reduce dust would include limiting soil disturbance, stabilizing all disturbed surfaces, limiting traffic, using water trucks to spray road surfaces, and using snow or other approved dust suppressants to cover disturbed areas to minimize movement of exposed soils.

Dust may be a source of contamination that could affect vegetation, including mercury or other metals deposited in dust. Mercury is present in the rocks that will be mined in the form of cinnabar. Therefore, mercury would be expected in the dust from mining and at various points in the processing of the ore. Control systems will be included at all points in the process where mercury might be emitted. Those controls, described in Hatch and Donlin Gold 2014 (Hatch 2014), are expected to remove 99.6 percent of all mercury processed and outperform national standards established by the EPA in 2011. Arsenic is also present in native soils. The effects on soils of metals in dust deposition have been analyzed in Section 3.2, Soils, and in analysis in Section 3.12, Wildlife.

The intensity of the impacts of fugitive dust on vegetation is expected to vary depending on proximity of vegetation to the source of the dust. Dust may cause variable physiological changes to vegetation pending exposure length or level. The duration of the effects would either be seasonal, when dust is washed off vegetation generally during winter months (or deciduous species lose their dust-covered leaves), or could continue for the life of the project and beyond, in cases where physiological changes may occur within plants, or where vegetation community changes may take place. The extent would be within areas adjacent to roads with vehicle traffic or in unpaved surface areas, and within the dust emissions areas, with highest concentrations of dust closest to the source. There is no specific context for fugitive dust in that vegetation types impacted are those found throughout the project area, although it is possible that a rare or sensitive plant may be impacted by dust.

3.10.3.2.5 CHANGES IN WATER AVAILABILITY

The project could cause changes in the quantity and distribution of surface water flows in the Project Area by:

- Reducing baseflows due to dewatering of the mine pit area (drawdown);
- Reducing mine-site runoff;
- Diverting stream flow or downslope water movement from its natural drainage; and
- Consuming water in the mine's processing facilities.

Changes in the distribution of surface flows would be caused by diverting water and altering the area's topography during development of the project facilities. Changes in surface water hydrology would be highest within the American Creek, Omega Gulch, parts of Crooked Creek, Anaconda Creek, Snow Gulch, and Crevice Creek drainages; surface water hydrology impacts would be much less pronounced when examining the overall hydrology of Crooked Creek or the Kuskokwim River.

Changes in surface water hydrology, described in Section 3.5, Surface Water Hydrology, could result in alterations to vegetation. Plant communities could change in affected areas as moisture regimes are altered. In some areas, vegetation could shift from a wetland plant community to a non-wetland plant community, or the reverse. Indirect effects would result from modifications to the hydrology in areas immediately adjacent to disturbed areas. For example, road fill would disrupt subsurface flows causing ponding upslope and dewatering downslope. This could change the composition of vegetation types adjacent to the road. Design measures include features to minimize these effects, and the extent of such changes cannot effectively be quantified prior to construction. Changes would be site specific and dependent on the size of the drainage area, slope, and soil characteristics.

Design features incorporated to minimize the alteration of hydrology in the area include:

- Proper siting and maintenance of drainage structures for the proposed roads;
- Siting access routes, airstrips, and other infrastructure facilities to avoid wetland areas to the extent feasible;
- Whenever possible, crossing drainages at right angles, and use bridges;
- Selecting material site (i.e., borrow) locations to avoid wetlands where feasible;
- Routing transmission lines in proximity to the road, where possible, to reduce wetland footprints and reduce the number of drainages affected by the project;
- Using brush berms along the toe of fills, where feasible, to control erosion;

- Restoring flat-to-gently sloping wetlands by removal of fill at project closure where feasible; and
- Developing multiple use facilities which use the same piece of ground for more than one purpose over the life of the mine.

The intensity of the impacts of changes in water availability on vegetation vary depending on the amount of water moved and the type of disturbance. The duration of the effects would last throughout the life of the project, or could be permanent for areas with topographic changes or in areas where vegetation composition has been altered. Location of changes in water availability potentially impacted vegetation would be concentrated in areas of water drawdown (see Figures 3.11-16 and 3.11-17, in Section 3.11, Wetlands). There is no specific context for changes in water availability in that vegetation types impacted are those found throughout the project area, although it is possible that a rare or sensitive plant may be impacted.

3.10.3.2.6 RARE AND SENSITIVE PLANTS

Six species of plants tracked by ACCS (ACCS 2017f) have been recorded in the Project Area; four species have been confirmed (see Table 3.10-4). In the Mine Site, the one reported but unconfirmed fowl mannagrass occurrence of one individual would likely be impacted by construction activities under all of the action alternatives during the Construction Phase. In the Transportation Corridor, there are no confirmed or observed rare or sensitive plants. In the Pipeline, there are six confirmed observations of four species (little prickly sedge, fragile rockbrake, elephanthead lousewort, and pearfruit smelowskia) comprising populations of between one and three individuals. Pearfruit smelowskia is listed on the BLM's Sensitive Species list (BLM 2010a, BLM 2010b). There are two unconfirmed reports of two species of sedge of one individual each (bristleleaf sedge, little prickly sedge). None of these populations are expected to be directly impacted by project activities during Construction or Operations for any of the action alternatives.

In terms of intensity, loss of any individuals would reduce the population size, which increases the risk of extirpation from the Project Area. The five species are more common outside of the Project Area and in some cases, outside of Alaska, and are not in danger of statewide or global extinction through any project activities. The unconfirmed population in the Mine Site would likely be impacted by construction activities as it occurs within the project footprint. The confirmed populations in the Pipeline component are not within any construction areas within the project footprint, although the location of the pearfruit smelowskia occurs within the Project Area near the pipeline corridor. The Pipeline component populations are not expected to be impacted by project activities.

Habitat exists for both confirmed and unconfirmed species within all of the Project Area, as well as for other species on the BLM sensitive species list and the ACCS rare plant list, in terms of scope or extent of impacts. More populations of confirmed and observed populations may be found during project activities. If an individual or population was removed or impacted by project activities, duration of impacts would be permanent, although species could be replanted within the Project Area to mitigate the loss. Rare and sensitive plant species are special status species within the Project Area in terms of context, although they do not have any specific legal protection state-wide.

3.10.3.2.7 NNIS IMPACTS

Preventing introduction and spread of NNIS of all taxa is important to prevent any negative ecological or economic consequences. The Project Area currently has relatively low presence of NNIS. Negative ecological consequences of invasions are well documented in peer-reviewed literature and in agency policy, guidance, field studies, and practices. Invasion impacts can include degradation of wildlife habitat; health impacts to birds, fish, or wildlife; loss of wildlife food sources; degradation or loss of subsistence foods; degradation of visual resources; degradation or loss of recreational opportunities or quality; changes to navigability in water bodies; hydrological changes; fire regime alterations; and loss of native plants, habitats, or communities. Economic consequences from invasions are possible, especially in terms of potential aquatic invasions that could impact shipping infrastructure, or potential negative impacts to fishing or guiding industries.

Detection of NNIS during project activities is often an indication that prevention measures and BMPs are not working in the way they were intended. If NNIS are detected during the life of the project or during the Closure Phase, adaptive management techniques can be applied to assess changes necessary to effectively apply prevention measures and BMPs.

Donlin Gold has developed an Invasive Species Prevention and Management Plan (ISPMP) for the Pipeline component (SRK 2018b) in cooperation with BLM and the State of Alaska (Appendix U). The ISPMP addresses the proposed natural gas pipeline area (Pipeline component). The ISPMP is intended to apply to all action alternatives. The ISPMP discusses how Donlin Gold would comply with state and federal regulatory and procedural requirements. Donlin Gold's Reclamation and Closure Plan (SRK 2017f) also incorporates design features to minimize and prevent invasions.

The ISPMP includes:

- Plans to continue to coordinate with landowners and state and federal agencies to determine location and extent of known infestations;
- Discussion of a training plan to proactively emphasize prevention;
- EDRR principles;
- Use of BMP during potential treatment activities, including those governing use of herbicides;
- A management plan for prevention, mitigation, control, and monitoring;
- Discussion of control methods that may be employed, such as mechanical/physical, chemical, biological, or cultural methods;
- A plan for what to do if an invasive species is found;
- A performance success discussion and reporting requirements;
- Identification of Project Area vectors (see Vectors section below);
- A list of agency specific requirements and authorities; and
- A Donlin Gold Gas Pipeline Equipment Hazard Analysis Critical Control Point (HACCP) Plan;

General NNIS BMPs

BMPs common to preventing introduction or spread of NNIS include, but are not limited to:

- Periodical inspection of lesser-used roads, ROWs, landing strips, docks, or other control points;
- Inventory and monitor for invasives during all project activities;
- Keeping equipment on site during the entire project;
- Providing training so that all property users can follow BMP practices;
- Equipment, vessel, or vehicle cleaning stations;
- Education and training in ecological harm resulting from deliberate transport or transplanting NNIS;
- Education and training in non-intentional transport of NNIS, such as within seed mixes, in reclamation material, on equipment, in potted plants, on packing crates, or other vectors;

Terrestrial Plant NNIS Impacts Summary

Risk of terrestrial plant NNIS invasion in all action alternatives is assessed by examining the invasiveness ranking score of known invasions within the project areas, and by assessing the vectors that may lead to introduction or spread of terrestrial plant NNIS. Table 3.10-5 gives invasiveness ranking scores for known infestations. There are no species known from the Project Area with a score higher than 80, which is the highest risk category (Extremely Invasive). Two species, bull thistle and Siberian peashrub, fall into the next highest category (Highly Invasive). Three more species are in the next category (Moderately Invasive), and 11 more are in the next lower category (Modestly Invasive). The remaining species are considered to be either Weakly Invasive or Very Weakly Invasive. Prevention, eradication, education, and training efforts may be strategized to focus on the highest risk species which have the greatest potential to cause the most ecological harm, or potential to spread the fastest with the most challenging eradication efforts needed.

The intensity of nonnative invasive terrestrial plant risk would vary by risk assessment scores assigned to specific plant species, by proximity to areas of known high concentrations of species (such as Tyonek or Bethel), or areas subject to vegetation removal, including mine facilities and buildings, road corridors, dock construction areas, staging areas, access locations, and other vegetation removal areas. Intensity is also dependent on the number of barges, vessels and vehicles present, the amount of personnel present, and the amount of materials brought to the Project Area.

Duration of impacts would occur throughout the life of the project, including Closure Phase activities. The geographic extent would be specific to areas where transportation vectors were present, but impacts could occur in a wider area if EDRR principles or mitigation are not adequately applied. During Construction, risk would be highest because of the importation of materials and construction equipment, as well as an increase in the number of personnel present and working throughout all components within the Project Area. During Operations, the continual movement of barges, vehicles, and personnel moving in and out would maintain risk throughout this phase. Activities including barge trips and vehicle traffic would be seasonal during the barging and operations season, with less risk during the winter season. During and after Closure, risk would be reduced due to lower volume of activity, but there would still be personnel present within the Transportation Corridor and Mine Site in particular. Risk would be lower for the Pipeline component, as the pipeline activity would be reduced; however, recreational use patterns may have changed resulting in higher use of the area.

The context would be that specific species have been identified as being higher risk or as already present within the Project Area, and that agency specific management policy would guide actions in appropriate locations for existing populations or any potential new infestations. Although there are no specifically legislated geographic locations identified for protected ecosystems, certain areas of wildlife habitat or those identified as Ecosystem of Conservation Concern may be focus areas for prevention and detection monitoring.

Terrestrial Plant NNIS BMPs

During the Construction phase, BMPs that can be applied with the goal of preventing nonnative invasive plant introduction and limiting spread include, but are not limited to:

- Following guidelines in: Controlling the spread of Invasive Plants During Road Maintenance (Graziano et al. 2014);
- Following guidelines in: Vehicle Cleaning Technology for Controlling the Spread of Noxious Weeds and Invasive Species (USDA Forest Service 2005). This includes identifying sites where equipment can be cleaned, plus a plan for seed and plant parts collection and disposal when practical;
- Following guidelines in: Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species (US Bureau of Reclamation 2009-2012). This includes removal of all mud, dirt, and plant parts from vehicles and equipment prior to moving it into the Project Area, and cleaning all equipment before relocating equipment to new sites within the Project Area, if operating in known infested areas;
- Following guidelines in: General Guidelines for the Establishment and Evaluation of Invasive Species Early Detection and Rapid Response Systems (NISC 2003);
- Following guidelines in: Guide to Noxious Weed Prevention Practices (USDA Forest Service 2001);
- Incorporation of NNIS prevention into road work layout, design, and decisions. This also involves avoiding or minimizing all types of travel through known infested areas, or restricting travel to those periods when spread of seed or propagules is least likely; and
- Minimizing soil disturbance and retaining desirable vegetation in and around construction sites to the maximum extent possible; and avoiding soil removal from any infested areas to prevent spread off-site. When it is necessary to conduct soil work in infested areas, schedule activity when seeds or propagules are least likely to be viable and to spread.

During the Operations and Closure phases, BMPs include, but are not limited to:

- Following guidelines in: Replanting and maintenance of native communities (NOAA Fisheries Service BMP, http://www.habitat.noaa.gov/pdf/best_management_practices/Replanting%20Project%20Sites.pdf);

- Following guidelines in: Cleaning Land Vehicles, Equipment, and Personal Gear, NOAA Fisheries Service (http://www.habitat.noaa.gov/pdf/best_management_practices/Cleaning%20of%20Land%20Vehicles%20and%20Equipment.pdf); Inspection of Vehicles, Equipment, and Personal Gear, NOAA Fisheries Service, (http://www.habitat.noaa.gov/pdf/best_management_practices/Inspection%20of%20Vehicles%20and%20Equipment.pdf);
- Following guidelines in: Backcountry Road Maintenance and Weed Management (Ferguson et al. 2003);
- Revegetating disturbed soil in a manner that optimizes plant establishment for a specific site, unless ongoing disturbance will prevent establishment of invasive plants, following guidelines in: Replanting and Maintenance of Native Communities, NOAA Fisheries Service (http://www.habitat.noaa.gov/pdf/best_management_practices/Replanting%20Project%20Sites.pdf);
- Inspecting any materials to be used in reclamation at the site of origin to ensure they are free of invasive material before use and transport; treating or avoiding infested sources;
- Requiring off-site materials to be certified weed-free and/or inspected prior to bringing to the Project Area;
- Minimizing roadside sources of seeds or plant material that could be transported to other areas within the Project Area;
- Retention of relatively closed canopies where possible;
- Cleaning or sanitizing all clothing, boots, and equipment prior to visiting sites; and
- Reseeding, planting, or otherwise revegetating disturbed areas as soon as practicable after the seedbed has been prepared.

During the Operations and Closure phases, monitoring practices can include, but are not limited to:

- Monitoring and evaluating success of revegetation (included as part of Donlin Gold's Reclamation and Closure Plan [SRK 2017f]); and
- Implementing a regular monitoring schedule during the Project and for three years after Project closure to ensure that any NNIS transported to the site are promptly detected and controlled.

Aquatic NNIS Impacts Summary

The intensity of nonnative invasive aquatic species risk would vary by season, with higher risk during active construction, operations, and shipping seasons, and by volume of barge and vessel traffic, with higher risk during times of greater barge activity.

Intensity of impacts to the Mine Site, the non-marine portions of the Transportation Corridor, and the Pipeline components would be mainly through freshwater species. Intensity would be limited as floatplane use is not anticipated. Increased project activity may raise the potential for introduction of elodea if mitigation measures are adequately applied, as this species is known to occur in the state of Alaska but not within the Project Area. Introduction through construction equipment, gear brought to the site, and other vectors is possible. Fish and aquatic biota and habitat could potentially be impacted if NNIS are introduced to streams, lakes, ponds, wetlands, or other aquatic habitat in these components. Intensity would be greater during Construction for Pipeline component, as aquatic habitats would be impacted due to pipeline construction activities. The Pipeline component contains adjacent nonnative and native ranges of northern pike, with risk of transmission from native to nonnative areas if mitigation and BMPs are not adequately applied. The Tyonek and MacKenzie Port sites would also include marine aquatic nonnative invasive risk, similar to risk in the Transportation Corridor. Intensity of impacts in the Transportation Corridor varies by the increase and annual amount of barge and vessel activity. Barges visiting the Port of Bethel would come via coastwise traffic, so species of concern are those identified for the western US Pacific coast (see Tables 3.10-7 and 3.10-8). Barges transporting materials to and from the Angyaruak (Jungjuk) dock site would generally not be the same barges that travel outside the US exclusive economic zone (EEZ) to outside ports. If barges do transition from open ocean to the Kuskokwim River, the risk of marine invasions is reduced as most marine NNIS would not survive in freshwater.

Duration of impacts would occur throughout the life of the project, including Closure phase activities. The geographic extent would be specific to areas where vectors were present, but impacts could occur in a wider area if mitigation measures are not adequately applied.

The context would be that specific species are subject to regulatory control. Certain marine species have been identified as being of highest potential risk for invasion in this region based on presence in coastal areas along the Pacific coast of North America; US Coast Guard, EPA, and ADEC regulations apply to management of ballast water. One freshwater species (elodea) is high risk, based on presence and location in the state of Alaska; this species is subject to ADNR quarantine (ADNR 2014). Northern pike, with both native and nonnative range adjacent with the Project Area, is subject to State of Alaska regulations concerning permitted conditions and prohibitions for importing, harboring, possessing, transporting, or releasing fish and animals into Alaska (AS 03.05.010, AS 03.05.027, AS 03.05.040, AS 44.37.030, AS 03.05.090, 5 AAC 92.141, 11 AAC 34.130, 11 AAC 34.140, 11 AAC 34.160, 11 AAC 34.170, AAC 34.115).

Aquatic NNIS BMPs

During all project phases, BMPs that can be applied to address nonnative invasive aquatic species introduction or spread include, but are not limited to:

- Following voluntary vessel anti-fouling practices developed by the USCG, such as developing a Biofouling Management Plan;
- Following voluntary floatplane practices outlined by organizations and state and federal agencies to prevent transmission of plant fragments between water bodies (www.dnr.alaska.gov/ag/Index/ElodeaInformationforFloatplaneLakes.pdf);

- Specific to Essential Fish Habitat (EFH), following practices to prevent ballast water invasive species transmission (NMFS 2016). See Section 3.13, Fish and Aquatic Resources, for further discussion of the EFH Assessment (Owl Ridge 2017);
- Following guidelines in: Preventing Accidental Introductions of Freshwater Invasive Species, USDA Forest Service (www.fs.fed.us/invasivespecies/documents/Aquatic_is_prevention.pdf);
- Following guidelines in: Alaska Aquatic Nuisance Species Management Plan (ADF&G 2002);
- Following guidelines in: Management Plan for Invasive Northern Pike in Alaska (ADF&G 2007);
- Following guidelines in: Decontamination of Crane Bags, NOAA Fisheries Service (www.habitat.noaa.gov/pdf/best_management_practices/Decontamination%20of%20Crane%20Bags.pdf);
- Following guidelines in: Cleaning Watercraft and Equipment, NOAA Fisheries Service (www.habitat.noaa.gov/pdf/best_management_practices/Cleaning%20of%20Watercraft%20and%20Equipment.pdf);
- Following guidelines in: Decontamination of Invasive Bivalve Species, NOAA Fisheries Service (www.habitat.noaa.gov/pdf/best_management_practices/Preventing%20Spread%20of%20Invasive%20Bivalve%20Species.pdf);
- Following guidelines in: Decontamination of shells used for Habitat Restoration, NOAA Fisheries Service (www.habitat.noaa.gov/pdf/best_management_practices/Decontamination%20of%20Shells.pdf);
- Following guidelines in: US Coast Guard guidance on hull fouling maintenance, through the International Maritime Organization's (IMO's) guidelines on controlling and managing biofouling (www.imo.org/blast/blastDataHelper.asp?data_id=30766&filename=207(62).pdf); and
- Check, clean, and dry all clothing, boots, and equipment (boats, trailers, nets, etc.) prior to visiting a site.

NNIS Mammals Impacts Summary

There is potential for invasions of rats from barges and other vessels with the marine, river, and port portions of the Transportation Corridor, and in the marine and port portions of the Pipeline component. If introduced, rats could have devastating effects on the ecosystem by eating and killing seabirds and disrupting their nesting efforts, as well as altering vegetation patterns and displacing other predators. Under Alaska law (5 AAC 92.141), it is illegal for any property owner or vessel operator to knowingly transport Muridae rodents (including Norway rats) into Alaska and it is the responsibility of the property or vessel owner to develop and implement ongoing rodent control and eradication plans if any such rodents are discovered.

BMPs for aquatic species can be applied to prevent Norway rat or other potential mammal invasions. Donlin Gold would be responsible for ensuring that vessels used for project activities were rat-free, and to monitor for invasions during the life of the project and through Closure, to comply with state law.

The intensity of nonnative invasive mammal species risk, specifically Norway rat invasion risk, would vary by season, with higher risk during the shipping season, and by volume of barge and vessel traffic, with higher risk during times of greater barge activity. Duration of impacts would occur throughout the life of the project, including Closure phase activities. The geographic extent would specific to areas where vectors were present, but impacts could occur in a wider area if mitigation measures are not adequately applied. The context would be that there is a legal basis for prevention and eradication of Norway rats, with the regulations enforced by the Department of Public Safety, Alaska Wildlife Troopers.

Other NNIS Impacts Summary

Potential exists for the introduction or spread of nonnative invasive bird, amphibian, invertebrate, or pathogen species to the Project Area due to project activities. However, population dynamics of these potential invasive species, as well as vectors for introduction and spread, are not well understood for these taxa in Alaska. Detailed analysis of potential impacts is not possible with the current level of understanding, although monitoring for presence of any such species may occur as part of other NNIS inventory or monitoring activities.

3.10.3.2.8 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 areas like the Pipeline, increased thawing might lead to more open water areas. Habitat changes associated with climate change may increase the potential area of habitat suitable for NNIS to establish populations. An increase in wildfire frequency or size due to drying may also increase the potential for NNIS introduction and spread. See Section 3.26 (Climate Change) for further details on climate change and resources.

3.10.3.2.9 SUMMARY OF IMPACTS FOR ALTERNATIVE 2

Table 3.10-13 presents the impacts of Alternative 2 and Alternative 2 – North Option by impact type and project component based on the assessment criteria in Table 3.10-9. A total of 17,894.6 acres of vegetation would be removed (62 acres less for the North Option).

Table 3.10-13: Summary Impacts[1] of Alternative 2 on Vegetation by Project Component

Impacts	Assessment Criteria			
	Magnitude or Intensity	**Duration**	**Extent or Scope**	**Context**
Vegetation removal or damage	In some areas, vegetation is removed both above and below ground, but the area is reclaimed. In some areas, vegetation is removed both above and below ground and is not reclaimed.	In some areas, vegetation would be affected for up to the life of the project and would return to a functional condition after the completion of the activity, although composition may not be the same as pre-disturbance conditions. In the Pipeline component, more impacts would occur during the Construction phase, although brushing would occur throughout Operations. In some areas, vegetation would not be anticipated to return at all, such as the pit lake and areas of exposed rock.	Impacts limited to the Project Area.	Affects common or ordinary vegetation and species. It is possible that a rare or sensitive plan may be impacted. It is possible that habitat classified as an Ecosystem of Conservation Concern may be impacted.
Accidental damage	In some cases of mild damage, changes in vegetation types may not be measurable or noticeable; limited to small areas or small number of species changed. In cases of more severe damage, there may be noticeable compositional or structural changes in vegetation types. In cases of severe damage, such as a high severity fire, there may be acute or obvious changes in vegetation types.	In some cases of mild damage, vegetation would be affected briefly but not longer than the span of a few years and would be expected to return to pre-activity condition, such as areas cleared for construction purposes only and then reclaimed. In other cases, vegetation would be affected for up to the life of the project and would return to a functional condition after the completion of the activity, although composition may not be the same as pre-disturbance conditions. In the case of severe fire, vegetation may not be anticipated to return at all in limited locations, such as areas of exposed rock.	Could affect vegetation within the EIS Analysis Area, in the case of unchecked fire or NNIS spread.	Affects common or ordinary vegetation and species. It is possible that a rare or sensitive plan may be impacted. It is possible that habitat classified as an Ecosystem of Conservation Concern may be impacted.
Fugitive dust or environmental contamination	In areas closest to exposure, there may be noticeable compositional or structural changes in vegetation types.	Vegetation would be affected for up to the life of the project and would return to a functional condition after the completion of the activity, although composition may not be the same as pre-disturbance conditions.	Could potentially impact vegetation within the Project Area.	Affects common or ordinary vegetation and species.

Table 3.10-13: Summary Impacts[1] of Alternative 2 on Vegetation by Project Component

Impacts	Assessment Criteria			
	Magnitude or Intensity	**Duration**	**Extent or Scope**	**Context**
Rare or sensitive species removal	Changes in vegetation types may not be measurable or noticeable; limited to small areas or small number of species changed.	Species would not be anticipated to return at all, unless they were transplanted or re-planted at the sites.	Impacts limited to the Project Area. Confirmed populations occur within the Pipeline component. Populations may occur within the Mine Site.	It is possible that a rare or sensitive plan may be impacted.
Changes in water availability	In areas immediately impacted by changes, such as within the cone of depression, there may be noticeable compositional or structural changes in vegetation types.	Vegetation would be affected for up to the life of the project and would return to a functional condition after the completion of the activity, although composition may not be the same as pre-disturbance conditions. It is possible that there may be acute or obvious changes in vegetation types, depending on the severity of change.	Affects vegetation within the Project Area.	Affects common or ordinary vegetation and species. It is possible that a rare or sensitive plan may be impacted. It is possible that habitat classified as an Ecosystem of Conservation Concern may be impacted.
NNIS introduction or spread	If BMPs and mitigation measures are adequately applied, any new NNIS introduced into the Project Area are controlled. Existing populations are not allowed to spread. If BMPs and mitigation measures are not adequately applied, existing populations could spread or new species could be introduced, resulting in ecological impacts.	Risk of introduction and spread would continue through all project phases but any new NNIS populations would be eradicated according to BMPs and mitigation measures. If BMPs and mitigation measures are not adequately applied, or control measures are not taken, invasions could be permanent.	Could potentially impact vegetation within the EIS Analysis Area.	If BMPs and mitigation measures are adequately applied, and regulatory guidance is followed, NNIS are not introduced, and all regulatory practices are followed, resulting in no new invasions. If such practices are not implemented, it is possible that NNIS may be introduced or spread, in violation of regulations.

Notes:

1 The expected impacts account for impact reducing design features proposed by Donlin Gold and Standard Permit Conditions and BMPs that would be required. It does not account for additional mitigation measures being considered.

3.10.3.2.10 MITIGATION AND MONITORING FOR ALTERNATIVE 2

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 vegetation include:

- Pre-Construction surveys of vegetation to be disturbed on BLM-managed land would be conducted to determine the presence or absence of any rare and sensitive plant species. If any individuals or populations are found, the appropriate agencies would be consulted to determine potential mitigation such as avoidance or transplant. These mitigation measures could substantially reduce the potential effects on any rare plants;
- All work would be performed in accordance with relevant permit and lease stipulations and in a manner to prevent infestation of bark beetles or other potential problems consistent with the Donlin Gold Timber Clearing Utilization Plan;
- Salvaged growth media and topsoil removed during construction would be used for revegetation. Salvaged material would be stored using methods to prevent erosion of the stockpiled salvaged material. Native seed mixes and natural recolonization would be utilized to the extent practicable in reclamation activities to minimize potential for introducing non-native or invasive species;
- The project design includes routing transmission lines in proximity to roads, where possible, to reduce additional vegetation impacts;
- 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;
- During the Operations Phase, concurrent reclamation activities (e.g., certain tiers and areas within the WRF) would be conducted immediately after construction and stabilization and whenever practicable in disturbed areas no longer required for active mining; and
- Burying the pipeline and blending with the natural setting minimizes the potential for pipeline to dominate the landscape and decreases visual impacts. The cleared pipeline ROW would be revegetated progressively throughout construction as segments of construction are complete. Vegetative cover would be maintained during Operations to the extent permitted under PHMSA regulations; minimizing visual contrast of ROW by blending with existing low vegetation or open areas. While the ROW would be revegetated, PHMSA regulations require brushing of the 50 foot ROW.

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

- 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 (FRP) Plans;
- 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);

- Development of an Invasive Species Prevention and Management Plan (ISPMP) and application of industry-standard BMPs relating to nonnative invasive species (NNIS) prevention and management; and
- Donlin Gold's Fire Prevention and Suppression Plan to mitigate accidental fire risk.

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 Section 5.7). Examples of additional measures being considered that are applicable to this resource include:

- Where practicable, leave riparian bank vegetation material intact or, where needed and practicable, store for replacement on the disturbed banks to stabilize and restore the crossing. Monitoring of crossing sites to identify sites that need additional restoration to prevent bank erosion should be implemented after construction. At stream bank crossings, placement of riparian mats or root masses would be placed to facilitate rapid vegetation regrowth to prevent bank erosion;
- 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;
- Where practicable, promote salvaging and re-spreading topsoil over the overburden piles and allowing native vegetation and native seed planting vegetation growth to keep topsoil viable until it is needed during final reclamation. In pipeline reclamation practices, segregate windrowed organic soils as cover material (where present);
- Apply measures to reduce the initial clearing requirements for the ROW, on a site - specific basis;
- Apply measures to reduce the initial clearing requirements for the ROW, on a site - specific basis. Avoid vegetation clearing during the bird nesting season;
- During final design locate any potential vegetation buffers to reduce visual impacts;
- Frost pack the pipeline trench cover in bogs and fens, cut the trench cover in blocks, set the blocks aside during construction and replace them over the trench fill afterwards;
- Segregate wetlands soil for use in wetland mitigation to the maximum amount practicable;
- Monitor revegetation progress of reclaimed construction areas and facilities annually for the first 5 years after closure or until observations indicate stabilized conditions. Should vegetative cover not meet criterion established by permit requirements or achievement goals specified in the reclamation plan, further remedial action may include reseeding the area, additional application of soil amendments, and/or incorporation of additional growth media on a particular site or facility; and
- Conduct a baseline survey and regular monitoring for nonnative invasive species (NNIS) of all taxa on all disturbed lands on all project components.

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

3.10.3.3.1 MINE SITE

There would be no change in the location or operations of the Mine Site under Alternative 3A, therefore the impacts to vegetation would be the same as described under Alternative 2.

3.10.3.3.2 TRANSPORTATION CORRIDOR

Alternative 3A differs from Alternative 2 in that it would include fewer ocean fuel barge trips and fewer river fuel barge trips because of the decreased use of diesel fuel. There would also be proportionally fewer trucks hauling diesel on the Jungjuk road (about half as many during the Operations Phase), which would reduce the amount of fugitive dust that could affect vegetation. Construction areas would be the same as Alternative 2, and most impacts to vegetation would be the same.

Reducing the number of fuel barge trips reduces, but does not eliminate, the risk of adverse impacts to vegetation from NNIS potentially transported by barges. The change in the number of fuel barge trips would not affect the impacts from vegetation removal, removal of rare or sensitive plants, changes in water availability, or risk of accidental damage.

3.10.3.3.3 PIPELINE

There would be no change in the location or operations of the Pipeline under Alternative 3A (except that an increased volume of natural gas would be shipped through the pipeline); therefore, the impacts to vegetation would be the same as described under Alternative 2.

3.10.3.3.4 SUMMARY OF IMPACTS FOR ALTERNATIVE 3A

Direct and indirect impacts on vegetation would be generally the same in Alternative 3A as those described under Alternative 2. A total of 17,894.6 acres of vegetation would be removed, same as Alternative 2. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

3.10.3.4 ALTERNATIVE 3B – REDUCED DIESEL BARGING: DIESEL PIPELINE

Under Alternative 3B, an 18-inch diameter diesel pipeline would be constructed from Cook Inlet to the Mine Site, instead of a natural gas pipeline, to eliminate diesel barging on the Kuskokwim River. The diesel Pipeline would be located in the same corridor proposed for the natural gas Pipeline under Alternative 2, with an additional segment between Tyonek and the start of the proposed corridor for the natural gas line. The diesel Pipeline would extend 334 miles from Cook Inlet to the Donlin Mine. The diesel Pipeline would require a 19-mile extension from the proposed terminus of the natural gas Pipeline, south to Tyonek. This additional segment would cross the Beluga River.

This alternative would require either construction of a new dock facility in Tyonek or expansion of the existing Tyonek North Foreland Barge Facility. A new tanker berth system would be needed at Tyonek to accommodate the tide, ice, and seismic conditions and provide adequate depth for continuous 24-hour operation. A barge landing at Tyonek sufficient for most tidal stages would be required to support the construction and operation of the facilities. Tanks sufficient for storing one month's fuel consumption, approximately 10-million gallons, would be installed at each end of the Pipeline.

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.

3.10.3.4.1 MINE SITE

There would be no change in the location of the Mine Site under Alternative 3B; however, there would be a change in Operations. Diesel fuel would be used instead of natural gas. The difference in fuel is not expected to change the impacts to vegetation at the Mine Site, so they would be the same as described for Alternative 2.

3.10.3.4.2 TRANSPORTATION CORRIDOR

The Transportation Corridor footprint is the same as described under Alternative 2; however, diesel barging on the Kuskokwim River would be eliminated after the Construction Phase. Both river and ocean cargo barges would still be necessary for cargo, but the fuel would go to Cook Inlet instead of Bethel. Total barge traffic on the Kuskokwim River would be reduced. The reduction in barge traffic would reduce barge-related potential invasion impacts to vegetation along the river and road, as well as reducing spill risk in this portion of the Transportation Corridor.

3.10.3.4.3 PIPELINE

The location of the diesel pipeline route would remain approximately the same as the natural gas pipeline route in Alternative 2. The addition of a diesel fuel barge from either northwest marine terminals or Nikiski to Tyonek would impact vegetation in the vicinity of Tyonek through direct vegetation removal for a new dock and tanks, and by increasing the potential for introduction of new NNIS or spread of existing known invasive plant species populations in Tyonek (see Figure 3.10-9). Alternative 3B would include an additional 19 miles of pipeline and clearing in the vicinity of the Tyonek dock, resulting in an additional 473.5 acres of vegetation removal compared to Alternative 2. The risk of invasion compared to Alternative 2 would also be slightly greater due to the longer pipeline route. See Table 3.10-14 for vegetation removal totals for Alternative 3B and the two options, along with totals for the Collocated Pipeline Option configured with Port MacKenzie.

- The Port MacKenzie Option would require an additional 452.8 acres of vegetation removal compared to Alternative 2 (or 20.7 acres less than Alternative 3B without options). The risk of invasion compared to Alternative 2 would be slightly greater due to the longer route.
- The Collocated Pipeline Option would require an additional 684.6 acres of vegetation removal compared to Alternative 2 due to the wider ROW (or 211.1 acres more than Alternative 3B without options). The risk of invasion would be slightly greater than Alternative 2 due to the wider pipeline corridor.
- The Collocated Pipeline Option configured with Port MacKenzie would require an additional 1,010.2 acres of vegetation removal compared to Alternative 2 (or 536.7 acres more than Alternative 3B without options). The risk of invasion would be slightly greater compared to Alternative 2 due to the longer pipeline route and the wider pipeline corridor.

In addition, spill response requirements and pre-positioned equipment storage would require leaving some construction facilities, roads, helipads, and airstrips in a usable condition after construction, causing long-term rather than temporary duration. Spill risks and effects are discussed in Section 3.24, Spill Risk.

Table 3.10-14: Alternative 3B and Options Vegetation Removal Impacts

Aggregated Vegetation Type	Impacted Acres[1]		Impacted Acres[2]	
	Alternative 3B	Alternative 3B with Port MacKenzie Option	Alternative 3B with Collocated Pipeline Option	Alternative 3B with Collocated Pipeline Option configured with Port MacKenzie
Kuskokwim Mountains Ecoregion				
Forested – Evergreen	556.8	556.8	570.2	570.2
Forested – Deciduous/Mixed	607.1	607.1	619.5	619.5
Shrub	954	954	989.9	989.9
Herbaceous	30.5	30.5	31.6	31.6
Other Land Cover	6.9	6.9	7	7
Tanana-Kuskokwim Lowlands Ecoregion				
Forested – Evergreen	556.8	556.8	653.6	653.6
Forested – Deciduous/Mixed	607.1	607.1	97.6	97.6
Shrub	954	954	557.1	557.1
Herbaceous	30.5	30.5	58	58
Other Land Cover	6.9	6.9	27.2	27.2
Alaska Range Ecoregion				
Forested – Evergreen	577.2	577.2	593	593
Forested – Deciduous/Mixed	253.2	253.2	259.7	259.7
Shrub	920.3	920.3	945.7	945.7
Herbaceous	39.7	39.7	40.8	40.8
Other Land Cover	25.1	25.1	25.9	25.9
Cook Inlet Basin Ecoregion				
Forested – Evergreen	146.3	231.9	147.8	251.8
Forested – Deciduous/Mixed	1,206.50	1,337.70	1,244.70	1,563.80
Shrub	619.8	373.6	633.6	567.9
Herbaceous	110	58.9	112.8	103.5
Other Land Cover	50.4	110.2	50.8	119.3
TOTAL:	**7,455.40**	**7,434.70**	**7,666.50**	**8,083.10**

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 (81.7 acres), Puntilla Airstrip (70.2 acres), and George River Airstrip (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 options. Alternative 3B would include 3 additional airstrips: Tatlawiksuk Airstrip (81.7 acres), Puntilla Airstrip (70.2 acres), and George River Airstrip (72.9 acres). These impacts are added to Alternative 2 impacts which were increased by 5 percent for the pipeline construction area and 8 percent for pipe storage yards for the collocated pipelines.

Source: Michael Baker 2017a, Boggs et al. 2016a, Nowacki et al. 2001

3.10.3.4.4 SUMMARY OF IMPACTS FOR ALTERNATIVE 3B

Direct and indirect impacts on vegetation would be the same in Alternative 3B as those described under Alternative 2, with the addition of the effects of the additional pipeline length and new dock and storage facilities in Alternative 3B and in either Option for Alternative 3B. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

3.10.3.5 ALTERNATIVE 4 – BIRCH TREE CROSSING (BTC) PORT

This alternative would move the port facility downstream to BTC which would reduce barge distances for freight and diesel, but would increase the access road distance from 30 miles for the Angyaruaq (Jungjuk) Road in Alternative 2 to 76 miles for the BTC Road. An ice road up the Crooked Creek valley would be required to start construction of the road and facilities needed, which would require additional clearing of tall woody vegetation. There would be no other substantive changes from Alternative 2.

3.10.3.5.1 MINE SITE

There would be no change in the location or operations of the Mine Site under Alternative 4; therefore, impacts to vegetation would be the same as described under Alternative 2.

3.10.3.5.2 TRANSPORTATION CORRIDOR

Alternative 4 would include a port at BTC with the same facilities proposed for Alternative 2. While there are fewer river miles between Bethel and BTC, this would be offset by a longer road to the Mine Site. Because the haul distance and round-trip time are longer, roughly twice as many trucks would be required to deliver materials during the barging season. The shorter barge distance would shorten the round trip barge travel time. Overall, there would be the same number of barge trips under Alternative 4 as in Alternative 2.

The change in the location of the port would eliminate project-related barge traffic on more than 60 miles of the Kuskokwim River between the BTC Port site and the Angyaruaq (Jungjuk) Port site. The longer port road and additional ice road would cause an additional 697.7 acres of vegetation removal, with possible conversion from forest and shrub vegetation community types to low vegetation types along the ice road. Table 3.10-15 lists acres of vegetation by type that would be removed. Rare or sensitive plant removal would not change from Alternative 2. Additional vegetation removal may increase invasion risk in terrestrial portions due to the longer road length. The elimination of barging upstream of BTC would reduce the risk of invasion in that section of the river. There may be slightly increased dust from the longer road length, increased risk of environmental contamination from the longer road length, and changes in water availability due to the longer road length construction.

Table 3.10-15: Alternative 4 Transportation Corridor Vegetation Removal Impacts

Aggregated Vegetation Type	Impacted Acres	Ecoregion Acres	Percent of Ecoregion
Kuskokwim Mountains Ecoregion			
Forested – Evergreen	732.2	10,533,652.8	0.01%
Forested – Deciduous/Mixed	125.2	3,675,388.5	<0.01%
Scrub Shrub	793.9	5,111,573.1	0.02%
Herbaceous	125.5	1,116,460.5	0.01%
Other Land Cover	14.3	659,232.3	<0.01%
TOTAL:	1,791.1	21,096,307.2	0.01%

Source: Michael Baker 2017a, Boggs et al. 2016a, Nowacki et al. 2001

3.10.3.5.3 PIPELINE

There would be no change in the location or operations of the Pipeline under Alternative 4; therefore, impacts to vegetation would be the same as described under Alternative 2.

3.10.3.5.4 SUMMARY OF IMPACTS FOR ALTERNATIVE 4

Direct and indirect impacts on vegetation would be generally the same in Alternative 4 as those described under Alternative 2. The longer mine impact road would impact more acres of vegetation. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

3.10.3.6 ALTERNATIVE 5A – DRY STACK TAILINGS

Alternative 5A would be an alternate tailings disposal method at the Mine Site. The primary objective of the dry stack process is to reduce the potential of tailings water leaving the tailings storage facility to reduce potential impact to the environment and overall footprint of the project. For Alternative 5A, the difference for direct vegetation impacts would be limited to the footprint of the TSF (see Figure 3.10-3). There are two Options for this alternative, the Unlined Option (TSF would not have a liner) and the Lined Option (TSF would have a liner). The Unlined Option would require 71.6 more acres of vegetation removal compared to Alternative 2. The Lined Option would require 362.1 more acres of vegetation removal compared to Alternative 2, because of the way the liner would be installed and configured at the site. For both Options, more evergreen forested types, deciduous/mixed forested types, and more scrub shrub types would be removed (Table 3.10-16). The dry stack method of tailings disposal would also increase the amount of dust produced, which could lead to greater fugitive dust-related impacts on vegetation. See Section 3.11, Wetlands, for a discussion on impacts to wetlands from fugitive dust.

The other two project components (the Transportation Corridor and Pipeline) would remain the same as described under Alternative 2.

Table 3.10-16: Alternative 5A Mine Site Vegetation Removal Impacts

Aggregated Vegetation Type	Alternative 5A Unlined Option TSF Impacted Acres	Alternative 5A Lined Option TSF Impacted Acres	Alternative 2 TSF Impacted Acres
Kuskokwim Mountains Ecoregion			
Forested – Evergreen	2,112.1	2,344.5	2,094.6
Forested – Deciduous/Mixed	243.6	271.4	196
Scrub Shrub	102.8	133.1	96.3
Herbaceous	4	4	4
Other Land Cover	0.5	0.5	0.5
TOTAL:	2,463.0	2,753.5	2,391.4

Source: Michael Baker 2017a, Nowacki et al. 2001

3.10.3.6.1 SUMMARY OF IMPACTS FOR ALTERNATIVE 5A

Direct and indirect impacts on vegetation would be generally the same in Alternative 5A as those described under Alternative 2, aside from the expected increase in fugitive dust. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

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

Alternative 6A consists of an alternative pipeline route segment. The only project component that would differ from Alternative 2 is the Pipeline component. The natural gas pipeline alignment would be located to the west of the Alternative 2 route between MP 106.5 and MP 152.7, and would traverse Dalzell Gorge. The different route would change the amount and types of vegetation that would be disturbed (Table 3.10-17). Overall, 12.4 less acres of vegetation would be removed compared to Alternative 2. Less scrub shrub types and other types would be removed, but more evergreen forested types, deciduous/mixed forested types, and herbaceous types would be removed. Impacts are expected to be similar to those described under Alternative 2. The other two project components (the Mine Site and Transportation Corridor) would remain the same as described under Alternative 2.

Table 3.10-17: Alternative 6A Pipeline Component Vegetation Removal Impacts

Aggregated Vegetation Type	Alternative 6A Impacted[1] Acres	Alternative 2 Impacted[1] Acres	Difference Acres
Alaska Range Ecoregion			
Forested – Evergreen	296.4	240.7	55.7
Forested – Deciduous/Mixed	54.1	25.7	28.4
Scrub Shrub	397.0	496.5	-99.5
Herbaceous	46.6	30.0	16.6
Other Land Cover	25.5	39.1	-13.6
TOTAL:	819.6	832.0	-12.4

Notes:
1 Comparison based on 150 foot-wide construction ROW for route segments between MP 106.5 and 152.7.
Source: Michael Baker 2017a, Nowacki et al. 2001

3.10.3.7.1 SUMMARY OF IMPACTS FOR ALTERNATIVE 6A

Direct and indirect impacts on vegetation would be generally the same in Alternative 6A as those described under Alternative 2. Design features, Standard Permit Conditions and BMPs most important for reducing impacts to vegetation are described in Alternative 2. Impacts associated with climate change would also be the same as those discussed for Alternative 2.

3.10.3.8 ALTERNATIVES IMPACT COMPARISON

Although there are differences among alternatives in the project components that would affect vegetation, (e.g., longer or shorter port road or pipeline, more or less barge trips, and smaller or larger mine footprint) the summary of impacts are similar among the action alternatives. That does not mean that all the alternatives would affect vegetation equally, but the percentage difference is small for vegetation impacts. A comparison of vegetation removal acres for all three project components by alternative (including options) is given in Table 3.10-18. A comparison of the impacts by alternative is presented in Table 3.10-19.

Table 3.10-18: Vegetation Removal Acres Summary (Acres)

	Alternative 2	Alternative 2 – North Option	Alternative 3A	Alternative 3B	Alternative 3B - Port MacKenzie Option	Alternative 3B - Collocated Pipeline Option	Alt 3B - Collocated Pipeline Option configured with Port MacKenzie	Alternative 4	Alternative 5A - Unlined Option	Alternative 5A - Lined Option	Alternative 6A
Mine Site	9,819.3	9,819.3	9,819.3	9,819.3	9,819.3	9,819.3	9,819.3	9,819.3	9890.9	10181.4	9,819.3
Transportation Corridor	1,093.4	1,093.4	1,093.4	1,093.4	1,093.4	1,093.4	1,093.4	1,791.1	1,093.4	1,093.4	1,093.4
Pipeline	6,981.9	6,919.5	6,981.9	7455.4	7434.7	7666.5	8083.1	6,981.9	6,981.9	6,981.9	6,969.5
Total Acres Removed	**17,894.6**	**17,832.2**	**17,894.6**	**18,368.1**	**18,347.4**	**18,579.2**	**18,995.8**	**18,592.3**	**17,966.2**	**18,256.7**	**17,882.2**
Difference from Alternative 2											
Mine Site	-	-	0.0	0.0	0.0	0.00	0.0	0.0	71.6	362.1	0.0
Transportation Corridor	-	-	0.0	0.00	0.0	0.0	0.0	697.7	0.0	0.00	0.0
Pipeline	-	-	0.0	473.5	452.8	684.6	1,101.2	0.0	0.0	0.00	-12.4
Total Difference from Alternative 2		**-62.4**	**0.0**	**473.5**	**452.8**	**684.6**	**1,101.2**	**697.7**	**71.6**	**362.1**	**-12.4**

Table 3.10-19: Comparison by Alternative* for Vegetation

	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
Impact-Causing Project Component						
Construction activities, project activities, and infrastructure	17,894.6 total acres of vegetation removal (17,832.2 acres, North Option [62 less acres]). Angyaruaq (Jungjuk) port site construction. 30-mile mine access road from port. Mine facilities construction. Road and facilities maintenance may require brushing of above-ground vegetation during Operations. Cone of depression at Mine Site due to water drawdown activities during Operations. 316-mile natural gas pipeline and ancillary facilities construction (North Option – less than 1 mile less in length) Pipeline corridor brushing of above-ground vegetation during Operations in 50' ROW. Summary: Vegetation will be removed, in some locations permanently. One Ecosystem of Conservation Concern may be impacted (spruce floodplain-	Differences: 17,894.6 total acres of vegetation removal (same as Alternative 2). Fewer diesel trucks and trips. Additional LNG Plant and storage tanks, reduced onsite diesel storage. Summary: Lower risk of invasion along road.	Differences: 18,368.1 total acres of vegetation removal (473.5 more than Alternative 2). Tyonek port site construction; 19-mile pipeline extension construction. 334-mile diesel pipeline and ancillary facilities construction. *Port MacKenzie Option* - Port improvements, alternative diesel pipeline route reconnecting at MP 28. 18,347.4 total acres of vegetation removal (452.5 more than Alternative 2, 20.7 acres less than Alternative 3B). *Collocated Pipeline Option* - wider ROW. 18,579.2 total acres of vegetation removal (684.6 more than Alternative 2, 211.1 acres more than Alternative 3B). *Collocated Option configured with Port MacKenzie* - total vegetation removal would be 18,995.8 acres (1,101.2 acres more than Alternative 2, 627.7 acres more than Alternative 3B). Summary:	Differences: 18,592.3 total acres of vegetation removal (697.7 more than Alternative 2). BTC port site construction and 76-mile mine access road. Summary: More vegetation removed. Higher risk of invasion along road.	Differences: *Unlined Option* - 17,966.2 total acres of vegetation removal (71.6 more than Alternative 2). *Lined Option* - 19,256.7 total acres of vegetation removal (362.1 more than Alternative 2). Summary: Similar vegetation removed in Unlined Option. More vegetation removed in Lined Option. Similar invasion risk to Alternative 2.	Differences: 17,882.2 total acres of vegetation removal (12.4 less than Alternative 2). 313-mile natural gas pipeline. Summary: Similar vegetation removed. Similar invasion risk to Alternative 2.

Table 3.10-19: Comparison by Alternative* for Vegetation

	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
	old growth forest). Vegetation damage may occur. Fugitive dust emissions may impact vegetation. There may be changes in vegetation due to changes in water availability. Rare or sensitive plants may be impacted. There is risk of nonnative species invasion from all project activities.		More vegetation removed in Alternative and 2 Options (including configuring Options together). Higher invasion risk due to additional construction and longer routes.			
Fugitive dust emissions	Fugitive dust emissions will occur due to project activities. <u>Summary:</u> Risk exists for vegetation impacts such as damage or compositional vegetation type changes due to fugitive dust emissions.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> Increased amount of fugitive dust. <u>Summary:</u> Higher risk of vegetation impacts such as damage or compositional vegetation type changes due to fugitive dust emissions.	Same as Alternative 2.
River barge trips (Transportation Corridor)	Construction - 89 trips/year (50 cargo, 19 fuel, 20 during first two years to staging above Devil's Elbow) Operations - 122 trips/year	<u>Differences:</u> Operations - 83 trips/year (64 cargo, 19 fuel) <u>Summary:</u>	<u>Differences:</u> Operations - 64 trips/year (cargo) <u>Summary:</u> Lower invasion risk along river	Same number of trips as Alternative 2, but river barges would only go as far	<u>Differences:</u> Operations - 129 trips/year (71 cargo, 58 fuel) <u>Summary:</u>	Same as Alternative 2.

Table 3.10-19: Comparison by Alternative* for Vegetation

	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
	(64 cargo and 58 fuel) Summary: Invasion risk exists due to river barge traffic as a vector.	Lower invasion risk along river barge route.	barge route.	as BTC port. Summary: Lower invasion risk along river barge route.	Slightly higher invasion risk along river barge route.	
Ocean barge trips (Transportation Corridor)	Construction - 30 trips/year to Bethel (16 cargo, 14 fuel) Operations - 26 trips/year to Bethel (12 cargo, 14 fuel) Summary: Invasion risk exists due to ocean barge traffic as a vector.	Differences: Operations - 5 trips/year per year to Bethel (all fuel) during Operations (17 total compared to 26 total in Alternative 2). Summary: Lower risk of invasion along ocean barge route.	Differences: Operations - no fuel barge trips compared to 14 in Alternative 2, for a total of 12 barge trips/year. Summary: Lower risk of invasion along ocean barge route.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Pipeline component)	Construction - 20 ocean barges during the first year from Anchorage to Beluga Landing. Summary: Invasion risk due to ocean barge traffic as a vector.	Same as Alternative 2.	Differences: Operations - 12 trips/year (fuel) compared to none in Alternative 2 (but no barge trips during Construction from Anchorage to Beluga Landing). Summary: Similar invasion risk along ocean barge route.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Direct or Indirect Impacts						
Acres of vegetation removed -	9,819.8 acres of vegetation removal. Of this, 2391.4 would	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Differences: *Unlined Option -*	Same as Alternative

Table 3.10-19: Comparison by Alternative* for Vegetation

	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
Mine Site	be in the TSF.				9,890.9 acres removed, 2,463.0 in TSF (71.6 more than Alternative 2). *Lined Option* - 10,181.4 acres removed, 2,753.5 in the TSF (362.5 more than Alternative 2).	2.
Acres of vegetation removed - Transportation Corridor	1,093.4 acres of vegetation removal.	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> 1791.1 acres of vegetation removal (697.7 acres more than Alternative 2).	Same as Alternative 2.	Same as Alternative 2.

Table 3.10-19: Comparison by Alternative* for Vegetation

	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
Acres of vegetation removed - Pipeline component	6,981.9 acres of vegetation removal (6,919.5 acres, North Option [62 less acres]).	Same as Alternative 2.	<u>Differences:</u> 7,455.4 acres of vegetation removal (473.5 more than Alternative 2). *Port MacKenzie Option*: 7,434.7 acres of vegetation removal (452.8 acres more than Alternative 2, and 20.7 acres less than Alternative 3B). *Collocated Pipeline Option:* 7,666.5 acres of vegetation removal (684.6 acres more than Alternative 2, and 211.1 acres more than Alternative 3B). *Collocated Pipeline Option configured with Port MacKenzie:* 8,083.1 acres of vegetation removal (1,101.2 acres more than Alternative 2, and 627.7 acres more than Alternative 3B).	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> 6,969.5 acres of vegetation removal (12.5 acres less than Alternative 2).
Rare or sensitive plant impacts	Four rare or sensitive plant species have been confirmed within the Project Area. Two additional species are recorded but unconfirmed. Mine Site - One reported but unconfirmed population of fowl mannagrass would likely be impacted by construction activities within the project	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2

Table 3.10-19: Comparison by Alternative* for Vegetation

	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
	footprint. Transportation Corridor - No rare or sensitive plants have been confirmed in the Project Area. Pipeline component - Populations of four confirmed species (little prickly sedge, elephanthead lousewort, fragile rockbrake, and pearfruit smelowskia [BLM sensitive species]) and one unconfirmed species (bristleleaf sedge) occur, but are not likely to be impacted by project activities as they occur outside the project footprint. Loss of any individuals would reduce the population size, which increases the risk of extirpation from the Project Area. Habitat exists for these five species and for other species on rare and sensitive plant lists within the Project Area.					
Vegetation damage	Vegetation damage including mechanical damage from construction activities, accidental wildland fire, accidental fuel or chemical spills, or damage from inappropriate forestry	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2

Table 3.10-19: Comparison by Alternative* for Vegetation

	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
	practices may occur.					
Changes in water availability	There may be changes in vegetation, resulting in vegetation type change or damage to vegetation, from changes in water availability due to water drawdown activities.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2
NNIS risk	NNIS may be introduced or existing populations may spread due to all project activities if mitigation measures and BMPs are not adequately applied. 27 nonnative invasive terrestrial plant species are known to occur within the Project Area. No other taxa of NNIS are known to have reproducing populations within the Project Area.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2.	Same as Alternative 2

Notes:
*The No Action Alternative would have no new impacts.