

*Grant Lake
Proposed Hydroelectric Project*

**2009 Aquatic Biology
Baseline Study Plan**
Draft

Prepared for:

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May 2009

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Grant Lake and Falls Creek Proposed Hydroelectric Projects Aquatic Biology Baseline Draft Study Plan, 2009

Introduction

Kenai Hydro LLC contracted with HDR Alaska, Inc. to provide baseline data to support Federal Energy Regulatory Commission (FERC) license applications for a proposed hydroelectric project at Grant Lake near Moose Pass, Alaska (Figure 1).

This study plan outlines study plan objectives that will provide baseline information for preparation of the Environmental Report, Exhibit E, of the FERC license application. These data will also provide information useful in the design mitigation of environmental and other impacts from development of small-scale hydroelectric energy generation at Grant Creek.

Study objectives were developed specifically to address requirements of Exhibit E of the FERC license application process. Some data requirements for Exhibit E are met by previous studies in support of an earlier licensing effort in the 1980s at Grant Lake (see previous studies below). The scope of work defined for this study is focused to fill data gaps and provide current information regarding fish and aquatic resources, instream flow requirements, and hydrology.

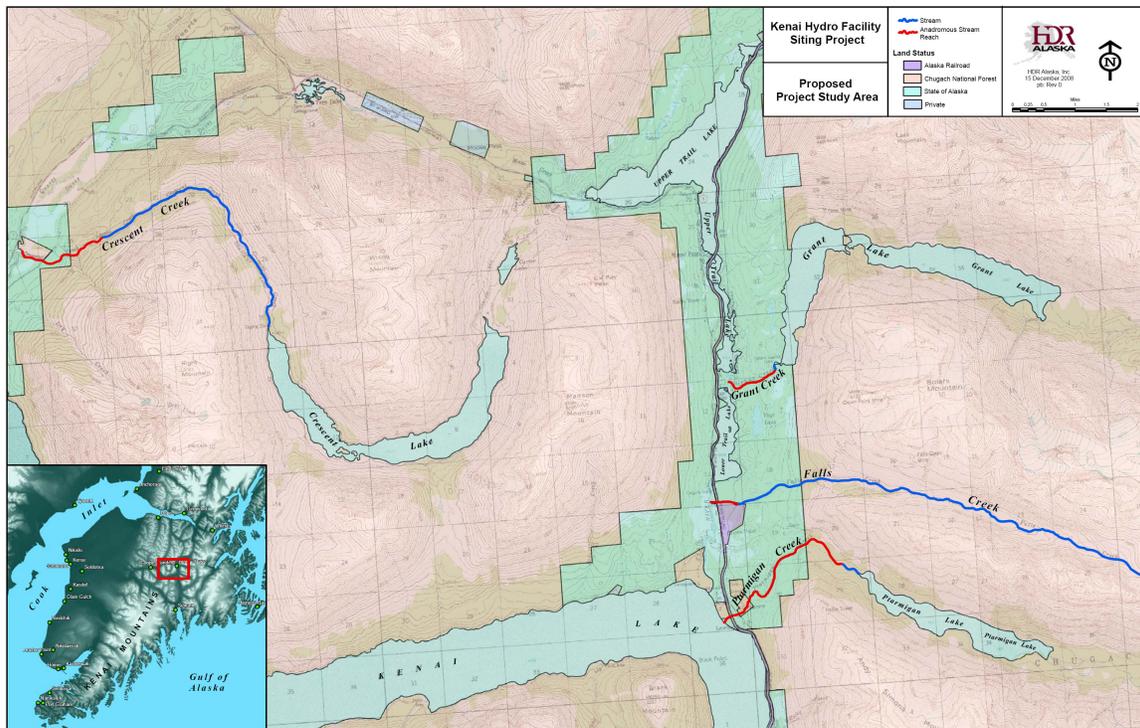


Figure 1. General location of proposed hydroelectric facilities at Grant Lake on the Kenai Peninsula, Alaska

Project History

The hydroelectric potential at Grant Lake (Figure 1) has been evaluated several times as a potential power source for the Seward/Kenai Peninsula area. In 1954, R.W. Beck and Associates (cited by APA 1984) prepared a preliminary investigation and concluded that a project was feasible. The U.S. Geological Survey (USGS) conducted geologic investigations of proposed power sites at Cooper, Grant, Ptarmigan, and Crescent Lakes in the 1950s (Plafker 1955). In 1980 CH₂M Hill (cited by APA, 1984) prepared a pre-feasibility study for a Grant Lake project and concluded that a project developed at the site would be feasible. The Grant Lake Project was referenced in the 1981 U.S. Army Corps of Engineers (USACE) National Hydroelectric Power Resources Study (USACE 1981). The most extensive study was performed by Ebasco Services, Inc. in 1984 for the Alaska Power Authority (now Alaska Energy Authority; APA 1984). Two of the alternatives evaluated by Ebasco included the diversion of adjacent Falls Creek into Grant Lake to provide additional water for power generation. This report relies on the Ebasco report for the basis of the current technical conclusions with regard to hydrology, geotechnical, and environmental considerations.

The Alaska Power Authority (APA) and Ebasco conducted detailed environmental studies of water use and quality; aquatic, botanical and wildlife resources; historical and archaeological resources; socioeconomic impacts; geological and soil resources; recreational resources; aesthetic resources; and land use (APA 1984). The primary environmental impact of Ebasco's preferred project would have been the complete dewatering and subsequent loss of all fish habitat in Grant Creek (natural outflow from Grant Lake; APA 1984). Under this alternative, Grant Creek would have been completely dewatered except for localized run-off and high flow events resulting in spill from the reservoir (APA 1984).

Ebasco (APA 1984) compiled a detailed feasibility report on the Grant Lake hydroelectric project, including environmental issues. The Arctic Environmental Data Center (AEIDC 1983) and USFWS (1961) conducted environmental baseline studies in the project area.

Project Area

The project is located near the community of Moose Pass, Alaska (pop. 206), approximately 25 miles north of Seward, Alaska (pop. 3,016), just east of the Seward Highway (State Route 9); this highway connects Anchorage (pop. 279,671) to Seward. The Alaska Railroad parallels the route of the Seward Highway, and is also adjacent to the project area. The town of Cooper Landing is located 24 miles to the northwest and is accessible via the Sterling Highway (State Route 1) which connects to the Seward Highway approximately 10 miles northwest of Moose Pass.

Grant Lake is located approximately 1.5 miles southeast from Moose Pass. It is located at an elevation of approximately 696 ft above mean sea level (MSL), with a maximum depth of nearly 300 ft and surface area of 2.6 square miles (APA 1984). Grant Lake's total drainage area is approximately 44 square miles. Tributaries include Inlet Creek at the headwaters and other glacial-fed streams in the watershed. Grant Lake consists of an upper and lower portion separated by a natural constriction and island near the midpoint.

The lake is ringed by mountains of the Kenai Mountain Range to the east, north, and south, with elevations ranging from 4,500 to 5,500 ft.

Grant Lake's only outlet, Grant Creek, runs west approximately 1 mile from the south end of Grant Lake to drain into the narrows between Upper and Lower Trail Lake. Trail River drains Lower Trail Lake, and then flows into Kenai Lake. Kenai Lake drains to the Kenai River at its west end near Cooper Landing (APA 1984). Grant Creek has a mean annual flow of 193 cubic feet per second (cfs), is 5,180 ft long, with an average gradient of 207 ft/mi; its substrate includes cobble and boulder alluvial deposits and gravel shoals (APA 1984). The stream is 25 ft wide on average. In its upper half, the stream passes through a rocky gorge with three substantial waterfalls; in its lower half, the stream becomes less turbulent as it passes over gravel shoals and diminishing boulder substrate (APA 1984).

Falls Creek is located approximately two miles south of the south end of Grant Lake; it flows into Trail River just downstream of Lower Trail Lake (approximately 1.8 miles downstream of Grant Creek). The Falls Creek watershed drains steep terrain between the Grant Lake and Ptarmigan Lake watersheds, is 11.9 square miles in area, contains no lakes, and has no major tributaries. Estimated mean annual flow of Falls Creek is 38 cfs; stream flow during the winter is minimal. Falls Creek is 42,240 ft (approx. 8 miles) long, average stream gradient is 418 ft/mi and stream width averages 15 ft wide. Substrate composition for Falls Creek includes cobble, boulder deposits, few gravel bars and a thin layer of fine silt near the mouth; the lower one mile of stream has been extensively channelized and modified by placer mining (APA 1984). Three to four acres adjacent to the active channel in the lower 0.5 miles are covered with tailings and 100 yards of the streambed in this area has been relocated (AEIDC 1983).

Fish Resources of Grant Creek

Introduction

Grant Lake and Grant Creek support different assemblages of fish species and possess varying quality and quantity of fish habitat. Only non-anadromous fish have been found in Grant Lake (AEIDC 1983, USFWS 1961, Johnson and Daigneault 2008), whereas anadromous fish are present in Grant Creek (Figure 2). The following sections describe proposed baseline studies of fish resources.

Grant Lake supports resident populations of sculpin (Cottidae) and threespine stickleback (*Gasterosteus aculeatus*), but salmon were not caught in Grant Lake or any of its tributaries during environmental assessments (USFWS 1961; AEIDC 1983; APA 1984); it is not included in the Anadromous Waters Catalog (AWC) published by Alaska Department of Fish and Game (ADF&G; Johnson and Daigneault 2008). Grant Creek is included in the AWC due to the presence of spawning Chinook, sockeye and coho salmon and rearing coho salmon (Johnson and Daigneault 2008).

Previous Studies

Previous licensing efforts in the 1960s and 1980s for proposed hydroelectric projects at Grant Lake included studies of fish resources in Grant Lake and Grant Creek. AIEDC (1983) conducted fish sampling from 1981 to 1982 as part of comprehensive environmental baseline studies and USFWS (1961) conducted limited sampling from 1959 to 1960.

Grant Lake Fish Resources

A 1981-1982 sampling program found no fish in any of the tributaries of Grant Lake (AEIDC 1983). Sculpin and threespine stickleback were the only fish found to inhabit Grant Lake. A series of impassable falls¹ near Grant Lake's outlet prevents colonization of the lake by salmonids via Grant Creek (APA 1984). Grant Lake supports a "small" population of slimy sculpin (*Cottus cognatus*) and a "dense" population of threespine stickleback (USFWS 1961). Density of threespine stickleback was ten times higher in the lower basin than the upper basin of Grant Lake (AEIDC 1983). A weir was operated at Grant Creek from 1985 to 1988 in order to obtain total counts of returning hatchery coho (1.9 million) released into Grant Lake from 1983 to 1986.

Grant Creek Fish Resources

Both anadromous and resident fish are present in Grant Creek, including salmon, trout and other fish. Spawning Chinook (*Oncorhynchus tshawytscha*), sockeye (*Oncorhynchus nerka*), and coho salmon (*Oncorhynchus kisutch*), as well as rainbow trout (*Oncorhynchus mykiss*) and Dolly Varden are found in the lower reaches of Grant Creek (APA 1984; Johnson and Daigneault 2008; Figure 2). Rearing Chinook, coho and rainbow trout are also present (APA 1984, Johnson and Daigneault 2008). Round whitefish (*Prosopium cylindraceum*) and Arctic grayling (*Thymallus arcticus*) were caught during angling surveys, but not assumed to spawn in Grant Creek (APA 1984).

Upper Grant Creek is impassable to salmon one half (APA 1984) to one mile (Johnson and Daigneault 2008) upstream of the mouth; fish habitat is most likely concentrated within the lower portion of stream. Habitat for juvenile fish exists mainly in stream margins, eddies, deep pools and side channels offering reduced velocities (APA 1984). Substrate material is coarse throughout the entire length of the creek due to high water velocity, which tends to wash away smaller gravels (APA 1984). Isolated areas of suitable spawning gravels occur in the lower half of the stream (APA 1984).

Periodic minnow trapping on Grant Creek from July 1959 through January 1961 captured Chinook salmon, coho salmon, Dolly Varden and sculpin (extent of sampling area unknown; USFWS 1961). Minnow trapping and electrofishing in 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

¹ 2007 ADFG Stream survey referenced in Anadromous Waters Catalog Stream Nomination #08-153, <http://www.sf.adfg.state.ak.us/SARR/FishDistrib/Nomination/FDDNomHome.cfm>

winter and spring (AEIDC 1983). Catches of Dolly Varden were generally most abundant in minnow traps, followed by juvenile Chinook, juvenile rainbow trout, and juvenile coho. Juvenile Chinook were the most commonly caught fish during electrofishing surveys (APA 1984).

APA (1984) estimated that Grant Creek supported 250 Chinook spawners and 1,650 sockeye spawners (APA 1984). These estimates were likely biased low due to visual counting methods. The stream was also estimated to support 209 8-inch “trout” (including Dolly Varden and rainbow trout; APA 1984). Spawning coho were not surveyed (APA 1984), but have been recorded as being present at unknown levels in the stream by the AWC (Johnson and Daigneault 2008). Maximum counts from intermittent stream surveys by ADFG were 76 Chinook (1963) and 324 (1952) sockeye salmon.²

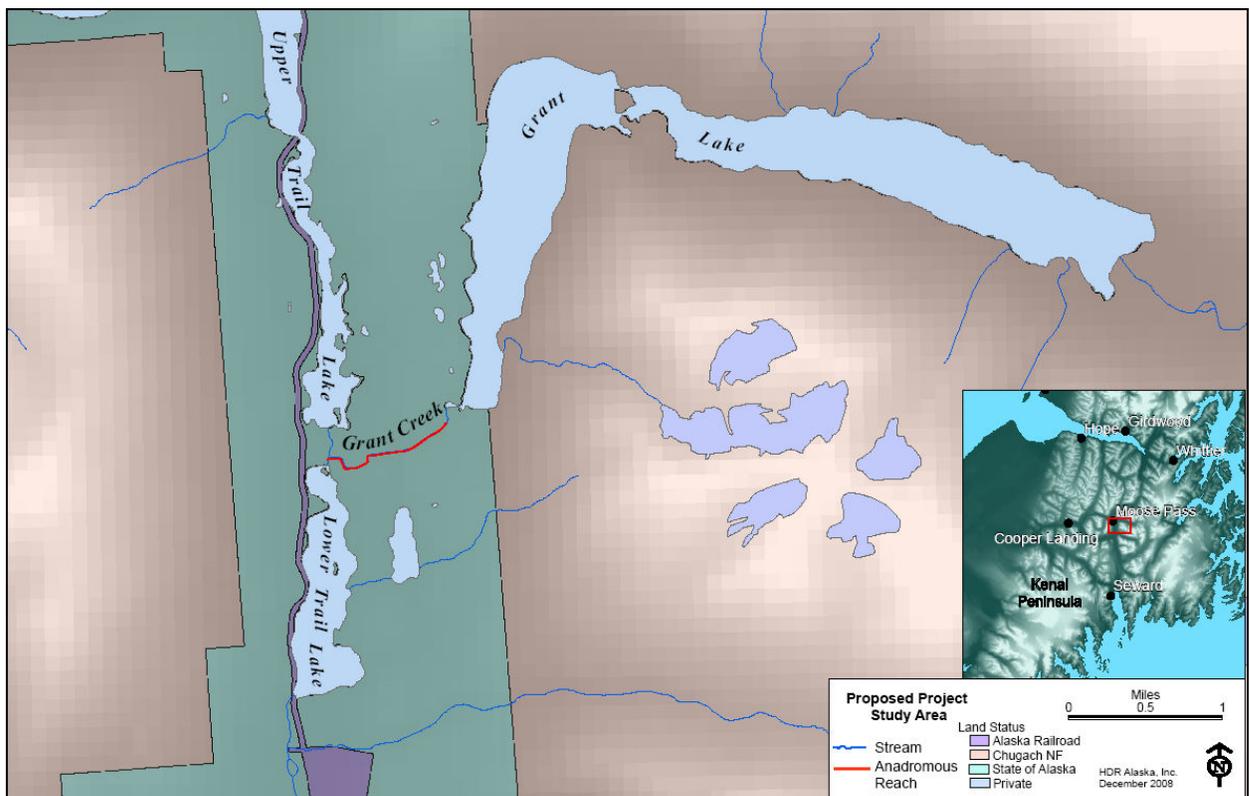


Figure 2. The anadromous reach of Grant Creek (section of stream in which anadromous fish are documented by the AWC; Johnson and Daigneault 2008).

²Anadromous Waters Catalog Stream Nomination #08-153,
<http://www.sf.adfg.state.ak.us/SARR/FishDistrib/Nomination/FDDNomHome.cfm>

Goals and Objectives

Study Goals

The goals of 2009 field work are to characterize fish use of habitats in Grant Lake and Grant Creek, and to describe anadromous fish habitat in Grant Creek. Work completed in 2009 will build upon the data provided by previous studies in this area (AEIDC 1983, USFWS 1961; see Previous studies above). Specific study objectives are addressed below.

The purpose of this study is to characterize resident and rearing fish use, fish spawning abundance and run timing in Grant Creek to provide background information necessary for a FERC environmental assessment. A secondary purpose is to describe fish habitat in Grant Creek. This study will also evaluate potential locations to install and operate a weir on Grant Creek which may be used in future baseline study efforts to determine salmon escapement.

Study Objectives

Objectives of 2009 field efforts will be to:

1. Characterize resident and rearing fish use of Grant Creek, specifically:
 - a. Determine the relative abundance and distribution of juvenile fish in Grant Creek.
 - b. Determine relative abundance and distribution of Dolly Varden and rainbow trout present in Grant Creek.
 - c. Characterize the use of the Gorge Reach by resident and rearing fish relative to down stream reaches.
2. Describe use of Grant Creek by adult migratory fish.
 - a. Estimate the abundance and run timing of spawning salmon
 - b. Estimate the abundance and run timing of spawning rainbow trout and Dolly Varden
3. Evaluate effectiveness of different fish sampling methods in Grant Creek.
 - a. Conduct feasibility study for siting and installation of a counting weir.
4. Conduct a detailed Global Positioning System (GPS)-based habitat survey of Grant Creek, in order to provide habitat suitability data for an in stream flow study of Grant Creek.

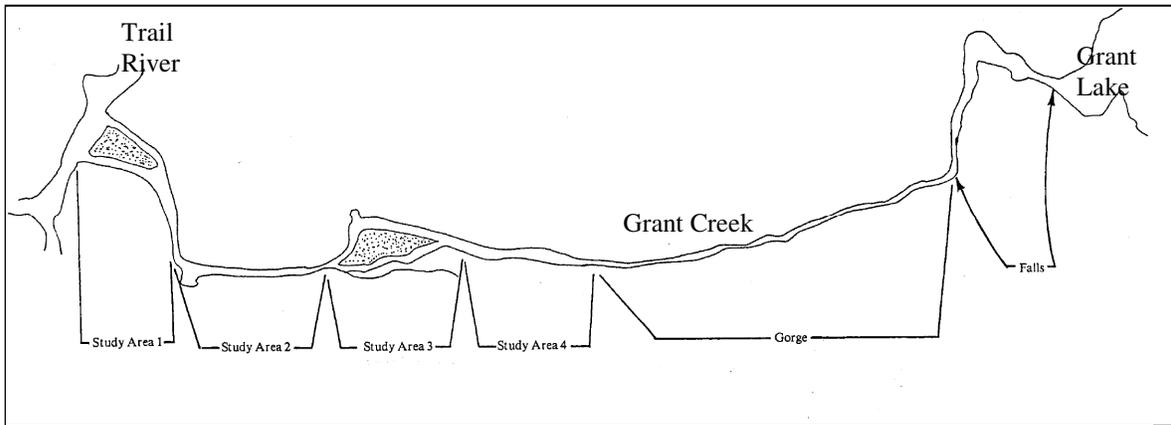


Figure 3. Stream reaches of Grant Creek (AEIDC 1983).

Study Design

Sampling Approach – Grant Creek

Grant Creek is 5,180 ft long from the mouth of Grant Lake to where it joins Trail River (AEIDC 1983). The upper half of the creek is a combination of a gorge and a series of waterfalls (AEIDC 1983; Figure 3). Grant Creek has a mean annual flow of 193 cubic feet per second (cfs; based on USGS gaging data 1947 to 1958; HDR 2009). Low flows occur from December to April and high flows occur from June to September; on average, flow ranges during from 150 cfs in mid-May 600 cfs in late June to back to 150 cfs in late October (HDR 2009). Grant Creek has an average gradient of 207 feet/mile (approximately 4%); its substrate includes cobble and boulder alluvial deposits and gravel shoals (APA 1984). Grant Creek is approximately 35 to 39 ft wide (measured in October and December 2008; HDR 2009), resulting in swift flows. Turbidity conditions in the creek range from what would be considered clear in the late fall, winter and early spring to moderately turbid with some glacial influence during the summer. Water quality samples for Grant Creek showed suspended solids levels ranging from 4.3 mg/L in August to 0.6 mg/L in October (Marcuson 1989). Arctic Environmental Data and Information Center (AEIDC), conducted field work there in the early 1980s and divided the lower half of Grant Creek into four uniform study reaches, each 0.125 miles long (Figure 3).

Ability of fish sampling methods to meet study objectives will depend on the appropriateness of that method to use in this turbid, shallow, high flow stream; methods that reduce fish mortality are favored. Previous investigators attempted to enumerate fish in Grant Creek unsuccessfully using electrofishing and block and removal techniques (AEIDC 1983; Zippin 1958); investigators cited poor conductivity of water and inability to secure block nets in place due to algal deposits and high flows as detractors from the effectiveness of this method to enumerate fish in Grant Creek (AEIDC 1983). Use of electrofishing may injure salmonids (reviewed in Snyder 2003) and thus may not be appropriate during time periods when spawning salmon are present in Grant Creek, precluding ability to compare catches in order to determine seasonal abundance and distribution of fish throughout the sampling period.

Resident and rearing fish under 200 mm in length have been sampled successfully with minnow traps in Grant Creek (AEIDC 1983, USFWS 1961), so repetition of this method is appropriate and results will be comparable to these earlier data. Hoop traps and angling surveys may be an effective method of sampling migratory salmonids larger than 200 mm (i.e. adult Dolly Varden and rainbow trout; Bartlett and Hansen 2000, Larson 1998, Bradley 1990), but use of hoop traps is precluded by high flows. Effectiveness of angling and visual count methods of enumerating adult fish will be assessed and compared in 2009.

Beach seining, visual counts, and total counts may be effective methods for evaluating adult migratory fish use of Grant Creek. However, substrate size and stream size would likely preclude beach seining as an effective technique for sampling fish in Grant Creek; the stream cannot safely be waded during all seasons and is too shallow to set nets using a boat. Turbidity may also limit accuracy of visual counts of adult salmonids (Hagen and Baxter 2005).

From 1985 through 1988 Cook Inlet Aquaculture Association (CIAA) monitored salmon escapement in Grant Creek using an aluminum picket weir spanning the entire width of the stream (Marcuson 1989). Given the stream conditions described above and the apparent success associated with CIAA efforts, a weir would likely be the most effective approach to enumerating salmon and resident fish species in Grant Creek.

Cost and logistics preclude operation of a weir at Grant Creek in 2009, but feasibility of this sampling method for use in the future will be evaluated in 2009. A reasonable approach for the 2009 field season would be to conduct foot and angling surveys to provide an initial indication of distribution and abundance. Both angling and foot surveys would be conducted for rainbow trout and Dolly Varden with only foot surveys used for adult salmon.

Resident and Rearing Fish Use of Grant Creek

HDR biologists will reestablish reaches identified by AEIDC (1983; Figure 3) and sample them for juvenile anadromous and resident fish. Target species will include Chinook and coho salmon, Dolly Varden, rainbow trout, and sculpin. Each reach will be uniformly sampled using baited ¼ inch mesh minnow traps to determine catch per unit effort (CPUE). CPUE can be defined as the catch per trap hour.

Minnow traps will be set for a uniform amount of time within each reach, presumably 24 hours. Reaches 1-4 and the Gorge Reach will receive uniform sampling efforts based on the length of each reach. Approximately 10 traps will be set in Reaches 1-4 and approximately 30 traps will be placed in the Gorge Reach. Due to the geomorphology of the Gorge Reach, setting 30 traps may not be feasible; however, effort will be made to set as many as possible. The Falls Reach will be sampled opportunistically; since it is a series of waterfalls, it will most likely not be feasible to set minnow traps uniformly

throughout the reach. Effort will be made to sample the outlet of Grant Lake (see below Fish Use of Grant Lake).

All sampling sites will be marked by a GPS, staked, and flagged for future identification. Habitat characteristics will also be recorded. Once minnow trapping is complete, effort will be made to electrofish the area around which the traps were placed to confirm minnow trapping results and to collect species that may not recruit to the traps. The electrofishing will occur after the minnow trapping so that it will not interfere with the trap catch. Fish captured in the minnow traps will be retained during the electrofishing effort, so as to not recapture them. Each site will be electrofished for a standard amount of time. All reaches will be minnow trapped bimonthly from May through October.

Angling surveys will be used to characterize the use of Grant Creek by rainbow trout and Dolly Varden throughout the open water season. Angling surveys will be conducted at least one day after foot surveys for adult migratory fish have occurred (see study section below, Use of Grant Creek by Adult Migratory Fish). This effort will provide information on seasonal distribution of species.

Fish captured will be identified to species level, and released near the point of capture. A target sample of fish will be sampled for length to the nearest millimeter ($n=30$ per sampling event and species); salmonids will be sampled for fork length or tip of the snout to the fork in the tail, and other fish will be sampled for total length or tip of snout to end of tail. As the distance from the outlet increases, CPUE is expected to decrease in Grant Creek.

Use of Grant Creek by Adult Migratory Fish

Angling Surveys

Spawning rainbow trout and Dolly Varden would be counted using a combination of methods. Grant Creek would be divided into the six reaches as previously identified by AEIDC in 1983.

Angling stations will be established within each stream reach, with each reach containing the same number of stations per river mile so that the level of effort between reaches is uniform. Angling stations would be identified in the field, flagged, and marked using GPS coordinates so that each station can be relocated. It is important to note that these angling stations will likely be the same as those identified in the Resident Fish Study. After completing the foot survey, field crew members will begin conducting angling surveys. Each angling station will be fished for 30 minutes, using rod and reel methods in accordance with ADF&G Sport Fishing Regulations.

Angling surveys for rainbow trout will be timed to coincide with the probable spawning time which occurs after breakup in late spring. Trout spawning normally begins after water temperatures warm to about 4°C. Grant Creek water temperatures will be monitored after ice-out to determine when surveys should be initiated.

All fish captured will be immediately landed and netted. Each fish will be measured, sexed (if possible), and its spawning condition described. After being captured each fish will be walked down stream and released in a slow water area away from the angling station.

In the event that foot and/or angling survey methods do not appear to be effective especially for Dolly Varden, field crews will conduct snorkel surveys in deep pools to determine the presence or absence of spawning fish. While it is recognized that this method would not provide a statistical estimate of abundance, it would however provide useful presence and absence information that future baseline studies could build upon.

Foot Surveys

Foot surveys will be conducted to estimate the abundance of spawning fish in Grant Creek. Two survey crews, made up of two members each, will begin at the downstream terminus of each stream reach. One survey crew on each stream bank will visually count fish as they move upstream. All fish tallied will be identified to species. The survey area will include all active channels including side channels and back water pool areas.

To avoid double counting each crew will attempt to count fish from the middle of the stream to the shore. Salmon that are obviously spawned out but still swimming (i.e. a live carcass) will be counted as a carcass rather than a live fish.

The number of fish counted within each stream reach will be tallied and GPS coordinates will be recorded at the end of each survey reach. Other data such as the number of active redds, areas of concentrated spawning activity, number of carcasses and survey conditions will also be recorded using GPS.

Weir Site Reconnaissance

Two or three locations near the mouth of the creek will be selected and assessed for the possible installation of a weir. An attempt will be made to find the weir location operated by CIAA in the 1980s. The following information will be recorded for each possible weir location:

- Channel geometry
- Bed width
- Wet width at low and high flow conditions
- Stream bank conditions – stability, erosional features, undercut bank, vegetation
- Substrate
- Thalweg velocity measurements at low and high flow conditions
- Fish use of the area – bank orientation, holding or moving upstream, active spawning, overall abundance; and
- Photographs

In addition to the information above, the use of different weir types and enumeration techniques will be evaluated such as of a resistance board weir or time laps videography.

This information will be used to draft a technical memorandum that will provide recommendations for the possible installation and operation of a weir.

Habitat Mapping of Grant Creek

Aquatic habitat within Grant Creek has not been well characterized. An aquatic habitat distribution survey will describe the existing instream conditions and will provide a baseline against which future conditions can be compared. A detailed, GPS-based, habitat survey will be conducted to quantify the aquatic habitat of Grant Creek. Habitat delineation will be based on the protocol outlined in U.S. Forest Service FSH 2090-Aquatic Habitat Management Handbook, which establishes standard techniques for conducting fish and aquatic stream habitat surveys in coastal Alaska (USFS 2001). Detailed methods are described in detail in USFS 2001. A modified Tier Three approach (USFS 2001) will be used.

Habitat surveys will be conducted by walking upstream from the mouth of Grant Creek to the outlet of Grant Lake. Linear stream reference points will be based on the upstream and downstream GPS coordinates of each habitat unit as well as correlated with photographs of representative habitat units. Photographs will be taken at the upstream end of the habitat unit, looking downstream. A subset of photographs will be reviewed to verify the habitat unit was classified correctly. Geo-referenced video of the creek will also be recorded at strategic locations at different flows to help document baseline habitat conditions.

Data will be recorded on a handheld personal computer with internal GPS. Channel bed width measurements, maximum habitat unit depth, dominant substrate, amount of large woody debris, and amount of undercut bank will be determined for all habitat units. Investigators will record riparian vegetation, tributary confluence location, surface water temperature, stream gradient, and USFS channel type (USFS 1992) as well as Rosgen channel type to the alpha level (Rosgen 1996). Blockages to adult anadromous salmonid migration (ADNR 2007) will also be measured. All existing structures observed in Grant Creek such as buildings, bridges, and culverts will be documented and photographs taken. Pebble counts and discharge measurements will be conducted for each reach (USFS 2001). Investigators will use data collected to produce cross sections of the stream for each reach (see Data Analysis below).

Side channels will be surveyed to the same tier as the adjacent main channel. The presence of a side channel will be identified based on the size of the island between each side channel at bank full flows using the following rule: a side channel is denoted if the island between the side channel and the main channel is at least as long as the creek is wide at bank full flow (USFS 2001).

The USFS and Alaska Department of Natural Resources (ADNR) defines blockages to adult salmon migration using specific criteria for each species of Pacific salmon, such as maximum fall height, pool depth, and channel gradient (USFS2001; ADNR 2007). ADNR criteria are similar to the USFS criteria; however, it differs regarding channel gradient. Since the USFS criteria have been developed for coastal regions in Alaska, and

ADNR criteria appear to be more suited to the inland setting of the project area; ADNR (2007) criteria will be adopted for this study (Table 1). Blockages to fish passage found during the survey will be noted as either permanent or ephemeral.

Table 1. Adult salmonid migration blockage criteria (ADNR 2007).

Criterion	Salmon species		
	Coho	Chinook	Sockeye
Maximum Fall Height: A blockage may be presumed if fall height exceeds:	11 Feet (3.35m)	11 Feet (3.35m)	10 Feet (3.05m)
Pool Depth: A blockage may be presumed if pool depth is less than the following, and the pool is unobstructed by boulders or bedrock	1.25 x jump height, except that there is no minimum pool depth for falls: <4 feet (1.2m)	1.25 x jump height, except that there is no minimum pool depth for falls: <2 feet (0.6m)	
Steep Channel: A blockage may be presumed if channel steepness is greater than the following without resting places for fish.	>225 feet (68.6m) @ 12% gradient >100 feet (30.5m) @ 16% gradient >50 feet (15.2m) @ 20% gradient >25 feet (7.62m) @ 24% gradient		

NOTE: To determine waterfall height, measure the additive height of falls only if there is no resting pool between them.

Habitat unit identification will be based on changes in habitat characteristics such as, hydrology, channel form, and substrate (USFS 2001). Macrohabitat units such as pools and fast water will be identified. These units will then be subdivided into one of eight possible mesohabitat units (Table 2). Pools will be categorized based on whether they are backwater, scour, or sloughs. Pools will be verified that they are actually pools by calculating their minimum residual pool depth. Fast water will be categorized as glides, riffles, or cascades. Presence of beaver ponds and undercut banks will also be noted. Island complexes will be identified and all channels will be characterized to the mesohabitat level (USFS 2001).

Table 2. Macro- and mesohabitat units (USFS 2001).

Macrohabitat units	Mesohabitat units
Pools (PL)	Backwater (PL-Bw)
	Scour (PL-Sr)
	Slough (SL-Sr)
Beaver Pond (BP)	Beaver Pond (BP)
Undercut Bank (U/C Bank)	Undercut Bank (U/C Bank)
Fastwater (FW)	Glide (GL)
	Riffle (RF)
	Cascade (CS)

The dominant substrate type will be identified in each habitat unit. Substrate will be categorized into 12 classifications ranging in size from organics through bedrock (Table 3). Additionally, substrate will be characterized at each cross section using a pebble count. Selection bias for substrate measurements is minimized as much as possible by conducting a “boot tip” survey where the observer selects the first particle encountered at the tip of their boot. Pebble counts consist of a random selection and measurement of streambed material at five transects. One transect will be located at the cross-section and two transects will be located at five meter increments upstream and downstream. A minimum of 20 samples will be surveyed along each transect. Substrate will be measured and classified (USFS 2001).

Table 3. Substrate size classification.

Substrate	Code	Size class
Organic	ORG	Organic
Sand/silt	SS	<2mm
Very fine gravel	VFG	2 – 3.9mm
Fine gravel	FGR	4 – 7.9mm
Medium gravel	MGR	8 – 15.9mm
Coarse gravel	CGR	16 – 31.9mm
Very coarse gravel	VCG	32 – 63.9mm
Small cobble	SC	64 – 127.9mm
Large cobble	LC	128 – 255.9mm
Small boulder	SB	256 – 512mm
Large/medium boulder	LMB	>512
Bedrock	BR	Bedrock

Riparian vegetation will be recorded every 100 meters or whenever there is a notable change; riparian vegetation will be categorized into 11 classifications (Table 4; USFS 2001).

Table 4. Riparian vegetation classification (USFS 2001).

Riparian vegetation type	Code
Conifer forest – closed	CFC
Conifer forest – open	CFO
Broad leaf forest – closed	BFC
Broad leaf Forest – open	BFO
Nonforest-shrub – willow	NSW
Nonforest-shrub – alder	NSA
Nonforest-shrub – other	NSO
Nonforest-herbaceous – estuarine	NHE
Nonforest-herbaceous – bog	NHB
Nonforest-herbaceous – fen	NHF
Nonforest-herbaceous – other	NHO

Velocity measurements will be recorded once per reach in Grant Creek (USFS 2001). Measurements will be made in accordance with USGS protocols (USGS 1982). Stream

gradient and surface water temperature will be measured eight times daily and/or at every 10th habitat unit (USFS 2001).

Quality Control

See Quality Control section of study plan.

Data Analysis

Resident and Rearing Fish Use of Grant Creek

CPUE will be determined by dividing the catch (number of fish caught) by the effort (fishing time). CPUE will be determined for each species in each reach and gear type (e.g. minnow trap, hoop trap, hook and line) and a total CPUE for each reach. It will then be compared between reaches to determine the greatest relative abundance for each species.

Due to small sample sizes and the likelihood that the data will not be normally distributed, Kruskal-Wallis test (a nonparametric ANOVA) will be used to determine if there are statistically significant differences in CPUE between reaches. If a significant result arises, Mann Whitney U tests will then be used to determine which reaches are significantly different from each other. If there are statistically significant differences between reaches, then those reaches contain differing CPUE and thus differing numbers of fish.

Relative abundance will be determined by species for each reach. Relative abundance values between reaches will also be compared statistically using similar methods as described above. Length frequency distribution graphs will be produced for each species to determine age classes present in each reach.

Use of Grant Creek by Adult Migratory Fish

Catch per unit of effort (CPUE) will be determined by dividing the catch by the effort of fishing time (i.e. catch per hour). CPUE will be determined for rainbow trout and Dolly Varden in each reach. It will then be compared between reaches to determine the greatest relative abundance for each species.

It is likely the sample sizes will be small and the data will not be normally distributed; therefore, the Kruskal-Wallis test (a nonparametric ANOVA) will be used to determine if there are statistically significant differences in CPUE between reaches. If a significant result arises, Mann Whitney U tests will then be used to determine which reaches are significantly different from each other. Statistically significant differences between reaches would indicate reaches contain differing CPUE and thus differing numbers of fish.

Run duration timing will be characterized by comparing the number of fish captured per sampling day over the total number of angling effort days. Length frequency distribution graphs will be produced for each species to estimate age classes present in each reach.

To characterize salmon spawning distribution, survey counts will be tallied by reach and compared using statistical methods described above to determine if there is a statistically significant difference between stream reaches.

Area under the curve methods (AUC) (English et al 1992) will be used in an attempt to estimate the total fish abundance by species. Note that this will likely not be possible for rainbow trout and Dolly Varden.

Habitat Mapping of Grant Creek

All GPS coordinates will be uploaded into Geographic Information System (GIS) and plotted. The stream network will then be digitized through the collected points. Linear referencing techniques will be used in GIS to assign river kilometers to each habitat unit on Grant Creek. The database will then be exported into MS Excel and habitat lengths will be calculated for each habitat unit. Area of each habitat unit will be determined by multiplying the habitat length by the bank full width. Aquatic habitats will be presented by habitat type, frequency, and distribution. Cross sectional drawings will be produced for each reach.

Personnel and Responsibilities

Amanda Prevel-Ramos: Lead Fish Biologist

Duties: Project management, prepare reports and study plan, budget tracking and communications with KHL and resource agencies, coordinate sampling schedule, conduct field work, QA/QC and data analysis, and reporting.

Paul McLarnon: Sr. Fish Biologist

Duties: Project oversight, review reports and study plan, budget tracking and communications with KHL and resource agencies

Heidi Weigner: Fish Biologist / Lead Field Biologist

Duties: Supervise field project, coordinate sampling schedule, conduct field work, QA/QC and data analysis, and reporting.

Patrick Blair: Stream Ecologist

Duties: Conduct habitat delineation field work, data entry, QA/QC, and data analysis.

Field Technicians (3)

Duties: conduct field work, data entry, and QA/QC.

Schedule

Field activities related to fish sampling in the project area will take place from approximately April through November 2009. Mobilization will occur in mid-April, with sampling beginning in May and continuing through November. A field sampling schedule is shown in Table 5.

Table 5. Fish sampling activities schedule at Grant Creek, 2009.

Activity	Time period
Habitat sampling	May
Rearing and resident fish sampling	May – October
Rainbow trout spawning surveys	May – June
Salmon spawning surveys	June – October
Dolly Varden spawning surveys	October - November

A comprehensive baseline studies report will be developed. Field methods, data analyses, results, discussion of results and corresponding maps and figures will be included in this report. A project deliverables schedule is shown in Table 6.

Table 6. Reporting schedule for fish studies at Grant Lake and Creek, 2009.

Deliverable	Date
Final baseline study plan	April 15, 2009
Draft environmental baseline studies report for 2009 field season	December 30, 2009
Final environmental baseline studies report for 2009 field season	January 31, 2009

Fish Resources of Grant Lake

Introduction

Grant Lake, located in the Kenai River drainage, is a 1,598 acre glacial-fed lake that is characterized by two basins surrounded by steep mountains. The shoreline in most places is steep, with bedrock outcroppings interspersed with gravel beaches. Both basins are deep, extending to depths of approximately 300 feet, and appear to have relatively uniform bottoms covered with deposits of thick clay and silt (AEIDC 1983). The two basins are separated by a narrow isthmus with an island in the middle. Water depth is less than 10 feet at the connection between the two basins (CIAA 1989). The shoreline is littered with floating and sunken organic debris. Patches of thick macrophyte growth extend from the lake bottom in the few littoral areas that are present. The water surface of the lake appears to fluctuate moderately, likely rising to its highest elevation during the summer runoff and falling to a low point in late winter (AEIDC 1983)

Numerous short streams originate from the steep mountains that surround much of the lake. Additionally, three glacial streams enter the lake, as well as two moderately turbid streams at the upper end of the upper basin (AEIDC 1983).

Sisson (1984) reported that Dolly Varden and a few rainbow trout occupy Grant Lake. However, numerous investigations (USFWS 1961, AEIDC 1983 and CIAA 1983) have indicated that Grant Lake currently only supports a small population of coast range sculpin (*Cottus aleuticus*) and a dense population of three spine stickleback (*Gasterosteus aculeatus*). AEIDC (1983) reported that no fish were found in any of the inlet streams and no other species of fish [except sculpin and stickleback] was taken in the lake. Falls

near the outlet of the lake form a fish passage barrier that prevents other fish species such as salmon and trout from entering the lake.

During October 1983 through 1986, approximately 1.9 million juvenile coho salmon were released into Grant Lake as part of a coho salmon enhancement program that was run by CIAA (Marcuson 1989). The objective of the program was to provide coho salmon to commercial, sports and personal use fisheries in Cook Inlet and the Kenai River Drainage. The Grant Lake stocking program produced poor results with an average survival of 0.19%. Of the 1.9 million fry stocked in Grant Lake, only 3,750 returned to Grant Creek (Marcuson 1989) and as a result the stocking program was discontinued.

Goals and Objectives

Study Goals

The purpose of this study is to characterize fish use within Grant Lake to help assess fish habitat value within the project area and provide background information necessary for the FERC environmental assessment.

Objectives

- Characterize fish community composition within Grant Lake.
- Verify the results of previous fish studies in Grant Lake.

Study Design

Historical sampling efforts in Grant Lake have employed baited minnow traps and variable mesh gill nets. The 2009 Grant Lake fish characterization baseline study will employ these same methods and also include beach seining in the lake and electrofishing in lake tributaries.

Gill nets will be deployed in approximately the same locations that were sampled in 1982 (AEIDC 1983; see Figure 4 for historic sample locations) as well as at other promising locations. Gill nets will be set both perpendicular and parallel to shore and at a variety of depths up to 200 feet deep. Nets will be fished for 6- to 8-hour periods and checked frequently each day. Gill net sets may occur over night but only if it is determined that there is a low risk of excessive fish mortality or entanglement of water fowl.

Minnow traps baited with cured salmon eggs will be fished in approximately the same locations as shown in Figure 4 as well as at other promising locations such as areas of habitat complexity like wood clusters and alluvial fan areas. All minnow traps will be fished overnight for approximately 24 hours.

Where possible, several areas throughout the lake shore will also be sampled using a 50-foot beach seine. The seine will be deployed perpendicular to shore and hauled in parallel to shore.

Tributaries to Grant Lake will be sampled using baited minnow traps that will be fished in approximately the same locations as shown in Figure 4. Additional areas that may appear to support fish may also be sampled. The length of each sample area will be 25 times the width of the stream channel. Baited minnow traps will be distributed throughout

the sample area and fished over night. After pulling all minnow traps the sample area will be electrofished using a single pass technique to verify minnow trapping results.

All fish captured will be identified to species, measured and released at the point of capture. The lake sampling program will consist of two separate sampling efforts with one sampling effort to occur in June shortly after ice-out before significant glacial melting activity and again in late summer (August – September). All sample locations will be recorded on a GPS and if necessary marked with flagging tape.

Sensitive or high value fish habitats, if present, will be identified and characterized based on depth, substrate, vegetative cover, turbidity and any fish capture results.



Figure 4. Sampling sites at Grant Lake (AEIDC 1983).

Numbers represent sampling sites; 1= variable mesh gill net sampling sites, 2= minnow trap sites, 3= plankton and water quality sampling sites, 4= benthos sampling sites.

Quality Control

See Quality Control section of study plan.

Data Analysis

Data analysis will consist of a characterization sensitive or high value fish habitats based on CPUE, fish presence / absence documentation, a list of species captured and their relative abundance.

Instream Flow Study

Goals and Objectives

The purpose of the instream flow study is to determine the potential effects of a range of flow regimes on physical habitat and water temperature in Grant Creek as a means of evaluating project operating alternatives and assessing project impacts per the requirements of the FERC licensing process and other regulatory requirements.

Study Objectives

- Review existing documentation of fish habitat, flow, and temperature in Grant Creek.
- Coordinate and share information with the habitat mapping, fish resources, and water quality studies that will be conducted concurrently on Grant Creek.
- Lead the collaborative preparation of an instream flow study design with the Instream Flow Technical Working Group (TWG).
- Conduct field data collection for instream flow.
- Locate, install, and maintain continuous and/or instantaneous flow and temperature stations on Grant Creek.
- Analyze and model fish habitat availability as a function of TWG-selected alternate flow regimes using existing and collected data.
- Document and report instream flow analysis and results.
- Assist Kenai Hydro LLC (KHL) in achieving a flow regime negotiated solution.

For a hydroelectric project, an instream flow study is typically an impact assessment rather than a baseline study. The purpose is to determine the potential change in available habitat as flow regime is changed under the conditions of the hydroelectric facility. To determine impacts, a proposed change in the baseline condition should be known. This means a hydroelectric facility plan should be progressed beyond a conceptual plan to a level at which spatial and temporal impacts may be estimated.

While an instream flow study is not typically a baseline study, physical habitat data is usually collected on the existing condition in the stream. Other baseline studies also feed into an instream flow study, including hydrology, water quality, fish resources, and habitat mapping.

It should be noted that the primary focus for the 2009 instream flow study program will be the collection of baseline hydrology data and the development of a detailed work plan.

Impact assessment related to the instream flow study will occur during future stages of the project.

An instream flow study assesses the potential change in physical habitat for fish (or other organisms or uses to be studied). But available habitat is not the only potential limiting factor for fish in natural streams. Availability of habitat is less critical if another factor (or factors) limits the population of a species or lifestage. Other factors should be assessed for their potential limitation to fish populations in Grant Creek, particularly water temperature, water quality, inter- and intra-specific competition, food availability, predation, disease, and the effect of ice on overwintering habitat. The Grant Creek instream flow study will include synthesis of some of these components that are being addressed in other sections of this study plan, including water temperature, water quality, and food availability.

Study Design

The Grant Creek instream flow study design is a collaborative effort that includes the members of the Instream Flow Technical Working Group (TWG). During the interagency meeting on March 24, 2009 in Moose Pass, Alaska, input on the structure and schedule of the TWG was requested from meeting participants. The TWG will convene several meetings to develop elements of the study design, which will be lead by HDR. The first meeting to kick off this process was held on April 21, 2009, in Kenai.

The decision points made on April 21, 2009, or yet to be made, are **highlighted in bold throughout** this document.

The instream flow study process will include surface hydrology and temperature components. Data collection methods for surface hydrology and air and water temperature are described in some detail in this study plan. They are, however, subject to verification and potential changes by the TWG. Detailed data collection procedures and locations will be documented in an instream flow work plan following study design development by the TWG and HDR.

Instream flow studies generally fall into three categories: monitoring/diagnostic, standard-setting, and incremental. At this point, the specific methodology to be used for the Grant Creek instream flow study has not been selected. An incremental method, such as the Instream Flow Incremental Methodology (IFIM; Bovee, 1982), provides a feasible approach for studying instream flows in the Grant Creek system. Thus, this document assumes the use of an IFIM approach. However, it should be noted that other instream flow methods will be evaluated for development of the instream flow study design, including 2-dimensional hydraulic modeling and habitat mapping methodologies.

The general steps of an incremental process include study planning, study implementation, analysis, and problem resolution. These four concepts are described in further detail below.

Study Planning

The goals of the study planning component of an incremental instream flow study are to collaboratively identify the problem, select the appropriate methodologies, identify and select the baselines, and develop a study plan. This component is the most crucial part of

the Grant Creek instream flow study. The study implementation team (KHL and HDR) and the stakeholders should be in agreement on all major aspects of the study before it begins.

The purpose of an instream flow study is **to identify the potential impacts** of a change in stream flow regime on physical habitat for the focal species/lifestages. The proposed hydroelectric project in Grant Creek will likely produce an altered flow regime that could impact the availability of physical habitat by affecting such parameters as depth, velocity, cover, and water temperature. Thus, the existing and proposed flow regimes may serve as “starting points” for the conversation on how the proposed project may impact fish habitat. At this stage of project development, exact potential impacts of the proposed hydroelectric project cannot be identified. Development of the hydroelectric facility plan will likely progress over the remainder of 2009 and into 2010, this will allowing the TWG to consider the potential impact of the project on physical habitat in the final instream flow work plan.

The TWG should identify the **temporal and spatial boundaries** within the potential impacts of the proposed project that will be studied. This includes the study reaches, tributaries, and time of year, and is linked to the progression of hydroelectric facility plan development in 2009 and early 2010. The TWG should also identify the focal species and lifestages of aquatic organisms¹ to study.

The TWG is tasked with **selecting the methodologies for the instream flow analysis**. An incremental methodology is the likely solution for the Grant Creek instream flow study, but multiple incremental tools exist to assess physical habitat as a function of flow. At the April 21, 2009 TWG meeting, the work group came to a **preliminary and conditional consensus that the PHABSIM method would be used for this study**, pending the review of information regarding other applicable methodologies and affirmation during the May 19, 2009 conference call.

In addition to the study methodology, on April 21, 2009 the TWG **identified the locations at which stream flow and water temperature would be measured**. A continuous flow station will be established in Grant Creek at the previously existing USGS station. Instantaneous flow stations will be established at the approximate location of the proposed powerhouse near the mouth of “the gorge” and near the mouth of the intermittent tributary located immediately upstream of the USGS station and above the gorge near the outlet of the lake. A continuous flow station will be established near the mouth of Falls Creek, as well.

Water temperature monitors will be established at the continuous and instantaneous flow stations. In addition, temperature monitors will be established in two pools in Grant Creek. If a spawning site is observed with a heavy concentration of spawning fish, efforts will be made to quickly establish a temperature monitoring station on the spawning area. If this is not possible due to excessive depths and/or velocities, the spawning area should be carefully documented and a temperature monitoring station will be established later in the year when flows are lower.

A crucial step in the Grant Creek instream flow study is **identification and selection of baselines**. The baselines refer to the base (or existing) conditions at the site. Key baselines to identify for the instream flow study include:

- Habitat mapping (to be studied concurrently)
- Target species & lifestages
- Habitat Suitability Criteria
- Study reaches
- Data collection and reduction methods
- Surface Hydrology – locations of continuous and instantaneous stations were selected at the April 21, 2009 TWG meeting.
- Stream temperature – general and specific locations of temperature data loggers were selected at the April 21, 2009 TWG meeting.
- Milestones and target dates

Finally, a **work plan document** will be developed that identifies the baseline data to be collected, the methods for collecting the data, and the locations of the data collection. The completed work plan document will serve as the deliverable for the study planning component of the instream flow study.

Study Implementation

Collectively, a large amount of data may be required as input to an incremental instream flow study. Some of these data may be general regional data, for example relative humidity and percent sunshine parameters for surface water temperature models. However, most of the required data should be specific to Grant Creek. Such data, for example stream flow, water temperature, and physical habitat, should be collected at locations that are strategically selected based on the habitat types and stream reaches they represent.

There are several categories of data that will likely be included in the instream flow study, and will be discussed by the TWG. These data include stream habitat inventory, habitat suitability criteria, physical habitat of the study reaches, hydrology, and surface water temperature.

The **stream habitat mapping** component will be performed in the summer of 2009. This information is crucial for both the analysis and synthesis of the instream flow model. Information from the stream habitat mapping study may be considered in the selection of study reaches and transects for the instream flow study. Detailed information regarding this study component is contained in the habitat mapping study plan.

Grant Creek is used by both anadromous and resident fish, including Chinook, sockeye, and coho salmon and rainbow trout, Dolly Varden, whitefish, Arctic grayling, and sculpin. In September 2009, HDR will present preliminary data detailing fish presence and use in Grant Creek. With this information in hand, the TWG will determine if the instream flow study will utilize previously-developed **habitat suitability criteria (HSC)**, develop site-specific HSC, or use some combination of the two. If site-specific criteria are to be developed, HDR proposes to develop probability of use curves as described in Bovee and Cochnauer (1977) or similar methodologies.

The general method to determine the HSC for Grant Creek will involve the following steps:

1. Review habitat suitability criteria (probability-of-use curves) developed for other IFIM studies on streams in Alaska and in the Pacific Northwest.
2. Select sets of criteria that appear to be most applicable to Grant Creek based on stream location, size, channel type, and other physical characteristics.
3. Initiate a review of the selected criteria by biologists familiar with Grant Creek and the Kenai River drainage. Modify the criteria as appropriate per recommendations from the review team.
4. Decide on field methods to determine if the modified criteria are representative of Grant Creek, or if site-specific HSC should be collected.

At a minimum, typical incremental instream flow studies collect data on channel geometry, water surface elevation, stream velocity, channel substrate size, and cover. The **methods and quantity of stream habitat data collection** are ultimately dependent on the selected methodology. Placement of study sites are also dependent on the selected methodology, and will be determined by the TWG in a two-day meeting and field trip tentatively scheduled for September 22-23, 2009.

Hydrology of Grant Creek and selected tributaries is an important component of the instream flow study. The locations of new hydrology data stations were determined during the April 21, 2009 TWG meeting as previously described. In 2009, hydrology data collection will be limited to surface water data collection, and will not include groundwater, vadose zone, or snow hydrology investigations.

Because surface water flow in Grant Creek can exhibit depths and velocities that exceed the limits for safe wading, high flow measurements will be collected using other methods. A potential technique is to collect flow measurements using current meters from a boat tied to a fixed cable. A second technique is to collect flow measurements using an Acoustic Doppler Current Profiler (ADCP).

Continuous stage/discharge stations

Continuously recording stations would be established in the ice-free channel as soon as conditions permit following breakup in 2009. At continuous stations, a pressure transducer will be installed at a cross section and connected to a data logger if a built-in logger is not included. The installation includes a stilling well to house the transducer. The transducer measures changes in pressure and converts pressure readings to stage – the depth of water above the transducer – to the nearest 1/100 foot, and records the data at preset time intervals.

An elevation survey is performed at each continuous discharge station. Typically, three benchmarks will be set at each station to provide a local datum for vertical control. The TWG will decide which, if any, of the hydrology stations are to be tied to the regional vertical datum.

A stage-discharge rating curve would be established at each station by conducting multiple stream flow surveys at the cross section at the location of the continuous stage

recorder. Stream flow is measured using USGS-approved equipment and methods, including portable flow meters, ADCP, or the salt-dilution method. The measured discharges are tied to stage by level survey of the water surface elevation at the cross section.

Continuously recording water temperature data loggers will be deployed at the hydrology stations as previously described. Other temperature stations may also be set, including pools and concentrated spawning locations. The deployment of these units will be in a steel or iron pipe attached by cable to a large tree or rock on the bank.

Atmospheric information such as air temperature, relative humidity, percent possible sun, and wind speed may need to be collected as well. Some of the atmospheric information are applicable regionally (i.e. percent possible sun) while other parameters may be dependent on site-specific conditions (i.e. wind speed, air temperature). The sources of atmospheric data will be determined by the TWG following selection of the methodology for the Grant Creek water temperature investigation.

Instantaneous stage/discharge stations

Flow is collected at instantaneous discharge stations using the stream flow methods described above. Continuous stage recording equipment is not installed at these stations. Like the continuous stations, benchmarks would be developed at these sites to provide the elevations for stage-discharge relationships.

Analysis

Instream flow analysis will follow the methodology ultimately selected by the TWG. An incremental instream flow analysis typically involves **data reduction, modeling, and analysis of modeling results**. The result of an incremental instream flow study is an index of available physical habitat for a given species and lifestage of fish over a range of flows. Analysis includes the development of a habitat time series that relates the index of habitat to a hydrograph, whether the hydrograph is based on measured flows or an **assortment of possible future flow regimes** that would be determined by the TWG. The habitat time series is an important tool that will be utilized in the problem resolution phase of the instream flow study.

Synthesis of the instream flow study components (physical habitat, hydrology, water temperature) with other study components including habitat mapping, fish resources, and water quality will be required to place the study results in the context of environmental flows for fish in Grant Creek.

Problem Resolution

The result of incremental instream flow modeling is an index of available physical habitat for a given species/lifestage of fish. The output of the habitat model and analysis does not provide a single best solution for instream flow; instead, it is a tool to aid formulating and evaluating flow alternatives. Establishment of a potential future flow regime relies heavily on the professional judgment of interdisciplinary teams including KHL and members of the TWG. The TWG must integrate their knowledge and professional

judgments about the biological resources and social needs to reach a **negotiated solution** that implies a balance between what can sometimes be seen as conflicting values.

The instream flow study is a tool that provides some process-based insight into how changes to flow in Grant Creek might impact the availability of physical habitat for fish. The modeling tools may be used to “test” the impacts of alternate flow regimes. The flexibility provided by the modeling tools is useful in the negotiation process, and can help identify a flow regime that meet the needs of fish and water resources.

Quality Control

See Quality Control section of study plan.

Schedule

The TWG will meet either in person or by conference call on multiple occasions to identify the study requirements previously detailed in this study plan. The product of the study design phase of the instream flow study is a work plan that identifies the methodology, models, study reaches, data needs, and project timelines. The implementation of future field work will be based on the work plan document.

Work Plan Development

The instream flow work plan will progress over the course of 2009 as certain information on Grant Creek relevant to the instream flow study is developed; including hydrologic baseline data, habitat mapping of Grant Creek, fish use, and development of a hydroelectric facility plan.

The following proposed schedule provides a preliminary outline for development of the instream flow work plan with input from the TWG. This proposed schedule is preliminary only and may be changed.

Mtg.No.	Tentative Date
1	4/21/2009
2	5/19/2009
3	9/22-23/2009
4	10/20-21/2009
5	11/17/2009
6	1/19/2010
7	2/16/2010

Quality Control

All data collection will be conducted by experienced personnel. Consistency and completeness will be assured in all field procedures. Data entry and management systems are described by study discipline above. Data will be recorded on custom standard datasheets; datasheets will be checked for accuracy and completeness by someone other than the recorder. Data entry and management will use a Microsoft

Access Database, Excel spreadsheets or other project-specific system for data management. HDR will provide three levels of QA/QC, which are described below.

QC Level 1 Field QC

At the end of each field day the task manager will review the data collected that day and make any needed comments or note any deficiencies that need to be addressed. This review will be noted on each data sheet.

QC Level 2 Line by Line Review

After data has been entered and prior to analysis, all data will be checked for data entry errors and completeness. Any changes to the data relative to data sheets will be documented as will completion of QC Level 2.

QC Level 3 Data Anomalies

Data outliers or inconsistencies identified, typically during analysis, will be evaluated to determine if they are erroneous, the result of sample bias or caused by natural variability. All data anomalies will be handled on a case-by-case basis for inclusion in subsequent analyses.

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