BRADLEY LAKE HYDROELECTRIC PROJECT

FERC No. 8221

BRADLEY LAKE EXPANSION NON-CAPACITY LICENSE AMENDMENT

EXHIBIT A
PROJECT DESCRIPTION

https://www.ecfr.gov/current/title-18/part-4/subpart-F#p-4.51(b)

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Both attachments will be filed with the Final Amendment Application (FAA)

ACRONYMS AND ABBREVIATIONS

A

AEA	Alaska Energy Authority

B

BLVD	Bradley Lake Vertical Datum
Bradley Lake Project	Bradley Lake Hydroelectric Project, FERC No. 8221

C

cfs	cubic feet per second
Commission	Federal Energy Regulatory Commission

E

EFMR	East Fork Martin River
El.	Elevation

F

FAA	Final Amendment Application
FERC	Federal Energy Regulatory Commission

H

HEA	Homer Electric Association

M

MIF	minimum instream flow
MW	megawatt

P

Project	Bradley Lake Expansion Project (Dixon Diversion and Bradley Lake Pool Raise)

W

WSEL	water surface elevation

1.0 INTRODUCTION

1.1 Overview of the Bradley Lake Hydroelectric Project and Proposed Expansion

The Alaska Energy Authority (AEA), Licensee and owner of the 120-megawatt (MW) Bradley Lake Hydroelectric Project (Bradley Lake Project; Federal Energy Regulatory Commission [FERC or Commission] No. 8221), is applying for a non-capacity FERC license amendment pursuant to the Commission's regulations at 18 Code of Federal Regulations 4.201[1].

The Bradley Lake Project, located near the head of Kachemak Bay on the south shore about 25 miles east-northeast of Homer, Alaska (see Figure 1.1-1), commenced commercial operation in 1991. 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. Travel to the site is generally by air from the Homer Airport.

Bradley Lake Project features include a 125-foot-high, 610-foot-long concrete-faced rockfill main dam at Bradley Lake (59.7553° North/150.8558° West), a separate concrete gravity spillway, and a 3.5-mile-long power tunnel that includes a 2,725-foot-long steel-lined tunnel leading to a 435-foot-long manifold section that contains the Y branch penstocks extending to the powerhouse. The Bradley Lake Project generates power from the waters of Bradley Lake, which includes water diverted to the lake from the Middle Fork Bradley River, Nuka Glacier, and Upper Battle Creek. Power is transmitted from the Bradley Lake Project powerhouse to the state's main grid at the Bradley Junction via two parallel, 20-mile-long, 115-kilovolt transmission lines. The Bradley Lake Project serves Alaska's Railbelt[2] from Homer to Fairbanks and easterly to the Delta Junction area and is operated by Homer Electric Association, which is under contract with AEA.

[1] The total installed capacity of the Bradley Lake Project is expected to increase by 3.1 MW as a result of the 16-foot increase in the net head at normal maximum pool from 917 feet to 933 feet with the implementation of the Bradley Lake Pool Raise. However, the increase in hydraulic capacity would be minor (less than 15 percent).

[2] The Railbelt in Alaska refers to the region served by the Alaska Railroad and the Railbelt electrical grid, which is responsible for providing electricity to approximately 75 percent of the state's population. This region extends from Fairbanks to Anchorage and includes the Kenai Peninsula.

AEA proposes to build a new diversion dam (Dixon Diversion) to divert seasonal meltwater coming from the Dixon Glacier, located at the headwaters of the Martin River, into Bradley Lake May through November as flows allow. AEA also proposes to raise the normal maximum operating pool elevation of Bradley Lake by about 16 feet (Bradley Lake Pool Raise) through a combination of raising the concrete spillway crest elevation, adding spillway crest gates, and raising the dam embankment crest. Together, these two components make up the Bradley Lake Expansion Project (or Project). Raising the normal maximum operating pool elevation would increase the usable storage capacity from 280,000 acre-feet to 342,000 acre-feet and the installed capacity of the Bradley Lake Project would increase from 119.7 megawatts (MW) to 122.8 MW due to increased head pressure associated with the pool raise. The amount of power the Bradley Lake Project can produce would increase on average from about 436,000 megawatt-hours (MWh) to 601,000 MWh each year (an increase of approximately 38 percent[3]), providing more power to the Railbelt.

The proposed Project is described herein. A redline version of the most recent FERC-approved Exhibit A[4] will be included as Attachment A, with a clean version as Attachment B in the Final Amendment Application (FAA).

[3] Since the Battle Creek Diversion became operational in late 2020, the inflow to Bradley Lake from other sources has been lower than the normal long-term average. The actual average annual power generation at the Bradley Lake Project from 2021 through 2025 was approximately 420,000 MWh while the expected long-term average based on the past 10 years of Bradley Lake generation plus the average output from the WFUBC diversion as if it had been online the entire 10-year period is approximately 436,000 MWh.
[4] FERC Accession Number: 20210617-3085

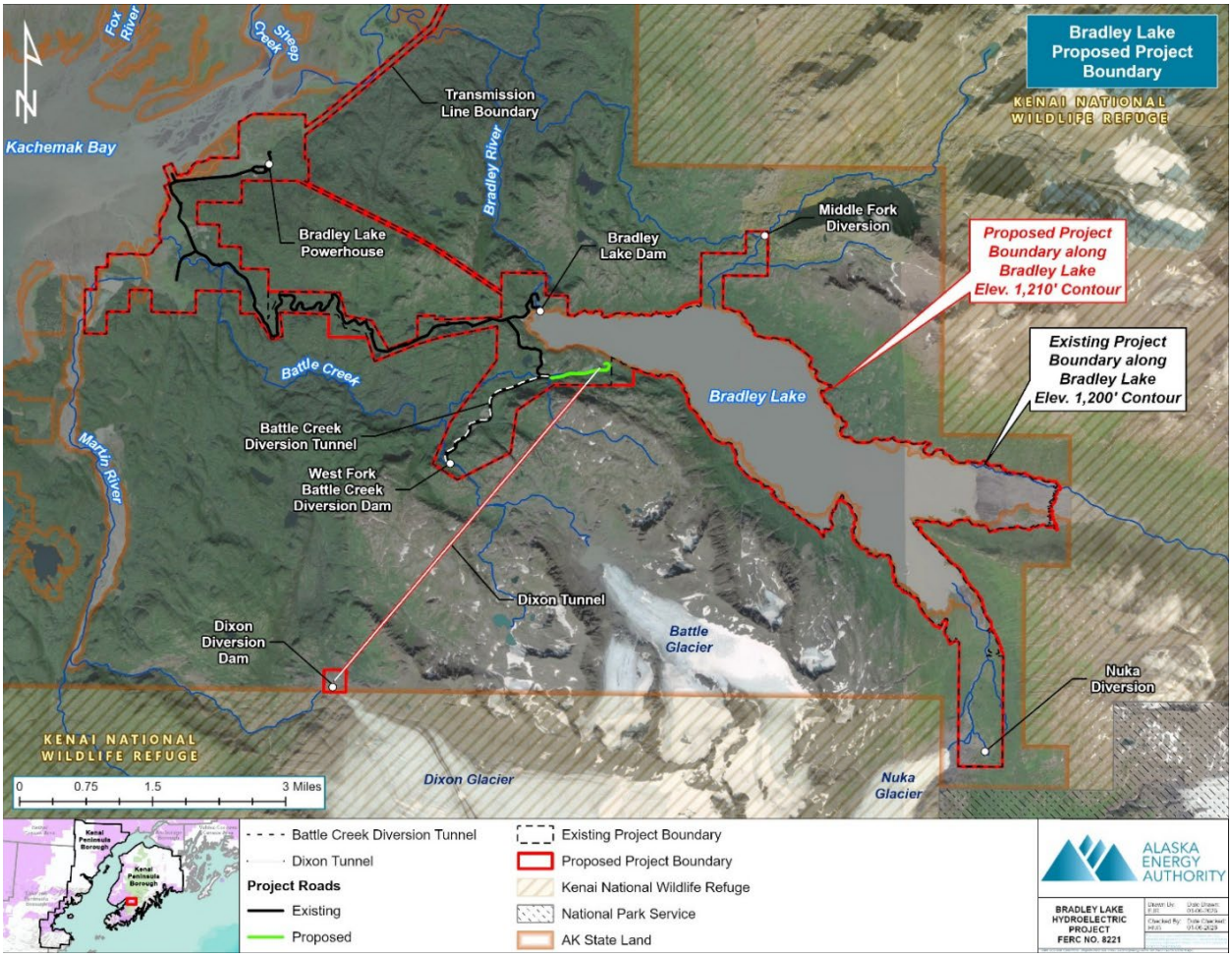

Figure 1.1-1 Location and features of the Bradley Lake Expansion Project near Kachemak Bay, Alaska.

2.0 PROJECT DESCRIPTION OF PROPOSED FACILITIES

2.1 Dixon Diversion

AEA is proposing a new water diversion system (Dixon Diversion) to divert flows from Dixon Glacier, located at the headwaters of East Fork Martin River (EFMR), to Bradley Lake via an underground tunnel conveyance system. The proposed Dixon Diversion development consists of the diversion dam, diversion tunnel, a tunnel discharge channel to Bradley Lake, and a new access road to the proposed tunnel exit. The Dixon Diversion would be operated from spring thaw until winter freeze May through November as flows allow after meeting the proposed EFMR minimum instream flow releases of 100 cubic feet per second (cfs) and would have capacity to divert a maximum of 1,650 cfs from the EFMR basin to Bradley Lake.

2.1.1 Diversion Dam, Head Works, and Conveyance Details

The Dixon Diversion dam (59.6932° North/ 150.9180° West) would be constructed on state-owned land near the terminus of the Dixon Glacier, approximately 5.9 miles south of the existing Bradley Lake Project powerhouse. AEA anticipates that the diversion dam would be a combination of a concrete weir wall approximately 21 feet high by 135 feet long, with two gated openings and a spillway crest elevation of 1,276 feet Elevation (El.) (elevations reference the Bradley Lake Vertical Datum [BLVD], unless otherwise specified) (Figure 2.1-1).

Water control features of the Dixon Diversion include:

- A motor-operated slide gate (tentatively 4-foot wide by 4-foot high) to regulate minimum instream flow through the diversion.
- A motor-operated slide gate (tentatively 6-foot wide by 6-foot high) at the diversion dam to provide a low-level outlet to maintain flow through the diversion dam during maintenance operations.
- Two "overshot" crest gates (tentatively Obermeyer gates) approximately 30-foot wide by 20-foot tall.
- A 14-foot wide by 14-foot-high motor-operated slide gate at the inlet portal to the diversion tunnel.

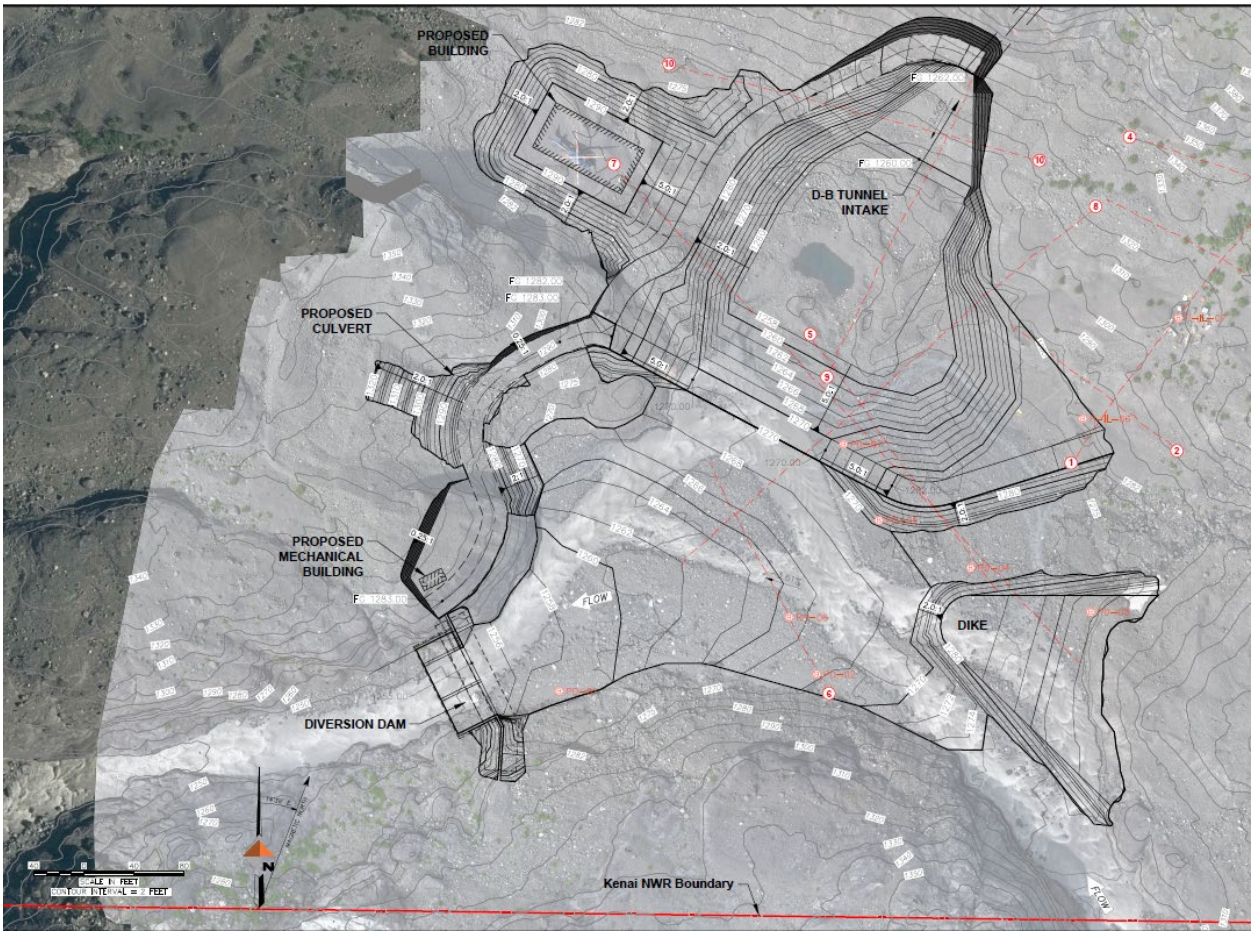

Figure 2.1-1 Schematic of proposed Dixon Diversion.

2.1.2 Flood Flow Capacity of Diversion

Control to Bradley Lake would consist of maintaining a minimum instream flow (MIF) of 100 cfs to the EFMR canyon through the MIF bypass gate, with the remaining flow, up to the tunnel capacity, diverted to Bradley Lake. Excess flow greater than the capacity of the tunnel would spill over the gates to the EFMR canyon. The diversion pool is currently estimated to have a storage capacity of approximately 37 acre-feet at El. 1,276 feet (top of gate and overflow section crest elevation) with a surface area of approximately 3.5 acres.

The diversion dam and tunnel inlet are designed to operate passively such that at headwater levels up to the spillway crest (El. 1,276 feet), the tunnel headworks would capture all flows except for the minimum instream flow. The capacity of the tunnel is 1,650 cfs at headwater levels at and above El. 1,275.5 feet. When inflow is greater than 1,750 cfs (tunnel capacity plus MIF), the portion of the flow greater than the capacity of

the tunnel would pass over the top of the overshot gates and/or the diversion gates would be lowered.

2.1.3 Dixon Diversion Tunnel

A tunnel would be bored to convey water northeast from the diversion to Bradley Lake. As proposed, diverted water would flow from the diversion pool through a 4.6-mile-long underground concrete-lined tunnel with an inside diameter of 14 feet. The tunnel would be constructed using a tunnel boring machine advancing from the downstream portal to the upstream portal near the proposed diversion dam. A segmental concrete system is proposed for the finished tunnel lining. Tunnel muck would be removed from the downstream end and disposed in an approximately 40.6-acre area near the tunnel outlet as shown in Exhibit E. When completed, water from the diversion would exit from this tunnel into a new tunnel discharge channel and flow into Bradley Lake. The invert of the tunnel entrance would be approximately at El. 1,262.0 feet, and the invert at the outlet would be at approximately El. 1,185.0 feet.

2.1.4 Diversion Tunnel Exit Portal Features

A 1,100-foot-long channel with a 16-foot-bottom width would be constructed to convey the diverted flows into Bradley Lake.

2.1.5 Exit Portal Access Road

A new 16-foot-wide gravel access road would be constructed, extending approximately 1 mile from the existing Battle Creek Diversion Access Road to the Dixon Diversion tunnel exit portal, partially located on top of the tunnel muck spoil disposal area.

2.1.6 Appurtenant Facilities

A maintenance building would be constructed at the Dixon Diversion facility.

2.2 Bradley Lake Pool Raise

Major elements of the existing Bradley Lake Project include a concrete faced rockfill dam, an ungated spillway having a discharge capacity of 23,800 cfs, a diversion tunnel which also serves as a low level outlet, a submerged intake leading to the power tunnel which, including the vertical shaft, is 19,152 feet long, a surface powerhouse located on the shore of Kachemak Bay, and a tailrace channel into the bay.

Bradley Lake Dam currently impounds Bradley Lake to a full pool elevation of 1,180 feet with a surface area of 3,802 acres and a usable storage capacity of approximately 280,000 acre-feet. Under the Bradley Lake Pool Raise, the lake level of Bradley Lake would be increased by 16 feet to El. 1,196 feet. This would result in an increase in the total surface area to 4,033 surface acres and an increase in usable storage capacity to approximately 342,000 acre-feet. The pool raise would be achieved through a combination of raising the concrete spillway crest elevation, adding spillway crest gates, and raising the embankment dam crest. The dam crest would be raised approximately 13 feet through a combination of increased rockfill, extending the upstream concrete facing, and reconstruction of the concrete parapet wall. The operating net head of the Bradley Lake Project, which is currently 917 feet, would increase to 933 feet with the Bradley Lake Pool Raise.

2.2.1 Modifications to Bradley Lake Dam

Modifications to Bradley Lake dam would include demolition of the existing concrete crest and parapet wall, placing rockfill on the downstream slope to raise the embankment crest to El. 1,202.9 feet, extending the concrete face to match the existing slope, and reconstructing a new 4-foot parapet wall (top of wall El. 1,206.9 feet) and cap at the dam crest (Figure 2.2-1). Rockfill would be initially placed at the downstream toe of the embankment and built in lifts extending to the new top of dam. Approximately four feet of freeboard is proposed above the estimated preliminary Probable Maximum Flood (PMF) elevation (El 1202.9) to the top of the parapet.

Earthfill would be placed on the left abutment to maintain continuity of the top of dam elevation to the exposed rock outcrop on the left abutment. The design would accommodate vehicle access to the dam crest, downstream toe, and the existing control buildings for the power tunnel and diversion works. It is assumed that the concrete parapet wall would be extended across the left side into the rock face to create a hydraulic barrier that is continuous from the concrete face of the embankment to the left abutment with a ramp from the existing access road over the parapet wall. The length of the dam would increase by 230 feet to a total of 830 feet.

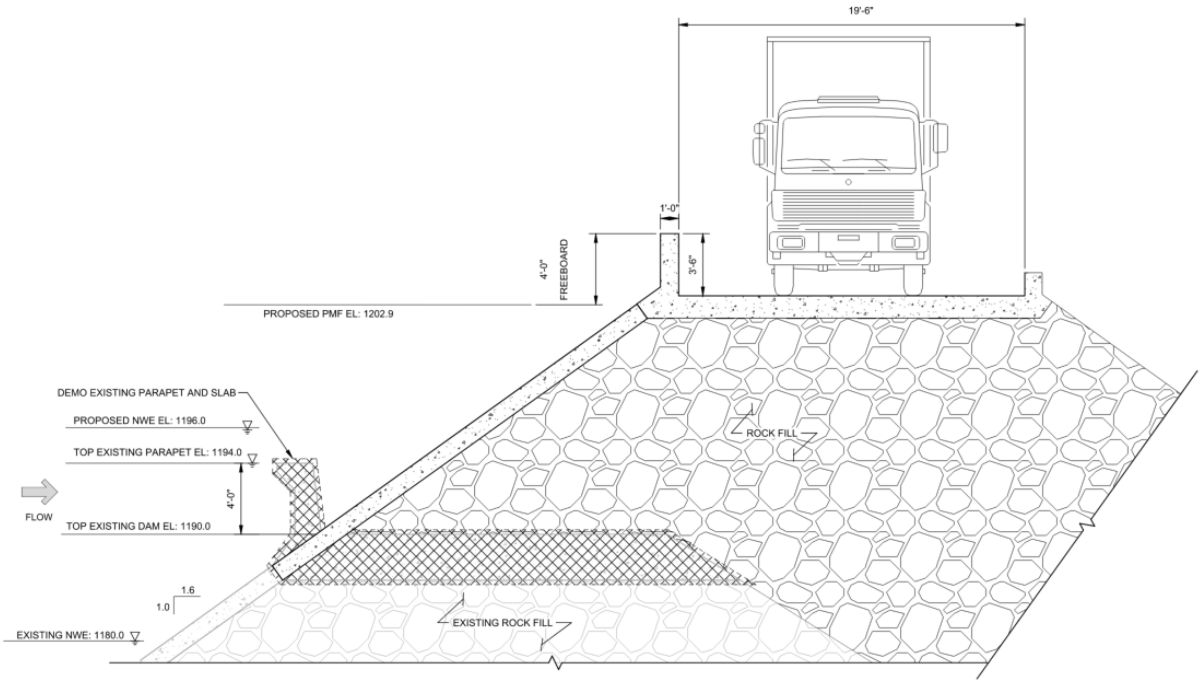

Figure 2.2-1 Schematic of proposed dam embankment for Bradley Lake Pool Raise.

On the right abutment, between the embankment and spillway, a combination of earthfill and concrete retaining walls will be constructed to maintain the proposed dam-crest elevation. A vehicle turnaround area and a ramp to the existing outlet works control building would be maintained. Near the downstream toe of the dam, a new access road would be constructed to extend across the embankment to provide access to the diversion tunnel outlet portal building and toe of the dam. To avoid covering the outlet portal building, a retaining wall would be constructed to retain the embankment fill and provide access to the building.

An extended staircase to the new crest elevation would provide access to the downstream side of the spillway and gallery. An extension of the existing grout curtain is planned to occur across the area between the spillway and the embankment, in addition to an extension of the grout curtain.

For the raised embankment, approximately 100,000 cubic yards of rockfill material is estimated. The raised section would also include filter (transition) materials placed behind the reinforced concrete face with a similar gradation to the existing materials. A drill and blast rock quarry would be developed in several borrow areas identified close to the dam site to generate the required fill materials for constructing the embankment raise.

2.2.2 Modifications to Bradley Lake Spillway

Modifications to the Bradley Lake Spillway include adding 8.5 feet of fixed concrete crest to El. 1,188.5 feet with a 7.5-ft high crest gate on top to El. 1,196.0 feet as shown in Figure 2.2-2. It is proposed that the spillway mass would be expanded upstream to meet stability requirements. The non-overflow abutments would also be raised in a similar fashion. This approach would maintain the current centerline for continuity with the adjacent embankment (that would also be raised).

The spillway geometry is planned to maintain a 3H:10V[5] upstream face and an 8H:10V downstream face. Spillway discharge at the preliminary PMF would be approximately 42,500 cfs at a lake level of El 1,202.9. It was assumed that the expanded spillway would be reinforced on the upstream face, with the upstream rebar drilled and grouted into the rock. This includes a new grout curtain installed under the proposed heel of the spillway and redrilling of the existing foundation drains.

[5] 3 units of horizontal distance: 10 units of vertical distance

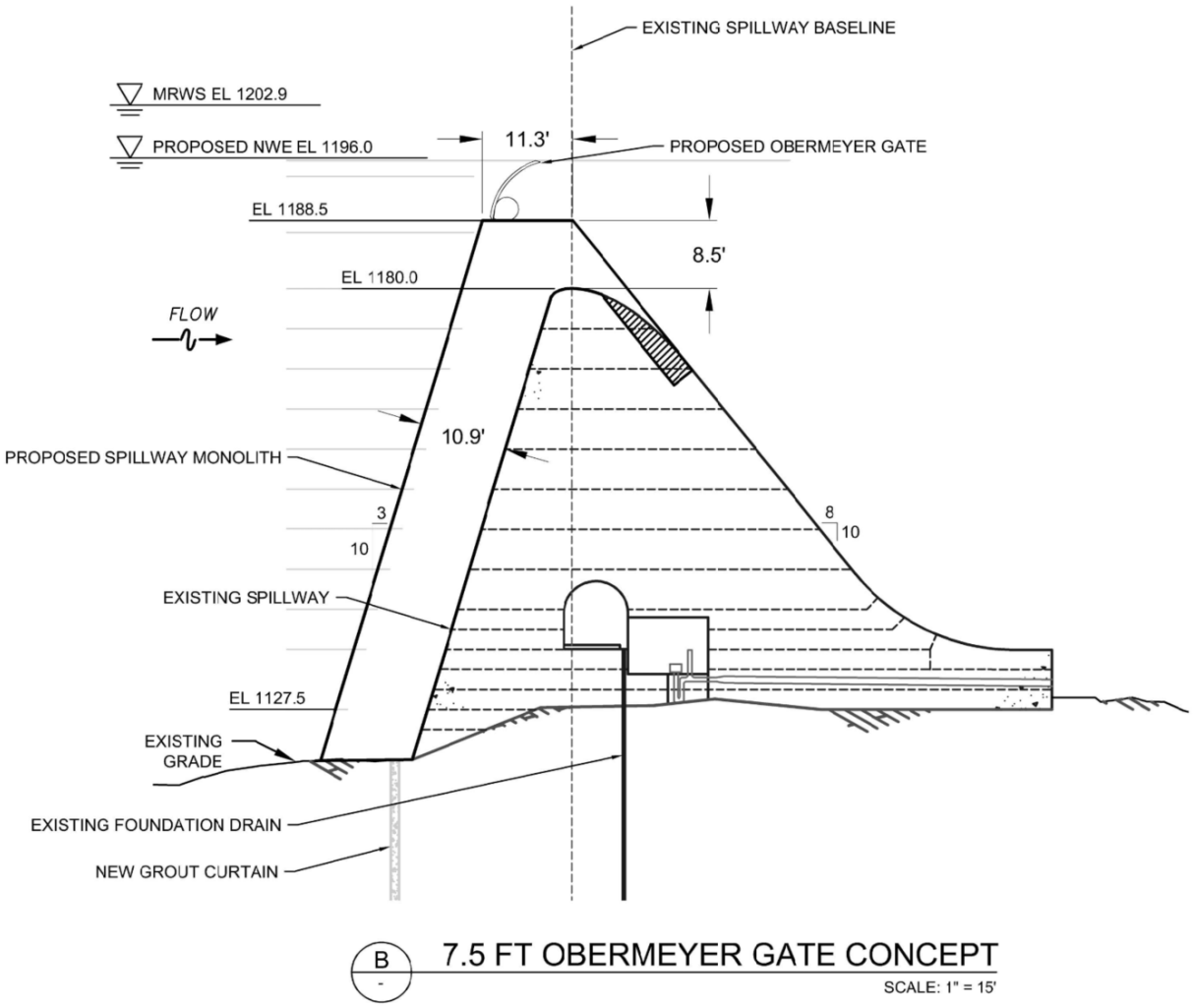

Figure 2.2-2 Schematic of proposed spillway for Bradley Lake Pool Raise with Obermeyer gates.

2.2.3 Increase in Installed Capacity due to 16-foot Pool Raise

The current total installed capacity of the Bradley Lake Project is 119.7 MW with a net head of 917 feet at normal maximum pool elevation. Based on the formula provided below, the capacity of the Bradley Lake Project is expected to increase to 122.8 MW as a result of the 16-foot increase in the net head at full pool (933 feet) with implementation of the Bradley Lake Pool Raise.

$$P2 = P1\ x\ (H2/H1)^{1.5}$$

Where *P2* is the new installed capacity, *P1* the existing installed capacity, *H2* the new net head, and *H1* the existing net head.

3.0 LAND OWNERSHIP

3.1 Land Ownership and Project Boundary Description

The proposed Bradley Lake Expansion Project would occupy no lands or interests in lands of the United States. The State of Alaska owns all the land within the existing 8,532.4-acre Bradley Lake Project boundary as well as the 272.6 acres of land to be added to the project boundary as part of this amendment. The legal description of the lands that would be added to the project boundary are provided in Table 3.1-1 and displayed in Exhibit G.

Table 3.1-1 New lands to be added to the Bradley Lake Project lands by the proposed license amendment.

Township	Range	Section	Exhibit G Plate	Project Acres
T005S	R010W	11	G-1	13.2
		12	G-1	37.6
		25	G-4	1.5
		36	G-4	45.9
T005S	R009W	10	G-2	7.6
		11	G-2	0.6
		14	G-3	3.5
		15	G-2	7.1
		16	G-2	43.1
		17	G-2	3.9
		19	G-2	2.7
		20	G-2	5.2
		22	G-2	8.3
		23	G-3	7.9
		24	G-3	4.2
		25	G-3	16.3
		26	G-3	3.8
		30	G-4	6.3
		36	G-3	2.9
		8	G-2	0.6
		9	G-2	5.1
T005S	R008W	19	G-3	5.6
		20	G-3	10.0
		29	G-3	3.8
		30	G-3	11.8
		31	G-3	14.1
Total Acreage				**272.6**

ATTACHMENT A-1

EXHIBIT A, REDLINE VERSION

This document will be submitted as part of the Final Amendment Application

ATTACHMENT A-2

EXHIBIT A, CLEAN VERSION

This document will be submitted as part of the Final Amendment Application