Grant Lake Hydroelectric Project (FERC No. 13212)

Biotic Monitoring Plan

Draft

Kenai Hydro, LLC

June 2015

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Acronyms and Abbreviations

ADF&G	Alaska Department of Fish & Game
AEIDC	Arctic Environmental Information and Data Center
ARRC	Alaska Railroad Corporation
AUC	area-under-the-curve
AWC	Anadromous Water Catalog
BMP	best management practices
cfs	cubic feet per second
CPUE	catch-per-unit-effort
DLA	Draft License Application
DTU	daily temperature unit
ECM	Environmental Compliance Monitor
FERC	Federal Energy Regulatory Commission
HVAC	heating, ventilating, and air conditioning
INHT	Iditarod National Historic Trail
KHI	Kenai Hydro, Inc.
KHL	Kenai Hydro, LLC
kV	kilovolt
kW	kilowatt
mm	millimeter
MW	megawatt
NAVD 88	North American Vertical Datum of 1988
OCMP	Operation Compliance Monitoring Plan
Plan	Biotic Monitoring Plan
POH	post-orbital hypural
PM&E	protection, mitigation, and enhancement
Project or Grant Lake Project	Grant Lake Hydroelectric Project
TWG	Technical Working Group
USGS	U.S. Geological Survey
WUA	weighted usable area

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Biotic Monitoring Plan
Draft
Grant Lake Hydroelectric Project (FERC No. 13212)

1 INTRODUCTION

This document provides a draft of Kenai Hydro, LLC's (KHL) proposed Biotic Monitoring Plan (Plan) for the Grant Lake Hydroelectric Project (Project or Grant Lake Project), Federal Energy Regulatory Commission (FERC) No. 13212. Activities associated with the proposed construction and operation of the Project include the construction of an intake structure in Grant Lake, a tunnel, a surge chamber, a penstock, a powerhouse, tailrace channel with fish exclusion barrier, access roads, a step-up transformer, a breaker, a transmission line, and a switchyard. The activities and structures associated with this Project have the potential to impact the aquatic resources.

This Plan includes background information on the Project, including baseline and advanced studies, identifies potential impacts to fish and fish habitat caused by the proposed Project. The plan also provides biotic monitoring requirements for three components: 1) during Project construction; 2) during Project operation; and 3) enhancement and mitigation measures.

1.1. Location

The proposed Grant Lake Project will be located near the community of Moose Pass, Alaska (population 219) in the Kenai Peninsula Borough, approximately 25 miles north of Seward, Alaska (population 2,693), and just east of the Seward Highway (State Route 9); this highway connects Anchorage (population 291,826) to Seward. The Alaska Railroad (ARRC) parallels the route of the Seward Highway, and is also adjacent to the Project area. Grant Lake is located in the mountainous terrain of the Kenai Mountain Range and has a normal water surface elevation of 703 feet North American Vertical Datum of 1988 (NAVD 88) and surface area of approximately 1,703 acres. A map showing the location of the Project is provided in Figure 1.[1]

1.2. Project Description

The Grant Lake Project will consist of the Grant Lake/Grant Creek development, an intake structure in Grant Lake, a tunnel, a surge chamber, a penstock, a powerhouse, tailrace channel with a fish exclusion barrier, access roads, a step-up transformer, a breaker, a switchyard, and an overhead transmission line. The powerhouse will contain two Francis turbine generating units with a combined rated capacity of 5 megawatts (MW) with a maximum design flow of 385 cubic feet per second (cfs). The general proposed layout of the Project is shown in Figure 2.

[1] The Project boundary alignment, in the vicinity of Grant Lake, follows the 703-foot contour line derived from USGS developed topographic data. Due to imprecision in the USGS topography, the Project boundary around Grant Lake does not currently align with the USFS-developed aerial imagery presented in some of the maps that depict the Project boundary as proposed by KHL in the Draft License Application (DLA; KHL 2015a). The Project boundary alignment will be refined as additional survey data of the Grant Lake shoreline becomes available. The updated Project boundary is anticipated to align more precisely with USFS imagery.

1.2.1. Grant Creek Diversion

The proposed Project consists of a reinforced concrete intake structure located on the south side of the natural lake outlet. No structural modifications would be made to the existing lake natural outlet. The Project will divert water up to a maximum of 385 cfs into the intake structure. When the lake level exceeds the natural outlet of 703 feet NAVD 88, a maximum of 385 cfs will be diverted into the intake structure and routed to the powerhouse. Flow in excess of 385 cfs would pass over the natural outlet to Grant Creek.

1.2.2. Grant Lake Intake

The Project water intake would be a concrete structure located approximately 500 feet east of the natural outlet of Grant Lake and adjacent to the shore. The intake structure consists of a reinforced concrete structure extending from approximately elevation 675 feet NAVD 88 up to a top deck elevation of 715 feet NAVD 88. The structure has an outside dimension of 38 feet by 20 feet. The structure includes intake trashracks, selective withdrawal intake gate with wire rope hoist, and a roller gate located on the water conveyance intake. The intake is divided into three bays, each fitted with an intake gate to provide flexibility for delivering the full flow range of 58 cfs to 385 cfs. The gate position within the water column will be set to deliver the required water temperature to Grant Creek below the powerhouse. The roller gate would be 11 feet tall by 11 feet wide and fitted with a wire rope hoist lift mechanism. Electrical power will be extended from the powerhouse to the intake to operate the intake and isolation gates. Pressure transducers will be installed to monitor the water level at the lake as well as within the intake tower. An access bridge 16 feet wide would be installed from the lake shore out to the intake structure.

The intake would allow for drawdown of Grant Lake to elevation 690 feet NAVD 88, thereby creating approximately 18,790 acre-feet of active storage for the Project between elevations 703 feet NAVD 88 and 690 feet NAVD 88. The intake can be designed to allow the Project to draw water near the surface at various levels of storage, if deemed necessary to meet downstream temperature requirements. The invert of the intake would be at elevation 675 feet NAVD 88 to provide for adequate submergence to the tunnel.

A bypass pipe would extend from the intake structure to the base of the existing water fall in Grant Creek. The installed pipe would be 900 feet long and approximately 18 inches in diameter, allowing the minimum flow ranging from 5 to 10 cfs to be released. A control gate would be located within the intake structure to regulate and monitor the bypass flow releases.

Legend

- Project Boundary
- Seward Highway
- Alaska Railroad

Property Ownership

- Borough
- Federal
- Private
- State

Lake
Trail
Upper
Moose Pass
Grant Lake
Grant Lake
Grant Creek
Lower Trail Lake
Vagt Lake
Solars Mountain
4500
4000
3500
3000
2500
2000
1500
1000
500

Alaska
Project Vicinity

MAP NOTES:
1. THIS MAP WAS DEVELOPED FOR KENAI HYDRO, LLC AS PART OF THE GRANT LAKE HYDROELECTRIC PROJECT (FERC NO. 13212), BIOTIC MONITORING PLAN. THE LOCATIONS OF PROJECT FEATURES ARE SUBJECT TO CHANGE AND ARE SHOWN FOR PLANNING PURPOSES ONLY.
2. THIS MAP WAS DEVELOPED FROM THE FOLLOWING RESOURCES:
   A. AERIAL IMAGERY DEVELOPED BY USFS.
   B. PROJECT FEATURE LOCATIONS PROVIDED BY MCMILLEN.
   C. LAND OWNERSHIP BOUNDARIES PROVIDED BY THE KENAI PENINSULA BOROUGH'S GIS DEPARTMENT.
3. THIS MAP PRESENTS DATA IN THE FOLLOWING GEOGRAHIC SYSTEMS:
   - HORIZONTAL DATUM: NORTH AMERICAN DATUM 1983 (NAD 83)
   - VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88)
   - PROJECTION: ALASKA 4 FIPS 5004 FEET STATE PLANE

REV	DATE	BY	DESCRIPTION

Drawing Scale: 0 0.25 0.5 1 Miles

N

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THE SONNA BUILDING
910 MAIN ST. SUITE 258
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Developed For:
Homer Electric Association, Inc.
A Touchstone Energy® Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO.13212

BIOTIC MONITORING PLAN

Figure 1
Location Map of Project Vicinity

DESIGNED	Jake Woodbury
DRAWN	Jake Woodbury
CHECKED	C. Warnock
ISSUED DATE	4/29/2015
DRAWING	
SCALE	1:35,000

Legend

- Alaska Railroad
- Seward Highway
- Project Boundary

Property Ownership

- Borough
- Federal
- Private
- State

Upper Trail Lake

Grant Lake

Intake

Intake Bypass Tunnel

Intake Tunnel

Intake Access Road

Transmission Line

Tailrace

Powerhouse

Penstock

Parking Area

Detention Pond

Surge Chamber

Grant Creek

Lower Trail Lake

Powerhouse Access Road

MAP NOTES:

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REV	DATE	BY	DESCRIPTION

Drawing Scale:

N

0 250 500 1,000 Feet

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BIOTIC MONITORING PLAN

Figure 2
General Project Features And Facilities

DESIGNED	Jake Woodbury
DRAWN	Jake Woodbury
CHECKED	C. Warnock
ISSUED DATE	4/29/2015

DRAWING

SCALE: 1:5,000

1.2.3. Tunnel and Surge Chamber

The intake structure would connect to a tunnel extending to the Project powerhouse. The tunnel would be approximately 3,300 feet long with a 10-foot-horseshoe shape. Drill and shoot techniques would be used to construct the tunnel using an entrance portal at the powerhouse for access. The lower 900 feet of tunnel would be constructed at a 15 percent slope. This section of the tunnel will be concrete lined. The upper 2,400 feet of tunnel would be constructed at a 1 percent slope and would be unlined. This proposed arrangement provides a low pressure hydraulic conduit in the upper tunnel reaches suitable for an unlined tunnel. A surge chamber is located at the transition between the two tunnel slopes. This chamber is approximately 10 feet in diameter and would extend from the tunnel invert elevation of 670 feet NAVD 88 to the ground surface at approximately elevation 790 feet NAVD 88. The surge chamber provides a non-mechanical relief for hydraulic transients that could occur if a load rejection occurs at the powerhouse. Rock anchors and shotcrete stabilization techniques would be used to stabilize the tunnel exposed rock surface where required. A rock trap would be located at the surge chamber location to collect dislodged rocks from the unlined tunnel section.

The tunnel would transition to a 6-foot diameter steel penstock approximately 150 feet from the powerhouse. The transition section would consist of a welded-steel concentric structure which transitions from the 10-foot tunnel section to the 72-inch diameter penstock. A steel liner would extend from the downstream tunnel portal approximately 300 feet into the tunnel. The liner would be installed within the exposed rock surface with grout pumped behind the liner to provide an impermeable and structurally- sound tunnel section. A similar steel tunnel liner section would be installed at the connection to the intake structure for a total distance of approximately 150 feet.

1.2.4. Penstock and Surge Tank

A 72-inch diameter steel penstock extends 150 feet from the downstream tunnel portal to the powerhouse. The welded steel penstock would be supported on concrete pipe saddles along the penstock route. The penstock would bifurcate into two 48-inch diameter pipes feeding each of the powerhouse turbines. The penstock, fitted with welded steel thrust rings, would be encased in concrete thrust blocks at the tunnel portal as well as the powerhouse. These thrust blocks would be designed to resist the full hydraulic load associated with the Project operation. An interior and exterior coating system would be applied to the penstock providing full corrosion protection. An access manway would be provided on the exposed penstock section allowing access for future inspection and maintenance.

1.2.5. Tailrace

The powerhouse draft tubes would connect to a tailrace channel located on the north side of the powerhouse structure. The draft tubes would extend from a low point elevation of approximately 509 feet NAVD 88 up to the tailrace channel invert elevation of 515 feet NAVD 88. The channel would continue to the east bank of Grant Creek. Each of the draft tubes will be gated, allowing the flow to be routed to the detention pond for spinning reserve operation. Isolation bulkheads would be provided, allowing dewatering of the draft tubes for inspection and maintenance of the turbine. The tailrace channel would be trapezoidal in shape with a bottom

width of 43 feet, side slopes of 2H:1V and a channel depth ranging from 13 feet at the powerhouse to 7 feet at the creek. A concrete structure would be constructed at the confluence of the channel and Grant Creek. A picket-style fish barrier would be placed on this concrete structure, as well as a provision for the installation of stoplogs, allowing the tailrace channel to be dewatered for inspection and maintenance. The channel would be excavated from native material and lined with riprap to provide a long-term, stable section. A staff gage and pressure transducer will be placed in the channel to monitor the water level in the channel.

1.2.6. Tailrace Detention Pond

An off-stream detention pond would be created to provide a storage reservoir for flows generated during the rare instance when the units being used for spinning reserve are needed for the electrical transmission grid. In this situation, the additional powerhouse flows would be diverted into the detention pond and then released slowly back into Grant Creek. It is anticipated that the discharge associated with a spinning reserve event would be dispersed via the tailrace channel which flows into Grant Creek. The detention pond would be located immediately south of the powerhouse and would have a capacity of approximately 15 acre-feet and a surface area of approximately 5 acres.

1.2.7. Powerhouse

The powerhouse would be located on the south bank of Grant Creek immediately west of the downstream tunnel portal and adjacent to the detention pond. The powerhouse would consist of a concrete foundation and a pre-engineered metal building superstructure. The building would be approximately 100 feet long (east to west) and 50 feet wide (north to south). The penstock would tie into the powerhouse on the south side and the tailrace channel on the north side of the building. The building floor would be set at approximately elevation 523 feet NAVD 88 and the centerline of the turbine runner at elevation 526 feet NAVD 88. The draft tube floor would be set at elevation 509 feet NAVD 88 with an operating tailwater inside the draft tubes ranging from 518.0 feet to 519.3 feet NAVD 88.

Two horizontal Francis type turbine/generator units with a rated total capacity of 5,000 kilowatt (kW) would be housed in the powerhouse structure. The powerhouse flow would range from a maximum of 385 cfs to a minimum of 58 cfs, with each turbine operating flow ranging from 192.5 cfs to 58 cfs. Associated mechanical and electrical equipment would include hydraulic power units, turbine isolation valves, penstock drain, utility water system, lube oil system, oil water separator, battery system, and heating, ventilating, and air conditioning (HVAC) system. A control room housing the motor control center, communication rack, fiber optic panels, computers, and related equipment would also be provided. The Project switchgear would be located within the powerhouse. A standby generator, transformer, and fused, pad-mounted switch assembly would be mounted on an enclosed switchyard located on the south side of the powerhouse. Dewatering pumps would be provided to support dewatering of the turbine draft tubes. A 30-ton bridge crane would be provided for equipment maintenance. The crane would travel on rails mounted on the steel building support columns. An energy dissipation valve would extend off the penstock and provide bypass flows into the Project tailrace.

1.2.8. Transmission Line/Switchyard

An overhead 115-kilovolt (kV) transmission line will extend from the powerhouse to the existing 115-kV transmission line located on the east side of the Seward Highway. In addition to overhead transmission structures, the facilities would include a switchyard at the powerhouse consisting of a 115-kV fused, pad-mounted disconnect switch and a pad-mounted 115-kV GSU transformer. The transmission line would run from the powerhouse parallel to the access road, where it would intersect Chugach Electric's transmission line. The interconnection would have a pole-mounted disconnect switch.

Wooden poles would be designed as tangent line structures on about 250-foot centers. Design of the line would also incorporate the latest raptor protection guidelines. Collision avoidance devices would be installed on the line at appropriate locations to protect migratory birds.

1.2.9. Appurtenant Facilities

The following pertinent mechanical and electrical equipment will be applicable to the Project:

- Intake selective withdrawal intake gate
- Intake trashrack system
- Intake roller gate used to isolate the tunnel and downstream generation facilities
- Control gate located on the bypass pipeline pipe
- A 30-ton bridge crane in the powerhouse
- Pumps located in the powerhouse used to dewater the draft tubes
- Pressure transducers located throughout the Project used to monitor the water level in the reservoir, tunnel and tailrace, as well as pressures in the tunnel and penstock
- Security cameras at the intake and powerhouse
- Sanitary waste holding tank at the powerhouse
- A power line extending from the powerhouse to the intake to supply electrical power to the gates and trashrack
- Temperature instrumentation at the intake structure and at various stream locations to monitor water temperature

This equipment, along with other identified miscellaneous mechanical and electrical equipment, will be developed during the final design and included in the construction documents.

1.2.10. Access Roads

The Project would require an access road to both the powerhouse, located near the base of the Grant Creek canyon, and to the intake at Grant Lake. The access road would be used to construct the Project and afterwards, to maintain the facilities. It is anticipated that the powerhouse would be visited approximately once per week and the intake visited approximately once per month, beginning just after the ice melts and continuing until just before freeze up. The powerhouse access road would be maintained year around. The intake access road would not be maintained in winter.

The 24-foot wide access road would tie into the Seward Highway at approximately MP 26.9. The route would travel eastward to cross Trail Lakes at the downstream end of the Narrows between Upper and Lower Trail Lakes and then continue eastward to the powerhouse. This route would be approximately one mile long. It would cross the ARRC tracks near an existing railroad crossing for a private driveway. The road would cross the narrow channel connecting Upper and Lower Trail Lakes with an approximately 110-foot-long single lane bridge. This bridge is proposed as a clear span with the west abutment located on bedrock and the east abutment on fill. The proposed route would avoid cuts and would travel along the base of some small hills on the south side of Grant Creek to the powerhouse. This proposed access road would have one 90-degree crossing of the Iditarod National Historic Trail (INHT).

The intake access road would be approximately one mile long, beginning at the powerhouse. The road would ascend a 230-foot bluff to reach the top of the southern rim of the Grant Creek canyon. A series of road switchbacks would be required to maintain a road grade of less than 8 percent. The road would then generally follow the southern edge of the canyon until it descends to Grant Lake. A small parking area and turn-a-round area would be provided at the intake structure. A 16-foot wide bridge will extend from the bank out to the intake structure.

The road would be gravel with a 16-foot top width. Maximum grade would be 8 percent. Periodic turnouts would be provided to allow construction traffic to pass. Fifty-foot radius curves would be used to more closely contour around the small steep hills of bedrock to limit the extent of the excavation and the height of the embankments.

1.2.11. Project Operations

Once constructed, the Project will operate to generate power throughout the calendar year based on inflow, available storage, lake elevation, and minimum flow requirements with Grant Creek. The lake will operate from the natural Grant Lake outlet elevation of 703 feet NAVD 88 down to a minimum lake elevation of 690 feet NAVD 88. The lake will be drawn down in the winter months utilizing a combination of Grant Creek inflows and stored water to meet the instream flows in the bypass reach (known as Reach 5 or the canyon reach) while also maintaining power production. Water flow predictions will be used to estimate snowpack and the corresponding runoff volume. The Project operation will then be tailored to maximize winter power production while also ensuring the lake refills to elevation 703 feet NAVD 88.

2 INFORMATION AND DATA

2.1. Historical Fisheries Information and Data

Historically, Grant Creek has been the subject of fisheries research of varying degrees of intensity. Periodic minnow trapping on Grant Creek from July 1959 through January 1961 captured juvenile Chinook salmon, coho salmon, Dolly Varden, and sculpin (extent of sampling area unknown; USFWS 1961). Minnow trapping and electrofishing in the lower reaches of Grant Creek for week-long periods in October 1981 and March, May, June, and August 1982 yielded higher catches of trout, salmon, and Dolly Varden in the fall and summer than in winter and spring (Arctic Environmental Information and Data Center [AEIDC] 1983). Catches of

Dolly Varden were generally most abundant in the minnow traps, followed by juvenile Chinook, juvenile rainbow trout, and juvenile coho. Juvenile Chinook were the most commonly caught fish during electrofishing surveys (Ebasco 1984).

Ebasco (1984) estimated that Grant Creek supported 250 Chinook and 1,650 sockeye spawners. The stream was also estimated to support 209 8-inch "trout" (including Dolly Varden and rainbow trout; Ebasco 1984). Spawning coho were not observed, but had been recorded as being present at unknown levels in the stream by the Anadromous Waters Catalog (AWC) published by the Alaska Department of Fish & Game (ADF&G; Johnson and Klein 2009). Maximum counts from intermittent stream surveys by the ADF&G were 76 Chinook (1963) and 324 (1952) sockeye salmon.

In 2009 KHL conducted a baseline aquatic resources study program to assist in the development of study plans associated with the FERC licensing effort. Based on these results, and after collaboration with stakeholders, KHL developed an initial set of study plans and embarked upon a 2010 natural resources study season to implement these initial studies. However, after further stakeholder collaboration, the program was discontinued in July 2010 in order to further revise the study plans and make them more quantitative in nature. The results of the baseline aquatics study, and the initial aquatics study plan work conducted in early 2010 yielded the following results.

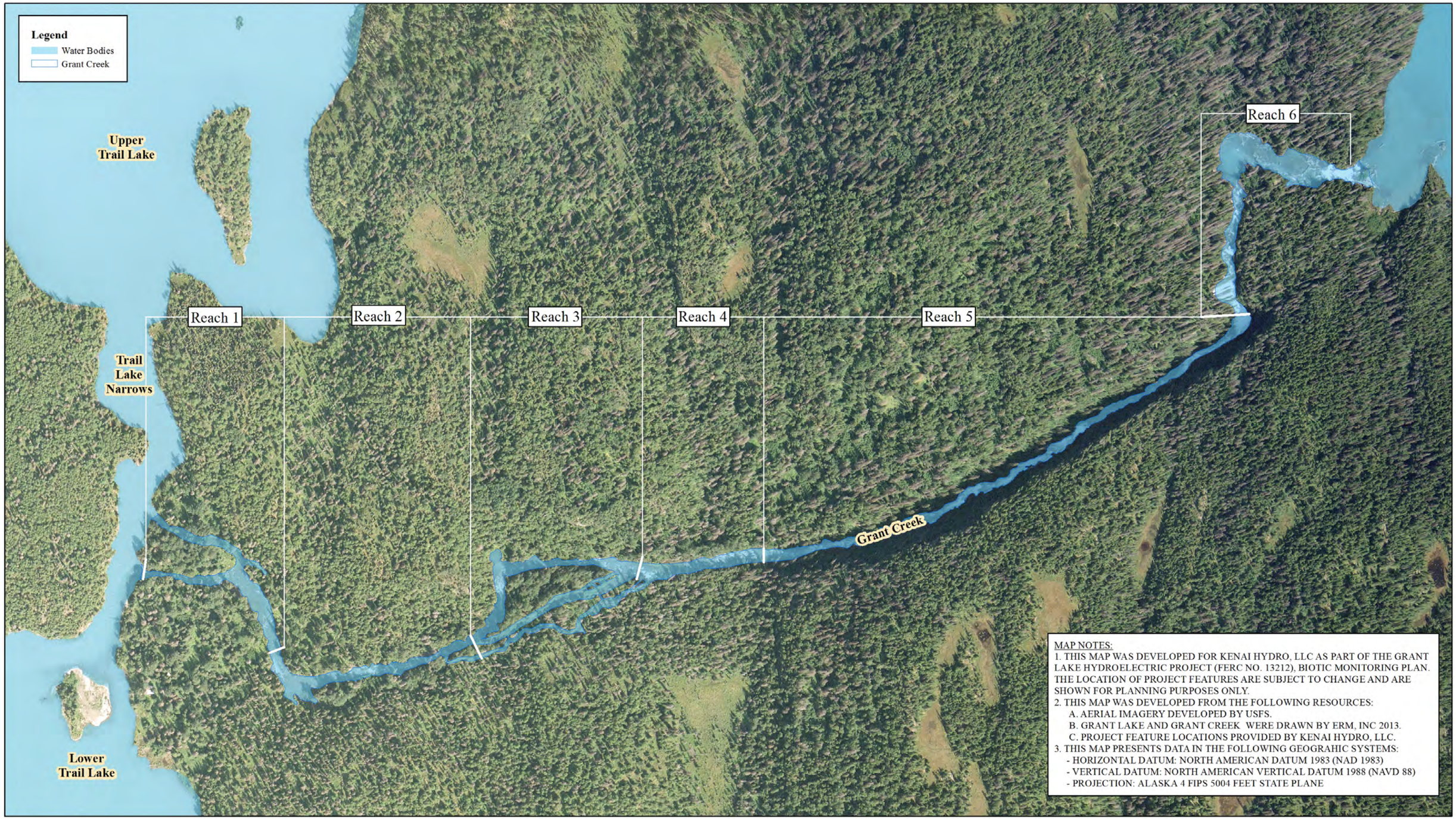
Consistent with studies conducted by AEIDC (1983), Grant Creek was divided into study Reaches 1 through 6 (Figure 3). Relative abundance and distribution of juvenile fish were determined by minnow trapping and calculating the catch-per-unit-effort (CPUE) for each reach. Dolly Varden were found to be the most abundant species in Grant Creek; they were distributed throughout Grant Creek Reaches 1 through 5, although they had a greater relative abundance in Reaches 4 and 5. Coho salmon was the next most abundant species, and individuals were distributed throughout Reaches 1 through 5. Coho, however, appeared to have the greatest relative abundance in Reach 1. Chinook salmon was the next most abundant species. There was a noticeable decrease in Chinook abundance in upstream reaches, and they were not caught above Reach 4. Other fish present in small numbers were sockeye salmon, rainbow trout, sculpin, and three-spine stickleback. Most salmon captured were young-of-the-year with few larger juveniles present (KHL 2010).

Relative abundance of adult rainbow trout and Dolly Varden was determined by calculation of angling CPUE (KHL 2010). Rainbow trout (n = 68) were found to be more abundant than Dolly Varden (n = 9) and were caught throughout the creek, although their relative abundance was higher in Reaches 3 through 5 than in Reaches 1 and 2. Dolly Varden were captured in Reaches 1, 2, and 3; their relative abundance was highest in Reach 1. Capture success was too low to allow population estimates with mark-recapture techniques. Adult rainbow trout were observed in the upper portions of the canyon reach.

This study was also aimed at determining the timing of resident fish spawning; however, it appeared that spawning, if present, occurred before or after the 2009 study period, since little evidence of spawning resident fish was observed (KHL 2010). Rainbow trout angling studies were continued in the spring and early summer of 2010 to confirm the presence of spawning and

determine fish numbers. The progression of reproductive condition and the presence of adult rainbow trout in spawning condition confirmed that spawning did occur in Grant Creek in 2010.

Abundance and run timing of spawning anadromous fish was estimated through data collected during visual surveys (KHL 2010). Both adult sockeye and Chinook salmon were seen in the lower five reaches. Chinook salmon entered Grant Creek first around the beginning of August. Sockeye salmon did not arrive until the end of August. Escapement of Chinook salmon was estimated to be 231 fish, and escapement of sockeye salmon was estimated at 6,293; these estimates were based on the area-under-the-curve (AUC) methodology (Bue et al. 1998). Two critical components necessary to calculate abundance using the AUC methodology (stream life and observer efficiency), however, were based on professional judgment rather than empirical data, potentially biasing estimates.



REV	DATE	BY	DESCRIPTION

N

Drawing Scale:

0 100 200 400 600 Feet

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A Touchstone Energy® Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

BIOTIC MONITORING PLAN

Figure 3
Grant Creek Reaches

DESIGNED J. Woodbury
DRAWN J. Woodbury
CHECKED C. Warnock
ISSUED DATE 4/29/2015

DRAWING

SCALE: 1:4,000

2.2. Summary of the 2013 Fisheries Research

After additional collaboration with stakeholders and significant, quantitative modifications to the methodology, the revised and comprehensive Aquatic Resources Study Plan was implemented in 2013 (KHL 2014a). The objectives of the study were to describe the run timing, abundance, distribution and spawning locations of adult anadromous salmonids. Additional information was also collected to describe the abundance and distribution (both spawning and feeding) of adult rainbow trout and Dolly Varden. Information was also collected to estimate the abundance and distribution of juvenile fish and to describe fish use of the Trail Lake Narrows downstream of the Grant Creek confluence.

The key species of adult salmon returning to Grant Creek included pink, Chinook, sockeye and coho salmon. Sockeye salmon were the dominant run entering Grant Creek with 1,117 fish counted above the weir; in addition, there were 10 pink, 23 Chinook and 237 coho salmon.

The run timing of adult salmon into Grant Creek occurred from the end of July and extended over a 13-week period to near the end of October. Pink salmon passed the weir on Grant Creek first, followed by Chinook, then sockeye, and finally coho.

The salmon spawning period in Grant Creek also extended over 13 weeks from the first week of August to the end of October. Pink salmon began spawning in early August; Chinook in mid-August; sockeye at the end of August, and coho began spawning the first week of October and were finished at the end of the month. The sensitive time period for adult salmon, based on spawning, was from the first week of August to the end of October.

The majority (95 percent) of critical spawning habitat was concentrated within Reaches 1-3 of Grant Creek. Spawning activity in Reach 4 was fairly low at 4 percent, and spawning in Reach 5 was about 1 percent of the total observed. The higher gradient habitat (cascades) of Reach 5 reduces the availability of suitable substrates and velocities for spawning salmon.

Rainbow trout and Dolly Varden were identified as key resident species migrating into Grant Creek. The period of migration for rainbow trout lasted 6 weeks, from the end of May to the end of June. The migration period for Dolly Varden lasted 4 weeks, from mid-August to mid-September. During the 2013 study period, no redds were observed for either rainbow trout or Dolly Varden; high flows and poor water clarity hampered survey efforts. While no redds were detected, recently-emerged fry were observed, confirming that both species spawn within Grant Creek; to what extent, however, is unknown. Radio telemetry detections of tagged rainbow trout suggest that it is possible that rainbow trout spawned in Reach 3; however, it should be noted that observations of radio-tagged rainbow in Reach 3 may well have been due to tagged fish taking advantage of feeding opportunities at those locations. The majority of radio tagged fish resided in Reaches 1 and 3 during the study period, suggesting that spawning and feeding locations are most likely in these reaches.

There was a total of 4,798 Chinook, 3,165 coho and 46,431 Dolly Varden juveniles estimated to have migrated out of Grant Creek in 2013. These estimates represent Reaches 1-5 upstream of the lower incline plane trap and only includes parr-sized fish. For juvenile Chinook, emigration from Grant Creek peaked in mid-to-late August and again in September. A smaller peak

occurred in May as age-1 juvenile fish emigrated from Grant Creek. Juvenile emigration for coho also peaked in mid-to-late August and in mid-to-late July. Juvenile emigration for Dolly Varden peaked in July and again in late August-early September.

Reach 5 of Grant Creek provides some juvenile rearing habitat but it is low in comparison to Reaches 1-4. The predominance of higher-gradient cascade habitat in Reach 5 (average gradient of 6.4 percent) reduces the amount of juvenile habitat. Reaches 1-4 provide the majority of juvenile rearing habitat in Grant Creek. Minnow trapping from April through October captured 3,468 fish. Relative abundance of fish caught in minnow traps, expressed as both CPUE and proportion of total catch, was highest in Reach 3, followed by Reach 1, Reach 2 and then Reach 4. Reach 3 contained the greatest diversity of habitats, with pools and riffles represented in many areas (side channels, backwater areas and mainstem).

Adult salmon, rainbow trout and Dolly Varden occur in the Trail Lakes Narrows area. The Trail Lake Narrows area is an upstream migration corridor for fish destined to spawn in Grant Creek and all other tributaries of Upper Trail Lake. Likewise, this area is also a downstream migration corridor for salmonid production upstream. Dolly Varden and rainbow trout probably reside in the area, taking advantage of juvenile salmon that migrate through or reside in this area. This area may also provide spawning and resting areas for adult salmon. Redds in suitable spawning gravels and sockeye carcasses were found that had not been sampled. Chinook and coho salmon may spawn in this area as well.

2.3. Summary of Projected Project Impacts

As part of the assessment of potential project impacts to fish and fish habitat, KHL conducted aquatic habitat mapping and instream flow studies on Grant Creek. Previous Instream Flow studies had been conducted in Grant Creek; an Instream Flow Study was completed in 1987 as part of a preliminary FERC license application prepared by Kenai Hydro, Inc. (KHI; not related to the current Kenai Hydro, LLC; Envirosphere 1987, KHI 1987a, and KHI 1987b).

As mentioned above, KHL initiated consultation for a collaborative process for a study of "instream flow" effects in Grant Creek in 2009 (KHL 2010). The primary goal of the 2009 Instream Flow Study program was to establish a Technical Working Group (TWG) consisting of state and federal resource agency staff, KHL staff, and interested members of the local community. Once established, the TWG met three times during the 2009 study season to review the results of the 2009 aquatic baseline study efforts, discuss and agree upon an acceptable instream flow evaluation method, and request additional information to support that selection (KHL 2010). A technical memorandum was drafted and shared with the Instream Flow TWG participants in 2009, detailing the results of the previous Instream Flow Study efforts (HDR 2009). Physical stream data required for instream flow modeling, per the proposed approach, were collected at 18 transects during low- and mid-flow conditions in 2010. The studies were continued in 2010, but the program was discontinued in July, 2010 after further stakeholder collaboration in order to revise the study plans and make them more quantitative in nature. When the aquatic habitat mapping and Instream Flow studies were re-initiated in 2013, these data were used where applicable.

In the 2013 investigations, habitat was mapped throughout the lower five reaches of Grant Creek, while the Instream Flow study concentrated on the lower four reaches of Grant Creek, including the side channels and the distributary in Reach 1. Grant Creek habitat (as measured by Weighted Usable Area) for 15 stages (based on species and life history) was modeled for flows ranging from 5 – 1,000 cfs. Modeled species and life history stages were for Chinook salmon (spawning, fry and juvenile rearing), Coho salmon (spawning, fry and juvenile rearing), sockeye salmon (spawning), rainbow trout (spawning, fry, juvenile and adult rearing), and Dolly Varden (spawning, fry, juvenile and adult rearing).

In order to give a better long-term representation of the Grant Creek streamflows, a record extension was developed. A correlation between the Grant Creek U.S. Geological Survey (USGS) gage (station 15246000) and the Kenai River at Cooper Landing USGS gage (station 15258000) provided a means to extend the streamflow record at the Grant Creek gage location. With that data extension, KHL developed a 66-year composite record of Grant Creek hydrology, both with and without the project. In general, Grant Creek flows from January through mid-May and the November through December period are proposed to be higher with-Project than they are currently pre-Project. Flows during the summer will be reduced, while the late spring and fall flows will be the same.

At the request of the Instream Flow Subgroup, KHL conducted further analyses to evaluate the effects of the Project flows on eggs deposited by resident and anadromous salmonids in suitable Grant Creek spawning habitat (effective spawning analysis), as well as habitat for all species and life history stages (habitat duration analysis).

KHL conducted the effective spawning analysis for the five species mentioned above, for all transects where spawning habitat existed. With the proposed increased flows in November through mid-May, incubating salmonid eggs will be afforded higher rates of protection with the Project in place than under the pre-Project regime. As a result, incubation will not be significantly affected by the Project.

As part of the habitat duration analysis, KHL modeled habitat for each species and life history stage for the five target species (Chinook, coho, and sockeye salmon, rainbow trout and Dolly Varden) for the 66-year composite record. The findings of that analysis are summarized below in Table 1.

Table 1. Results of the Grant Creek habitat time series analysis (KHL 2014b), which depicts the post-Project weighted usable area (WUA) relative to the pre-Project conditions for anadromous and resident salmonids by life stage.

Species	Spawning (%)	Fry Rearing (%)	Juvenile Rearing (%)	Adult Rearing (%)
Chinook	99.5	96.9	100.2	---
Coho	100.0	99.0	99.2	---
Sockeye	99.0	---	---	---
Dolly Varden	100.3	98.9	102.9	96.5
Rainbow Trout	98.7	101.4	99.3	94.2

Overall, with-Project WUA is nearly identical to pre-Project WUA, at 99.8 percent. The lowest with-Project WUA is for Dolly Varden and Rainbow trout adult rearing. Adult rearing periodicity for these species extends from mid-May to the end of November. Project flows are reduced during the summer (June – August), which is the reason for lower adult rearing with-Project WUA during this period. It is important to note that this analysis does not take into consideration potential mitigation and enhancement measures for the Project. Section 4 discusses our proposed aquatic mitigation and enhancement measures and associated analyses in detail that will provide additional increases to WUA beyond the existing condition described above.

In addition, increased winter flows will also provide more rearing habitat in the Reach 2/3 side channels. These side channels, as well as the Reach 1 distributary, provide a large percentage of the rearing habitat in lower Grant Creek. Monitoring will be conducted to evaluate the increased rearing potential in these areas.

Potential negative Project impacts include reduced flows in Reach 5, with concomitant reductions in spawning habitat; reduced flows to mobilize sediment recruited from Reach 5, and reduced resident adult rearing during the summer months. Potential positive impacts from the Project in Reach 5 include better maintenance of juvenile rearing habitat along with the likelihood of increased juvenile rearing habitat availability in addition to higher/more stable flows in the quality reaches (i.e., Reaches 1 – 4) during incubation and rearing; decreased summer flows will maintain habitat and help prevent stranding and potential egg desiccation as flows decrease, and operational changes will allow for high quality side channels to be more consistently wetted.

3 BIOTIC MONITORING DURING CONSTRUCTION

The comprehensive studies conducted during the licensing process highlight sensitive areas utilized by both adult and juvenile salmonids. That research also provides a solid baseline of information on the current status of fish populations within Grant Creek. Coupled with this knowledge, KHL will conduct additional monitoring of Grant Creek aquatic resources during the construction phase of the Project to ensure that construction activities do not result in deleterious impacts to Grant Creek fish habitat or fish populations. Biotic monitoring during construction will provide information on an annual basis to assist in assessing whether changes have occurred to fish communities in Grant Creek.

3.1. Potential Project-related impacts on fish during construction

Construction activities include tunnel blasting, construction of roads, and the construction of the Project infrastructure discussed in Section 1.2. Potential construction-related effects of the Grant Lake Project include:

1) Habitat alteration by sedimentation or erosion during the construction of the Project infrastructure (i.e., penstock, powerhouse, tailrace, detention pond and roads), and

2) Accidental release of contaminants into Grant Creek during the construction of the facilities.

As a result of the potential alterations highlighted above, there may be impacts to the fish community within Grant Creek, which could include:

- Potential displacement of juvenile salmonids from critical rearing habitat, and
- Potential displacement of spawning adults due to construction activities.

3.2. Goals

A series of biotic monitoring measures are proposed in order to identify changes, if any, to the presence/absence of fish populations in Grant Creek during construction activities related to building the Project infrastructure. Fish monitoring will be used to determine continued use of Grant Creek through fisheries investigations outlined below.

3.3. Objectives

The objectives include:

- Determine if construction activities displace juvenile salmonids from critical rearing habitat, and
- Determine if construction actions disrupt either the distribution or timing of adult salmonids in Grant Creek.

A series of best management practices (BMP) and construction associated plans will be developed in advance of any construction activities to ensure that environmental impacts are avoided. These plans will account for water quality conditions, amongst other variables. In addition, an Environmental Compliance Monitor (ECM) will be on-site daily during all construction activities. This individual will be responsible for assessing water quality conditions during construction and notifying appropriate parties, if necessary.

3.4. Fisheries Research Methodologies

Monitoring activities will be broken down into two primary components: the sampling of juvenile salmonids, and the sampling of adult salmonids.

3.4.1. Juvenile Salmonid Investigations

In order to evaluate if construction activities displace or alter the distribution of juvenile salmonids from critical habitats, KHL proposes the following investigation:

Minnow traps will be deployed twice each construction year (likely in early June and early August), with typically 10 traps deployed per reach; sampling will include the mainstem, the distributary in Reach 1, and the side channels in Reach 2/3. The exception may be within Reach 5 due to limited access; however, the lower third of Reach 5 will be sampled with 5 to 6 traps if possible, and efforts will be made to sample upper Reach 5 downstream of the lower most waterfall (dependent upon flows which may limit access due to safety). Within each reach, an

effort will be made to sample all habitat types during the sample period. Traps will be baited with a 16.4 cm^3 mass of sterilized salmon eggs and will be fished for approximately 24 hours. Captured fish will be anesthetized in a solution of clove oil (6 drops per 3.8 liters of water), and all salmonid juveniles will be enumerated by species, and will then be weighed and measured (fork length) to the nearest 0.1 gram and millimeter, respectively. Fish will then be recovered in fresh river water and released near the area of capture. Catch for each trap will be converted into CPUE (number of fish per hour) by species, which will be compared to data collected during the 2009 and 2013 studies. Data will be compiled by species, month, reach, and channel type (i.e., mainstem, backwater, or side-channels).

3.4.2. Adult Salmonid Investigations

Adult sampling will consist of three primary components: visual, redd, and carcass surveys. All three surveys will be conducted twice for each species within each of the two construction years, and will be conducted on separate days within the sample week. Sample timing will be based on 2013 data, and will be conducted to coincide with the documented peak run-timing for each species.

Visual and redd surveys will be conducted as in 2013. Biologists will hike upstream along each bank of Grant Creek wearing polarized sunglasses to reduce glare, and will document adult fish and redds (by species). Visual observations will be documented on maps, which will later be cataloged into a GIS database. As in 2013, the biologists will utilize hand-held radios to coordinate observations to maximize efficiency and to reduce the potential for double counting.

Carcass surveys will be dedicated to the search and collection of spawned out salmon; however, any carcasses found during other surveys will be sampled as opportunity presents itself. All recovered salmon carcasses will be identified as to species and sex, and length (post-orbital hypural [POH]) will be recorded to the nearest centimeter. Additionally, all females will be inspected as to spawning success (i.e., pre-spawn mortality, completely spawned, the number of remaining eggs).

Visual and redd surveys will provide information as to the presence/absence of adult fish and redds relative to historical peaks, which can be compared to 2013 data; carcass surveys will provide an indication of spawning success relative to 2013 observations.

3.5. Schedule

The construction of the Project is expected to take two years to complete. The first summer construction period will be used to install Project roads (e.g., the access bridge across the Trail Lake Narrows and the access road to the powerhouse and intake sites). During the winter period, the tunnel will be bored, and the second summer construction period will be used to complete the remaining structures. This Plan will coincide with all construction activities; that is, juvenile and adult sampling will occur during both years of construction, or as long as construction activities occur.

One juvenile minnow trapping survey will occur in early June, and the other will take place in early August. Actual dates of minnow trapping will vary due to a variety of factors, weather and streamflow conditions being the most likely variables.

Adult surveys, including visual, redd and carcass surveys will coincide with existing data documenting peak run timing for anadromous species in Grant Creek. Two surveys per species will occur; it is anticipated that surveys for sockeye would occur in late August/early September, late August/early September for Chinook and early to mid-October for coho.

4 BIOTIC MONITORING DURING PROJECT OPERATION

As summarized in Section 2.3, it is anticipated that the operation of the Project will have minimal impact on the Weighted Usable Area for all life stages of all salmonids utilizing Grant Creek. Similarly, the loss of spawning habitat is anticipated to be minimal. These projections, however, are based on model simulations, and as such, must be verified through monitoring and empirical data.

4.1. Potential Project-related effects on fish from Project Operations

Once constructed, the expectation is that the operation of the Project will result in:

1) Decreased flows in Reach 5 throughout the year;
2) Decreased sediment recruitment from Reach 5 due to these decreased flows;
3) Increased winter flows;
4) Decreased summer flows, and
5) Potential water temperature changes (addressed in the Operation Compliance Monitoring Plan, [OCMP; KHL 2015b]).

Based on the anticipated alterations to Grant Creek due to the operation of the Project, a number of potential biological responses may occur, which include:

- Decreased fish utilization in Reach 5 (both juvenile and adult salmonids) due to decreased year-round flows;
- Potential increase in juvenile rearing habitat availability in Reach 5;
- Potential alteration in spawning locations, or an overall decrease in spawning within Grant Creek due to the long-term decline in suitable spawning substrates;
- Increased rearing habitat within the Reach 2/3 side channels due to increased winter flows; and
- Decreased summer rearing habitat for adult resident fish within the mainstem sections of Reaches 1-4.

4.2. Goals

This section of the Plan is being developed in order to identify changes, if any, to the presence/absence of fish populations in Grant Creek during Project operations. Fish monitoring

will be used to determine continued use of Grant Creek through fisheries investigations outlined below.

4.3. Objectives

The objectives include:

- Determine if greater flows in the Reach 2/3 side channels during the winter result in juvenile rearing during this timeframe and at these locations;
- Determine if mitigation efforts in the Reach 1 distributary result in increased juvenile utilization;
- Determine if relative juvenile abundance and distribution deviates from baseline conditions due to Project operations, and
- Determine if adult distribution deviates from baseline conditions due to project operations.

4.4. Fisheries Research Methodologies

Post-construction monitoring will consist of both juvenile and adult monitoring components. For juveniles, minnow trapping and winter-time snorkeling will be used. For adults, visual, redd and carcass surveys will be used.

4.4.1. Juvenile Salmonid Methodologies

The minnow trapping methodology utilized for the construction phase will be replicated for the operations phase. Specifically, minnow traps will be deployed during the months of July through October, and in April (winter water temperature conditions). Supplemental sampling during the months of August through October will coincide with periodic sampling of adults, and can be accomplished concurrently to streamline sampling activities. Data collected will provide information on juvenile distribution and relative abundance that can be compared to 2013 baseline information (CPUE). Sampling will be conducted in years 2 and 5 of operations.

Typically, 10 traps per reach will be deployed and will include the mainstem, the distributary in Reach 1, and the side channels in Reach 2/3. The intent will be to sample as much of Reach 5 as possible, including the upper section downstream of the lower most waterfall; as a result of reduced flows within Reach 5 year-round, access to Reach 5 should be greatly improved, allowing greater sampling opportunities.

Within each reach, an effort will be made to sample all habitat types during the sample period. Traps will be baited with a 16.4 cm^3 mass of sterilized salmon eggs and will be fished for approximately 24 hours. Captured fish will be anesthetized in a solution of clove oil (6 drops per 3.8 liters of water), and all salmonid juveniles will be enumerated by species, and will then be weighed and measured (fork length) to the nearest 0.1 gram and millimeter, respectively. Fish will then be recovered in fresh river water and released near the area of capture. Catch for each trap will be converted into CPUE by species, which will be compared to data collected during the 2009 and 2013 studies, as well as additional data collected as part of the Plan. Data will be compiled by species, month, reach, and channel type (i.e., mainstem, backwater, or side-

channels). Minnow trap data will address the issues of whether operations influence the relative abundance and distribution of juvenile salmonids with Reaches 1-5 and the side channels and distributaries of Grant Creek, as well as winter-time usage of the Reach 1 distributary and the Reach 2/3 side channels.

Concurrent with April minnow trapping, snorkel surveys will be conducted in the side channels of Reach 2/3 and the Reach 1 distributary. Given the cold water temperatures during April that mimic winter conditions and based upon 2013 surveys, KHL's observations indicate minnow trapping is less effective due to the lethargy of juveniles in these conditions. All salmonids observed will be categorized by species and length (an estimate of total length partitioned into 20-millimeter [mm] bins), and an estimate of fish density (number of fish per 100 m^2) will be calculated for habitat and channel types. Snorkel results will address the issue of whether increased winter flows provide new winter rearing habitat in the Reach 1 distributary and the Reach 2/3 side channels, and if so, to what extent.

4.4.2. Adult Salmonid Methodologies

Sampling methods described above for the construction phase of monitoring in Section 3 will also be employed for the Project operation period. Adult sampling will consist of three primary components: visual, redd, and carcass surveys. All three surveys will be conducted twice per species throughout the spawning period, coinciding with peak run timing per existing data. The surveys will be spaced a week apart. Surveys will occur in years 2 and 5 of operations.

For visual and redd surveys, biologists will hike upstream along each bank of Grant Creek wearing polarized sunglasses to reduce glare, and will document adult fish and redds (by species). Observations will be documented on maps, which will later be cataloged into a GIS database. As in 2013, the biologists will utilize hand-held radios to coordinate observations to maximize efficiency and to reduce the potential for double counting. Carcass surveys will be conducted in conjunction with the visual and redd counts.
All recovered salmon carcasses will be identified as to species and sex, and length (mid-eye to fork; POH) will be recorded to the nearest centimeter. Additionally, all females will be inspected as to spawning success (i.e., pre-spawn mortality, completely spawned, the number of remaining eggs).

Visual and redd surveys will provide information as to the relative distribution of adult fish and redds (by reach), which can be compared to 2009 and 2013 data. The collection of salmon carcasses and an assessment of pre-spawning mortality (compared to 2013) will provide a sense of overall spawning success.

Sockeye populations are known to vary from year to year; as such, natural variation is to be anticipated to occur between years. KHL proposes, in addition to conducting counts in Grant Creek, to monitor other fish runs to the Kenai River. Fish numbers may be available for other systems on the Kenai Peninsula, notably the Russian and Kasilof rivers. By comparing fish abundance to other systems in the Kenai, Grant Creek adult numbers can be indexed to determine if the trends found in Grant Creek are similar to other rivers, of if potential perturbations may be the cause of variance in Grant Creek populations.

One such source is ADF&G for numbers and timing of sockeye to the Kenai River:

https://www.adfg.alaska.gov/sf/FishCounts/index.cfm?ADFG=main.displayResults&COUNTLOCATIONID=40&SpeciesID=420

Adult salmonid numbers will be compared to the Kenai River and reference streams, where available. These analyses will be used to monitor trends in overall Kenai River salmon populations to determine if any changes in Grant Creek populations may be due to overall natural variation and cycles of fish on the Kenai River, of if Project operations could be a factor influencing these populations.

4.5. Schedule

A suite of monitoring activities will take place in years 2 and 5 following construction of the Project; specifically, juvenile minnow trapping and adult visual, redd, and carcass surveys, along with snorkel surveys.

As discussed above, minnow trapping will be conducted during the months of July through October, and in April with one sample event per month lasting approximately three days. Snorkel surveys will also be conducted in April, and will coincide with minnow trapping activities.

Adult surveys (i.e., visual, redd and carcass) will be conducted during years 2 and 5 of operations and coincide with the peak run timing window for each anadromous species. Two surveys per species will be conducted per year spaced a week apart. It is anticipated that surveys for sockeye would occur in late August/early September, late August/early September for Chinook and mid to late October for coho.

The schedule for meetings with the stakeholders is provided in Section 6.

5 BIOLOGICAL MONITORING FOR ENHANCEMENT/MITIGATION MEASURES

In addition to monitoring construction activities and Project operations, KHL will evaluate the effectiveness of proposed protection, mitigation and enhancement (PM&E) measures listed below. This section provides goals, objectives, and methodologies for evaluating these measures.

5.1. Proposed Protection, Mitigation and Enhancement

A suite of PM&E measures have been proposed for the Project. These measures include, but are not limited to the following:

- Enhancement of Reach 2/3 Side Channels. KHL has proposed more consistent flows and winter-time inundation of these side channels as a result of Project operations. The proposed operational flows will increase aquatic habitat in these side channels.
- Additional Flow in the Reach 1 Distributary. This measure, proposed by KHL, would remove the upstream control, providing greater and more consistent flows in this distributary, increasing both rearing and spawning habitat.

- Spawning Gravel Augmentation/Flushing Flows. Spawning substrate is naturally limited within Grant Creek. This PM&E measure, proposed by KHL, would evaluate the need for gravel supplementation within the mainstem of Grant Creek, and/or periodic need for channel maintenance (i.e., flushing) flows to move upstream sediment.
- Spawning Gravel Augmentation within the Reach 1 Distributary. To create spawning habitat within the Reach 1 distributary, gravel augmentation, in addition to enhanced flows due to the upstream control removal, will be implemented at this location.

5.2. Goals and Objectives

5.2.1. Goals

This component of the Plan is intended to evaluate the efficacy of PM&E measures proposed to enhance fish populations and habitat within Grant Creek. Fish and aquatic habitat monitoring, as described below, will be used to monitor changes to enhanced or mitigate resources. Specific goals include:

- Increase rearing habitat for juvenile salmonids in the Reach 1 distributary and Reach 2/3 side channels;
- Increase spawning habitat for adult salmonids in the Reach 1 distributary and Reach 2/3 side channels;
- Evaluate impacts on suitable spawning substrate in the Grant Creek mainstem associated with Project operations;
- Increase suitable spawning substrate in the Reach 1 distributary; and
- Maintain minimum instream flows of 5 to 10 cfs in Reach 5.

5.2.2. Objectives

The objectives include:

- Determine if greater flows in the Reach 2/3 side channels during the winter increase juvenile salmonid numbers in these side channels;
- Determine if increased flows in the Reach 1 distributary (throughout the year) results in increased juvenile and adult utilization;
- Determine if enough gravel recruitment consistent with prior natural conditions is occurring under operational conditions to promote the increased salmonid spawning activity and utilization intended by permitting consistent access to these areas;
- Determine if gravel placement in the Reach 1 distributary results in increased salmonid spawning activity and utilization; and
- Determine if Project operations is negatively impacting gravel recruitment relative to natural conditions in the Grant Creek mainstem.

5.3. PM&E Methodologies

PM&E monitoring will consist of juvenile and adult salmonid monitoring as well as aquatic habitat monitoring in reaches where mitigation or enhancement measures will take place. For juveniles, snorkel surveys and minnow trapping will be used in the Reach 1 distributary and the Reach 2/3 side channels. For adults, visual surveys of spawners, redds, and carcasses will be conducted at those locations as well. KHL will quantify salmonid spawning gravels within the Grant Creek mainstem (excluding Reach 5) to assess the need for gravel augmentation.

5.3.1. Juvenile Salmonid Methodologies

Juvenile sampling methodologies will be consistent with the methods described in Section 3.4.1, that is, minnow trapping as well as snorkeling, will be used to gather data on juvenile salmonid distribution and numbers within the Reach 1 distributary and the Reach 2/3 side channels. Minnow trapping will occur synonymous with surveys described above in Section 3.4.1. Ten minnow traps per reach will be baited with a mass of sterilized salmon eggs and will be fished for a 24 hour period in the distributary in Reach 1 and the side channels in Reach 2/3. A single minnow trapping survey will occur in April, with sampling to occur in all habitat types found within these reaches during the sampling period, and catch for each trap will converted into CPUE. Snorkel surveys will be conducted concurrently to best streamline sample activities.

Estimates of CPUE, with PM&E measures in place will be used to determine if juvenile salmonid populations utilize new winter habitats developed in the Reach 2/3 side channels and within the Reach 1 distributary due to the implementation of mitigation and enhancement measures.

The PM&E juvenile salmonid surveys will be conducted as part of the juvenile surveys described in Sections 3.4.1 and 4.4.1. It is recommended that surveys be conducted during years 2 and 5 after the Project is in operation once PM&E measures have been implemented.

5.3.2. Adult Salmonid Methodologies

Stream surveys (including redd, visual and carcass surveys) will be conducted and will coincide with the peak run timing window for each anadromous species. Two surveys per species will be conducted during years 2 and 5 of operations, and will be spaced a week apart. It is anticipated that surveys for sockeye would occur in late August/early September, late August/early September for Chinook and mid to late October for coho.

Methods will be the same as described in Sections 3.4.2 and 4.4.2. Baseline information for adult salmonid presence will be compared to data from the 2013 surveys.

5.3.3. Gravel Supplementation/Channel Maintenance Methodologies

Grant Creek is a sediment transport-limited fluvial environment. The major source of sediment in the spawning reaches is recruited from rock-fall occurring episodically within Reach 5. The biologically-significant transport of sediment from Reach 5 likely occurs during the higher season storm flow events. As a result, salmonid spawning is opportunistic, and occurs where

suitable substrates are found, with less emphasis on appropriate water depths and velocities. Because of these natural limitations, KHL is proposing to provide channel maintenance flows and gravel supplementation as appropriate, in consultation with the stakeholders.

5.3.3.1. Study Area

The study area is Lower Grant Creek from the Reach 4/5 break downstream to its confluence with the Trail Lakes Narrows (Figure 3).

5.3.3.2. Methods

Methods described below were gleaned from Merz and Setka (2004). These methods, including site selection, gravel amounts, size, etc., timing of restoration measures and channel maintenance flows are preliminary, and are subject to consultation with the stakeholders.

5.3.3.2.1. Site Selection, Gravel Placement, and Schedule

KHL proposes augmentation of gravel at the Reach 1 distributary in lower Grant Creek, and to assess the need for mainstem gravel augmentation in consultation with stakeholders; all gravel used during the implementation of this PM&E measure will be native material mined during the construction of the tunnel that extends from the lake intake structure to the surge chamber. Mainstem gravel may be placed within Grant Creek at the reach 4/5 break, immediately below the tailrace. This site would serve as a gravel recruitment station and allow Project outflow to distribute supplemental gravel downstream into the high quality habitat areas of Grant Creek (reaches 1-4). In lieu of the Reach 4/5 recruitment station, gravel may also be placed manually at select locations within the Reach 1-4 mainstem; this alternative would also be developed in consultation with the stakeholders. In addition to the possible mainstem augmentation, suitable spawning substrate will be manually distributed within the Reach 1 distributary. Gravel (25 – 150 mm) will be placed in the stream or at recruitment stations, per Merz and Setka (2004).

Gravel to be used in this PM&E measure will be acquired in year one of construction, and will be obtained during the boring of the tunnel extending from the lake intake structure to the surge chamber. In year two of construction, gravel augmentation will occur within the Reach 1 distributary and will coincide with construction of the Project infrastructure. Distribution of the material will likely be accomplished utilizing heavy equipment that is on-site, but methods will ultimately be determined in consultation with stakeholders. Actual location of augmentation will be based on pebble counts within the Reach 1 distributary. Augmentation efforts will focus on areas where suitable substrates do not currently exist, and where water depth and velocity are adequate.

The assessment of potential augmentation within the mainstem of Grant Creek (Reaches 1-4) will be based on pebble counts during years 2 and 5, post-construction. At the conclusion of the 5-year period, KHL in consultation with stakeholders, will make a determination on the need for gravel augmentation within the mainstem.

5.3.3.2.2. Pebble Counts

As described in Metz and Setka (2004) and Bauer and Burton (1993), pebble counts will be conducted at four randomly-selected, longitudinal transects in each selected site in the Reach 1 distributary. About 100 samples per transect will be taken, both before and after (within 12 months) gravel supplementation has occurred. Measurements will be taken every 0.25 - 0.5 feet (0.08 – 0.15 meters) in the Reach 1 distributary. Per Metz and Setka (2004), substrate from pebble counts will be categorized into 12 size categories: (<8.0, 8.0, 16.0, 22.2, 31.8, 44.5, 63.5, 89.0, 127.0, 177.8, 254.0, and > 254.0 mm).

Sites will also be selected in the Grant Creek mainstem. In the mainstem, measurements will be taken every 0.5 – 1.0 feet (0.15 – 0.3 meters). About 100 samples per transect will be taken, both before and after (within 12 months) of gravel supplementation. These surveys will be conducted in an effort to document both baseline conditions (pre-operation) and operational conditions to document what (if any) alterations related to sediment transport have occurred as a result of Project operations.

5.3.3.2.3. Adult Surveys

Visual, redd, and carcass surveys will be conducted within the Grant Creek mainstem, the Reach 1 distributary, and the Reach 2/3 side channels as described in Sections 3.4.2 and 4.4.2. These activities will be an extension of surveys conducted to assess the impacts associated with operations of the Project and take place in years 2 and 5 of operations.

5.4. Schedule

Once PM&E measures are in place, KHL proposes to conduct efficacy surveys during years 2 and 5 post-construction. It is important to note that additional collaboration with stakeholders is planned post-license issuance and during construction to fully develop an appropriate plan for any gravel supplementation efforts associated with Grant Creek. At present, KHL anticipates an adaptive management approach. Based upon the operational analysis conducted by KHL, the potential exists for channel maintenance type flows to occur via the natural outlet from Grant Lake during operation that would be sufficient for gravel recruitment from Reach 5. This may occur on a consistent enough periodic timeline to preclude the need for gravel supplementation in the mainstem of Grant Creek. This will need to be determined once operations commence. Thus the need for continued collaboration with stakeholders to determine the appropriate need for and level of analysis related to the effectiveness of the measure.

6 COMMUNICATIONS

Provisions in this Plan will be formally adopted and implemented by KHL upon FERC approval of the Plan and after issuance of the FERC license. Requisite stakeholders will be consulted well in advance of construction efforts being implemented to assure a comprehensive and collaborative planning effort for those measures (described above) associated with construction.

All Plan activities in a given year will be documented as part of an annual compliance reporting/meeting process. Every winter, KHL will convene a global meeting with all

stakeholders and FERC to review all management plans and related monitoring efforts associated with construction and subsequent operation of the Project. It is during these annual proceedings when results will be documented, identified issues will be discussed and modifications to plans and/or additional measures will be adopted to ensure that minimal impact to the natural environment is occurring as a result of Project construction and operations. With respect to this Plan, primary topics discussed during the annual compliance reporting/meeting process will include:

- A summary of the actions that KHL implemented during the previous calendar year related to:
    - Juvenile fish species assessments
    - Adult fish species assessments
    - Monitoring of PM&E measures
- A discussion of any substantial differences between the actions provided in this Plan (and subsequent agreements) and the actions that KHL implemented, including explanations for any substantial differences.
- Results of any surveying that occurred during the previous calendar year, conclusions that KHL draws from the monitoring results, and any change to this Plan that KHL proposes based on the monitoring results.
- Stakeholder input with respect to any necessary modifications to the existing plan
- Per Section 5.4 and at the appropriate time, ongoing collaboration associated with the need for gravel supplementation in Grant Creek

Ultimately, the draft Annual Compliance Report will be revised to incorporate stakeholder comments and update modified plans for the following year's natural resource implementation and compliance efforts. The Annual Compliance Report will be filed with FERC by April 1 of each year and copies will be made available to the stakeholders and FERC via the internet.

Additionally, all monitoring efforts during construction activities will be managed by KHL's on-site ECM. This person will be responsible for assuring that all procedural aspects of the natural resource and construction management plans as well as general BMP for construction efforts are being adhered to. This person will be the lead in confirming that all methods and associated data collection activities are occurring as scheduled and all associated data is being entered and reported on appropriately. The ECM will be the primary, on-site contact for both confirmation of appropriate activities with respect to monitoring during construction and the conduit for communicating any issues that may be occurring to insure timely resolution.

7 REFERENCES

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