AMENDMENT TO BRADLEY LAKE HYDROELECTRIC PROJECT (FERC No. 8221), BRADLEY LAKE EXPANSION PROJECT

Vegetation and Wildlife Habitat Mapping Study

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ACRONYMS AND ABBREVIATIONS

A

ABR	ABR, Inc.—Environmental Research & Services
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
AVC	Alaska Vegetation Classification

B

Bradley Lake Project	Bradley Lake Hydroelectric Project (FERC No. 8221)

D

DSP	Draft Study Plan

E

El.	Elevation

F

FERC	Federal Energy Regulatory Commission

G

GPS	Global Positioning System

I

ICD	Initial Consultation Document
ITU	Integrated Terrain Unit

N

NHD	National Hydrography Dataset

P

PM&E	Protection, mitigation, and enhancement
PRM	Project River Mile
Project	Bradley Lake Expansion Project

U

USFWS	United States Fish and Wildlife Service

W

WLFZ	water level fluctuation zone

1.0 INTRODUCTION

1.1 Background

The Alaska Energy Authority (AEA), licensee and owner of the 120-megawatt Bradley Lake Hydroelectric Project (Bradley Lake Project; Federal Energy Regulatory Commission [FERC] No. 8221), is pursuing a FERC license amendment. The purpose of the proposed amendment is to gain authorization to divert runoff and seasonal meltwater coming from Dixon Glacier at the headwaters of the Martin River to Bradley Lake and to raise the Bradley Lake Dam and spillway to increase the reservoir's storage capacity and produce more power.

AEA filed an Initial Consultation Document (ICD) (AEA 2022a) with FERC on April 27, 2022. The ICD describes existing facilities and current Bradley Lake Project operations; characterizes the affected environment; and describes two proposed project alternatives for producing energy from Dixon Glacier meltwater. Following the ICD filing, AEA hosted Joint Agency and Public Meetings in Homer, Alaska, on June 14, 2022, to discuss the ICD and receive stakeholder input. In November 2022, AEA filed a Draft Study Plan (DSP) (AEA 2022b) with FERC, based on the two alternatives, outlining 10 studies, including the Vegetation and Wildlife Habitat Mapping Study (ABR, Inc.—Environmental Research & Services [ABR] 2024). Stakeholders filed comments to the DSP in December 2022. AEA briefly paused the FERC amendment process while it conducted additional feasibility studies and narrowed down the proposed project alternatives.

Based on further investigations, AEA decided to move forward with the proposed alternative diverting Dixon Glacier meltwater to Bradley Lake and raising the Bradley Lake Dam/spillway to increase storage capacity in the lake (Bradley Lake Expansion Project or Project). The proposed Project would include construction of: a diversion dam near the toe of Dixon Glacier; an approximately 4.6-mile-long diversion tunnel bored through the mountain extending from Dixon Glacier to Bradley Lake, diverting water from the Martin River basin to Bradley Lake; approximately 1 mile of new, 16-foot-wide, gravel-surfaced access road from the existing Upper Battle Creek diversion access road to the outlet of the proposed diversion tunnel (together referred to as the Dixon Diversion); and modification of the existing Bradley Lake Dam to raise the normal maximum pool

elevation currently at Elevation (El.) 1,180 feet[1] by 16 feet to El. 1,196 feet (referred to as the Bradley Lake Pool Raise). The entire proposed Project, encompassing the Dixon Diversion and Bradley Lake Pool Raise, is located on state-owned land.

AEA re-initiated the amendment process in 2024 by hosting public meetings in March and April 2024 and January 2025 to review the selected Project alternative, stakeholder comments to the DSP, and AEA's proposed modifications to the DSP. Consultation specific to this study can be found in Appendix A of the 2024 *Vegetation and Wildlife Habitat Mapping Study Report* (ABR 2024). AEA implemented several studies in 2025, including this one. This report describes the combined results of the Vegetation and Wildlife Habitat Mapping Study completed by ABR during 2024 and 2025.

1.2 Modifications to the Draft Study Plan

The Vegetation and Wildlife Habitat Mapping Study DSP (AEA 2022b, Section 4.7) states that the study area would encompass the Wetland Delineation study area (AEA 2022b, Section 4.6) with additional buffer sizes around Project elements depending on the focal wildlife species list to be analyzed in the Wildlife Habitat Evaluation Study (AEA 2022b, Section 4.8) and consultation with agency stakeholders. Consultation was initiated at the Terrestrial Resources Meeting on March 19, 2024. After the meeting, the Alaska Department of Fish and Game (ADF&G) and United States Fish and Wildlife Service (USFWS) provided recommendations for the vegetation and wildlife habitat mapping extent and/or wildlife species to include in the habitat evaluation analysis (see Appendix A in ABR 2024). A second consultation meeting was held on April 1, 2024, and AEA adopted the recommendations of both agencies. Accordingly, the fine-scale mapping extent for this study encompasses all areas that would be affected by Project development and a surrounding buffer zone of 250-meters (820-feet). In addition, focused wildlife habitat mapping was conducted in two larger blasting area buffer zones with 2-kilometer (1.2-mile) radii surrounding the proposed diversion tunnel inlet and outlet, the new access road, and the Bradley Lake Dam and associated construction areas; this mapping was done to facilitate an assessment of potential construction impacts to a set of disturbance-sensitive wildlife species. One additional agency meeting was held in January 2025 on terrestrial resources, and no comments or recommendations for change were made at that time.

[1] Unless otherwise specified, all elevations reference the Bradley Lake Vertical Datum.

1.3 Project Nexus

The proposed Bradley Lake Expansion Project construction and operation activities would result in the alteration of wildlife habitats, which necessitates implementation of the Vegetation and Wildlife Habitat Mapping Study in combination with the Wildlife Habitat Evaluation Study to address potential impacts to wildlife habitats. It is estimated that 120 bird species and 31 mammal species are known or likely to occur in the vicinity of the Bradley Lake Project during one or more life-history stages (see Section 4.5 in Exhibit E of the Draft Amendment Application). The proposed action would include construction of an approximately 1-mile-long, 16-foot-wide road; development of a worker camp, borrow sites, and staging areas; construction of the Dixon Diversion and a diversion tunnel to Bradley Lake; disposal of tunnel muck; and modification of the Bradley Lake Dam to raise the maximum pool elevation. These actions would result in the loss of 163 acres of existing wildlife habitat for birds and mammals from the placement of artificial fill within the proposed Project construction footprint. A total of 37 acres within the construction footprint were previously cleared and disturbed and would be used for construction staging areas. Natural plant recolonization and proposed revegetation efforts at the tunnel muck spoil site at Bradley Lake could result in the rehabilitation of approximately 37 acres of wildlife habitat, which would serve to offset up to 23 percent of the 163 acres of habitat lost during construction.

At Bradley Lake, there would be an additional 229 acres of existing habitats near the lake shoreline that would be altered by seasonal inundation from the proposed 16-foot pool raise. Additionally, the partial diversion of the Dixon Glacier meltwater would seasonally reduce flows in the Martin River, affecting water quality, sediment deposition, and riparian habitat. There would also be temporary behavioral impacts on wildlife from increased noise and human disturbance during construction activities.

The Vegetation and Wildlife Habitat Mapping Study facilitates a quantification of habitat alteration post-construction, stratified by focal species and habitat value in the Wildlife Habitat Evaluation Study (ABR 2026). The wildlife habitat map of current pre-Bradley Lake Expansion Project conditions, combined with the results of the Wildlife Habitat Evaluation Study, will identify suitable habitats for the wildlife species of concern for the Project and define the extent of the suitable habitats each species is likely to use consistently in the study area. Suitable habitats, ranked as high or moderate value for each species, are classified for all life-history stages that occur in the study area. These data will allow a spatially explicit identification of habitats that may benefit from protection, mitigation,

and enhancement (PM&E) measures across a variety of potentially impacted wildlife species.

2.0 GOALS AND OBJECTIVES

The overall goals of the Vegetation and Wildlife Habitat Mapping Study were to prepare baseline maps of the existing and predicted future vegetation and wildlife habitats in those areas of the Bradley Lake Expansion Project that would undergo habitat loss (from the expansion of Bradley Lake and the extraction and placement of fill for Project infrastructure), the disposal of tunnel muck material, and habitat change (from reductions in flow in the Martin River). This mapping information, in conjunction with the categorization of habitat values for wildlife species in the Wildlife Habitat Evaluation Study, was used to assess impacts to wildlife resources from the proposed Bradley Lake Expansion Project. The information from the two studies in 2024 and 2025 is summarized in the FERC license amendment application; this information was used to quantitatively assess habitat loss and habitat alteration effects from the proposed expansion for wildlife species considered of most concern to Bradley Lake Project stakeholders. The results of the two studies were also used to develop any necessary PM&E measures to minimize the impact to wildlife habitats. The information on predicted future wildlife habitats developed in this study was used in conjunction with the results of the Wildlife Habitat Evaluation Study to evaluate how wildlife resources in the area may change in the future because of the proposed Bradley Lake Expansion Project.

The specific objectives of the Vegetation and Wildlife Habitat Mapping Study were as follows:

1. Identify, delineate, and map existing vegetation and wildlife habitat types in the study area in a 250-meter (820-foot) buffer surrounding proposed Project impact areas, Bradley Lake, and the Martin River drainage.
2. Quantify long-term habitat change in the Bradley Lake Expansion Project study area by preparing a wildlife habitat map depicting predicted future habitats based on proposed construction impacts, operational impacts, and ongoing habitat change from climate change and natural plant succession.

Specific products of the study included vegetation and wildlife habitat maps for existing and future conditions and an impact assessment (prepared in the FERC license amendment application) for the suitable habitats for wildlife species of concern.

3.0 STUDY AREA

The study area for the Vegetation and Wildlife Habitat Mapping Study was developed in consultation with the ADF&G and USFWS during March and April 2024 (see Appendix A in ABR 2024). No further additions to the study plan were made during the January 2025 meeting. This report evaluates the areas outside the Martin River and in the Martin River floodplain separately because impacts vary significantly between the two areas.

3.1 Outside Martin River

Outside the Martin River, the study area for fine-scale vegetation and wildlife habitat mapping consists of a 250-meter (820-foot) buffer surrounding the maximum proposed Bradley Lake Pool Elevation, the Bradley Lake Dam and spillway, the proposed access road, material extractions sites, laydown pads, the worker camp, and tunnel muck placement areas (Figure 3.2-1). At the time the mapping buffer was created in 2024, the pool-raise alternative with the largest pool elevation increase (28 feet) was used as the maximum pool elevation. The mapping study area outside the Martin River encompasses a total of 7,600 acres.

In addition, targeted wildlife habitat mapping was conducted within two 2-kilometer (1.2-mile) buffer zones surrounding areas where blasting may be needed during construction, including the proposed Dixon Diversion site in the upper Martin River, the new access road alignment, and the Bradley Lake Dam and associated borrow sites at Bradley Lake (Figure 3.2-1). This was done to assess the presence of suitable habitats for wildlife species that are sensitive to blasting impacts (see ABR 2026). In total, the two targeted wildlife habitat mapping areas for blasting impacts encompass 8,464 acres, though suitable habitats for the disturbance-sensitive wildlife species represent only 6,989 acres in those buffer zones.

3.2 Martin River Floodplain

The Martin River floodplain study area includes a 250-meter (820-foot) buffer surrounding the edges of the active floodplain from the toe of the Dixon Glacier to its confluence with Kachemak Bay and the entire intertidal delta area (Figure 3.2-1). The mapping study area for the Martin River floodplain encompasses 3,580 acres.

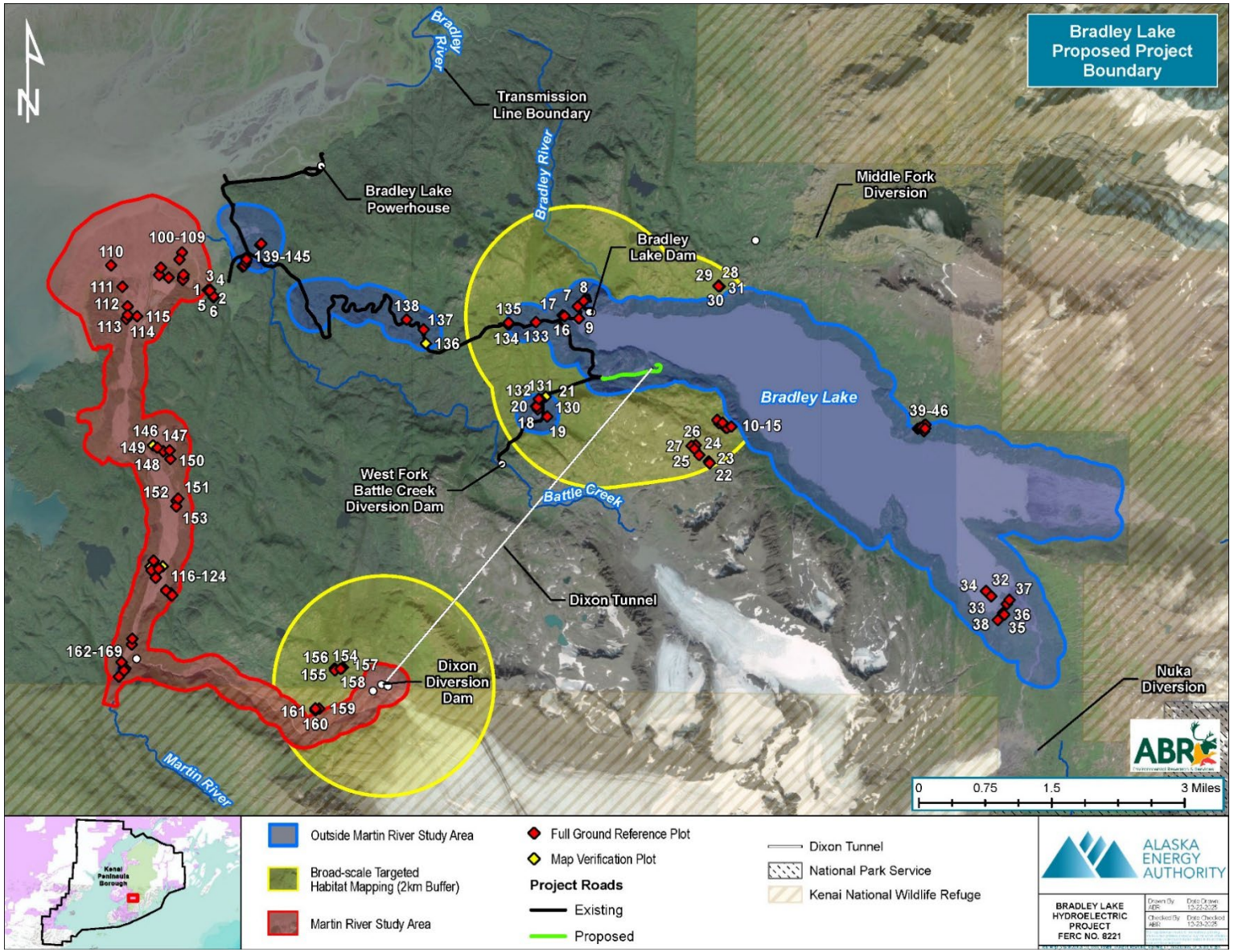

Figure 3.2-1 Vegetation and Wildlife Habitat Mapping Study area boundaries for the Bradley Lake Expansion Project, 2024 and 2025 study areas.

4.0 METHODOLOGY

4.1 Mapping Approach

Wildlife habitats were mapped using a hierarchical methodology based on Integrated Terrain Unit (ITU) mapping methods developed for Ecological Land Surveys conducted in tundra, boreal forest, and coastal regions in Alaska (see Wells et al. 2014 for an example study in Kenai Fjords National Park). The ITU mapping approach involves mapping individual terrain units such as vegetation type, physiography, surface form, and disturbance type combined into composite units. Individual ITU units represent the range of land cover variation in the study area. When deriving wildlife habitats, ITUs are aggregated into broader, ecologically important categories that represent the habitats used by wildlife in the study area. A vegetation map at Level IV of the Alaska Vegetation Classification (AVC; Viereck et al. 1992) and a wildlife habitat map based on the best combination of ITUs will be produced to yield a habitat map that accurately reflects current use by wildlife.

Within the study area, map polygon boundaries were digitized on-screen using ArcGIS software. Polygon boundaries for the ITU variables were determined by photointerpretation of landscape features on a high-resolution (0.5-foot pixel size) aerial orthophoto mosaic acquired for the Project area by NV5 Global, Inc., on behalf of AEA on July 28, 2022.

Interpretation of landscape features and ITU variables was supported by ground reference survey data collected during the 2024 and 2025 summer field seasons. All mapping was conducted at a scale of 1:5,000, and the minimum map polygon size was 0.5 acre. In cases where vegetation types were small or not easily distinguished in aerial photography, the mapping scale was reduced to 1:2,000. In 2024, a preliminary desktop vegetation map was prepared prior to the field studies to guide the selection of the field sample sites, and then the preliminary map was updated after field data collection was complete. In 2025, a preliminary map was prepared prior to the field survey based in part on the vegetation mapping prepared for the Geomorphology and Sediment Transport Study (Watershed GeoDynamics 2025). Both the Martin River and outside the Martin River study areas were updated according to field data in the fall of 2025.

Each map polygon was assigned the following ITU attributes:

1. Vegetation type/land cover class—uses the Level IV AVC described by Viereck et al. (1992) with additions by ABR for vegetation types not described in the AVC and non-vegetated land cover types; AVC Level IV classes are defined by vegetation structure and dominant plant species (e.g., open white spruce forest, closed tall alder shrub, subarctic lowland sedge wet meadow).
2. Physiography class—represents broad, landscape-scale geomorphic features and landscape position (e.g., riverine, lacustrine, lowland, upland, subalpine, alpine).
3. Surface form class—represents finer scale geomorphic features, (e.g., ridge crest, toeslope, kettle basin, point bar); the physiographic classes used were modified from Washburn (1973) and Jorgenson et al. (2003).

To capture low-flow streams that are known to be present but difficult to detect using remote sensing alone, National Hydrography Dataset (NHD) flowlines were reviewed in conjunction with the ITU mapping. Where NHD flowlines indicated a stream was likely to be present, a stream was added to the map. The specific location of these streams was based on features visible in high-resolution imagery and elevation data.

4.2 Derivation of Wildlife Habitats

After the ITU mapping in the study area was complete, a final set of wildlife habitat types was derived from the mapping of physiography, AVC Level IV vegetation and land cover types, and surface forms. In the aggregation process, physiographic location, vegetation structure (e.g., forest, tall scrub, low scrub, dwarf scrub, meadow), dominant plant species, and surface forms were the primary factors assessed when determining combinations of landscape features that would be used similarly by wildlife. In deriving wildlife habitat types, emphasis was placed on those vegetation and landscape features known to be important for wildlife, such as food availability (plant forage species and prey species habitats); nest, brood-rearing, and den site characteristics (surface form and vegetation features); and security, escape, and shelter habitat typically provided by vegetation cover. Dominant plant species as well as species composition were considered when defining scrub habitats in particular. For example, habitats supporting both low or tall willows and alders were treated separately from other shrub-dominated habitats because of the importance of willows for moose browse. Because the wildlife habitat types mapped in this study would be used directly in the Wildlife Habitat Evaluation Study, the study team's goal in the aggregation process was to derive a set of wildlife habitat types that would be meaningful in assessing habitat value for the specific set of bird and mammal species of concern that occur in the Project area, including the list of disturbance-sensitive mammals

and birds identified for the targeted wildlife habitat mapping in the 2-kilometer (1.2-mile) blasting area buffer zones.

4.3 Field Surveys

The 2024 field effort was a brief reconnaissance survey focused on collecting ground reference data for the 2024 study area as well as gathering limited data for the future mapping areas to support potential desktop efforts prior to the 2025 field season. In 2025, additional field data were collected primarily in the Martin River floodplain and the newly added material site and tunnel muck disposal areas. A group of two scientists, accompanied by a bear guard, collected ground reference data on vegetation and wildlife habitats. Two types of survey plots were sampled: full ground reference plots and map verification plots (see below). A typical plot consisted of a roughly circular area with a radius of approximately 30 feet (9 meters), located within relatively homogeneous vegetation. Plot size and shape were modified as needed, based on the spatial extent of the plant community being sampled (e.g., narrower plots were used in estuarine fringe habitats).

Data collected at full ground reference plots included vascular plant species composition and visual areal cover estimates for vascular plants to facilitate the proper classification of vegetation types at AVC Level IV (Viereck et al. 1992). Field determinations of Level IV vegetation classes were also recorded; these field calls were reviewed later in the office and revised when needed based on the recorded plant cover data. Additional data recorded included the percentage of areal cover (visually estimated) of each structural class of vascular plants (trees, saplings, tall shrubs, low shrubs, dwarf shrubs, tall herbs, and low herbs) and nonvascular plants (floating aquatics, aquatic plants, mosses, and lichens). Descriptive soils information, including the depth of surface organic horizons and the dominant mineral soil texture, were recorded. These data were used to assist in defining vegetation and wildlife habitat types and to evaluate the potential value of wildlife habitats for birds and mammals. Site characteristics recorded at each plot included physiography, surface form (Jorgenson et al. 2003; Schick and Davis 2008), and slope and aspect (in degrees). Digital photographs were taken of the vegetation and soils (see below) at each plot, global positioning system (GPS) coordinates were recorded, and any indications of human use (recreational or subsistence use) or wildlife use (e.g., nests, dens, scat, tracks) were also noted.

In addition to the full ground reference plots, map verification plots were sampled at locations selected in the field to help facilitate the vegetation and wildlife habitat mapping efforts. Map verification plots are designed to improve map accuracy while requiring minimal field sampling time. Map verification plots were sampled in habitats that had been previously well documented with full ground reference plots and provided additional replication to confirm the links between photo-signatures and ground data. A limited set of data elements were collected at map verification plots, including cover estimates for the dominant vascular plant species, Level IV vegetation class (Viereck et al. 1992), physiography class, USFWS National Wetlands Inventory wetland type, water regime class, site photos, and GPS coordinates. No soils information was recorded at map verification plots.

All field data were recorded on customized, ABR-prepared applications, running on Android tablet computers. Navigation at the site was aided by ArcGIS Field Maps software (accessed through ArcGIS online), which allowed real-time depictions of plot locations in the field over the same satellite imagery used in the mapping. Upon completion of field work, the data were uploaded to a wetland-specific relational database maintained on ABR servers and were subjected to a set of sequential data quality assurance/quality control procedures to ensure data accuracy before being used to prepare the habitat map.

4.4 Vegetation and Wildlife Habitat Change Detection

To determine future habitats post-construction and predict how wildlife habitats would develop after 60 years of Project operations, measurable natural changes to vegetation community structure (spruce bark beetle [*Dendroctonus rufipennis*] kill and plant succession), direct climate change effects (increased temperatures and precipitation), indirect climate change effects (extreme weather events beyond the long-term climate normals), and the expected Bradley Lake Expansion Project impacts were considered. Information on long-term habitat change at the Eklutna Hydroelectric Project in Southcentral Alaska (Davis et al. 2023) and along the lower Bradley River was also used to predict future habitats in the Bradley Lake Expansion Project area.

Habitat change was measured by comparing the current and post-Project wildlife habitat maps and calculating the area of habitat loss, alteration, or gain for specific habitats and the loss or gain in habitat value based on the habitat-value ranking results from the Wildlife Habitat Evaluation Study. These results can be used to target elements of the

Bradley Lake Expansion Project with the highest impacts on individual species in developing PM&E measures.

5.0 RESULTS

5.1 Outside Martin River

5.1.1 Field Survey

ABR conducted field surveys from July 29 to August 1, 2024, in the areas outside the Martin River, including Bradley Lake, and from July 30 to August 4, 2025, in the Martin River floodplain and outside the Martin River where a worker camp, staging areas, borrow sites, and the tunnel muck placement site are planned.

Over the course of two seasons, a total of 56 full ground reference plots (Appendix A) and four map verification plots (Appendix B) were sampled (Figure 3.2-1). A total of 40 plots were completed within the boundaries of the Bradley Lake study area; 20 plots were completed within the area outside the Martin River within a 2-kilometer (1.2-mile) radius of proposed blasting sites and in areas along the existing access road identified for the worker camp, staging areas, and borrow sites.

5.1.2 Physiography

The areas outside the Martin River span six physiographic types (Table 5.1-1). A seventh type, Alpine physiography, occurs only at higher elevations within the construction blasting buffer zones (see Section 5.3 below). Subalpine physiography occurs above the treeline and is characterized by both low and tall shrub thickets and openings of dwarf scrub, evergreen tree woodland, barren outcrops, and forb-dominated meadows. The subalpine zone encompasses the entire 250-meter (820-foot) buffer zone surrounding Bradley Lake. The upland zone extends from the inland extent of coastal physiography at the shore of Kachemak Bay to the treeline. The terrain is steep, undulating, and well-drained, supporting forest and tall shrub vegetation types. Lacustrine physiographic areas are dominated by lacustrine processes and consist of lakes and ponds and associated areas where the hydrology is largely controlled by the adjacent waterbody. Lacustrine features include Bradley Lake and small ponds along the Battle Creek diversion outlet, which are artificially controlled by the Battle Creek diversion outlet, and naturally occurring small ponds in basins and slope breaks throughout the subalpine and upland physiographic zones. The lowland areas mapped outside of the Martin River are typically concave in topography, poorly drained, and often associated with the smaller lacustrine features. In these settings, the vegetated bog or marsh is supported by the relatively high-water table and surface water fluctuations of the adjacent waterbody. Riverine

physiographic areas include rivers and streams and associated riparian areas that are influenced by riverine processes, the most important of which is overbank flood events. In the area outside the Martin River, riverine physiography includes riparian areas along the glacial freshwater streams flowing into Bradley Lake and the lower reaches of Battle Creek. The coastal zone is defined in this study area as those areas below the mean high higher water mark that are subject to tidal influences. Coastal physiography outside the Martin River is limited to the Battle Creek delta.

Table 5.1-1 Physiography class descriptions and acreages in the Bradley Lake Expansion Project study area outside the Martin River.

Physiography	Description	Area (acres)	Percentage of Study Area (%)
Coastal	Defined as areas in the active intertidal below the mean high higher water mark, subject to the ebb and flow of tides. Includes the Battle Creek delta.	46.9	0.6
Lowland	Low-lying flat areas typically associated with lacustrine features and cut off from active riverine processes. Occurs in small, isolated patches in depressional features or valley bottoms.	4.3	0.1
Lacustrine	Driven by lacustrine processes in which the waterbody is the dominant feature; includes open water, shoreline emergent vegetation zones, and adjacent wetlands where water levels are controlled by the lake. Limited to the active Bradley Lake reservoir and small subalpine lakes.	3,470.4	45.7

Physiography	Description	Area (acres)	Percentage of Study Area (%)
Riverine	More than just a proximal relationship with rivers and streams; riverine communities show evidence of influence by riverine processes, particularly hydrology. Riverine habitat is found along steep narrow freshwater streams, large braided systems at the head of Bradley Lake, and a tidally influenced portion of Battle Creek.	690.9	9.1
Subalpine	Defined by elevation and corresponding lack of trees; tall and low shrubs are typically present; often steeply sloping. All terrain above treeline surrounding Bradley Lake is within the subalpine zone.	2,789.5	36.7
Upland	Steep or undulating terrain, often forested ranging from the treeline at the coast to the treeline of the subalpine zone.	598.1	7.9
Totals		**7,600.1**	**100.0**

5.1.3 Vegetation, Land Cover, and Surface Forms

The 26 vegetation and land cover classes mapped in the study area outside the Martin River and the acreage occupied by each are listed in Table 5.1-2. The 26 classes are comprised of two coniferous forest classes, two mixed forest classes, four tall scrub classes, two low scrub classes, five dwarf shrub classes, two mesic meadow classes, two freshwater wetland meadow classes, two saltwater wetland meadow classes, one mosaic type, two barren or partially vegetated classes, one freshwater land cover type, and one marine water type. Several vegetation types mapped are not described in Viereck et al. (1992) but were developed by ABR for previous studies in Alaska to address additional plant communities that occur in the state (e.g., barren and partially vegetated classes). The complexes vegetation class represents a mosaic of types and was developed for this study specifically to address areas where vegetation and land cover types are too finely intermingled to be accurately mapped at a 1:5,000 scale. Aside from the prevalence of

freshwater land cover types, accounted for by Bradley Lake itself, the study area is strongly dominated by low and tall scrub and barren vegetation types; forest and herbaceous-dominated vegetation is much less prevalent (Table 5.1-2, Figure 5.1-1).

Table 5.1-2 Vegetation and land cover types and acreages in the Bradley Lake Expansion Project study area outside the Martin River.

Vegetation and Land Cover Type	Area (acres)	Percentage of Study Area (%)
Fresh Water	3,424.7	45.1
Marine Water	0.6	<0.1
Halophytic Sedge Marsh	0.7	<0.1
Halophytic Sedge Wet Meadow, saline	24.3	0.3
Halophytic Sedge–Grass Wet Meadow, brackish	21.4	0.3
Subarctic Lowland Sedge Wet Meadow	4.3	0.1
Subarctic Lowland Sedge-Moss Bog Meadow	2.1	<0.1
Mixed Herbs	6.8	0.1
Bluejoint-Shrub	6.6	0.1
Dry Dwarf Shrub	8.1	0.1
Ericaceous Dwarf Shrub Tundra	47.0	0.6
Ericaceous Dwarf Shrub Lichen Tundra	2.1	<0.1
Crowberry Dwarf Shrub Tundra	3.6	<0.1
Mountain-heath Dwarf Shrub Tundra	203.5	2.7
Closed Low Willow	5.0	0.1
Open Low Willow	258.8	3.4
Closed Tall Willow	4.8	0.1
Closed Tall Alder	1,661.8	21.9
Open Tall Alder	339.8	4.5
Open Tall Alder Willow	7.7	0.1
Lutz Spruce Woodland	496.2	6.5
Open Lutz Spruce Forest	112.3	1.5
Closed Black Cottonwood-Lutz Spruce	24.3	0.3
Open Black Cottonwood-Lutz Spruce	30.7	0.4
Complexes	240.6	3.2
Partially Vegetated	35.1	0.5
Barren	627.2	8.3
Totals	**7,600.1**	**100.0**

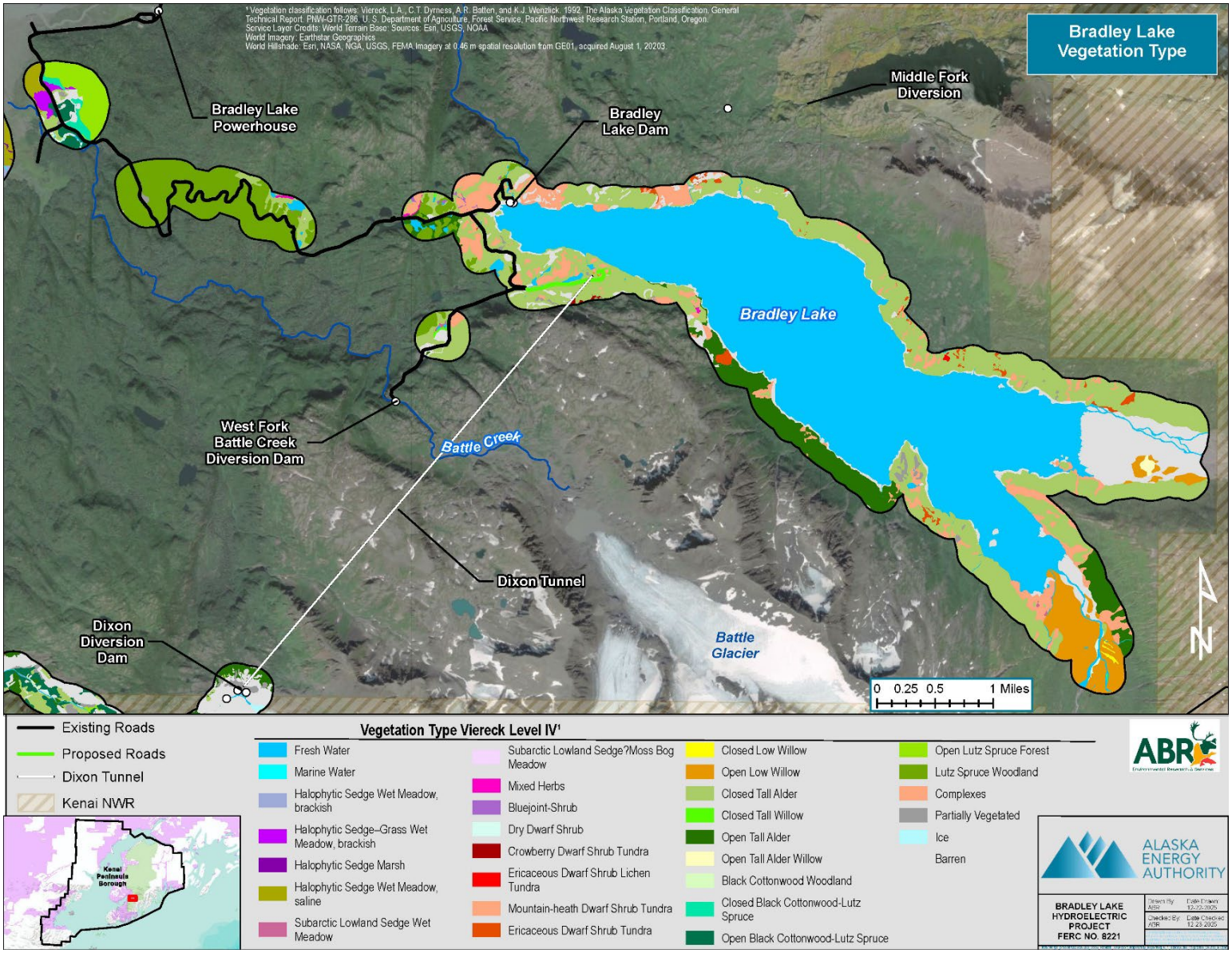

Figure 5.1-1 Vegetation types in the Bradley Lake Expansion Project study area outside the Martin River.

In the mapping process, each vegetation class polygon was assigned a representative geomorphic surface form. A total of 13 surface forms were mapped in the study area: basins or depressions, drainage, fluvial bar, human modified, infrastructure, lake margins, river or stream, variable channel characteristics, undifferentiated slope, steep slope, rocky cliff, undulating terrain, and persistent waterbodies. As described above in Section 4.2, surface forms, along with physiography and land cover type, were used to derive multi-variate wildlife habitat types.

5.1.4 Current Wildlife Habitat Types

Based on the July 2022 aerial photography for the study area, physiography, vegetation and land cover classes, and surface forms were combined and aggregated to develop the final set of 25 wildlife habitat types that were mapped in the study area outside the Martin River (Table 5.1-3, Figure 5.1-2). Detailed descriptions and total acreages for all mapped wildlife habitats are provided in Appendix C.

Except for the extensive coverage of the Human Modified Reservoir habitat (Bradley Lake), Upland and Subalpine Tall Alder Scrub is the most extensive vegetated habitat, covering 1,993.8 acres (Table 5.1-3, Figure 5.1-2). Upland and Subalpine Tall Alder Scrub occurs on steep to moderately sloped hillsides above Bradley Lake (Figure 5.1-2). Soils range from well-drained and rocky to more poorly drained with well-developed organic horizons. The open to closed canopy scrub communities in this type are dominated by tall Sitka alder (*Alnus sinuata*), with red elderberry (*Sambucus racemosa*), salmonberry (*Rubus spectabilis*), and devil's club (*Oplopanax horridus*) typically present. Understory species commonly present include spreading woodfern (*Dryopteris dilatata*) and largeleaf avens (*Geum macrophyllum*).

Table 5.1-3 Wildlife habitat types and acreages in the Bradley Lake Expansion Project study area outside the Martin River.

Wildlife Habitat Type	Area (acres)	Percentage of Study Area (%)
Tidal Gut	0.6	<0.1
Coastal Saline Wet Sedge Marsh	0.7	<0.1
Coastal Saline Wet Sedge Meadow	24.3	0.3
Estuarine Brackish Wet Sedge-Forb Meadow	21.4	0.3
Freshwater Lakes and Ponds	43.7	0.6
Human Modified Reservoir	3,343.8	44.0
Rocky Shore and Cobble Beach	102.5	1.3
Rivers and Streams (High Gradient-High Flow)	4.2	0.1
Rivers and Streams (Low Gradient-High Flow)	28.9	0.4
Rivers and Streams (Mixed Gradient-Low Flow)	4.0	0.1
Riverine Barrens	360.8	4.7
Riverine Dryas Dwarf Shrub	8.1	0.1
Riverine Low and Tall Willow	265.6	3.5
Riverine Mixed Spruce-Black Cottonwood Forest	3.0	<0.1
Riverine Tall Alder	15.6	0.2
Upland and Subalpine Herb Meadow	13.4	0.2
Upland and Subalpine Tall Alder Scrub	1,993.8	26.2
Upland and Subalpine Tall Willow Scrub	3.0	<0.1
Upland and Subalpine Wet Graminoid Moss Bog	6.4	0.1
Upland Mixed Lutz Spruce-Black Cottonwood Forest	660.5	8.7
Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex	240.6	3.2
Subalpine and Alpine Barrens	29.7	0.4
Subalpine and Alpine Dwarf Ericaceous Scrub	256.2	3.4
Rocky Cliffs	83.1	1.1
Artificial Fill	86.2	1.1
Totals	**7,600.1**	**100.0**

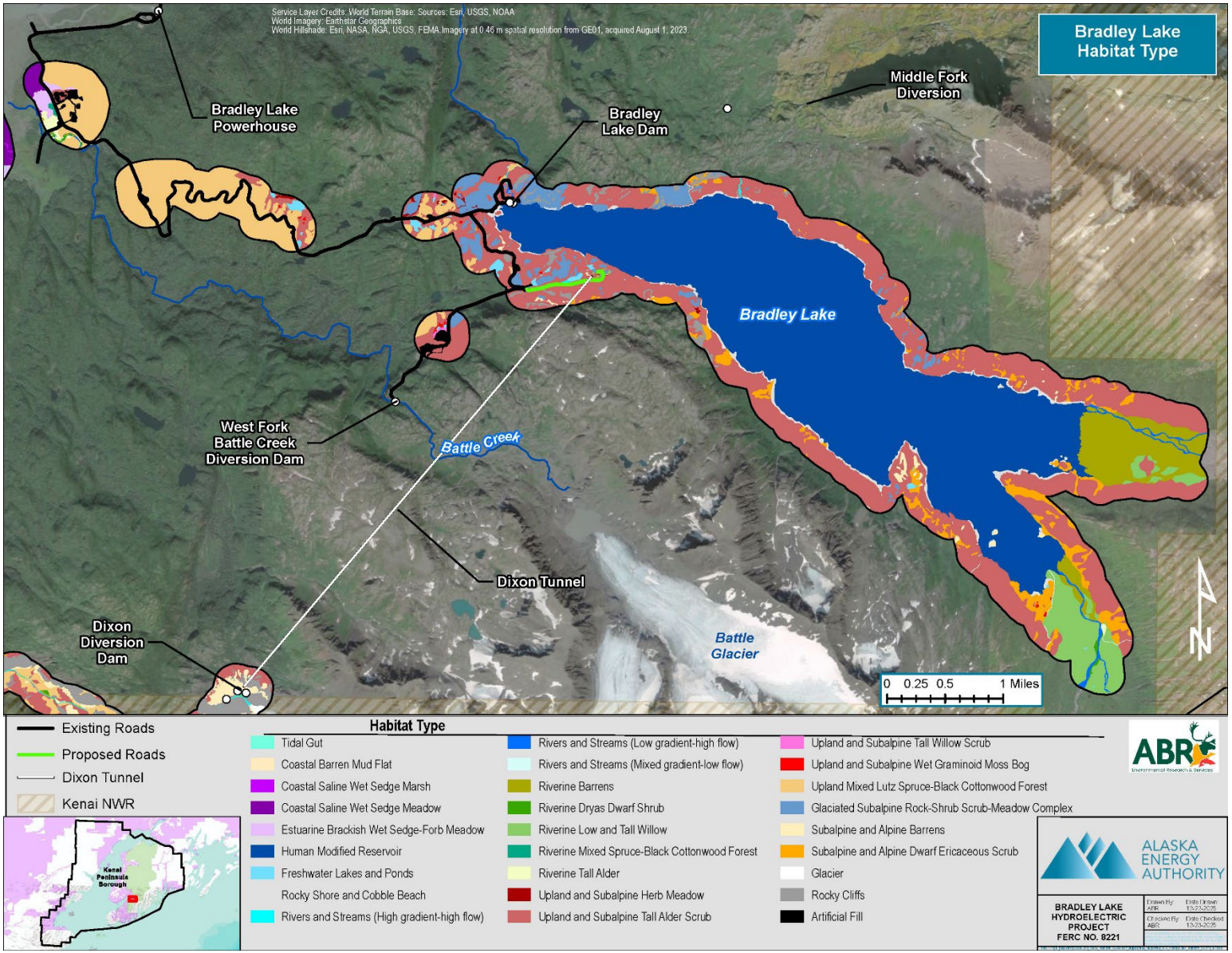

Figure 5.1-2 Wildlife habitat types in the Bradley Lake Expansion Project study area outside the Martin River.

Riverine Low and Tall Willow comprises approximately 265.6 acres and is found primarily on the active floodplain of the lake inlet on the east side of Bradley Lake (Table 5.1-3, Figure 5.1-2). Willow species include diamond leaf willow (*Salix pulchra*), undergreen willow (*Salix commutata*), and feltleaf willow (*Salix alaxensis*), often with a significant graminoid species component of spike bentgrass (*Agrostis exarata*), bluejoint (*Calamagrostis canadensis*), and tufted hairgrass (*Deschampsis cespitosa*). This habitat occurs on the active floodplain, which receives overbank flooding from the adjacent glacial and clearwater streams but may also be influenced by the artificial fluctuations in the level of Bradley Lake. A closely related habitat to Riverine Low and Tall Willow is Riverine Barrens, which comprises approximately 90.1 acres and is limited to the active braided channel systems next to the two glacial-fed inlet streams to Bradley Lake.

The Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex (240.6 acres, Table 5.1-3) is unique to the Bradley Lake area and is a finely intermixed mosaic of vegetation and land cover types occurring on complex undulating glaciated terrain. As described in Appendix C, the complex is comprised of small patches of barren exposed bedrock and colluvium, dwarf shrub tundra, alder and willow scrub, and herb meadow. The small patches of vegetation making up this habitat are too small to accurately delineate at the 1:5,000 mapping scale and would largely fall below the 0.5-acre minimum mapping size. Because the terrain features of this undulating surface form are complex, the Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex was determined to function as an individual wildlife habitat, especially for the large mammal species of concern for the Project.

The Upland and Subalpine Wet Graminoid Moss Bog comprises 6.4 acres and occurs in small discrete patches on the landscape, often well below the minimum mapping size (Table 5.1-3, Figure 5.1-2). Nevertheless, wetlands are not a significant component of the area outside of the Martin River floodplain. These wetlands typically occupy shallow basins or slope breaks along the mountainsides and are often characterized by deep accumulation of organic moss peat. Vascular plant dominants include tufted bullrush (*Trichophorum caespitosum*), russet sedge (*Carex saxatilis*), round sedge (*C. rotundata*), tussock cottongrass (*Eriophorum vaginatum*), alpine bistort (*Polygonum viviparum*), and felwort (*Swertia perenis*). A finely detailed wetland delineation for a smaller study area was prepared in the Wetland Delineation Study (see Kleinschmidt Associates 2024, Attachment 1).

The steep mountainous upland terrain along the existing access road primarily supports Upland Mixed Lutz Spruce-Black Cottonwood Forest encompassing 660.5 acres in the

study area outside of the Martin River. Species composition of all the forest types in the study area has been significantly altered by past and ongoing spruce bark beetle infestations, which have significantly reduced or eliminated mature upper canopy Lutz spruce (*Picea x lutzi*). With the opening of these coniferous forest habitats, understory broadleaf species including black cottonwood (*Populus trichocarpa*) and alder now provide significant cover. Small pockets of open or closed needleleaf forest may remain but in general the upland forest has changed over the last 30 years to primarily mixed forest and tall scrub.

A total of four coastal habitats subject to periodic flooding from saline or brackish water occur at the mouth of Battle Creek in the study area outside of the Martin River. Coastal habitats combined cover 47.0 acres (Table 5.1-3).

5.1.5 Future Wildlife Habitat Types

5.1.5.1 Construction Impacts

In the area outside the Martin River, Project construction impacts include the placement of additional fill at the worker camp at the coast; extraction of gravel at borrow sites; placement of tunnel muck spoils, upon which the new access road, tunnel outlet, and portal channel will be built; and construction to raise the existing Bradley Lake Dam. Existing disturbed areas will be used for construction staging activities and will result in no additional habitat impacts. It is assumed that the roads and facilities would remain in operation and would be unvegetated in 60 years. The tunnel muck disposal area at Bradley Lake will undergo natural colonization and revegetation, and additional PM&E measures (see Section 4.5 in Exhibit E of the Draft Amendment Application) would involve revegetation efforts to facilitate the development of vegetation cover and minimize erosion. It is expected that alder shrubs will readily colonize the ground bedrock and would be aided by Project revegetation efforts. The revegetated habitats, however, may be patchy depending on local microtopography and drainage, and plant species diversity is likely to be low, which will reduce wildlife habitat quality compared to natural shrub habitats lost during construction.

The area of Artificial Fill, encompassing both cleared and disturbed areas and gravel fill, in the study area after construction is depicted in Figure 5.1-3, and the wildlife habitats expected to be impacted by construction activities are listed in Table 5.1-4.

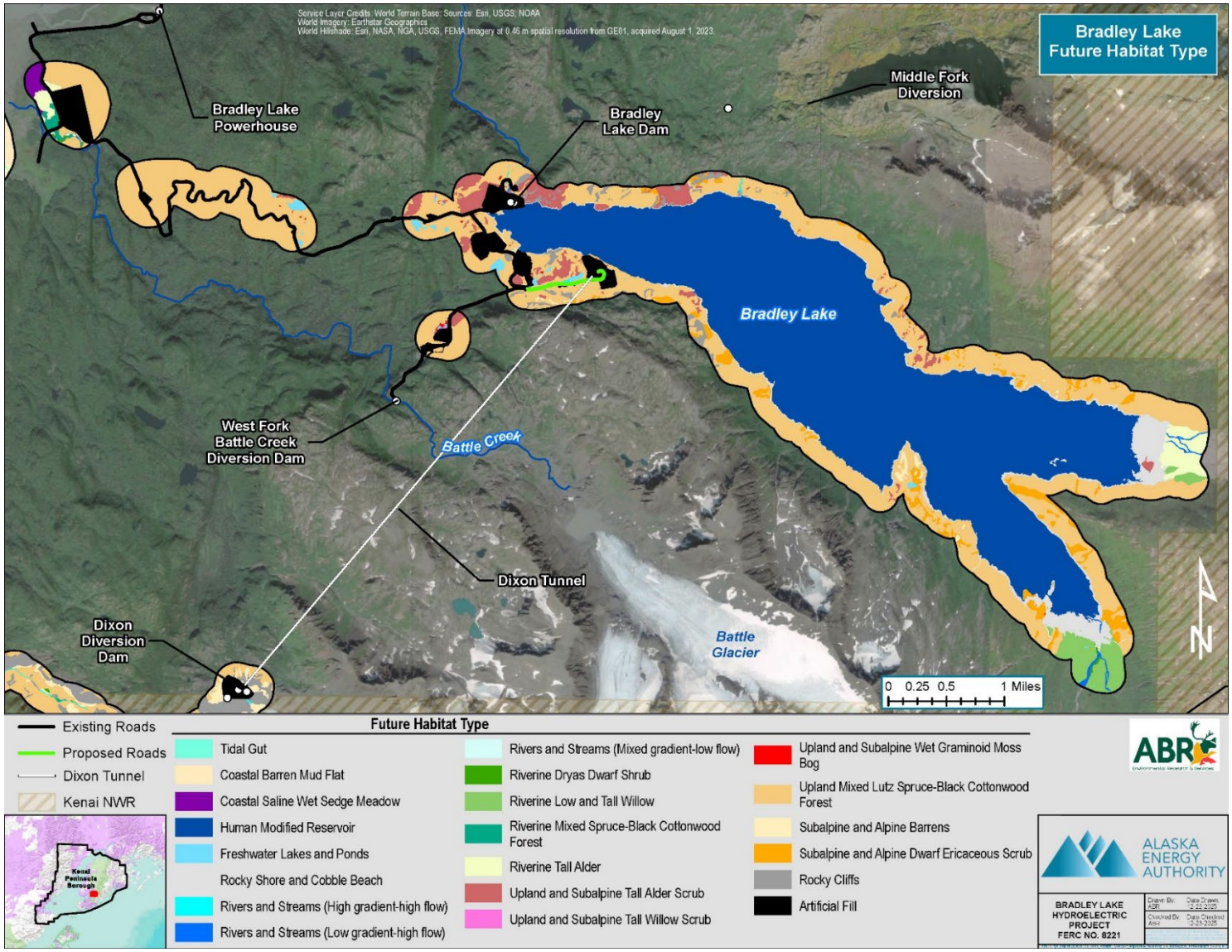

Figure 5.1-3 Future wildlife habitat types in the Bradley Lake Expansion Project study area outside the Martin River.

Table 5.1-4 Wildlife habitat losses within the proposed construction footprint in the Bradley Lake Expansion Project study area outside the Martin River.

Impacted Habitat Type	Area (acres)	Percentage of Total Impact Area (%)
Human Modified Reservoir	5.5	2.7
Freshwater Lakes and Ponds	2.1	1.0
Rocky Shore and Cobble Beach	1.5	0.7
Rivers and Streams (High Gradient-High Flow)	0.4	0.2
Rivers and Streams (Low Gradient-High Flow)	0.6	0.3
Riverine Low and Tall Willow	1.5	0.7
Upland and Subalpine Tall Alder Scrub	72.7	36.3
Upland and Subalpine Tall Willow Scrub	<0.1	<0.1
Upland and Subalpine Wet Graminoid Moss Bog	0.6	0.3
Upland Mixed Lutz Spruce-Black Cottonwood Forest	38.8	19.4
Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex	35.2	17.6
Subalpine and Alpine Barrens	2.2	1.1
Rocky Cliffs	1.9	0.9
Artificial Fill	37.2	18.6
Totals	**200.2**	**100.0**

Development of the lower Battle Creek worker camp and borrow site would result in some permanent habitat losses due to placement of fill and gravel extraction. The majority of these impacts would occur in Upland Mixed Lutz Spruce-Black Cottonwood Forest and Upland and Subalpine Tall Alder Scrub, which are the two most commonly impacted types at lower elevations outside the Martin River (Table 5.1-4). Areas of fill that are abandoned after construction are likely to undergo natural colonization by alder shrubs for some portions of the pad, which may be roughly equivalent to the Upland and Subalpine Tall Alder Scrub habitat. Areas of mature Upland Mixed Lutz Spruce-Black Cottonwood Forest, however, may not return in the 60-year post-construction period. The proposed worker camp and borrow site is along the existing access road adjacent to the Battle Creek estuary, and some secondary impacts to the intertidal zone may occur.

Overall, Artificial Fill outside the Martin River, including both cleared and disturbed areas and gravel fill, currently encompasses 37.2 acres within the proposed construction

footprint; this type would increase to a total of 200.2 acres from the additional 163.0 acres of fill required for Project construction (Table 5.1-4). Considering all areas impacted outside the Martin River, the placement of new gravel fill and tunnel muck would impact several wildlife habitats, particularly Upland and Subalpine Tall Alder Scrub (72.7 acres), Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex (35.2 acres) and Upland Mixed Lutz Spruce-Black Cottonwood Forest (38.8 acres, Table 5.1-4). Natural plant recolonization and revegetation efforts at the tunnel muck spoils area would result in the replacement of some lost wildlife habitat, most likely dominated by alder shrubs as described above. As proposed, the tunnel muck spoils site would encompass 40.6 acres after construction. Subtracting the area for the tunnel outlet access road (approximately 2.3 acres) and the tunnel outlet and portal channel to Bradley Lake (approximately 0.6 acres), which would be permanent features built on tunnel muck spoils, results in approximately 37.7 acres of rehabilitated wildlife habitat that is likely to regenerate on the deposited tunnel muck. As described above, these habitats will likely be of lower quality for wildlife compared to natural shrub habitats and they will also be located adjacent to areas of human disturbance in the tunnel outlet area. Nevertheless, over a 60-year Project operations period, up to 37.7 acres of rehabilitated wildlife habitat could become established in the tunnel outlet area to offset approximately 23 percent of the 163.0 acres of habitat lost during construction.

5.1.5.2 Operations Impacts

Operational impacts outside the Martin River after the construction phase is complete would primarily involve an increase in the maximum pool elevation at Bradley Lake. Based on daily lake level monitoring data from 2020–2025 (which included lower than average Bradley Lake inflows) and the modeling of future lake level changes, the water level fluctuation zone (WLFZ) during future operations could range from as low as El. 1,080 feet to El. 1,090 feet in early spring to near the maximum pool elevation of El. 1,196 feet in the fall (Figure 5.1-4). This indicates the future WLFZ could span up to or greater than 100 feet in elevation. The mapping data from this study—based on aerial photography acquired on July 28, 2022 when the lake level was El. 1,153 feet—indicate that a set of 15 wildlife habitat types currently exist between El. 1,153 feet and the current maximum pool elevation of El. 1,180 feet (Table 5.1-5). This band of habitats, which is known to span an elevational range of 27 feet, may be roughly representative of the upper portions of the future WLFZ that are exposed during the early part of the growing season (Figure 5.1-4). Given this information, the most likely future scenario is that the wildlife habitats, probably in the same locations and proportions that exist now between El. 1,153 feet and El. 1,196

feet (as shown in Table 5.1-5), would persist in the upper regions of the future WLFZ. Because of annual inundation, however, these habitats would likely have reduced plant species diversity and reduced vegetation cover and would be of lower quality for wildlife. In contrast, habitats in the lower regions of the future WLFZ would be inundated for a longer period of time each year and likely would transition to partially vegetated habitats dominated by graminoid species that can better survive inundation or barren cobble and rock. When they are inundated, all habitats in the WLFZ would function as seasonally flooded freshwater lacustrine habitats

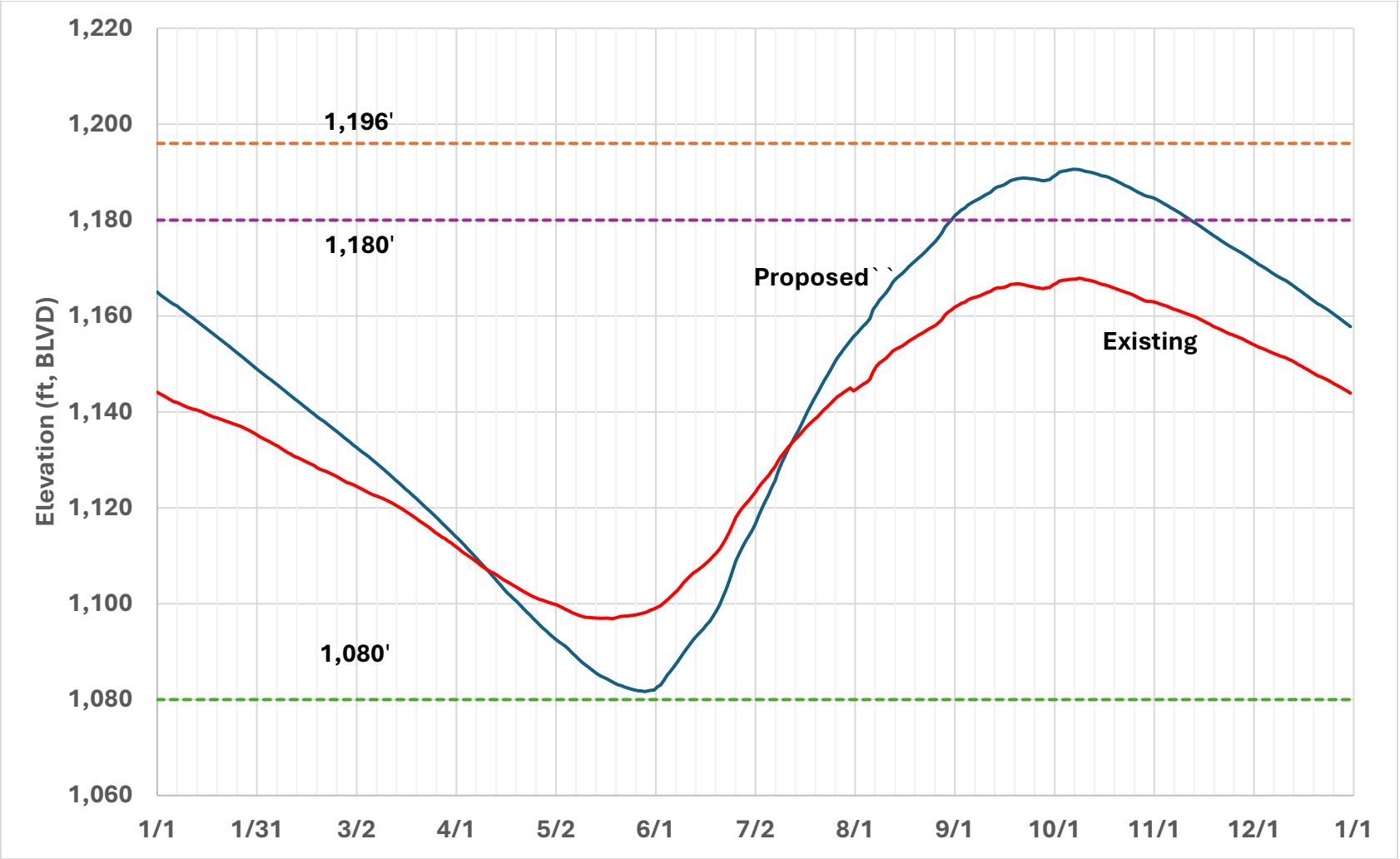

Figure 5.1-4 Average annual water level curves at Bradley Lake for existing conditions (2020–2025 data, red line) and projected conditions for the proposed Project (blue line), relative to current and future maximum pool elevations of El. 1,180 feet and El. 1,196 feet.

Table 5.1-5 Wildlife habitats expected to be altered by lake-level rise that would occur within the future water level fluctuation zone at Bradley Lake.

Affected Habitat Type	Acres in WLFZ, El. 1,153 ft to El. 1,180 ft[a]	Acres in WLFZ, El. 1,180 ft to El. 1,196 ft[b]	Total Acres
Freshwater Lakes and Ponds	0.5	0.0	0.5
Rocky Shore and Cobble Beach	93.8	4.8	98.6
Rivers and Streams (High Gradient-High Flow)	0.1	0.1	0.2
Rivers and Streams (Low Gradient-High Flow)	7.4	5.1	12.5
Rivers and Streams (Mixed Gradient-Low Flow)	1.2	0.4	1.6
Riverine Barrens	211.0	59.8	270.8
Riverine Dryas Dwarf Shrub	0.0	2.0	2.0
Riverine Low and Tall Willow	53.4	65.9	119.3
Riverine Tall Alder	0.0	1.8	1.8
Upland and Subalpine Tall Alder Scrub	43.5	69.9	113.4
Upland and Subalpine Wet Graminoid Moss Bog	0.2	1.2	1.4
Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex	1.0	0.7	1.7
Subalpine and Alpine Barrens	2.7	0.1	2.8
Subalpine and Alpine Dwarf Ericaceous Scrub	36.0	16.2	52.2
Rocky Cliffs	0.1	0.3	0.4
Artificial Fill	0.0	1.0	1.0
Totals	**450.9**	**229.3**	**680.2**

[a] Acres of wildlife habitats present in the existing upper water level fluctuation zone (WLFZ) between El. 1,153 feet—the lake level on the aerial photography acquired on July 28, 2022, and used to map habitats in this study—and the current operational maximum pool elevation of El. 1,180 feet.

[b] Acres of wildlife habitats present in the expected upper WLFZ between the current and future operational maximum pool elevations of El. 1,180 feet and El. 1,196 feet.

The most common habitats that are likely to occur in the future WLFZ are Riverine Barrens, and Riverine Low and Tall Willow at the shallow upper end of Bradley Lake, and Upland and Subalpine Tall Alder Scrub and Rocky Shore and Cobble Beach that occur all around the lake (Table 5.1-5). The unvegetated habitats, Riverine Barrens, Rivers and Streams, and Rocky Shore and Cobble Beach likely would see little reduction in habitat quality from inundation, but the habitat quality of Riverine Low and Tall Willow, Upland and Subalpine Tall Alder Scrub, and the other vegetated habitats along the Bradley Lake shoreline would be reduced due to annual inundation. As noted above, when inundated, these habitats would function as seasonally flooded lake habitats.

5.1.5.3 Project-Induced and Natural Habitat Change

To provide a basis for determining changes in wildlife habitat use over time in the areas outside the Martin River, the extents of future habitats predicted to occur in the study area after a period of 60 years of Project operations were estimated. The estimated future extent of each habitat was based on the known boundaries of the area to be impacted by the Project (the Project footprint), predicted ongoing impacts from Project operations, and expected natural plant successional changes as influenced by climate change. We assume that the current habitats include the full range of successional stages expected in the area in the future and that no new habitats would develop over the 60-year period. A crosswalk between the current habitat types and predicted future habitats and the rationale for the change is presented in Table 5.1-6, and the predicted change in the acreage of wildlife habitats from current to future conditions is presented in Table 5.1-7.

A small portion of the mouth of Battle Creek is included in the outside Martin River study area and is predicted to undergo riparian habitat changes because of the ongoing reduction in flows from the Battle Creek diversion (AEA 2015). Under reduced flows and following natural plant succession processes, some of the Riverine Barrens at the mouth of Battle Creek would transition to Riverine Tall Alder, and some of the existing Riverine Tall Alder would develop into Upland Mixed Lutz Spruce-Black Cottonwood Forest (Table 5.1-6). The Riverine Dryas Dwarf Shrub occurring on very well-drained substrates at the mouth of Battle Creek is expected to remain stable over the 60-year period. In the Eklutna River drainage in southcentral Alaska, the rapid transition of braided river bars to shrub and forest habitats under a dramatically reduced flow regime was documented through retrospective image analysis of vegetation changes in riparian areas over a 63-year period (Davis et al. 2023). This is very similar to the 60-year future projection period used for the Bradley Lake Expansion Project.

Table 5.1-6 Crosswalk and rationale for predicted changes to current habitats after 60 years of Bradley Lake Project operations in the Martin River floodplain and areas outside the Martin River.

Current Habitat	Future Habitat	Rationale for Change
Tidal Gut	Tidal Gut	No change expected
Coastal Barren Mudflat	Coastal Barren Mudflat	Coastal mudflats have remained similar in extent over the last 25 years. The extensive silt input from Martin River and other glacial rivers in upper Kachemak Bay suggest that mudflats are likely to increase in extent with continued receding of glaciers.
Coastal Saline Wet Sedge Marsh	Coastal Barren Mudflat	The saline marsh habitat in the study area occurs in the newly developed Martin River mouth where new alluvium is currently being deposited over the vegetated layers.
Coastal Saline Wet Sedge Meadow	Coastal Barren Mudflat	The saline wet meadow habitat in the study area occurs in the newly developed Martin River mouth where new alluvium is currently being deposited over the vegetated layers.
Estuarine Brackish Wet Sedge-Forb Meadow	Riverine Tall Alder	The estuarine meadow at the highest elevation of the intertidal zone next to the lower Battle Creek, have a significant shrub cover and were assumed to be gradually transitioning to closed alder communities
Human Modified Reservoir	Human Modified Reservoir	The Bradley Lake reservoir will increase in size as a result of the Project construction.
Human Modified Ponds	Rivers and Streams (Low Gradient-High Flow)	This transition was only for the mitigation ponds that were drained by the movement of the Martin River channel.
Lacustrine Freshwater Isolated off-channel pond	Lacustrine Freshwater Isolated Off-channel Pond	Isolated lakes adjacent to the Martin River floodplain are expected to remain cut off.

Current Habitat	Future Habitat	Rationale for Change
Lacustrine Freshwater Tapped off-channel pond	Lacustrine Freshwater Tapped Off-channel Pond	The tapped off-channel ponds are expected to retain the surface water connection to the main channel even under reduced flows during Project operations.
Lacustrine Fringe Fresh Grass-Sedge Marsh		Mapped individually based on the characteristics of the adjacent pond.
Freshwater Lakes and Ponds	Freshwater Lakes and Ponds	Assume little or no change to non-riverine freshwater lakes and ponds under a warming climate with increased precipitation.
Rocky Shore and Cobble Beach	Rocky Shore and Cobble Beach	No change is expected to rocky shores that do not fall within or below the water level fluctuation zone of the Bradley Lake reservoir.
Rivers and Streams (High gradient-high flow)	Rivers and Streams (High Gradient-High Flow)	No change is expected to undisturbed stream reaches throughout the study area.
Rivers and Streams (Low gradient-high flow)	Rivers and Streams (Low Gradient-High Flow)	No change is expected to undisturbed stream reaches throughout the study area.
Rivers and Streams (Mixed gradient-low flow)	Rivers and Streams (Mixed Gradient-Low Flow)	No change is expected to undisturbed stream reaches throughout the study area.
Riverine Barrens	Riverine Tall Alder	Riverine barrens were assumed to transition to tall alder habitat if the Martin River transitions to a single channel, the model likely overestimates the development of alder communities.
Riverine Active Braided Floodplain	Rivers and Streams (Low Gradient-High Flow)	Assume that the Martin River floodplain will trend from a braided system to a single channel system, a possible channel location was digitized based on the current location of the main channel.

Current Habitat	Future Habitat	Rationale for Change
Riverine Mature Black Cottonwood Forest	Riverine Mature Black Cottonwood Forest	Mature black cottonwood forest is the climax community in the Martin River delta and was assumed to remain with little change in the future.
Riverine Dryas Dwarf Shrub	Riverine Dryas Dwarf Shrub	Riverine dryas habitat develops on the oldest and poorest drained surfaces in areas where the braided channel transitions to a single channel. Organics take a long time to develop in arid conditions, and Riverine Dryas Dwarf Shrub was considered a climax community in these areas.
Riverine Flooded Black Cottonwood Scrub	Riverine Tall Alder	Recently flooded areas of black cottonwood scrub were assumed to transition to riverine tall alder over time, with the assumption that these areas are younger surfaces with new fine material deposited to support early successional shrub growth.
Riverine Low and Tall Willow	Riverine Low and Tall Willow	Riverine willow habitat occurs most typically at higher elevations in the study area next to clearwater streams or in small, isolated drainages; no change is expected.
Riverine Mixed Spruce-Black Cottonwood Forest	Riverine Mixed Spruce-Black Cottonwood Forest	Riverine mixed stands occupy the oldest riparian surfaces and are expected to continue to mature but remain mixed forest.
Riverine Tall Alder	Riverine Mixed Spruce-Black Cottonwood Forest	Riverine tall alder stands are expected to continue toward younger aged stands of spruce and poplar mixed forest.
Upland and Subalpine Herb Meadow	Upland and Subalpine Tall Alder Scrub	Subalpine herb meadows are moist communities with well-developed organic layers that are likely to develop shrub habitat under a warming climate.
Upland and Subalpine Tall Alder Scrub	Upland Mixed Lutz Spruce-Black Cottonwood Forest	Upland tall alder communities will likely trend toward a more mature mixed forest as young spruce in the understory mature and subalpine alder communities may

Current Habitat	Future Habitat	Rationale for Change
		transition to mixed forest or woodland communities under a warming climate.
Upland and Subalpine Tall Willow Scrub	Upland and Subalpine Tall Willow Scrub	Willow habitat occurs most typically at higher elevations in the study area in small, isolated drainages or associated wetlands; no change is expected.
Upland and Subalpine Wet Graminoid Moss Bog	Upland and Subalpine Wet Graminoid Moss Bog	Assume no change to the extent of moss bog habitat under a warming climate with increased precipitation.
Upland Mixed Lutz Spruce-Black Cottonwood Forest	Upland Mixed Lutz Spruce-Black Cottonwood Forest	Existing mixed forest habitat is expected to mature over time, trending toward more needleleaf tree cover, but it is not expected to transition to needleleaf forests.
Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex	Upland and Subalpine Tall Alder Scrub	With climate change and natural succession, the complex habitats are likely to trend toward increased shrub habitats.
Subalpine and Alpine Barrens	Subalpine and Alpine Barrens	The substrate of subalpine barren habitat is primarily excessively well drained bedrock or colluvium that is not likely to transition to supporting vegetation.
Subalpine and Alpine Dwarf Ericaceous Scrub	Subalpine and Alpine Dwarf Ericaceous Scrub	Ericaceous shrub habitat at high elevations is likely relatively stable habitat.
Glacier	Subalpine and Alpine Barrens	If the glacier recession rate observed over the past 25 years remains constant, the glaciated areas in the study area will be exposed bedrock and till in the future.
Rocky Cliffs	Rocky Cliffs	No change is expected to known cliff habitat in the area except for those cliffs that are within the water level fluctuation zone of the Bradley Lake reservoir.
Artificial Fill	Artificial Fill	Existing fill and facilities will remain in use.

Table 5.1-7 Predicted wildlife habitat gains and losses due to climate change and natural plant succession in the Bradley Lake Expansion Project study area outside the Martin River.

Habitat Type	Current Area (acres)	Future Area (acres)	Gains/ Losses (acres)
Tidal Gut	0.4	0.4	0.0
Coastal Saline Wet Sedge Marsh	0.7	0.0	-0.7
Coastal Saline Wet Sedge Meadow	24.3	24.3	0.0
Estuarine Brackish Wet Sedge-Forb Meadow	20.2	0.0	-20.2
Freshwater Lakes and Ponds	41.1	41.1	0.0
Rocky Shore and Cobble Beach	2.7	2.8	0.2
Rivers and Streams (High Gradient-High Flow)	3.7	3.7	0.0
Rivers and Streams (Low Gradient-High Flow)	15.8	15.8	0.0
Rivers and Streams (Mixed Gradient-Low Flow)	2.5	2.5	0.0
Riverine Barrens	90.1	0.0	-90.1
Riverine Dryas Dwarf Shrub	6.1	6.1	0.0
Riverine Low and Tall Willow	144.8	144.7	-0.1
Riverine Mixed Spruce-Black Cottonwood Forest	3.0	16.7	13.7
Riverine Tall Alder	13.7	110.2	96.5
Upland and Subalpine Herb Meadow	13.4	0.0	-13.4
Upland and Subalpine Tall Alder Scrub	1,806.7	222.3	-1,584.5
Upland and Subalpine Tall Willow Scrub	1.3	1.3	0.0
Upland and Subalpine Wet Graminoid Moss Bog	4.3	4.3	0.0
Upland Mixed Lutz Spruce-Black Cottonwood Forest	619.0	2,420.6	1,801.6
Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex	203.7	0.0	-203.7
Subalpine and Alpine Barrens	24.7	24.7	0.0
Subalpine and Alpine Dwarf Ericaceous Scrub	203.9	203.9	0.0
Rocky Cliffs	80.9	80.9	0.0
Artificial Fill	46.0	46.0	0.0
Totals	**3,373.1**	**3,373.1**	

Note: Does not include habitats expected to occur in the construction footprint or altered in the future water level fluctuation zone at Bradley Lake.

Spruce bark beetle infestations on the Kenai Peninsula between 1987 and 2000 have caused significant mortality to upper canopy mature Lutz spruce in the study area outside the Martin River floodplain (Boucher and Mead 2006; Boggs et al. 2008). Based on field observation in the study area, the overall mortality of supra-canopy trees is near 100

percent, with significant recruitment of lower canopy spruce saplings and young trees that are often below a closed canopy of broadleaf trees and shrubs. Within the Kenai Borough, bark beetle populations are estimated to be at near endemic levels since at least 2023 (University of Alaska Fairbanks 2018). The vegetation map prepared in the early 1980s for the 1986 Bradley Lake Transmission Line Assessment (i.e., prior to the heavy spruce tree mortality from the spruce bark beetle infestation) indicates that most of the Project area mapped as Upland Mixed Lutz Spruce-Black Cottonwood Forest currently was open to closed needleleaf forest in the 1980s (Stone & Webster Engineering Corporation 1986). Assuming no further major bark beetle outbreaks, it was assumed that much of the existing Upland and Subalpine Tall Alder Scrub would continue to recruit spruce trees and transition to Upland Mixed Lutz Spruce-Black Cottonwood Forest in 60 years.

Changes in climate trends on the Kenai Peninsula over the next 60 years are projected to trend toward warmer temperatures and increased precipitation, which may result in the treeline moving to a higher elevation. It was assumed that the Glaciated Subalpine Rock-Shrub-Meadow Complex, except for areas of bare rock, and the Upland and Subalpine Tall Alder Scrub habitat surrounding Bradley Lake would gradually transition toward a mixed forest woodland habitat, which is included in the Upland Mixed Lutz Spruce-Black Cottonwood Forest type. Under this scenario, the study area below treeline would undergo a substantial shift from a tall-scrub dominated system to a forested system. For example, under the projected future conditions, the mixed forest type currently encompasses 619.0 acres and increases in 60 years to 2,420.6 acres while the Upland and Subalpine Tall Alder Scrub type decreases from 1,806.7 to 222.3 acres (Table 5.1-7).

5.2 Martin River Floodplain

5.2.1 Field Survey

The Martin River field survey was conducted in 2025. A total of 43 full ground reference plots (Appendix A) and six map verification plots (Appendix B) were sampled (Figure 3.2-1).

5.2.2 Physiography

The Martin River floodplain spans five physiographic types (Table 5.2-1). Subalpine physiography occurs above the treeline and is characterized by both low and tall shrub thickets and openings of dwarf scrub, barren rock outcrops, and barren colluvium. The subalpine zone is limited to the area immediately surrounding the terminus of the Dixon Glacier. The upland zone extends from the inland extent of coastal physiography at the

Kachemak Bay shore to the treeline, but excludes the active floodplain of the Martin River, which is riverine physiography. The terrain in the uplands is steep, undulating, and well-drained, supporting forest and tall shrub vegetation. Lacustrine physiographic areas are dominated by lacustrine processes (lakes and ponds and associated areas where the hydrology is largely controlled by the adjacent waterbody). Lacustrine features include Red Lake, Swan Lake, and several isolated and tapped off-channel ponds downstream of Red Lake in the Martin River floodplain. Riverine physiographic areas include the active floodplain of the Martin River and some smaller tributaries to the Martin River. All riverine areas include rivers and streams and associated riparian areas that are influenced by riverine processes, the most important of which are overbank flooding and sediment deposition. Coastal physiography occurs at the mouth of the Martin River below the mean higher high water mark and is subject to the ebb and flow of the tide.

5.2.3 Vegetation, Land Cover, and Surface Forms

The 22 vegetation and land cover classes mapped in the Martin River floodplain and the acreage occupied by each are listed in Table 5.2-2. The 22 classes are comprised of two coniferous forest classes, two mixed forest classes, one broadleaf tree class, three tall scrub classes, two dwarf shrub classes, two mesic meadow classes, one freshwater wetland meadow class, three saltwater wetland meadow classes, three barren or partially vegetated classes, one freshwater land cover type, and one marine water type. Several vegetation types mapped are not described in Viereck et al. (1992) but were developed by ABR for previous studies in Alaska to address additional plant communities that occur in the state (e.g., barren and partially vegetated classes). A total of 1,392.4 acres (38.9 percent) of the study area is encompassed by barrens, which includes riverine barrens, mudflats, and exposed bedrock. Open Black Cottonwood-Lutz Spruce Forest encompasses 707.1 acres (19.8 percent) of the study area and typically occurs on steep upland banks at the edge of the active riverine areas. Other relatively common vegetation types include Open Lutz Spruce Forest at 295.7 acres (8.3 percent) and tall alder communities, which collectively account for 413 acres (11.5 percent) of the study area and occur on the active river floodplain and on the surrounding upland slopes (Table 5.2-2, Figure 5.2-1).

Table 5.2-1 Physiography class descriptions and acreages in the Bradley Lake Expansion Project study area within the Martin River floodplain.

Physiography	Description	Area (acres)	Percentage of Study Area (%)
Coastal	Defined as areas in the active intertidal below the mean higher high water mark, subject to the ebb and flow of tides. Includes the Battle Creek delta.	860.8	24.0
Lacustrine	Driven by lacustrine processes in which the waterbody is the dominant feature; includes open water, shoreline emergent vegetation zones, and adjacent wetlands where water levels are controlled by the lake. Limited to tapped and isolated freshwater lakes off the main channel of the Martin River.	38.4	1.1
Riverine	More than just a proximal relationship with rivers and streams; riverine communities show evidence of influence by riverine processes, particularly hydrology. In the Martin Rier floodplain study area, most riverine physiography is the active braided glacial river floodplain with limited habitat associated with smaller tributaries to the Martin River.	1,196.0	33.4
Subalpine	Defined by elevation and corresponding lack of trees; tall and low shrubs are typically present; often steeply sloping. All terrain above the treeline surrounding the terminus of the Dixon Glacier is within the subalpine zone.	532.0	14.9
Upland	Steep or undulating terrain, often forested ranging from the treeline at the coast to the treeline of the subalpine zone.	952.4	26.6
Totals		**3,579.6**	**100.0**

Table 5.2-2 Vegetation and land cover types and acreages in the Bradley Lake Expansion Project study area within the Martin River floodplain.

Vegetation and Land Cover Type	Area (acres)	Percentage of Study Area (%)
Fresh Water	134.0	3.7
Marine Water	19.5	0.5
Halophytic Sedge Marsh	2.5	0.1
Halophytic Sedge Wet Meadow, saline	83.1	2.3
Halophytic Sedge Wet Meadow, brackish	43.9	1.2
Subarctic Lowland Sedge-Moss Bog Meadow	0.3	<0.1
Mixed Herbs	1.0	<0.1
Bluejoint-Herb	47.2	1.3
Dry Dwarf Shrub	99.3	2.8
Crowberry Dwarf Shrub Tundra	0.3	<0.1
Closed Tall Alder	195.0	5.4
Open Tall Alder	218.0	6.1
Open Tall Scrub, post burn or disturbance	150.0	4.2
Black Cottonwood Woodland	5.8	0.2
Closed Black Cottonwood-Lutz Spruce	94.3	2.6
Open Black Cottonwood-Lutz Spruce	707.1	19.8
Open Lutz Spruce Forest	295.7	8.3
Lutz Spruce Woodland	21.5	0.6
Partially Vegetated	64.6	1.8
Ice	4.2	0.1
Barren	1,392.4	38.9
Totals	**3,579.6**	**100.0**

5.2.4 Current Wildlife Habitat Types

As described above, physiography, land cover classes, and surface forms were combined and aggregated to develop the final set of 29 wildlife habitat types that were mapped in the study area in the Martin River floodplain based on the current imagery (Table 5.2-3, Figure 5.2-2, and Appendix C).

Collectively, riverine wildlife habitats encompass 1,108.0 acres of the Martin River floodplain study area (Table 5.2-3). Riverine wildlife habitats include open stream waters (channelized portions of the Martin River and smaller off-channel tributaries), Riverine Barrens, Riverine Active Braided Floodplain, Riverine Dryas Dwarf Shrub, Riverine Tall Alder, Riverine Flooded Black Cottonwood Scrub, Riverine Mature Black Cottonwood Forest, and Riverine Mixed Spruce-Black Cottonwood Forest. These wildlife habitats represent seral stages along several successional pathways unique to the Martin River floodplain. Riverine Mature Black Cottonwood Forest is a climax community that is most common near the coast on the oldest inactive floodplain surfaces. It typically consists of a closed canopy of large mature black cottonwood with an open understory of tall shrubs and devil's club. Riverine Mixed Spruce-Black Cottonwood Forest also occupies older inactive riverine surfaces, typically at the edge of the floodplain adjacent to the steep upland terrain. Mixed forest communities consist of closed canopies of Lutz spruce and black cottonwood with typically very sparse understories. The organic layer is well developed, composed of leaf-litter peat. Riverine Tall Alder is the seral stage preceding the transition to mixed forest. Riverine Tall Alder may occur in dense large stands on the edges of the floodplain or in smaller isolated patches on older surfaces of inactive braided plains. Riverine Tall Alder may also include scattered individuals of Lutz Spruce and a poorly developed understory. The individual spruce trees aged during the 2025 field survey in typical Riverine Tall Alder stands were roughly 30 to 35 years old. Riverine Dryas Dwarf Shrub was considered a relatively stable seral stage that likely persists for many years due to the xeric, extremely well-drained substrates typical of the type. Riverine Dryas Dwarf Shrub is characterized by thick mats of Drummond's mountain avens (*Dryas drummondii*) and some forbs including field locoweed (*Oxytropis campestris*) and beach pea (*Lathyrus japonicus*). On the Martin River floodplain in particular, the braided river channel overflows its banks regularly, creating disturbed off-channel habitats such as Riverine Flooded Black Cottonwood Scrub (Figure 5.2-2), which is characterized by deep sediment deposits, mortality of existing vegetation, and regrowth of shrubs and young tree species (Appendix C).

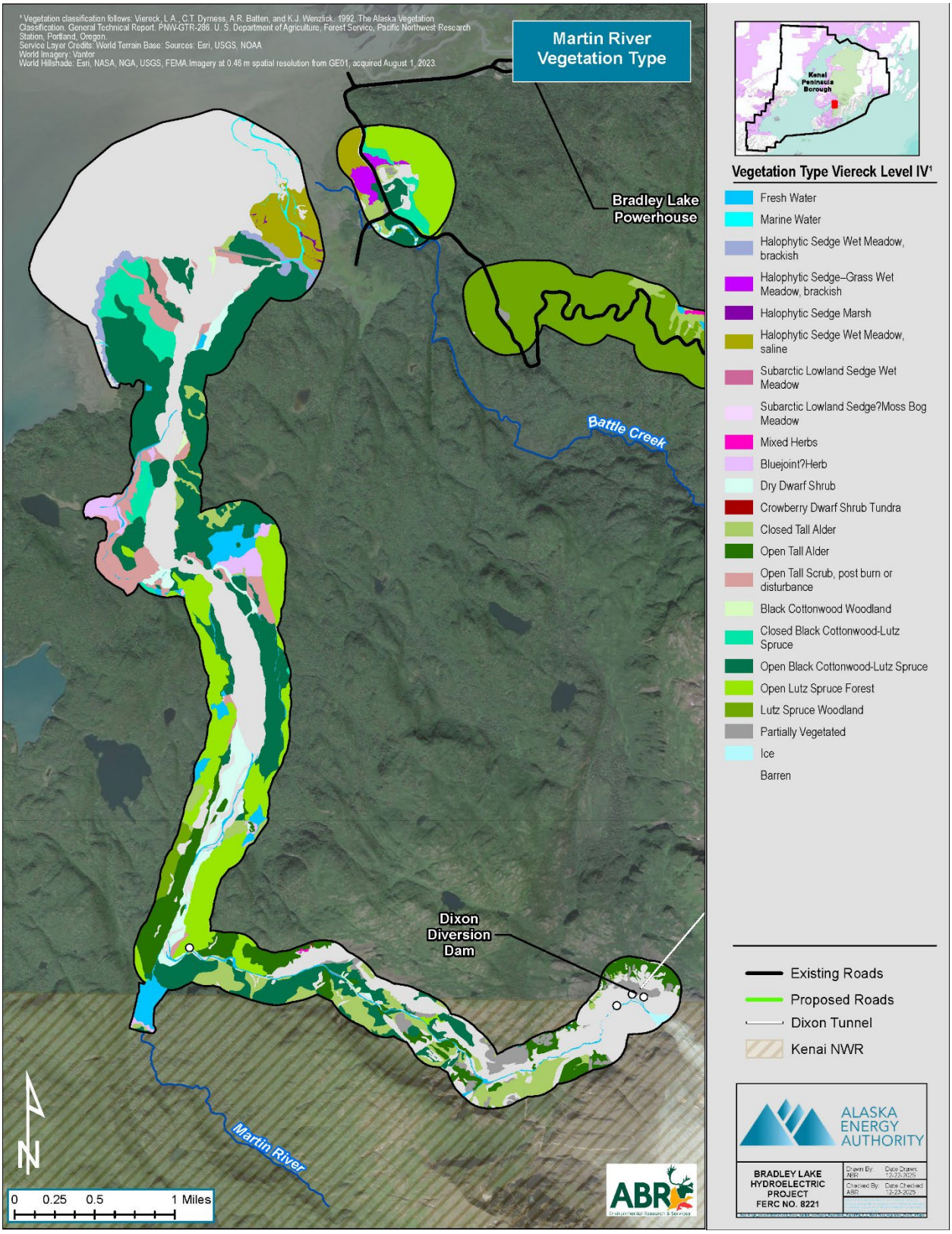

Figure 5.2-1 Vegetation types in the Bradley Lake Expansion Project study area in the Martin River floodplain.

Table 5.2-3 Wildlife habitat types and acreages in the Bradley Lake Expansion Project study area in the Martin River floodplain.

Wildlife Habitat Type	Area (acres)	Percentage of Study Area (%)
Tidal Gut	19.5	0.5
Coastal Barren Mudflat	711.8	19.9
Coastal Saline Wet Sedge Marsh	2.5	0.1
Coastal Saline Wet Sedge Meadow	83.1	2.3
Estuarine Brackish Wet Sedge-Forb Meadow	43.9	1.2
Human Modified Ponds	2.8	0.1
Lacustrine Freshwater Isolated off-channel pond	12.8	0.4
Lacustrine Freshwater Tapped off-channel pond	33.2	0.9
Lacustrine Fringe Fresh Grass-Sedge Marsh	47.2	1.3
Freshwater Lakes and Ponds	30.6	0.9
Rivers and Streams (High gradient-high flow)	24.5	0.7
Rivers and Streams (Low gradient-high flow)	17.8	0.5
Rivers and Streams (Mixed gradient-low flow)	12.3	0.3
Riverine Barrens	34.4	1.0
Riverine Active Braided Floodplain	373.9	10.4
Riverine Dryas Dwarf Shrub	99.3	2.8
Riverine Tall Alder	26.8	0.7
Riverine Flooded Black Cottonwood Scrub	150.0	4.2
Riverine Mature Black Cottonwood Forest	4.3	0.1
Riverine Mixed Spruce-Black Cottonwood Forest	364.7	10.2
Upland and Subalpine Herb Meadow	1.0	<0.1
Upland and Subalpine Wet Graminoid Moss Bog	0.3	<0.1
Upland and Subalpine Tall Alder Scrub	386.2	10.8
Upland Mixed Lutz Spruce-Black Cottonwood Forest	755.3	21.1
Subalpine and Alpine Barrens	99.8	2.8
Subalpine and Alpine Dwarf Ericaceous Scrub	0.3	<0.1
Glacier	4.2	0.1
Rocky Cliffs	234.3	6.5
Artificial Fill	2.8	0.1
Total	**3,579.6**	**100.0**

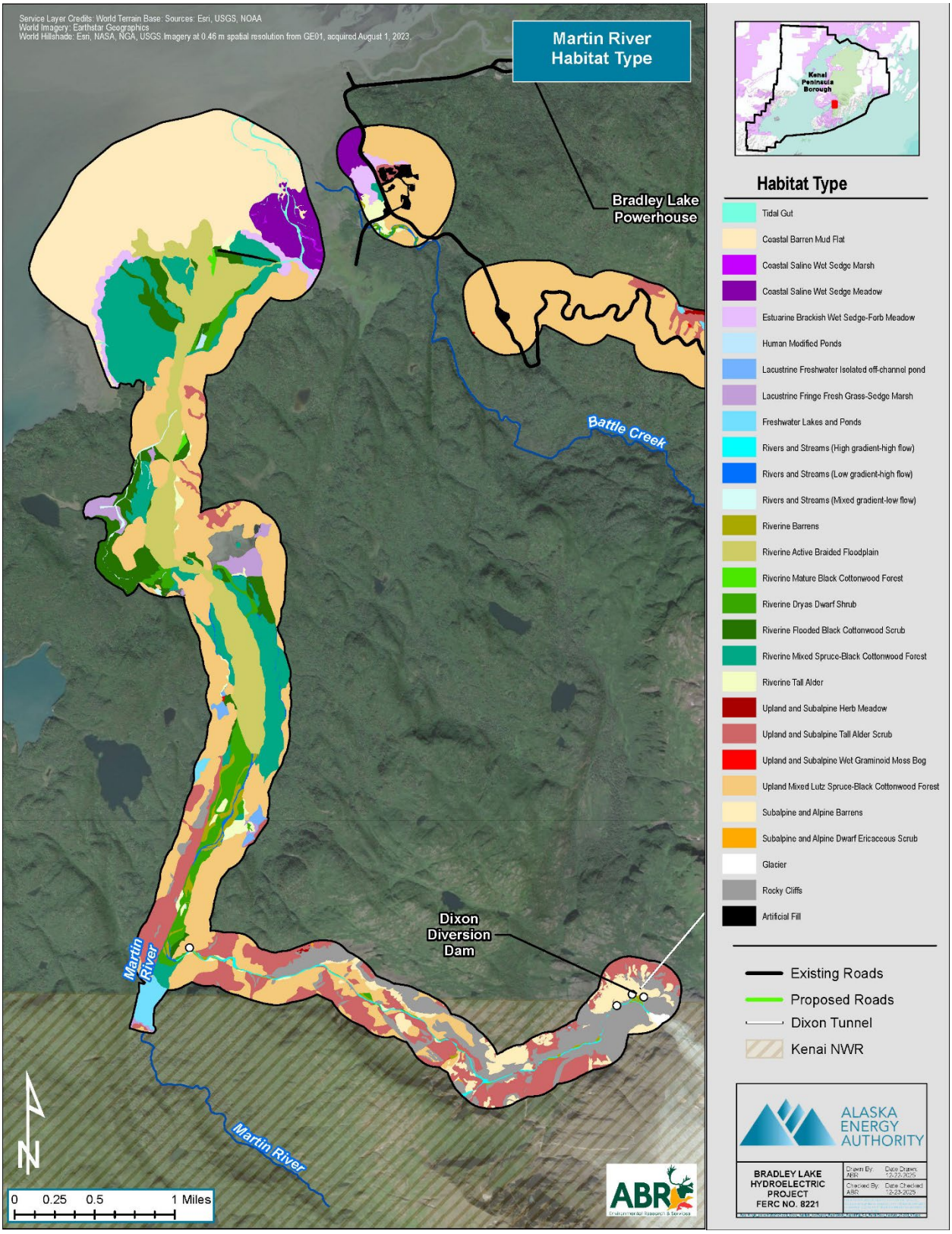

Figure 5.2-2 Wildlife habitat types in the Bradley Lake Expansion Project study area in the Martin River floodplain.

There are five lacustrine wildlife habitats encompassing 126.6 acres in the Martin River floodplain study area including Human Modified Ponds, Lacustrine Freshwater Isolated Off-channel Ponds, Lacustrine Freshwater Tapped Off-channel Ponds, Lacustrine Fringe, Fresh Grass-Sedge Marsh, and Freshwater Lakes and Ponds (Table 5.2-3). There is one mitigation pond that remains after the levee breach at the mouth of the river in 2023; it is an unvegetated pond developed in an abandoned material site adjacent to the airstrip (Figure 5.2-2). Freshwater Lakes and Ponds occur in depressional features in the upland and subalpine areas above the Martin River canyon. One Lacustrine Freshwater Isolated Off-channel Pond is located just south of Red Lake as described in the *Geomorphology and Sediment Transport Study Report* (Watershed GeoDynamics 2025). This pond no longer has a direct surface water connection to the main channel and supports rooted and floating aquatic vegetation and is surrounded by a productive lacustrine marsh habitat (Lacustrine Fringe Fresh Grass-Sedge Marsh). Lacustrine Fringe Fresh Grass-Sedge Marsh habitat is characterized by a thick cover of graminoids including bluejoint grass (*Calamagrostis canadensis*), field horsetail (*Equisetum arvense*), water sedge (*Carex aquatilis*), Lyngbye's sedge (*Carex lyngbyei*) and three flowered rush (*Juncus triglumis*). The organic layer is relatively poorly developed, and many of these marshes have standing dead tall shrub or tree species throughout. Red Lake and Swan Lake are both mapped as Lacustrine Freshwater Tapped Off-channel Ponds because both waterbodies have a continuous surface water connection to the Martin River, and both receive floodwaters frequently during flood events. Red Lake occurs in a broad depressional area along the East Fork Martin River, whereas Swan Lake is an impoundment of trapped floodwaters.

The Martin River delta includes four saline habitats (Tidal Gut, Coastal Barren Mudflat, Coastal Saline Wet Sedge Marsh, and Coastal Saline Wet Sedge Meadow) and one brackish estuarine type (Estuarine Brackish Wet Sedge-Forb Meadow, Table 5.2-3). Together the five marine-influenced wildlife habitats encompass 860.8 acres, the majority of which is Coastal Barren Mudflat (711.8 acres). Coastal Saline Wet Sedge Marsh is the least common saline type, typically concentrated around the edges of tidal guts with often pure stands of robust Lyngbye's sedge. This type is likely flooded by marine water at every tide. Coastal Saline Wet Sedge Meadow has sparse cover of Lyngbye's sedge, Pacific silverweed (*Argentina egedii*), seaside arrowgrass (*Triglochin maritima*), and sea plantain (*Plantago maritima*). The substrate is marine silts and is flooded at every tide. Estuarine Brackish Wet Sedge-Forb Meadow is the most diverse salt-affected wildlife habitat occurring near or above the mean higher high water mark. It includes various salt-tolerant graminoids and forbs such as bluejoint, seaside arrowgrass, field horsetail, large leaved

lupine (*Lupinus polyphyllus*), and large flower speargrass (*Poa eminens*). Low to tall deciduous shrubs are also present (Appendix C).

Upland and subalpine wildlife habitats occur on the canyon walls and hillsides surrounding the upper canyon of the Martin River, encompassing 1,242.9 acres across six wildlife habitats. The most common type within the upland and subalpine physiography is Upland Mixed Lutz Spruce-Black Cottonwood Forest encompassing 755.3 acres. Soils in this type are typically well-drained silt loams with well-developed organic horizons composed of decomposed leaf litter. The mature tree canopy, composed of Lutz spruce, black cottonwood, and Alaska paper birch (*Betula neoalaskana*), ranges from open to woodland, and a robust tall shrub understory is often present. The understory in this type is dominated by tall Sitka alder, with red elderberry, salmonberry, devil's club, spreading woodfern, and largeleaf avens. Upland and Subalpine Tall Alder Scrub is also common, covering 386.2 acres, and is typically found on steep slopes or narrow drainageways and depressions. The shrub canopy is closed and composed primarily of Sitka alder with a sparse understory with scattered forbs. The remaining habitats in the upland and subalpine zones include Upland and Subalpine Herb Meadow, Upland and Subalpine Wet Graminoid Moss Bog, Subalpine and Alpine Barrens, and Subalpine and Alpine Dwarf Ericaceous Scrub, which often occur in smaller isolated patches.

The remaining three wildlife habitats include Glacier (terminus of the Dixon Glacier), Rocky Cliffs, and Artificial Fill, covering 241.3 acres in the Martin River floodplain. Rocky Cliff habitat is relatively extensive, accounting for 234.3 acres, and it occurs primarily on the steep canyon walls of the upper Martin River. A small portion of the Dixon Glacier falls within the study area boundaries (4.2 acres), and Artificial Fill (2.8 acres) is limited to the area surrounding the abandoned airstrip at the mouth of the river (Table 5.2-3).

5.2.5 Future Wildlife Habitat Types

5.2.5.1 Construction Impacts

Habitat loss due to direct impacts within the Project footprint in the Martin River floodplain is limited to 25.8 acres at the proposed Dixon Diversion site. Habitat impacts include blasting; placement of fill for construction of the diversion dam, diversion pond, and tunnel inlet; and the staging and storage of heavy equipment. Most of the impacts would affect existing barren wildlife habitats, including Riverine Barrens, Subalpine and Alpine Barrens, and Rocky Cliffs (Table 5.2-4). Permanent impacts to these barren areas would have minimal habitat consequences for most species, with the exception of Golden

Eagles (*Aquila chrysaetos*) and mountain goats that routinely use steep rocky cliff habitats. The proglacial segment of Martin River (Rivers and Streams, 1.4 acres) falls within the direct effects footprint. Portions of the existing channel would be diverted to the diversion pond and tunnel intake, and the remaining downstream channel would likely remain mostly intact after the diversion infrastructure construction is complete. The only vegetated habitat in the direct impact area is Upland and Subalpine Tall Alder Scrub (0.8 acres), which, at this higher elevation, is a sparsely vegetated early successional habitat that would likely regenerate in 60 years in protected microsites with adequate fines in the substrate.

Table 5.2-4 Wildlife habitat losses in the proposed direct impact area for the Dixon Diversion site in the Martin River floodplain.

Habitat Type	Area of Impacts (acres)	Percentage of Impact Area (%)
Rivers and Streams (High Gradient-High Flow)	1.4	5.4
Riverine Barrens	1.8	7.0
Upland and Subalpine Tall Alder Scrub	0.8	2.9
Subalpine and Alpine Barrens	17.5	67.9
Rocky Cliffs	4.3	16.8
Total direct impact area	**25.8**	**100.0**

5.2.5.2 Operations Impacts: Project-induced and Natural Habitat Change

To provide a basis for determining changes in wildlife habitat use over time in the Martin River floodplain, the extents of future habitats predicted to occur in the study area after a period of 60 years of Project operations were estimated. The estimated future extent of each habitat was based on the known boundary of the area to be directly impacted by Project construction (the Dixon Diversion footprint), the predicted seasonal reductions in flow in the Martin River, and expected natural plant successional changes as influenced by climate change. It was assumed the existing set of wildlife habitats include the full range of successional stages expected in the Martin River floodplain in the future and that no new habitats would develop in the 60-year operations period. A crosswalk between current habitat types and predicted future habitats in the floodplain and the rationale for the changes is presented in Table 5.1-6.

The proposed amount of water to routinely be diverted from the Martin River through the Dixon Diversion, the reduced seasonal flows in the river, and the proposed periodic

flushing flows are likely to have the effect of transitioning the braided sections of the Martin River to a single channel system (see the *Geomorphology and Sediment Transport Study Report;* Watershed GeoDynamics 2025). This trend is expected to change the seasonal flooding patterns in the Martin River floodplain and likely contribute to habitat change, particularly in the areas that are currently active braided plains. In an analogous river system, some portions of the Eklutna River underwent similar changes over the course of 63 years of dewatering, where braided channel reaches transitioned to tall, closed alder in the active floodplain and well-developed mixed forest on the higher terraces (Davis et al. 2023). On the formerly braided sections of the Eklutna River, very little barren habitat remained after 63 years of substantially reduced flows. For the proposed Project, successional vegetation patterns between Project River Mile (PRM) 5.3 and 4.3 of the Martin River—where the river has been gradually shifting to a single channel system (Watershed GeoDynamics 2025)—were used to predict the potential changes in riverine and riparian habitats in the downstream braided reaches. In the PRM 5.3 to 4.3 area, the inactive braided plain has been recolonized by Riverine Dryas Dwarf Shrub, which was interpreted to be a stable plant community in areas where the substrate is primarily boulders and cobbles and is extremely xeric. In off-channel habitat that is composed of finer grained material, it is expected that Riverine Tall Alder would develop first and gradually transition toward the stable community of Riverine Mixed Spruce-Black Cottonwood Forest. Assumptions made and descriptions of the plant successional pathways expected in the lower Martin River are presented in Table 5.1-6.

If most of the active braided riparian areas in the lower Martin River transition to Riverine Dryas Dwarf Shrub in 60 years, it is predicted that habitat would increase by 319.8 acres from 99.3 currently (Table 5.2-5). Riverine Tall Alder is expected to increase from 26.8 acres to 260.1 acres as it also colonizes areas no longer subjected to regular overbank flooding. Riverine Mixed Spruce-Black Cottonwood Forest is expected to increase at a more moderate rate from 364.7 acres currently to 391.5 (an increase of 26.8 acres). Riverine Active Braided Floodplain and Riverine Flooded Black Cottonwood Scrub are both maintained by regular but unpredictable off-channel overbank flooding. In the transition from the braided system to the single-channel system, it is predicted that both of those habitats would be lost in the future (Table 5.2-5, Figure 5.2-3).

Table 5.2-5 Predicted wildlife habitat gains and losses due to river flow reductions, climate change, and natural plant succession in the Bradley Lake Expansion Project study area in the Martin River floodplain.

Habitat Type	Current Area (acres)	Future Area (acres)	Acreage change (acres)
Tidal Gut	19.5	19.5	0.0
Coastal Barren Mudflat	711.8	797.4	85.6
Coastal Saline Wet Sedge Marsh	2.5	0.0	-2.5
Coastal Saline Wet Sedge Meadow	83.1	0.0	-83.1
Estuarine Brackish Wet Sedge-Forb Meadow	43.9	0.0	-43.9
Human Modified Ponds	2.8	0.0	-2.8
Lacustrine Freshwater Isolated Off-channel Pond	12.8	12.8	0.0
Lacustrine Freshwater Tapped Off-channel Pond	33.2	33.2	0.0
Lacustrine Fringe Fresh Grass-Sedge Marsh	47.2	0.0	-47.2
Freshwater Lakes and Ponds	30.6	30.6	0.0
Rivers and Streams (High Gradient-High Flow)	23.1	23.1	0.0
Rivers and Streams (Low Gradient-High Flow)	17.8	61.4	43.6
Rivers and Streams (Mixed Gradient-Low Flow)	12.3	12.3	0.0
Riverine Barrens	32.6	0.0	-32.6
Riverine Active Braided Floodplain	373.9	0.0	-373.9
Riverine Dryas Dwarf Shrub	99.3	419.1	319.8
Riverine Tall Alder	26.8	286.9	260.1
Riverine Flooded Black Cottonwood Scrub	150.0	0.0	-150.0
Riverine Mature Black Cottonwood Forest	4.3	4.3	0.0
Riverine Mixed Spruce-Black Cottonwood Forest	364.7	391.5	26.8
Upland and Subalpine Herb Meadow	1.0	0.0	-1.0
Upland and Subalpine Wet Graminoid Moss Bog	0.3	0.3	0.0
Upland and Subalpine Tall Alder Scrub	385.4	1.0	-384.4
Upland Mixed Lutz Spruce-Black Cottonwood Forest	755.3	1,140.7	385.4
Subalpine and Alpine Barrens	82.2	86.5	4.2
Subalpine and Alpine Dwarf Ericaceous Scrub	0.3	0.3	0.0
Glacier	4.2	0.0	-4.2
Rocky Cliffs	230.0	230.0	0.0
Artificial Fill	2.8	2.8	0.0
Total	**3,553.7**	**3,553.7**	

Note: Does not include habitats expected to occur in the construction footprint at the Dixon Diversion site.

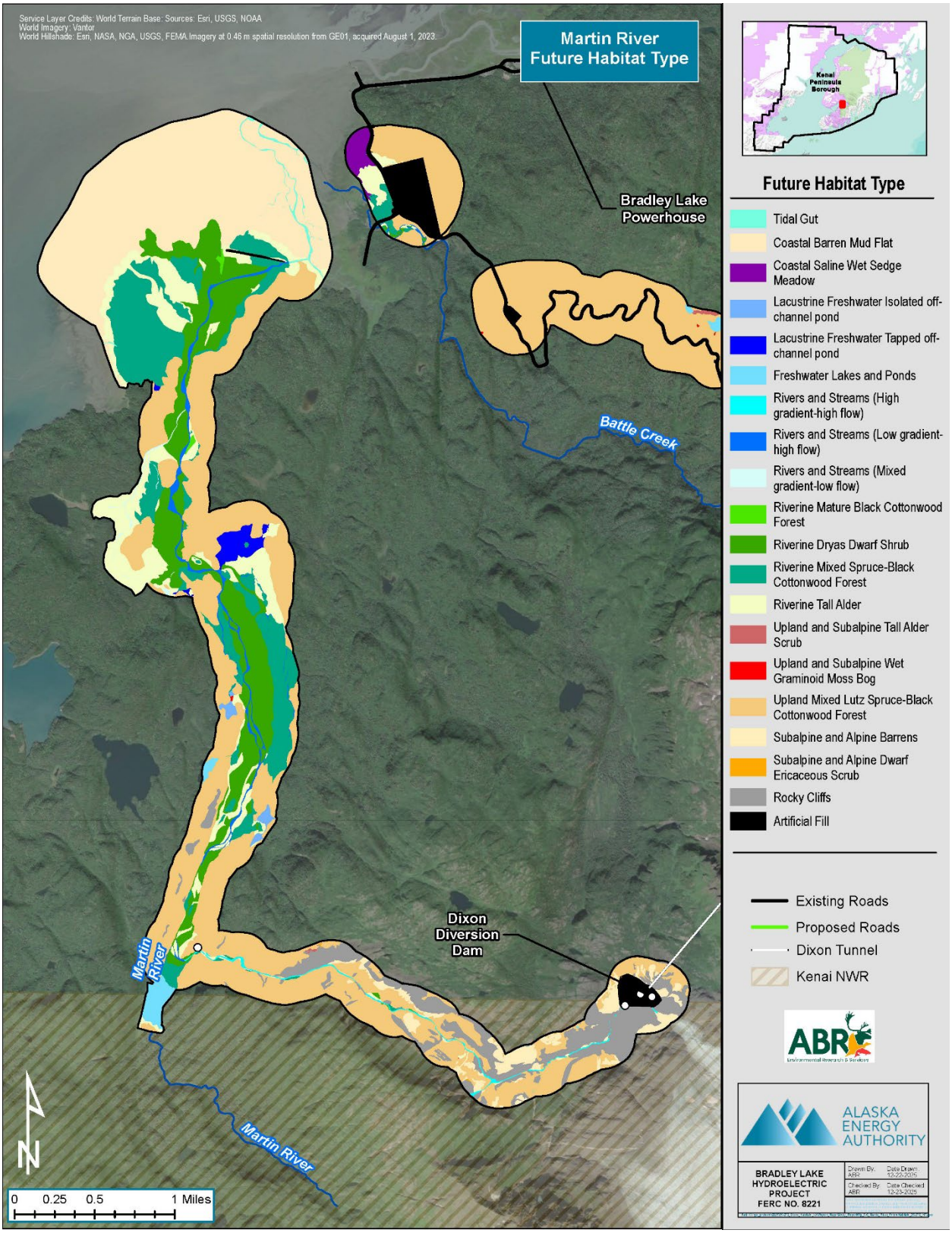

Figure 5.2-3 Future wildlife habitat types in the Bradley Lake Expansion Project study area in the Martin River floodplain.

With reduced flows, the volume of sediment deposition in the Martin River floodplain is likely to decline during the operations phase of the Project. Based on the presence of several other larger glacially fed river systems that contribute sediment to upper Kachemak Bay, especially the Fox River, it is predicted that Project-induced reductions in fine sediment deposition in the bay are not likely to be measurable. Moreover, under climate change and with the continued receding of glaciers in Alaska, it is likely that more fine glacial sediment will be deposited in the bay than in the past, dwarfing the reduced input from the Martin River. However, the recent Martin River channel migration across the mitigation pond levee near the bay has resulted in rapid changes to estuarine habitats that are likely to continue in the near term and will result in measurable changes. As of 2025, a new alluvial fan was developing at the new river outlet east of the abandoned airstrip, which is where all the vegetated estuarine and marine-influenced habitats occur. As the new alluvial fan continues to develop, it is predicted all of the Coastal Saline Wet Sedge Marsh, Coastal Saline Wet Sedge Meadow, and Estuarine Brackish Wet Sedge-Forb Meadow would be lost (2.5, 83.1, and 43.9 acres lost, respectively; Table 5.2-5). Once the rapid change from the channel migration stabilizes, the area is likely to resemble the western side of the delta, which is primarily barren mudflats and alluvium. These effects combined account for the predicted increase in the acreage of Coastal Barren Mudflat from 711.8 to 797.4 acres over a 60-year Project operations period (Table 5.2-5).

The remaining changes in vegetated riparian and upland habitats would occur as the landscape recovers from the spruce bark beetle kill impacts, and overarching climate warming and increased precipitation trends result in accelerated plant succession toward shrub and forest habitats. As in the Project areas outside the Martin River floodplain, it is predicted that Upland and Subalpine Tall Alder Scrub would gradually transition to Upland Mixed Lutz Spruce-Black Cottonwood Forest, the latter type increasing from 755.3 acres to 1,140.7 acres (gain of 385.4 acres; Table 5.2-5). Based on the predicted rate of melt of the Dixon Glacier (see the *Geomorphology and Sediment Transport Report*; Watershed GeoDynamics 2025), it is predicted that after 60 years Subalpine and Alpine Barrens would replace the 4.2 acres of Glacier habitat that currently exists in the study area (Table 5.2-5).

5.3 High-value Wildlife Habitat in Blasting Area Buffer Zones

5.3.1 Field Survey

Several field plots were sampled within the 2-kilometer (1.2 mile) buffer zones surrounding the two planned Project blasting areas; however, the entire Bradley Lake

Expansion Project mapping dataset was used to develop the high- and moderate-value habitat mapping for the disturbance-sensitive wildlife species assessed in the Wildlife Habitat Evaluation Study (ABR 2026).

5.3.2 Current Wildlife Habitat Types

The extent of high- and moderate-value wildlife habitats for six disturbance-sensitive wildlife species (black bear [*Ursus americanus*], brown bear [*Ursus arctos*], Golden Eagle, moose [*Alces alces*], mountain goat [*Oreamnos americanus*], and wolverine [*Gulo gulo*]) were mapped in the buffer zones surrounding the two planned Project blasting areas. When combined, high- and moderate-value habitats are referred to as suitable habitats that are expected to be regularly used by the species in question during one or more important life-history stages (ABR 2026). Of the suitable habitats for the six species, 10 occur in the two blasting area buffer zones combined (Table 5.3-1, Figure 5.3-1).

Table 5.3-1 Acreage of suitable and non-suitable habitats for six disturbance-sensitive wildlife species in 2-kilometer buffer zones surrounding planned Project blasting areas.

Priority Mammal Habitat	Area (acres)	Percentage of Total Area (%)
Non-suitable habitat	1,475.3	17.4
Freshwater Lakes and Ponds	103.2	1.2
Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex	1,594.2	18.8
Riverine Low and Tall Willow	0.1	<0.1
Rocky Cliffs	1,464.9	17.3
Subalpine and Alpine Barrens	461.4	5.5
Subalpine and Alpine Dwarf Ericaceous Scrub	785.7	9.3
Upland and Subalpine Herb Meadow	11.3	0.1
Upland and Subalpine Tall Alder Scrub	1,545.8	18.3
Upland and Subalpine Tall Willow Scrub	3.0	<0.1
Upland Mixed Lutz Spruce-Black Cottonwood Forest	1,019.2	12.0
Total	**8,464.1**	**100.0**

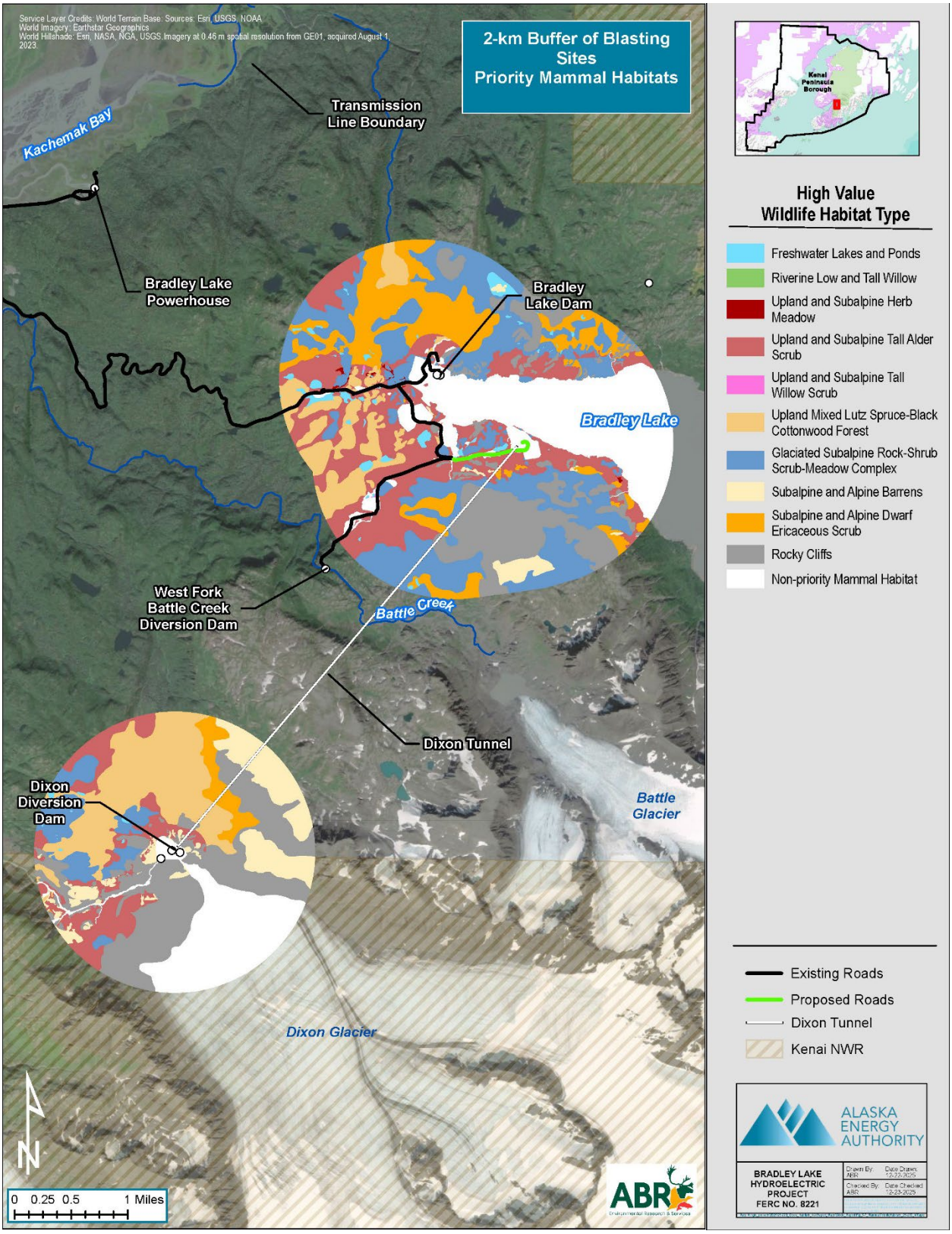

Figure 5.3-1 High- and moderate-value wildlife habitat types in 2-kilometer buffer zones surrounding the planned Project blasting areas.

In total, habitats that are not suitable for the six species (ranked as low or negligible value, ABR 2026) encompass 17 percent of the blasting area buffer zones (combined); these areas primarily include the existing and newly flooded areas at Bradley Lake and the toe of the Dixon Glacier (Figure 5.3-1).

Across both blasting area buffer zones, approximately 66 percent of the mapped area consists of four suitable wildlife habitats: Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex, Rocky Cliffs, Upland and Subalpine Tall Alder Scrub, and Upland Mixed Lutz Spruce-Black Cottonwood Forest. The remaining 17 percent of the mapped area consists of six wildlife habitats, including Freshwater Lakes and Ponds, Riverine Low and Tall Willow, Subalpine and Alpine Barrens, Subalpine and Alpine Dwarf Ericaceous Scrub, Upland and Subalpine Herb Meadow, and Upland and Subalpine Tall Willow Scrub. Both blasting area buffer zones encompass higher elevation alpine areas above treeline where dry, sparsely vegetated and barren terrain is dominant. A small section of the upper Martin River is included, which accounts for the presence of Riverine Low and Tall Willow, but the remaining riverine waters and riparian habitats in the blasting area buffer zones were not included in the mapping because those riverine habitats were not ranked as suitable for the six focal wildlife species (ABR 2026).

6.0 SUMMARY

The primary direct Project effects on wildlife habitats in the mapping study area outside the Martin River would occur from the extraction of gravel and the placement of fill for supporting construction activities and the construction of new Project infrastructure. Wildlife habitats would also be altered from the increase in the maximum pool elevation at Bradley Lake and the predictable seasonal flooding of habitats in a broader WLFZ along the lake shoreline. The placement of artificial fill would result in the permanent loss of an additional 163 acres of wildlife habitat (Table 5.1-4), and up to 680 acres of wildlife habitats would be altered by lake level fluctuations and seasonally changing habitat states (terrestrial to aquatic) at Bradley Lake. The most significant direct habitat losses from fill would be to Upland and Subalpine Tall Alder Scrub, Upland Mixed Lutz Spruce-Black Cottonwood Forest, and Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex.

During the same 60-year period of Project operations, natural plant succession processes in the area outside the Martin River are expected to result in substantial declines in the extent of Upland and Subalpine Tall Alder Scrub and substantial increases in the extent of Upland Mixed Lutz Spruce-Black Cottonwood Forest. In future years, climate change is predicted to result in increased temperatures and precipitation, and it is likely to accelerate plant succession in the mapping study area. Over the course a 60-year Project operations period, the pre-existing spruce-dominated forest is expected to recover from significant spruce bark beetle kill and transition from a current tall deciduous shrub-dominant system to a mixed-forest system.

Direct impacts in the Martin River floodplain would be limited to the Dixon Diversion site (25.8 acres, Table 5.2-4). By far, the greatest habitat loss in this area would be to Subalpine and Alpine Barrens (17.5 acres). Indirect impacts in the Martin River floodplain because of reduced flows are predicted to result in the transition of the active braided river sections to a single-channel system. It is predicted that most existing, well-drained, and xeric braided riverine barrens would transition to Riverine Dryas Dwarf Shrub (a gain of 319.8 acres) and Riverine Tall Alder (a gain of 260.1 acres). The recent Martin River natural channel migration (now passing through the mitigation ponds at the Kachemak Bay shoreline) is actively resulting in habitat loss to the vegetated intertidal habitats where a new alluvial fan is developing. These ongoing habitat changes in the Martin River delta are not Project-induced but will likely result in measurable losses to existing vegetated intertidal habitats as they transition to gravel barrens and Coastal Barren Mudflat.

7.0 STUDY STATUS AND SCHEDULE

AEA completed the Vegetation and Wildlife Habitat Mapping Study as described above in 2025 and provided a comprehensive report summarizing study activities and results for both the 2024 and 2025 study seasons.

8.0 REFERENCES

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APPENDIX A

FULL GROUND REFERENCE PLOTS

Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221) Bradley Lake Extension Project

Vegetation and Wildlife Habitat Mapping Change Study Appendix A: Full Ground Reference Plots

Prepared for:

Alaska Energy Authority
813 West Northern Lights Boulevard
Anchorage, Alaska 99503-2495

Prepared by:

ABR, Inc.—Environmental Research & Services
1225 E International Airport Rd #110
Anchorage, AK 99518

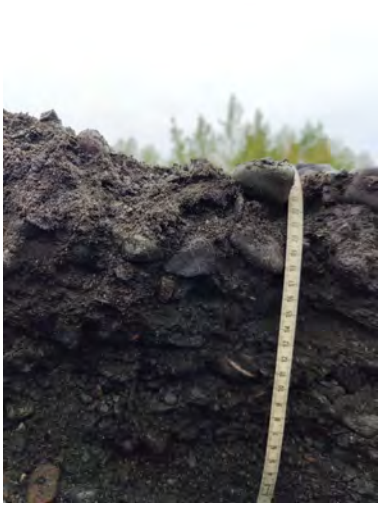
January 2026

Sampling Point: dixon_100
Date: 2025-07-30
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Water
Dominant Mineral: Sandy

Notes: Martin River distributary. Main stem of Martin River, blow out of the end of the old runway.

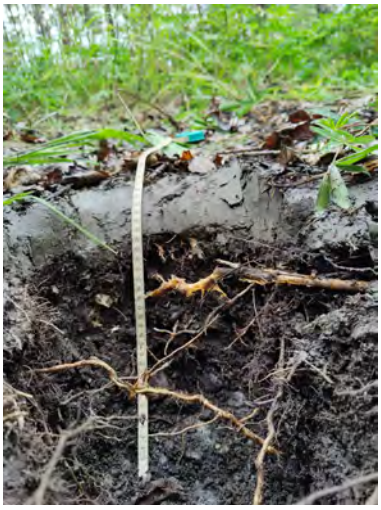
Sampling Point: dixon_101
Date: 2025-07-30
Wildlife Habitat: Artificial Fill
Physiography: Riverine
Macrotopography: Lateral Bar
Viereck code: Barren
Dominant Mineral: Sandy

Notes: Riverine barrens, exposed after river cut through and eroded the airstrip.



Sampling Point: dixon_102
Date: 2025-07-30
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Paper Birch-Balsam Poplar-Spruce
Dominant Mineral: Gravelly

Notes: Soils have 3-4 cm glacial silt deposit over buried organics. Flooding deposit appears to be 2-3 years old. Mixed forest.



Sampling Point: dixon_103
Date: 2025-07-30
Wildlife Habitat: Estuarine Brackish Wet Sedge-Forb Meadow
Physiography: Coastal
Macrotopography: Flat or fluvial related
Viereck code: Halophytic Sedge-Grass Wet Meadow, brackish
Dominant Mineral: Gravelly

Notes: 10 cm glacial silt over gravel. Edge of forest, revegetating salt marsh

Sampling Point: dixon_104
Date: 2025-07-30
Wildlife Habitat: Coastal Saline Wet Sedge Meadow
Physiography: Coastal
Macrotopography: Channel
Viereck code: Brackish Water
Dominant Mineral: Water

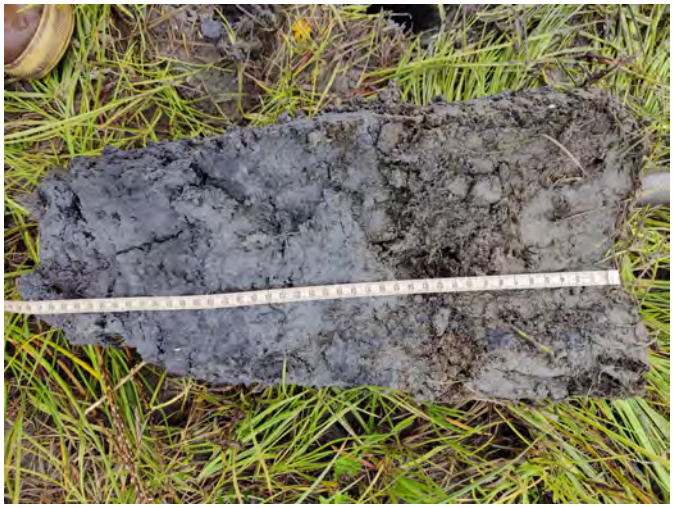
Notes: Tidal gut waterbody.

Sampling Point: dixon_105
Date: 2025-07-30
Wildlife Habitat: Coastal Saline Wet Sedge Meadow
Physiography: Coastal
Macrotopography: Flat or fluvial related
Viereck code: Halophytic Sedge Marsh
Dominant Mineral: Clayey

Notes: Sedges at the edge of a tidal gut.

Sampling Point: dixon_106
Date: 2025-07-30
Wildlife Habitat: Coastal Saline Wet Sedge Meadow
Physiography: Coastal
Macrotopography: Flat or fluvial related
Viereck code: Halophytic Sedge Wet Meadow
Dominant Mineral: Clayey

Notes: Silt deposit over riverine gravels. Typical salt marsh.



Sampling Point: dixon_107
Date: 2025-07-30
Wildlife Habitat: Riverine Tall Alder
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Closed Tall Alder
Dominant Mineral: Clayey

Notes: Thick silt deposits in closed shrubs. Young alder stand, mud and equisetum in understory.

Sampling Point: dixon_108
Date: 2025-07-30
Wildlife Habitat: Artificial Fill
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Tall Shrub
Dominant Mineral: Sandy

Notes: Fresh sand and silt to 30cm above previous surface. Flooded out dwarf poplar forest.

Sampling Point: dixon_109
Date: 2025-07-30
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Closed Black Cottonwood
Dominant Mineral: Sandy

Notes: 20cm sand and loamy very fine sand over fibric organics (oi) of old surface. Closed poplar, recently flooded.

Sampling Point: dixon_110
Date: 2025-07-30
Wildlife Habitat: Riverine Active Braided Floodplain
Physiography: Coastal
Macrotopography: Water Tracks Or Feather Pattern
Viereck code: Barren
Dominant Mineral: Gravelly

Notes: Gravel and sand from river flooding over marine silt and sand. Mussels and fucus also present.

Sampling Point: dixon_111
Date: 2025-07-30
Wildlife Habitat: Riverine Flooded Black Cottonwood Scrub
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Partially Vegetated
Dominant Mineral: Sandy

Notes: Thick >40cm riverine deposit. Ghost black cottonwood forest, high cover of standing dead with pioneer species.

Sampling Point: dixon_112
Date: 2025-07-30
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Black Cottonwood Forest
Dominant Mineral: Sandy

Notes: 8 cm silt over sand. 3-5 years since last flood event. Mature cottonwood forest.

Sampling Point: dixon_113
Date: 2025-07-30
Wildlife Habitat: Riverine Flooded Black Cottonwood Scrub
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Broadleaf-Tall Scrub Woodland
Dominant Mineral: Gravelly

Notes: Cottonwood saplings, some over bank flooding but not serious flow.

Sampling Point: dixon_114
Date: 2025-07-30
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Water Tracks Or Feather Pattern
Viereck code: Closed Black Cottonwood
Dominant Mineral: Gravelly

Notes: 10cm sand over riverine gravel. Cottonwood forest.

Sampling Point: dixon_115
Date: 2025-07-30
Wildlife Habitat: Riverine Active Braided Floodplain
Physiography: Riverine
Macrotopography: Bar
Viereck code: Barren
Dominant Mineral: Gravelly

Notes: High water river bar.

Sampling Point: dixon_116
Date: 2025-07-31
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Upland
Macrotopography: Point Bar
Viereck code: Partially Vegetated
Dominant Mineral: Gravelly

Notes: Riverine gravel deposit from flood event. Revegetating riverine deposit

Sampling Point: dixon_117
Date: 2025-07-31
Wildlife Habitat: Lacustrine Fringe Fresh Grass-Sedge Marsh
Physiography: Lacustrine
Macrotopography: Flat or fluvial related
Viereck code: Fresh Sedge Marsh
Dominant Mineral: Sandy

Notes: Organic mat over silt and sand. Underlying gravel may not be from river. Wet sedge fringe of small pond, ghost forest of standing dead cottonwood.

Sampling Point: dixon_119
Date: 2025-07-31
Wildlife Habitat: Riverine Tall Alder
Physiography: Upland
Macrotopography: Bar
Viereck code: Midgrass-Herb
Dominant Mineral: Gravelly

Notes: 3 cm silt over large gravel. Convex riverine deposits, large cobbles, lots of lichen development.

Sampling Point: dixon_120
Date: 2025-07-31
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Point Bar
Viereck code: Partially Vegetated
Dominant Mineral: Rubbly

Notes:

Sampling Point: dixon_121
Date: 2025-07-31
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Channel
Viereck code: Closed Tall Alder
Dominant Mineral: Sandy

Notes: Fine sand deposit over gravel riverbed.

Sampling Point: dixon_123
Date: 2025-07-31
Wildlife Habitat: Riverine Tall Alder
Physiography: Riverine
Macrotopography: Bar
Viereck code: Closed Tall Alder
Dominant Mineral: Sandy

Notes: Slightly elevated abandoned bar. Small patch of big cottonwood saplings or young trees with closed shrub beneath.

Sampling Point: dixon_124
Date: 2025-07-31
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Black Cottonwood-Sitka Spruce Forest
Dominant Mineral: Sandy

Notes: Gravelly sand with silt at 29cm. Base of an old abandoned channel, forest floor is almost all leaf litter. Some of the mature spruce are dead, unsure why but maybe bark beetle.

Sampling Point: dixon_126
Date: 2025-07-31
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Riverine
Macrotopography: Bar
Viereck code: Open Tall Shrub
Dominant Mineral: Gravelly

Notes: High and dry abandoned river terrace. Robust Stereocaulon, cottonwood a little bit dwarfed, young spruce are up to 30 years old.

Sampling Point: dixon_130
Date: 2025-08-01
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Upland
Macrotopography: Undifferentiated Slope
Viereck code: Open Tall Alder-Willow
Dominant Mineral: Loamy

Notes: Coluvium, sand and coarse frags at 25cm. Characteristic shrub at this elevation

Sampling Point: dixon_131
Date: 2025-08-01
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Upland
Macrotopography: Undifferentiated Slope
Viereck code: Closed Tall Alder
Dominant Mineral: Loamy

Notes:

Sampling Point: dixon_132
Date: 2025-08-01
Wildlife Habitat: Upland Mixed Lutz Spruce-Black Cottonwood Forest
Physiography: Subalpine
Macrotopography: Crest
Viereck code: Lutz Spruce Woodland
Dominant Mineral: Loamy

Notes: Rock at 40cm

Sampling Point: dixon_133
Date: 2025-08-01
Wildlife Habitat: Upland Mixed Lutz Spruce-Black Cottonwood Forest
Physiography: Subalpine
Macrotopography: Shoulder
Viereck code: Lutz Spruce Woodland
Dominant Mineral: Loamy

Notes:

Sampling Point: dixon_135
Date: 2025-08-01
Wildlife Habitat: Upland and Subalpine Herb Meadow
Physiography: Subalpine
Macrotopography: Undifferentiated Slope
Viereck code: Vaccinium Dwarf Shrub Tundra
Dominant Mineral: Loamy

Notes:

Sampling Point: dixon_137
Date: 2025-08-01
Wildlife Habitat: Upland Mixed Lutz Spruce-Black Cottonwood Forest
Physiography: Upland
Macrotopography: Undifferentiated Slope
Viereck code: Open Low Rose Shrub
Dominant Mineral: Gravelly

Notes: Steep south slope.

Sampling Point: dixon_138
Date: 2025-08-01
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Upland
Macrotopography: Shoulder
Viereck code: Closed Tall Alder
Dominant Mineral: Loamy

Notes:

Sampling Point: dixon_139
Date: 2025-08-02
Wildlife Habitat: Riverine Barrens
Physiography: Riverine
Macrotopography: Point Bar
Viereck code: Barren
Dominant Mineral: Rubbly

Notes:

Sampling Point: dixon_140
Date: 2025-08-02
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Lateral Bar
Viereck code: Seral Herbs
Dominant Mineral: Gravelly

Notes: Slightly higher than 139

Sampling Point: dixon_141
Date: 2025-08-02
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Lateral Bar
Viereck code: Open Tall Willow
Dominant Mineral: Gravelly

Notes:

Sampling Point: dixon_142
Date: 2025-08-02
Wildlife Habitat: Riverine Tall Alder
Physiography: Riverine
Macrotopography:
Viereck code: Closed Tall Willow
Dominant Mineral: Sandy

Notes: Possible this is a drained shrub swamp?

Sampling Point: dixon_143
Date: 2025-08-02
Wildlife Habitat: Upland Mixed Lutz Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Balsam Poplar Forest
Dominant Mineral: Sandy

Notes: Area floods intermittently. Trunk damage visible from last year.

Sampling Point: dixon_144
Date: 2025-08-02
Wildlife Habitat: Upland Mixed Lutz Spruce-Black Cottonwood Forest
Physiography: Upland
Macrotopography: Undifferentiated Slope
Viereck code: Open Mixed Forest
Dominant Mineral: Loamy

Notes:

Sampling Point: dixon_145
Date: 2025-08-02
Wildlife Habitat: Upland Mixed Lutz Spruce-Black Cottonwood Forest
Physiography: Upland
Macrotopography: Flat or fluvial related
Viereck code: Closed Mixed Forest
Dominant Mineral: Loamy

Notes: Soils are silt over gravelly loamy sands. Alders are tree size.

Sampling Point: dixon_147
Date: 2025-08-02
Wildlife Habitat: Lacustrine Fringe Fresh Grass-Sedge Marsh
Physiography: Riverine
Macrotopography: Nonpatterned
Viereck code: Fresh Grass Marsh
Dominant Mineral: Sandy

Notes:

Sampling Point: dixon_148
Date: 2025-08-02
Wildlife Habitat: Lacustrine Fringe Fresh Grass-Sedge Marsh
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Bluejoint Meadow
Dominant Mineral: Sandy

Notes: Soils are sands over buried organic layer at 28cm.

Sampling Point: dixon_149
Date: 2025-08-02
Wildlife Habitat: Lacustrine Fringe Fresh Grass-Sedge Marsh
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Closed Tall Alder
Dominant Mineral: Sandy

Notes: Fine sand over medium sand over laminated layers of fine/coarse sand.

Sampling Point: dixon_150
Date: 2025-08-02
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Balsam Poplar Forest
Dominant Mineral: Sandy

Notes: Flooded vegetated riverbank. Fresh flooding

Sampling Point: dixon_151
Date: 2025-08-02
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Closed Tall Alder-Willow
Dominant Mineral: Gravelly

Notes: Flooded in the past 10 years, but not recent.

Sampling Point: dixon_152
Date: 2025-08-02
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Balsam Poplar Forest
Dominant Mineral: Gravelly

Notes: Coarse sands over river gravel/cobbles at 26cm. Dominant mineral texture in upper 40cm could be sandy.

Sampling Point: dixon_153
Date: 2025-08-02
Wildlife Habitat: Riverine Active Braided Floodplain
Physiography: Riverine
Macrotopography: Lateral Bar
Viereck code: Dry Dwarf Shrub
Dominant Mineral: Gravelly

Notes:

Sampling Point: dixon_154
Date: 2025-08-03
Wildlife Habitat: Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex
Physiography: Subalpine
Macrotopography: Crest
Viereck code: Partially Vegetated
Dominant Mineral: Bouldery

Notes:

Sampling Point: dixon_155
Date: 2025-08-03
Wildlife Habitat: Upland Mixed Lutz Spruce-Black Cottonwood Forest
Physiography: Subalpine
Macrotopography: Shoulder
Viereck code: Open Balsam Poplar Forest
Dominant Mineral: Blocky

Notes: Forest duff over bedrock.

Sampling Point: dixon_156
Date: 2025-08-03
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Subalpine
Macrotopography: Undifferentiated Slope
Viereck code: Closed Tall Alder-Willow
Dominant Mineral: Blocky

Notes: Forest duff over bedrock.

Sampling Point: dixon_159
Date: 2025-08-03
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Subalpine
Macrotopography: Basins Or Depressions
Viereck code: Open Balsam Poplar Forest
Dominant Mineral: Rubbly

Notes: Site in a small basin. Soils are organic duff over morainal sands and gravel with bedrock at 10 cm

Sampling Point: dixon_160
Date: 2025-08-03
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Subalpine
Macrotopography: Undifferentiated Slope
Viereck code: Closed Tall Willow
Dominant Mineral: Rubbly

Notes: . Alder on stabilized talus slope.

Sampling Point: dixon_161
Date: 2025-08-03
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Subalpine
Macrotopography: Undifferentiated Slope
Viereck code: Open Balsam Poplar Forest
Dominant Mineral: Gravelly

Notes: Cottonwood on moraine colluvium.

Sampling Point: dixon_162
Date: 2025-08-03
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Bar
Viereck code: Open Low Alder
Dominant Mineral: Bouldery

Notes: Flooded vegetated bar

Sampling Point: dixon_165
Date: 2025-08-03
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Lateral Bar
Viereck code: Open Tall Shrub
Dominant Mineral: Gravelly

Notes:

Sampling Point: dixon_166
Date: 2025-08-03
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Riverine
Macrotopography: Flat or fluvial related
Viereck code: Open Balsam Poplar Forest
Dominant Mineral: Rubbly

Notes: Flood-killed spruce forest replaced by cottonwood and alder. Lots of fallen spruce in understory.

Sampling Point: dixon_167
Date: 2025-08-03
Wildlife Habitat: Riverine Mixed Spruce-Black Cottonwood Forest
Physiography: Lacustrine
Macrotopography: Lake Margins
Viereck code: Closed Tall Alder
Dominant Mineral: Sandy

Notes: Lake margin

Sampling Point: dixon_168
Date: 2025-08-03
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Mid-Channel Bar
Viereck code: Partially Vegetated
Dominant Mineral: Rubbly

Notes: Bar is cobbles capped with sand. Evidence of recent flooding in past 5 years.

Sampling Point: dixon_169
Date: 2025-08-03
Wildlife Habitat: Riverine Tall Alder
Physiography: Riverine
Macrotopography: Mid-Channel Bar
Viereck code: Open Spruce-Balsam Poplar Forest
Dominant Mineral: Sandy

Notes: Mid-channel bar at inactive elevation. 35 cm sand over river gravel.

APPENDIX B

VERIFICATION PLOTS

Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221)
Bradley Lake Extension Project

Vegetation and Wildlife Habitat Mapping Change Study
Appendix B: Verification Plots

Prepared for:

Alaska Energy Authority
813 West Northern Lights Boulevard
Anchorage, Alaska 99503-2495

Prepared by:

ABR, Inc.—Environmental Research & Services
1225 E International Airport Rd #110
Anchorage, AK 99518

January 2026

Sampling Point: dixon_118
Date: 2025-07-31
Wildlife Habitat: Lacustrine Fringe Fresh Grass-Sedge Marsh
Physiography: Lacustrine
Macrotopography: Waterbodies
Viereck code: Fresh Water

Notes: Untapped pond, cut in half by the new delta.

Sampling Point: dixon_122
Date: 2025-07-31
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Channel
Viereck code: Fresh Water

Notes: Re-flooded abandoned channel. Chlorotic looking alder, some are defoliated, in a re-flooded channel.

Sampling Point: dixon_125
Date: 2025-07-31
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Upland
Macrotopography: Lower Slope, Concave, North Facing
Viereck code: Open Black Cottonwood-Sitka Spruce Forest

Notes: Steep forested slope just off the old floodplain.

Sampling Point: dixon_134
Date: 2025-08-01
Wildlife Habitat: Artificial Fill
Physiography: Lacustrine
Macrotopography: Waterbodies
Viereck code: Fresh Water

Notes:

Sampling Point: dixon_136
Date: 2025-08-01
Wildlife Habitat: Artificial Fill
Physiography: Lacustrine
Macrotopography: Waterbodies
Viereck code: Water

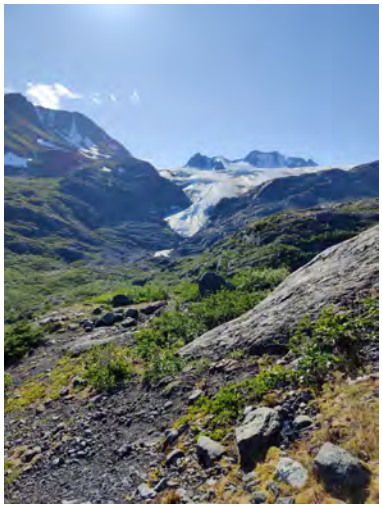
Notes: Shallow pond with emergent and floating aquatics

Sampling Point: dixon_146
Date: 2025-08-02
Wildlife Habitat: Lacustrine Fresh Water Tapped off-channel pond
Physiography: Riverine
Macrotopography: Waterbodies
Viereck code: Water

Notes: Swan lake. Connected basin.

Sampling Point: dixon_157
Date: 2025-08-03
Wildlife Habitat: Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex
Physiography: Subalpine
Macrotopography: Cliff (Rocky)
Viereck code: Barren

Notes: Plot on periphery of cliff.



Sampling Point: dixon_158
Date: 2025-08-03
Wildlife Habitat: Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex
Physiography: Subalpine
Macrotopography: Cliff (Rocky)
Viereck code: Open Tall Alder

Notes: Vegetated micro sites on rocky cliffs, north facing.

Sampling Point: dixon_163
Date: 2025-08-03
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Channel
Viereck code: Water

Notes: Washout of vegetated bar

Sampling Point: dixon_164
Date: 2025-08-03
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Lateral Bar
Viereck code: Closed Tall Alder

Notes: Alder-cottonwood shrub on abandoned channel deposit.

APPENDIX C

WILDLIFE HABITAT DESCRIPTIONS

Table C-1 Wildlife habitat type descriptions in the Vegetation and Wildlife Habitat Mapping Study area, 2025.

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
Tidal Gut	Active channels with marine silt substrate that are flooded twice a day with salt water during each high tide, may have an upstream freshwater connection. No rooted vegetation within the channel, banks may be barren marine silts or robust stands of *Carex lyngbei*.	19.5	0.6
Coastal Barren Mudflat	Barren silt flats occurring in the lowest elevations of the intertidal zone in the Martin River delta.	711.8	0.0
Coastal Saline Wet Sedge Marsh	Typically monotypic stands of *Carex lyngbyei* occurring in narrow fringes on the edges of tidal guts. Most likely flooded with salt water diurnally. Primarily found at the outlet of Martin River and limited occurrence in the Bradley Creek delta.	2.5	0.7
Coastal Saline Wet Sedge Meadow	Wet sedge/forb salt marsh community in the low intertidal zone, likely receiving marine water input diurnally at each low and high tide. Species include *Carex lyngbyei*, *Argentina egedii*, T*riglochin maritima* and *Plantago maritima*. Low cover with significant exposed mud. Water input is likely to be primarily saline with very little freshwater influence. Located in both the Martin River and Battle Creek outlets.	83.1	24.3

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
Estuarine Brackish Wet Sedge-Forb Meadow	Salt tolerant sedges and forbs in the higher elevations of the intertidal zone closest to treeline that may receive salt water input at irregular intervals. The habitat ranges in species diversity and composition but mostly characterized by a mix of salt tolerant graminoids and forbs with traces of deciduous shrubs. Dominant species include; *Calamagrostis canadensis*, *Equisetum arvense*, *Triglochin maritima*, *Lupinus polyphyllus*, and *Poa eminens*. Shrubs include low forms of *Betula neoalaskana*, *Salix barclayi* and *Salix lasiandra*.	43.9	21.4
Human Modified Reservoir	Bradley Lake is the only mapped lake in the area. It is a deep >3,000-acre glacial-fed lake filling the basin with steep shorelines and borders with little to no emergent or floating vegetation.	0.0	3,343.8
Human Modified Ponds	Impounded waters in abandoned gravel extraction sites in the Martin River floodplain. One small mitigation pond remained upstream of the river mouth in 2025 after the levy was breached in 2023 and filled the two ponds nearest the coast with sediment. Ponds receive turbid river water through extreme overbank	2.8	0.0

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	flooding events. Spawning of salmon has been observed in these ponds.		
Lacustrine Freshwater Isolated Off-channel Pond	The Martin River corridor contains one isolated off-channel pond that was formed by an old channel diversion which was eventually cut off from the river by the deposition of a deep alluvial fan. There is no seasonal or perennial surface water connection to the river and if the freshwater ponds contain fish it would be a resident population. Surrounded by well-developed littoral fringe vegetation and moss bog. The pond also supports water lily and potamageton floating aquatic vegetation. The area immediately surrounding the ponds has numerous standing dead alder stems which suggests that the early successional habitat was a tall alder shrub community that was replaced by a graminoid wetland once the water levels in the pond stabilized.	12.8	0.0
Lacustrine Freshwater Tapped Off-channel Pond	Swan Lake and two smaller impoundments on the Martin River are shallow ponds or small	33.2	0.0

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	lakes formed during overbank flooding events. They are still connected to the Martin River through continuous surface water channels and support salmonids and resident fish populations. The water is turbid because overbank flooding events through the established channels are frequent. These water bodies are surrounded by well developed littoral fringe marshes and wet sedge-grass meadows with significant organic development. Standing dead alder stems and black cottonwood are often present.		
Lacustrine Fringe Fresh Grass-Sedge Marsh	Flat areas on active glacial outwash deposits typically adjacent to off-channel impoundments. Substrates are less well drained than partially vegetated gravel bars and are composed of finer grained materials. Organic horizon development is limited. Dominant species include *Calamagrostis canadensis*, *Equisetum arvense*, *Carex aquatilis*, *Carex lyngbyei* and *Juncus triglumis*. Standing dead alder or black cottonwood stems are often present.	47.2	0.0
Freshwater Lakes and Ponds	Shallow ponds and small lakes forming along drainage courses or in glacially carved depressions. In most cases these are isolated	30.6	43.7

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	features with intermittent or absent surface water connection to downstream waters; however, Red Lake is included in this habitat class which has a perennial clearwater connection to the Martin River. Most waters in this class could support resident fish populations but Red Lake also provides anadromous fish (sockeye salmon) spawning and rearing habitat. All waterbodies are clear water with varying degrees of emergent and floating aquatic vegetation. At higher elevations may be associated with moss bog wetland banks. In the Martin River area freshwater lakes are usually off-channel ponds that have become isolated over time. Outside the Martin River, the majority of freshwater habitat are small depressional ponds forming in slope breaks along stream courses.		
Rocky Shore and Cobble Beach	Gently sloping barrens along the shoreline of Bradley Lake. This habitat often occurs where drainageways join the Bradley Lake basin, formed within the inundation zone in the reservoir. Little or no lacustrine fringe vegetation has developed and the substrate consists of unconsolidated coarse fragments from gravels to boulders.	0.0	102.4

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
Rivers and Streams (High Gradient-High Flow)	Permanently flooded channels of freshwater where gradient and flow are relatively high. Sources of water are glacial meltwater, glacial lakes and surface water runoff. Water levels fluctuate rapidly but experience peak levels during spring melt and rainy periods.	24.5	4.2
Rivers and Streams (Low Gradient-High Flow)	Permanently flooded channels of freshwater where gradient is relatively low but flow remains high. Sources of water are glacial meltwater, glacial lakes and surface water runoff. Water levels fluctuate rapidly but experience peak levels during spring melt and rain events.	17.8	28.8
Rivers and Streams (Mixed Gradient-Low Flow)	Permanently flooded channels of freshwater where gradient ranges from low to high and flow is relatively low. Sources of water may be groundwater but dominated by surface water runoff. Water levels fluctuate rapidly but experience peak levels during spring melt and rainy periods	12.3	4.1
Riverine Barrens	Flat gravel bars in a braided channel system on active glacial outwash deposits. Substrates are extremely well drained sand and gravels. Vegetation covers <30% and consists of pioneer species including *Epilobium latifolium*, *Oxytropis campestris*, *Latharus japonicus*, *Alnus*	34.4	360.8

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	sinuata, *Populus trichocarpa* (seedlings), *Salix alaxensis* and *Salix sitchensis*.		
Riverine Active Braided Floodplain	The width of the active riverine channel in the lower reaches of the Martin River where alluvium is actively being deposited. Consists of fast flowing water and barren gravel bars. The active channels change paths frequently, multiple times through the growing season. Some alluvial deposits may support very limited cover of forbs including *Chamerion latifolium*, *Oxytropis campestris*, and *Populus trichocarpa* seedlings. Standing dead, mature cottonwood trees may also be present in areas with aggradation of sediment from recent channel migrations.	373.9	0.0
Riverine Mature Black Cottonwood Forest	Occurs on the oldest abandoned riverine surfaces, likely more prevalent toward the coast. Closed to open canopy with large mature black cottonwood trees. The understory is sparse tall alder shrub (*Alnus sinuata*) and devil's club (*Oplopanax horridus*). Leaf litter occupies a significant amount of forest floor cover. Live black cottonwood stands grade into areas of	4.3	0.0

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	standing dead cottonwood in several places in the Martin River delta.		
Riverine Dryas Dwarf Shrub	Occurs on older abandoned riverine surfaces that are extremely well drained gravels and cobbles, typically in isolated stands surrounded by younger aged surfaces, mixed alder shrub, or active riverine deposits. Sparsely vegetated with *Dryas drummondii*, *Oxytropis campestris*, *Lathyrus japonicus*, *Alnus sinuate, Picea* x *lutzi,* and *Populus trichocarpa* (saplings) with the development of some fruticose lichen.	99.3	8.1
Riverine Flooded Black Cottonwood Scrub	This type is limited to the forest types surrounding the old airstrip next to the delta that have been recently flooded due to the breach recent channel relocation. These stands were still living in 2025, but significant sediment has been deposited during multiple overbank flooding events and still had flowing water in some areas during the sampling in 2025. Expected to have significant mortality in the coming years. Dominant species is sapling sized	150.0	0.0

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	Populus trichocharpa with traces of *Picea* x *lutzii* and *Salix alaxensis*. Significant deposition of fine riverine material with evidence of an organic layer at 30 centimeters (12 inches).		
Riverine Low and Tall Willow	Located on flat, active glacial outwash. With well drained substrates composed of silt, sand, and gravels. Limited organic horizon development receiving frequent sediment deposition. Vegetation is dominated by *Salix pulchra* with *Agrostis exarata*, *Equisetum arvense*, and *Calamagrostis canadensis* among the understory components.	0.0	265.6
Riverine Mixed Spruce-Black Cottonwood Forest	Mixed Lutz spruce and black cottonwood in closed to open canopies. Occurs on the flat abandoned riverine terraces typically next to the steep sloping hillsides. Understory species are more diverse than younger riparian surfaces, but the understory is still much less diverse than the adjacent upland mixed forest types.	364.7	3.0
Riverine Tall Alder	Closed to open stands of *Alnus sinuata* occurring on older riverine deposits near younger aged surfaces or active riverine deposits particularly surrounding water bodies and near the coast. This type also includes some areas with scattered *Picea* x *lutzii* trees (aged	26.8	15.6

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	between 30 and 35 years). Understory is bare except for continuous cover of leaf litter.		
Upland and Subalpine Herb Meadow	Relatively small clearings in the forest and in protected landscape positions in the subalpine dominated largely by herbaceous plant species. Soils are well drained with deep organics. Characterized by numerous forb species including *Viola langsdorffii*, *Anemone parviflora*, *Silene acaulis*, *Thalictrum alpinum*, *Artemisia borealis*, *Castilleja unalaschecensis*, *Epilobium latifolium* and *Epilobium latifolium*. Dwarf shrubs and subshrubs are present including *Luetkea pectinata*, *Salix Chamissonis* and *Salix reticulata* and a significant cover of sedges may be present including *Carex macrochaeta*.	1.0	13.4
Upland and Subalpine Tall Alder Scrub	Slopes varying from gentle to steep, occurring throughout the upland and subalpine zones. This type can occur in rocky drainageways, steep slopes, and in protected drainages at higher elevations. Substrates are well drained and range from rocky with very little organic accumulation to deep organic deposits on more moderate slopes and lower elevations. Occurs in open and closed forms. Dominated by shrub species including *Alnus sinuata*, *Rubus*	386.2	1993.8

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	spectabilis, *Betula kenaica*, and *Oplopanax horridus*. Understory species include *Athyrium filix-femina*, *Dryopteris diliatata*, and *Mitella nuda*.		
Upland and Subalpine Tall Willow Scrub	Tall closed willow communities in isolated patches next to open water or within drainage features. Willow species include; *Salix pulchra* and *S. barclayi*. Understory species may include; *Petasites frigidus*, *Trientalis europaea*, *Sanguisorba officinalis*, and *Carex macrochaeata*. Small willow patches may be present within the Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex habitat but are too small to map and are often indistinguishable from alder shrub in imagery.	0.0	3.0
Upland and Subalpine Wet Graminoid Moss Bog	Shallow basins along stream-courses within upland forested slopes or in protected subalpine basins, with deep accumulation of saturated moss peat. Dominated by Sphagnum moss species with graminoid and forb species assemblages including *Carex saxatilis*, *C. rotundata*, *Carex enanderi* in the wetter bog types. *Carex macrochaeta*, *Swertia perennis*, *Epilobium latifolium*, *Sanguisorba stipulata* and	0.3	6.4

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	Aconitum delphinifolium occur in the smaller high elevation bogs. Dwarf and low shrubs are also common including *Harimanella stelleriana*, *Salix pulchra* and *Salix commutata*.		
Upland Mixed Lutz Spruce-Black Cottonwood Forest	Occurs on hillsides througout the Project area ranging from below treeline to the edge of the intertidal zone. Open to woodland canopy of *Picea* x *lutzi*, *Populus trichocarpa* and *Betula neoalaskana*. Supra canopy Lutz spruce is significantly impacted by bark beetle kill with some stands having 100% mortality of mature individuals. The understory is closed tall shrub consisting of *Alnus* species, *Rubus spectabilis*, *Sambucus racemosa* and *Oplopanax horridus*.	755.3	660.5
Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex	Undulating, complicated terrain with exposed bedrock, dwarf shrub tundra, moss bog, and alder or willow shrub occurring in close proximity in areas of sharp topographic relief. Dwarf shrub species such as *Empetrum nigrum* and *Vaccinium uliginosum* dominate the higher elevation, exposed areas while low to tall *Alnus sinuata* shrubs dominate the incised, protected areas. Pockets of dense tall willow shrub may be present within headwaters and along drainageways. Small patches of moss bog may be present along small watercourses. Exclusively	0.0	240.6

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
	mapped in the subalpine areas immediately surrounding Bradley Lake outside of the Martin River study area.		
Subalpine and Alpine Barrens	Barren or partially vegetated areas on extensive exposed bedrock and mineral soil on exposed ridge crests. Soils lack an organic horizon and substrates range from exposed bedrock to coarse, excessively drained gravels. Vegetation, where present, is <30% of cover and consists of dwarf shrubs such as *Loiseleuria procumbens*, *Empetrum nigrum*, and dwarf *Salix* species.	99.8	29.7
Subalpine and Alpine Dwarf Ericaceous Scrub	Vegetated areas on high, exposed crests and undulating terrain above Bradley Lake. Moderately thick organic layers over well drained weathered bedrock. Vegetated cover is dominated by dwarf shrubs including *Harimanella stelleriana*, *Vaccinium uliginosum*, *Empetrum nigrum*, and *Phyllodoce empetriformis*.	0.3	256.2
Glacier	Toe of the Dixon Glacier in the upper elevations of the Martin River study area. Unvegetated glacier ice with till material on the surface.	4.2	0.0

Wildlife Habitat	Description	Martin River Floodplain (acres)	Area Outside Martin River (acres)
Rocky Cliffs	Steep, unvegetated, unweathered parent material generally found along the edges of the Martin River canyon, around the shoreline of Bradley Lake and scattered throughout the steep slopes of the subalpine zone near Bradley Lake.	234.3	83.1
Artificial Fill	Fill, or recently modified surfaces that have been modified by human activity and are barren. Current disturbed surfaces in the Martin River area include the abandoned runway and levees surrounding the mitigation ponds. Most disturbed surfaces are found outside the Martin River floodplain including the existing access road and dam facilities.	2.8	86.2

Amendment to Bradley Lake Hydroelectric Project (FERC No. 8221) Bradley Lake Extension Project

Vegetation and Wildlife Habitat Mapping Change Study Appendix C: Verification Plots

Prepared for:

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Prepared by:

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December 2025

Sampling Point: dixon_118
Date: 2025-07-31
Wildlife Habitat: Lacustrine Fringe Fresh Grass-Sedge Marsh
Physiography: Lacustrine
Macrotopography: Waterbodies
Viereck code: Fresh Water

Notes: Untapped pond, cut in half by the new delta.

Sampling Point: dixon_122
Date: 2025-07-31
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Channel
Viereck code: Fresh Water

Notes: Re-flooded abandoned channel. Chlorotic looking alder, some are defoliated, in a re-flooded channel.

Sampling Point: dixon_125
Date: 2025-07-31
Wildlife Habitat: Upland and Subalpine Tall Alder Scrub
Physiography: Upland
Macrotopography: Lower Slope, Concave, North Facing
Viereck code: Open Black Cottonwood-Sitka Spruce Forest

Notes: Steep forested slope just off the old floodplain.

Sampling Point: dixon_134
Date: 2025-08-01
Wildlife Habitat: Artificial Fill
Physiography: Lacustrine
Macrotopography: Waterbodies
Viereck code: Fresh Water

Notes:

Sampling Point: dixon_136
Date: 2025-08-01
Wildlife Habitat: Artificial Fill
Physiography: Lacustrine
Macrotopography: Waterbodies
Viereck code: Water

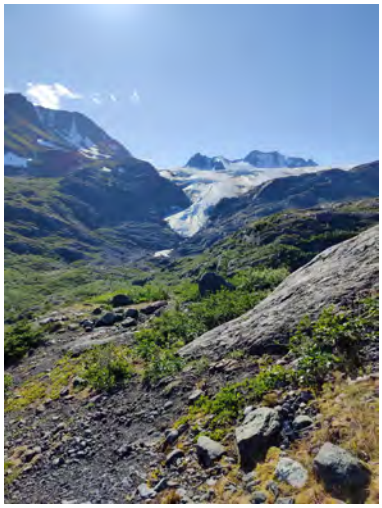
Notes: Shallow pond with emergent and floating aquatics

Sampling Point: dixon_146
Date: 2025-08-02
Wildlife Habitat: Lacustrine Fresh Water Tapped off-channel pond
Physiography: Riverine
Macrotopography: Waterbodies
Viereck code: Water

Notes: Swan lake. Connected basin.

Sampling Point: dixon_157
Date: 2025-08-03
Wildlife Habitat: Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex
Physiography: Subalpine
Macrotopography: Cliff (Rocky)
Viereck code: Barren

Notes: Plot on periphery of cliff.



Sampling Point: dixon_158
Date: 2025-08-03
Wildlife Habitat: Glaciated Subalpine Rock-Shrub Scrub-Meadow Complex
Physiography: Subalpine
Macrotopography: Cliff (Rocky)
Viereck code: Open Tall Alder

Notes: Vegetated micro sites on rocky cliffs, north facing.

Sampling Point: dixon_163
Date: 2025-08-03
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Channel
Viereck code: Water

Notes: Washout of vegetated bar

Sampling Point: dixon_164
Date: 2025-08-03
Wildlife Habitat: Riverine Dryas Dwarf Shrub
Physiography: Riverine
Macrotopography: Lateral Bar
Viereck code: Closed Tall Alder

Notes: Alder-cottonwood shrub on abandoned channel deposit.