Old Harbor Hydroelectric Fish Habitat and Spawning Survey Report

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Old Harbor Hydroelectric Project

Fisheries Introduction

Alaska Village Electric Cooperative (AVEC), the electric utility provider in Old Harbor, Alaska, with funding from the Alaska Energy Authority (AEA), is seeking to develop a hydroelectric resource near the community of Old Harbor on Kodiak Island. The project is needed to stabilize energy costs and to provide a long-term and sustainable energy source in the community.

Project Components

The proposed Old Harbor Hydroelectric Project consists of:

- An estimated dependable capacity of 130 kilowatts (kW). The peak installed-capacity will primarily depend on economics and the projected increase in demand. AVEC has chosen to permit the project with a peak capacity of 300 kW.
- A water intake area at the Mountain Creek tributary of Barling Bay Creek, including a 4-foot cutoff (diversion) wall that will not create any significant impoundment of water.
- An 8,900 feet (approximate) penstock.
- A single 300-kW Pelton turbine with a hydraulic capacity of 7 cubic feet per second (cfs) coupled directly to a 480-volt, 3-phase generator.
- A 600 square-foot (approximate) powerhouse at the turbine's tailrace.
- Water discharge from the tailrace into a lake, or channeled across the lowlands to a nearby stream with final discharge at Lagoon Creek.
- A 1.25-mile (approximate), 7.2 kV three-phase overhead power line.
- A 3-mile (approximate) access road.

AVEC is seeking a Federal Energy Regulatory Commission (FERC) Hydroelectric Project License under the Integrated Licensing Process (ILP). With substantial agency input, AVEC developed a Proposed and Revised Study Plan that describes the methodology for this and other field studies conducted for the project.

This study characterizes aquatic habitats and completes a spawning survey in Lagoon Creek, Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog No. 258-52-10015 (Lagoon Creek Tributary). It also determines presence/absence of anadromous fish in the Swimming Pond and two unnamed ponds north of the project area. The parameters of the study identify anadromous fish presence/absence, identifies specimens to species, qualitatively describe aquatic habitats, and establish baseline water quality data. The findings of this study will help determine potential impacts from the Old Harbor Hydroelectric Project (OHHE).

Existing Information

According to the State of Alaska Catalog of Anadromous Streams, Lagoon Creek (258-52-10015) and Lagoon Creek Tributary (258-52-10015-2004) support spawning Coho (*Oncorhynchus kisutch*), chum (*O. keta*), and pink (O. *gorbuscha)* salmon (ADF&G 2009). The National Marine Fisheries Service Essential Fish Habitat lists the areas identified above as Essential Habitat for all species of salmon. At the time of the field survey Lagoon Creek (258-

52-10015) is not listed as Section 303(d) impaired waterbodies by the State of Alaska (ADEC 2010).

Prior to this study, AVEC performed extensive studies of the fishery resources as part of the previous licensing process. The two areas of study were Mountain Creek and Lagoon Creek. Three reports were provided by AVEC's fisheries consultant, Lonnie White (White 1996, 1996a, 1998), pertaining specifically to assessment of resources and impacts in those two drainages. In the report by White (1998), the spring fed feeder streams with consistent flow, like the Lagoon Creek Tributary, attracted spawning salmon, whereas the streams that occasionally went dry, like the main branch of Lagoon Creek, were devoid of spawning salmon.

Project Area

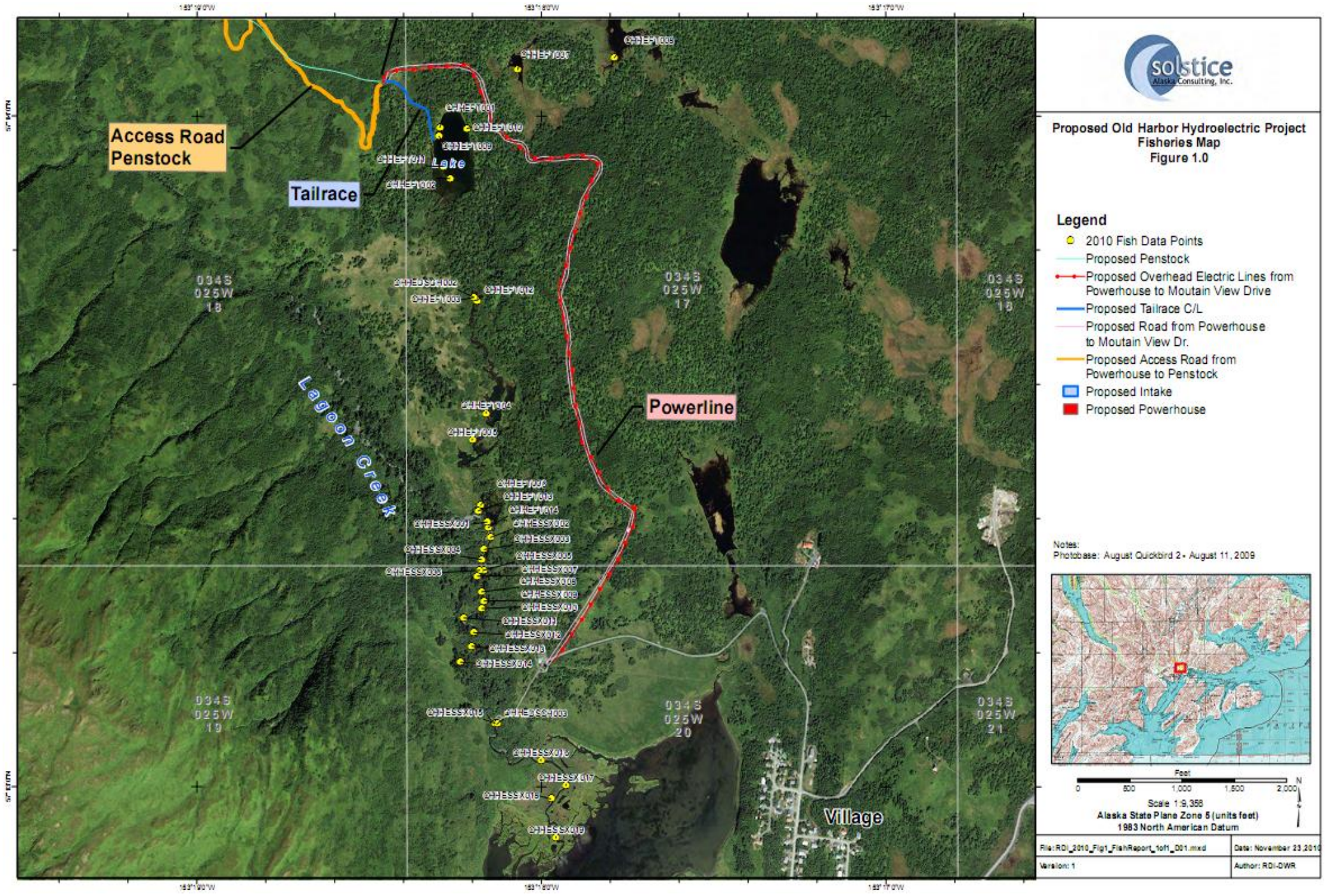
The waterbodies included in the presence/absence study were two ponds north of the study area in the Big Creek watershed, the waterbody known as the Swimming Pond, and Lagoon Creek (Figure 1). The fish habitat study was focused on the reach of Lagoon Creek from its inception south of the Swimming Pond to the mouth.

Methods

Analysis of Lagoon Creek included channel characteristics, baseline water quality data, and qualitative presents/absence surveys for anadromous fish through short term fish trapping and a spawning survey. Physical measures included stream discharge, channel width, average depth, substrate particle size, corrected velocity, stream feature type, in-stream woody debris (IWD), riparian vegetation, and estimated stream channel shade.

Water quality data was collected using a YSI 556 multiprobe and included temperature, DO%, DO mg/L, and pH when available. The YSI probe was completely submerged in the stream or pond and allowed to stabilize. Stabilization would typically take up to ten minutes. To avoid delay in project data collection the probe would often be turned on and placed in the water while other work was done in tandem. When possible the probe was allowed to remain on and in the water while moving to a new site. This allowed the probe to continue to take measurements and reduced stabilization times.

Twenty two cross sectional profiles were measured at locations along Lagoon Creek. Channel widths, depths, velocity (three cross sections), and feature type were measured on straight channel sections, at ordinary high water (vegetation line), and separated longitudinally by approximately 150 feet where practical.


Access Road
Penstock
Tailrace
Powerline
Lagoon Creek
Village
0348
025W
18
0348
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17
0348
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16
0348
025W
19
0348
025W
20
0348
025W
21
Proposed Old Harbor Hydroelectric Project
Fisheries Map
Figure 1.0
Legend
2010 Fish Data Points
Proposed Penstock
Proposed Overhead Electric Lines from Powerhouse to Moutain View Drive
Proposed Tailrace C/L
Proposed Road from Powerhouse to Moutain View Dr.
Proposed Access Road from Powerhouse to Penstock
Proposed Intake
Proposed Powerhouse
Notes:
Photobase: August Quickbird 2 - August 11, 2009
Feet
0
500
1,000
1,500
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N
Scale 1:9,358
Alaska State Plane Zone 5 (units feet)
1983 North American Datum
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Date: November 23,2010
Version: 1
Author: ROI-DWR

Discharge was measured at three locations on Lagoon Creek using cross sectional profiles. Depth and stream channel were measured and put into $1/10^{th}$ feet units. Velocity was measured at 0.8 and 0.2 depth with a Marsh McBirney Flowmate model 2000 (MMB). The Marsh McBirney is designed for low flow shallow systems as was characteristic in Lagoon Creek.

Three sites were preselected for taking discharge. The First, OHHEDSCH002, was near the headwaters of Lagoon Creek. The second discharge measurement, OHHEDSCH001, was in the middle section below the beaver dam. The third, OHHEDSCH003, was taken at the pump house close to the mouth of Lagoon Creek.

$$\text{Cross Sectional Area } (ft^2) * \text{Average Stream Velocity (ft/sec)} = \text{DSCH (cfs)}$$

Three other velocities were taken during the August field effort using timed surface observations. A predetermined distance of 50' or 25', depending on stream dynamics, was measured using a standardized tape. A floating object was then placed on the water surface and timed until it reached the end of the tape. This was repeated three times for each site. The velocity was then multiplied by a correction value to compensate for substrate. Correction values are 0.8 for coarse gravel and 0.9 for mud and sand.

$$\text{Velocity (ft/sec)} = (\text{Distance (ft)} / \text{Time}_{avg})*(\text{Correction Value})$$

In stream Woody Debris (IWD), substrate, riparian vegetation, and % shade were collected while traversing the stream channel between cross sectional data points. The presence/absence of adult spawning salmon was observed by visually surveying waterbodies and short-term fish trapping.

IWD was collected by tallying dead woody debris in the stream channel greater than 1" in diameter and > 1' in length. Substrate particle size was determined while traversing the stream by measuring a random sample at each new stream feature and at the cross sectional profiles with a standardized measuring stick. Substrate was categorized based on size in inches as silt (very fine), sand (.04-.08), gravel (.08-2.5), cobble (2.5-10.1), and boulder (10.1-80). Riparian vegetation and % shade were determined using ocular estimates of percent cover.

The fish trapping effort was a qualitative study and is not designed for nor implies population dynamics of any of the observed waterbodies. The fish trapping study was only a presence/absence study looking for juvenile anadromous fish species and no other measurements were taken on trapped specimens. Fish trapping was conducted upstream and downstream from the beaver dam on Lagoon Creek, in the Swimming Pond and at two ponds adjacent to the northern end of the project area in the Big Creek watershed. Fish were captured and removed from the waterbodies in minnow traps. Six traps were baited with commercially cured salmon roe and placed within slow moving pool habitats of Lagoon Creek, and off the shore in the remaining waterbodies. After all trapping sets were completed and given an adequate amount of time to soak; fish from each set were identified to species, counted, and returned to the stream or pond.

Spawning surveys for adult salmon were conducted in August and October 2010. In August we observed the entire length of Lagoon Creek from its inception south of the swimming pond to the mouth were it meets the brackish water of the estuary. In October, all but a small section of Lagoon Creek was surveyed due to increased bear activity. In each case, observers donned polarized glasses and traversed the shore and stream channel looking for the presence of adult salmon. Specifically, observers looked in deep water pools, riffles and along cut banks. If any adult salmon were observed estimated, number and species were recorded.

Results

The section of Lagoon Creek above the beaver damn (Figure 2) is a relatively short (< 0.5 mile), low energy low flow system categorized by low energy pools. The stream channel is not well defined in the upper section. The riparian vegetation is predominantly sedge meadow, blue joint herbaceous, and willow scrub shrub. The predominate substrate in the pools are typically organic mud, silt and sands. We did not observe, at any time, zero flow in the upper section of Lagoon Creek. The upper section becomes ponded as it approaches a large beaver damn mid section. It is obvious that the recent beaver activity mid section on Lagoon Creek is affecting the flow regime of the stream. Whether or not these effects are positive or negative to the spawning or rearing of anadromous fish cannot be determined at this time.

The section of Lagoon Creek below the beaver damn is a relatively short (< 0.5 mile), stable, low energy, meandering stream, categorized by pools and riffles. The predominate substrate in the riffles was medium gravels and cobble. Pools are typically silt and sands. We did not observe at any time zero flow on Lagoon Creek. However it is obvious that the recent beaver activity mid section on Lagoon Creek (Figure 3) is affecting the flow regime of the stream. Whether or not these effects are positive or negative to the spawning or rearing of anadromous fish cannot be determined at this time.

The average width of the Lagoon Creek is 26.5' and the average depth is 0.89'. Average velocity is 1.43 ft/sec (Table 1). IWD was abundant in the sections of stream where the riparian vegetation was predominately alder/willow/poplar (Figure 4) and low towards the mouth where riparian vegetation was predominately persistent herbaceous vegetation. Average shade cover followed the same tread as IWD in that it was higher in the upper sections where woody vegetation was the predominate riparian vegetation and lower towards the mouth. Average estimated shade was 33% with the highest shade being recorded in the midsection of the stream.

Figure 2: Headwaters of Lagoon Creek

Figure 3: Beaver Dam on Lagoon Creek

Figure 4: Typical Riparian Vegetation Middle Section Lagoon Creek

Table 1: OHHE Lagoon Creek Channel Measurements and Field Data

Sample Point	Date	GPS	Channel Width (ft)	Depth Average (ft)	Corrected Velocity (ft/sec)	Substrate	Stream Feature	In Stream Woody Debris > 1" Diameter	Riparian Veg	Est. Shade % Stream Cover
OHHESSX001	8/26/2010	N57 13.395 W153 18.15	13.20	0.47	1.37	Gravel/Cobble	Riffle	2	Alder/Willow	20
OHHESSX002	8/26/2010	N57 13.372 W153 18.14	73.80	0.43		Gravel/Cobble	Riffle	12	Alder/Willow	70
OHHESSX003	8/26/2010	N57 13.354 W153 18.16	29.40	0.60		Gravel/Sand	Pool	23	Alder/Willow	85
OHHESSX004	8/26/2010	N57 13.339 W153 18.17	24.70	0.89		Gravel/Cobble	Riffle	18	Alder/Willow	85
OHHESSX005	8/26/2010	N57 13.323 W153 18.16	21.00	0.88		Sand/Gravel	Run	34	Alder/Willow	85
OHHESSX006	8/26/2010	N57 13.323 W153 18.17	24.40	0.72		Gravel/Sand	Run	8	Alder/Willow	20
OHHESSX007	8/26/2010	N57 13.314 W153 18.18	26.30	1.50		Sand/Gravel	Pool	21	Alder/Willow	20
OHHESSX008	8/26/2010	N57 13.291 W153 18.17	25.20	1.20		Gravel/Sand	Pool	24	Poplar/Willow	35
OHHESSX009	8/26/2010	N57 13.277 W153 18.16	25.70	1.00		Gravel/Cobble	Riffle	12	Poplar/Willow	35
OHHESSX010	8/26/2010	N57 13.266 W153 18.17	36.00	0.50	1.85	Gravel/Cobble	Riffle	12	Poplar/Willow	20
OHHESSX011	8/26/2010	N57 13.252 W153 18.22	72.60	0.76		Gravel/Sand	Pool	15	Poplar/Willow	15
OHHESSX012	8/26/2010	N57 13.230 W153 18.19	22.90	0.77		Gravel	Run	26	Poplar/Willow	15
OHHESSX013	8/26/2010	N57 13.210 W153 18.20	24.30	0.68	3.15	Gravel	Riffle	30	Poplar/Willow	40
OHHESSX014	8/26/2010	N57 13.186 W153 18.23	25.20	0.83		Cobble/Gravel	Riffle	24	Poplar/Willow	50
OHHESSX015	8/26/2010	N57 13.095 W153 18.13	28.90	1.90		Sand/Gravel	Pool	10	Poplar/Willow	40
OHHESSX016	8/26/2010	N57 13.039 W153 18.00	21.70	0.83	0.71	Sand/Gravel	Pool	8	Persistent Emergent	<10
OHHESSX017	8/26/2010	N57 13.002 W153 17.92	20.10	0.86		Gravel	Run	3	Persistent Emergent	<10
OHHESSX018	8/26/2010	N57 12.982 W153 17.97	17.80	0.47		Gravel	Riffle	0	Persistent Emergent	<10
OHHESSX019	8/26/2010	N57 12.924 W153 17.95	26.70	2.60		Gravel/Sand	Pool	2	Persistent Emergent	<10
OHHE DSCH001	10/15/2010	N5713'43.8"W15318'11.8	8.80	0.28	1.29	Gravel	Riffle		Alder/Willow	20
OHHE DSCH002	10/16/2010	N5713'43.8"W15318'11.	14.30	0.31	0.06	Silt/Sand	Pool		Willow	15
OHHE DSCH003	10/16/2010	N5713'05.6"W15318'07.8	28.60	1.08	0.17	Sand/Gravel	Run		Willow	10
		Average	26.50	0.89	1.43					

Discharge measurements were taken at three locations along Lagoon Creek (Figure 5). The discharge near the inception of Lagoon Creek, OHHE DSCH002, was low (Table 2). Based on our field observations it appears that this area is a ground water discharge zone. The hydrodynamics of the stream near the inception are thought to be primarily groundwater derived but would also include sheet flow and precipitation inputs. Lagoon Creek is thought to be a perennial stream even though low flows were observed in the beginning stretches.

Figure 5: Discharge Being Collected Near the Headwaters of Lagoon Creek

The second discharge measurement was taken below the beaver dam mid section of the stream (Figure 6). Discharge was greater at this location. The influence of the beaver dam and the storage capacity of the subsequent pond cannot be determined at this time. The third and final discharge measurement was taken at the pump house near the mouth of Lagoon Creek (Figure 7). This location is below any tributaries to Lagoon Creek and as a result the discharge near the mouth is approximately double that of the mid section reaches of the stream (Table 2).

Figure 6: Discharge Being Taken Downstream of the Beaver Dam Middle Section Lagoon Creek

Figure 7: Discharge Being Taken at the Pump House Lower Section Lagoon Creek

Table 2: OHHE Lagoon Creek Discharge Measurements

Sample Point	GPS	Stream Width (ft)	Depth Average (ft)	Cross Sectional Area (ft^2)	Velocity Average (ft/sec)	DSCH (ft^3/sec)
OHHE DSCH002	N57 13'43.8" W153 18' 11.8"	14.3	0.3125	4.46875	0.06125	0.273711
OHHE DSCH001	N57 13'21.3" W153 18' 10.2"	8.8	0.28125	2.475	1.285	3.180375
OHHE DSCH003	N57 13'05.6" W153 18' 07.8"	28.6	1.08125	30.92375	0.171363636	5.299206

Baseline water quality data was taken during the October field trip at each fish trap site and discharge site for a total of 10 data sets. The baseline data was recorded in a field data book and followed the protocol outlined above. Over all trends were similar among sample sites and among the different water bodies (Figure 3). We were not able to collect pH at each site due to low water temperatures affecting the YSI meter and the two that were recorded appear low and should not be considered as definite. Temperature and DO indicate suitable conditions for rearing salmon. Even in low energy water with shallow depths <1' DO and temperature remained adequate.

Figure 3: OHHE Baseline Water Quality Data

Location	Water Body	Date	Temp	DO%	DO mg/L	pH	Adults Spawning Observed
Beaver Pond	Lagoon Creek	10/15/2010	4.42	84.6	10.82		N
OHHEDSCH 001	Lagoon Creek	10/15/2010	5.00	87.0	11.10		N
OHHEFT009	Swimming Pond	10/16/2010	4.99	95.5	12.18		N
OHHEFT010	Swimming Pond	10/16/2010	5.03	90.6	11.52		N
OHHEFT011	Swimming Pond	10/16/2010	4.99	93.5	12.02		N
OHHEFT012	Lagoon Creek	10/16/2010	4.27	89.7	11.70		N
OHHEFT013	Lagoon Creek	10/16/2010	4.71	77.5	9.97		N
OHHEFT014	Lagoon Creek	10/16/2010	4.72	87.9	11.29		N
OHHE DSCH003	Lagoon Creek	10/16/2010	5.52	88.7	11.18	6.15	N
OHHEWQ001	Lagoon Creek	10/16/2010	5.63	89.9	11.29	6.12	N
		Average	4.93	88.5	11.31	6.14	

Fish trapping took place during the August and October field efforts. The purpose of the fish trap study was to determine presence/absence of anadromous fish. No other physical measurements were collected on the trapped specimens and no assumption of population dynamics should be inferred. Lagoon Creek and its tributary were previously cataloged as anadromous by ADF&G. The Swimming Pond and the two ponds north of the project area (Figure 8) were not cataloged as anadromous waters as of the date of the study. Our fish trapping results show that the entire stretch of Lagoon creek, from its inception to the mouth, is anadromous (Table 4). The two ponds north of the project area, in the Big Creek watershed, were also found to be supporting anadromous fish. The Swimming Pond was not found to be supporting anadromous fish.

Figure8: Fish Trapping on the Northern Pond in the Big Creek Watershed

Figure9: Identifying Specimens at the OHHEFT013 on Lagoon Creek.

Spawning surveys were conducted during the August and October field efforts. Field biologist traversed the entire length of Lagoon Creek in an effort to visually identify spawning anadromous fish. Presence/absence of adult spawning salmon was also noted while observing the Swimming Pond. No active adult spawning salmon were observed in Lagoon Creek or the Swimming Pond. Remains of adult salmon were observed within 400' of the mouth, along the shore of Lagoon Creek. The remains were highly decomposed and hard to identify due to bears feeding on the carcasses. Left intact were primarily jaw and gill plate structures and appeared to be chum salmon. An estimated 150 carcasses were observed near the mouth. No actively spawning salmon were observed in the stream near the mouth. No other carcasses were observed on any other stretches of Lagoon Creek, the Beaver Pond or the Swimming Pond.

Table 4: OHHE Anadromous Fish Survey

Trap	Date Set	Date Pulled	GPS	Time Set	Time Pulled	Depth (ft)	Species*	Adults Spawning Observed
OHHEFT001	8/26/2010	8/26/2010	N57 13.983 W153 18.296	0851	1505	3	26 Sb	N
OHHEFT002	8/26/2010	8/26/2010	N57 13.907 W153 18.266	0857	1512	4	32 Sb	N
OHHEFT003	8/26/2010	8/26/2010	N57 13.730 W153 18.197	0922	1522	2.5	10 Co	N
OHHEFT004	8/26/2010	8/26/2010	N57 13.557 W153 18.161	0952	1537	4.5	31 Co	N
OHHEFT005	8/26/2010	8/26/2010	N57 13.517 W153 18.201	1002	1541	3	37 Co, 6 Dv	N
OHHEFT006	8/26/2010	8/26/2010	N57 13.420 W153 18.177	1022	1557	4.5	18 Co,23 Dv	N
OHHEFT007	8/27/2010	8/27/2010	N57 14.069 W153 18.069	0852	1659	3	2 Co, 1 Dv	N
OHHEFT008	8/27/2010	8/27/2010	N57 14.087 W153 17.789	0923	1712	3	14 Co, 5 Dv, 10 Sb	N
OHHEFT009	10/15/2010	10/16/2010	N57 13' 58.2" W153 18' 17.9"	1301	0958	4	14 Sb, 1 Dv	N
OHHEFT010	10/15/2010	10/16/2010	N57 13' 58.9" W153 18' 13.0"	1310	1005	1	16 Sb	N
OHHEFT011	10/15/2010	10/16/2010	N57 13' 55.5" W153 18' 17.2"	1316	1015	2	19 Sb	N
OHHEFT012	10/15/2010	10/16/2010	N57 13' 43.5" W153 18' 11.3"	1348	1037	3.5	0	N
OHHEFT013	10/15/2010	10/16/2010	N57 13' 24.7" W153 18' 11.0"	1439	1107	2	38 Co, 1 Dv	N
OHHEFT014	10/15/2010	10/16/2010	N57 13' 23.2" W153 18' 09.3"	1442	1126	2	28 Co, 6 Dv	N

*Key: Sb= Stickle Back, Co = Coho, Dv = Dolly Varden

Conclusion

The purpose of this study was to collect baseline data which will be use by agency personnel in determining mitigation of impacts from the OHHE project. This study is limited in that it does not have the benefit of long term observations such as trends in flow regime, depth, and water chemistry.

Two conclusions can be drawn from this study based on the information that was collected. The Lagoon Creek system is productive rearing habitat for Coho salmon and changes in the current flow regime may affect the system's ability to retain its unique habitat structure. Second, our investigation showed that the Swimming Pond is not supporting anadromous fish and that it does not appear there is a significant surface water nexus between it and Lagoon Creek. It would be expected that if there were a significant surface water nexus, at anytime during the year, juvenile Coho would be present in the Swimming Pond.

The southern end of the Swimming Pond has what appears to be an intermittent outlet (Figure 10); however the outlet is not well understood. It is unclear if this intermittent outlet makes a surface water connection between Lagoon Creek and the Swimming Pond during periods of high precipitation and spring runoff.

Figure 10: Intermittent Outlet Channel on Southern End of the Swimming Pond. Red Line Indicates Intermittent Channel.

Looking at historical aerial photography (Figure 1) one can see the Swimming Pond floods during the spring. Even with the appearance of an intermittent outlet the overflow discharge from the Swimming Pond appears to drain to the Southwest and does not make the connection to Lagoon Creek. Conversely, the close proximity of the two waterbodies and the evident drawdown of the Swimming Pond each summer cannot be ignored. It is thought, based on our observations, that the connection between the two waterbodies is through ground water. However this conclusion is made based on limited surface observations.

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