INITIAL CONSULTATION DOCUMENT

AMENDMENT TO BRADLEY LAKE HYDROELECTRIC PROJECT (FERC NO. 8221)

PROPOSED DIXON DIVERSION

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DEFINITIONS OF TERMS, ACRONYMS, AND ABBREVIATIONS

A	
ACCSUA	Alaska Center for Conservation Science at the University of Alaska
ACSP	Alaska Shorebird Group
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AEA	Alaska Energy Authority
ANS	aquatic nuisance species
APE	area of potential effect
ASCP	Alaska Shorebird Conservation Plan
B	
BCC	Birds of Conservation Concern
BLM	Bureau of Land Management
BMC	Birds of Management Concern
C	
°C	degrees Celsius
CEII	Critical Energy Infrastructure Information
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHA	Critical Habitat Area
CIAA	Cook Inlet Aquaculture Association
CIBW	Cook Inlet Beluga Whale
cm	centimeters
Commission	Federal Energy Regulatory Commission
D	
DO	dissolved oxygen
DPS	Distinct Population Segment
E	
EFH	essential fish habitat
ESA	Endangered Species Act
F	
FERC	Federal Energy Regulatory Commission
G	
GMU	Game Management Unit
I	
ICD	Initial Consultation Document
K	
kV	kilovolt
KP-CISMA	Kenai Peninsula Cooperative Invasive Species Management Area
M	
mg/L	milligrams per liter
MVA	megavolt-amperes

MLRAs	Major Land Resource Areas
msl	mean sea level
mm	millimeters
MW	megawatt
N	
NAWCP	North American Waterbird Conservation Plan
NAWMP	North America Waterfowl Management Plan
NERR	National Estuarine Research Reserve
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPHA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity units
NWI	National Wetlands Inventory
P	
PCE	primary constituent elements
PME	protection, enhancement and mitigation
S	
SHPO	State Historic Preservation Officer
T	
TDS	total dissolved solids
U	
USDA	United States Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Z	
ZPE	zone of potential effect

1.0 INTRODUCTION

The Alaska Energy Authority (AEA) is pursuing a Federal Energy Regulatory Commission (FERC) license amendment associated with the existing 120-megawatt (MW) Bradley Lake Hydroelectric Project (Bradley Lake Project, FERC No. P-8221). The purpose of the amendment is to gain authorization to divert water from the Dixon Glacier to generate additional power. This Initial Consultation Document (ICD) describes the potential Dixon Diversion Project to be investigated using FERC's consultation process described at 18 Code of Federal Regulations (CFR) Section 4.38(b).

AEA owns the Bradley Lake Project, which is operated on behalf of AEA by Homer Electric Association. The Bradley Lake Project is located on the Bradley River in the Kenai Peninsula Borough northeast of the town of Homer in Southcentral Alaska. The existing Bradley Lake Project diverts water from the Middle Fork Bradley River, Nuka River, East Fork Upper Battle Creek, and the West Fork Upper Battle Creek into Bradley Lake and to the Bradley Lake Project powerhouse, located near upper Kachemak Bay, through a 3.5-mile-long power tunnel. The Project is located outside (east and north) of the Kenai Refuge administered by the U.S. Fish and Wildlife Service (USFWS), and discharges into the Kachemak Bay National Estuarine Research Reserve (NERR; Figure 1-1).

With this ICD, AEA is initiating first-stage consultation for a proposed capacity license amendment for the Bradley Lake Project. AEA is investigating the feasibility of developing the outflow from Dixon Glacier (designated as the East Fork of the Martin River in this document) for additional water supply for increased Project generation purposes. AEA will seek FERC authorization for the construction, operation, and maintenance of a new diversion system at the toe of Dixon Glacier that would divert flows from the East Fork of the Martin River. The intent of the proposed action would be to increase the generation of renewable hydropower at the Bradley Lake Project and/or develop a new Martin River powerhouse.

AEA is exploring alternative configurations to utilize the flow from Dixon Glacier. Two potential diversion configurations have been identified, as described in Section 4.0. As a component of the application for a license amendment, AEA would request authorization to increase the maximum pool elevation of the Bradley Lake impoundment. Three potential new maximum pool elevations have been identified. The new diversion system, powerhouse, and all associated structures would be entirely on state lands that are managed by the Alaska Department of Natural Resources (ADNR).

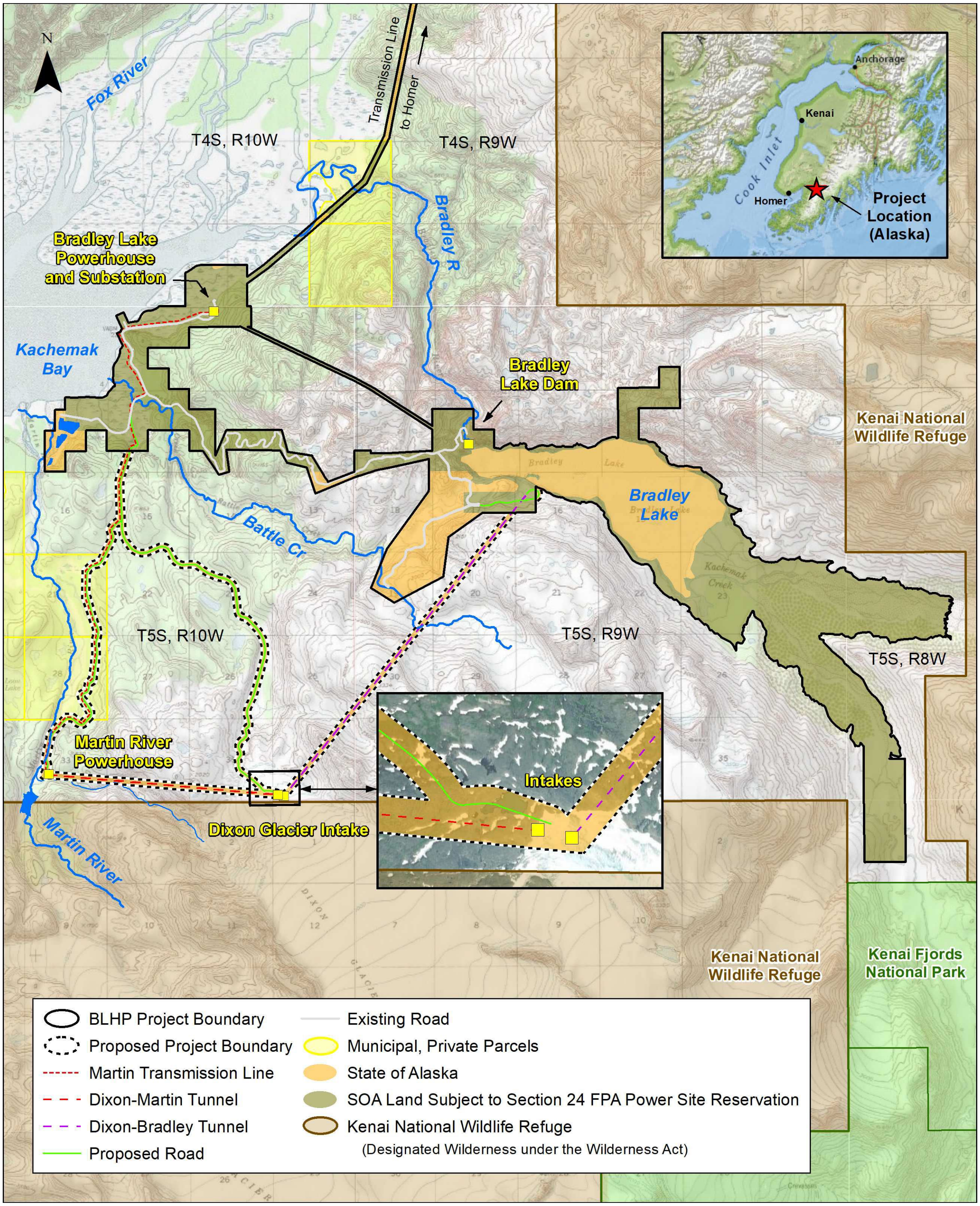


Figure 1-1 Location of the Bradley Lake Project and Proposed Action

AEA is distributing this ICD to FERC, federal and state resource agencies, local governments, Indian tribes, and other parties potentially interested in the proposed amendment proceeding. This ICD contains the following information:

- Section 2.0 – Proposed Process Plan and Schedule
- Section 3.0 – Description of the Existing Bradley Lake Project
- Section 4.0 – Description of the Proposed Project
- Section 5.0 - Description of the Existing Environment
- Section 6.0 – Anticipated Effects and Potential Studies

Section 2.0 provides additional description of AEA's anticipated three-stage consultation and outreach efforts associated with this proposed action. AEA will develop a draft and final amendment application that will refine the proposed action and include the applicable exhibits.

2.0 LICENSE AMENDMENT PROCESS PLAN AND SCHEDULE

2.1 Amendment Process and Schedule

Depending on the alternative selected, AEA's proposed action could result in either a capacity or non-capacity amendment[1], but under any alternative the proposed action would include potential modification of Bradley Lake Dam and construction of a new diversion that would result in a significant change in the normal maximum surface area or elevation of Bradley Lake. Therefore, AEA intends to conduct the three-stage consultation process described in 18 CFR § 4.38(b), (c), and (d) to include: (1) reaching out to relevant agencies, tribes, and members of the public (stakeholders), holding a public meeting and consulting with stakeholders regarding any study needs and requests; (2) conducting study planning, implementing studies, and providing a draft application for review and comment to stakeholders; and (3) filing the final amendment application with FERC to include revisions to applicable existing exhibits as defined in 18 CFR §4.201(b).

In following FERC regulations requiring three-stage consultation, AEA intends to fully engage interested stakeholders and provide detailed analysis of the potential effects of the new proposed diversion and increase in impoundment level of Bradley Lake in its license amendment application. With the filing of the ICD, AEA has requested to be designated FERC's non-federal representative for informal ESA consultation (which includes analysis of Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation and Management Act), and Section 106 consultation pursuant to the National Historic Preservation Act (NPHA). Table 2-1 provides a preliminary process schedule of the anticipated FERC approval process for the Dixon Diversion amendment application.

[1] As defined in 18 Code of Federal Regulations (CFR) § §4.201(b), the Federal Energy Regulatory Commission (FERC) defines a capacity amendment application as "an amendment that would increase the project's actual or proposed total installed capacity by 2 megawatts or more and increase the project's maximum hydraulic capacity by 15 percent or more." Project modifications that do not meet both the installed and hydraulic capacity criteria are considered non-capacity amendments.

Table 2-1 Preliminary Dixon Diversion Amendment Process Schedule

Responsible Party	Activity	Dates
AEA/Stakeholders	Initial Agency Consultation	January - March 2022
AEA	Conduct 2022 Preliminary Studies	Summer 2022
Stage 1		
AEA	File and Distribute ICD, Request for Non-federal Representative, and Newspaper Notice	April 2022
FERC	FERC Issues Notice of Amendment Accepted	May 2022
AEA	Provide Agencies/Public with Notification of Joint Meeting Location and Timing	May 2022
AEA/Stakeholders	Hold Joint Agency/Public Meeting and Site Visit	June 14-15, 2022
FERC/Stakeholders	Comments on ICD/ Proposed Studies Due	August 14, 2022
Stage 2		
AEA	Distribute Study Plans	October 2022
Stakeholders	Comments on Study Plans	December 2022
AEA	Conduct 2023 Season Studies	Spring/Summer 2023
AEA	Issue Study Reports	October 2023
Stakeholders	Comments on Study Report	December 2023
AEA	Conduct 2024 Season Studies (if needed)	Spring/Summer 2024
AEA	Submit Draft Amendment Application	October 2024
FERC/Stakeholders	Comments on Draft Amendment Application	January 2025
Stage 3		
AEA	Submit Final Amendment Application	May 2025
FERC	FERC Notice of Amendment	July 2025
FERC	Comments on Amendment Application	October 2025
FERC	FERC EA/EIS* (subject to change)	July 2026
AEA	FERC Amendment Order (subject to change)	January 2027

Note: Post license Order actions, including key engineering, construction and FERC dam safety milestones will be developed once the alternative is selected.

2.2 Joint Agency and Public Meeting and Site Visit

AEA plans to hold an agency site visit and Joint Agency and Public Meeting (Joint Meeting or meeting) to discuss AEA's proposed amendment and information provided in the ICD. The agency site visit will be on June 15, following the Joint Meeting. AEA consulted with agencies regarding availability and intends to conduct a Joint Meeting on June 14, 2022, at the Aspen Suites Hotel in Homer, Alaska from 5pm to 7pm. The Joint Meeting will allow AEA to provide information and receive public input regarding AEA's proposal to amend the license for the Bradley Lake Hydroelectric Project. The public meeting details include:

June 14, 2022
5 to 7 pm.
Aspen Suites Hotel
Sterling Highway in Homer, Alaska
Alaska Aspen Meeting Room

The agenda for the Joint Agency and Public Meeting will consist of (a) a description of the existing project and proposed action, (b) an explanation of the FERC amendment process, (c) a discussion of the anticipated study program, and (d) obtaining input from the public regarding resource aspects to be addressed in the amendment application. AEA kindly requests that resource agencies planning to attend the agency site tour submit an RSVP to Bryan Carey at bcarey@akenergyauthority.org or by phone at (907) 771-3065 by May 20, 2022.

2.3 Summary of Consultation to Date

AEA invited multi-agency partners including representatives of Alaska Department of Fish and Game (ADFG), Alaska Department of Natural Resources (ADNR), the Kenai National Wildlife Refuge, National Marine Fisheries Service (NMFS), and the United States Forest Service to an informal outreach meeting on February 8, 2022. AEA presented an overview of the proposed action and described early information gathering activities to be implemented in 2022, including a Red Lake outflow gage and limited fish and water quality sampling in the Martin River.

2.4 Expected Application Contents and License Modifications

For capacity-related amendment applications, the required exhibits, or revisions or additions to any existing exhibits, would depend on the scope of the licensed project, as defined in 18 CFR §4.201(b). As defined in 18 CFR §4.201(c), a non-capacity amendment application must contain those exhibits that require revision considering the nature of the proposed amendments. All applications to amend a license need to include an initial or introductory statement as specified in 18 CFR 4.201(a).

AEA anticipates that the proposed Dixon Diversion amendment application would require the following exhibits to include description of the selected proposed alternative and analysis of potential related environmental and economic effects of the proposed action.

- Exhibit A – Project Description
- Exhibit B – Project Operations and Resource Utilization
- Exhibit C – Construction Schedule
- Exhibit D – Project Costs and Financing
- Exhibit E – Environmental Report
- Exhibit F – General Design Drawings
- Exhibit G – Project Boundary

The analysis would focus on the lands and habitats potentially affected by construction, operation, and maintenance of the proposed diversion elements, including access roads and transmission lines. Potential effects of an increase in size of the Bradley Lake impoundment would also be analyzed and discussed. Collectively, these areas are referred to as the "zone of potential effect" (ZPE); this ZPE would be refined into a formal amended project boundary (i.e., Exhibit G) for the Bradley Lake Project in the final amendment application, based on the results of completed environmental studies.

2.5 Other Permitting Efforts

In addition to the FERC process, AEA would also consult with federal and state resource agencies to obtain the applicable permits associated with the selected proposed action, including required permits associated with proposed field studies, and for the construction and operation of the proposed diversion facilities. Following is a preliminary summary of the anticipated additional permits,

- Alaska Department of Fish and Game Title 16 Habitat permit
- Revised ADNR Water Right
- US Army Corps of Engineers Section 404 Clean Water Act permit

- ADNR Division of Mining, Land, and Water permit to excavate materials
- ADNR Division of Mining, Land, and Water permit for access across state lands
- Special Use permits associated with the Kenai National Wildlife Refuge and Wilderness Area
- Alaska Department of Fish and Game Special Area permit for the Kachemak Bay and Fox River Flats critical habitat areas (CHAs)

The required permits will be further identified in consultation with the appropriate resource agencies once the proposed action alternative is selected.

3.0 EXISTING BRADLEY LAKE PROJECT

3.1 Existing Project Facilities

Bradley Lake Dam is a concrete-faced rockfill dam 125 feet high that raises the natural water level of Bradley Lake by 100 feet. Normal full pool of Bradley Lake is at an elevation of 1,180 feet[2] with usable storage of approximately 280,000 acre-feet. Bradley Lake Dam includes a 4-foot-high parapet wall on the crest and an ungated ogee spillway located on a saddle feature 150 feet east of the dam with crest elevation 1,180 feet and a discharge capacity of 23,800 cfs at pool elevation 1190.6 feet. Bradley Lake is fed by both natural and diverted water sources. The primary natural tributaries to Bradley Lake are an unnamed tributary referred to as the Upper Bradley River, Kachemak Creek, and Marmot Creek. A diversion conveys water from the Middle Fork of the Bradley River to Marmot Creek, a tributary to Bradley Lake, through two reaches of open channel approximately 760 feet and 483 feet long. A glacial pool immediately below Nuka Glacier is located on the divide between the upper Nuka River and the Upper Bradley River. A low dike was constructed that directs the first 5 cfs of flow entering the glacial pool into the upper Nuka River and any remaining inflow into the Upper Bradley River. Diversions from the Battle Creek basin include a low diversion dam on the East Fork Upper Battle Creek that diverts water to an unnamed tributary to Bradley Lake and a 16-foot-high diversion dam on the West Fork of Upper Battle Creek directing flow through 9,270 feet of pipeline to the existing Upper Battle Creek diversion outlet channel. Outflows from Bradley Lake include releases through a 470-foot-long diversion, 18-foot-nominal diameter horseshoe-shaped tunnel through the east abutment for instream flow releases into the Bradley River downstream of Bradley Lake Dam (Lower Bradley River) and the 18,110-foot-long power tunnel that carries water from Bradley Lake to the powerhouse, located on the south shore and near the head of Kachemak Bay.

The Bradley Lake Hydroelectric Project commenced operation in 1991. The 138-foot-long, 66-foot-wide, 112-foot-high reinforced concrete powerhouse includes two 60-

[2] All elevations unless otherwise noted in this report are referred to Bradley Lake Project Datum, at which zero is equal to 13.63 feet above mean lower low water at Bear Cove. Add 9.76 feet at Bradley Dam vertical control station "Venus" to convert Project Datum to North American Vertical Datum of 1988 elevations.

megawatt (MW) generating units with a nominal generating capacity of 120 MW at 917 feet net head. Each generating unit consists of a six jet, vertical shaft Pelton turbine driving a 63 Mega Volt-Amps (MVA) generator at 0.95 power factor. The penstock includes a wye for a potential future third unit. The Project tailrace channel, with a bottom width of 67 feet, discharges into Kachemak Bay. The Project is connected to the existing Kenai Peninsula transmission and distribution system via a 20-mile overhead transmission line, consisting of two parallel 115-kilovolt (kV) lines.

Access to the facility is limited to aircraft or marine craft due to the remote location and lack of connection to the state road system. Water access to the Project is from a dock facility consisting of five sheet pile cells placed into the tidal flats of Kachemak Bay. A rockfill, gravel-surfaced causeway extends approximately 700 feet from the shoreline, which connects the barge dock cells to the Project access road at the bay shoreline. Use of this facility is available only during half tides and greater. A small, aluminum floating dock is attached to the sheet pile cells to provide mooring for skiffs belonging to the public. This small dock is removed each winter to prevent it from being damaged by ice.

Travel to the site is generally by air from the Homer Airport. The Project airstrip is 2,400 feet long and 75 feet wide and is equipped with plane lights, a taxi and parking apron, weather building, and warning lights. The airstrip is designed for visual flight rule use only and is not open to the public. About 10.8 miles of gravel surface access roads were constructed as part of the original (1989-1991) project and connect the powerhouse, airstrip, lower and upper construction camps, and the dam. An additional 2.8 miles of gravel surface access roads were constructed in 2018-2020 for the West Fork Upper Battle Creek diversion.

Table 3-1 Bradley Lake Project Description

Project Element	Description
Dam	Concrete-faced rockfill, 600 feet-long, 125-feet high, 360,000 cubic yards rockfill, and 10,800 cubic yards concrete
Spillway	Ungated concrete ogee section, 175-feet long (11,000 cubic yards concrete)
Power Tunnel	13-foot nominal diameter, fully concrete lined, approximately 19,152 feet in length
Diversion Tunnel	21-foot horseshoe concrete lines/penstock tunnel, 407.5-feet long
Penstock	Steel, 9-foot diameter with 6.5-foot diameter branches
Middle Fork Diversion	1,517-foot diversion includes upper and lower channels with intake basin and stilling basin
Nuka Diversion	2 diversion and control dikes, pilot channel and outlet weir
Upper Battle Creek Diversions [1]	East Fork: 300-foot diversion channel with talus diversion berm. West Fork: 22-foot high rock fill diversion dam with concrete core wall; Diversion pipeline 9,271 feet long, pipe diameter from 63-inch to 96-inch.
Airstrip	Gravel surface airstrip 2,400-feet long by 75-feet wide incorporated into access road
Annual Firm Energy	329 gigawatt hours
Average Annual Energy	376 gigawatt hours
Transmission Line	115 kV, two parallel lines, 20-miles long
Barge Dock	Sheet pile cells, granular fill
Access Roads	13.6 miles, gravel
Powerhouse	Surface, steel superstructure, 160-feet long, 80-feet wide, 92-feet high
Turbines	2 each Pelton, vertical shaft, 90,170 horsepower maximum
Generators	2 each, rated output at maximum operating pool is 63 MVA
Governors	2 each Emerson digital

Source: FERC 06032021 Exhibit A, [1] Description of Upper Battle Creek Diversions updated after Exhibit A filing in June

3.2 Existing Project Operations

The Bradley Lake Project releases water from the powerhouse directly into Kachemak Bay via the tailrace channel. As summarized in Table 3-2, under the existing license per the FERC Amendment Order issued on September 8, 2020, AEA is required to provide minimum flow releases into the Lower Bradley River from Bradley Lake Dam, as measured at the U.S. Geological Survey (USGS) tidewater streamflow gage number 15239070 on the Lower Bradley River. The minimum flow may be temporarily modified if required by operating emergencies beyond the control of the licensee, and for short periods upon agreement between the licensee and Alaska Department of Fish and Game (ADFG).

Table 3-2 Lower Bradley River Minimum Flow Requirements

Date	24- Hour Rolling Average Minimum Flow[1]	Instantaneous Minimum Flow
May 12 to September 14	100 cfs	92.5 cfs
September 15 to 23	Decrease flow 5 cfs per day to 50 cfs	Based on a flow of 100 cfs, decrease flow 5 cfs per day minus an additional 7.5 percent[2]
September 24 to October 31	50 cfs	46.25 cfs
November 1	Decrease flows 5 cfs per day to 40 cfs	Based on a flow of 50 cfs, decrease flow 5 cfs per day minus 7.5 percent
November 2 to April 30	40 cfs	37 cfs
May 1 to 11	Increase flows 5 cfs per day to 100 cfs	Based on a flow of 40 cfs, increase flow 5 cfs per day minus 7.5 percent

Source: FERC Order Amending Minimum Flows, issued September 8, 2020.

[1] The 24-hour rolling average is defined as the average flow for a point in time using the proceeding 12-hour period and the succeeding 12-hour period.

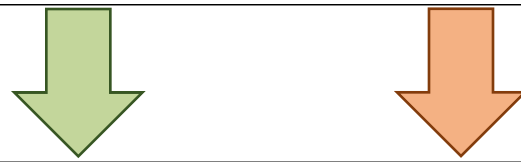
[2] For example on September 15 the required 24-hour rolling average minimum flow is 95 cfs and the required instantaneous flow is 87.9 cfs (95 cfs - 7.5 percent). On September 16, the required 24-hour rolling average minimum flow is 90 cfs and the required instantaneous flow is 83.3 cfs (90 cfs - 7.5 percent).

Amended License Article 56 requires AEA to provide minimum flow releases from the West Fork Upper Battle Creek diversion dam of 15 cubic feet per second (cfs), plus any additional flow exceeding the pipeline capacity of 600 cfs July 1 through September 15; 25 cfs, plus any flow exceeding the pipeline capacity, or all available flow if diversion is not occurring October 1 through November 30 or until the diversion is shut down for year; and 5 cfs, plus any additional flow exceeding the pipeline capacity, or all available flow if diversion is not occurring, at all other times. For channel maintenance, AEA must release an instantaneous peak flow of 800 cfs for a minimum duration of 8 hours at least 3 years out of each rolling 10-year period of project operation. Storms resulting in flows of 800 cfs for a duration of 8 hours, as measured at the gage required in Article 58, would count for one channel maintenance flow. Additionally, lesser flows and/or durations recorded at the required gage may count as a maintenance flow event if the licensee consults with the ADFG following the event and the agency approves the flow as a maintenance flow event.

4.0 PROPOSED ACTION

AEA proposes the development of a new water diversion system from the toe of Dixon Glacier on the East Fork of the Martin River. AEA is currently exploring alternative configurations. Under all scenarios, water from Dixon Glacier would be diverted and the Bradley Lake pool elevation would be increased. Various combinations of these changes are summarized in Figure 4-1.

	Alternatives					
Tunnel	Dixon-Bradley Lake (DB)			Dixon-Martin River (DM)		
Pool Raise Height	7	14	28	7	14	28



Structures	**DB7**	**DB14**	**DB28**	**DM7**	**DM14**	**DM28**
Dixon Diversion Dam	x	x	x	x	x	x
BL Spillway Modification	x	x	x	x	x	x
BL Embankment Modification		x	x		x	x
Martin River Powerhouse				x	x	x
Road: Workforce Housing to Dixon Diversion	x	x	x	x	x	x
Road: Martin River Powerhouse Spur				x	x	x
Road: Bradley Lake Tunnel Portal	x	x	x			
Transmission: Martin River Powerhouse to BLHP				x	x	x

Figure 4-1 Summary of Proposed Action Alternatives for the Dixon Diversion Including Tunnel and Pool Raise Alternatives and the Proposed Structures Associated with Each Alternative

4.1 Proposed Project Facilities

4.1.1 Dixon Diversion

A new diversion dam would be constructed on state-owned land to impound water sufficient to feed a power tunnel to either Bradley Lake or a Martin River powerhouse. The design and configuration would be determined as part of the Project feasibility assessment and development. AEA anticipates that the diversion would be a concrete weir wall approximately 25-feet high by 75-feet long; and a crest elevation of 1,275 feet. The approximate inlet elevation for either tunnel would be 1,263 feet, subject to additional topographic surveys and design layout. A forebay area would act as a stilling basin for the intake, currently estimated to include approximately 1.0 surface acre with a storage capacity of approximately 5 acre-feet at elevation 1,275 feet. With a Martin River tunnel, pool level would be controlled by adjusting the powerplant flow. With a tunnel to Bradley Lake, control would consist of maintaining minimum in-stream bypass to the East Fork Martin River canyon with the remaining flow, up to the tunnel capacity, diverted to Bradley Lake. Under both scenarios, excess flow greater than the capacity of the tunnel would spill over the diversion weir wall to the East Fork Martin River canyon.

4.1.2 Conveyance Structures

4.1.2.1 Dixon Diversion to Bradley Lake Tunnel

A tunnel would be bored to route water from the proposed Dixon Diversion on state-owned land below the toe of Dixon Glacier to the southwestern portion of Bradley Lake. AEA anticipates that this flowline would be comprised of an approximately 4.9-mile-long tunnel with a diameter of approximately 12 feet. The invert of the tunnel entrance would be approximately 1,263 feet and the invert at the outlet would be approximately 1, 210 feet.

4.1.2.2 Dixon Diversion to Martin River Tunnel

A power tunnel would be bored between the powerhouse on the Martin River and the intake on state-owned land below the toe of Dixon Glacier. The pressurized tunnel would be approximately 2.75-miles long and have a diameter of approximately 10 feet. The invert of the tunnel entrance would be at approximately 1,263 feet and would convey water to the powerhouse on the Martin River at an elevation of approximately 300 feet.

4.1.3 Martin River Powerhouse

The Martin River powerhouse would be located approximately 5 miles upstream of the mouth of the Martin River, on the eastern shore near the confluence of the East Fork Martin River and the outflow from Red Lake. The reinforced concrete powerhouse footprint would be approximately 100 feet by 60 feet and house a 55 MW vertical Pelton turbine. The footprint will be refined based on topography and geotechnical investigations.

4.1.4 Bradley Lake Dam Modification

Bradley Lake Dam currently impounds Bradley Lake to a full pool elevation of 1,180 feet (Project Datum) with a surface area of 3,820 acres and a storage capacity of approximately 284,000 acre-feet. Regardless of which alternative is selected, AEA will request that FERC authorize an increase in the maximum authorized pool elevation for Bradley Lake. Notwithstanding the feasibility of Dixon Diversion alternatives, AEA has determined that a pool raise at Bradley Lake is warranted to increase flexibility in the timing of power generation; and that proposal might proceed under a separate amendment, which AEA could pursue along a parallel path until a determination is made regarding the feasibility of the Dixon Diversion alternatives described above.

4.1.4.1 7-foot Alternative

The 7-foot Alternative would involve increasing the level of Bradley Lake to elevation 1,187 feet by adding 7-foot-high spillway crest gates over the fixed (concrete) spillway crest. The crest of the embankment would not need to be raised as the design flood could be passed through the spillway with the spillway crest gates opened. This would result in an increase in the total surface acreage to 3,914 surface acres and an increase in storage capacity to approximately 312,000 acre-feet. This raise maintains the maximum reservoir level within the existing project boundary at an elevation of 1,200 feet.

4.1.4.2 14-foot Alternative

The 14-foot Alternative would involve increasing the level of Bradley Lake to elevation 1,194 feet through a combination of raising the concrete spillway crest elevation and adding spillway crest gates. Under this alternative, the dam crest would also be raised 7 feet through a combination of increased rockfill and a new parapet wall that would be extended to the left abutment. This would result in an increase in the total surface area to 4,021 surface acres and an increase in storage capacity to approximately 343,000 acre-feet. AEA has planned this pool raise to ensure that Kenai National Wildlife Refuge lands would not be inundated at the proposed new maximum pool elevation.

4.1.4.3 28-foot Alternative

The 28-foot Alternative would involve increasing the normal full pool level of Bradley Lake to elevation 1,208 feet through a combination of raising the concrete spillway crest elevation and adding spillway crest gates. Under this alternative, the dam crest would also be raised 21 feet through a combination of increased rock fill and a new parapet wall that would be extended to the left abutment; the diversion tunnel gatehouse would also be raised. This would result in an increase in the total surface area to 4,224 surface acres and an increase in storage capacity to approximately 389,000 acre-feet. AEA has planned this pool raise to ensure that Kenai National Wildlife Refuge lands would not be inundated at the proposed new maximum pool elevation. The maximum flood pool level would remain on lands owned by the State of Alaska.

4.1.5 Access Roads

A total of approximately 7.3 or 10.1 miles of new, 16-foot-wide, gravel-surfaced access roads would be constructed to support operations and maintenance of the new project facilities. An approximately 6.3-mile-long road segment would extend from the existing Bradley Lake Access Road to the new Dixon Diversion. For the Dixon-Martin alternative, a spur would extend about 3.8 miles to the Martin River powerhouse. For the Dixon-Bradley tunnel alternative, a spur road off the existing Upper Battle Creek access Road would be extended 1 mile to the downstream exit of the tunnel from the Dixon Diversion.

4.1.6 Transmission Line

AEA would install a new, approximately 6.9 mile-long, 115-kV transmission line to connect the new Martin River powerhouse to the existing substation at the Bradley Lake Project powerhouse for the Dixon-Martin Alternative. Subject to further evaluation, AEA intends this transmission line to parallel the Dixon Diversion and Martin River powerhouse access road described above. From the existing Bradley powerhouse substation, the Project would connect to the Homer Electric Association line between Fritz Creek and Soldotna via the existing 115-kV transmission line. The transmission line was constructed in 1990 and is in excellent condition. AEA would evaluate the capacity of the existing line to handle any increased load.

4.2 Proposed Project Operations

4.2.1 Proposed Diversion Operations

The pool level for diversion to the Martin River powerhouse would be controlled by adjusting the powerhouse flow to maintain a constant elevation. Control for flow diverted to Bradley Lake would consist of maintaining minimum in-stream bypass to the East Fork Martin River canyon with the remaining flow, up to the Dixon-Bradley Lake tunnel capacity, diverted to Bradley Lake. Excess flow would spill over the diversion spillway to the East Fork Martin River canyon. The outflow from Dixon Glacier at the diversion is very low in the winter, and it is anticipated that the powerhouse would be shut down annually from November through May.

4.2.2 Proposed Pool Management

No change to Project minimum flows (timing, amount, or duration) into the Lower Bradley River are proposed. However, the proposed operations would change either the timing, duration, or extent of Project discharges at the BLHP powerhouse tidal outflow location with corresponding changes in Bradley Lake storage.

5.0 AFFECTED ENVIRONMENT

The area potentially affected by the construction, operation and maintenance of the proposed action is referred to as the zone of potential effect (ZPE).

5.1 General Description of Project Location

Bradley Lake Hydroelectric Project is located on the Kenai Peninsula approximately 25 miles northeast of Homer, Alaska in the Southcentral region of Alaska. The Southcentral region of the state is geographically bounded by the Alaska Range to the north and west, the Wrangell Mountains to the east, and the Kenai Mountains to the southwest. This region includes Cook Inlet, the Matanuska-Susitna Valley, the Kenai Peninsula, Prince William Sound, and the Copper River Valley.

The Kenai Peninsula extends approximately 150 miles southwest from the Chugach Mountains, south of Anchorage. It is separated from the mainland on the west by Cook Inlet and on the east by Prince William Sound. More than half of the peninsula's 6 million acres have a history of federal management, including establishment of predecessors to the current Chugach National Forest in 1907, Kenai National Wildlife Refuge in 1941, and Kenai Fjords National Park in 1978 (Morton et al. 2015). The 2-million-acre Kenai National Wildlife Refuge stretches from the northern tip of the Peninsula to the south side of Kachemak Bay and includes parts of the Harding Icefield (USFWS 2010). Kenai Fjords National Park protects 670,000 acres including portions of the Harding Icefield and its outflowing glaciers and coastal fjords along the Gulf of Alaska on the Kenai Peninsula's southern shore (NPS 2020). Other nearby protected areas include the 380,000-acre combination of the adjacent Kachemak Bay State Park and Kachemak Bay State Wilderness Park near the mouth of Kachemak Bay (ADNR 2020).

The climate of Southcentral Alaska is subarctic. The hours of daylight per day varies from almost 19 hours in June to 6 hours in December (NOAA 2022a). Kachemak Bay has a subarctic coastal climate; its weather is moderate compared to interior Alaska (ADNR 2020). Winters are snowy and long, with the average January high temperature only slightly below freezing. In Halibut Cove, snow averages 88 inches per season, falling primarily from November through March, with some accumulation in October and April, and rarely in May (ADNR 2020). Precipitation is spatially variable around Kachemak Bay. Homer receives only about 25 inches of rainfall annually due to the influence of the

Kenai Mountains to the southeast, which shelter it from the Gulf of Alaska (USACE 1982). The outlet of Bradley Lake was estimated to receive 40 inches annually (USACE 1982). Kachemak Glacier, less than 11 miles from Bradley Lake, averages approximately 180 inches per year (USACE 1982). Most of the rain falls between September and December (U.S. Climate Data 2022).

5.1.1 Bradley River

Bradley Lake is fed by both natural and diverted water sources. The two major natural inflow tributaries to the lake are Kachemak Creek, which begins at Kachemak Glacier, and an unnamed tributary referred to as the Upper Bradley River. The Upper Bradley River begins at the Nuka Glacier and, historically, had a unique attribute in that natural flow from the Nuka Glacier periodically shifted between flowing north into the Upper Bradley River and draining south into the Nuka River (FERC 1985). Since the Nuka Diversion was constructed, the first 5 cfs of flow from Nuka Glacier that reaches the glacial pond on the divide flows to the Nuka River and the remainder flows into the Upper Bradley River. A diversion dam is also located on the Middle Fork Bradley River, diverting flow into Marmot Creek, a tributary of Bradley Lake. Diversions on the East Fork Upper Battle Creek and West Fork Upper Battle Creek also direct flow into the reservoir. Outflows from Bradley Lake include the Lower Bradley River and the Project power tunnel to the BLHP powerhouse. From Bradley Lake, the Bradley River flows northward for approximately 5 miles and discharges into Kachemak Bay. The North Fork of the Bradley River and the bypass reach of the Middle Fork flow into the mainstem about 3.3 miles downstream of the Bradley Lake Dam. The drainage area of the Bradley River is estimated to be approximately 82.4 square miles (USGS 2021d).

5.1.2 Martin River

The East Fork of the Martin River begins near the toe of the Dixon Glacier and then flows north for 7 miles into the eastern portion of Kachemak Bay (Figure 5-1). The river historically drained from both the Dixon Glacier and the Portlock Glacier, but glacial retreat has isolated the Portlock Glacier runoff, and the Martin River now receives water from primarily the Dixon Glacier (CoastView 2019; Freethey and Scully 1980). The uppermost reach of the Martin River is within the Kenai National Wildlife Refuge (Figure 1-1). Approximately 3.4 miles downstream of the proposed diversion dam, after a drop in elevation of approximately 900 feet, the East Fork of the Martin River is joined by the outflow channel from Red Lake, a small (approximately 25 acre) lake which discharges

Pertinent Abutting Watersheds

Dixon Diversion Project

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Figure 5-1 Subbasins of the Martin River

into the Martin River from the southwest. Downstream of Red Lake the Martin River is braided and meanders approximately 5 miles, dropping 300 feet to Kachemak Bay. The Martin River has migrated across the delta at its mouth, and currently most of the river flows through forest at the west side of the delta before emptying into Kachemak Bay. During construction of the Bradley Lake Project, gravel was mined from the Martin River delta, leaving three remediated borrow pits as ponds adjacent to the Martin River near its mouth (Parry and Seaman 1994).

5.1.3 Kachemak Bay

Kachemak Bay is on the southwest tip of the Kenai Peninsula. Kachemak Bay is 39 miles long and 24 miles wide at its entrance, with more than 320 miles of shoreline. The Bradley Lake Hydroelectric Project and proposed Dixon Diversion are near the head of Kachemak Bay, on its southern shore. The area in the vicinity of the Project is characterized by extensive tidal flats and shifting river deltas (FERC 1985). Watersheds at the head of the bay, and most watersheds on the bay's south side, are fed by glaciers lying on the north and west slopes of the Kenai Mountains. The southern slopes of Kachemak Bay are a steep, mountainous, ice field, with tree line at approximately 1,600 feet and the glacier-covered Kenai Mountains ultimately rising to over 5,000 feet (ADNR 2020). The Harding Icefield is approximately 31 miles by 50 miles and includes glaciers in the Grewingk-Yalik Glacier Complex that flow into Kachemak Bay (Adalgeirsdottir et al. 1998). Kachemak Bay is split into inner and outer bays by Homer Spit, which extends 4 miles into the bay from the northern shoreline. The tides at Kachemak Bay are extreme, with an average vertical difference (also called mean range) of over 15 feet (15.8 ft; ADNR 2020). Average high tides are about +18 feet, though high tides can reach +28 feet. Low tide reaches -5.9 feet as measured at the Seldovia Tide Station (ADNR 2020). In general, water flows into Kachemak Bay on the southern side and out of the bay on the northern side. The inflowing water is more marine while the outflowing water is more estuarine, being more turbid and less saline, due to the outflow of several rivers and streams that terminate in the bay (ADNR 2020).

As part of the Coastal Zone Management Act, the National Oceanic and Atmospheric Administration (NOAA) designated Kachemak Bay as a NERR 1999 (Field and Walker 2003). The Kachemak Bay NERR encompasses over 365,000 acres of almost exclusively state-managed lands and includes the waters of Kachemak Bay east of the line connecting Bluff Point in the north with Point Pugibshi in the south, the Fox River Flats, a large portion of Kachemak Bay State Park/Wilderness Park, the Beluga Slough property in public ownership, and city-owned tidelands and marshlands along the Homer Spit (Field and Walker 2003).

Kachemak Bay is also designated by the State of Alaska as CHA for the purpose of protecting and preserving habitat areas that are especially crucial to the endurance of fish and wildlife (Field and Walker 2003). The majority of the Kachemak Bay NERR falls within either the Kachemak Bay and Fox River Flats CHAs managed by ADFG or Kachemak Bay State Park, managed by the Alaska Division of Parks & Outdoor Recreation (Field and Walker 2003). Kachemak Bay NERR is also used as a resource to conduct research, monitoring, education, trainings, and community engagement, particularly by the Alaska Center for Conservation Science at the University of Alaska, Anchorage (ACCSUA). Therefore, administratively, the Kachemak Bay NERR is managed collectively by NOAA and ADFG with input from a council of agency and Kachemak Bay community stakeholders (Field and Walker 2003). However, ACCSUA is considered the lead agency according to NOAA as the ACCSUA provides daily oversight in addition to conducting research (NOAA 2022b). Processes that contribute to the formidable fish, shellfish, bird, and mammal productivity in the region are extensively studied in addition to the consequences of climate change and human-induced activities to these resources.

5.2 Geology and Soils

The majority of the ZPE occurs within two Level III Ecoregions of Alaska: the higher elevation Pacific Coastal Mountains (119) Ecoregion and at lower elevations along the Kachemak Bay, the Coastal Western Hemlock-Sitka Spruce Forests (120) Ecoregion (Gallant et al. 1995).

The Pacific Coastal Mountains Ecoregion includes steep and rugged mountains along the coast of Southeast and Southcentral Alaska, which receive more precipitation annually than either the Alaska Range or Wrangell Mountains Ecoregions. Glaciated during the Pleistocene epoch, most of the ecoregion is still covered by glaciers and ice fields. Most of the area is barren of vegetation, but where plants do occur, dwarf and low scrub communities dominate (ADFG 2015).

The Coastal Western Hemlock-Sitka Spruce Forests Ecoregion is located along the shores of Southeast and Southcentral Alaska. The terrain is a result of intense glaciation during late advances of the Pleistocene epoch. The deep, narrow bays, steep valley walls that expose much bedrock, thin moraine deposits on hills and in valleys, very irregular coastline, high sea cliffs, and deeply dissected glacial moraine deposits covering the lower slopes of the valley walls are all evidence of the effects of glaciation. The region has the mildest winter temperatures in Alaska, accompanied by large amounts of precipitation. Forests of western hemlock and Sitka spruce are widespread (ADFG 2015).

The ZPE is located within the Southern Alaska (W1) Land Resource Region, which includes the arc of coastal mountains and lowlands along the Gulf of Alaska from the Alexander Archipelago in the southeast to Kodiak Island and the southern portion of the Alaska Peninsula to the west and includes the areas surrounding Cook Inlet. Highest elevation areas include rugged mountains with bare rock, talus, glaciers, and ice fields. The region includes glacial moraines, rolling hills, outwash planes and rugged coastline (USDA NRCS 2006).

The ZPE spans multiple Major Land Resource Areas (MLRAs), including Southern Alaska Coastal Mountains (222), Cook Inlet Mountains (223), and Alexander Archipelago-Gulf of Alaska Coast (220) with the existing transmission lines entering the Cook Inlet Lowlands (224) (USDA NRCS 2006). Soils in these MLRAs are variable but can be generalized with Gelepts and Cryenpt on steep mountain slopes and Cryods, Cryands, Aquands, and Cryepts on lower slopes, foothills and moraine (USDA NRCS 2006). Further, Spodosols and Andisols intergrade in some areas, particularly near volcanic surfaces, whereas Fluvents and Aquent are dominant on floodplains and low terraces. Histosols and Histic subgroups of other orders occur throughout the region and are found on level and depressional landforms and slopes along the coast (USDA NRCS 2021).

Few United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soil surveys have been completed for the Kenai Peninsula Borough. There are multiple soil survey areas within the ZPE, including Kenai Mountains and Kachemak Bay State Park Area (AK 774), Kenai Peninsula – Kanai Fjords National Park and Bordering Area (AK 773), and Western Kenai Peninsula Area (AK 652) (USDA NRCS 2021). However, soil data is only available for the Western Kenai Peninsula Area, which is located in the northern portion of the ZPE, including the existing transmission lines. In this northern area, the higher elevations and steep slopes are predominantly Lithic Haplocryands – Alic Haplocryands rock outcrop complexes (613, 614). These mountainous soils have parent materials of volcanic ash over till, are generally well-drained, have very high runoff potential, and are susceptible to erosion. Moving downgradient towards Kachemak Bay, the soils transition to Tutka-Portgraham complex (697) along slopes and hills. These soils are silty volcanic ash over glacial till and hard bedrock. Tidal influenced soils within Kachemak Bay include the Tidal Flats (688) and Typic Cryaquents (701) along the bay's margins, which are silty or clayey soils over marine deposits typically found along deltas and estuaries (USDA NRCS 2021).

5.3 Water Resources

5.3.1 Hydrology

All of the streams in the Kachemak Bay watershed have two annual peak periods of streamflow (Field and Walker 2003). The highest occurs in the fall (late August through November) when most precipitation falls, and the next peak occurs in the spring and early summer when the snow melts (Savard and Scully 1984). Low flow occurs at the end of winter, mid-February through mid-April, after which glaciers and snowmelt are the primary source of flow (Freethey and Scully 1980). The volume of flow from glacial rivers can be 10 times as much as that from clearwater rivers (Freethey and Scully 1980).

5.3.1.1 Bradley River

Hydrologic data for the Bradley River basin has been collected by USGS at five locations (Figure 5-2; Table 5-1). USGS Gage 15238990 is located in the Upper Bradley River near the Nuka Glacier approximately 1.2 miles downstream from Nuka Glacier terminus and 2.5 miles upstream from the confluence with Kachemak Creek at an elevation of approximately 1,250 feet above mean sea level (msl; USGS 2021a). The other gage measuring inflow to Bradley Lake is located on the Middle Fork of the Bradley River (USGS Gage 15239050), upstream of the Middle Fork diversion dam. USGS Gage 15239001 is located approximately 1,300 feet downstream of Bradley Lake Dam (USGS 2021c). USGS Gage 15239060 is located on the Middle Fork Bradley River downstream of the North Fork Bradley River and approximately 5.5 miles downstream of the Middle Fork Bradley River diversion dam, upstream of its confluence with the mainstem Lower Bradley River (USGS 2021b). The Middle Fork of the Bradley River gage is located approximately 3.6 miles downstream of Bradley Lake Dam at an elevation of approximately 225 feet msl (USGS 2021d). A gage is also located on the lower portion of the Bradley River: the Bradley River near tidewater (USGS Gage 15239070). The tidewater gage is located 0.8 miles downstream of USGS Gage 15239060 at elevation of approximately 25 feet msl (USGS 2021e).

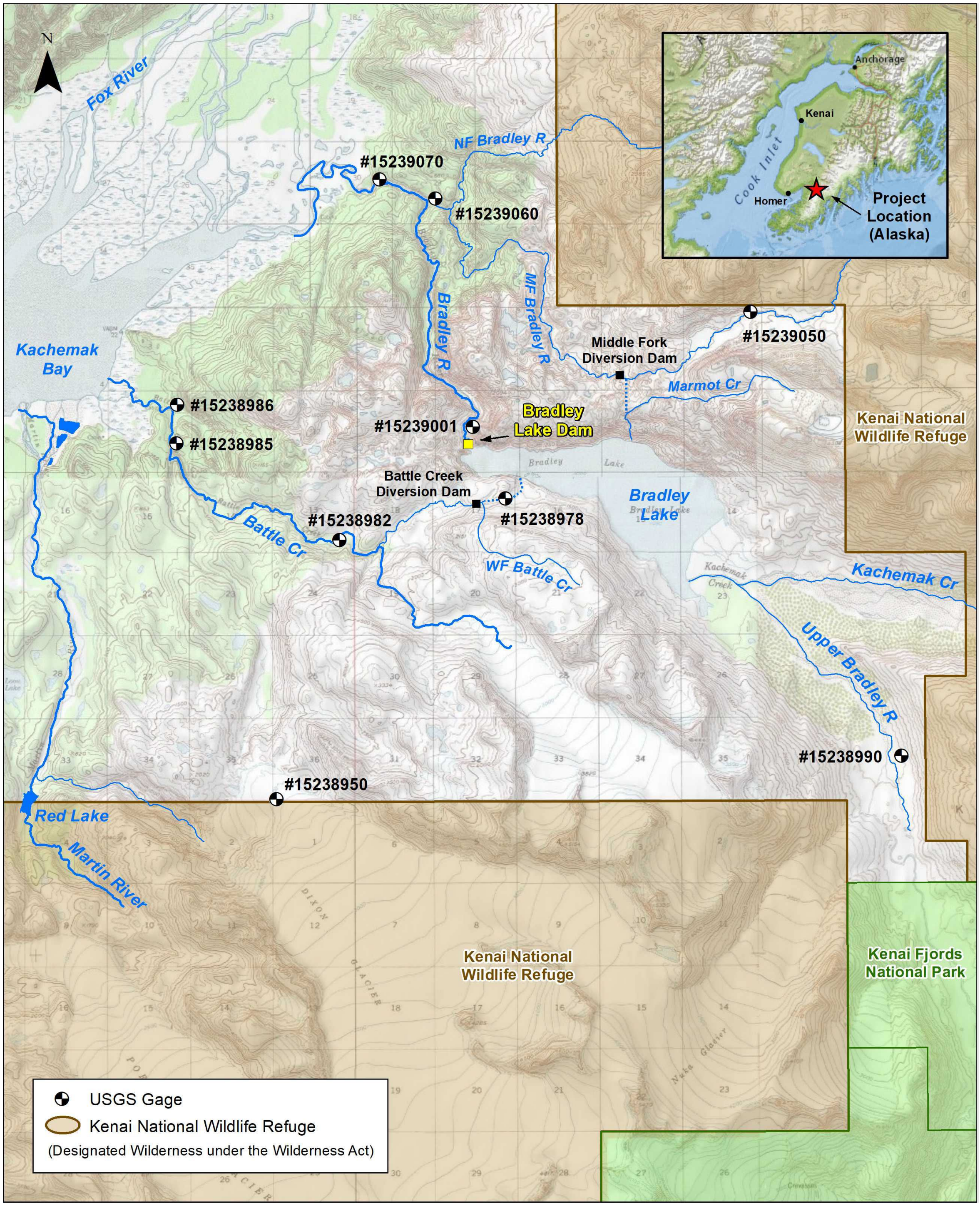


Figure 5-2 USGS Streamflow Gage Locations in the Bradley, Battle Creek, and Martin River Basins (Source: USGS 2022b)

Table 5-1 Active USGS Streamflow Gages in the Bradley and Martin River Basins

USGS Gage	Drainage Area (sq mi.)	Latitude	Longitude	Elevation (feet)	Available Period of Record
15239050 MF BRADLEY R NR HOMER AK	9.1	59°46'42"	150°45'15"	2,300[1]	October 1979 to current year
15239060 MF BRADLEY R BL NF BRADLEY R NR HOMER AK	unknown	59°47'54"	150°51'48"	225[1]	August 1996 to current year
15238990 UPPER BRADLEY R NR NUKA GLACIER NR HOMER AK	12.7	59°42'02"	150°42'09"	1,250[1]	October 1979 to current year
15239001 BRADLEY R BL DAM NR HOMER AK	66	59°45'30"	150°51'02"	1,054[2]	October 1989 to March 8, 2016, May 21, 2019 - current water year
15239070 BRADLEY R NR TIDEWATER NR HOMER, AK	82.4	59°48'06"	150°52'58"	25[1]	Water years 1986 to 1999, and October 2010 to current year
15238950 DIXON C NR HOMER AK	19.1	59°41'34.07"	150°55'6.11"		December 2021 to present

Source: USGS 2021a, 2021b, 2021c, 2021d, 2021e, 2021f, 2022a

Note: [1]NGVD29 [2]Project Datum [3]NAVD88

The Bradley River is typical of streams in coastal Alaska with low flows occurring during the winter and seasonal high flows occurring late in the late spring and again in late summer and fall. Approximately 90 percent of the annual runoff from the basin occurs during May-October. Discharge at the gages is typically recorded consistently during summer as the gages can become affected by ice during the colder months. Ice forms in the river in early November and remains intermittently through mid-April (Rickman 1998). The exception is USGS Gage 15239001, located directly downstream of Bradley Lake Dam, which measures discharge in 15-minute intervals year-round (USGS 2021c). During winter studies between 1993 and 1998, Rickman (1998) noted that warm water (2 to 4 degrees Celsius, °C) released from Bradley Lake in November and early December weakened and eroded ice, even during periods of cold air temperatures. Water released from the lake after mid-December was no longer warm enough to cause ice erosion in the Lower Bradley River.

Table 5-2 summarizes the annual discharge data collected along the Bradley River and Table 5-3 summarizes the average monthly discharge. In general, the Upper Bradley River average flow is 159.5 cfs with 53 cfs discharging from Bradley Lake into the Bradley River and the balance routed through the powerhouse to Kachemak Bay. Discharge at the mouth of the Bradley River, which is where minimum flow compliance is monitored, averages 121.1 cfs due to additional flow from the Middle and North Forks of the Bradley River (Figure 5-2).

Table 5-2 USGS Stream Gage Average, Minimum, and Maximum Annual Discharge (cfs) Measurements on the Bradley River 2005-2020

Year	Upper Bradley River 15238990	Middle Fork Bradley River Below North Fork Bradley River 15239060*	Bradley River Below Dam 15239001	Middle Fork Bradley River 15239050	Bradley River Near Tidewater 15239070*
2005	166.1 (0.0-832.0)	44.8 (7.0-153.0)	38.8 (0.9-111.0)	57.4 (2.4-330.0)	102.0 (42.0-802.0)
2006	137.2 (0.0-1,060.0)	41.7 (3.7-155.0)	42.2 (0.1-82.4)	43.6 (2.7-697.0)	106.8 (45.0-1,020.0)
2007	125.3 (0.0-822.0)	32.6 (2.7-157.0)	49.2 (0.1-131.0)	50.4 (1.9-208.0)	104.9 (47.0-296.0)
2008	72.0 (0.0-576.0)	44.1 (2.1-156.0)	37.2 (0.1-77.8)	53.8 (3.0-588.0)	119.9 (40.0-510.0)
2009	120.9 (0.0-1,280.0)	34.0 (0.0-1,280.0)	55.2 (0.3-108.0)	51.6 (2.5-621.0)	98.8 (43.8-400.0)
2010	142.4 (0.0-839.0)	46.2 (0.0-945.0)	33.6 (0.3-92.9)	63.1 (2.4-462.0)	101.3 (41.0-497.0)
2011	117.6 (0.0-1,240.0)	39.6 (0.0-1,240.0)	39.9 (0.1-86.2)	43.2 (2.7-646.0)	97.4 (51.7-807.0)
2012	135.9 (0.0-2,590)	44.8 (0.0-2,050.0)	40.6 (0.2-1,070.0)	57.2 (2.8-802.0)	133.3 (46.0-1,550.0)
2013	158.6 (0.0-2,030.0)	30.8 (0.0-2,030.0)	73.6 (0.1-1,030)	49.7 (3.0-267.0)	122.0 (61.1-1,150.0)
2014	187.3 (0.0-1,970.0)	37.1 (0.0-1,970.0)	70.2 (9.6-1,250.0)	55.1 (3.5-241.0)	127.0 (44.3-1,650.0)
2015	197.7 (0.0-1,800.0)	47.4 (0.0-1,800)	50.9 (6.0-97.0)	38.3 (3.5-217.0)	111.3 (55.0-602.0)
2016	193.6 (0.0-1,650.0)	64.9 (1.5-1,650.0)		57.1 (4.6-306.0)	127.5 (50.7-980.0)
2017		32.5 (2.50-141.0)		43.9 (3.0-284.0)	95.6 (39.6-514.0)
2018		35.8 (3.6-145.0)		49.5 (3.5-254.0)	100.0 (48.7-611.0)
2019		43.0 (6.3-139.0)		54.9 (4.8-232.0)	143.5 (54.1-2,590.0)
2020		38.1 (5.4-125.0)	51.4 (0.1-90.8)	49.0 (4.2-491.0)	125.3 (48.3-963.0)
Average	**159.5 (0.0-2,590)**	**43.8 (0.0-2,050)**	**53.0 (0.1-1,250)**	**51.1 (1.9-802.0)**	**121.1 (39.6-2,590)**

Source: USGS 2021a,b,c,d,e *Incomplete data were used for statistical calculations

Table 5-3 USGS Stream Gage Average, Minimum, and Maximum Monthly Discharge (cfs) Measurements on the Bradley River 2005-2020

Month	Upper Bradley River 15238990	Middle Fork Bradley River Below North Fork Bradley River 15239060*	Bradley River Below Dam 15239001	Middle Fork Bradley River 15239050	Bradley River Near Tidewater 15239070*
Jan	4.4 (0.0-20.6)	16.1 (4.1-29.8)	44.9 (35.2-53.5)	6.2 (2.5-11.5)	84.4 (51.5-160.3)
Feb	0.8 (0.0-4.4)	13.2 (3.2-30.7)	45.3 (28.2-57.7)	4.5 (3.1-7.0)	65.3 (47.1-104.2)
Mar	0.3 (0.0-1.9)	10.4 (3.1-40.1)	45.9 (34.6-63.5)	3.8 (2.2-5.2)	61.7 (49.0-94.4)
Apr	4.8 (0.0-25.6)	18.5 (5.9-35.6)	35.3 (18.6-59.9)	4.6 (2.3-10.7)	74.5 (53.6-124.4)
May	63.4 (0.8-208.3)	87.9 (76.2-105.6)	21.4 (4.3-50.8)	24.0 (8.6-58.0)	150.4 (122.7-179.1)
Jun	262.2 (107.9-351.3)	63.3 (42.2-93.5)	27.0 (0.7-76.9)	101.0 (41.0-137.8)	160.8 (122.8-222.8)
Jul	463.5 (207.6-822.8)	55.8 (18.8-107.6)	60.6 (15.7-94.1)	157.0 (94.8-226.5)	131.0 (111.0-146.9)
Aug	478.7 (156.9-747.4)	33.3 (14.7-59.1)	87.7 (58.3-108.0)	122.0 (84.2-190.9)	125.4 (108.1-143.0)
Sep	368.0 (191.6-616.1)	28.2 (13.6-50.5)	133.3 (8.26-447.9)	105.0 (56.1-220.5)	195.8 (103.3-486.8)
Oct	140.4 (31.9-304.6)	46.1 (28.2-57.2)	28.2 (2.9-83.8)	55.0 (21.0-154.6)	118.9 (76.8-186.6)
Nov	34.3 (1.3-110.1)	26.0 (10.1-40.5)	35.1 (4.6-55.2)	21.0 (9.0-40.4)	98.2 (62.2-178.5)
Dec	10.1 (<0.1-57.0)	20.8 (7.7-47.1)	46.7 (25.5-111.0)	9.3 (5.1-19.8)	101.4 (56.1-333.6)

Source: USGS 2021a,b,c,d,e

*Incomplete data were used for statistical calculations

5.3.1.2 Martin River

The East Fork Martin River drains approximately 19 square miles of the Dixon Glacier (Figure 5-1). Historic flow data are unavailable; USGS installed the Dixon Creek gage in the fall of 2021 (USGS Gage 15238950). Historic East Fork Martin River flow has been estimated based on a 42-year record of gaged flow from the Nuka Glacier into the Upper Bradley River (USGS 15238990; 1979-2021), adjusted for differences in basin area. The estimated annual peak flow from Dixon Glacier was greater than 1,000 cfs in 39 of 42 years and greater than 2,000 cfs in 19 of 42 years (). Average annual flow ranged from a minimum of 79 cfs in 1996 to a maximum of 358 cfs in 2013. Flows were estimated to be less than 1 cfs approximately 30 percent of the time, typically between November and May. Seasonally, median estimated flows were highest in July (603 cfs) and August (635 cfs), followed by September (412 cfs) and June (320 cfs), and were less than 100 cfs more than half of the time during all other months of the year (Figure 5-4 Estimate of Flow Duration for the East Fork Martin River, 1979-2021).

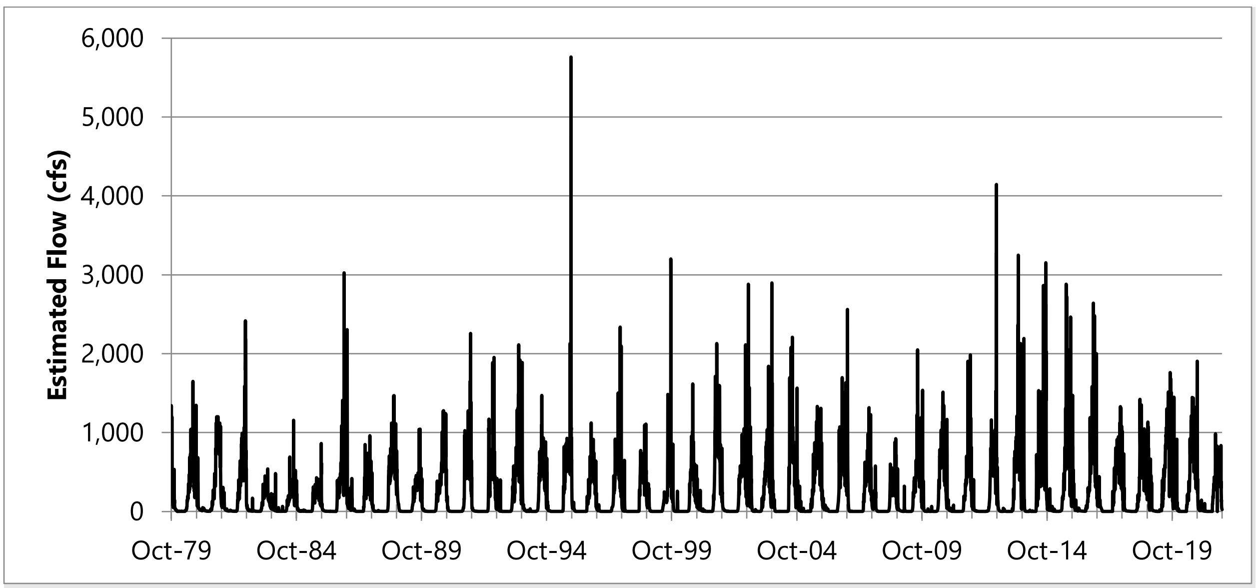


Figure 5-3 Estimated Flow in the East Fork Martin River, 1979-2021.

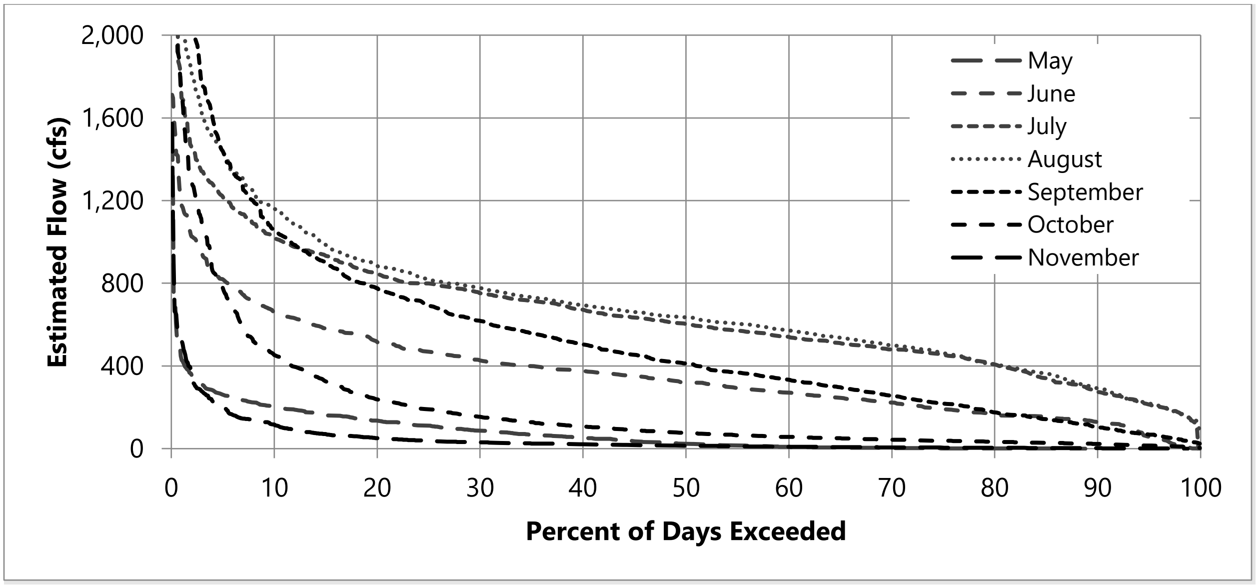


Figure 5-4 Estimate of Flow Duration for the East Fork Martin River, 1979-2021

5.3.2 Water Rights

Water rights in Alaska are issued by the ADNR under the Alaska Water Use Act (AS 46.15). AEA has water rights with the state of Alaska for the Bradley Lake Hydroelectric Project, including all portions of the Bradley River and Bradley Lake (LAS 2836; LAS 6998), an unnamed tributary to Upper Battle Creek (LAS 13370), the West Fork of Upper Battle Creek (LAS 27720), and the project waterfowl nesting site located to the west of Bradley Lake near Kachemak Bay (LAS 2837; LAS 14316).

The Martin River is currently undammed. AEA submitted an application for Water Rights for 480,000 acre feet per year from the Martin River (LAS 33602). The application was accepted but adjudication postponed until project designs are complete and environmental studies conducted.

5.3.3 Water Quality

5.3.3.1 State Standards

The Alaska Department of Environmental Conservation (ADEC) is responsible for establishing Alaska's Water Quality Standards (18 AAC 70). The purpose of the water quality standards is to protect each of the designated uses of water bodies in the state, including as supply for drinking, agriculture, aquaculture, and industrial, as well as contact and secondary recreation and the growth and propagation of fish, shellfish, other aquatic life, and wildlife. Within the Bradley River and Martin River basins, primary concerns are for the protection of anadromous and resident fish species. This water quality section is focused on the parameters that have the potential to affect anadromous and resident fish. Table 5-4 lists the criteria for freshwater streams in Alaska for "growth and propagation of fish, shellfish, other aquatic life, and wildlife."

Table 5-4 Water Quality Standards for Alaska Fresh Water Uses

Pollutant	Criteria*
Dissolved Gas	Dissolved oxygen (DO) must be greater than 7 milligrams per liter (mg/L) in waters used by anadromous or resident fish. In no case may DO be less than 5 mg/L to a depth of 20 centimeters (cm) in the interstitial waters of gravel used by anadromous or resident fish for spawning. For waters not used by anadromous or resident fish, DO must be greater than or equal to 5 mg/L. In no case may DO be greater than 17 mg/L. The concentration of total dissolved gas may not exceed 110% of saturation at any point of sample collection.
Dissolved Inorganic Substances	Total dissolved solids (TDS) may not exceed 1,000 mg/L. A concentration of TDS may not be present in water if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life.
pH	May not be less than 6.5 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions.
Sediment	The percent accumulation of fine sediment in the range of 0.1 millimeters (mm) to 4.0 mm in the gravel bed of waters used by anadromous or resident fish for spawning may not be increased more than 5% by weight above natural conditions (as shown from grain size accumulation graph). In no case may the 0.1 mm to 4.0 mm fine sediment range in those gravel beds exceed a maximum of 30% by weight (as shown from grain size accumulation graph). In all other surface waters no sediment loads (suspended or deposited) that can cause adverse effects on aquatic animal or plant life, their reproduction or habitat may be present.
Temperature	May not exceed 20℃ at any time. The following maximum temperatures may not be exceeded where applicable: Migration routes 15℃ Spawning areas 13℃ Rearing areas 15℃ Egg & fry incubation 13℃ For all other waters, the weekly average temperature may not exceed site-specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms.
Turbidity	May not exceed 25 nephelometric turbidity units (NTU) above natural conditions. For all lake waters, may not exceed 5 NTU above natural conditions.

*The water quality standards listed in this table include the criteria for the growth and propagation or fish, shellfish, other aquatic life, and wildlife

Source: ADEC 2022

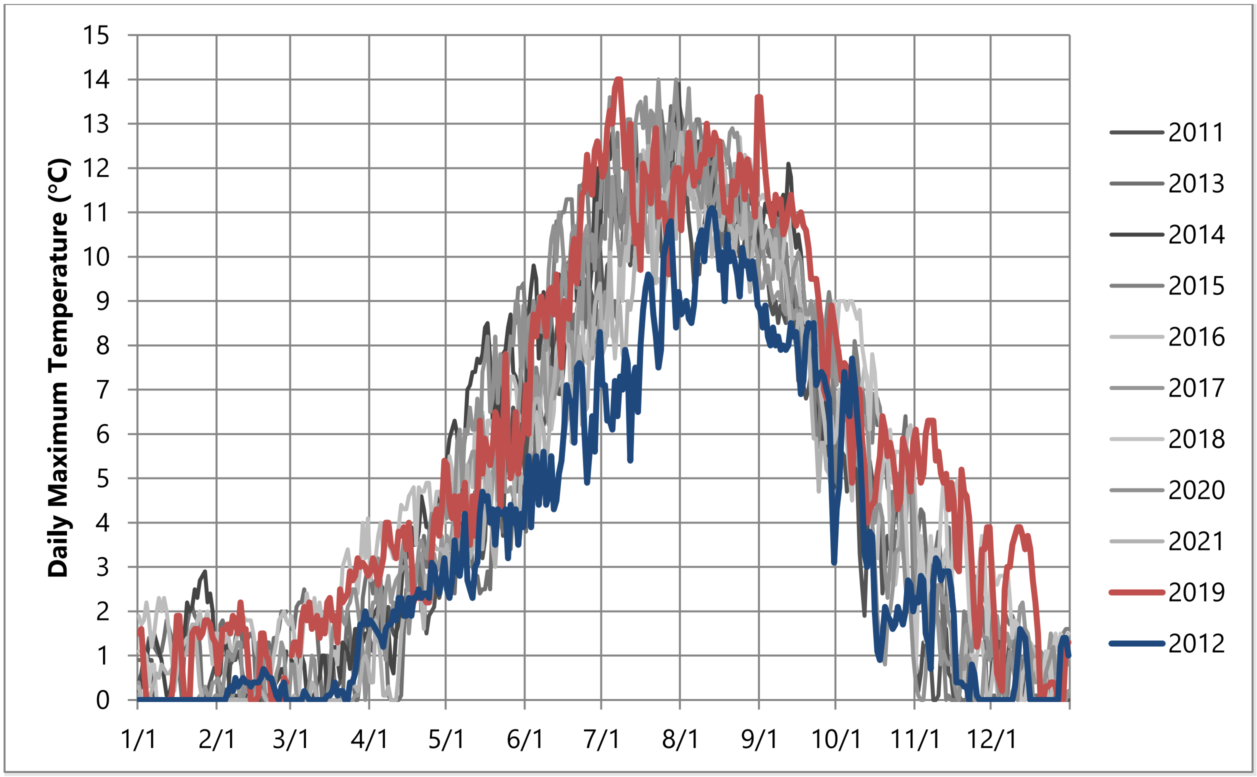
5.3.3.2 Bradley River

The water quality of Bradley Lake and Bradley River is pristine and typical of glacial streams with high, turbid summer flows and low, clear winter flows (USACE 1982). Glacially-influenced lakes are opaque from glacial flour, which limits the growth of algae and primary producers that provide the base of the food web in clear lakes (Field and Walker 2003). Limited historic water quality data is available for the Bradley River and Bradley Lake. During licensing studies conducted in the 1980s, summer concentrations of suspended sediments in Bradley Lake were over 150 milligrams per liter (mg/L) compared to 10 mg/L in the winter (FERC 1985).

Licensing studies in the 1980s evaluated temperatures in Bradley Lake documenting that Bradley Lake typically remained isothermal during the months with no ice, ranging from 7 to 10 ℃ (FERC 1985). However, in some years Bradley Lake became slightly stratified, with the top 20 feet of the water column exhibiting temperatures from 8 to 10 ℃. From November through May, when Bradley Lake was typically covered in ice, the water temperature ranged from 2 to 2.5 ℃ at the bottom and 0 ℃ near the surface (FERC 1985).

Water quality monitoring in the Bradley River has focused on potential impacts of the Bradley Lake Hydroelectric Project on fish habitat downstream of the dam. Bradley River surface water and winter intragravel temperatures have been monitored at the mouth of the Bradley River (USGS Gage 15239070). Intragravel water temperature is generally warmer than surface water temperature during the winter months in glaciated streams (Baldrige and Trihey 1982). This was true for the Lower Bradley River during monitoring between March 1993 and April 1998 where the intragravel water temperature was generally 0.5 to 1.0 °C warmer than that for surface water during winter months (Rickman 1998). Changes in surface and intragravel water temperatures during winter months were typically a function of periodic warm rains. During this winter monitoring, dissolved oxygen concentrations for the Lower Bradley River ranged from 9.5 mg/L to 15.0 mg/L with percent saturation ranging from 67 to 103 percent. Dissolved oxygen concentrations of intragravel water ranged from 8.2 to 15.3 mg/L.

Summer water temperatures at the mouth of the Bradley River (USGS Gage 15239070) are relatively cool. Data from water years 2011- 2021 documented an annual peak of daily maxima in July and August between 11.1°C in 2012 and 14.0°C in 2019 (Figure 5-5). These temperatures comply with state standards for salmon rearing and migration, and consistently provide suitable salmon spawning and incubation temperatures September through June.



Source: USGS 2021e

Figure 5-5 Daily Maximum Water Temperature (℃) at the Mouth of the Bradley River (2011-2021) with warm (2019) and cool (2012) year highlighted.

5.3.3.3 Martin River

There is little water quality data for the Martin River. The Martin River is generally comparable to the Bradley River. However, temperatures in the Martin River are approximately 5 ℃ cooler than in the Bradley River during the summer and fall months (FERC 1985). In addition, turbidity is typically higher in the Martin River (FERC 1985) as glacier cover in the basin is higher. The Martin River contains low levels of fecal coliform bacteria (APA 1984).

5.4 Fish and Aquatic Resources

The Martin River basin provides habitat for resident and anadromous fishes as described below. No fishes have been documented in Bradley Lake or the Upper Bradley River basin included in the ZPE (USACE 1982, FERC 1985).

5.4.1 Aquatic Habitat

Headwaters of glacial streams on the southern shore of Kachemak Bay flow through deep cut canyons in the Kenai Mountains before aggrading and braiding in their lower reaches near the bay. Substrates reflect this geography and tend to consist of boulders and cobble in the upper reaches that transition into cobble and gravel in the middle reaches before grading into finer material in the intertidal reaches. The interstices of cobble and gravel in glacial streams are filled with sand and fine glacial silt (FERC 1985). Generally, sediment and bedload are high and are important factors limiting aquatic production and influencing fish habitat use.

During construction of the Bradley Lake Project, gravel was mined from the Martin River delta. In 1991, three former borrow pits adjacent to the Martin River near its mouth were rehabilitated to include 30 acres of overwintering habitat and a 2,800-foot spawning channel for Coho Salmon (*Oncorhynchus kisutch*; Parry and Seaman 1994). The rearing ponds and spawning channel occupy approximately one-third of the Martin River delta area.

5.4.2 Fish Assemblage

Limited fish sampling has been conducted in the Martin River Basin. Licensing studies conducted for the original Bradley Lake Hydroelectric Project identified the Lower Bradley River as having the largest fish run sizes among the Bradley River, Battle Creek and Martin River (FERC 1985). ADFG has documented occasional fish observations both from aerial surveys of adult salmon, minnow trapping, seining, and electrofishing (Geifer and Blossom 2021). Beyond this limited sampling data, fish data from neighboring Battle Creek are presented as a likely comparable system. Both Battle Creek and the Martin River are short glacial streams (less than 10 river miles) that enter Kachemak Bay within 1 mile of each other.

Battle Creek was studied extensively in 2010 and 2011 with study reaches beginning at tidewater and extending upstream to the terminus of Battle Glacier (AEA 2011). Seven fish species were documented in Battle Creek including resident and anadromous species. Resident fishes collected from freshwater and tidally influenced habitats included Ninespine Stickleback (*Pungitius pungitius*), Threespine Stickleback (*Gasterosteus aculeatus*), sculpin, and Starry Flounder (*Platichthys stellatus*; FERC 2016). Starry Flounder were collected in the tidally influenced reaches of Battle Creek. Although

Starry Flounder, typically a marine species, have been documented in freshwater habitats. Starry Flounder likely rear in Kachemak Bay and follow tidal movements into the Battle Creek, the Bradley River, and other tributaries (AEA 2011). Anadromous species in Battle Creek included Coho Salmon, Sockeye Salmon (*O. nerka*), and Dolly Varden (*Salvelinus malma*). Anadromous fish species are further described below.

Anadromous fishes are those that spend most of their lives in marine environments, and upon maturity migrate from the ocean into freshwater habitats to reproduce. Kachemak Bay, Cook Inlet, and tributaries that feed this system support populations of multiple anadromous species, including Eulachon (*Thaleichthys pacificus*), Dolly Varden, and Pacific Salmon species. Life histories and status of these species in the Kachemak Bay system are described below.

5.4.2.1 Eulachon

Eulachon, an anadromous species of smelt, ranges from northern California to southwest Alaska, and into the southeastern Bering Sea. These fish typically spend three to five years in saltwater, before returning to freshwater to spawn during late-winter through mid-spring (iNaturalist 2021). Spawning habitat includes slow moving reaches of rivers and streams with sandy gravel bottoms. Suitable lotic habitats often include glacier fed streams (ADFG 2012). Adults sometimes return to their natal streams to spawn, but may instead return to streams located near their natal streams. Most adults die after spawning, although some survive to make a second spawning run in subsequent years. Young Eulachon move downstream within weeks of hatching, and rear to maturity in saltwater habitats (ADFG 2012).

Eulachon are seasonably abundant in multiple drainages across Southeast and Southcentral Alaska, including watersheds that feed into Cook Inlet. Previous fish assemblage monitoring in the Fox River watershed at the head of Kachemak Bay documented seasonal runs of Eulachon in the lower reaches of the Fox River (Faurot and Palmer 1992). Specifically, Eulachon were documented in the lower Fox River from mid-May through late June during gill netting surveys. No Eulachon spawning activity was observed, but it was hypothesized that spawning occurred in the lower Fox River, as all sampled fish were in spawning condition. Similarly, fish surveys in the Lower Bradley River in 1979 and 1980 captured Eulachon between May 14 and June 21 between river miles 3 and 5.2 (USACE 1982).

Eulachon are a documented food source for beluga whales that were historically observed in waters at the head of Kachemak Bay during the spring and summer months (ADFG 2012). Additionally, Eulachon densities have been positively correlated with beluga whale fat reserves, with high summertime densities of Eulachon associated with increased fat reserves in beluga whales in the lower reaches of Cook Inlet (CIRCAC 2021). Cook Inlet supports a commercial Eulachon fishery, which targets fish returning to the Susitna River. Annual harvest in this fishery has ranged from 300 - 200,000 pounds during the past 30 years (ADFG 2012). Eulachon are also harvested throughout southern and southwest Alaska for subsistence purposes, as described in Section 5.9.3.

5.4.2.2 Dolly Varden

Dolly Varden in Alaska include both sea-run and freshwater-resident populations. Sea-run Dolly Varden in southern Alaska (i.e., populations that reside in Cook Inlet/Kachemak Bay and tributaries) spawn in the fall. Females dig redds (spawning nests) in streambed gravel, where eggs are deposited and fertilized. Fertilized eggs remain in gravel for 4-5 months, with hatch-timing dependent upon water temperature. Fry (free-swimming juveniles) emerge during April-May and disperse into areas with low water velocity, where they reside for 2-4 years as juveniles before moving downstream to saltwater habitats. While in saltwater, juveniles rear and develop into the adults, before returning to spawn in freshwater during the fall. Adult Dolly Varden then reside in freshwater habitats through the winter (ADFG 2021a).

Dolly Varden were the most common fish species observed during 2010-2011 fish assemblage assessments in the Battle Creek drainage, comprising over half of the total fish collections. Multiple Dolly Varden age and size classes, including young-of-year, adult resident, and adult anadromous forms, were documented. Most individuals were found in reaches with low water velocities, and suitable spawning habitat was present in riffles and tailwaters of pools over gravel and cobble substrate. Spawn timing in Battle Creek occurred in late-September through October, and recently-constructed redds were identified (FERC 2016). Results of the 2010-2011 surveys suggest that some Dolly Varden present in Battle Creek were using the habitat year-round for rearing, while others used the creek seasonally to move between the systems in Kachemak Bay (AEA 2011).

Genetic baseline sampling by ADFG in the Martin River in August 2016 captured Dolly Varden throughout the anadromous reach of the Martin River, including in sampling of Red Lake, near the confluence with the East Fork Martin River (Otis 2016).

5.4.2.3 Pacific Salmon

Pacific salmon species spawn in freshwater tributaries, and fry may reside in freshwater for a year or more, or immediately move downstream to saltwater habitats. The length of freshwater residence and timing of downstream migrations vary both within and across species as well as river systems. Young Pacific salmon species use habitats close to the shoreline in saltwater, and some then make movements to open ocean habitats. After 1-4 years in saltwater, Pacific salmon adults return to their natal streams to spawn (DFO 2019). As semelparous species, most Pacific salmon species spawn only once and then die.

Cook Inlet and its tributaries support fisheries for five species of Pacific salmon found in Alaska: Chinook Salmon (*O. tshawytscha*), Chum Salmon (*O. keta*), Coho Salmon, Sockeye Salmon, and Pink Salmon (*O. gorbuscha*; ADFG 2009) indicating that runs of these species are present in waters around Kachemak Bay. Previous fish assemblage surveys conducted by AEA in nearby Battle Creek documented multiple age classes of Coho Salmon and Sockeye Salmon (FERC 2016). Chinook Salmon, Chum Salmon, Pink Salmon, and Sockeye Salmon have been previously documented in the Lower Bradley River (FERC 1985).

A review of the ADFG's Anadromous Waters Catalog classifies the Martin River (241-14-10600) from the mouth to Red Lake as habitat for Sockeye Salmon, Coho Salmon, Chum Salmon and Dolly Varden (AWC 2022, Geifer and Blossom 2021). AEA is not aware of any documentation of Chinook or Pink Salmon in the Martin River. Surveys documented the presence of Coho Salmon and Dolly Varden in the Martin River, with concentrations of Coho Salmon juveniles in clear side channels in August 2012. Sockeye Salmon spawning activity was observed in Red Lake, approximately 5 river miles upstream from Kachemak Bay. The spawning population of Sockeye Salmon in Red Lake was estimated at approximately 350 fish in August 1980 based on aerial observations, and it appears that the habitat continues to support a spawning population based on additional aerial observations in 1993 and observations of adults and juveniles in 2016 (ADFG 2016). Coho Salmon juveniles and Dolly Varden were also documented in Red Lake during 2016 sampling (ADFG 2016). Fish sampling in the restored borrow pits near the mouth of the Martin River in 1993 documented use by juvenile Coho Salmon, Dolly Varden, and sticklebacks (Parry and Seaman 1994). ADFG sampling in 2016 also documented use by sticklebacks and juvenile Coho Salmon and Sockeye Salmon (Otis 2016).

Observations in the Martin River are consistent with early establishment of Dolly Varden in newly deglaciated streams, where their benthic feeding is compatible with turbid water and their use of higher gradient habitats (Milner et al. 2000). Coho Salmon are also relatively rapid colonizers, especially when lateral groundwater-fed clearwater habitats are available and compatible with sight feeding on drifting prey items (Milner 1997). Sockeye Salmon are known to rapidly colonize streams where lakes are present (Milner 1997).

Immature Chinook Salmon are found in open water habitats of Kachemak Bay year-round. Adult Chinook Salmon make April-August movements to spawn in tributaries of Cook Inlet. During this time-period, Chinook Salmon are more concentrated in marine habitats in lower Cook Inlet, where they stage prior to making movements into freshwater habitats to spawn.

Outplanting of hatchery-reared salmon has occurred in the southern Cook Inlet. ADFG has implemented Chinook Salmon stocking efforts in Seldovia Bay, south of Kachemak Bay, since 1987. Additional annual Chinook Salmon stocking efforts occur in a man-made fishing lagoon near Homer, Alaska and Halibut Cove Lagoon, located across Kachemak Bay from Homer (ADFG 2009).

Stocking efforts have also been implemented to support the Sockeye Salmon fishery. Annual Sockeye Salmon stocking efforts conducted by the Cook Inlet Aquaculture Association (CIAA) occur in China Poot Lake, where fry rear before moving downstream to China Poot Bay and into Kachemak Bay. After 2-3 years, the returning adults support commercial and recreational fisheries. Additionally, a state-owned, CIAA-operated hatchery in Tutka Bay produces Pink Salmon for commercial harvest with returns of approximately 932,800 adults in 2020 (ADFG 2009; NCCOS 2020).

5.4.3 Essential Fish Habitat

The ZPE includes essential fish habitat (EFH), under the Magnuson-Stevens Fishery Conservation and Management Act. To protect the productivity and sustainability of U.S. marine fisheries, habitat conservation provisions include marine and freshwater habitats utilized by anadromous species managed under a federal fishery management plan, which includes the five species of Pacific salmon found in Alaska. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon and includes those waters identified in ADFG's "Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes" (Geifer and Blossom 2021).

Kachemak Bay provides designated marine EFH for Chinook Salmon, Chum Salmon, Coho Salmon, Pink Salmon, and Sockeye Salmon. A summary of the status of these species in Kachemak Bay is provided above. The Martin River provides designated freshwater EFH for Chum Salmon, Coho Salmon, and Sockeye Salmon in the mainstem of the Martin River upstream to Red Lake (ADFG 2021b).

5.5 Wildlife and Botanical Resources

The wide range of habitats and climatic conditions within Southcentral Alaska has resulted in a great diversity of fauna and flora. This section describes botanical and wildlife resources in the ZPE.

5.5.1 Botanical Resources

Forest communities on the south side of Kachemak Bay are dominated by Sitka spruce forests that grow between sea level and 2,200 feet in elevation. Forests of black cottonwood occur along riparian corridors, rivers, and creeks, and away from the direct marine influence of the bay. Non-forest plant communities occur in alpine and sub-alpine areas where extreme temperatures, steep slopes, and lack of soil development limit tree growth. Alders dominate the subalpine community and occur in variable associations with birch and willow. The herb layer is diverse with a variety of grasses, wildflowers, ferns, and mosses. At higher elevations in this region, the vegetation is generally barrens or alpine tundra with mixed herbaceous and shrub cover; temperature rainforests and mixed hardwood forests of white and Sitka spruce, aspen, birch, and cottonwood; dense thickets of willow and alder; and meadows with various sedges, grasses, and forbs (ADFG 2015). Vegetative community types in the ZPE include Closed Coniferous Forest, Open Coniferous Forest, Birch Forest, Balsam Poplar Forest, Mixed Spruce-Birch Forest, Mixed Spruce-Balsam Poplar Forest, Tall Alder Shrubland, Low Willow Shrubland, Bog, Tall Grassland, Mesic Herbaceous Sedge-Grass, Saltwater Herbaceous Sedge-Grass, Shrub Tundra, Elymus Grassland, and Floodplains (FERC 1985).

No state or federally protected plant species have been documented in the ZPE. However, according to the ACCSUA Rare Plant Portal (ANHP 2022b), 17 rare or uncommon plant species occur within the project vicinity. Of these 17 plants, only one species is on the Bureau of Land Management (BLM) sensitive species list: sessile-leaved scurvy-grass (*Cochlearia sessilifolia*) (BLM 2019). Five other species are on the BLM "watchlist"; species that were considered for "sensitive" designation but did not warrant inclusion. The watchlist serves to help document, raise awareness, and retain information regarding the species (BLM 2019). Watchlist species include northern sedge (*Carex deflexa*), dunhead sedge (*Carex phaeocephala*), pale agoseris (*Agoseris glauca*), serrulate surf-grass (*Phyllospadix serrulatus*), and fourpart dwarf gentian (*Gentianella propinqua*).

5.5.2 Wetlands, Littoral Zones, and Riparian Habitats

Alaska's waterways, riparian zones, and waters within sustain diverse populations of fish and wildlife (ADFG 2015). In Alaska the four main types of wetlands (bog, grass wetlands, sedge wetlands, and marsh), littoral habitats, and riparian zones are numerous, widespread, and complex. These areas provide migratory routes, spawning and rearing habitats, nesting and fledging areas, overwintering habitats, and shelter or refugia to a wide variety of species. According to the ACCSUA Alaska Land Cover and Wetlands data portal (ACCSUA 2022) and the USFWS National Wetlands Inventory (NWI) of southern Alaska (USFWS 2022), a mix of wetland types occur within the ZPE. These wetlands include a mix of freshwater, estuarine, and marine wetlands. The latest NWI was conducted using 1:65,000 scale, color infrared imagery from 1977. The delineation of wetlands that may be considered jurisdictional waters of the U.S. under Section 404 of the Clean Water Act has not occurred throughout the ZPE, although surveys associated with previous Project construction and environmental assessments have been completed around Bradley Lake (FERC 1985, 2016) and Battle Creek (AEA 2011). The presumed wetland types in unsurveyed areas include a mix of lakes, freshwater ponds, riverine wetland systems, and freshwater forested/shrub wetlands in higher elevations, and freshwater emergent, estuarine, and marine wetlands along Kachemak Bay.

5.5.3 Wildlife Resources

According to published documentation, 97 bird species and 27 mammal species are known or likely to occur within the Bradley Lake Project boundary (USACE 1982, 1985; APA 1984). Although several amphibians are known to occur within the same ecoregions of the project location, their ranges are mostly restricted to areas in the southeastern regions of the Alexander Archipelago. There are no known occurrences of herpetofauna within the project vicinity according to the Alaska Center for Conservation Science (ACCS) data for wildlife (ACCS 2021).

5.5.3.1 Mammals

The ZPE is within the ADFG's Game Management Unit (GMU) 15C. GMU 15C includes the portion of the Kenai Peninsula and adjacent islands draining into the Gulf of Alaska and Cook Inlet. Previous studies identified important wildlife habitats within the Battle Creek diversion ZPE (AEA 2011). Mammal species include a range of small to large mammals, such as rodents, carnivores, furbearers, and ungulates (Table 5-5). Additional details regarding impacted species are described below.

Table 5-5 Mammal Species Known or Likely to Occur in the ZPE Boundary

Common Name	Scientific Name
American beaver	*Castor canadensis*
Singing vole	*Microtus miurus*
Root (tundra) vole	*Microtus oeconomus*
Northern redback vole	*Myodes rutilus*
Muskrat	*Ondatra zibethicus*
Northern bog lemming	*Synaptomys borealis*
Porcupine	*Erethizon dorsatum*
Hoary marmot	*Marmota caligata*
Red squirrel	*Tamiasciurus hudsonicus*
Snowshoe hare	*Lepus americanus*
Cinereus shrew	*Sorex cinereus*
Pygmy shrew	*Sorex hoyi*
Dusky shrew	*Sorex monitcolus*
Little brown bat	*Myotis lucifugus*
Coyote	*Canis latrans*
Gray wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Canada lynx	*Lynx canadensis*
Wolverine	*Gulo gulo*
River otter	*Lontra canadensis*
Ermine (short-tailed weasel)	*Mustela erminea*
Least weasel	*Mustela nivalis*
Mink	*Neovison vison*
Black bear	*Ursus americanus*

Kenai brown bear	*Ursus arctos*
Mountain goat	*Oreamnos americanus*
Moose	*Alces alces*

Source: AEA 2011

5.5.3.1.1 Moose

Moose (*Alces alces*) generally make seasonal movements between calving, rutting, and wintering areas. Rutting, and breeding, occurs during late-September and early October for most populations in Alaska, and calves are born during the spring. The Fox River Flats at the head of Kachemak Bay are an important moose calving area on the southern Kenai Peninsula (Bailey et al. 1978). Moose feed on willow, birch, and aspen twigs during the fall and winter, and move to areas where they can graze on low lying vegetation during the spring. Moose are more commonly found near aquatic habitats in the summer months, where they often feed on vegetation in shallow ponds and wetlands (ADFG 2021c).

Moose habitats within the ZPE include areas near the Kachemak Creek and Upper Bradley River inflows to Bradley Lake (Kachemak Creek Flats) and the mouth of the Martin River (FERC 1985). Moose were observed during aerial surveys of Kachemak Creek Flats during October 1983 in the freshwater wetlands at the head of the lake and in the subalpine, alder-willow slopes in later fall. The number of moose remained in the Kachemak Flats area through April. Rappoport et al. (1981) described high quality moose range adjacent to the borrow area at the mouth of the Martin River. Heavy moose use of shrub willow habitat between the lower Martin River and lower Battle Creek was documented between 1979 and 1982 (FERC 1985). No moose or moose signs (tracks, scat, browse on vegetation) were observed in aerial surveys of the Martin River delta conducted from October 1983 to June 1984, but moose were observed at the mouth of nearby Battle Creek in late February (FERC 1985).

As a mitigation measure associated with the development of the Bradley Lake Hydroelectric Project, Kachemak Moose Habitat Inc. was established by AEA in 1996 to fund the purchase of land for the benefit of resident moose populations. This mitigation measure was developed to offset impacts associated with the filling of Bradley Lake, which flooded areas of suitable moose habitat. A large percentage of lands purchased through this program include areas around the southern Kenai Peninsula, including in the vicinity of the Homer Airport CHA (ADFG 2007). The Beluga Wetlands Complex within the Homer Airport CHA provides overwintering habitat for approximately 100 moose, while the overall herd size in the greater Homer area has been estimated at 500 moose during recent years (ADFG 2007; ADFG 2021d). Additionally, the 2013 overall moose population for GMU 15 is listed at over 6,000 animals, which is an increase from the 1980s (USFWS 2021a).

Moose in the vicinity of Kachemak Bay are managed as part of ADFG Unit 15C, as part of the larger unit (GMU 15) that encompasses the Kenai Peninsula. An annual antlerless (cow) hunt is conducted in GMU 15C, while adjacent areas are designated as trophy hunt units for mature bulls. GMU 15C also has a state-designated subsistence hunt. In addition to subsistence and general permit antlerless hunts that are regulated by ADFG, federal subsistence hunts include an early hunt that begins prior to the state season, and a cow hunt. Management objectives for moose populations in the region include area specific bull/cow ratio goals, as well as goals associated with the general maintenance of healthy and productive populations (Herreman 2018).

Aerial surveys conducted during 2010 documented low bull numbers relative to cows in areas of suitable habitat around Kachemak Bay. Management actions restricting bull harvest were taken, and the bull/cow ratio has improved in recent years. In addition to hunter harvest, motor vehicle collisions are a documented source of annual moose mortality in the Kachemak Bay region. An average of 52 moose per year were killed by vehicle collisions in Unit 15C during recent years, while adjacent units documented average moose mortality from vehicle collisions at 46 moose (Unit 15B) and 83 moose (Unit 15A). Annual population counts suggest that the moose population is increasing, and that current population levels are within management objectives. Additionally, habitat quality in the area around Kachemak Bay is expected to improve as regeneration occurs in habitats that have been burned by wildfires (Herreman 2018).

5.5.3.1.2 Mountain Goat

The mountain goat's range is restricted to the steep mountain ranges of northwestern North America, from the northern Cascade and Rocky mountains to Southcentral Alaska. Mountain goats in coastal areas, like those found near the Bradley Lake Project, generally make altitudinal migrations from alpine summer ranges to winter ranges at or below the tree line in old-growth forest habitats. Breeding occurs during late-October through early December. Mountain goats generally graze on sedges, forbs, and low-growing shrubs during the summer, and transition to browsing during the winter months (ADFG 2021e).

Historic mountain goat wintering habitats near the ZPE include steep slopes along the north shore of Bradley Lake, and on slopes that run along a 3-mile stretch of the Bradley River downstream from Bradley Lake. Additional mountain goat habitat is present near the terminus of Dixon Glacier, and in the nearby East Fork Martin River Canyon. Previous mountain goat studies were conducted in the vicinity of Bradley Lake during and after construction of the Bradley Lake Hydroelectric Project. Monitoring of mountain goat populations helped to better understand habitat use by this species and address concerns that traditional wintering habits may be impacted by Project activities. AEA worked with ADFG to assess impacts of development on overwintering mountain goats. Specific objectives of this assessment were to determine the number, sex/age composition, and geographic distribution of goats on the Bradley Lake and Bradley River winter ranges, and to determine if these goat populations were impacted by construction efforts (Holdermann 1991).

Mountain goat surveys documented an increase in abundance during 1986-1990. Mountain goat abundance was highest in suitable habitat along Bradley Lake and the Bradley River during December through April, although mountain goats were also present in this area during October through June. Overwintering abundance (January through April) was highest on steep broken cliffs along the west side of the Bradley River Canyon. Mountain goats near Dixon Glacier were found in similar habitats. Animals in this area utilized steep cliffs along the East Fork Martin River as overwintering habitat, with some animals remaining year-round. Additional mountain goats were observed along the terminus and the northwest, lateral margin of Dixon Glacier (Holdermann 1991). In two instances, mountain goats appeared to temporarily avoid portions of their normal range in response to construction activities. In both instances, however, normal habitat use patterns were observed following the cessation of construction activities. Overall results of the mountain goat monitoring effort did not document significant detrimental impacts to the species associated with Bradley Lake Project construction efforts (Holdermann 1991). Mitigation measures that have previously been implemented at the Project for the protection of mountain goats include minimizing the number of helicopter flights for meteorological and stream gage station maintenance during the winter months (USACE 1982).

Current habitat use and population demographics are monitored by the ADFG through aerial surveys. There are 33 aerial survey units for estimating goat populations on the Kenai Peninsula, including an area that encompasses the Martin River, the Bradley River, and Dixon Glacier. Current population estimates for the Kenai Peninsula range from 3,300-4,750 mountain goats (ADFG 2021e). Long-term monitoring data suggests that the mountain goat population on the Kenai Peninsula has decreased by over 30 percent during the past several decades (USFWS 2021b). Threats to the species on the Kenai Peninsula include severe winter conditions, harvest, and an increase in winter recreation activities such as backcountry skiing, heli-skiing, snowmachining, and helicopter touring. These activities can increase stress levels to the species, especially during critical periods of the year when overall fitness and survival would be affected (ADFG 2021e).

5.5.3.2 Birds

The Project vicinity includes habitat for multiple bird species, including some that are identified as special status species by state and federal agencies (Table 5-6). Species documented in the ZPE include waterfowl, upland game birds, waterbirds, raptors, shorebirds, gulls, and passerines. Common upland song birds documented during previous surveys include black-capped chickadee, fox sparrow, dark-eyed junco, kinglets, warblers, and corvids. Waterfowl and shorebirds include mergansers, buffleheads, scoters, goldeneyes, swan, loons, terns, gulls, greater yellow legs, and dowitchers (FERC 2016). Many shorebird species that winter in the area utilize the Fox River flats at the head of Kachemak Bay. As winter ice builds, some duck species use open water habitats in the ice-free bays along the southeast shoreline of Kachemak Bay. Duck movements are also tidally influenced and dabbling ducks will roost on the Martin River delta during times that the Fox River flats are submerged (FERC 1985). Waterfowl and raptor numbers have been documented as peaking during the spring and fall migration periods. Bradley Lake and lotic habitats, including the Martin River, provide habitat for several species of waterbirds (waterfowl, loons, gulls) and shorebirds. Adjacent forest and scrub areas provide habitat for landbird species (primarily passerines) and several species of raptors and shorebirds. Abundance surveys have documented that bald eagle and gull densities increase during the spring, and peak during mid-May when the Eulachon run occurs. Trumpeter Swans have been observed nesting in beaver ponds associated with the ZPE during recent years. In general, migratory birds primarily nest in southern Alaska from April 15 through July 15 in forested areas, and from May 1 through July 15 in treeless habitats (FERC 2016).

Birds documented in the ZPE include those identified as special status species by state and federal agencies. The USFWS identifies Birds of Conservation Concern (BCC) as species, subspecies, and populations that are not federally-listed as threatened or endangered, but that may become candidates for federal listing without additional conservation actions being taken (USFWS 2021c). The BLM designates sensitive species and their habitats "to promote their conservation and reduce the likelihood and need for such species to be listed pursuant to the ESA" (BLM 2019). Candidates for this designation include native species that may be found on BLM-administered lands (BLM 2019). Additional plans that include conservation statuses for bird species include the North American Waterfowl Management Plan (NAWMP), the North American Waterbird Conservation Plan (NAWCP), and the Alaska Shorebird Conservation Plan (ACSP) (NAWMP 2018; Kushlan et al. 2006; Alaska Shorebird Group 2019).

Table 5-6 Birds Known to Occur Within the ZPE.

Common Name	Scientific Name	Conservation Status[1]
Greater White-fronted Goose	*Anser albifrons*	*BMC, NAWMP*
Snow Goose	*Anser caerulescens*	*BMC, NAWMP*
Canada Goose	*Branta canadensis*	*BMC, NAWMP*
Trumpeter Swan	*Cygnus buccinator*	*BMC, NAWMP*
Tundra Swan	*Cygnus columbianus*	*BMC, NAWMP*
Gadwall	*Mareca strepera*	*BMC, NAWMP*
American Wigeon	*Mareca americana*	*BMC, NAWMP*
Mallard	*Anas platyrhynchos*	*BMC, NAWMP*
Northern Shoveler	*Spatula clypeata*	*BMC, NAWMP*
Northern Pintail	*Anas acuta*	*BMC, NAWMP*
Green-winged Teal	*Anas crecca*	*BMC, NAWMP*
Greater Scaup	*Aythya marila*	*BMC, NAWMP*
Common Goldeneye	*Bucephala clangula*	*NAWMP*
Barrow's Goldeneye	*Bucephala islandica*	*NAWMP*
Bufflehead	*Bucephala albeola*	*NAWMP*
Harlequin Duck	*Histrionicus histrionicus*	*BMC, NAWMP*
White-winged Scoter	*Melanitta deglandi*	*BMC, NAWMP*
Surf Scoter	*Melanitta perspicillata*	*BMC, NAWMP*
Common Merganser	*Mergus merganser*	*NAWMP*
Red-breasted Merganser	*Mergus serrator*	*NAWMP*
Spruce Grouse	*Falcipennis canadensis*	
Willow Ptarmigan	*Lagopus lagopus*	
Rock Ptarmigan	*Lagopus muta*	
Red-Throated loon	*Gavia stellata*	*BMC, BLM-S*
Red-necked Grebe	*Podiceps grisegena*	
Horned Grebe	*Podiceps auritus*	*NAWCP*
Bald Eagle	*Haliaeetus leucocephalus*	*BMC*
Northern Goshawk	*Accipiter gentilis*	*BMC*

Common Name	Scientific Name	Conservation Status[1]
Sharp-shinned Hawk	*Accipiter striatus*	
Red-tailed Hawk	*Buteo jaimaicensis*	
Northern Harrier	*Circus hudsonius*	*BCC*
Merlin	*Falco columbarius*	
Peregrine Falcon	*Falco peregrinus*	*BMC*
American Kestrel	*Falco sparverius*	
Sandhill Crane	*Antigone canadensis*	
Semipalmated Plover	*Charadrius semiplamatus*	
Spotted Sandpiper	*Actitis macularius*	
Wandering Tattler	*Tringa incana*	*BCC, ACSP*
Greater Yellowlegs	*Tringa melanoleuca*	
Lesser Yellowlegs	*Tringa flavipes*	*BMC, BCC, ASCP*
Western Sandpiper	*Calidris mauri*	
Least Sandpiper	*Calidris minutilla*	
Pectoral Sandpiper	*Calidris melanotos*	*BCC, ASCP*
Sharp-tailed Sandpiper	*Calidris acuminata*	*ACSP*
Short-billed Dowitcher	*Limnodromus griseus*	*BCC, ASCP*
Long-billed Dowitcher	*Limnodromus scolopaceus*	*ACSP*
Common/Wilson's Snipe	*Gallinago gallinago/delicata*	*BMC*
Red-necked Phalarope	*Phalaropus lobatus*	*ACSP*
Bonaparte's Gull	*Chroicocephalus philadelphia*	*NAWCP*
Mew Gull	*Larus canus*	*NAWCP*
Herring Gull	*Larus argentatus*	*NAWCP*
Glaucous-winged Gull	*Larus glaucescens*	*NAWCP*
Arctic Tern	*Sterna paradisaea*	*BMC, NAWCP*
Great Horned Owl	*Bubo virginianus*	
Short-eared Owl	*Asio flammeus*	*BMC*
Boreal Owl	*Aegolius funereus*	
Northern Saw-whet Owl	*Aegolius acadicus*	*BCC*
Belted Kingfisher	*Megaceryle alcyon*	*BCC*
Hairy Woodpecker	*Picoides villosus*	
American Three-toed Woodpecker	*Picoides dorsalis*	
Northern Flicker	*Colaptes auratus*	
Gray (Canada) Jay	*Perisoreus canadensis*	
Stellar's Jay	*Cyanocitta stelleri*	
Black-billed Magpie	*Pica hudsonia*	
American (Northwestern) Crow	*Corvus (caurinus) brachyrhynchos*	
Common Raven	*Corvus corax*	
Tree Swallow	*Tachycineta bicolor*	
Violet-green Swallow	*Tachycineta thalassina*	

Common Name	Scientific Name	Conservation Status[1]
Bank Swallow	*Riparia riparia*	
Cliff Swallow	*Petrochelidon pyrrhonota*	
Black-capped Chickadee	*Peocile atricapillus*	
Boreal Chickadee	*Peocile husonicus*	
Brown Creeper	*Certhia americana*	
American Dipper	*Cinclus mexicanus*	*BCC*
Golden-crowned Kinglet	*Regulus satrapa*	
Ruby-crowned Kinglet	*Regulus calendula*	
Swainson's Thrush	*Catharus ustalatus*	
Hermit Thrush	*Catharus guttatus*	
American Robin	*Turdus migratorius*	
Varied Thrush	*Ixoreus naevius*	*BCC*
American Pipit	*Anthus rubescens*	
Lapland Longspur	*Calcarius lapponicus*	
Orange-crowned Warbler	*Leiothlypis celata*	
Yellow-rumped Warbler	*Setophaga coronate*	
Townsend's Warbler	*Setophaga townsendi*	
Northern Waterthrush	*Parkesia noveboracensis*	
Wilson's Warbler	*Cardellina pusilla*	
Savannah Sparrow	*Passerculus sandwichensis*	*BCC*
Fox Sparrow	*Passerella iliaca*	
Lincoln's Sparrow	*Melospiza lincolnii*	
Golden-crowned Sparrow	*Zonotrichia atricapilla*	
Dark-eyed Junco	*Junco hyemalis*	
Rusty Blackbird	*Euphagus carolinus*	*BMC, BCC, BLM-S*
Pine Grosbeak	*Pinicola enucleator*	
White-winged Crossbill	*Loxia leucoptera*	
Pine Siskin	*Spinus pinus*	

Source: APA 1984Conservation Status: BCC = Birds of Conservation Concern (USFWS 2021c); BMC = Birds of Management Concern (USFWS 2011); NAWMP = the North American Waterfowl Management Plan (NAWMP 2018); NAWCP = North American Waterbird Conservation Plan (Kushlan et al. 2006); ASCP = Alaska Shorebird Conservation Plan (ASG 2019); BLM-S = BLM Sensitive Species (BLM 2019))

5.5.3.2.1 Bald Eagle

Bald Eagles are more abundant in Alaska than anywhere else in the United States, with a 2021 statewide population estimate of approximately 30,000 birds (ADFG 2121f). Most Bald Eagles in Alaska winter in southern Alaska, while some leave the state completely during the colder months. Bald eagles generally nest close to water, and nesting begins in April. Juvenile Bald Eagles do not attain adult plumage or breed for 4-5 years (ADFG 2021f). Bald Eagles are found at the Bradley Lake Project year-round and are most abundant during May. Timing of this abundance has historically been associated with Eulachon runs (AEA 2011).

Bald Eagle studies were conducted prior to development of the Bradley Lake Project to assess the potential for disturbance associated with construction activities during 1986-1991. Surveys identified 68 natural Bald Eagle nesting territories around the perimeter of Kachemak Bay, and the total number of territories increased around Kachemak Bay during the study period. Nest sites specifically within the Bradley Lake Project area also increased, by a total of 51 percent during the study period. The number of successful Bald Eagle pairs (i.e., rearing young) remained stable during the study period. Bald Eagles occupied four nesting territories in 1986 in the Bradley Lake Project area, with a total of eight nests. The number of Bald Eagle nests increased to 11 complete natural nests, and 7 additional artificial nests, after construction of the Project in 1991. Overall, no evidence was found that the construction of the Bradley Lake Hydroelectric Project adversely affected Bald Eagles (Roseneau and Bente 1993).

5.5.4 Introduced, Invasive, and Nuisance Species

Non-native species whose introduction causes or is likely to cause economic harm, environmental harm, or harm to human health, are considered an "invasive species" (Presidential Executive Order 13112). Invasive species can change ecosystems by altering habitat composition, competing with native species for resources, changing predator/prey relationships, reducing productivity, or otherwise disrupting natural ecological functions.

In general, southern areas of Alaska are subject to higher risk of invasions from aquatic nuisance species (ANS) because of the warmer climate, more developed lands, more disturbed habitats, and road access. In addition, ports with high volume marine commercial traffic, such a as Cook Inlet, are at higher risks of invasions from ANS (ADFG 2002). According to the ADFG ANS Management Plan (2002), ANS with highest potential threats to Alaska include Northern Pike (*Esox lucious*), Atlantic Salmon (*Salmo salar*), Yellow Perch (*Perca flavescens*), green crab (*Carcinus maenas*), Chinese mitten crab (*Eriocheir sinense*), New Zealand mudsnail (*Potamopyrgus antipodarum*), zebra mussel (*Dreissena polymorpha*), and other invertebrates; whirling disease (*Myxobolus cerebralis*); as well as the plants hydrilla (*Hydrilla verticillata*), dotted duckweed (*Landoltia [Spirodela] punctata*), purple loosestrife (*Lythrum salicaria*), Eurasian water-milfoil (*Myriophyllum spicatum*), reed canary grass (*Phalaris arundinacae*), Japanese knotweed

(*Polygonum cuspidatum*), salt marsh cordgrass (*Spartina alterniflora*), dense-flowering cordgrass (*Spartina densiflora*), and swollen bladderwort (*Utricularia inflate*).

Invasive plants are periodically surveyed, treated, and monitored within the current Bradley Lake Project boundary. These surveys and treatments are conducted as part of the Kenai Peninsula Cooperative Invasive Species Management Area (KP-CISMA) and Homer Soil and Water Conservation District collaborations to eradicate invasive plants on public and private lands and waters on the Kenai Peninsula (KP-CISMA 2022). As of 2020, 10 non-native plant occurrences have been documented in the surveyed areas (ANHP 2022a). Most occurrences occur along easily accessible areas or edges of disturbance such as roadways, construction areas, temporary encampments, gravel pits, and features associated with hydroelectric development. Identified species include yellow sweetclover, white sweetclover, reed canarygrass, pineapple weed, oxeye daisy, orange hawkweed, narrowleaf hawkweed, common plantain, and common dandelion (ANHP 2022a). As typical of invasive species establishment, these introduced species were located along areas of disturbance and transportation corridors, where seed and plants parts are usually brought in on vehicles or construction equipment (Slemmons 2007).

5.6 Threatened, Endangered, and Candidate Species

The Endangered Species Act (ESA) provides a program for the conservation of threatened and endangered plants and animals and their habitats. The lead federal agencies for implementing the ESA are USFWS and NMFS. The law requires federal agencies, in consultation with the USFWS (terrestrial and freshwater species) or NMFS (marine species), to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. The law also prohibits any action that causes a "taking" of any listed species of endangered fish or wildlife.

According to the USFWS Information for Planning and Conservation’s official species list for Kenai Peninsula Borough, Alaska, three federally listed species have known or potential ranges within the borough (USFWS 2021d). These species include northern sea otter (*Enhydra lutris kenyoni*, threatened), Short-tailed Albatross (*Phoebastria ablatrus*, endangered), and Steller’s Eider (*Polysticta stelleri*, threatened). Designated critical habitat for northern sea otter is present in Kenai Peninsula Borough but is located over 50 miles west of the ZPE, in Cook Inlet.

Of these three ESA listed species, only Short-tailed Albatross has the potential to occur within the ZPE (USFWS 2021d). Short-tailed Albatross was listed as endangered under the ESA in July 2000 and a recovery plan was published in September 2008. This species is widely distributed across its historic range, with the population estimated to be 1,200 birds, 600 of which are of breeding age. Currently, most of the world's breeding population nests on Torishima Island, Japan. Nesting sites are typically on steep sites on soils with loose volcanic ash, usually with grasses that stabilize the soils and provide nesting materials. The only terrestrial areas within U.S. jurisdiction that this species uses for attempted nesting occurs on the Midway Atoll (USFWS 2000). However, the marine range of Short-tailed Albatross extends into the open ocean of the Gulf of Alaska, Bering Sea, Aleutian Islands, and the North Pacific Ocean (USFWS 2012a). The extent to which the species uses these areas is not known. The Short-tailed Albatross marine range extends into the Kachemak Sound adjacent to the ZPE, but the species is not known to use terrestrial habitats within Alaska and is unlikely to have ever bred in Alaska (Sherburne 1993).

Several federally listed marine mammals under the jurisdiction of NMFS have ranges that extend into Cook Inlet and Kachemak Bay. These species include humpback whale (*Megaptera novaeangliae*; Western North Pacific Distinct Population Segment [DPS]; endangered), right whale (*Eubalaena japonica*; North Pacific right whale; endangered), blue whale (*Balaenoptera musculus*; endangered), beluga whale (*Delphinapterus leucas*; Cook Inlet DPS), stellar sea lion (*Eumetopias jubatus*; Western DPS; endangered), and fin whale (*Balaenoptera physalus*, endangered). As described in more detail below, critical habitat for Cook Inlet beluga whale has been established in Cook Inlet and Kachemak Bay adjacent to the ZPE.

5.6.1 Cook Inlet Beluga Whale

The DPS of beluga whale that inhabits Cook Inlet (CIBW) was listed as an endangered species under the ESA on October 22, 2008 (73 FR 62919). Critical habitat was designated for CIBW DPS by NMFS on April 11, 2011 (76 FR 20180) and extends across two areas comprising 3,013 square miles of marine habitat, including Kachemak Bay (NMFS 2009). Kachemak Bay is in Area 2 of the designated critical habitat, which consists of 2,275 square miles of less concentrated spring and summer beluga use but known fall and winter use. NMFS finalized a recovery plan for the CIBW DPS in December 2016. The endangered Cook Inlet beluga whale population has declined by nearly 80 percent since 1979, from about 1,300 whales to an estimated 279 whales in 2018 (NMFS 2022); the 10-year (2008-2018) Cook Inlet beluga whale population trend is declining 2.3 percent per year, which is faster than the previous estimate of -0.5 percent/year (NMFS 2020).

Generally, CIBW spend the ice-free months in upper Cook Inlet, gathering in river mouths with abundant fish prey. Breeding and then calving typically occur during this gathering period. Then as ice begins to form in the upper inlet, CIBW disperse into smaller groups, and some head south to the deeper waters of the mid and lower portions of Cook Inlet during winter (NMFS 2008a).

The traditional ecological knowledge of Alaska Natives and NMFS aerial survey data document a historical contraction of the summer range of CIBWs (Huntington 2000; Rugh et al. 2010). While belugas were once abundant and frequently sighted in the lower inlet, including Kachemak Bay during summer, they are now primarily concentrated in the upper half of the inlet (Rugh et al. 2010; Shelden and Wade 2019). Belugas were regularly sighted in the 1980s at the Homer Spit and the head of Kachemak Bay, appearing during spring and fall of some years in groups of 10-20 individuals (Speckman and Piatt 2000). Belugas have also been common at Fox River Flats, Muddy Bay, and the northwest shore of Kachemak Bay, sometimes remaining in Kachemak Bay all summer (NMFS 2009). Beluga sightings were fewer and of smaller groups in the 1990s (Speckman and Piatt 2000). During NMFS aerial surveys in June and July from 1996 to 2011, only a single beluga whale was seen in Kachemak Bay in 2001 (Shelden and Wade 2019). Year-round acoustic monitoring at Homer Spit during 2008-2013 did not detect any beluga whales (Castellote et al. 2020).

Diminished presence of belugas in lower Cook Inlet may be a result of reduced population size or changes in habitat use due to alterations in habitat quality including prey species distribution and abundance, ambient noise levels, or sea temperatures (Speckman and Piatt 2000). A reoccupation of peripheral habitats may be the first indication of recovery as the CIBW population begins to increase (Rugh et al. 2010).

NMFS has identified five primary constituent elements (PCEs) that are essential to the conservation of CIBWs:

- **PCE 1** -Intertidal and subtidal water of Cook Inlet with depths less than 30 feet (mean low lower water) and within 5 miles of high and medium flow anadromous fish streams
- **PCE 2** -Primary prey species consisting of four species of Pacific salmon (Chinook Salmon, Sockeye Salmon, Chum Salmon, and Coho Salmon), Eulachon, Pacific Cod (*Gadus macrocephalus*), Walleye Pollock (*Theragra chalcogramma*), Saffron Cod (*Eleginus gracilis*), and Yellow Fin Sole (*Limanda aspera*)
- **PCE 3** -Waters free of toxins or other agents of a type or amount harmful to CIBWs
- **PCE 4** -Unrestricted passage within or between the CHAs
- **PCE 5** -Waters with in-water noise below levels resulting in the abandonment of CHAs by CIBWs

5.7 Recreation, Land Use, and Aesthetics

5.7.1 Recreation

The proposed Dixon Diversion will be located on ADNR land. The Project will also be located immediately adjacent to the Kenai National Wildlife Refuge; however, no project works will be located within the refuge. There are six campsites near the barge basin dock and Bradley Lake that are managed by Bradley Lake personnel (ADNR 2000).

Previous assessments of recreational use in the area by AEA have indicated low recreational use, due to the region's remoteness (AEA 2011). FERC exempted AEA from Form No. 80 recreation use report filing requirements in an order dated January 27, 2004. The proposed Dixon Diversion Project occurs in similarly remote and rough terrain, and a similarly low recreational use potential is expected.

5.7.2 Land Use

The Bradley Lake Project is located on the Kenai Peninsula within the Kenai Peninsula Borough. Land use within this area is managed according to the Kenai Area Plan (ADNR 2000). The Project is located within Region 8 of the Kenai Area, which encompasses the upper Kachemak Bay and the drainages flowing into it, including the Bradley and Martin rivers (ADNR 2000). Region 8 is further divided into four distinct areas: 1) the Fox River Flats; 2) mostly state lands surrounding Caribou Lake and the Fox Creek drainage; 3) the Bradley Lake Hydroelectric Project; and (4) the tidelands. The region is enveloped by the Kenai Refuge on the north and east, the Kenai Fjords National Park on the south, and

Kachemak Bay State Park on the southwest. A portion of the Kachemak Bay CHA and all of the Fox River Flats CHA is contained within Region 8. All of Kachemak Bay is a NERR (ADNR 2000).

The Kenai National Wildlife Refuge was established in 1941 and is managed by USFWS. The Kenai Refuge was previously established as the Kenai National Moose Range following moose population decline in the region due to commercial guided hunts. The mission of Kenai Refuge and the National Wildlife Refuge System overall is to administer a network of lands for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats for future generations. In addition, a multitude of recreational opportunities are available on the Kenai Refuge including camping, canoeing/kayaking, fishing, hiking, hunting and trapping, photography, and wildlife viewing. Notable attractions within the Kenai Refuge include the Skilak Wildlife Recreation Area, Swan Lake Canoe Route, and Swanson River Canoe Route (USFWS 2012b).

In 1980, 1.35 million acres of the 1.92-million-acre Kenai National Wildlife Refuge were designated as federal wilderness under the Alaska National Interest Lands Conservation Act (ANILCA). Kenai Wilderness areas are managed to protect wilderness values such as healthy watersheds for spawning salmon and habitat for sensitive species such as Trumpeter Swans, wolves, wolverine, lynx, and brown bears. Wilderness lands also provide scenic and wildlife-related recreation opportunities (USFWS 2019).

The Kenai Fjords National Park was established as a national park in 1980 to preserve the fjord and rainforest ecosystems, wildlife, and historical and archeological remains. With a span of over 600,000 acres, the Kenai Fjords National Park provides recreational opportunities, including boat tours, canoeing/kayaking, camping, fishing, beach combing, biking, hiking, cross-country skiing, dog sledding, flightseeing, and mountaineering. Popular places within the park include Exit Glacier, the Nuka Bay Mining District, and the Harding Icefield (NPS 2020).

Kachemak Bay State Park is Alaska's first state park. It contains over 400,000 acres and encompasses mountain, glacier, forest, and ocean environments (ADNR 2020). The park provides numerous opportunities for recreation, including camping, fishing, hiking, biking, boating, and wildlife viewing. Attractions within the Kachemak Bay State Park are the Grewingk Glacier, Poot Peak, China Poot Bay, Halibut Cove Lagoon, Humpy Creek, and China Poot (Leisure) Lake (ADNR 2022).

The CHAs of Alaska are managed through their Critical Habitat Area Management Plan, which has the goal of protecting habitats particularly crucial to the continuation of fish and wildlife, and to restrict all other uses not consistent with this purpose (ADFG 1993). A Special Area Permit is required from the ADFG to conduct certain activities within the CHAs, including any action likely to have a significant effect on vegetation, drainage, water quality, soil stability, fish, wildlife, or their habitats (ADFG 1993).

The Kachemak Bay NERR boundaries encompass the Kachemak Bay and Fox River Flats CHAs. Additionally, the Kachemak Bay NERR includes the waters of Kachemak Bay east of the line connecting Bluff Point in the north with Point Pugibshi in the south, the Fox River Flats, a large portion of Kachemak Bay State Park/Wilderness Park, the Beluga Slough property in public ownership, and city-owned tidelands and marshlands along the Homer Spit. The NERR system was put in to place as part of the Coastal Zone Management Act and is managed by NOAA (Field and Walker 2003).

The Bradley Lake Project and surrounding lands are managed as a separate unit through the Kenai Area Plan (ADNR 2000). The area surrounding the Project is owned by the state and since 1962, approximately 38,066 acres have been managed as a power-producing site consistent with FERC license requirements in addition to accommodating recreation and public access where safely feasible. The area is also managed for wildlife habitat and harvest. The Martin River and lands to the west are undeveloped. A gravel pit was developed at the mouth of the Martin River during construction of the Bradley Lake Project (ADNR 2000).

5.7.3 Aesthetics

The new facilities will be constructed in remote, undeveloped areas of state land. While the diversion structure and water conveyances will be new additions to the landscape, they will be in remote areas that are infrequently visited by the public.

5.8 Socioeconomics

The existing Bradley Lake Project is a critical component of the energy infrastructure and supply in Alaska’s railbelt region. The Bradley Lake Project provides 5-10 percent of the annual railbelt electric power needs. The Bradley Lake Project is most important to the railbelt electric system during the cold and dark winter months when demand for both electric power and gas for heat is at its highest. The power produced at the Bradley Lake Project is purchased by Chugach Electric Association, Inc. (41.0 percent), Golden Valley

Electric Association, Inc. (22.8 percent), Matanuska Electric Association, Inc. (18.6 percent), Alaska Electric Generation & Transmission Cooperative, Inc. acting on behalf of Homer Electric Association, Inc. (16.2 percent), and the City of Seward (1.4 percent).

The Kenai Peninsula Borough has a population of 58.5 thousand people and a median age of 40.8 years. Median household income is $66,064. The two largest ethnic groups in Kenai Peninsula Borough are white (non-Hispanic; 79.9 percent), and American Indian and Alaska Native (non-Hispanic) 7.72 percent. Most (98.6 percent) residents in Kenai Peninsula Borough are U.S. citizens. The economy of the Kenai Peninsula Borough employs 25,300 people. The largest industries are health care and social assistance (4,400 people), retail trade (2,750 people), and educational services (2,379 people; U.S. Census Bureau 2021).

The largest population center to the ZPE is Homer, Alaska (approximately 25 air miles) with a population of 5,709 (U.S. Census Bureau 2021). According to the 2019 American Community Survey data, there are 2,736 males and 2,973 females in Homer. The median age in Homer is 41.1 years. An estimated 2,747 people aged 16 and older are employed in Homer, primarily within management, business, science, and arts occupations (U.S. Census Bureau 2021). Communities located within 15 miles of Homer include Anchor Point (population of 2,129), Diamond Ridge (1,245), Fritz Creek (2,074), Kachemak (474), and Nikolaevsk (246; U.S. Census Bureau 2021).

5.9 Cultural Resources

5.9.1 Historical and Archaeological Resources

The earliest evidence of habitation within Kachemak Bay and the surrounding area dates to approximately 3,000 years ago. Termed the Marine Kachemak Tradition, this time period reflects a reliance on marine resources. Riverine Kachemak, which dates to between 2,000 and 1,000 years ago, demonstrates a move to a stronger reliance on terrestrial and riverine resources. Approximately 1,000 years ago, there was a shift from the Kachemak tradition to the Dena'ina Athabascan. These sites are more common in the archaeological record in the region and are represented by semi-subterranean structures with multiple rooms with a central hearth. In addition, tools were made of wood and bone compared to stone tools from the Kachemak traditions (FERC 2016). The Kachemak Bay Dena'ina had a distinct maritime culture that revolved around hunting harbor seals, porpoises, and beluga whales from skin kayaks (Klein 1987). Land-based activities included catching halibut from the tidal flats and collecting clams and mussels along the beaches (Klein 1987). Russia had an impact on Alaska beginning as early as the late 1600s, establishing forts in Kachemak Bay in time. European exploration of the region did not begin until the later 1770s (FERC 2016).

Fur, coal, and gold are resources sought within the Kachemak Bay region. Fur trading between the indigenous Dena'ina people and Russian settlers led to fox-fur farming becoming a major economic activity in the region. Fox-fur farms near the Bradley Lake Project date back to the 1920s and 1930s (FERC 2016). Beginning in the early 1890's, coal was actively prospected along the northern shore of Kachemak Bay. Coal operations shut down in 1897 but started back up again in 1899 when the Cook Inlet Coal Fields Company built Homer on the spit and started mining. The company shut down a few years later, leaving the town abandoned, until the 1920s when homesteaders and fishermen moved into the area (NOAA 1988). The first gold explorations at the mouth of the Kenai River occurred in 1850 and continued into the 1880s when gold was found in several creeks on the Kenai Peninsula (FERC 2016). The Klondike strike of 1897 led to the gold miners departing the area (NOAA 1988).

Historical and archaeological resource surveys were conducted for the original Bradley Lake License Application in 1979, 1980, and 1983. The methodology included pedestrian surveys and low-elevation helicopter flight reconnaissance. Shovel tests were also utilized in strategic locations. All seven of the sites were located more than 1 mile outside of the project area of potential effect (APE) and the Alaska SHPO determined that no historical or archeological resources were identified in the project area. An additional survey of the Bradley Lake Project APE was conducted in 2016 using low, helicopter overflights and pedestrian surveys. Several subsurface shovel probes were excavated, and snow patches were examined to determine the presence or absence of cultural materials; no such resources were discovered (FERC 2016).

AEA continues to follow its FERC-approved Cultural Resources Management Plan, filed on November 22, 1985. If any previously unrecorded archeological or historical areas are discovered during project construction, operation, or project-related activities, AEA would cease the activity immediately and notify the Alaska State Historic Preservation Officer (SHPO).

5.9.2 Tribal Resources

Four Federally recognized Tribes and five Native Corporations have been identified as either having an interest in, or potentially being affected by, the proposed Project. The Federally recognized Tribes are: Seldovia Village Tribe, Native Village of Nanwalek, Native Village of Port Graham, and Kenaitze Tribe. The Native Corporations that may be impacted include: Seldovia Native Association, Inc., English Bay Corporation, Port Graham Corporation, Chugach Alaska Corporation, and Cook Inlet Regional, Inc. AEA will initiate consultation with any potentially affected Tribes and Native Corporations.

5.9.3 Subsistence Resources

In the state of Alaska, subsistence is defined as "noncommercial customary and traditional uses" of fish and wildlife (AS 16.05 – AS 16.40). The fish stocks and game populations that are considered customary and traditional are identified by the Alaska Board of Fisheries and the Alaska Board of Game (ADFG 2021g). Only Alaska natives may participate in the taking of marine mammals for subsistence purposes. Otherwise, subsistence hunting and fishing in designated areas are open to Alaskan residents who have been in the state for 12 consecutive months (ADFG 2021g).

The Bradley Lake Project encompasses an area within the state's non-subsistence area on the Kenai Peninsula (ADFG 2021g). According to Alaska Statute 16.05.258(c), non-subsistence areas are defined as areas where dependence upon customary and traditional uses of fish and wildlife is not a principal characteristic of the economy, culture, or way of life. However, the ZPE does include reaches of federal rural area, which allow for subsistence hunting and fishing on federal lands (ADFG 2021h).

Kachemak Bay supports a personal use gill net fishery targeting Coho Salmon. The fishery is open to Alaska residents with valid licenses. Permitting and harvest is managed through the Homer ADFG office. Limits for the fishery include an annual quota of 25 Coho Salmon per permit holder, plus 10 for each additional household member. The fishery closes by Emergency Order when a harvest range of 1,000-2,000 Coho Salmon has been caught. The fishery can also be closed prior to obtaining the guideline harvest number if the ADFG determines that continuation of the fishery would have negative impacts on wild Coho Salmon stocks (ADFG 2021h). In addition to salmon, Eulachon have traditionally supported subsistence fisheries throughout Southeast Alaska. Native American tribes have traditionally fished Eulachon during spawning runs for food and use of the species' high oil content. The species remains an important food source in some rural Alaskan communities. Modern methods for collection of Eulachon include dip nets, small mesh gill nets, and seines (ADFG 2012).

Cook Inlet supports a beluga whale harvest for Alaska Natives. The Marine Mammal Protection Act established a moratorium on the take of marine mammals, including Cook Inlet beluga whales. However, this act provided an exception for certain Alaska Indian, Aleut, and Eskimo residents to take any marine mammal with purposes associated with subsistence. Subsistence under these conditions includes creating and selling authentic Native articles of handicrafts and clothing. NMFS has issued regulations establishing long-term harvest limits on the maximum number of Cook Inlet beluga whales that may be taken by Alaska Natives for subsistence purposes, in response to unstable population numbers (NMFS 2008b).

Since 1987, an annual moose subsistence hunt has been conducted in the southern portion of Cook Inlet, near Point Pogibshi and Rocky and Windy bays. An average of 2 bulls per year have been harvested during this subsistence hunt in recent years (ADFG 2018).

6.0 POTENTIAL EFFECTS AND ANTICIPATED STUDIES

6.1 Potential Resource Effects

AEA's initial list of potential effects within the ZPE that warrants analysis includes the following:

Dixon Diversion to Bradley Lake

- Surface geology and soils, including slope stability, soil erosion, sedimentation, and turbidity;
- Flow diversion including reduced flows in the Martin River and associated potential water quality changes
- Aquatic habitat alterations in the Martin River
- Potential indirect effects on fish prey populations for Cook Inlet beluga whale within CIBW critical habitat (PCE 2).
- Bradley Lake shoreline wetlands and vegetation associated with the pool raise
- Wetlands and terrestrial habitats impacted by the tunnel, roads, and diversion
- Temporary construction activity impacts on wildlife

Dixon Diversion Martin River Powerhouse

- Surface geology and soils, including slope stability, soil erosion, sedimentation, and turbidity;
- Flow diversion, including reduced flows in the East Fork Martin River bypass reach and associated potential water quality changes
- Aquatic habitat in East Fork Martin River
- Bradley Lake shoreline wetlands and vegetation associated with the pool raise
- Wetlands and terrestrial habitats impacted by the tunnel, powerhouse, roads, diversion, and transmission.
- Temporary construction activity impacts on wildlife

Additionally, AEA would analyze how the proposed alternatives may impact the resource management objectives of the Kenai National Wildlife Refuge and the Kachemak Bay management goals and objectives.

6.2 Proposed and Ongoing Studies

In the development of the ICD, AEA collected and summarized the reasonably available information regarding the Project and its potential effects on the human and natural environments. AEA conducted preliminary consultation with agencies and anticipates preliminary studies during 2022 field season. AEA anticipates additional studies involving site characterization and feasibility assessment during 2023 field season to inform development of a final project description for its license amendment application.

A preliminary list of potential resource studies includes:

Anticipated 2022 Field Season

- Topographic LiDAR survey
- Geologic Investigations
- East Fork Martin River Gaging
- Video monitoring of salmon at the outlet of Red Lake mid-June through mid-October
- Juvenile salmon sampling in the Martin River
- Bradley Lake shoreline vegetation characterization

Anticipated 2023 Field Season

- Continued flow monitoring in the Martin River
- Water Quality Monitoring in the Martin River
- Aquatic habitat characterization of the Martin River
- Fish use of the Martin River
- Wetland delineation
- Cultural Resource study

AEA will identify and develop additional study needs in consultation with stakeholders. AEA requests that agencies and stakeholders follow the study request parameters as specified by 18 CFR § 16.8(b)(5). Specifically, the interested resource agency, Indian tribe, or member of the public is requested to provide the applicant with study requests as outlined below:

- Describe the goals and objectives of each study proposal and the information to be obtained.

- If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.
- If the requestor is not a resource agency, explain any relevant public interest considerations regarding the proposed study.
- Describe existing information concerning the subject of the study proposal, and the need for additional information.
- Explain any nexus between Project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.
- Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate filed season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.
- Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Study requests must be filed within 60 days of the Joint Agency and Public Meeting or by August 14, 2022 (see Section 2.1, Process Plan and Schedule) and should be sent to: Bryan Carey, Alaska Energy Authority at bcarey@akenergyauthority.org.

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