Final Grant Lake Project Natural Resource Study Report Meeting Minutes

(March 18-20, 2014)

Grant Lake Hydroelectric Project (FERC No. 13212)
Natural Resources Work Group (NRWG) Meeting
Aspen Suites Hotel, 100 E. Tudor Rd., Anchorage, AK
March 18, 2014, 8:00 am to 5:30 pm

In Attendance

Dwayne Adams, USKH
Amal Ajmi, ERM
Emily Andersen, McMillen LLC (McMillen)
Katy Beck, Beck Botanicals
John Eavis, U.S. Forest Service (USFS) *[via phone]*
Kim Graham, USKH
Jessica Ilse, USFS *[via phone]*
Joe Klein, Alaska Department of Fish and Game (ADF&G) *[via phone]*
Kevin Laves, USFS *[via phone]*
Katie McCafferty, Army Corps of Engineers (USACE)
Mort McMillen, McMillen
Monte Miller, ADF&G
Jason Mouw, ADF&G
Paul Pittman, Element Solutions
Eric Rothwell, National Oceanic and Atmospheric Administration (NOAA Fisheries) *[via phone in afternoon]*
Mike Salzetti, Kenai Hydro, LLC (KHL)
Charles Sauvageau, McMillen
Lesli Schick, Alaska Department of Natural Resources (ADNR) *[morning only]*
Levia Shoutis, ERM
Robert Stovall, USFS *[via phone]*
Cassie Thomas, National Park Service (NPS)
Kelly Tilford, McMillen
Cory Warnock, McMillen

Meeting Summary

Introductions and Agenda

Mike Salzetti (KHL) began the meeting with introductions and Cory Warnock (McMillen) reviewed the proposed meeting agenda (see Attachment 1):

- Engineering Feasibility
- Terrestrial Resources
- Water Resources
- Recreation and Visual Resources
- Licensing Path Forward

Cory noted that all materials from the meeting (agenda and presentations) will be posted to the Grant Lake Hydroelectric Project (Project) website (http://www.kenaihydro.com/index.php) after the meeting.

Engineering Feasibility

Mort McMillen (McMillen) presented the engineering feasibility work done to date (see PowerPoint included as Attachment 2).

- *Comment:* With respect to the map showing proposed Project infrastructure (*Slide 6*[1]), Cassie Thomas (NPS) asked if the detention pond is a new feature.

[1] For all PowerPoint presentations given during the meeting, slide numbers refer to the PDF page number.

- *Response:* Mike Salzetti (KHL) stated that the pond was part of the modified Project proposal in 2010. The intent of the pond is to provide spinning reserve to the power system (in the event of a disruption to the power supply).

- *Comment:* With respect to the hydrologic characteristics of the Project (*Slide 13)*, Monte Miller (ADF&G) asked whether the values were correlated with the Trail River USGS stream gauge.
- *Response:* Mort responded that they were.

- *Comment:* Eric Rothwell (NOAA Fisheries) asked if the flow duration values (*Slide 14)* were based on actual flow discharge measurements for a complete calendar year.
- *Response:* Mort responded that they were.

- *Comment:* With respect to the conclusions of the Project's hydrologic review (*Slide 18)*, Eric Rothwell asked if there is any concern about the accuracy of the 20% exceedance flow (the target flow for the beginning of analyzing powerhouse sizing,) given that it is based on a relatively short record (1948-1958).
- *Response:* Mort indicated that the analysis will be run with the 20% exceedance value "bumped" up/down on each side.

- *Comment:* With respect to the discussion of the HECRAS model (*Slide 20*), Eric Rothwell noted that at the study plan meeting (December 12, 2012), the methodology for evaluating operational impacts downstream of the Project was unknown, and asked if that is better understood now.
- *Response:* Mort replied that hydraulic impacts can be evaluated using the HECRAS model, and impacts to other factors, like water temperature, would be discussed during the respective resource presentation.

- *Comment:* During the discussion of the HECRAS model calibration (*Slide* 22), Monte Miller noted that the Instream Flow Incremental Methodology (IFIM) cross sections were defined by fish presence, but the preferred methodology is to tie the cross sections to fish habitat and asked whether that is of concern for the hydraulic analysis.
- *Response:* Mort responded that they are not currently working on water surface area calculations, but rather, trying to establish the rating curve. That said, for the final analysis, the HECRAS model will be updated with the bathymetry and topographic data that will be collected in summer 2014.

- *Comment:* With respect to the geotechnical update (*Slide 28*), Monte Miller asked whether the tunnel will be bored or blasted.
- *Response:* Mort indicated that it would be blasted.

- *Comment:* As part of the operational model demonstration (*Slide 33*), Eric Rothwell asked if the HECRAS model is ready to run IFIM constraints.
- *Response:* Mort indicated that the model is at a point of being fully functional and ready to start running scenarios.

- *Comment:* With respect to the engineering schedule (*Slide 35)*, Monte Miller asked about the timing for issuing the Draft License Application (DLA) for stakeholder comment.
- *Response:* Cory Warnock (McMillen) indicated that KHL is targeting end of 2014/early 2015.

  Katie McCafferty (USACE) asked if that would be the same timing as submittal of the Section 404 application to USACE, to which, Cory replied yes.

  Cory asked that if there is other staff within a resource agency that should be reviewing the engineering deliverables, to provide him the contact information.

- *Comment:* Cassie Thomas stated that understanding that the HECRAS model is still under development, what are the preliminary thought regarding the degree of Grant Lake elevation fluctuation during Project operations.
- *Response:* Mort indicated that the current target is 11 feet without a dam, and 13 feet with one.

Terrestrial Resources Study Results

Levia Shoutis (ERM) presented an overview of the terrestrial resources studies (see PowerPoint included as Attachment 3, *Slides 1-6*).

Katy Beck (Beck Botanicals) presented the vegetation, sensitive plant, and invasive plant components of the terrestrial resources study results (see PowerPoint included as Attachment 3, *Slides 7-41)*.

- *Comment:* With respect to the discussion of potential qualitative impacts on vegetation (*Slide 21*), Cassie Thomas (NPS) asked whether there is vulnerability due to wind throw.
- *Response:* Katy Beck replied yes, but no more than other areas of the Kenai Peninsula.

- *Comment:* With respect to the discussion of next steps for the vegetation and sensitive/invasive plant components (*Slide 40*), Cassie Thomas (NPS) noted that she could envision a scenario where the Project is operating on/off in the fall when ice is developing, potentially resulting in scouring downstream.
- *Response:* Mort noted that the engineers will run the HECRAS model taking into consideration the “shoulder” seasons (i.e., ice formation in the fall and ice melt in the spring), with an intake and without (i.e., the natural outlet), and provide that output to the natural resource leads for impacts analysis.

- *Comment:* Monte Miller (ADF&G) noted that based on the engineering presentation, normal pool elevation of Grant Lake is ±2 feet of natural pool elevation (i.e., 703 feet) and asked what, if anything, would be the impacts to plants with a 13-foot elevation fluctuation.
- *Response:* Katy Beck replied that the plants can already withstand some inundation given the natural fluctuation of approximately 7 feet.

- *Comment:* Robert Stovall (USFS) noted that relative to development of management plans (*Slide 40*), KHL would want to consult with Betty Charnon (USFS).
- *Response:* Katy Beck agreed and noted that she has been in contact with Betty already during the study phase.

Levia Shoutis presented the wetlands component of the terrestrial resources study results (see PowerPoint included as Attachment 3, *Slides 42-67)*.

- *Comment:* Katie McCafferty clarified that the study area for the wetlands component (*Slide 44*) went to elevation 705 feet, which is the entire area of lake if dam in place (i.e., +2 feet of natural pool elevation, i.e., 703 feet).
- *Response:* Levia replied yes, and noted that the study plan had indicated up to 703 feet.

- *Comment:* Katie McCafferty asked the percentage of wetlands within the wetland/non-wetland mosaic areas on the south side of Grant Creek (*Slide 60*).
- *Response:* Levia replied 20%.

- *Comment:* Katie McCafferty indicated that the 15 functional classes were established as part of the functional assessment of all "waters" within the study area (e.g. Trail Lakes Narrows) (*Slide 62*) and asked if any specific wetlands appeared to exhibit human disturbance.
- *Response:* Levia replied no.

- *Comment:* Katie McCafferty stated that the wetland analysis should include a functional assessment of Grant Creek and Grant Lake and the streams associated thereof.
- *Response:* Levia clarified that such an analysis had not yet been conducted. Cory Warnock (McMillen) requested that Katie include the request with informal written comments and suggested that Katie and Levia further discuss details about such an analysis following the meeting.

- *Comment:* Cassie Thomas asked about the scope of the wetlands study area relative to the proposed Iditarod National Historic Trail (INHT) re-alignment and whether any wetlands impacts are associated with that effort.
- *Response:* Levia indicated that they briefly looked at this, and did not believe that the INHT crossed any wetlands, but could confirm during the recreation and visual resources presentation.

Amal Ajmi (ERM) presented the wildlife components of the terrestrial resources study results (see PowerPoint included as Attachment 3, *Slides 68-104)*.

- *Comment:* Cassie Thomas noted that with the short-term construction activity and long-term increased public access that could result from the Project, there is the potential for increased hunting.
- *Response:* Cory acknowledged the comment and indicated that public access would be further discussed during the recreation and visual resources presentation and that cross resource issues would be discussed at the end of the day.

<<LUNCH BREAK>>

Water Resources Study Results

Chuck Sauvageau (McMillen) presented the water quality and hydrology components of the water resources study results (see PowerPoint included as Attachment 4).

- *Comment:* Monte Miller (ADF&G) stated that the questionable 2009 dissolved oxygen data due to potentially faulty equipment (see *Slide 6)*, maybe does not belong in the data set at all.
- *Response:* Chuck acknowledged comment.

- *Comment:* Monte Miller noted that on the graph showing water temperature results in Grant Creek in 2014 (*Slide 10*), there was an apparent dip in April to near 0 ºC at all but the GC 600 station and asked if a thermistor was out of the water. *Response:* Chuck responded that they are certain all thermistors remained in the water because they weighted the thermistor housings to insure they remained on the bottom of the channel.
- *Comment:* With respect to the water temperature results for the Grant Creek off-channel areas (*Slide 12*), Monte Miller recalled that during the September 2013 Project site visit the crossing at the Reach 2 backwater area ("moose pond") was at the shallowest 2.5-3 feet deep, and asked whether backwater into the off-channel from the creek could impact the water temperatures.
- *Response:* Chuck responded that groundwater seeps on the adjacent hillside and hyporheic flow are what fill the pond. The main channel of Grant Creek flowing past the moose pond outlet controls the depth of the back water with minimal main channel infiltration. No impact.

- *Comment:* Relative to water temperature study conclusions (*Slide 20*), Monte Miller asked whether the mixing period in Grant Lake was determined.
- *Response:* Chuck replied that the mixing period was not looked at, but believes it to occur early to mid-September.

- *Comment:* With respect to the re-established U.S. Geological Survey (USGS) gaging station (*Slide 21)*, Monte Miller asked if measurements were taken in Grant Lake to correlate to the collected gage data in order to determine whether there is accretion.
- *Response:* Chuck responded no.

- *Comment:* With respect to the historic and 2013 hydrology results (*Slide 24)*, Monte Miller noted that it appears that one year of data (2013) potentially shows the extremes, whereas the historic record (1948-1958) shows the average over time.
- *Response:* Chuck agreed with the comment.

- *Comment:* Relative to the accretion study results (*Slide 25)*, Monte Miller commented that there is an apparent accretion rate of 0.2 cfs.

- *Response:* Chuck concurred, saying that, in other words, a difference due to measurement error. Cassie Thomas (NPS) asked whether they considered measuring flows in the fall when ground is not frozen to confirm the conclusion. Chuck replied that the fall flows (200 cfs) become too hazardous for trying to acquire the data and at these higher flow volumes it would be difficult to accurately quantify small flow differences within the canyon reach of Grant Creek. Monte commented that accretion will become a factor, if Project operations remove water from Grant Creek.

Paul Pittman (Element Solutions) presented the geomorphology component of the water resources study results (see PowerPoint included as Attachment 5).

- *Comment:* Relative to the observations of the Grant Creek sediment transport (*Slide 19*, Eric Rothwell (NOAA Fisheries) asked whether the sediment deposition also demonstrated spawning in isolated pockets behind "lunkers".
- *Response:* Paul responded yes.

- *Comment:* With respect to potential mitigation actions (*Slide 24*), Eric Rothwell asked if that could involve gravel augmentation.
- *Response:* Paul responded yes.

- *Comment:* Cassie Thomas (NPS) asked when the southeast corner of Grant Creek was diverted, and whether the diversion could have created a sediment source.
- *Response:* Paul indicated that based on the existing vegetation, the diversion likely occurred from decades, up to a century ago, and that it is not believed to be a source of sediment.

Recreation and Visual Resources Study Results

Dwayne Adams (USKH) presented the recreation and visual resources study results (see PowerPoint included as Attachment 6).

- *Comment:* Relative to the discussion of the study's scope of work (*Slide 4)*, Cassie Thomas (NPS) asked if field staff of other resource studies documented observations of recreational use.
- *Response:* Dwayne replied that the aquatics staff, who was on site for the entire study period, emailed him details regarding fishing activity, which was mostly during the summer.

- *Comment:* With respect to the dates of study site visits (*Slide 5)*, Cassie Thomas noted that March 3 and July 12 were weekends (Saturday and Friday, respectively), and asked if there appeared to be more recreational activity then versus a week day.
- *Response:* Kim Graham (USKH) concurred.

- *Comment:* Monte Miller (ADF&G) asked if there was concern with having only one summer site visit.

- *Response:* Dwayne clarified that there were two summer visits (July 12 survey and August 25 aircraft flight). Monte noted that those dates would not fall on the angling season though. Dwayne said that they primarily relied on the aquatics field staff for that information.

- *Comment:* When reviewing the potential Project impacts to the recreation and visual resources (*Slide 12)*, specifically the possible increase of access, Cassie Thomas asked if KHL has considered gating the primary proposed access road.
- *Response:* Cory Warnock (McMillen) indicated that specific to access, KHL has made no decision and is open to considering all potential options, including gating of the access road. Mike Salzetti (KHL) added that KHL will want to take into account the various resource agencies' needs as they relate to their respective land management goals and objectives. Cassie recommended that the process for determining the solution for access be collaborative and that it include the public. Cory and Mike agreed with both suggestions.

Dwayne indicated that if there are additional information needs relative to winter recreation that it would be good to understand now, in order to try to coordinate data gathering with USKH's existing plan to survey supplemental areas soon. John Eavis (USFS) commented that two days of recreational use survey work is insufficient and suggested installing trail cameras to collect additional data in order to justify the existing conclusions regarding recreation use. John also indicated that information on the ice condition for winter motor use on Grant Lake would be useful. In general, Cassie Thomas replied that it would be good to understand the competing recreational needs of various agencies/groups. Cory suggested a call to discuss additional recreation information needs. Individuals identified as potential participants included, Cassie Thomas, Robert Stovall (USFS), John Eavis, and Lesli Schick (ADNR).

Licensing Path Forward/Closing

Cory Warnock (McMillen) stated that KHL welcomes informal written comments on the draft study reports, and requests that they be provided by Friday, April 25, at which point, KHL will work to finalize the reports and file them, along with the meeting notes, with the Federal Energy Regulatory Commission (FERC). Cassie Thomas (NPS) noted that she will be traveling most of the next four weeks but will try to provide the minor comments that she has by the deadline. Robert Stovall (USFS) noted that he has asked his staff to provide him comments on the relevant study reports by April 25. Monte noted that despite the internal glitch with ADF&G being able to receive the draft study reports electronically, he should be able to meet that deadline.

Mike Salzetti (KHL) stated that KHL's primary objectives over the next few months are to continue with the momentum gained from the engineering progress made thus far, and to start to integrate operational scenarios across the various resource disciplines. Cory noted that consistent with the engineering schedule, which has a number of deliverables due by May, KHL anticipates holding the next agency meeting in the June/July timeframe, with the primary focus being on 1) progress made with the operations modeling; 2) outstanding significant resource issues; and 3) exploring potential options for addressing Project impacts. Cassie suggested a more collaborative, "workshop" format for the June/July meeting, rather than presentations.

Cory indicated that except for maybe the need to present engineering information, that is what KHL envisions as well. Monte stated that ADF&G recognizes that the licensing process is transitioning from the studies to license application development.

<<ADJOURN 4:00PM>>

Action Items

- If there is other staff within a resource agency that should be reviewing engineering deliverables, **resource agency representatives** to provide Cory Warnock (McMillen) the contact information.
- **Levia Shoutis (ERM) and Katie McCafferty (USACE)** to coordinate on a functional assessment for Grant Creek, Grant Lake, and the associated streams thereof.
- **KHL** to schedule a call to discuss additional recreation information needs.
- **Stakeholders** to provide informal comments on the draft study reports by Friday, April 25.

Attachments

Attachments are available on the March 18-20, 2014 Natural Resources Study Report Meetings page at www.kenaihydro.com.

Attachment 1: Meeting Agenda
Attachment 2: Grant Lake Engineering Feasibility PowerPoint presentation
Attachment 3: Terrestrial Resources Study Results PowerPoint presentation
Attachment 4: Water Resources, Water Quality and Hydrology Study Results PowerPoint presentation
Attachment 5: Water Resources, Geomorphology Study Results presentation
Attachment 6: Recreation and Visual Resources Study Results PowerPoint presentation

Grant Lake Hydroelectric Project (FERC No. 13212)
Aquatic Resources Work Group (ARWG) Meeting
Aspen Suites Hotel, 100 E. Tudor Rd., Anchorage, AK
March 19, 2014, 8:00 am to 5:00 pm

In Attendance

Emily Andersen, McMillen LLC (McMillen)
Jeff Anderson, U.S. Fish and Wildlife Service (USFWS) *[via phone]*
Patti Berkhahn, Alaska Department of Fish and Game (ADF&G) *[via phone]*
John Blum, McMillen
Gary Fandrei, Cook Inlet Aquaculture Association (CIAA) *[via phone]*
Kevin Laves, USFS *[via phone]*
Katie McCafferty, Army Corps of Engineers (USACE)
Mark Miller, BioAnalysts (BA) *[via phone]*
Monte Miller, Alaska Department of Fish and Game (ADF&G)
Sally Morsell, Northern Ecological Services (NES) *[via phone]*
Jason Mouw, ADF&G
Carl Reese, ADNR *[via phone]*
Eric Rothwell, National Oceanic and Atmospheric Administration (NOAA Fisheries)
Mike Salzetti, Kenai Hydro, LLC (KHL)
Charles Sauvageau, McMillen
John Stevenson, BA
Kelly Tilford, McMillen
Cory Warnock, McMillen

Meeting Summary

Introductions and Agenda

Mike Salzetti (KHL) began the meeting with introductions and Cory Warnock (McMillen) reviewed the proposed meeting agenda (see Attachment 1):

- Engineering Feasibility
- Aquatic Resources, Macroinvertebrates and Periphyton
- Aquatic Resources, Fisheries Assessment
- Licensing Path Forward

Cory noted that all materials from the meeting (agenda and presentations) will be posted to the Grant Lake Hydroelectric Project (Project) website (http://www.kenaihydro.com/index.php) after the meeting.

Engineering Feasibility

Kelly Tilford presented the engineering feasibility work done to date (see PowerPoint included as Attachment 2).

- *Comment:* With respect to the discussion of flood water surface elevations (*Slide 26*[1]), Eric Rothwell (NOAA Fisheries) asked whether the flow of record is observed or an extrapolation.

[1] For all PowerPoint presentations given during the meeting, slide numbers refer to the PDF page number.

- *Response:* Kelly responded (and Chuck Sauvageau confirmed) that it was not preferable to extrapolate flow readings above 1,000 cfs since the highest measured discharge value was ~700 cfs. Therefore, HECRAS modeling output was utilized.

- *Comment:* Jason Mouw (ADF&G) expressed two concerns with the proposed detention pond (shown on *Slide 6*), 1) temperature control impacts (heating up in summer and freezing of the pond in the winter); and 2) temperature issues with potential flow back into Grant Creek.
- *Response:* Kelly noted that the detention pond is intended to absorb discharge during high, pulse flows. It is anticipated that there would be flow through under the ice cover. Mike Salzetti (KHL) added that the initial purpose of the pond was to provide spinning reserve for the power system (in the event of a disruption to the power supply), but now integrating in the environmental impacts, could possibly also serve as a temperature control (e.g., install a bubbler to draw in cold winter air). Cory stated that the plan is to provide refined details about the Project infrastructure at the next agency meeting (in the June/July timeframe).

- *Comment:* Katie McCafferty (USACE) stated that now having heard the wetlands discussion (at the March 18 Natural Resources Work Group [NRWG] meeting), she can see that the location of the detention pond is in close proximity to an identified patch of wetlands and asked if more details about the detention pond are known yet (i.e., will there be an outfall pipe or natural drainage, is the wetlands connected to Grant Creek, will the pond be lined).
- *Response:* Kelly said the details about the pond have yet to be determined. Cory Warnock (McMillen) suggested conferring with Levia Shoutis (ERM) regarding the connectivity of the relevant wetlands to Grant Creek.

- *Comment:* Monte Miller commented that the tailrace outfall could attract upstream migrating fish from Grant Creek, which should be taken into account with the design of the outfall.
- *Response:* Cory indicated that there have been preliminary internal discussions about the outfall design. The preference would be to not use any screens, but no decisions have been made thus far. Mike Salzetti added that one option is an elevated outfall. Mike also noted that KHL has been in discussions with the Kenai Peninsula Borough about this topic relative to their Anadromous Fish Habitat Protection ordinance. Monte stated that the potential for back flow into the Project outflow during extreme flow events should be considered relative to the design. Kelly replied that the tunnel would designed to be hydraulically isolated for a 100-year flood event.

- *Comment:* Relative to the discussion of the current potential scenarios for the Project layout *(Slide 7)*, Monte Miller (ADF&G) asked how a lake tap would work if water needed to be drawn from different levels based on the temperature discussion from the water resources presentation at the March 18 NRWG meeting.
- *Response:* Kelly replied that if necessary, the structure could include a multi-variable level intake system.

- *Comment:* Eric Rothwell asked what the active storage capacity of the Project would be.
- *Response:* Mike Salzetti replied that he did not know the estimate off hand, but it should be available in the 2010 revised Project description *[the value was later confirmed during the meeting to be 15,900 acre-feet with the no dam alternative (between elevation 692 and 703 feet)]*.

Aquatic Resources Study Results, Macroinvertebrates/Periphyton

Chuck Sauvageau (McMillen) presented the macroinvertebrate and periphyton study results (see PowerPoint included as Attachment 3*)*, and pointed out that Sally Morsell from Northern Ecological Services (NES), who conducted the study, is on the phone to answer questions.

- *Comment:* Monte Miller (ADF&G) asked if the notable fewer Chironomidae in 2009 at GC300 relative to other samples (*Slide 10*) could have been due to weather conditions in that year that may have resulted in fewer flies/mosquitoes.
- *Response:* Sally indicated that they tried to assess whether the relatively low numbers were due to an environmental cause or sampling conditions, but could not definitively conclude either way. She noted that in general, it is challenging to sample in the Project area. Flows in 2009 were comparable to those in other sampling periods; however, how comfortable an individual technician was to wade out into Grant Creek where Chironomidae prefer to over winter may have been a factor.

- *Comment:* Relative to comparing the Grant Creek data with other streams in Cook Inlet (*Slide 18)*, Monte Miller asked whether stream gradient, which can impact various population density and taxa richness metrics, was taken into account.
- *Response*: Sally stated that some Alaska Stream Condition Index (ASCI) data was available from the Kenai for high gradient streams such as Grant Creek. Grant Creek habitat scored low, however the best use of the Grant Creek baseline data is for comparison to future conditions in Grant Creek.

- *Comment:* Monte Miller stated, relative to differences seen in density and taxa numbers between GC100 and GC 300, generally density and taxa numbers increase as one moves downstream and so GC100 would likely be a better monitoring location.
- *Response:* Sally responded yes, that was a reasonable conclusion given the results to date.

- *Comment:* Jason Mouw (ADF&G) asked if individual species by sample are detailed in the report.
- *Response:* Sally responded yes, that raw data tables are provided in a report appendix.

Aquatic Resources Study Results, Fisheries Assessment

John Stevenson (BioAnalysts) presented the fisheries assessment results (see PowerPoint included as Attachment 4*)*.

- *Comment:* Monte Miller (ADF&G) commented that it was unfortunate the incline plane design (i.e., 1/4" mesh; *Slide 9*) did not allow for capturing of smaller fish.
- *Response:* John S. agreed. Monte added that it was unfortunate that the upper incline plane malfunctioned (*Slides 9 and 39*). John S. clarified that the incline plane did not malfunction, but rather, had to be shut down intermittently due to high flows and debris and not having a suitable alternate location to move it to during these events.

- *Comment:* With respect to the discussion of potential impacts, specific to juvenile rearing habitat (*Slide 63)*, Eric Rothwell (NOAA Fisheries) asked at what flow does the Reach 2 distributary become watered.
- *Response:* John S. replied 420 cfs. Monte Miller noted that it was de-watered during the September 2013 site visit.

- *Comment:* Monte Miller asked whether fish can get out of Reach 2 distributary when it is cut off from the main channel.
- *Response:* John S. stated no, once loss of connectivity, fish are trapped from getting back into Grant Creek, although they can swim through to Trail Lake Narrows at the other end.

- *Comment:* Monte Miller asked if there was a known reason for the relatively low Chinook counts in 2013.
- *Response:* John S. said that they did not know for sure, although he noted that timing of installation of the adult weir (May 23, 2013; *Slide 4*) was based on 2009 distribution data, which was later than is generally typical, so may have missed capturing and tagging some of the early returns. John S. added that the goal was to tag 65 fish, but only 9 were tagged.

- *Comment:* Eric Rothwell asked if there was a general sense of where the rearing mesohabitats (like tiny alcoves and glides/pools) were located in Reaches 1-4.
- *Response:* John S. replied that based on the snorkeling, ideal mesohabitats were consistently found in deeper, quiet side channels and ice shelves in Reach 3 as well as right back above the adult weir, which was particularly quiet in April. Jason Mouw (ADF&G) added that similarly with spawning, he has observed it consistently occurring in the same areas of the creek each of the last four years. Cory Warnock noted that mesohabitats and definitions thereof would be discussed in more detail during the instream flow study presentation (at the March 20 Aquatic Resources Work Group [ARWG] meeting).

- *Comment:* Jeff Anderson (USFWS) asked about the level of confidence in the observed redd counts (*Slide 26).*
- *Response:* John S. noted that there is always an inherent risk of not observing all redds and explained that while water clarity decreased near the end of the study period, potentially impairing ability to see all of the redds, the field staff did weekly counts of redds, and since actively working in the field seven days a week, any new redds observed in between official counts were included in the dataset.

- *Comment:* Jeff Anderson asked if the relatively low number of radio-tagged Dolly Varden (*Slide 14*) could be due to the pickets on the adult weir that tend to attract smaller sized fish.
- *Response:* John S. replied yes that is possible. He added that another possibility is that it was a low migration year for the species.

- *Comment:* Jeff Anderson asked if the peak movement of parr/early smolts was observed in fall, prior to overwintering.
- *Response:* Referring to *Slide 50*, Monte Miller pointed out that he believes some fingerlings move into Grant Creek from Trail Lake Narrows.
- *Comment:* Referring to Table 5.1-10 of the Fisheries Assessment, Draft Report (February 2014), Jeff Anderson stated that the approximately 20% estimate of 0.x aged Chinook and coho seems high.
- *Response:* John S. replied that they will check with the ADF&G staff that performed the age analysis using scale samples to confirm the findings. Monte Miller noted that it is possible the apparent 0.x migrate out to the Trail Lake Narrows, rather than out to sea, and therefore, only temporarily fall out of the system. John S. concurred with that possibility and admitted that it is not possible to say with 100% that fish that apparently migrate downstream, return upstream.

- *Comment:* Jeff Anderson asked about potential impacts to habitat in the tailrace.
- *Response:* Kelly Tilford (McMillen) responded that the impacts cannot be determined until the Project operations scenario and detention pond design are further refined. Cory Warnock indicated that more should be known by the next agency meeting in June/July.

- *Comment:* Jeff Anderson asked if there are plans to provide the fisheries assessment data to Jay Johnson (ADF&G) for the *"Atlas and Catalogue of Waters Important for Spawning, Rearing, or Migration of Anadromous Fish"*.
- *Response:* John S. replied no, but can do so if deemed appropriate. John S. noted that consistent with the terms of the fish resource permit, a summary report has been provided to Scott Ayers (ADF&G). Monte Miller added that Robert Begich should also receive the relevant data.

Licensing Path Forward/Closing

Mike Salzetti (KHL) stated that KHL's primary objectives over the next few months are to continue with the momentum gained from the engineering progress made thus far, and to start to integrate operational scenarios across the various resource disciplines. Cory Warnock noted that consistent with the engineering schedule, which has a number of deliverables due by May, KHL anticipates holding the next agency meeting in the June/July timeframe, with the primary focus being on 1) progress made with the operations modeling; 2) outstanding significant resource issues; and 3) exploring potential options for addressing Project impacts.

[Note explicitly stated at the March 19 meeting, but mentioned in other agency meetings that same week, KHL welcomes informal written comments on the draft study reports, and requests

that they be provided by Friday, April 25, at which point, KHL will work to finalize the reports and file them, along with the meeting notes, with the Federal Energy Regulatory Commission (FERC).]

<<ADJOURN 1:00PM>>

Action Items

- **BioAnalysts** to check with ADF&G about fish scale age analysis.
- **BioAnalysts** to provide relevant fisheries assessment data to Jay Johnson (ADF&G).
- **Stakeholders** to provide informal comments on the draft study reports by Friday, April 25.

Attachments

Attachments are available on the March 18-20, 2014 Natural Resources Study Report Meetings page at www.kenaihydro.com.

Attachment 1: Meeting Agenda
Attachment 2: Grant Lake Engineering Feasibility PowerPoint presentation
Attachment 3: Aquatic Resources, Macroinvertebrate and Periphyton Study Results PowerPoint presentation
Attachment 4: Aquatic Resources, Fisheries Assessment Results PowerPoint presentation

Grant Lake Hydroelectric Project (FERC No. 13212)
Aquatic Resources Work Group (ARWG) Meeting
Aspen Suites Hotel, 100 E. Tudor Rd., Anchorage, AK
March 20, 2014, 8:00 am to 3:00 pm

In Attendance

Emily Andersen, McMillen LLC (McMillen)
Jeff Anderson, U.S. Fish and Wildlife Service (USFWS) *[via phone]*
Patti Berkhahn, Alaska Department of Fish and Game (ADF&G) *[via phone]*
John Blum, McMillen
Joe Klein, ADF&G
Katie McCafferty, Army Corps of Engineers (USACE)
Mark Miller, BioAnalysts (BA) *[via phone]*
Monte Miller, Alaska Department of Fish and Game (ADF&G)
Jason Mouw, ADF&G
Eric Rothwell, National Oceanic and Atmospheric Administration (NOAA Fisheries)
Kim Sager, Alaska Department of Natural Resources (ADNR) *[via phone]*
Mike Salzetti, Kenai Hydro, LLC (KHL)
Hal Shepherd, Center for Water Advocacy (CWA) *[via phone]*
John Stevenson, BA
Kelly Tilford, McMillen
Cory Warnock, McMillen

Meeting Summary

Introductions and Agenda

Mike Salzetti (KHL) began the meeting with introductions and Cory Warnock (McMillen) reviewed the proposed meeting agenda (see Attachment 1):

- Aquatic Resources, Instream Flow
- Integrated Natural Resources/Engineering Discussion

Cory noted that all materials from the meeting (agenda and presentations) will be posted to the Grant Lake Hydroelectric Project (Project) website (http://www.kenaihydro.com/index.php) after the meeting.

Aquatic Resources Study Results, Instream Flow

John Blum (McMillen) presented the instream flow study results (see PowerPoint included as Attachment 2*)*.

- *Comment:* Monte Miller (ADF&G) commented that it has been understood that Reach 5 would be de-watered at certain times of the year, but given the current location of the tailrace outfall from the detention pond at the Reach 4/5 break (*Slide 12*[1]*)*, it appears that Reach 4 could be periodically de-watered as well.
- *Response:* Mike Salzetti (KHL) re-iterated that it is likely that the detention pond would not be used most of the year. Cory noted that while the location of powerhouse is fairly set, the orientation of the outfall is still to be determined. Kelly Tilford (McMillen)

[1] For all PowerPoint presentations given during the meeting, slide numbers refer to the PDF page number.

added that there are many options to ensure proper conditions (e.g., angle of flow, type of habitat where the flow is released, etc.).

- *Comment:* Katie McCafferty (USACE) asked if it is known how often the detention pond might be utilized in a given year.
- *Response:* Mike Salzetti replied no, but spin is only required if a [generating] unit fails on the Railbelt grid. Historical failure rates could be determined based on the Railbelt regional power data.

- *Comment:* In reference to the discussion about mesohabitats in Grant Creek (*Slide 14),* Eric Rothwell (NOAA Fisheries) asked at what flows the mesohabitats were determined at.
- *Response:* John Blum answered that the flows were between 150 and 250 cfs.

- *Comment:* Jason Mouw (ADF&G) commented that there are several habitat types discussed relative to mesohabitats (*Slide 14),* and asked if the definitions are provided somewhere.
- *Response:* John Blum indicated that the terms are defined in the Aquatic Resources study plan (March 2013).

- *Comment:* Jason Mouw asked how the transects (the basis of the Habitat Suitability Index [HSI] curves) relate to documented fish utilization/spawning areas.
- *Response:* John Blum indicated that transects were prioritized for that reason, but also noted that while in the field, the crew walked the entire stream, not just transects, to note observed fish and redds within 10 to 15 feet of a given transect. Mike Salzetti asked Jason if there was a deliverable (e.g., a map) that could provide the desired information. Jason indicated that he would detail what information he is looking for in his informal written comments.

- *Comment:* Jason Mouw asked about the distribution of HSI curves throughout Reaches 1-4 and other relevant data (e.g., at what flows measurements taken at, distance from shore, etc.).
- *Response:* John Blum said that he could provide the relevant data as it is all detailed in a spreadsheet.

- *Comment:* Jeff Anderson (USFWS) pointed out that the species and life history stage table (*Slide 17)* does not appear to match with Table 4.2-4 in the Instream Flow/Aquatic Habitat Mapping Study, Draft Report (February 2014). He also asked why fry rearing sockeye salmon was not checked yes.
- *Response:* John Blum stated that juvenile rearing coho salmon should have been checked in the report (Table 4.2-4), and same for juvenile Chinook salmon in the table in the presentation. He agreed to correct any discrepancies in the final report. Regarding the fry rearing sockeye, John Blum replied that they believe the species to migrate out quickly, and therefore, there would not be any apparent rearing.

- *Comment:* Specific to connectivity in Reach 5 (*Slides 30-33)*, Monte Miller asked why the average of the T510 and 520 site flow data was calculated.
- *Response:* John Blum stated that it is the approach used by Thompson (1972), but agrees that it may not be the ideal approach when assessing connectivity of a stream.

- *Comment:* Relative to the Reach 5 connectivity analysis, Jeff Anderson asked whether habitat quality of the reach was determined.
- *Response:* John Stevenson reiterated that a total of 5 redds were observed in the reach, 16 fish observed (rearing) during snorkeling, and 36 salmonids captured in minnow traps. John Blum indicated that the flow information needs to be integrated with the fish timing data to start to get at the habitat quality of Reach 5. Mike Salzetti pointed out that in order for the Project to work properly, a significant amount of the Reach 5 flow will need to be bypassed through the Project.

- *Comment:* Jeff Anderson asked how the substrate in the Reach 5 canyon may impact sediment recruitment.
- *Response:* Cory Warnock indicated that the Geomorphology study presentation (given at the March 18 Natural Resources Work Group [NRWG] meeting), goes into detail about this, but provided a few highlights: 1) gravel recruitment would be episodic (100s to 1,000 years), likely due to a major slide; 2) any sediment recruitment will come from Reach 5, and not Grant Lake; and 3) the observed flaking of gravel may be more due to fish spawning activity than from high flows. Jeff Anderson stated that based on this, then there is evidence that flows due to Project operations will affect Reach 5 habitat, but there would be no impact on sediment transport. Mike Salzetti clarified that the geomorphology study showed that sediment transport in Reach 5 *would* be impacted by Project operations.

- *Comment:* Specific to potential habitat enhancements in the side channels at the Reach 2/3 break (*Slides 34-44*), Jason Mouw commented that while the side channels generally offer good habitat, except for at the head of the island complex, few fish are observed there. He added that it would seem utilization of the side channels could be limited by the relatively low winter flows and temperature controlling bedrock.
- *Response:* John Blum re-iterated that the next step with the instream flow work is to overlay the fish presence information with the habitat delineations to explore these theories.

- *Comment:* Specific to the discussion regarding the Reach 1 distributary (*Slides 45-53)*, Patti Berkhahn (ADF&G) asked about the flow during the September 2013 Project site visit.
- *Response:* Cory Warnock (McMillen) indicated that the flow in Grant Creek was approximately 400 cfs, and thus the distributary approximately 4 cfs.

- *Comment:* Eric Rothwell asked whether there is a rating curve for the Reach 1 distributary.
- *Response:* John Blum replied, no, its calculation is being based on stage/discharge data.

- *Comment:* Eric Rothwell observed that based on the information presented for the resources at the various meetings (March 18-20), integration of natural resources with the proposed Project operation scenarios is the next logical step. And added that there are still some questions to be answers (e.g., utilization of winter flows). Also, in general, Project operations will be constrained by the relatively small useable storage area of Grant Lake.
- *Response:* The group generally concurred.

- *Comment:* Eric Rothwell asked about the Q2 of the 11-year (1948-1958) plus 1 year (2013) record and its duration.
- *Response:* Mike Salzetti indicated that per Ebasco (1984), it is 1,000 cfs, and with regression, station weighted at 961 cfs. Eric replied that with the limited usable storage capacity that exists, it would seem difficult to prevent significant flow events from spilling into Reach 5 (e.g., 10 days of 1,000-cfs flows would fill Grant Lake).

- *Comment:* Monte Miller asked about the current thoughts regarding maximum operational flows.
- *Response:* Mike Salzetti stated that the current proposal is around 385 cfs and added that KHL plans to manage the lake levels to keep from [unnecessarily] spilling water.

- *Comment:* Joe Klein (ADF&G) commented that there are two apparent pieces missing from the evaluation thus far: 1) an estimate of effective spawning habitat; and 2) when comparing the Project operations scenarios, development of a habitat timing series.
- *Response:* John Blum agreed and stated that both would be done, likely ahead of the next agency meetings (likely in the June/July timeframe), provided the relevant hydrologic data and operations model output are available.

- *Comment:* Joe Klein recommended that for IFIM modeling, a record longer than 11 + years (1948-1958) should be utilized and asked what the potential correlation between Grant Creek and the Kenai River might be.
- *Response:* John Blum stated that he would review the Kenai River gauge at Cooper Landing data with an engineer to verify its correlation potential and if it was determined to be adequate, use it to extend the record.

- *Comment:* Jeff Anderson asked how the substrate utilized by sockeye and Chinook in Grant Creek compares to that in other streams.
- *Response:* John Blum responded that the size is generally similar; however, the substrate in Grant Creek is predominantly fractured or jointed bedrock.

- *Comment:* Jeff Anderson noted that he did not see a discussion in the Instream Flow/Aquatic Habitat Mapping Study, Draft Report, about the overflow into the adjacent trees/forest at the Reach 1/2 break.
- *Response:* Referring to the flow partitioning information (*Slide 21)*, John Blum noted that the Reach 2 distributary activates starting at 450 cfs.

Cory Warnock stated that from a process perspective, as discussed at this meeting and those on March 18 and 19, KHL sees the next steps as continuing with the engineering feasibility work, beginning to integrate the operations modeling output with the natural resource study information, and meeting again with stakeholders in the June/July timeframe to discuss the progress made, but asked how the group wanted to proceed specific to the instream flow work. Jeff Anderson asked what field work would continue in 2014. Cory explained that there would be spring and summer wildlife surveys (consistent with the current scope of the terrestrial resources study plan) and continued collection of hydrology data. Jeff suggested further study of coho rearing/overwintering (per the fisheries assessment results discussion at the March 19 Aquatic Resources Work Group [ARWG] meeting) to better understand what was observed in 2013, building upon the single year of Chinook and coho escapement data, which will ultimately inform development of protection, mitigation and enhancement (PM&E) measures. Monte agreed with the request and noted that he has a general concern with having to base PM&E decisions on a limited and possibly incomplete data set. Cory suggested the use of 1980s data (Ebasco 1984) when a weir was also in place and incorporating it in with the 2013 information. Monte agreed with proposal as long as the methodologies were similar. Eric Rothwell alternatively recommended allowing the engineering feasibility work to proceed with the existing information, reserving the right that if the output shows that more habitat information is required to fully understand Project impacts, then the case for more study can be made at that time. Eric stated that if HEA was documenting "full utilization" of the species documented in Grant Creek, that this approach seemed appropriate.

In light of the various additional information requests made during the day's meeting, Cory proposed a bi-weekly Instream Flow Subgroup call that would utilize an iterative approach (question, analysis, discussion, etc.). The group concurred with the proposal. The group agreed to March 27 for the first subgroup call. John Blum indicated that he would circulate a draft agenda.

Integrated Natural Resources/Engineering Discussion

Mike Salzetti gave a brief history of how the Grant Lake Project came about. The utility, Homer Electric Association (HEA)[2], traditionally dealing only in power transmission, decided to evaluate generation when its wholesale power purchase agreement with Chugach Electric Association, Inc. was set to expire in 2013. Most generation thus far is natural gas-fired, but with the changing price of gas, hydropower has become more economically viable. KHL considers the Grant Lake Project a great opportunity. Because the Project would be a minor percentage of KHL's portfolio, KHL is open to considering operational scenarios that maximizes the benefit to natural resources (e.g., not maximize generation in winter in order to mimic natural flows in order to protect aquatic habitat). Based on the study results to date, Mike Salzetti indicated that KHL believes that the Project could be designed to have a net neutral impact to the environment.

Eric Rothwell (NOAA Fisheries) recommended building upon that foundation, and to come back for the next meetings with output from proposed operational scenarios and preliminary PM&Es, including associated rationale. Monte Miller (ADF&G) added that once there are actual

[2] KHL, the applicant for the Project, is a wholly-owned subsidiary of HEA.

operational scenarios to discuss, the group can move away from speculation and towards viable solutions.

Licensing Path Forward/Closing

Cory Warnock (McMillen) stated that KHL welcomes informal written comments on the draft study reports, and requests that they be provided by Friday, April 25, at which point, KHL will work to finalize the reports and file them, along with the meeting notes, with the Federal Energy Regulatory Commission (FERC).

Mike Salzetti (KHL) stated that KHL's primary objectives over the next few months are to continue with the momentum gained from the engineering progress made thus far, and to start to integrate operational scenarios across the various resource disciplines. Cory noted that consistent with the engineering schedule, which has a number of deliverables due by May, KHL anticipates holding the next agency meeting in the June/July timeframe, with the primary focus being on 1) progress made with the operations modeling; 2) outstanding significant resource issues; and 3) exploring potential options for addressing Project impacts. Monte recommended setting the meeting as soon as possible, and to try to avoid scheduling meetings the last week of June/first week of July due to the Fourth of July holiday.

<<ADJOURN 11:30AM>>

Action Items

- **John Blum (McMillen)** to provide Jason Mouw (ADF&G) relevant data about the HSI curves.
- **John Blum** to correct the inconsistencies between the table in Slide 17 and the same table in the Instream Flow/Aquatics Habitat Mapping Study, Draft Report (Table 4.2-4).
- **John Blum** to develop effective spawning habitat estimates and habitat timing series information.
- **Mike Salzetti (KHL)** to determine how often the detention pond may be utilized annually.
- **John Blum** to circulate a draft agenda for the March 27 Instream Flow Subgroup meeting.
- **Stakeholders** to provide informal comments on the draft study reports by Friday, April 25.

Attachments

Attachments are available on March 18-20, 2014 Natural Resources Study Report Meetings page at www.kenaihydro.com.

Attachment 1: Meeting Agenda
Attachment 2: Aquatic Resources, Instream Flow Study Results PowerPoint presentation

Final Grant Lake Project Natural Resource Study Report Presentations

(March 18-20, 2014)

Grant Lake Hydroelectric Project (FERC No. 13212)
Natural Resource Study Results Meeting
March 18, 2014 – Anchorage, AK

Water Resources Studies

Water Quality

Hydrology

In Association with

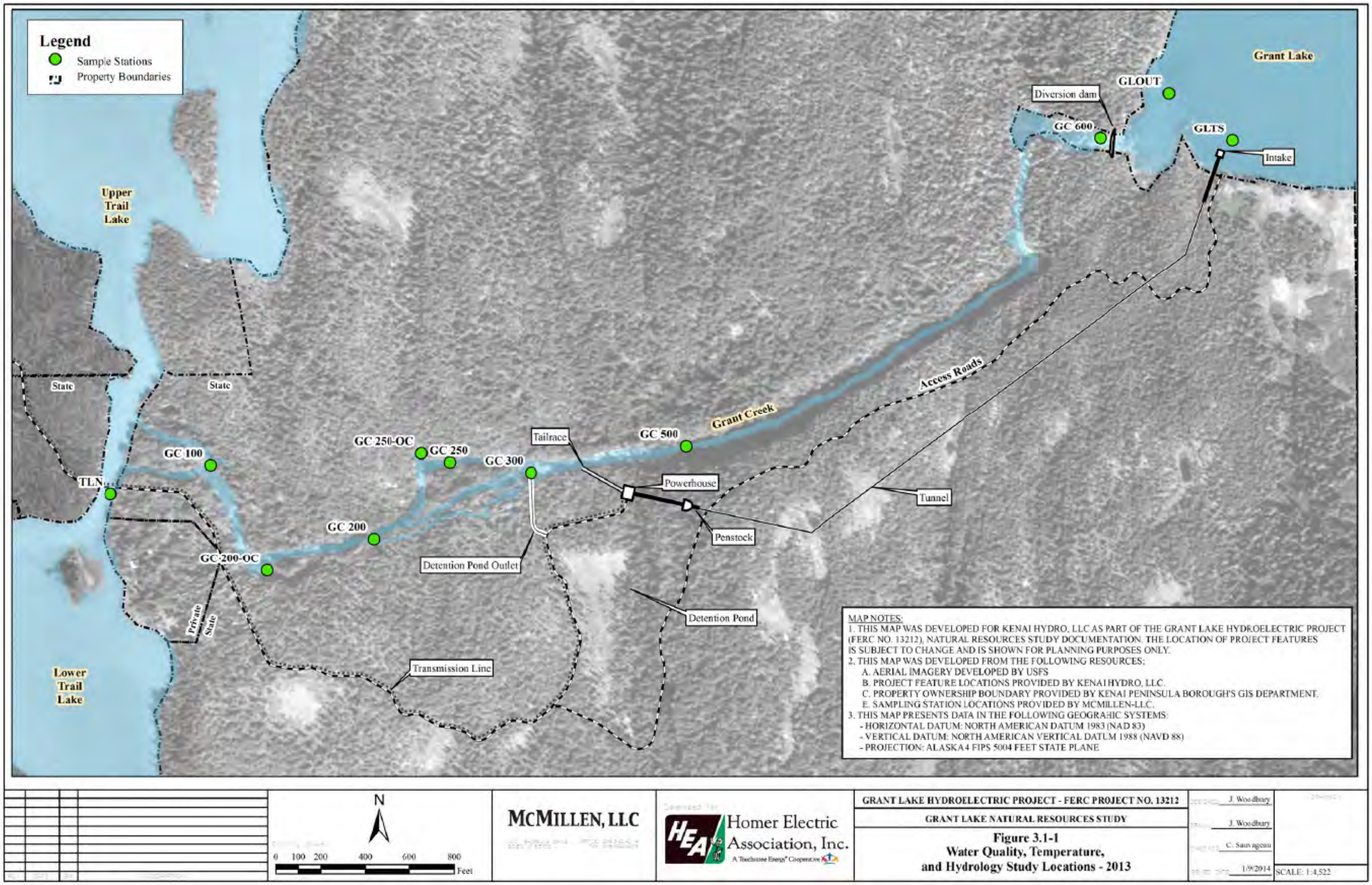
Resource Area Studies

- Water Quality and Temperature Studies
  - Grant Lake and Grant Creek Water Chemistry Sampling
  - Grant Lake and Grant Creek Water Temperature Data Collection
  - Trail Lakes Narrows Water Chemistry Sampling

Grant Lake and Grant Creek sampled once in late summer 2013

Trail Lakes Narrows sampled 3X, spring, summer, fall.

Water Quality and Hydrology Site Locations



Water Quality Study Parameters and ADEC Standards

Parameter	Units	ADEC Water Quality Standards*
Alkalinity ($CaCO_3$)	mg/L	no criteria
Total dissolved solids (TDS)	mg/L	≤ 1000 mg/l
Total suspended sediment (TSS)	mg/L	no criteria
Kjeldahl Nitrogen	mg/L	no criteria
Nitrate/Nitrite	mg/L	10 mg/l
Orthophosphate	mg/L	no criteria
Total phosphorous	mg/L	no criteria
Lead	µg/L	16.4 µg/l (acute); 0.64 µg/l (chronic)
Hardness	mg/L	no criteria
Calcium	mg/L	no criteria
Magnesium	mg/L	no criteria
Sodium	mg/L	<2.55 mg/l
Potassium	mg/L	no criteria
Low level mercury	µg/L	1.4 µg/l (acute); 0.77 µg/l (chronic)
Fluoride	mg/L	no criteria
Chloride	mg/L	860 mg/l (acute); 230 mg/l (chronic)
Sulfate	mg/L	no criteria
pH	S.U.	≥6.5 to ≤8.5
Temperature	°C	May not exceed 20°C at any time; maximum temperatures may not exceed, where applicable: migration routes: ≤15°C; spawning areas: ≤13°C; rearing areas: ≤ 15°C; egg/fry incubation: ≤13°C.
Dissolved oxygen (DO)	mg/L	>7mg/l and <17 mg/l in waters used by anadromous fish; >5mg/l and <17 mg/l for waters not used by anadromous fish
Specific Conductivity	mS/cm	no criteria
Oxygen Reduction Potential (ORP)	mV	no criteria
Turbidity	NTU	Not to exceed 25 NTU above natural conditions. For all lake waters, may not exceed 5 NTU above natural conditions.
* Based on the following water use class/subclass: (1) fresh water/(C) growth and propagation of fish, shellfish, other aquatic life, and wildlife		

Water Quality Study Results – Trail Lakes Narrows

Hydrolab Readings		Hydrolab #1 June 2013	Hydrolab #2 June 2013	Hydrolab #1 August 2013	Hydrolab #2 August 2013	Hydrolab #1 Sept 2013	Hydrolab #2 Sept 2013
Temp	**°C**	9.05	9.08	11.81	11.94	8.39	8.51
Sp. Cond	**mS/cm**	0.08	0.08	0.07	0.04	0.07	0.07
Dissolved Oxygen	**% Sat**	102.5	102.5	102.9	102.1	87.4**	102.6
Dissolved Oxygen	**mg/l**	11.88	11.85	11.19	11.09	10.8**	11.82
ORP	**mV**	399	385	526	315	387	335
pH	**S.U.**	7.51	7.63	7.63	6.32	7.06	6.60
Turbidity	**NTU**	9.4	na	na	na	9.4	na
Depth	**m**	1.6	1.7	2.0	2.0	1.0	1.0
Analytical Lab Results			DUP				DUP
pH	**S.U.**	7.60	7.60	6.90		7.20	7.10
Turbidity	**NTU**	8.5	8.8	13.0		11.0	11.0
T. Hardness	**mg/l**	38.9	41.2	33.0		36.8	33.8
T. Alkalinty	**mg/l**	25.1	25.5	18.7		22.0	21.8
TDS	**mg/l**	44	49	43		54	50
TSS	**mg/l**	3.1	5.7	11.3		4.1	3.8
T. Nitrate+Nitrite	**mg/l**	0.35	0.39	0.14		0.27	0.25
K. Nitrogen	**mg/l**	ND	ND	ND		ND	ND
T. Phosphorus	**mg/l**	ND	ND	0.03		ND	0.01
Orthophosphate	**mg/l**	ND	ND	0.02		0.02	0.02
Chloride	**mg/l**	0.32	0.32	0.21		0.21	0.21
Fluoride	**mg/l**	ND	ND	ND		ND	ND
Sodium	**mg/l**	1.17	1.15	0.91		0.99	1.05
Calcium	**mg/l**	13.6	14.4	11.3		12.5	11.4
Magnesium	**mg/l**	1.2	1.3	1.2		1.4	1.3
Potassium	**mg/l**	0.53	0.59	ND		0.62	0.56
Sulfate	**mg/l**	16.0	16.0	13.1		15.0	15.0
Lead	**µg/l**	0.2	ND	0.40		0.30	0.23
Low level Mercury	**µg/l**	0.0017	0.0016	0.0036		0.0022	0.0022
Gas Range Organics	**mg/l**	ND	ND	ND		ND	ND
Diesel Range Organics	**mg/l**	ND	ND	ND		ND	ND

na: not analyzed

ND: not detected

** faulty probe confirmed by manufacturer

Water Quality Study Results – Grant Creek (Site GC 200)

Hydrolab Readings		Jun-09	Aug-09	Jun-10	Aug-13
Temp	°C	7.4	11.26	8.51	12.46
Sp. Cond	mS/cm	na	0.07	0.09	0.06
Dissolved Oxygen	% Sat	60.9	75.1	92.3	101.5
Dissolved Oxygen	mg/l	7.31	8.22	10.79	10.89
ORP	mV	na	na	216	408
pH	S.U.	7.66	7.39	7.39	7.02
Turbidity	NTU	0.75	11.10	1.17	4.00
Depth	m	na	na	na	1.9
Lab Analyses					
pH	S.U.	na	na	na	7.00
Turbidity	NTU	na	na	na	4.0
T. Alkalinity	mg/l	25.0	23.5	25.5	20.6
T. Hardness	mg/l	na	na	na	34.4
TDS	mg/l	60	44	50	51
TSS	mg/l	0.8	3.4	0.7	2.9
T. Nitrate/Nitrite	mg/l	0.455	0.292	0.269	0.190
K. Nitrogen	mg/l	ND	ND	ND	ND
Orthophosphate	mg/l	ND	ND	ND	ND
T. Phosphorus	mg/l	ND	ND	ND	ND
Chloride	mg/l	na	na	0.284	0.225
Fluoride	mg/l	na	na	ND	ND
Sodium	mg/l	na	na	1.14	1.18
Calcium	mg/l	na	na	13.3	11.7
Magnesium	mg/l	na	na	1.26	1.25
Potassium	mg/l	na	na	0.52	0.54
Sulfate	mg/l	na	na	17.9	15.1
Lead	µg/l	3.09	ND	ND	ND
LL Mercury	µg/l	ND	0.0016	ND	0.0013

na: not analyzed

ND: not detected

Water Quality Study Results – Grant Lake (Site GLOUT)

Hydrolab Readings		Jun-09	Jun-09	Aug-09	Aug-09	Jun-10	Jun-10	Aug-13	Aug-13
Depth	m	0-Surf	4-Mid	0-Surf	6-Mid	0-Surf	6-Mid	0-Surf	3-Mid
Temp	°C	7.95	7.27	14.87	11.49	9.38	9.30	12.17	11.81
Sp. Cond	mS/cm	na	na	0.09	0.09	0.08	0.08	0.08	0.08
Dissolved Oxygen	% Sat	64.4	63.8	55.2	52.3	75.5	74.0	103.3	101.9
Dissolved Oxygen	mg/l	7.64	7.70	5.57	5.71	8.61	8.50	11.14	11.08
ORP	mV	na	na	na	na	73	29	334	332
pH	S.U.	7.27	7.37	7.24	7.24	6.98	7.06	6.28	6.59
Turbidity	NTU	0.82	na	4.18	na	1.46	1.14	4.50	5.10
Lab Analyses									
pH	S.U.	na	na	na	na	na	na	7.10	7.00
Turbidity	NTU	na	na	na	na	na	na	4.5	5.1
T. Alkalinity	mg/l	23.8	23.2	24.0	24.0	26.0	25.6	20.8	20.9
T. Hardness	mg/l	na	na	na	na	na	na	35.6	36.5
TDS	mg/l	51.3	40.0	32.5	47.5	57.0	64.0	46.0	52.0
TSS	mg/l	0.60	0.50	1.96	2.77	ND	0.75	2.08	2.75
T. Nitrate/Nitrite	mg/l	0.414	0.651	0.268	0.298	0.311	0.344	0.206	0.175
K. Nitrogen	mg/l	ND	ND	ND	ND	ND	ND	ND	ND
Orthophosphate	mg/l	ND	ND	ND	ND	ND	ND	ND	ND
T. Phosphorus	mg/l	ND	ND	ND	ND	ND	ND	ND	ND
Chloride	mg/l	na	na	na	na	0.298	0.291	0.221	0.220
Fluoride	mg/l	na	na	na	na	ND	ND	ND	ND
Sodium	µg/l	na	na	na	na	1.16	1.12	0.95	0.95
Calcium	µg/l	na	na	na	na	13.8	13.4	11.5	11.6
Magnesium	µg/l	na	na	na	na	1.32	1.27	1.18	1.2
Potassium	µg/l	na	na	na	na	0.53	0.53	0.51	0.51
Sulfate	mg/l	na	na	na	na	17.6	17.9	15.3	15.4
Lead	µg/l	ND	ND	ND	ND	ND	ND	0.24	ND
LL Mercury	µg/l	ND	ND	0.0014	0.0021	0.0011	0.0011	0.0011	0.0014

na: not analyzed

ND: not detected

Water Quality Study Results – Grant Lake (Site GLTS)

Hydrolab Readings		Jun-09	Jun-09	Jun-09	Aug-09	Aug-09	Aug-09	Jun-10	Jun-10	Jun-10	Aug-13	Aug-13	Aug-13
Depth	m	0-Surf	10-Mid	19-Bot	0-Surf	9-Mid	17-Bot	0-Surf	6-Mid	17-Bot	0-Surf	9-Mid	17 - Bot
Temp	°C	8.64	5.41	4.33	14.66	10.37	6.09	9.36	9.25	4.41	12.29	10.98	6.24
Sp. Cond	mS/cm	0.09	0.09	0.09	0.09	0.09	0.1	na	na	na	0.08	0.08	0.09
Dissolved Oxygen	% Sat	68.4	61.3	55.5	56.2	52.1	48.4	76.2	74.1	66.5	103.6	100.9	94.5
Dissolved Oxygen	mg/l	7.96	7.74	7.2	5.63	5.82	5.99	8.73	8.52	8.63	11.15	11.18	11.76
ORP	mV	na	na	na	na	na	na	91	26	65	319	320	327
pH	S.U.	7.43	7.49	7.06	7.56	7.2	7.06	6.68	6.82	6.43	7.26	7.42	7.42
Turbidity	NTU	0.6	na	na	3.87	na	4.8	0.81	1.14	1.17	3.9	7.8	4.8
Lab Analyses													
pH	S.U.	na	na	na	na	na	na	na	na	na	6.80	6.80	6.80
Turbidity	NTU	na	na	na	na	na	na	na	na	na	3.9	7.8	4.8
T. Alkalinity	mg/l	23.5	24.5	24	24.8	24.6	25.4	25.8	25.3	25.8	20.2	20.9	22.6
T. Hardness	mg/l	na	na	na	na	na	na	na	na	na	36.1	36.9	39.7
TDS	mg/l	75.0	68.8	61.3	46.3	48.8	45.0	67.0	64.0	63.0	43.0	45.0	49.0
TSS	mg/l	0.7	1.0	0.8	1.9	2.6	2.8	0.5	ND	0.7	2.7	2.6	4.2
T. Nitrate/Nitrite	mg/l	0.42	0.42	0.41	0.28	0.30	0.32	0.30	0.31	0.30	0.17	0.19	0.31
K. Nitrogen	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Orthophosphate	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND
T. Phosphorus	mg/l	ND	0.021	ND	ND	ND	ND	ND	ND	ND	ND	0.02	0.04
Chloride	mg/l	na	na	na	na	na	na	0.30	0.29	0.47	0.22	0.22	0.27
Fluoride	mg/l	na	na	na	na	na	na	ND	ND	ND	ND	ND	ND
Sodium	mg/l	na	na	na	na	na	na	1.16	1.15	1.16	0.95	0.96	1.08
Calcium	mg/l	na	na	na	na	na	na	13.5	13.3	13.4	11.6	11.6	13.0
Magnesium	mg/l	na	na	na	na	na	na	1.3	1.3	1.3	1.2	1.2	1.3
Potassium	mg/l	na	na	na	na	na	na	0.53	0.51	0.52	0.51	0.53	0.52
Sulfate	mg/l	na	na	na	na	na	na	18.0	17.9	17.9	15.1	15.4	16.9
Lead	µg/l	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
LL Mercury	µg/l	ND	ND	ND	0.0015	0.0016	0.0017	ND	ND	ND	0.0011	0.0015	0.0015

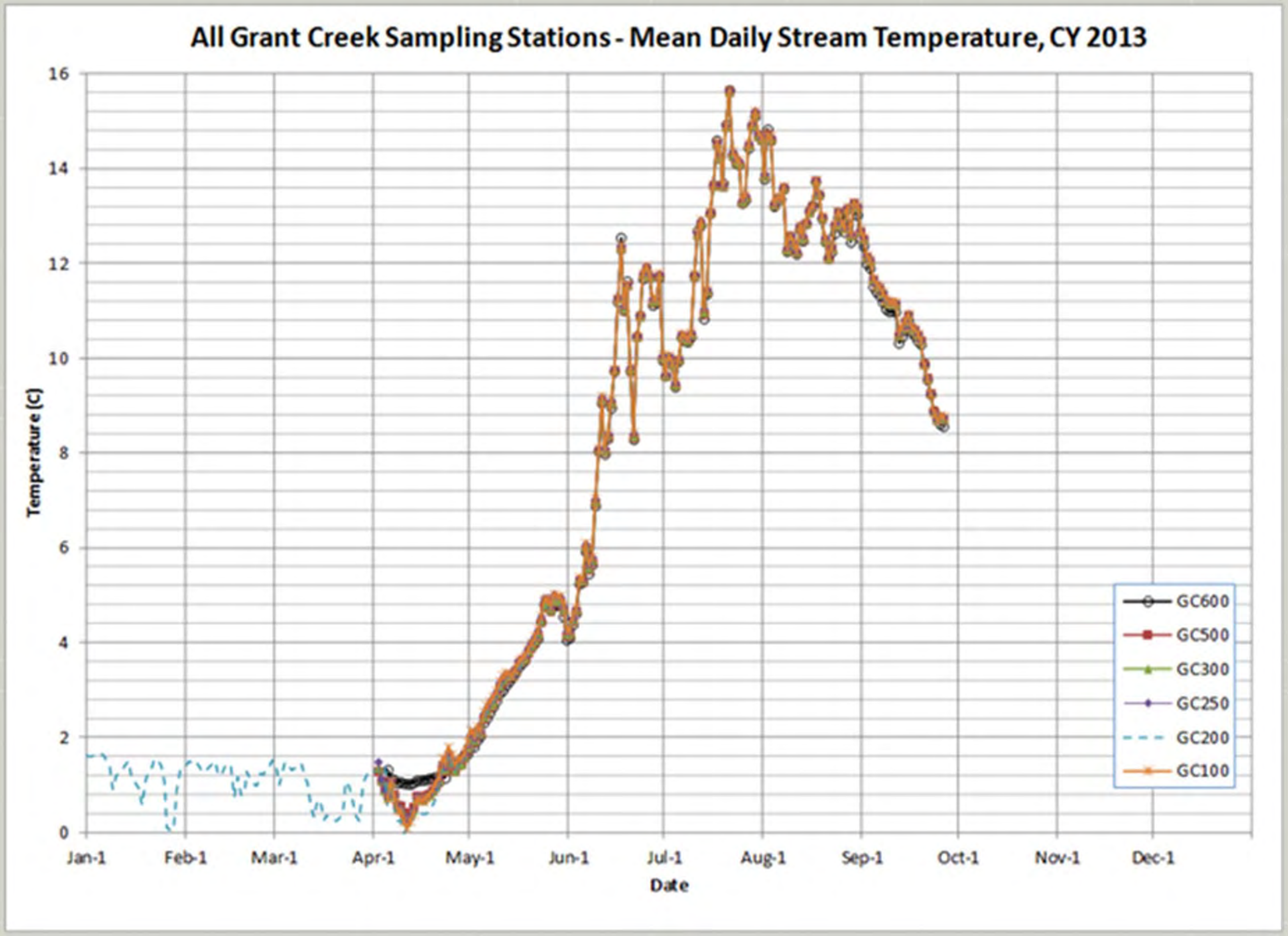
na: not analyzed

ND: not detected

Water Quality Study – Conclusions

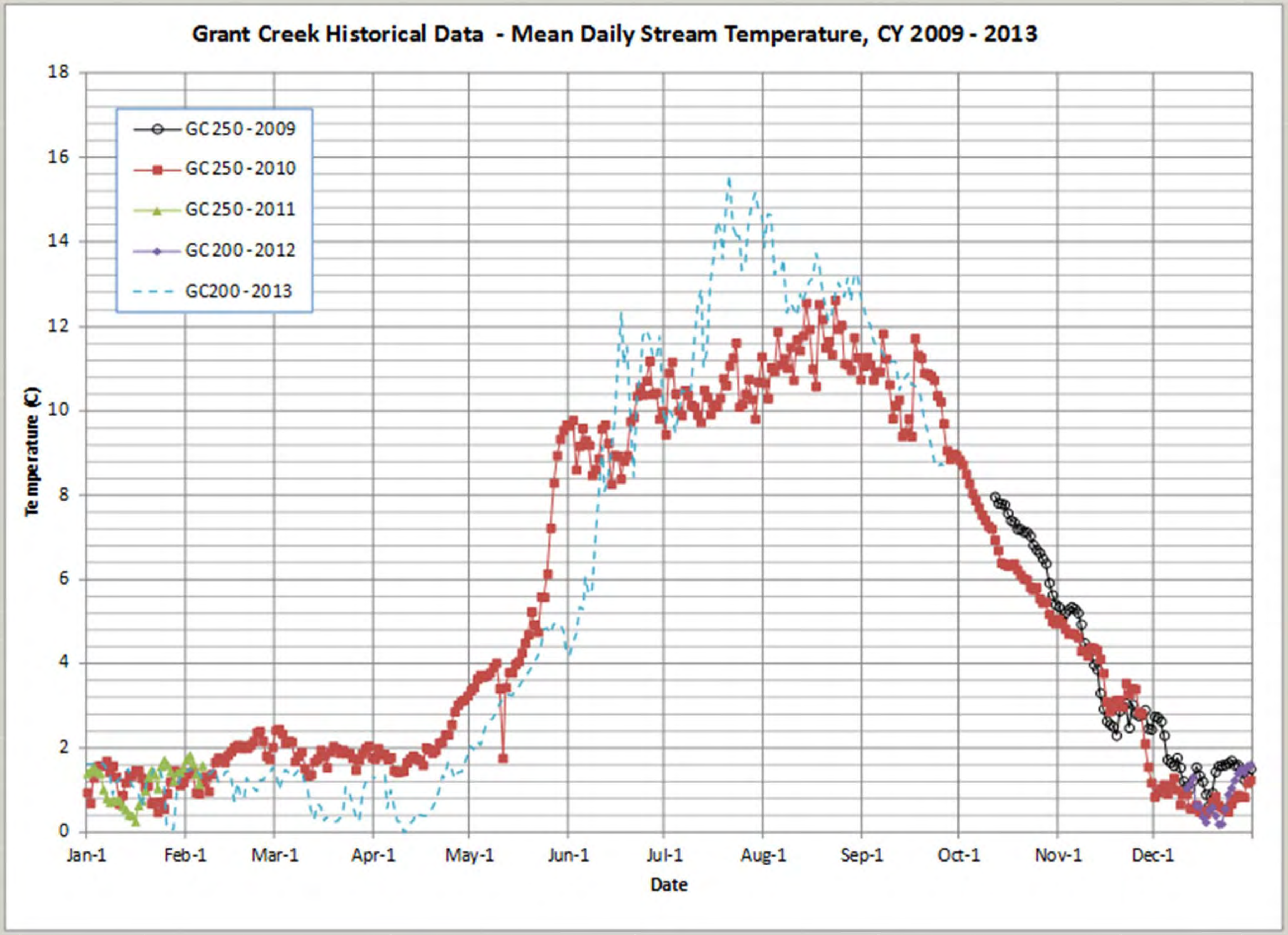
- Overall, Grant Lake, Grant Creek, and Trail Lakes have excellent water quality based on ADEC standards.
- Nearly all 2013 water quality parameters indicate stable and consistent values from the lower basin of Grant Lake (0.0 m to18.0 m depth range), downstream to the Trail Lakes Narrows. **slightly higher turbidity values at Trail Lakes Narrows is the exception to this trend*
- Most water quality parameters have remained stable based on historical sampling efforts from the early 1980’s and 2009-2010.
- 2013 dissolved oxygen results agree with ADF&G and AEIDC studies in the early 1980’s. Low DO levels reported from 2009-2010 assumed to be a result of faulty monitoring equipment or calibration procedures. Some of the DO levels reported in the 2009-2010 sampling seasons would cause substantial impairment to resident or anadromous fish populations.

Water Temperature Results – Grant Creek 2013

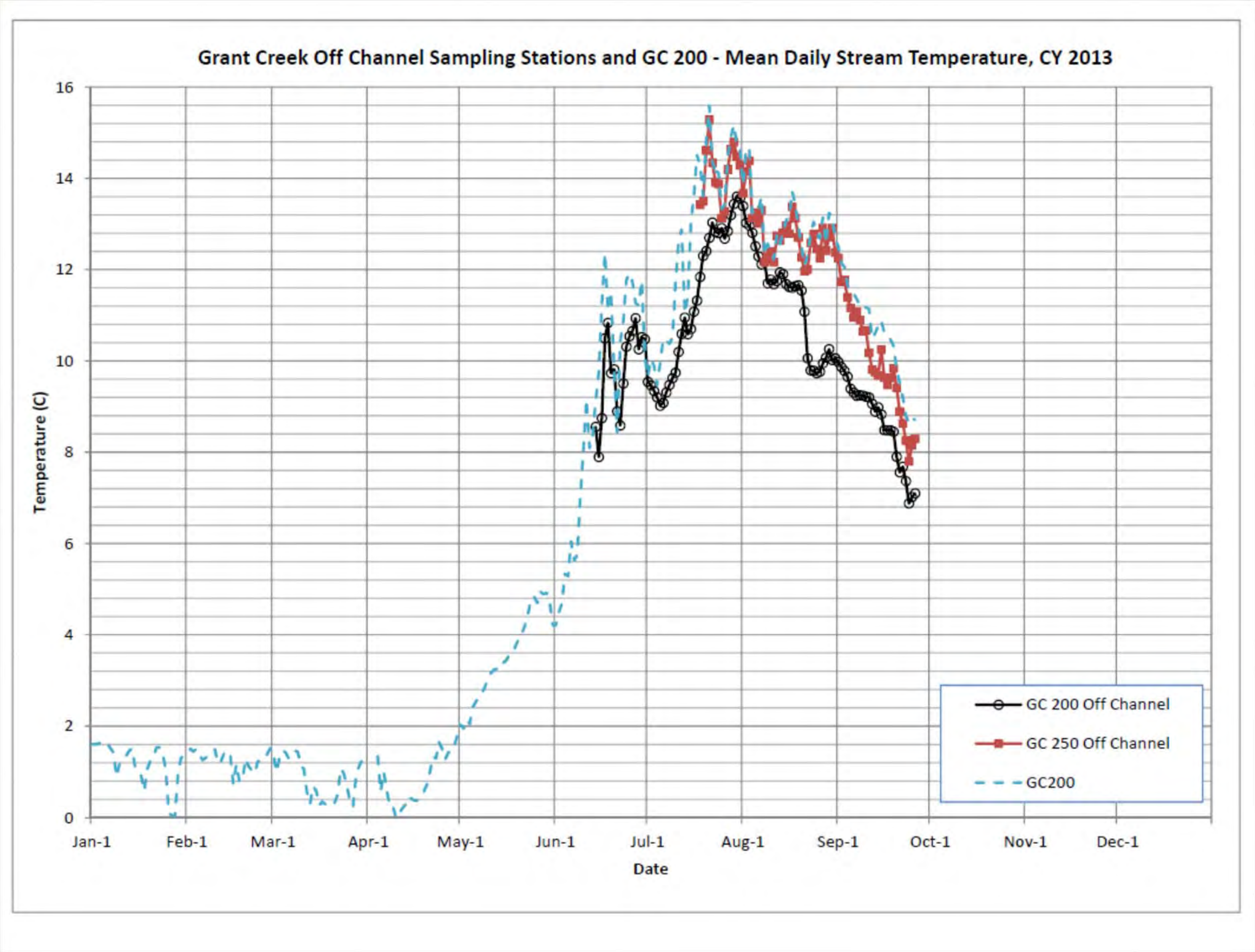


20140815-5155 FERC PDF (Unofficial) 8/15/2014 4:14:07 PM

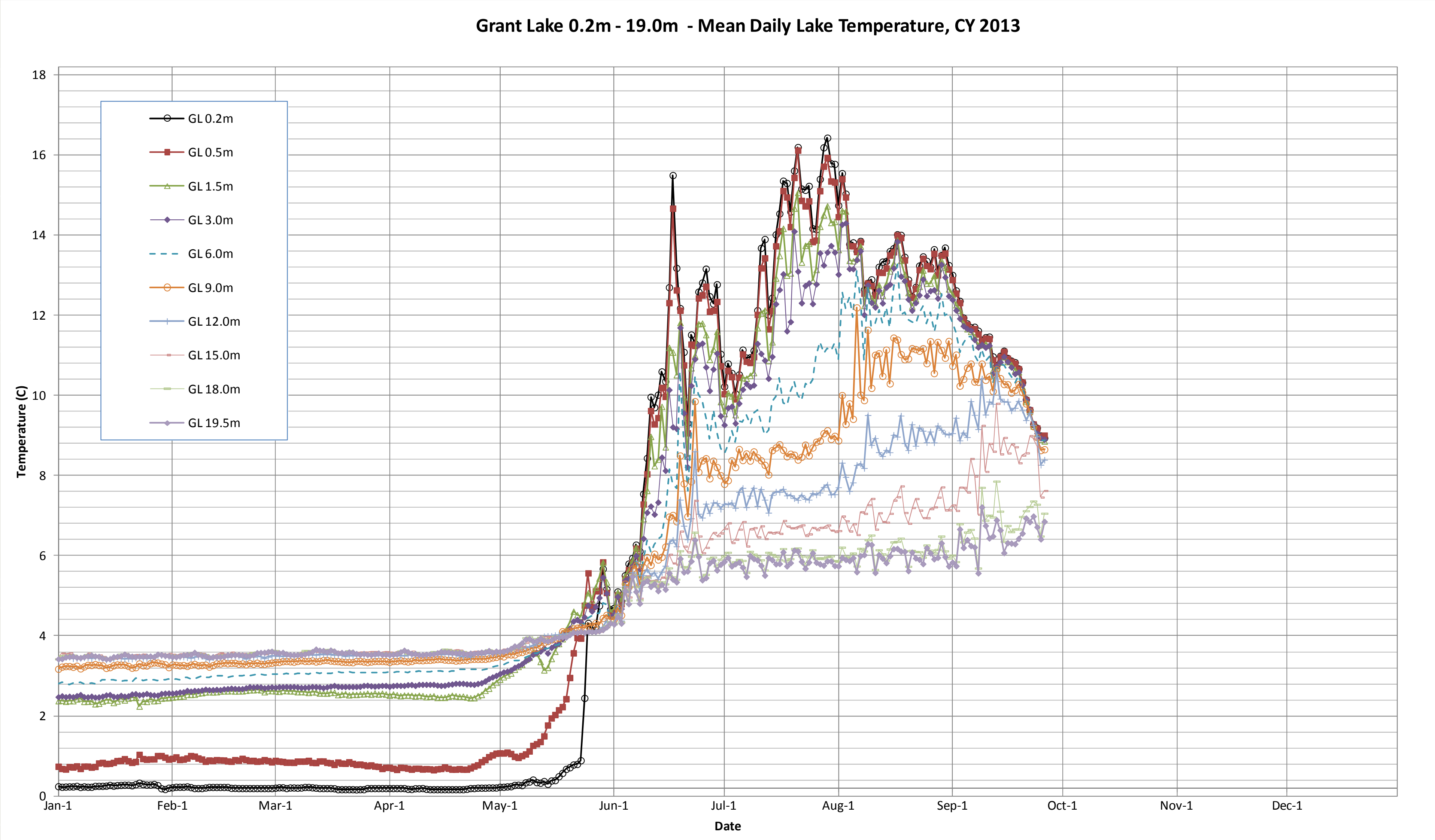
Water Temperature Results – Grant Creek 2009-3013



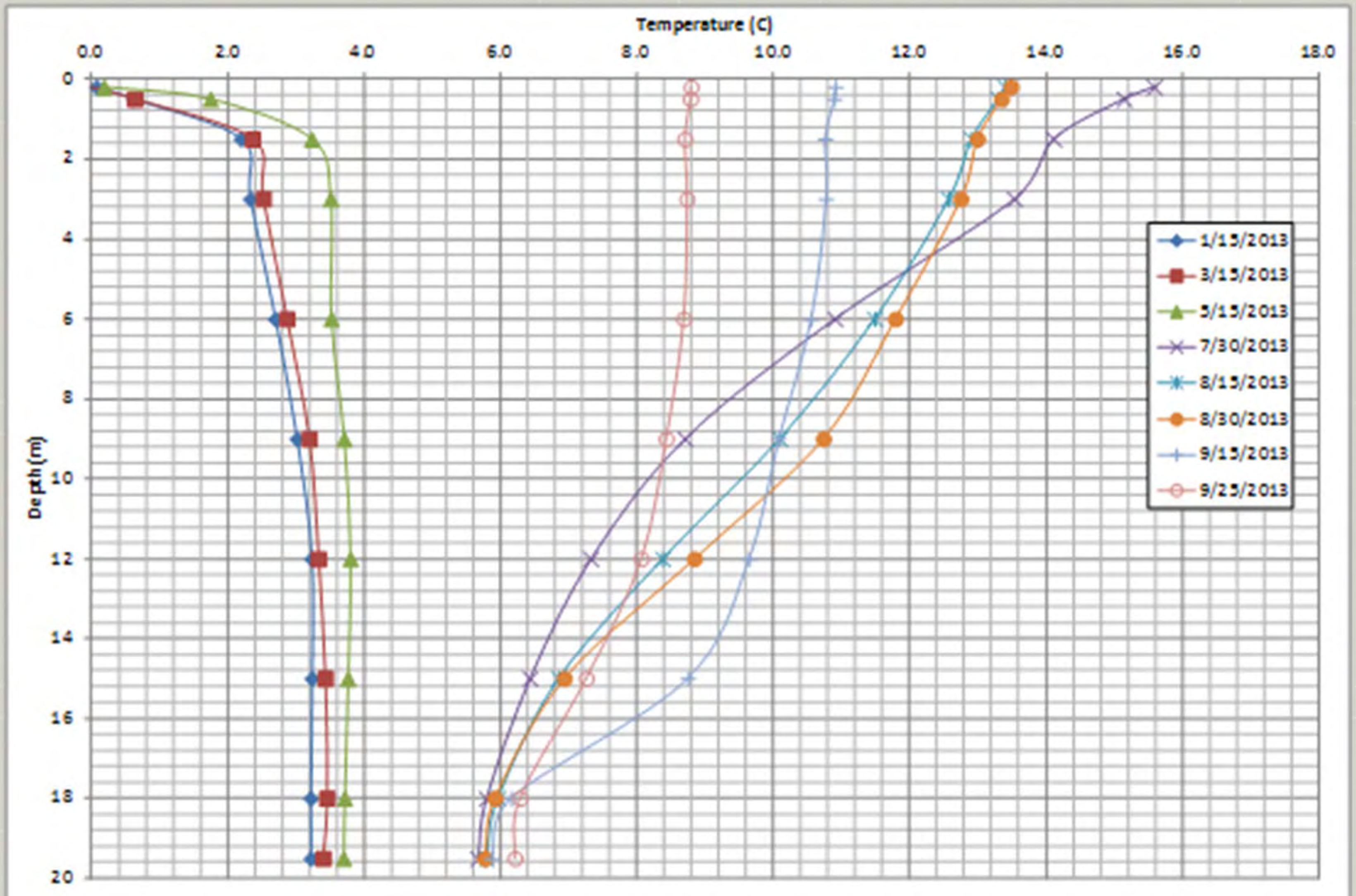
Water Temperature Results – Grant Creek Off Channel Areas



Water Temperature Results – Grant Lake Hydrograph

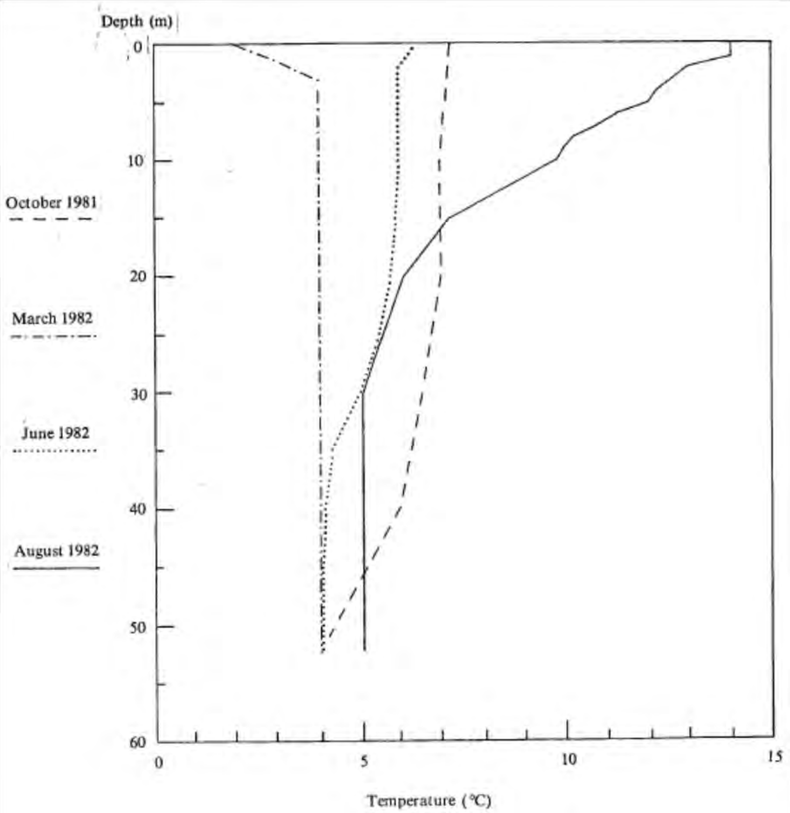


Water Temperature Results – Grant Lake Profiles

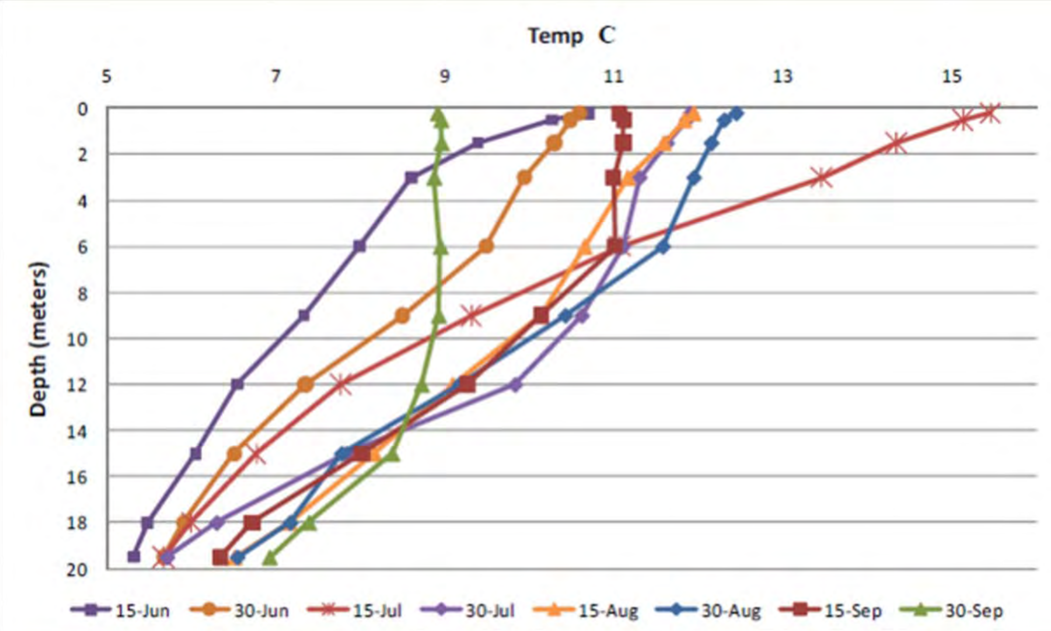


Grant Lake - Mean Daily Temperature Profiles, CY 2013

Water Temperature Results – Historical Grant Lake Profiles



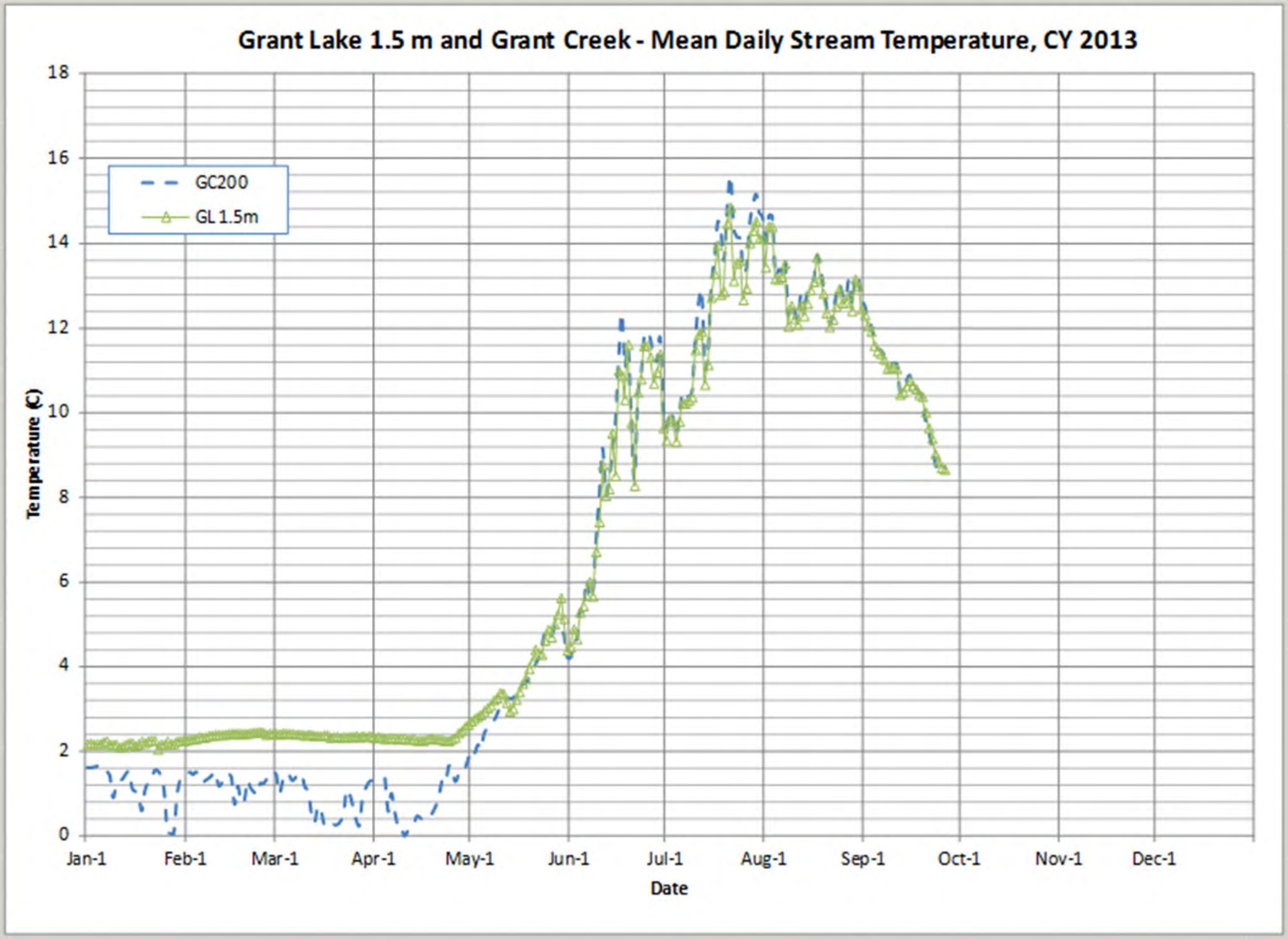
a)



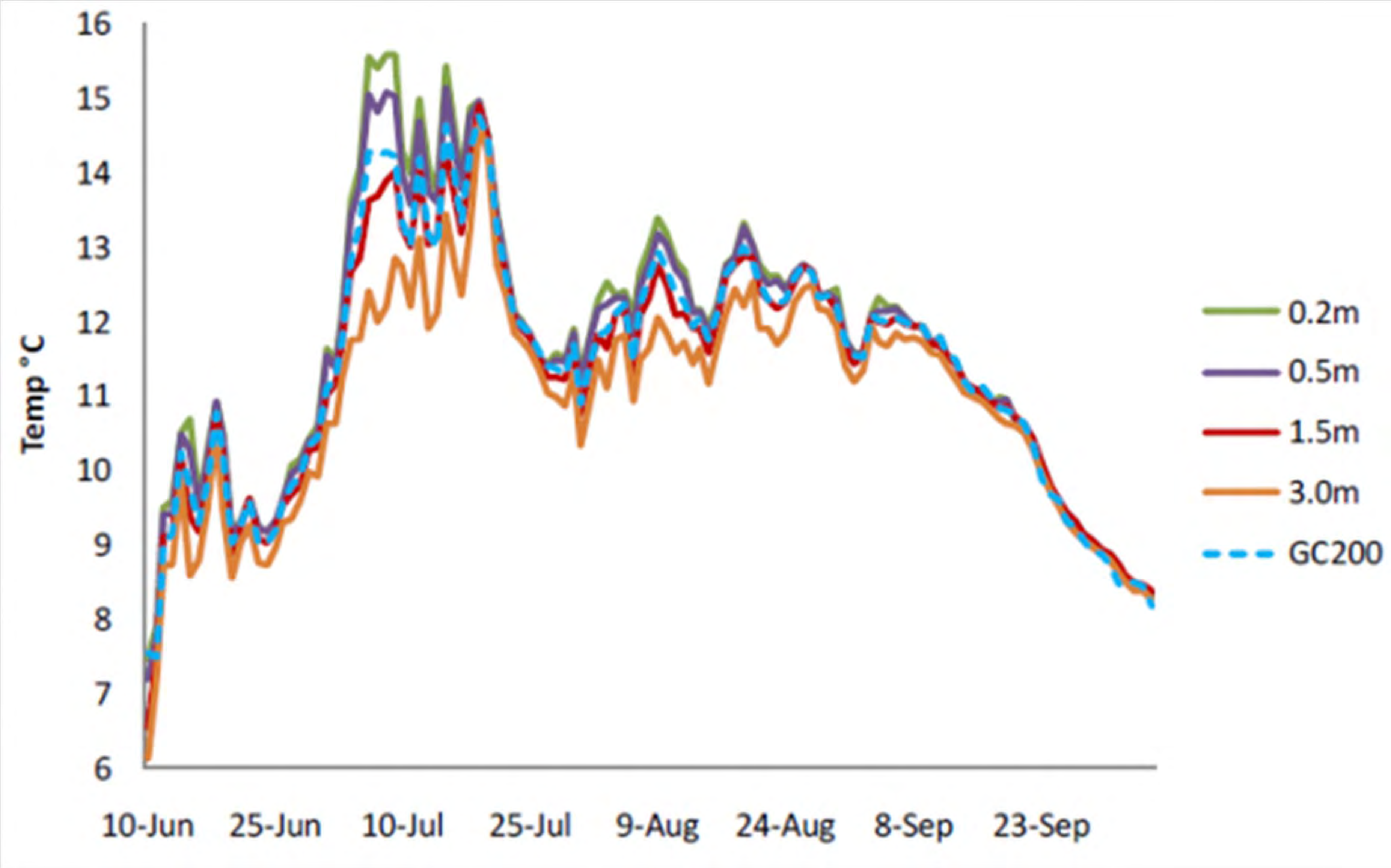
b)

Historical water temperature profiles in Grant Lake from a) AEIDC and b) HDR.

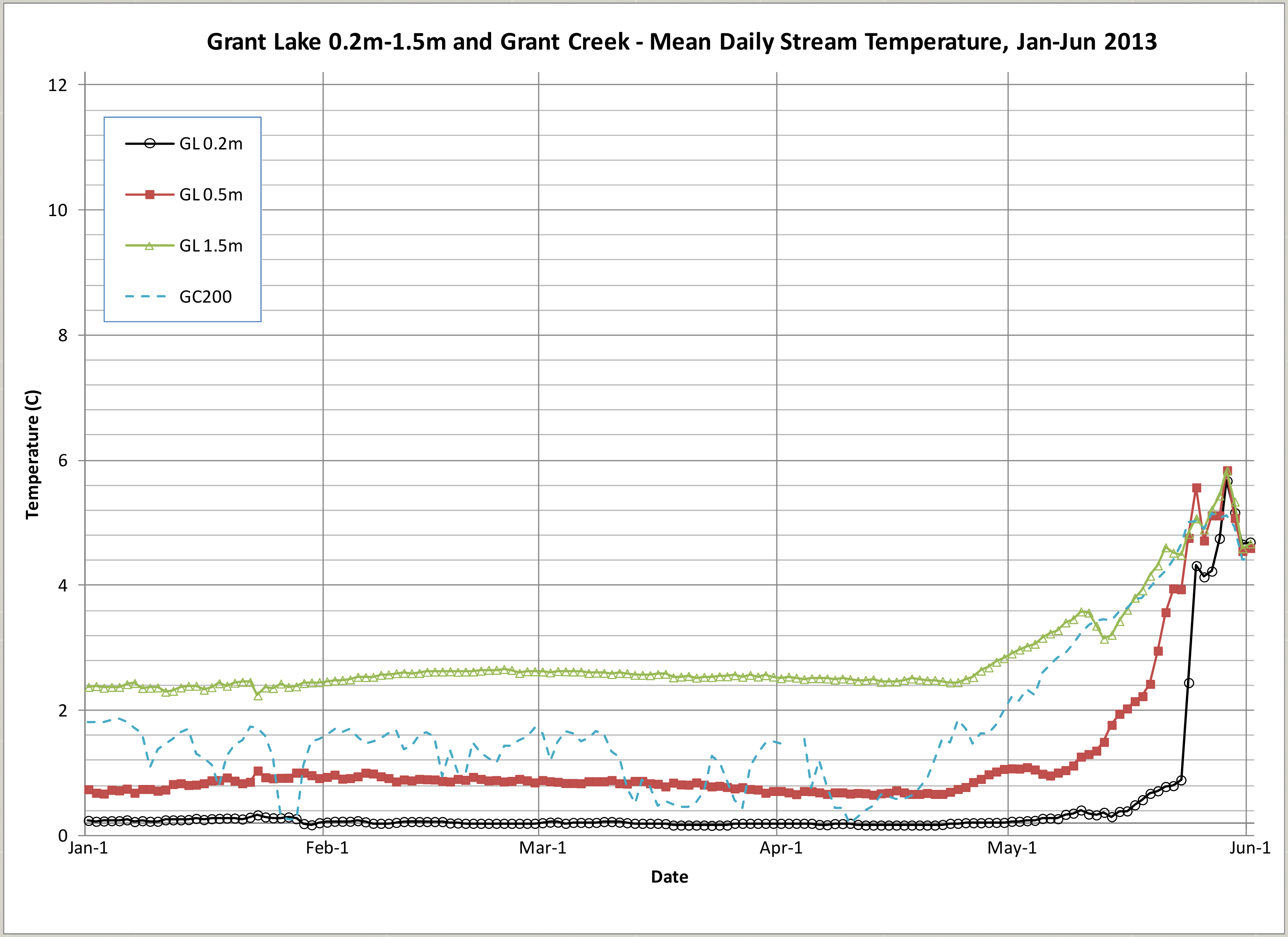
Water Temperature Results – Grant Lake and Grant Creek (2013)



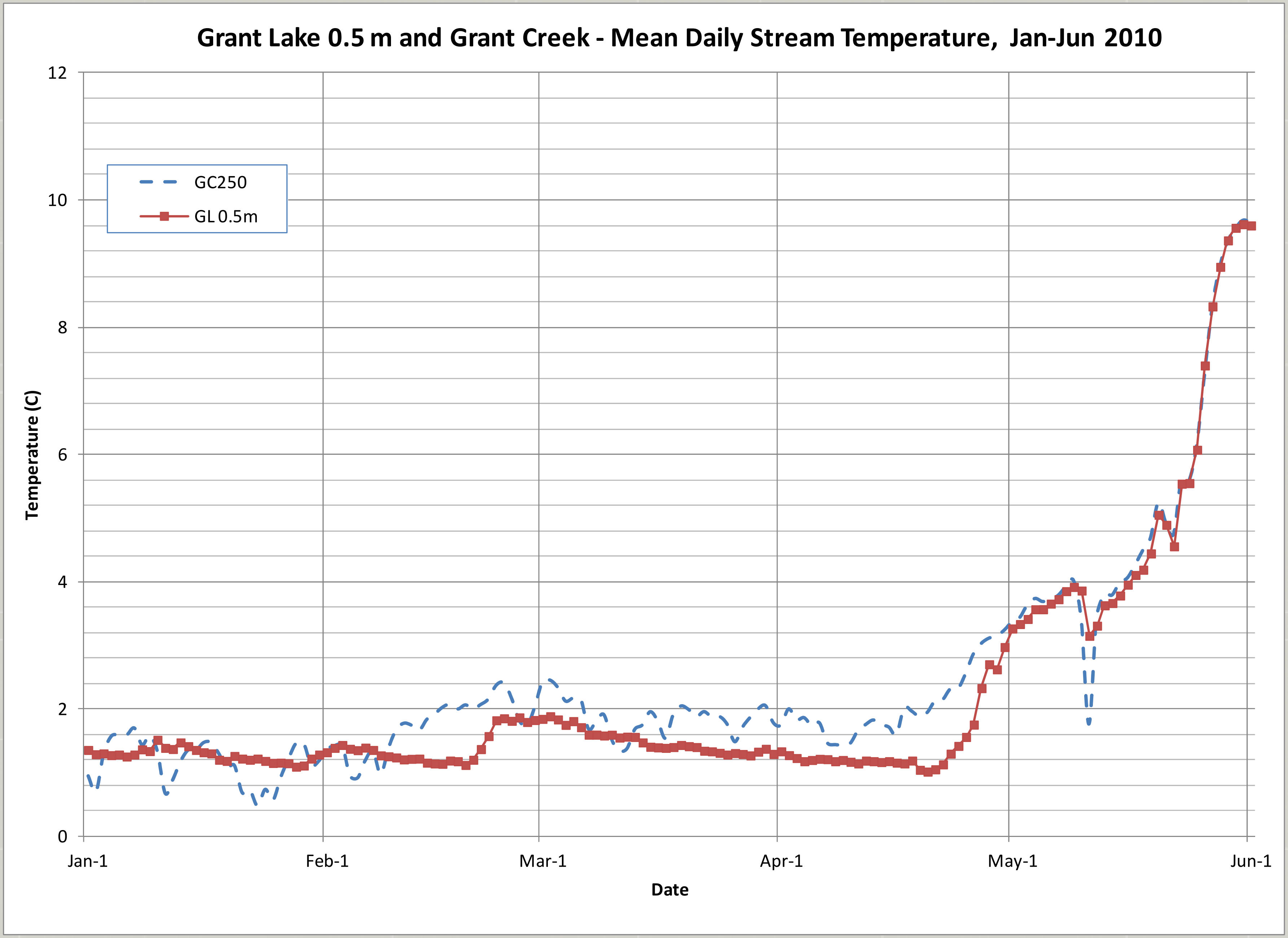
Water Temperature Results – Grant Lake and Grant Creek (2009)



Water Temperature Results – Grant Lake and Grant Creek (Jan-Jun 2013)



Water Temperature Results – Grant Lake and Grant Creek (Jan-Jun 2010)



Water Temperature Study – Conclusions

- General
  - All lake and creek temperature trends are consistent with historical data.
- Ice Free Period
  - Grant Creek water temperatures are identical from the upper Canyon Reach (GC 600) to the lower section of Reach 1 (GC 100) and are closely correlated with Grant Lake temperatures at a depth of 1.5 meters
  - One off-channel site (GC200-OC) appears to have some groundwater influence as mean daily temperature values were slightly lower and did not exhibit the same inter-daily fluctuations as main channel sites.
  - Grant Lake temperatures gradually decrease with depth, but the lower basin does not appear to stratify during the summer.
- Winter/Ice Period
  - Grant Lake exhibits a typical winter temperature profile of cold surface water temperatures (~0.2 -1.0° C) with warmer temperatures at depths greater than 1.5 meters (~2.4 -3.6° C).
  - Grant Lake temperatures at 1.5 meters are steadily at ~2° C, while Grant Creek water temperatures fluctuate between ~0.0 -1.6° C.
  - Upper Canyon Reach Site (GC 600) may follow the Grant Lake temperature hydrograph as opposed Grant Creek hydrographs in lower reaches (e.g. GC 200)

Resource Area Studies

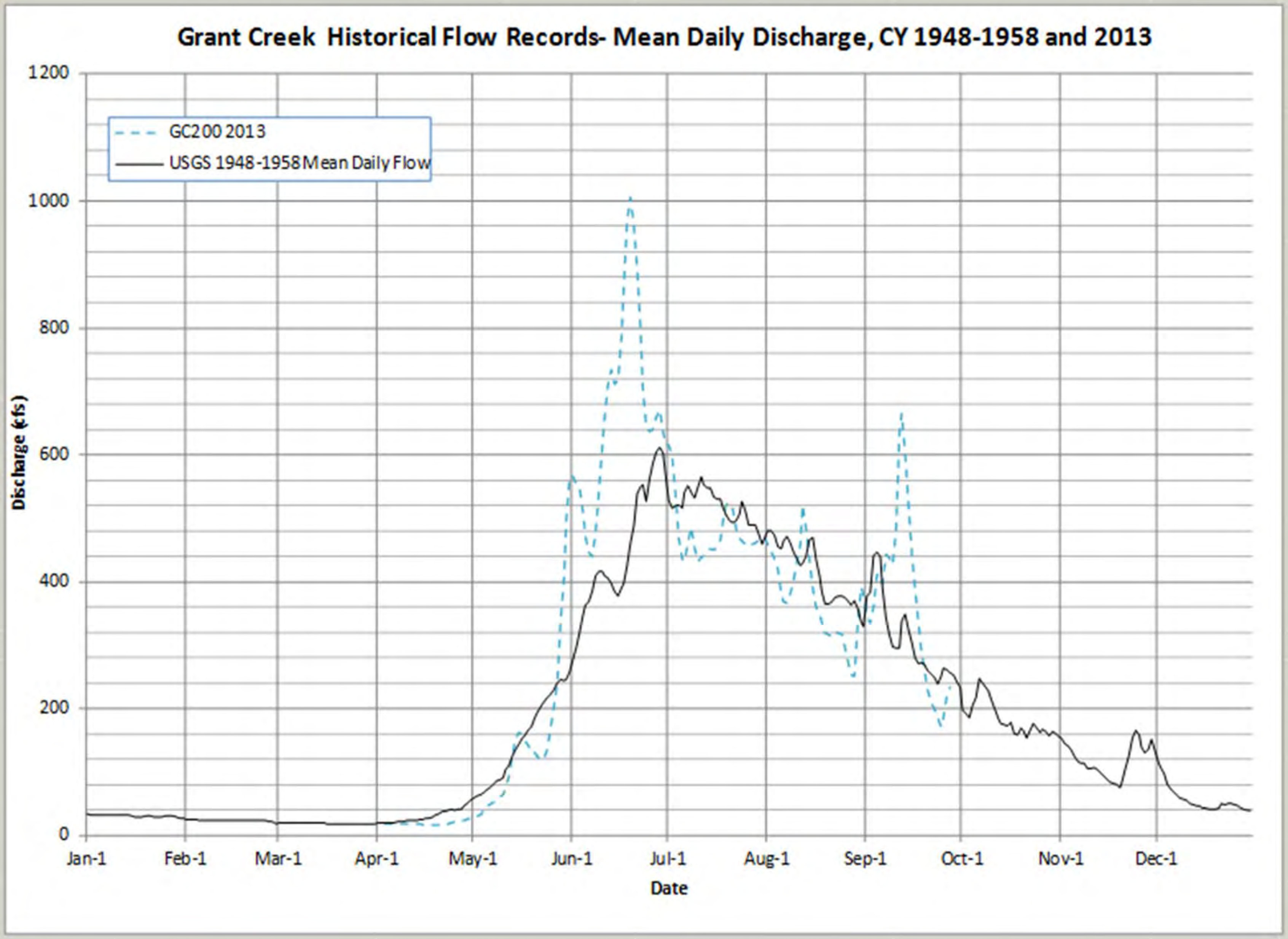
- Hydrology Studies
  - Re-establish historical USGS gaging station to continuously monitor stage.
  - Take multiple discharge measurements throughout the season to develop a stage-discharge rating curve and extend the period of record.
  - Conduct a low flow accretion study in Reach 5 and Reach 6 (i.e., Canyon Reach) of Grant Creek

Hydrology Results – 2013 Gaging Equipment

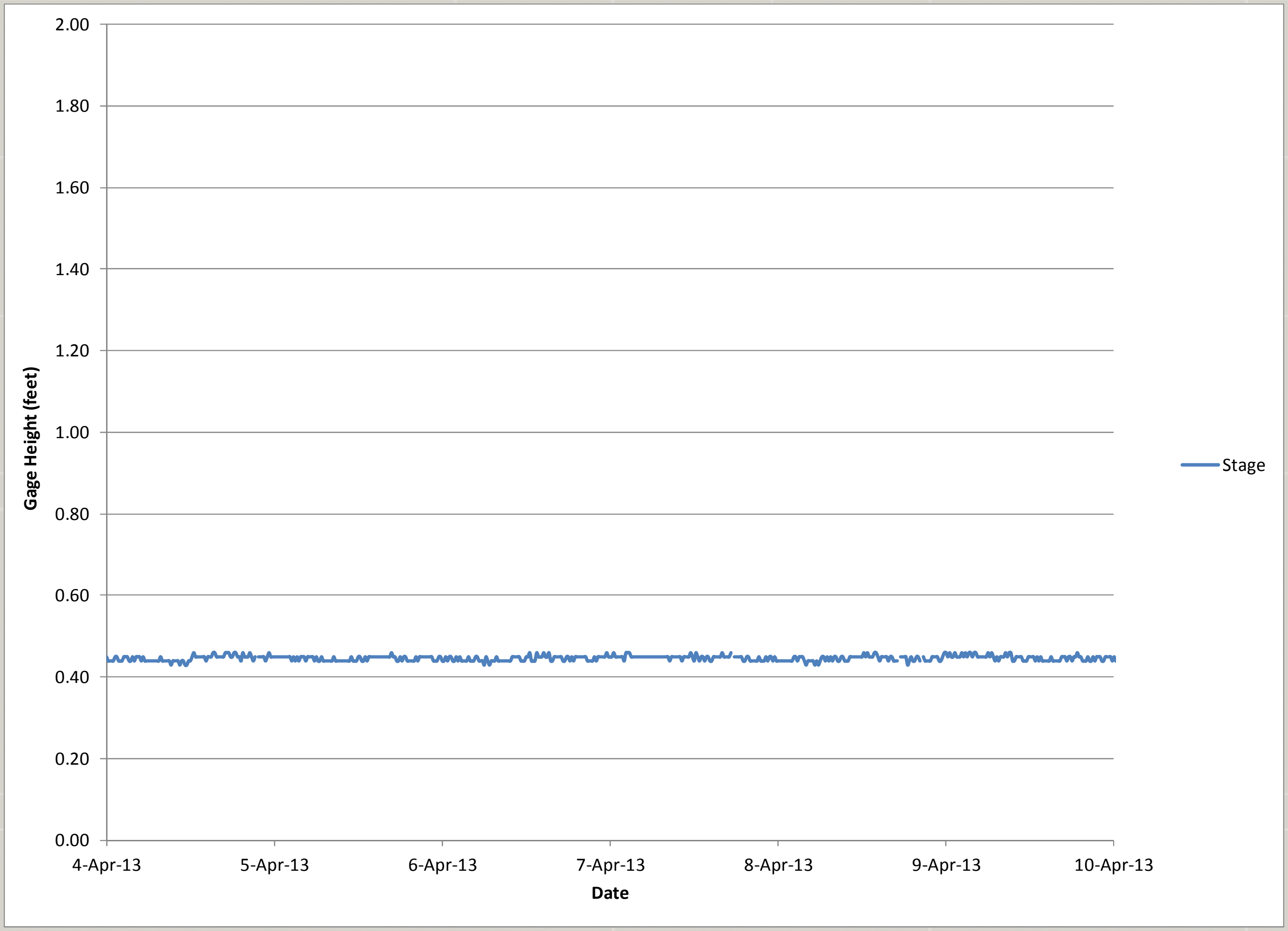
Hydrology Results – Discharge Summary

Q Meas #	Date	Stream Gage Water Level (ft)	Measured Discharge (ft^3/s)	Calculated Discharge (ft^3/s)	Percent Difference (meas/calc)
				Rating 1 LF	
1	4/4/2013	0.45	18.3	18.9	-3.3%
2	4/19/2013	0.41	16.6	16.1	2.8%
3	5/3/2013	0.64	34.3	34.3	0.0%
4	5/9/2013	0.88	59.6	58.4	2.0%
5	5/10/2013	0.93	63.1	64.0	-1.5%
				Rating 1 HF	
6_{HF}	5/14/2013	1.40	145.5	152.7	-4.7%
7_{HF}	6/12/2013	2.84	694.0	680.4	2.0%
8_{HF}	8/21/2013	2.00	312.2	324.6	-3.8%
9_{HF}	9/27/2013	1.78	257.6	253.7	1.5%
10_{HF}	10/11/2013	1.49	167.4	174.2	-3.9%

Hydrology Results – 2013 and Historical Mean Daily Flows



Hydrology Results - Accretion Study



- Reach 6 Discharge = 18.1 cfs April 5, 2013 ($Q_{section}$: 36 verticals; Max Q_{total} = 8.6%)
- Reach 5 Discharge = 18.3 cfs April 4, 2013 ($Q_{section}$: 42 verticals; Max Q_{total} = 8.1%)

Hydrology Study – Conclusions

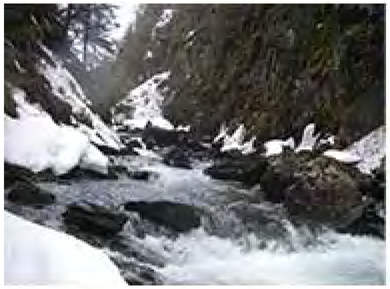
- Discharge measurements ranging from 17 cfs to 694 cfs were completed and accurately defined the stage-discharge relationship in 2013.
- Stream flow period of record accurately extended starting on April 3, 2013 and directly comparable to USGS data based on gage location and regular calibration and maintenance.
- The 2013 discharge record (April 3- Sept 27, 2013) was similar to the historical USGS record with a few deviations from the general pattern in June and September .
  - The higher flows in June of 2013 most likely resulted from a sustained heat wave that that caused elevated rates of snow and glacial melt.
  - In September 2013, a pattern of frequent and long duration rain events is what caused flows to spike above the 11 year average.
- The accretion study results indicate that all of the water entering the Canyon Reach is conveyed downstream, with no net losses or gains for the 0.5 mile segment of Grant Creek.
- HEA has maintained the gage throughout the winter and will continue collecting and analyzing hydrology data to extend the long-term stream flow record.

Water Resources – Questions and Comments?

Recreation & Visual Resources Study

Grant Lake Hydroelectric Project (FERC No. 13212)

March 18th, 2014 - Anchorage, AK





In Association with

HEA

Recreation & Visual Resources Study

- Overview of Report
  - Goals and Objectives
  - Scope of Work
  - Methods
  - Component 1:
    - Recreation Resources
    - Possible Impacts
  - Component 2:
    - Visual Resources
    - Possible Impacts

Recreation & Visual Resources Study

- Goals and Objectives
  - Measure quality of scenic environment
  - Evaluate impacts of Project:
    - Visual impacts
      - » Access roads
      - » Buildings
    - Recreational impacts
      - » Local use
      - » Seasonal use

Recreation & Visual Resources Study

– Scope of Work
  - (1) Winter and (1) Summer site visit for data collection and observations
  - (1) Sight-seeing flight
  - Creation of (4) visual simulations
  - Evaluation of alternative route of Iditarod National Historic Trail (INHT).

Recreation & Visual Resources Study

Methods

- Site visits
- Observations/Mapping
- Data Collection
- Site analysis

Site Visit Purpose	Date	Instruments	Data Collected
Winter Survey	3/3/13	Camera, GPS unit, Decibel reader	Winter use, winter viewsheds, field observations
INHT reroute	5/31/13	Camera, GPS unit, Decibel reader	Alternative trail reroute, trail viewpoints
Summer Survey	7/12/13	Camera, GPS unit, Decibel reader	Summer use, summer viewsheds, field observations
Aircraft flight	8/25/13	Camera	Sight-seeing route, aerial viewsheds

Recreation & Visual Resources Study

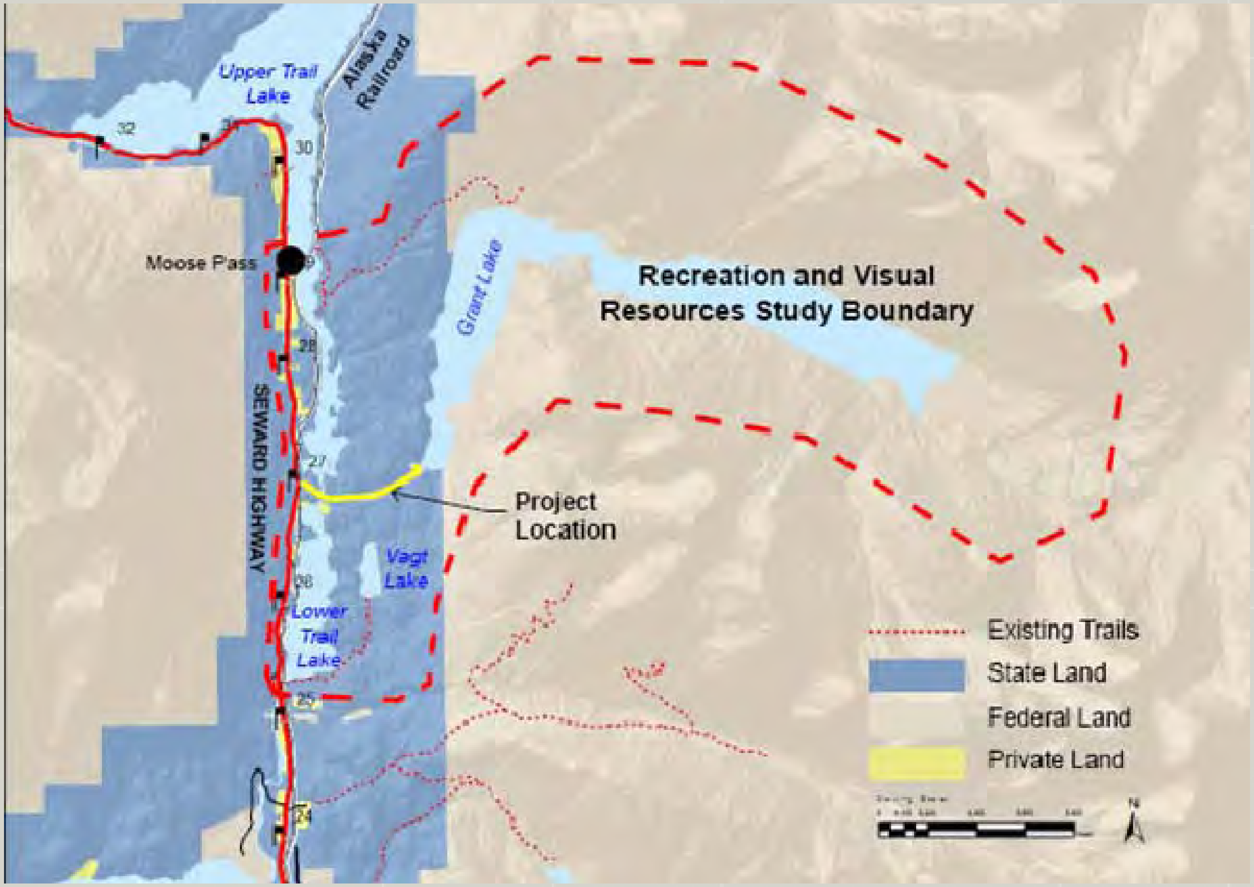
Study Overview

- Project Location
- Existing landscape

Recreation & Visual Resources Study

Study Boundaries

- Lakes
- Mountains
- Trails
- Highway
- Land Ownership

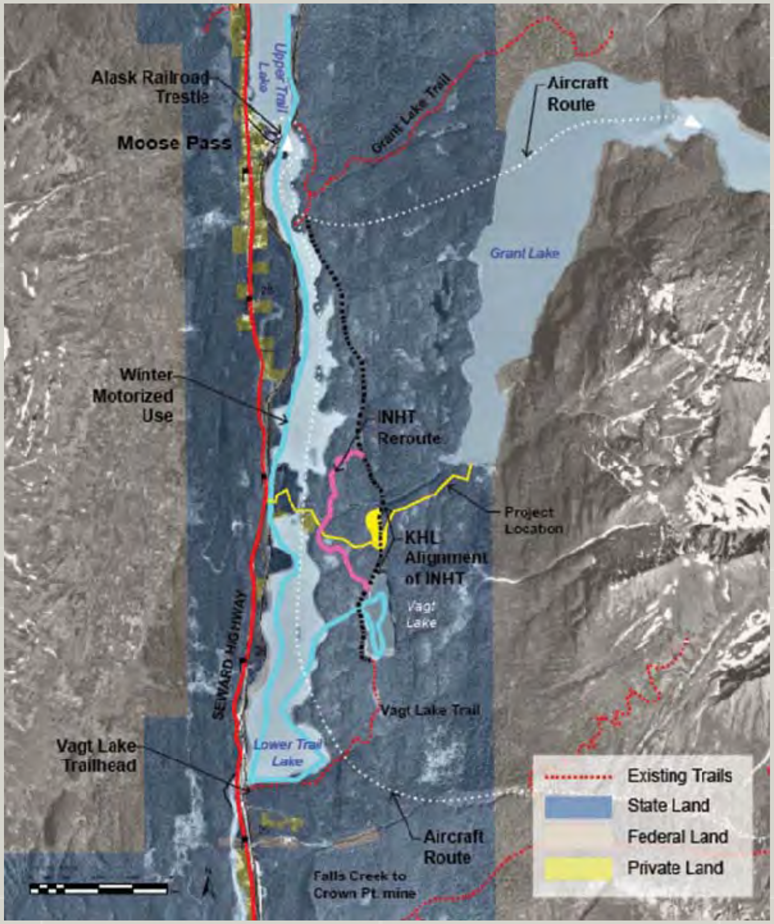


Recreation & Visual Resources Study

Component #1 –

Recreation Resources

- Winter Use
- Summer Use
- Motorized
- Non-motorized



Recreation & Visual Resources Study

Observed Winter Uses:

- Snowmachine
- Snowshoeing
- Cross-country skiing
- Dog-walking

Recreation & Visual Resources Study

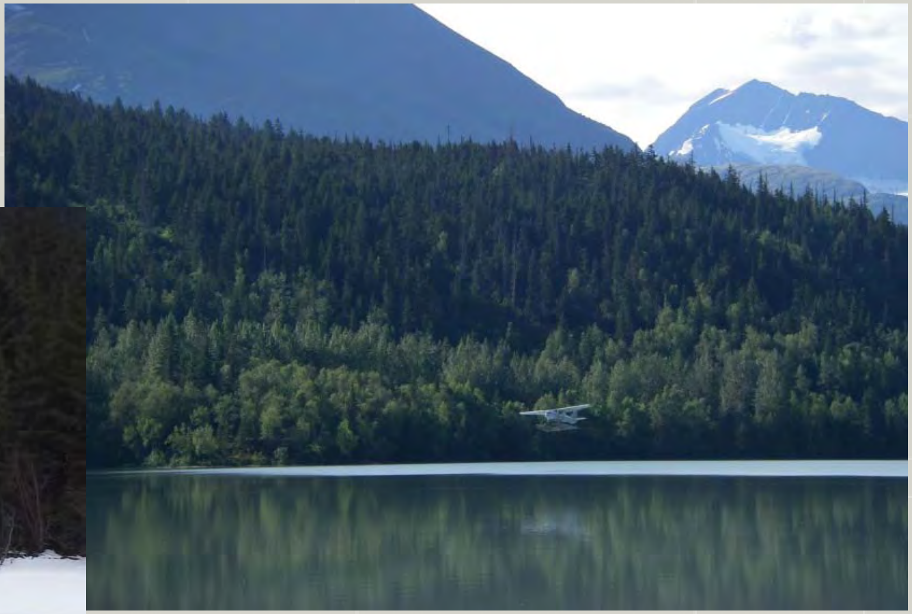
Observed Summer Uses:

- Fishing & boating
- ATV use
- Hiking
- Driving for pleasure & Sight-seeing
- Dog-walking

Recreation & Visual Resources Study

Noise:

- Recorded levels 40db or less, background hum from highway
- Peak noises (80-90db) caused by aircraft take-offs and snowmachine use

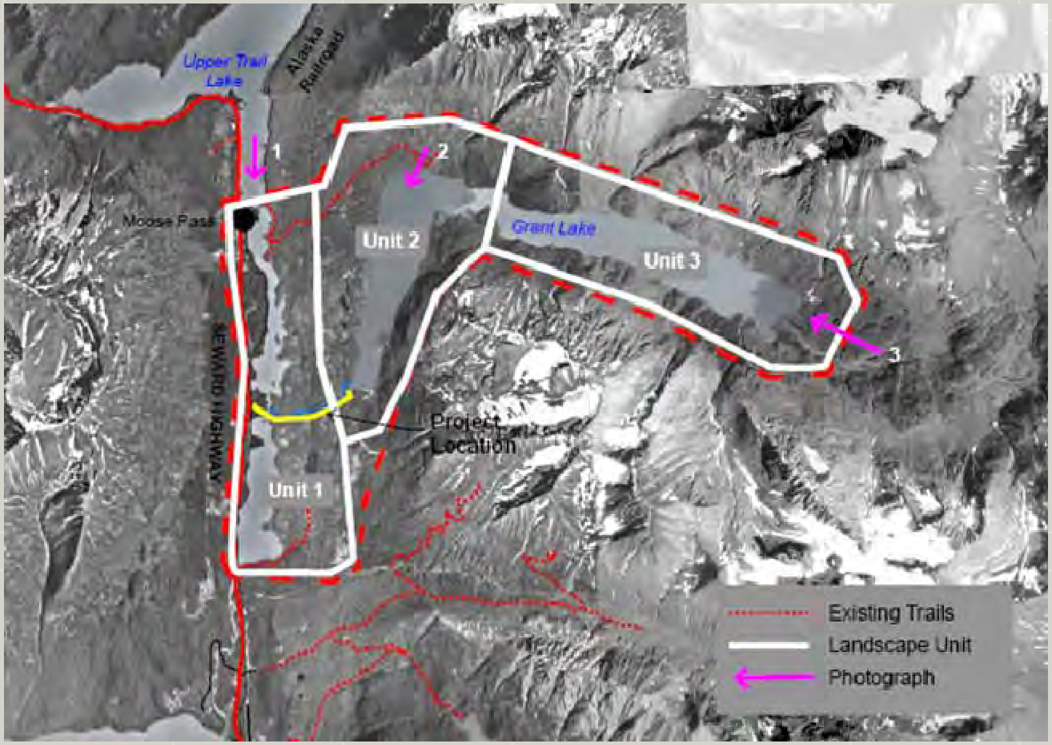


Recreation and Visual Resources Study

- Possible Impacts:
  - Possible increased access to non-salmon fishing
  - Possible increased access to INHT
  - Possible increased access to Grant Lake
  - Possible increased hunting pressure for all large game
  - Noise limited to occasional maintenance vehicles and noise within Powerhouse
  - Minimal light pollution limited to Powerhouse building

Recreation and Visual Resources Study

- Component #2 – Visual Resources
  - USFS – *Landscape Aesthetics: A Handbook for Scenery Management*
  - Ecological Units
    1. Trail Lakes Valley
    2. Grant Lake West
    3. Grant Lake East



Recreation and Visual Resources Study

- Viewers: Who will be seeing the Project's impacts and what are they sensitive to?

Viewer Group	Expected Values
Residents	Generally a desire for protection of visual quality, including views from roadways, waterways, and individual residences. Generally cautious concerning changes to visual environment.
Recreationists/ Tourists	Includes both road and rail traffic. Generally high appreciation for visual quality of an area and desire for undisturbed areas. Also share a desire for views from roadways and waterways.
Aircraft	High variability in visual values and the acceptance of changes to existing visual conditions. Many are sight-seers with high degree of sensitivity to visual quality.

*USFS – *Landscape Aesthetics: A Handbook for Scenery Management*

Recreation and Visual Resources Study

- Distance Zones, Viewer Exposure, & Seasonal Variations:

Distance Zones	Distance	Description	Distance Zones
Foreground (fg)	0 – 0.5 miles	Distinguish vegetative detail and full use of senses	Foreground (fg)
Middleground (mg)	0.5 – 4 miles	Distinguish large boulders, small openings in the forest	Middleground (mg)
Background (bg)	4 miles to horizon	Distinguish groves of trees, large openings in the forest.	Background (bg)

Viewer Group	Exposure Period
Residents	Continual
Recreationists/ Tourists	Varies-generally minutes
Aircraft	Varies-generally seconds or minutes

*USFS – *Landscape Aesthetics: A Handbook for Scenery Management*

Recreation and Visual Resources Study

- Scenic Attractiveness:

Class	Title	Description
A	Distinctive	Areas where landform, vegetative patterns, water characteristic and cultural features combine to provide unusual, unique, or outstanding scenic quality. These landscapes have strong positive attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.
B	Typical	Areas where landform, vegetative patterns, water characteristics, and cultural features combine to provide ordinary or common scenic quality. These landscapes have generally positive, yet common, attributes of variety, unity, vividness, mystery, intactness, order harmony, uniqueness, pattern, and balance. Normally they would form the basic matrix within the ecological unit.
C	Indistinctive	Areas where landform, vegetative patterns, water characteristics, and cultural land use have low scenic quality. Often water and rockform of any consequence are missing in class C landscapes. These landscapes have weak or missing attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

- Scenic Classes:

		Distance Zone and Concern Levels		
		Fg1	Mg1	Bg1
Scenic Attractiveness	A	1	1	1
	B	1	2	2
	C	1	2	3

*USFS – *Landscape Aesthetics: A Handbook for Scenery Management*

Recreation and Visual Resources Study

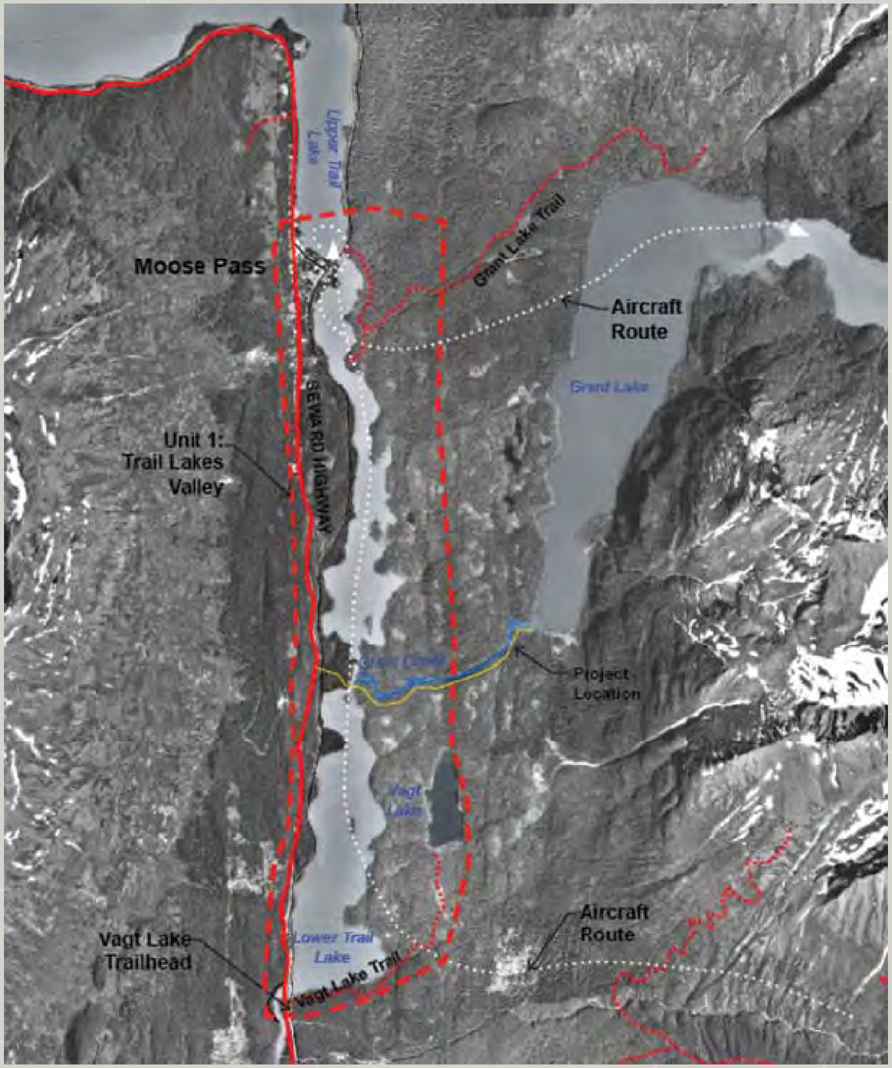
- Landscape Analysis Discussion
  - Unit 1: Trail lakes Valley

Photograph 1: Looking South, Upper and Lower Trail Lakes, Vagt Lake, Kenai Lake, Seward Hwy, and Moose Pass

Recreation and Visual Resources Study

- Unit 1: Trail Lakes Valley:
  - Foreground views
  - Variable terrain & vegetation
  - Landforms
  - Highly variable viewsheds
  - High scenic attractiveness
  - Moderately intact

- Possible Impacts:
  - Powerline connection across Seward Hwy
  - Bridge at narrows
  - Crossing of INHT
  - Access road visible from creek at some locations



Recreation and Visual Resources Study

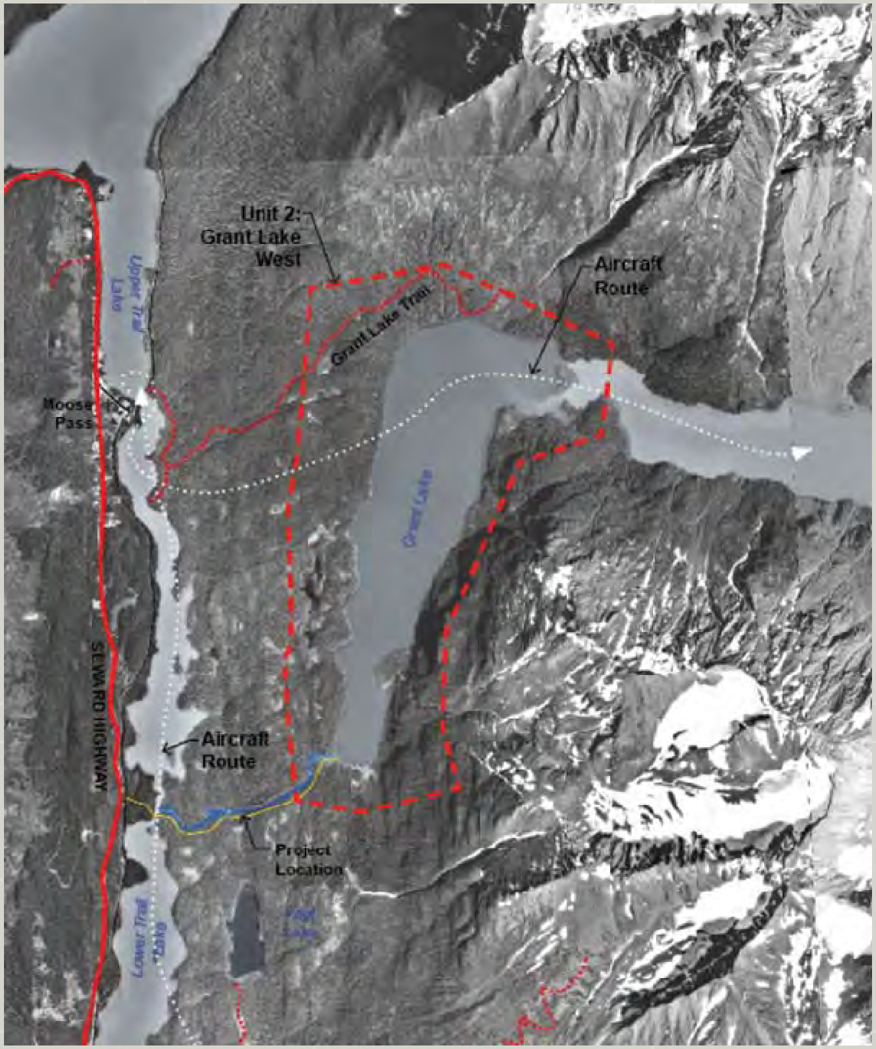
- Landscape Analysis Discussion
  - Unit 2: Grant Lake West

Photograph 2: Looking South across Grant Lake

Recreation and Visual Resources Study

- Unit 2: Grant Lake West:
  - Foreground & middleground
  - Highly distinctive/attractive
  - Virtually intact
  - Unseen by highway
  - Limited viewers

- Possible Impacts:
  - Intake structure with access road will be exposed



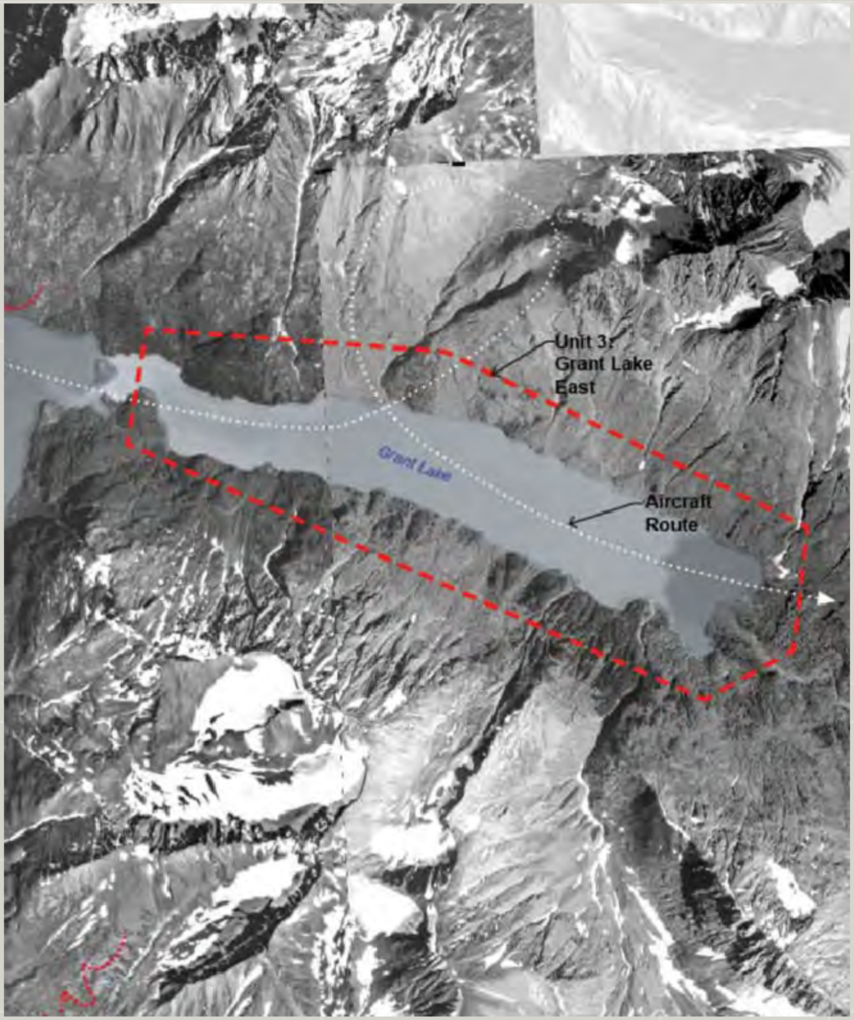
Recreation and Visual Resources Study

- Landscape Analysis Discussion
  - Unit 3: Grant Lake East

Photograph 3: Looking West across Grant Lake

Recreation and Visual Resources Study

- Unit 3: Grant Lake East:
  - Viewer group limited to hunters, sight-seers, no trail access
  - Highly distinctive, managed as wilderness
- Possible Impacts:
  - Lake level after Project may vary above present levels



Recreation and Visual Resources Study

- Key View #1: Access Road from Seward Hwy MP 26.9

BEFORE:

Existing driveway

AFTER:

Driveway relocated to new access road

Recreation and Visual Resources Study

- Key View #2: View of Intake Structure and Lake Shoreline

BEFORE:

Existing creek outfall

AFTER:

Powerhouse, detention pond, spillover, seasonal access road, intake structure, drying of creekbed.

Recreation and Visual Resources Study

- Key View #3: View of Facilities from Seward Hwy

BEFORE:

Existing view toward facilities

AFTER:

Seasonal access road in distance, most exposed during winter conditions

Recreation and Visual Resources Study

- Key View #4: Access Road or Powerhouse from the Right-of-Way for the Proposed INHT

BEFORE:

Existing view through forest

AFTER:

Intersection of INHT with access road

Recreation and Visual Resources Study

- Impacts to Visual Resources and Possible Mitigation:
  - Impacts are localized and mostly unseen
  - Opportunity to increase views with INHT reroute

Grant Lake Hydroelectric Project (FERC No. 13212)
Water Resources Studies - Geomorphology
March 18, 2014 – Anchorage, AK





MCMILLEN
DESIGN with Vision. BUILD with Integrity.

In Association with

HEA

Geomorphology Study

Paul Pittman – Element Solutions

- Contact Information:

Element Solutions
1812 Cornwall Avenue, Bellingham, WA 98225
p 360.671.9172 | c 360.815.4177 | f 360.671.4685
ppittman@elementsolutions.org | www.elementsolutions.org

Geomorphology Study Purpose

Two Separate Studies:

1. The **Shoreline erosion** study to consider changes in shoreline erosion resulting from lake impoundment and drawdown scenarios.
2. The **spawning substrate recruitment study** was to provide a basis for predicting and assessing potential changes to material movement, sedimentation, and gravel recruitment that may occur in Grant Creek with proposed operational management, especially as related to the long-term maintenance of fish spawning substrate.

.

Geomorphology – Grant Lake Shoreline Erosion

Background

Two concepts are currently being evaluated for water control at the outlet of Grant Lake:

1. The first option would consist of a natural lake outlet that would provide control of flows out of Grant Lake.
2. The second option, would consist of a concrete gravity diversion structure constructed near the outlet of Grant Lake that would increase Water Surface Elevation (WSE) by 2 feet.

Geomorphology – Grant Lake Shoreline Erosion

– Methods
  - Desk-top GIS analysis
  - Existing shoreline condition inventory (boat-based field assessment, geo-referenced photos, field interpretation and GIS-based mapping product)
  - Prediction of potential geomorphic response classified by "geomorphic unit" integrated with fetch and field indicators to assess "relative erodiblity".

Relative Fetch Distance	Geomorphic Unit					
	Alluvial Deltaic	Alluvial Fan	Beach	Colluvium	Landslide (bedrock)	Bedrock
Short	Moderate	Moderate	Moderate	Low	Low	Low
Medium	Moderate-High	Moderate-High	Moderate-High	Moderate-Low	Moderate-Low	Low
Long	High	High	High	Moderate	Moderate	Low

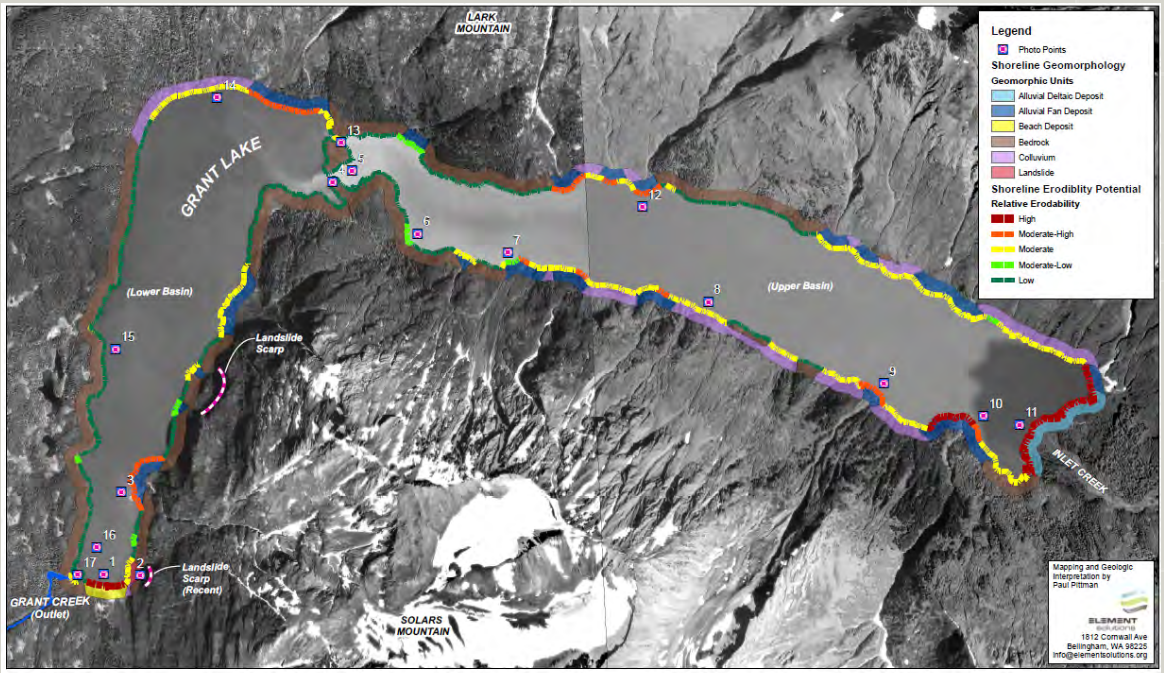
Geomorphology – Grant Lake Shoreline Erosion

– Observations

  • Grant Lake is located in a deep glacially-carved basin flanked by the high bedrock peaks of Lark and Solars Mountains

Geomorphology –
Grant Lake Shoreline Erosion

- Observations
  - Grant Lake encompasses two almost separate bathymetric lake basins that are separated by a shallow submerged ridge at a narrow “neck” that connects the two basins

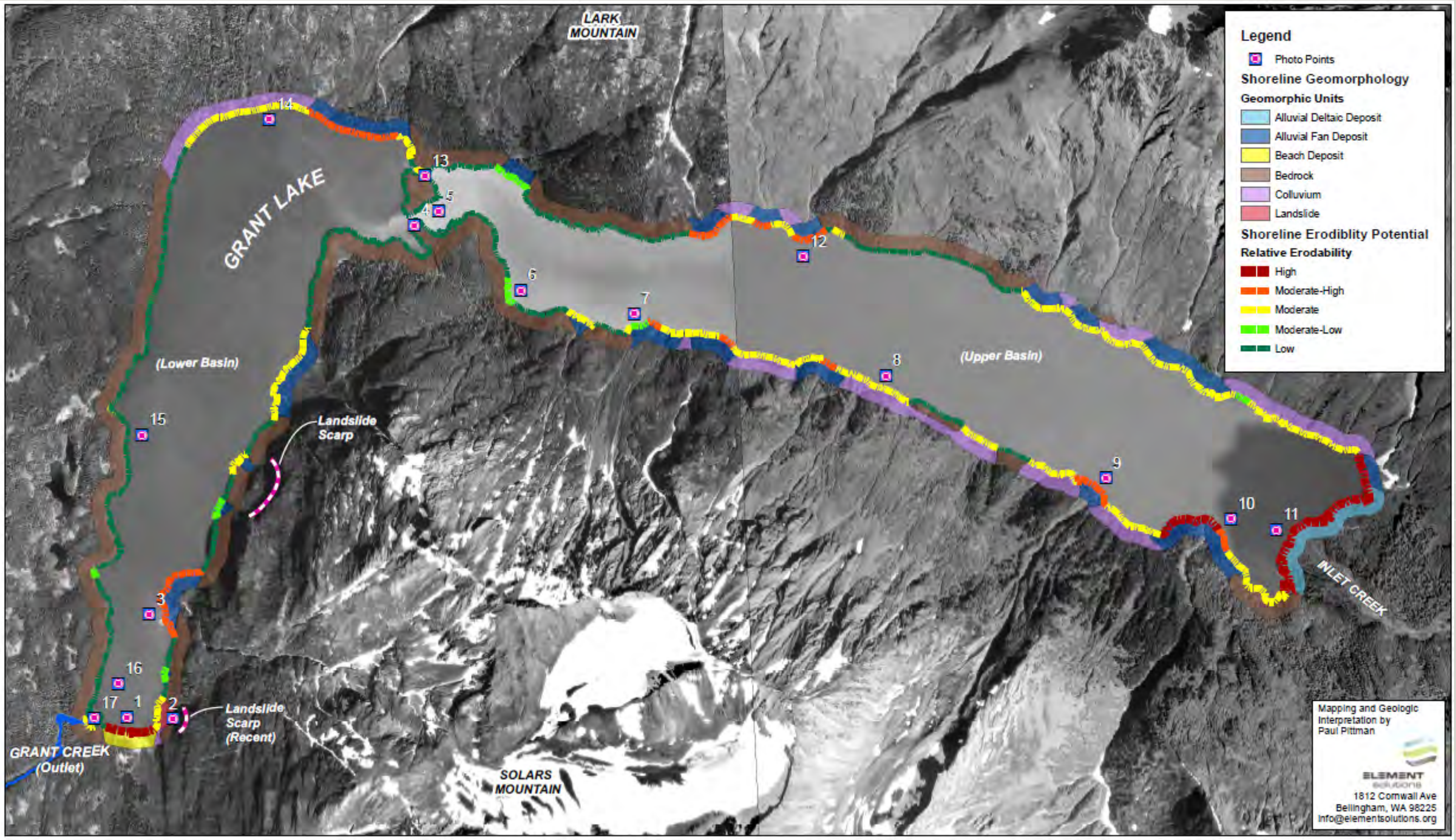


Geomorphology – Grant Lake Shoreline Erosion

– Observations
  - Much of the overall shoreline zone is steep bedrock

Geomorphology –
Grant Lake Shoreline Erosion

Findings



Geomorphology – Grant Lake Shoreline Erosion

– Findings

Operations will affect the timing, duration and range of WSE, and thus change the Grant Lake shoreline erosional patterns. In summary, an increase in WSE under the diversion structure scenario will cause:

- Landward regression, more prominent in areas of low sloping shoreline
- Loss of shoreline vegetation within the zone between existing OHWM and management scenario OHWM
- Higher erosion potential in areas with large fetch and more erodable, unconsolidated shoreline geology, but wind wave erosion is anticipated to be relatively minor and localized
- Stream incision from reduced WSE will result, but effects will be localized to deltaic and alluvial fan areas adjacent to the shoreline

Geomorphology – Grant Lake Shoreline Erosion

- Conclusions
  - Effects of wind-driven waves limited by fetch
  - Steep, bedrock or coarse sediment dominant shoreline
  - Impacts are greater for weir alternative, but they are anticipated to be temporary and limited to area within OHWM
  - Net changes to shoreline erosion from WSE variability resulting from proposed management scenarios are anticipated to be relatively minor and localized

Geomorphology – Grant Creek Sediment Transport

– Background

- Operation of the Project would alter the flow regime and create a situation where flow will bypass the canyon reach

Geomorphology – Grant Creek Sediment Transport

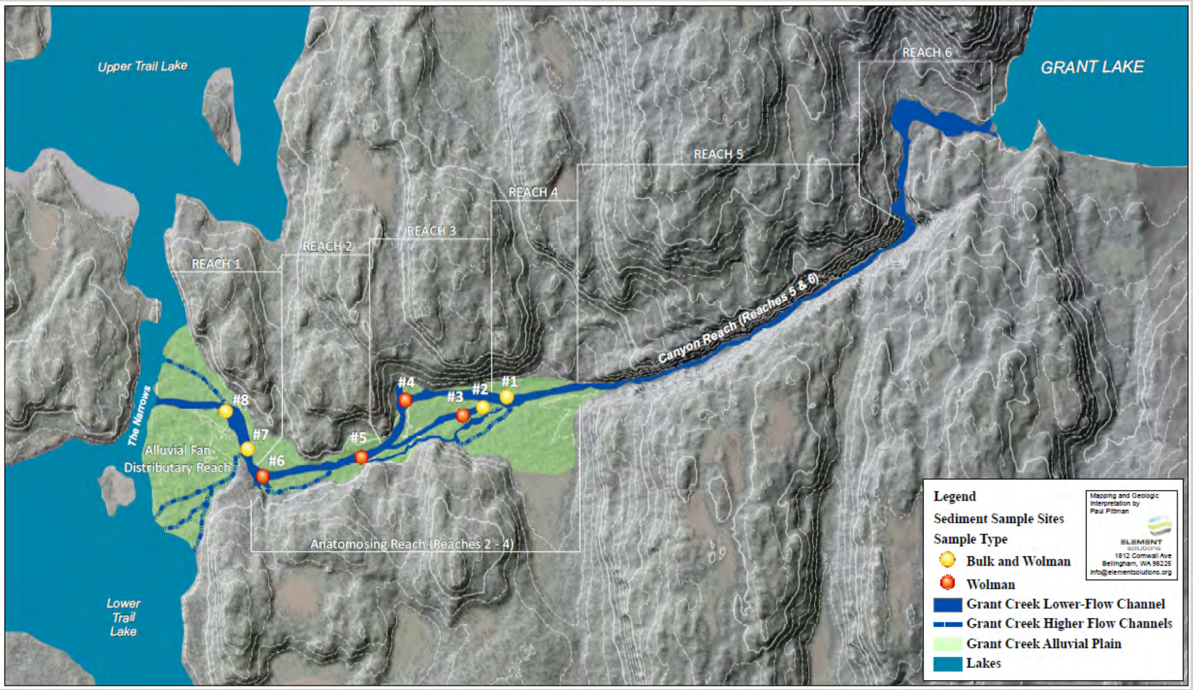
– Methods

- Desktop analysis (geomorphic mapping and characterization)
- Field sediment characterization (surface and subsurface) at anticipated spawning areas (*see map handout*)
- Field geomorphic characterization (sediment inputs, channel form, transport/deposition)
- Considered use of existing transport equations to predict potential bedload sediment transport changes under management scenarios

Geomorphology – Grant Creek Sediment Transport

– Observations

- In its upper half, Grant Creek passes through a steep bedrock canyon with three substantial waterfalls. The canyon is the primary bedload sediment source.
- In its lower half, Grant Creek becomes less steep with boulder and cobble dominant alluvial substrate .

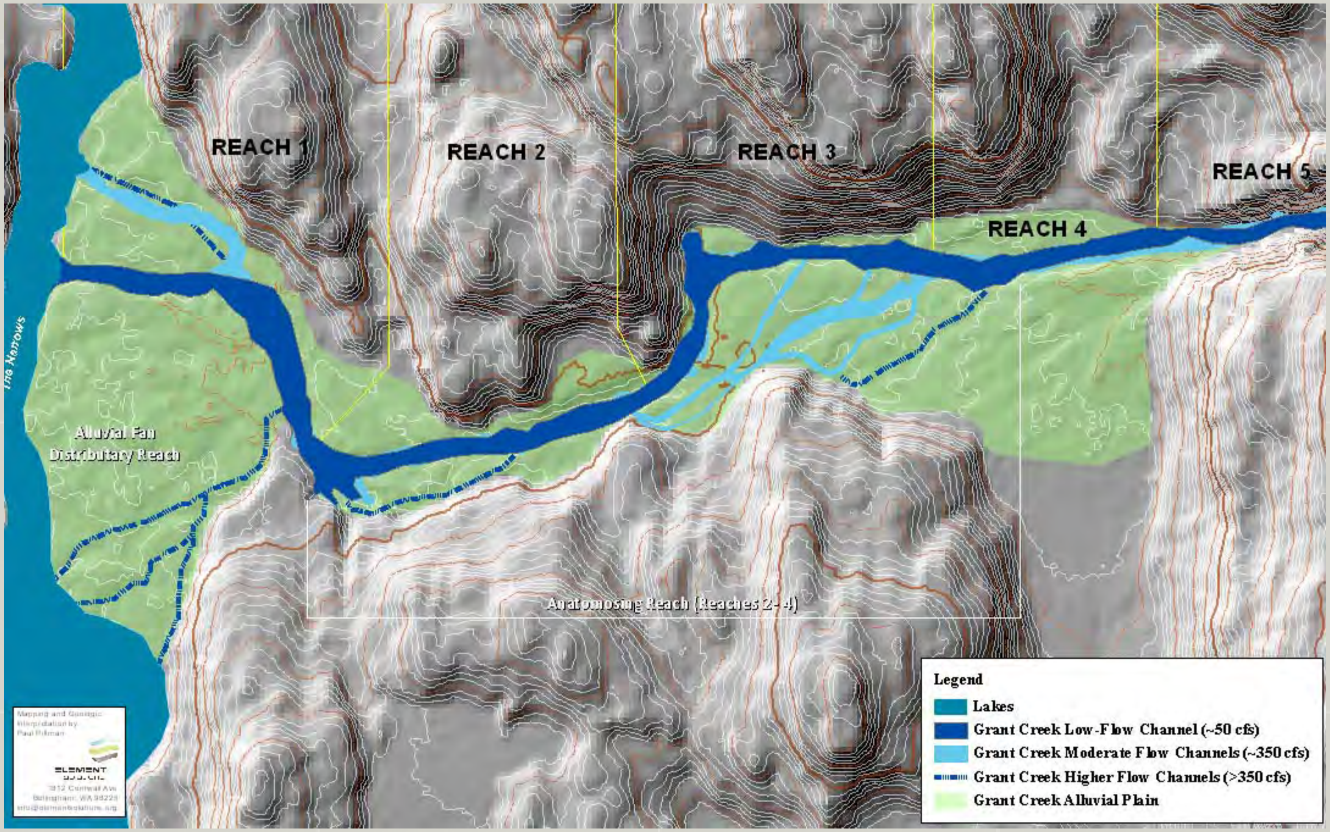


Geomorphology –
Grant Creek Sediment Transport

– Observations
  - Grant Creek is a high energy, turbulent stream with a wide variability in flow regime.

Geomorphology –
Grant Creek Sediment Transport

- Observations
  - Very large eposidic “events” are the primary drivers of alluvial plain morphology



Geomorphology –
Grant Creek Sediment Transport

- Observations
  - Substrate was very angular and either blocky (large a axis, similar b-c axes) or platy (similar a-b axes, small c axis) and related to canyon geology

Geomorphology – Grant Creek Sediment Transport

– Observations

- Although there is a great variability in spawning substrate size preference between individual fish, different species and different river systems, the salmon in Grant Creek appear to use large substrate limited only by their physical ability to dislodge it

Geomorphology – Grant Creek Sediment Transport

– Observations Continued

  • Sediment deposition demonstrated “hiding” and surface sediment was in general fairly “locked” and locally armored

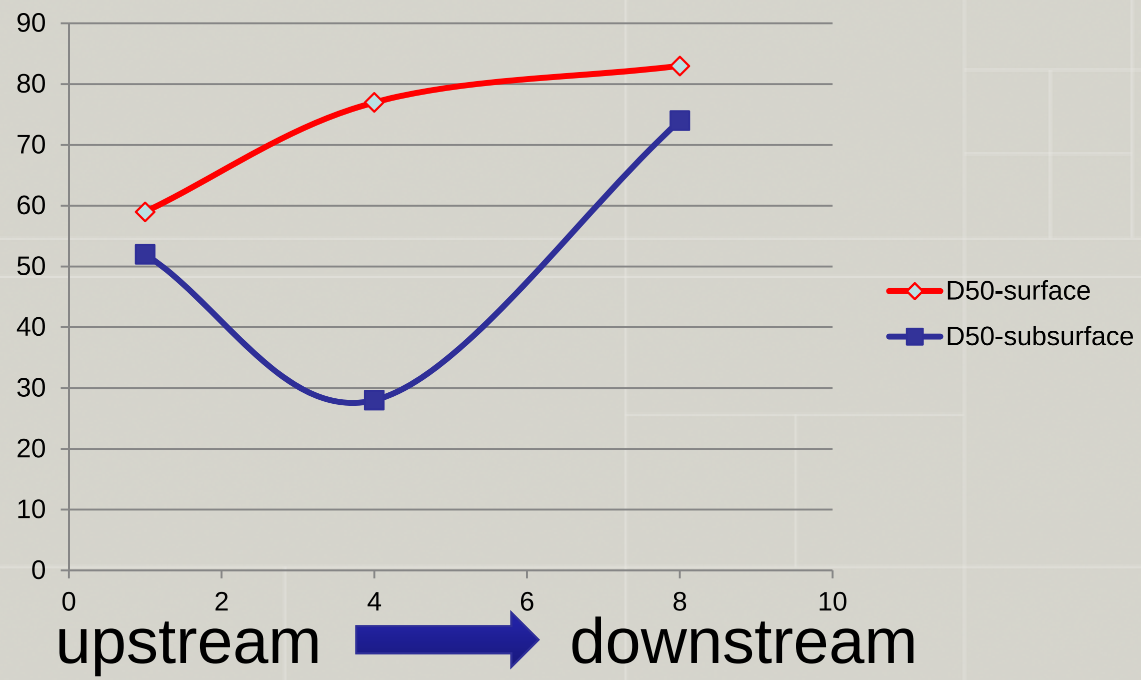
Geomorphology – Grant Creek Sediment Transport

– Observations Continued

- Stream flow turbulence exacerbated by boulder “lag” and bedforms and was hydraulically complex

Geomorphology – Grant Creek Sediment Transport

- Observations Continued
  - Bedload sediment in general was course, well-graded, and “clean”
  - No anticipated trends in downstream fining were measured in either surface or subsurface measurements



Geomorphology – Grant Creek Sediment Transport

– Findings

- Attempts to calculate or measure shear stress values in mountain rivers are complicated by the channel bed roughness and the associated turbulence and velocity fluctuations (Wohl, 2000), in addition to sediment particle shape, lag deposits, and armoring further reduced confidence in qualitative assessments (Yager 2012)
- It is probable that the flow regime under management scenarios (>385 cfs) is sufficient to only mobilize or re-mobilize some small diameter bedload sediment (~62 mm-*blocky*, but confidence in this value is low)
- The sediment supply to lower Grant Creek will decrease with the canyon bypass

Geomorphology – Grant Creek Sediment Transport

– Findings continued

- Channel bed substrate is anticipated to coarsen or armor (surface and near surface) and increase in pavement thickness
- The diversity of bedform morphology and associated hydraulic complexity is anticipated to decrease under a managed flow regime
- Channel morphology complexity and floodplain connectivity is anticipated to decrease with reduced sediment input

Geomorphology – Grant Creek Sediment Transport

- Conclusions
  - The anticipated physical changes to the fluvial system are predicted to have ecological impacts, but these potential changes were not quantified
  - Potential mitigation actions to reduce some of the impacts exist
    - Sediment supply mitigation
      - Providing canyon flows
      - Providing sediment nourishment
    - Flow variability mitigation
      - Providing variable “channel maintenance” flows (high to low)

Geomorphology – Questions….?

Paul Pittman

p 360.671.9172

c 360.815.4177

ppittman@elementsolutions.org

Grant Lake Engineering Feasibility

March 18, 2014

MCMILLEN

DESIGN with Vision. BUILD with Integrity.

In Association with

HEA

Presentation Outline

- Historical review
- Itemized status of tasks
- Project configuration and operational scenarios
- Deliverables
- Next steps
- Questions/comments

Historical Review – Previous Studies

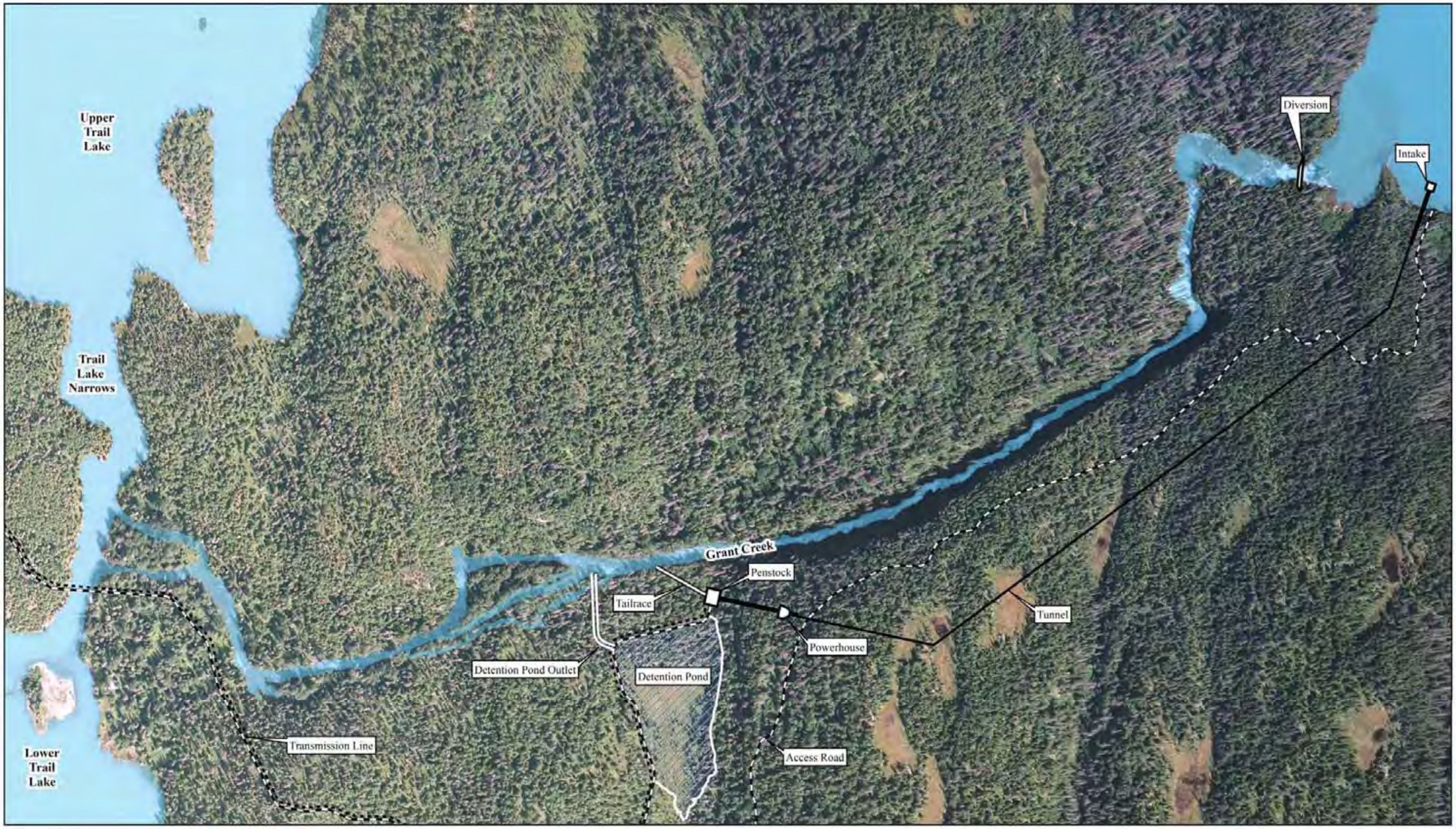
Year	Study
1954	R.W. Beck and Associates preliminary investigation
1955	U.S.G.S geological investigations of proposed power sites at Cooper, Ptarmagin, and Crescent Lake
1980	CH2M Hill pre-feasibility study
1981	USACE National Hydroelectric Power Resources Study
1984	Ebasco Services Project Feasibility Analysis
2009-10	HDR site evaluation and analysis

Itemized Status of Tasks

Task	Description	Status
1.0	Data Collection and Site Visit	Complete
2.0	Surveys and Mapping	Ongoing
3.0	Geotechnical Investigations	Internal draft review
4.0	Hydrologic Analysis	Draft TM
5.0	Hydraulic Analysis	Draft TM
6.0	Operation and Generation Analysis	Initial model complete
7.0	Alternatives Development and Evaluation	To be completed
8.0	Cost Estimates and Financial Analysis	To be completed
9.0	Project Schedule/Construction Methodology	To be completed
10.0	Preliminary Design Report	To be completed
11.0	Prepare FERC Exhibits	To be completed

Current Project Configuration and Operational Scenarios

- Lake intake
- 3200 ft long tunnel
- 8-ft diameter surge chamber near tunnel outlet
- 360 ft long steel penstock
- 45-ft by 60-ft powerhouse
- Evaluating turbine-generator options
- Powerhouse access road/intake access road
- Transmission line and substation



N
0 150 300 600 Feet

MCMILLEN, LLC

Homer Electric Association, Inc.
A Touchstone Energy® Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

GRANT LAKE NATURAL RESOURCES STUDY

Proposed Hydroelectric Project Infrastructure

J. Woodbury
J. Woodbury
C. Warnock
3/10/2014
1:4,000

Current Scenarios – FERC License Application

- Use previous alternatives from Ebasco report for basis of alternatives development and evaluation
- Alternatives A, B, C involve raising the lake level and will be used for basis of comparison
- Alternatives D, E (and others) will be used for lake tap with no lake raise and various powerhouse size configurations

Current Scenarios – Example

Alt.	Description	Features
A	Intake Upstream from Saddle Dam	Two dams, penstock, surge tank, powerhouse, transmission, access roads
B	Intake at Main Dam with Tunnel and Surface Conduit	Two dams, two powerhouses, surge tank, tunnel, transmission, access roads
C	Intake at Main Dam with Surface Conduit	Similar to Alt. B
D	Lake Tap with Two Equal Size Units Powerhouse	Lake tap intake, tunnel, penstock, surge tank, powerhouse, access roads, and transmission
E	Lake Tap with One Small and One Large Unit Powerhouse	Lake tap intake, tunnel, penstock, surge tank, powerhouse, access roads, and transmission

Deliverables – Engineering Work Tasks

Task	Description	Deliverable
1.0	Data Collection and Site Visit	Bibliography
2.0	Surveys and Mapping	Boundary survey
3.0	Geotechnical Investigations	Preliminary Report
4.0	Hydrologic Analysis	Technical Memo
5.0	Hydraulic Analysis	Technical Memo
6.0	Operation and Generation Analysis	Technical Memo
7.0	Alternatives Development and Evaluation	Technical Memo
8.0	Cost Estimates and Financial Analysis	Technical Memo
9.0	Project Schedule/Construction Methodology	Technical Memo
10.0	Preliminary Design Report	Draft/Final Report
11.0	Prepare FERC Exhibits	Exhibits A thru G

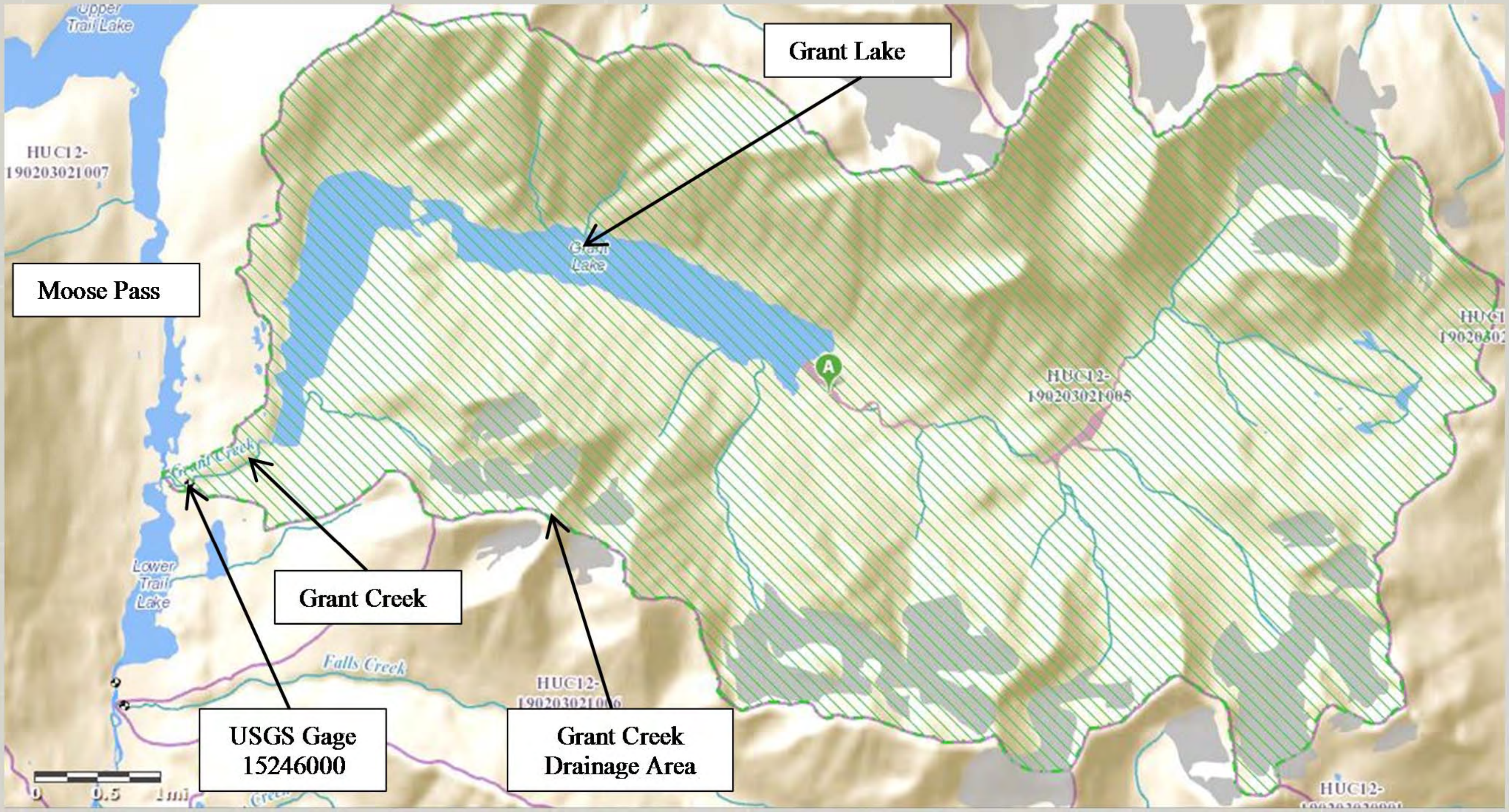
Summary - Work Completed

- Review draft Hydrology TM results
- Review draft Hydraulics TM results
- Summarize approach to geotechnical site assessment
- Outline operational/generation model
- Present next work tasks steps and schedule

Hydrologic Review – Purpose and Scope

- Complete an independent review and analysis of previous hydrologic analyses using available gage data and basin characteristics
- Determine the peak stream flow magnitude and frequency discharges
- Complete a flow duration and mean daily flow analysis to use in the Project energy production evaluation

Hydrologic Review – Basin Map



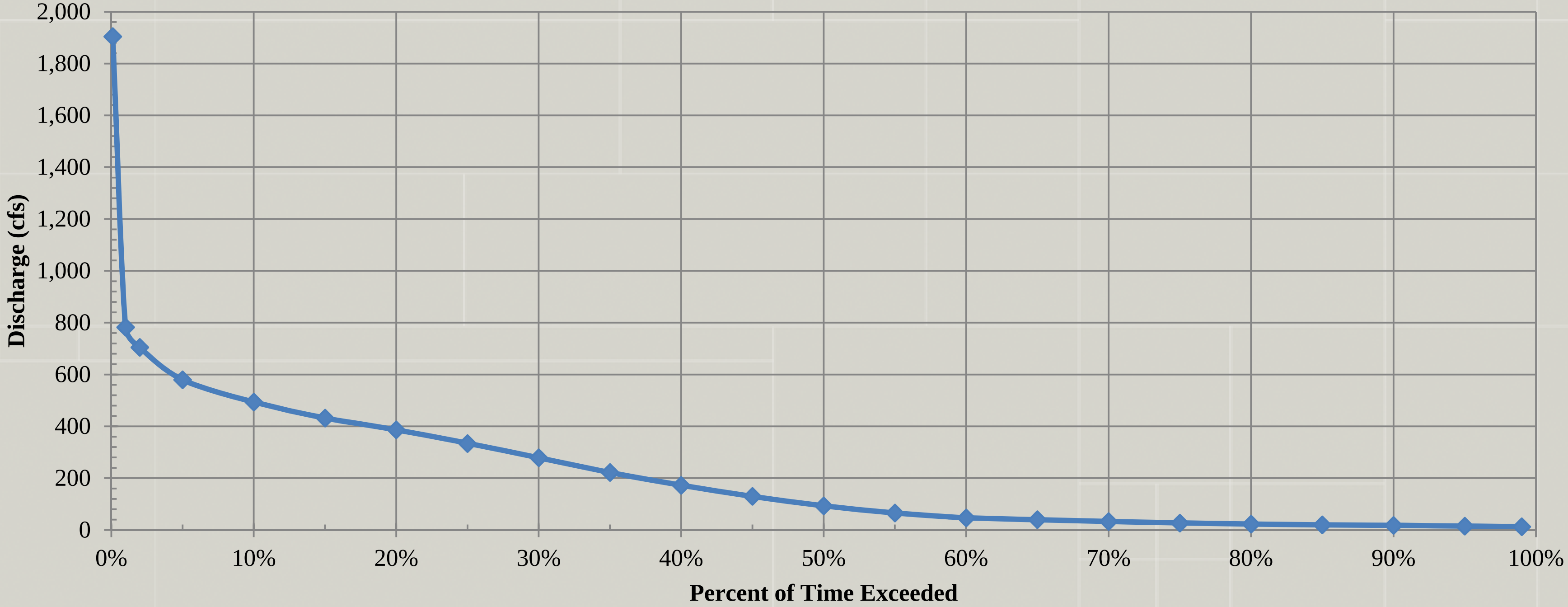
Hydrologic Review – Characteristics

Item	Value
USGS Station No.	15246000
Station Name	Grant Lake near Moose Pass, AK
Drainage Area	44.2 square miles
Mean Basin Elevation	2,900 ft
Areas of Lakes and Ponds (storage)	10%
Area of Forest	20%
Mean Annual Precipitation	90 inches
Mean Min. January Temperature	10 o F

Hydrologic Review – Flow Duration

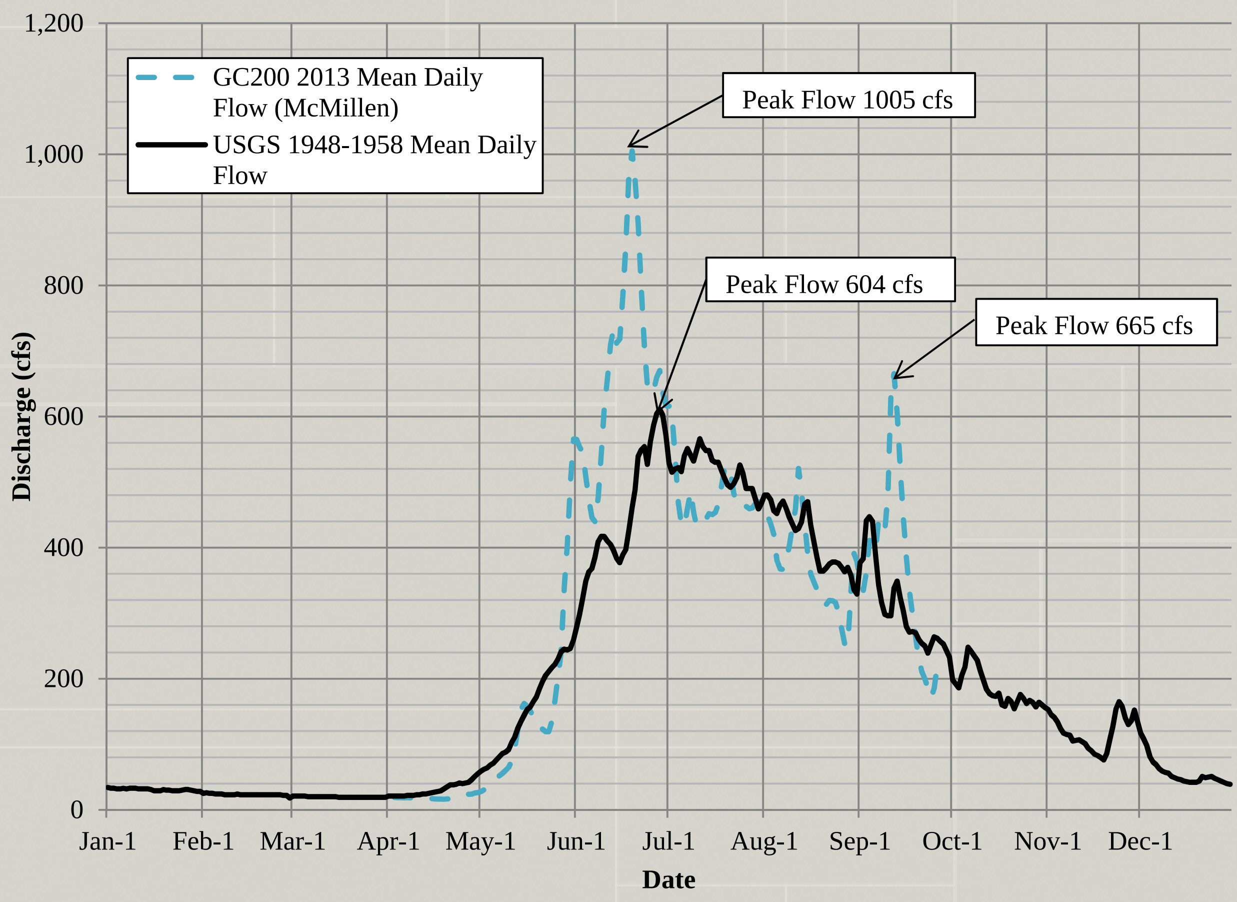
Percent of Time Exceeded	Grant Creek Discharge (cfs)
95%	15
90%	18
80%	23
70%	33
60%	47
50%	93
40%	172
30%	279
20%	387
10%	494
5%	580

Hydrologic Review – Flow Duration



Grant Creek Flow Duration Analysis

Hydrologic Review – Mean Daily Flow



Grant Creek Mean Daily Flow - 1948-1958 and 2013 (Calendar Year)

Hydrologic Review – Mean Annual Flow

Calendar Year	Grant Creek Annual Mean Discharge (cfs)	Classification Based on Long Term Kenai River Record
1948	193.9	Normal
1949	193.4	Normal
1950	181.1	Dry
1951	175.3	Dry
1952	209.5*	Dry
1953	275.1	Wet
1954	173.8	Dry
1955	162.5	Dry
1956	148.7	Dry
1957	202.3	Wet

* Outlier

Hydrologic Review – Conclusions

- Current analysis results were consistent with previous analyses
- 95% exceedance flow of 15 cfs
- 5% exceedance flow of 580 cfs
- 20% exceedance flow of 387 cfs
- 100-year flood of 3,310 cfs for powerhouse flood protection

Hydraulic Review – Purpose and Scope

- Determine the water surface profiles along Grant Creek for various flows
- Develop a tailwater rating curve for the powerhouse tailrace channel
- Determine the 100-year water surface at the powerhouse proposed location
- Provide the design flow and head assumptions for various generation scenarios/turbine-generator configurations

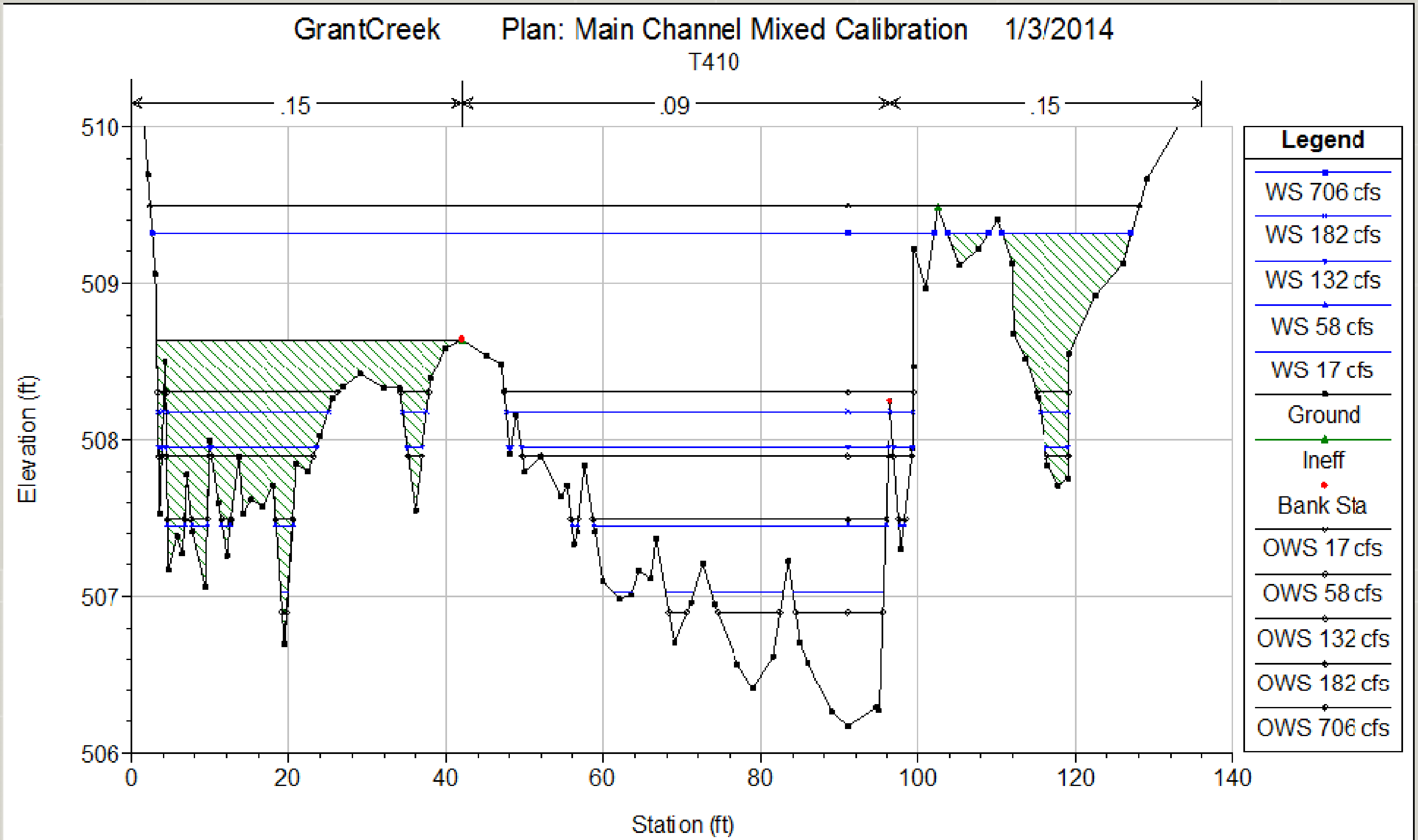
Hydraulic Review – HECRAS Model

- Purpose of the model – to fill in the gaps in the hydraulic record and perform simulation of various flow regimes
- Uses IFIM cross-sections to develop the basic model geometry
- Input hydrologic flow values determined in TM 1
- Calibrated using field measured water surfaces conducted to support the IFIM analysis

Hydraulic Review – HECRAS Model

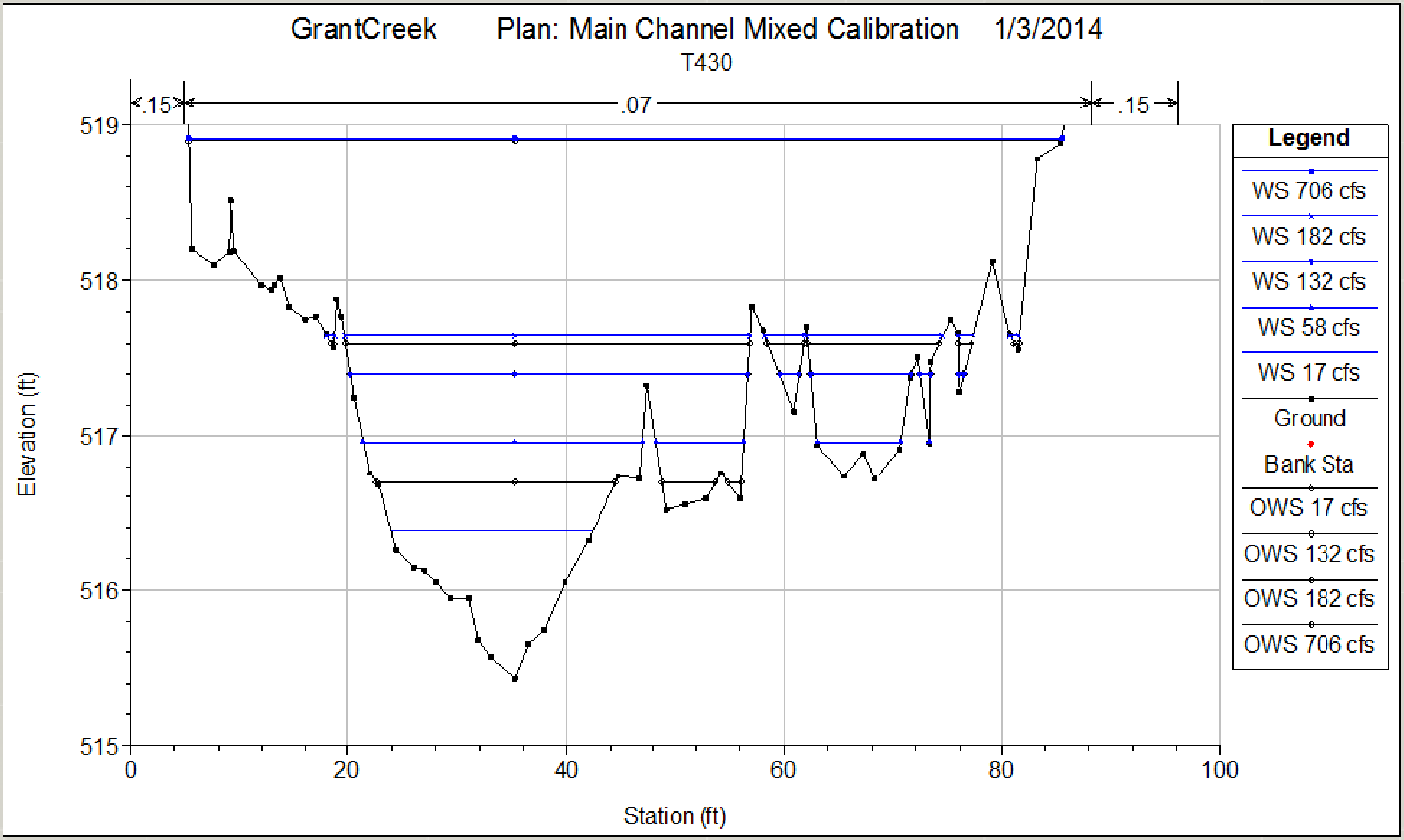
Cross Section Name (IFIM Study)	HEC-RAS Station (ft)	Main Channel Roughness (n)	Overbank Roughness (n)
T220	50	0.07	0.10
T230	82	0.07	0.10
T300	932	0.07	0.10
T310	1061	0.07	0.10
T400	1381	0.07	0.08
T410	1435	0.09	0.15
T430	1865	0.07	0.15
T510	2110	0.07	0.15

Hydraulic Review – Model Calibration



Modeled (WS) vs. Observed Water Surface (OWS) Elevations – Cross Section T410

Hydraulic Review – Model Calibration

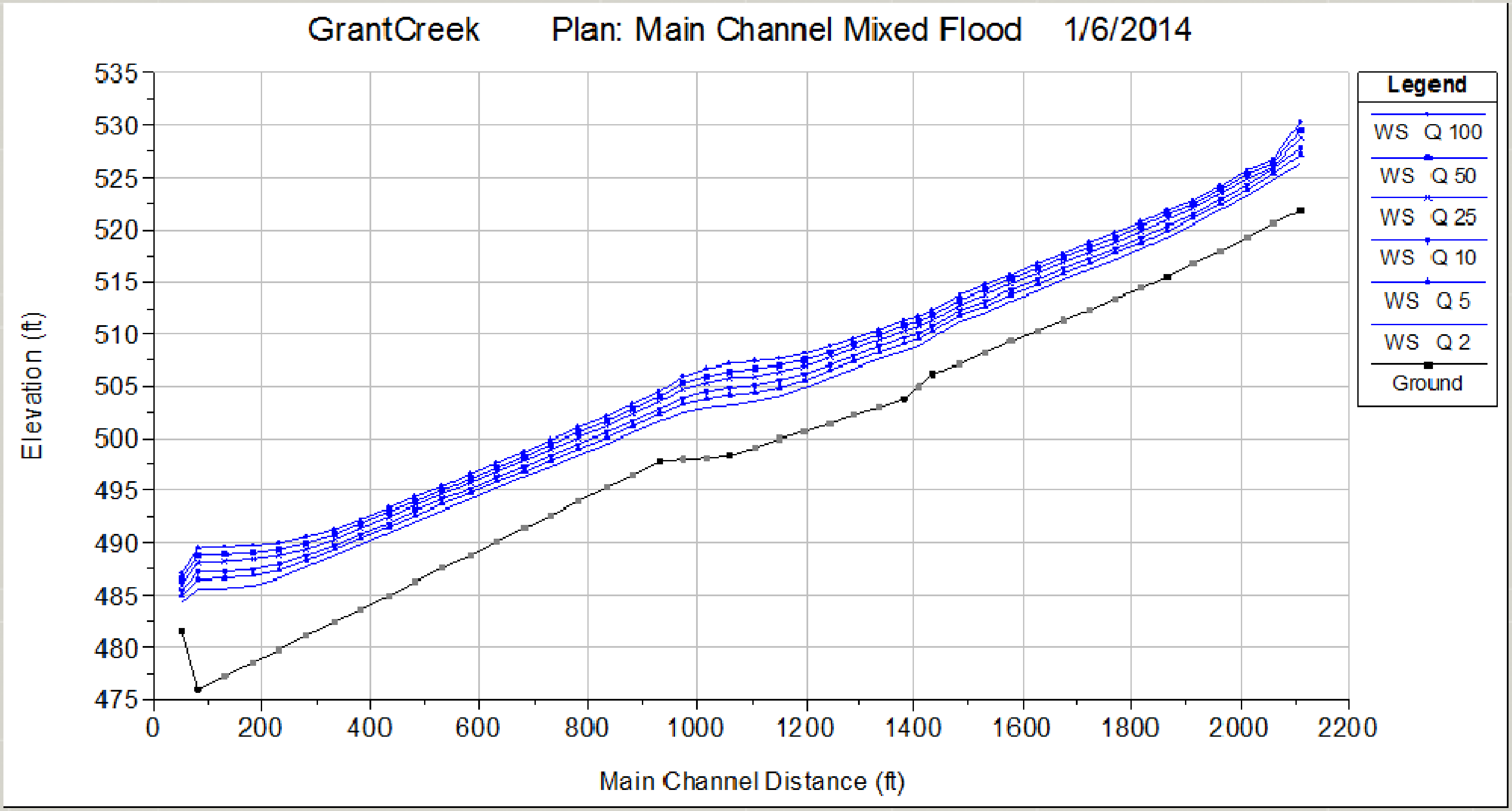


Modeled (WS) vs. Observed Water Surface (OWS) Elevations – Cross Section T430

Hydraulic Review – Model Sensitivity

	T410 (Sta. 1435)		T430 (Sta. 1865)	
	Calibration n-values	Sensitivity n-values	Calibration n-values	Sensitivity n-values
Discharge (cfs)	W.S. Elev. (ft)	W.S. Elev. (ft)	W.S. Elev. (ft)	W.S. Elev. (ft)
17	507.0	506.9	516.4	516.3
58	507.5	507.3	517.0	516.9
132	508.0	507.7	517.4	517.2
182	508.2	507.9	517.6	517.5
706	509.3	509.0	518.9	518.6
961 (2-year)	509.7	509.3	519.3	519.0
3310 (100-year)	512.3	511.4	521.8	521.2

Hydraulic Review – Profiles



Grant Creek Hydraulic Profiles – 2-year through 100-year Floods

Hydraulic Review – Flood Water Surface

Discharge (cfs)	Flood Frequency	Water Surface Elevation (ft)
961	2-year	515.1
1410	5-year	515.8
1790	10-year	516.3
2350	25-year	516.9
2810	50-year	517.3
3310	100-year	517.8

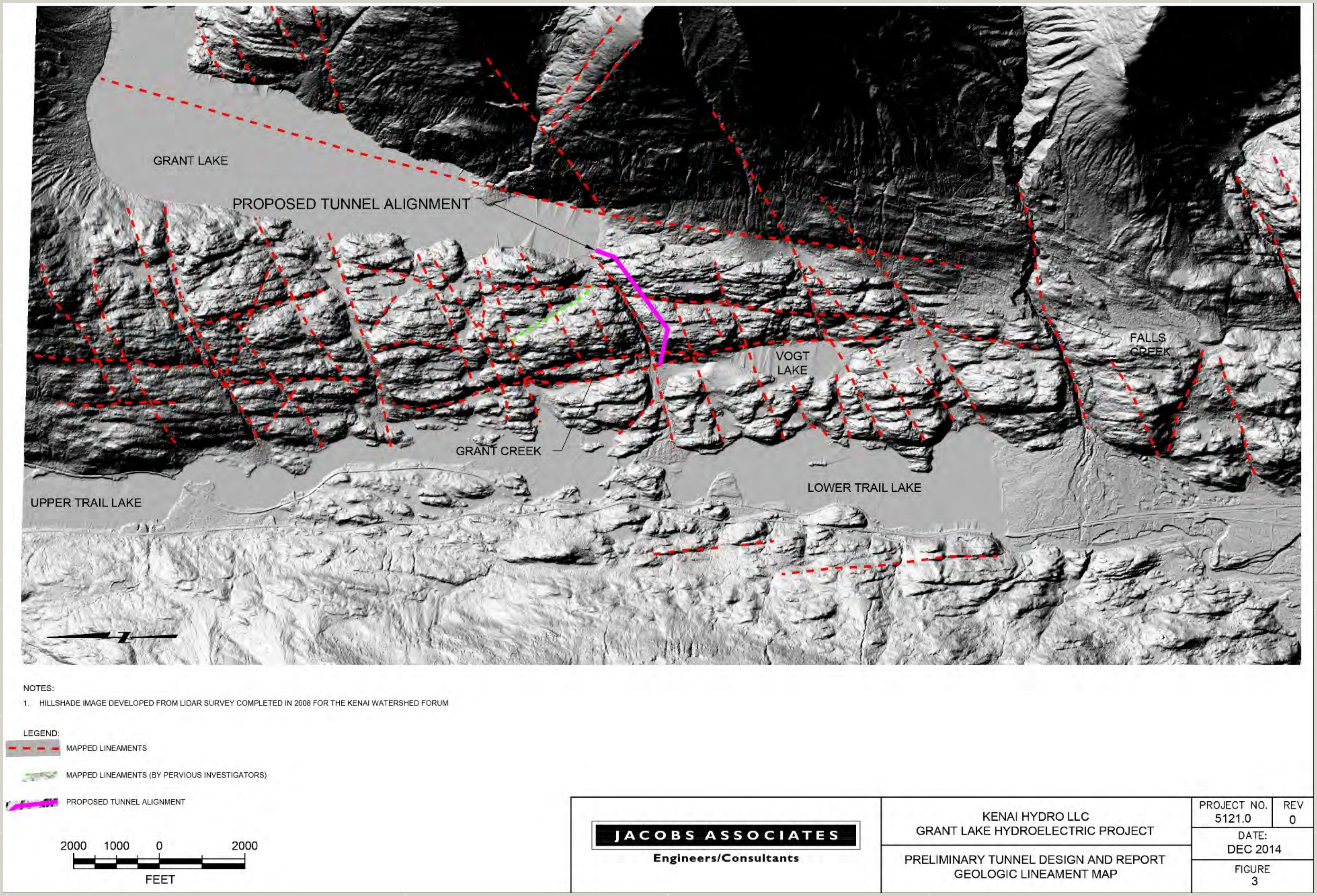
Hydraulic Review – Conclusions

- Design 100-year flood water surface elevation of 517.8 ft at a discharge of 3,310 cfs
- Significant hydraulic gradient through stream reach, evidenced by relatively small shifts in stream profile across flow regimes

Geotechnical Update

- Utilize existing data for preliminary design development
- Conducted a reconnaissance-level site investigation to determine develop basic geologic mapping
- Update the preliminary tunnel design using the field data as well as previous investigations
- Summarize in a preliminary design report

Geotechnical Update – Tunnel Plan



Geotechnical Update – Downstream Portal

Geotechnical Update – Intake Access

Operational/Generation Model

- Developed to allow estimation of generation production under various operational scenarios
- Utilizes gage data with mean daily flow estimates to generate daily power production
- Allows powerhouse size and unit configuration to be varied as well as tunnel and penstock size optimization
- Can also allow for input minimum flow requirements

Operational/Generation Model

- Exit to demonstration of operation/generation model

Next Steps

Task	Description	Next Steps
1.0	Data Collection and Site Visit	Complete
2.0	Surveys and Mapping	Prepare boundary survey
3.0	Geotechnical Investigations	Issue draft report
4.0	Hydrologic Analysis	Finalize TM
5.0	Hydraulic Analysis	Finalize TM
6.0	Operation and Generation Analysis	Develop run scenarios
7.0	Alternatives Development and Evaluation	Develop/evaluate alts.
8.0	Cost Estimates and Financial Analysis	Set up templates
9.0	Project Schedule/Construction Methodology	Set up templates
10.0	Preliminary Design Report	Develop outline
11.0	Prepare FERC Exhibits	Develop templates

Next Steps – Engineering Schedule

Task	Description	Milestone Date
1.0	Data Collection and Site Visit	Complete
2.0	Surveys and Mapping	7/1/14
3.0	Geotechnical Investigations	5/1/14
4.0	Hydrologic Analysis	5/1/14
5.0	Hydraulic Analysis	5/1/14
6.0	Operation and Generation Analysis	5/1/14
7.0	Alternatives Development and Evaluation	8/1/14
8.0	Cost Estimates and Financial Analysis	8/1/14
9.0	Project Schedule/Construction Methodology	8/1/14
10.0	Preliminary Design Report	8/30/14
11.0	Prepare FERC Exhibits	9/30/14

Questions/Comments

Terrestrial Resources Presentation For the Grant Lake Hydroelectric Project

Grant Lake Hydroelectric Project (FERC No. 13212)
Natural Resource Studies Meeting
March 18, 2014– Anchorage, AK

In Association with

HEA

Owner

MIKE SALZETTI
(907) 283-2375
msalzetti@homerelectric.com

Project Manager

CORY WARNOCK (MCM)
(360) 384-2662
cwarnock@longviewassociates.com

JOHN BLUM (MCM)
(360) 734-5915
john.blum@mcmillen-llc.com

MARK MILLER (BA)
Fisheries Biologist

JOHN STEVENSON (BA)
Fisheries Biologist

SALLY MORSELL (NES)
Macroinvertebrate & Periphyton

GARY FANDREI (CIAA)
Weir Fabrication & Monitoring

MORT MCMILLEN, PE (MCM)
Weir Design Lead

CHARLES SAUVAGEAU (MCM)
(360) 734-5915
charles.sauvageau@mcmillen-llc.com

PAUL PITTMAN, LEG (ES)
Geomorphology

DR. GEORGE ROBISON, PE (MCM)
Water Quality

MICHAEL YARBOROUGH (CRC)
(907) 300-6069
mry@crcalaska.com

LINDA YARBOROUGH (CRC)
Cultural Resource Specialist

RONALD STANEK (CRC)
Subsistence

Terrestrial Resources Task Lead

JOHN GANGEMI (ERM)
(406) 837-2020 ext 2#
john.gangemi@erm.com

AMAL AJMI (ERM)
Wildlife Specialist

LEVIA SHOUTIS (ERM)
Wetlands Specialist

KATY BECK (BBS)
Botanist Specialist

DWAYNE ADAMS (USKH)
(907) 343-5248
dadams@uskh.com

KIM GRAHAM (USKH)
Mapping and Analysis

Key Team Members: McMillen (MCM), BioAnalysts (BA), OASIS Environmental, ERM Company (ERM), Cultural Resource Consultants (CRC) USKH (USKH), Elemental Solutions (ES), Northern Ecological Services (NES), Beck Botanical Services (BBS)

Botanical Resources Studies

- General vegetation type mapping (Beck Botanical Services)
- Sensitive plant and invasive plant survey (Beck Botanical Services)
- Mapping wetlands and other waters of the U.S. (ERM)

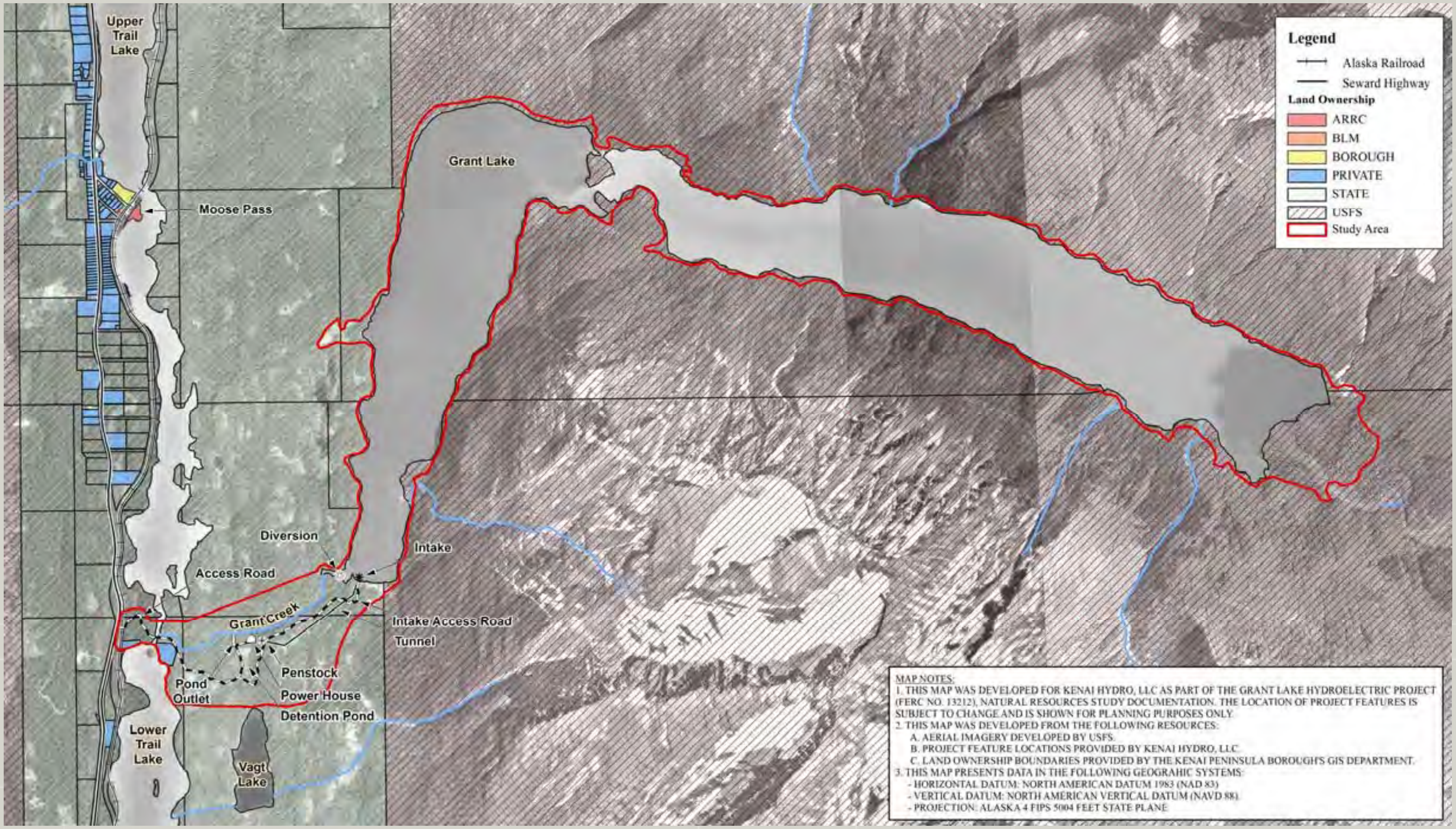
Wildlife Resources Studies

- Raptor nesting surveys
- Breeding landbirds and shorebirds
- Waterbirds
- Terrestrial mammal surveys

Field Study Timeline

	Study Component	2013								2014						
		May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Botanical	Wetlands and Waters															
	General Vegetation															
	Sensitive and Invasive Plants															
Wildlife	Raptor (Goshawk Nesting)															
	Landbirds and Shorebirds															
	Winter Waterbirds															
	Terrestrial Mammals (Moose)															

Combined Terrestrial Assessment Area



Terrestrial Vegetation: Grant Lake Project

- General Vegetation Type Survey
- Invasive Plant Survey
- Sensitive Plant Survey

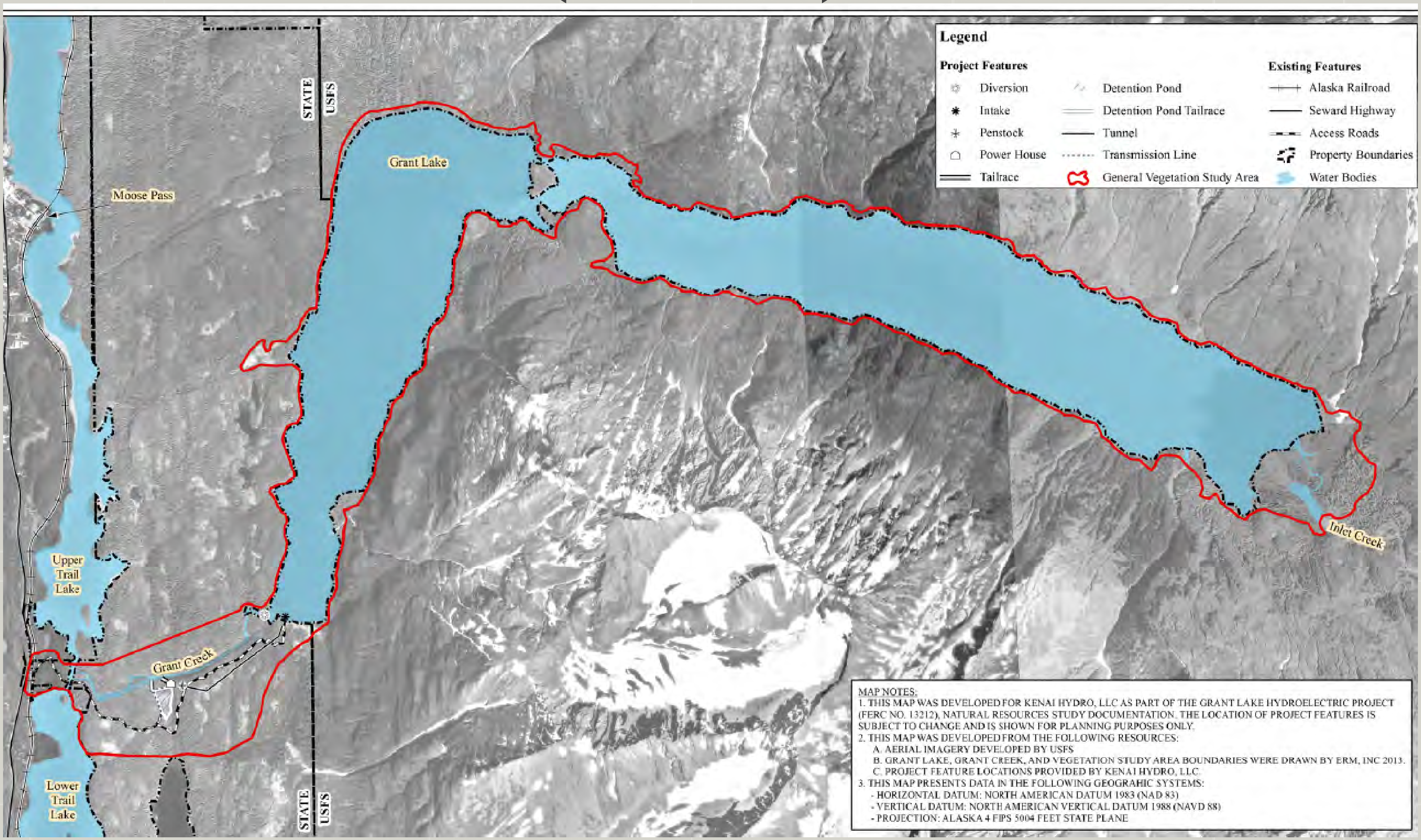
General Vegetation Type Objectives

- Vegetation Type Mapping
  - Refine existing vegetation type map of the Project vicinity using existing GIS layers, aerial photography, and available satellite imagery
  - Produce a technical report with a description of Project vegetation

General Vegetation – Existing Information

- Sets of aerial photograph imagery of the general area dating from between 1996 and 2004 was available from the USFS.

General Vegetation Type Study Area (red line)



General Vegetation Type Survey Methods

- A combination of field observations, ground truthing, and aerial photo interpretation was used to update vegetation type polygon boundaries
- The resulting vegetation type map was used to calculate total acres and percentages of each vegetation type present
- Only upland vegetation types were mapped – wetland veg is covered in a later presentation

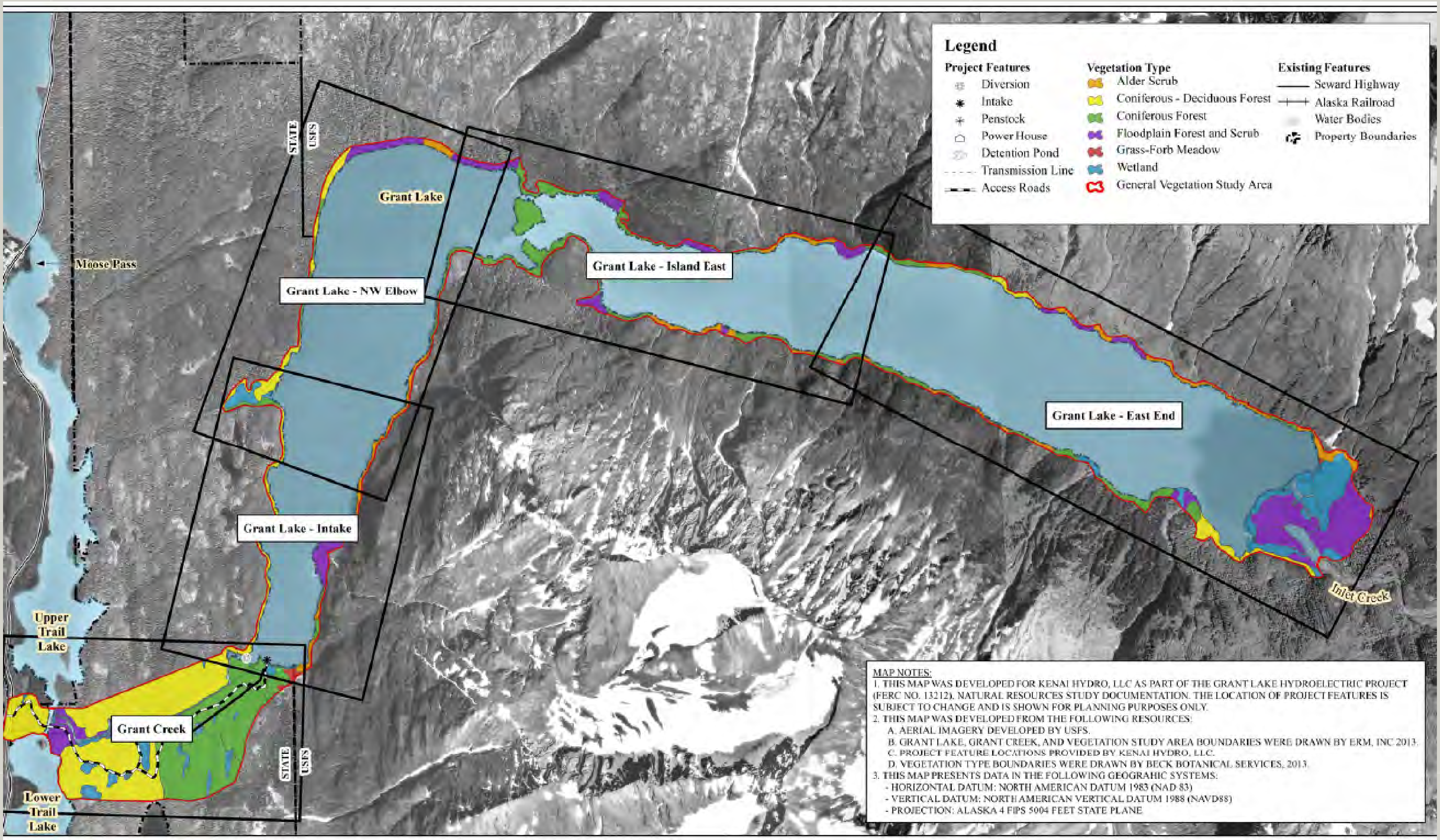
General Vegetation Survey Results

- Total of 570.5 acres in study area
- 5 upland vegetation types were mapped:
  - Coniferous Forest
  - Coniferous-Deciduous Forest
  - Floodplain Forest and Scrub
  - Grass-Forb Meadow
  - Alder Scrub
- These vegetation types are all common in Alaska

General Vegetation Types, Acres, and Percentages

Vegetation Type	Acres	Per-cent	NatureServe Ecological System
Coniferous Forest	173.7	30.5%	Alaska Sub-boreal White-Lutz Spruce Forest and Woodland, Alaskan Pacific Maritime Mountain Hemlock Forest, Alaska Sub-boreal Mountain Hemlock-White Spruce Forest
Coniferous-Deciduous Forest	177.1	31.0%	Alaska Sub-boreal White Spruce-Hardwood Forest
Alder Scrub	34.5	6.0%	Alaska Sub-boreal Avalanche Slope Shrubland
Grass-Forb Meadow	2.2	0.4%	Western North American Sub-boreal Mesic Bluejoint Meadow
Floodplain Forest and Scrub	106.0	18.6%	Western North American Boreal Montane Floodplain Forest and Shrubland
Wetlands	77.1	13.5%	Wetland Vegetation types
Total	570.5	100%	

General Upland Vegetation Types



Grant Lake Vegetation Types

Coniferous Forest

Coniferous-Deciduous Forest

Floodplain Forest and Scrub

Grass-Forb Meadow

Alder Scrub

General Vegetation: Potential Qualitative Construction (Short Term) Impacts

- Potential Direct Impacts: Vegetation clearing, soil disturbance, altered natural grade, fill material placement, damage by machinery

- Potential Indirect Impacts: Invasive plant infestation; soil erosion; poor native vegetation reestablishment; change of light or moisture levels; shift to earlier successional vegetation types.

General Vegetation: Potential Qualitative Operational (Long Term) Impacts

- Potential Direct Impacts: Loss of natural vegetation; Grant Creek flow regime changes; Grant Lake inundation, water level fluctuations, and drawdowns.

- Potential Indirect Impacts: Invasive plant infestation; alteration and/or loss of upland veg types; effects of new Grant Creek flow regime; effects of new Grant Lake level fluctuation regime.

Invasive Plant Survey Objectives

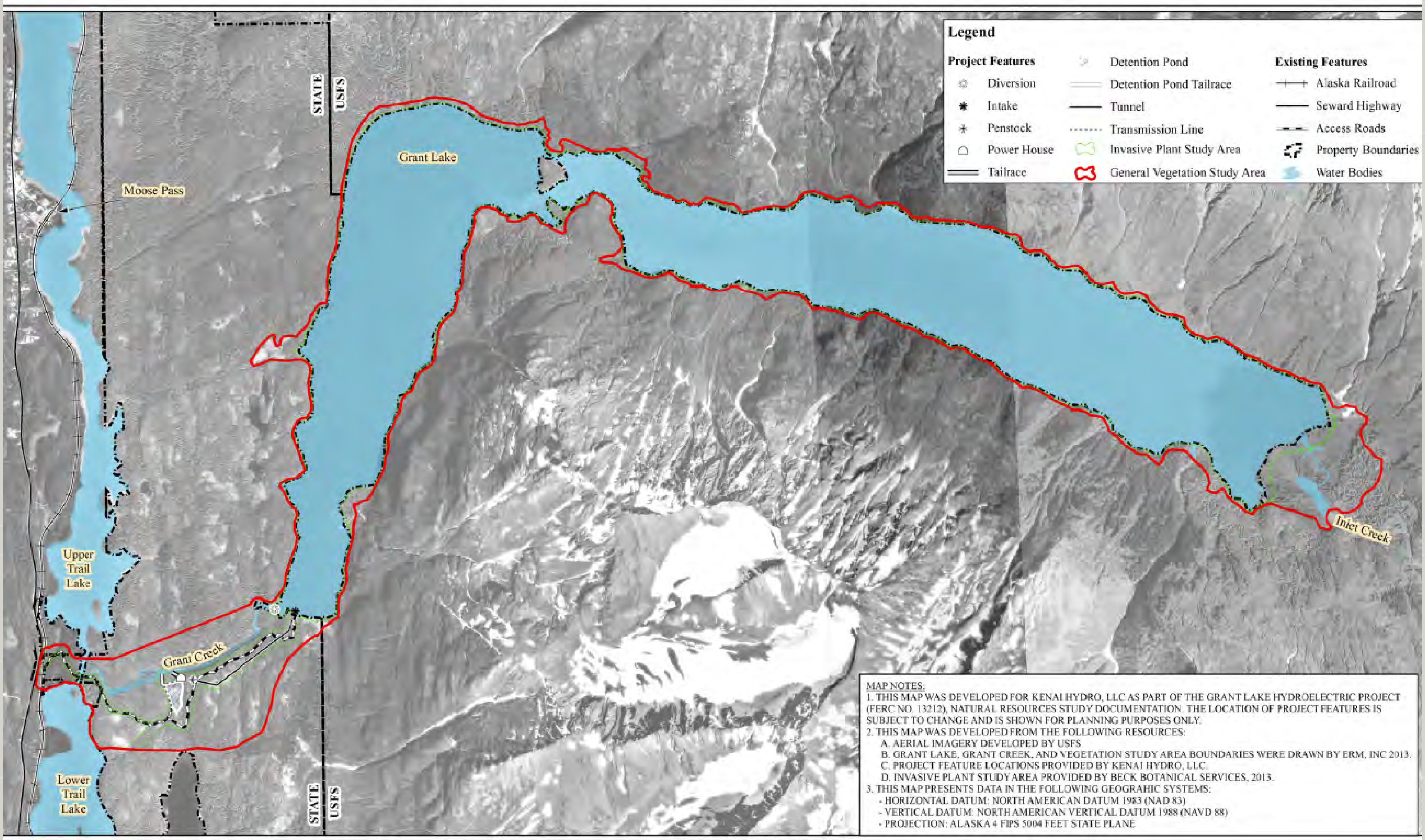
– Locate and document populations of invasive plants in areas potentially affected by Project construction and operation

– Produce a technical report

Invasive Plant Survey – Existing Information

- The NRIS (Natural Resource Information System) database has documentations of multiple populations of 7 invasive plant species within ¼ mile of the study area.
- Most of these populations are located along the Seward Highway, Alaska Railroad, and the area between Upper Trail and Lower Trail lakes.

Invasive Plant Study Area (green line)



Invasive Plant Survey Methods

- Focus surveys in likely potential habitats for invasive plants (roadsides, trails, human use areas, etc.)
- Document invasive plants with AKEPIC (Alaska Exotic Plant Info Clearinghouse) forms
- Keep records of survey locations
- Take GPS points, as necessary

Invasive Plant Survey Results

- Overall, few populations of invasive plants were documented in the Invasive Plant Study area.
- Populations were relatively small.
- Invasive species included: common dandelion, white clover, Kentucky bluegrass, and annual bluegrass.
- These 4 species have been documented in the larger area.
- Almost all of these were associated with human disturbance areas like the Seward Highway, Alaska Railroad ROWS, the Grant Lake Trail, and other developments.

Invasive Plants: Potential Project Impacts

- Invasive plant populations in the Project area could become larger;
- Invasive plant populations could spread to new areas within the Project area;
- New species of invasive plants could spread to areas affected by the Project; and
- Invasive plant populations could spread out of the Project area into adjacent areas.
- An Invasive Plant Management Plant with BMPs will be developed to minimize invasive plant impacts.

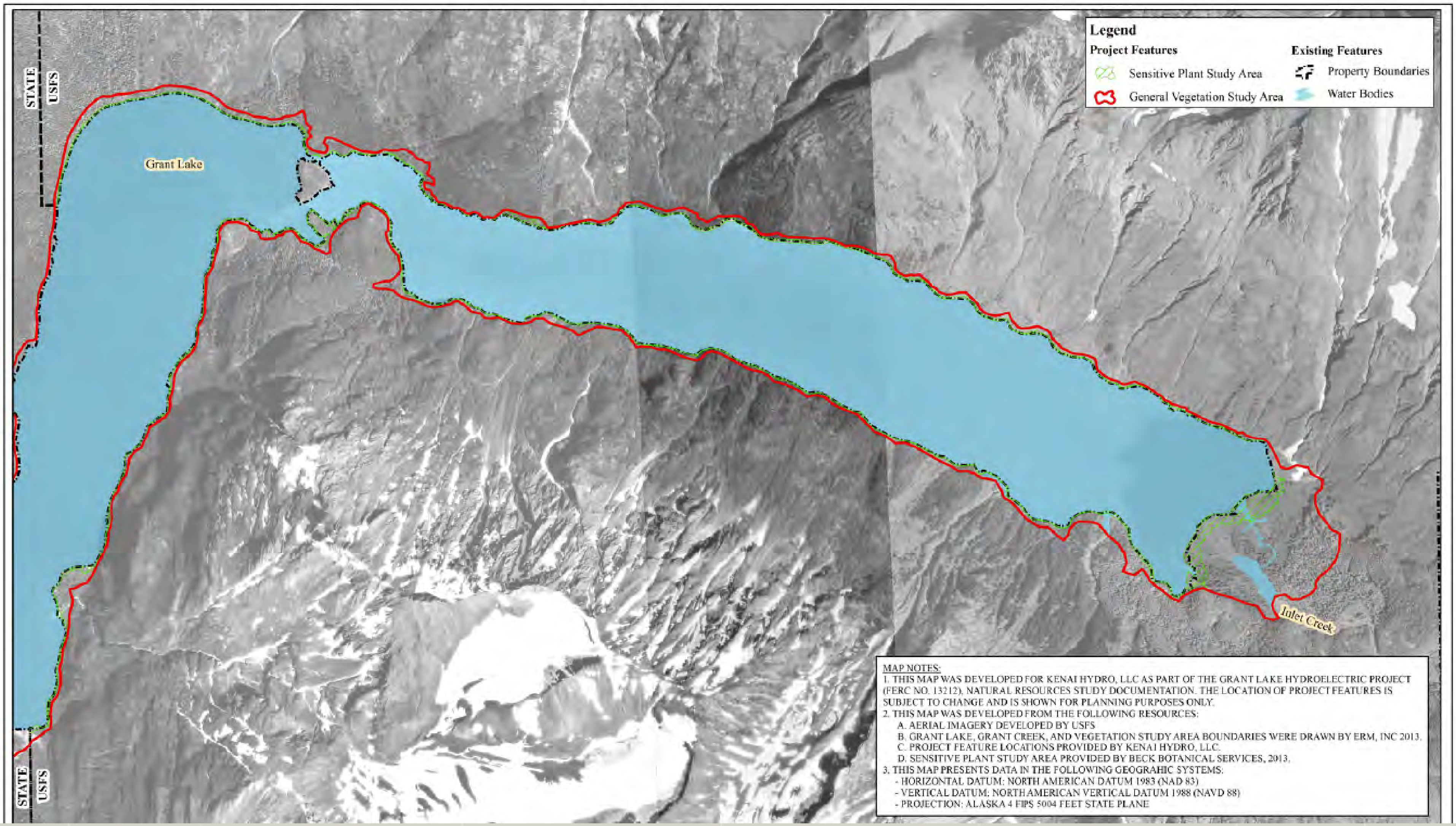
Sensitive Plant Survey Objectives

– Satisfy Forest Service requirements for a Biological Evaluation (BE) of plants on its lands

Sensitive Plant Survey: Previous Efforts

- No sensitive plant survey work had been done in the Project area previous to 2013.
- A data search revealed no known populations of Sensitive plants in the Project area.

Sensitive Plant Study Area (green line)



Sensitive Plant Survey Methods

- Follow USFS procedures for Sensitive Plant Surveys (Stensvold 2002)
- Focus surveys in high potential habitats
- Use Level 5 (Intuitive Controlled) intensity survey
- Complete TES Plant Element Occurrence Forms
- Complete the USFS Plant Survey Field Form
- Keep records of survey locations
- Record all vascular plant species observed
- Take GPS points, as necessary

Sensitive Plant Survey Results

- A small population of the USFS Sensitive plant species pale poppy (*Papaver alboroseum*) was located on USFS land on the north side of Grant Lake
- 15 plants were located
- It was estimated that the population was located between 701 and 705 feet (normal maximum lake elevation is 703 feet)
- The habitat was sparsely vegetated, cobble, sand, and gravel on a south-facing creek outwash

Pale Poppy (*Papaver alboroseum*)

Pale Poppy Flower

Pale Poppy Habitat

Potential Impacts to Sensitive Plants

Project effects could cause potential qualitative impacts to the pale poppy population or other un-detected sensitive plant populations on USFS lands.

- Project Effects: Shoreline inundation, drawdowns, and lake water level fluctuations

- Potential Direct Impacts: Inundation of plants and loss of suitable habitat

- Potential Indirect Impacts: Spread of invasive plants; light or moisture changes

Next Steps:

- Draft Biological Evaluation for Plants
  - Assess potential Project impacts and PME's for Sensitive Plants
  - Develop Sensitive Plant Management Plan
- Draft Invasive Plant Management Plan
  - Assess potential Project impacts with regard to invasive plants
  - Develop construction BMP's
  - Include in the Draft License Application

Questions?

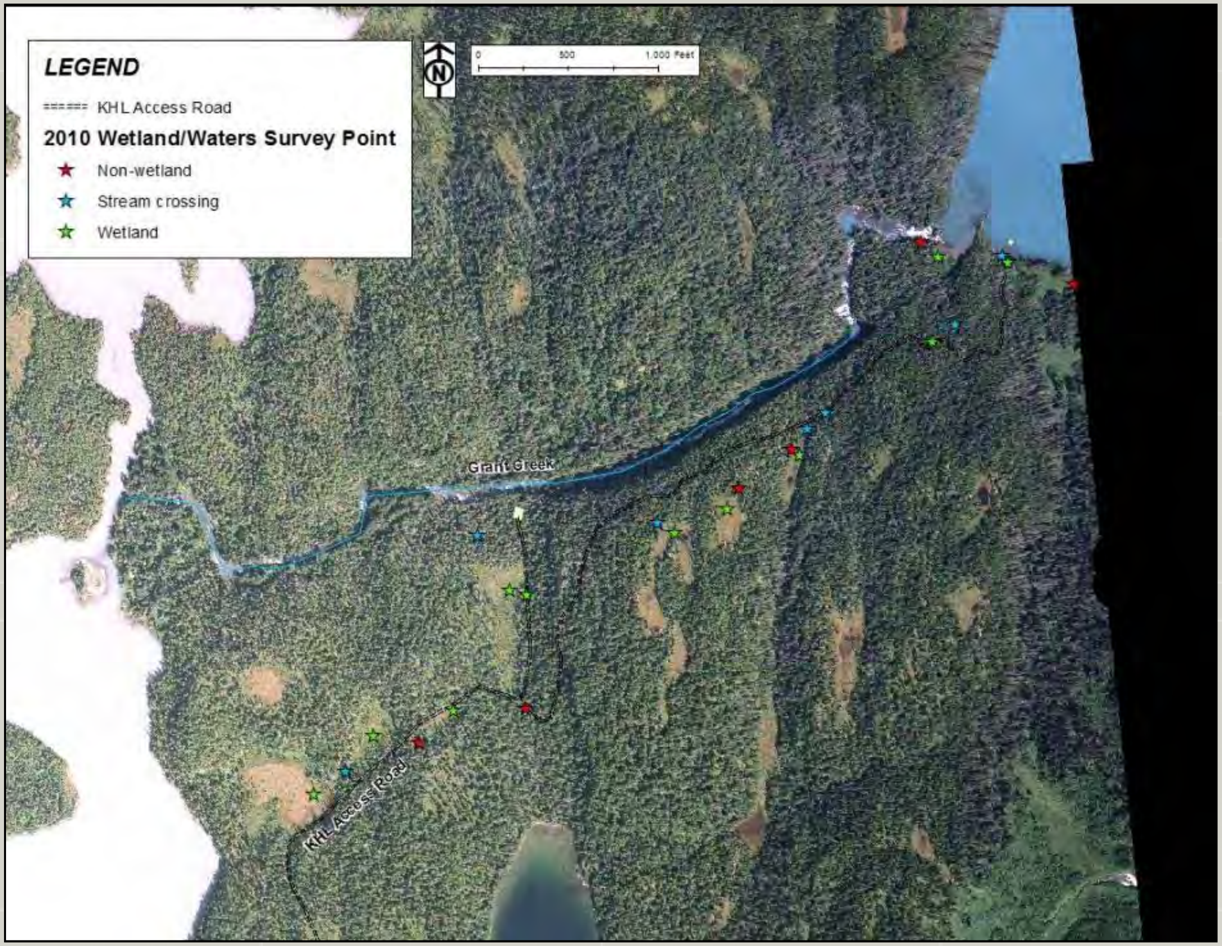
Wetlands and Waters of the U.S. Studies

Goal: Identify and describe the wetlands and waters potentially affected by the Project

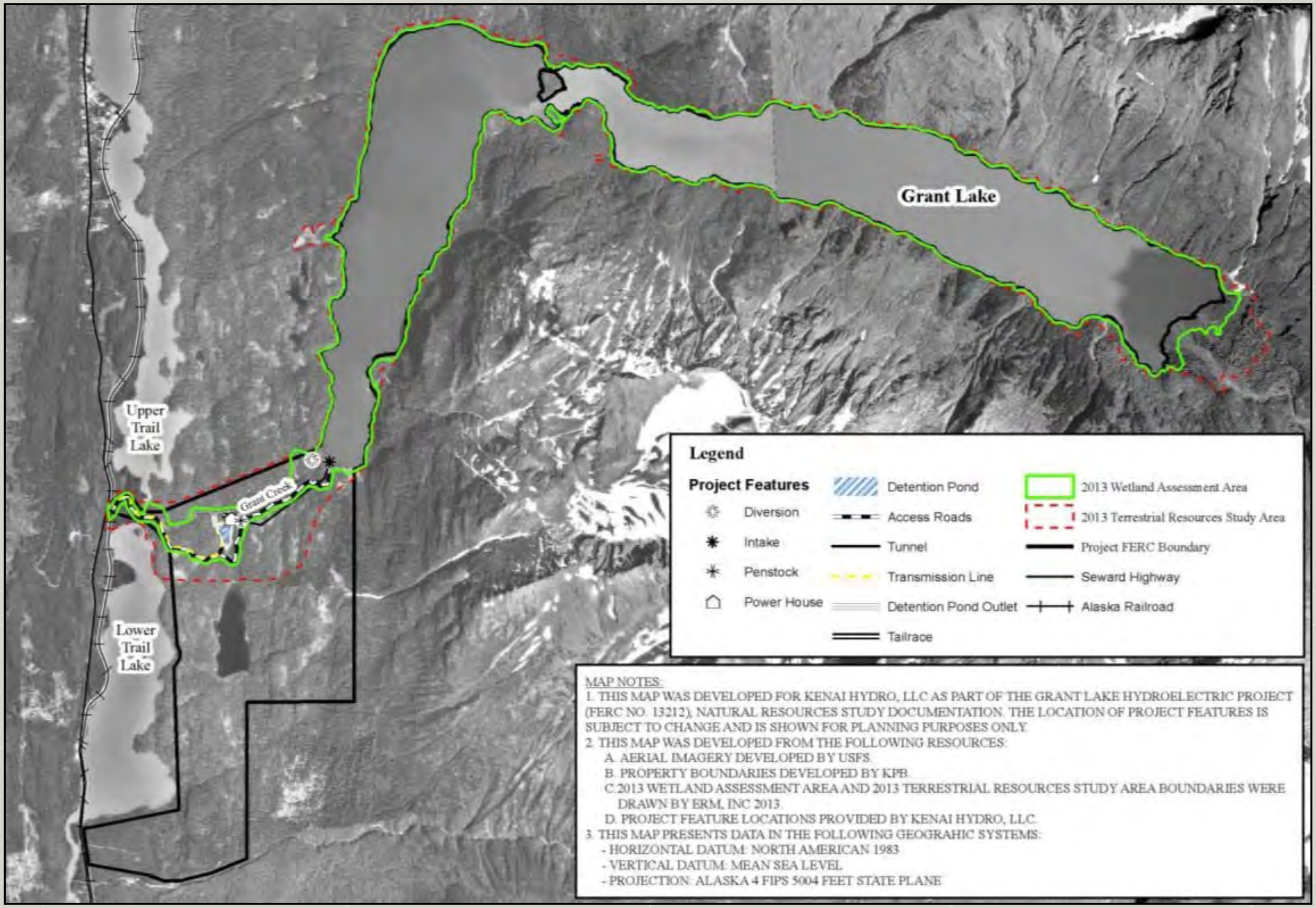
- Wetlands mapping and classification
- Functional assessment

2010 Work

- Field sampled 43 points within transmission corridor



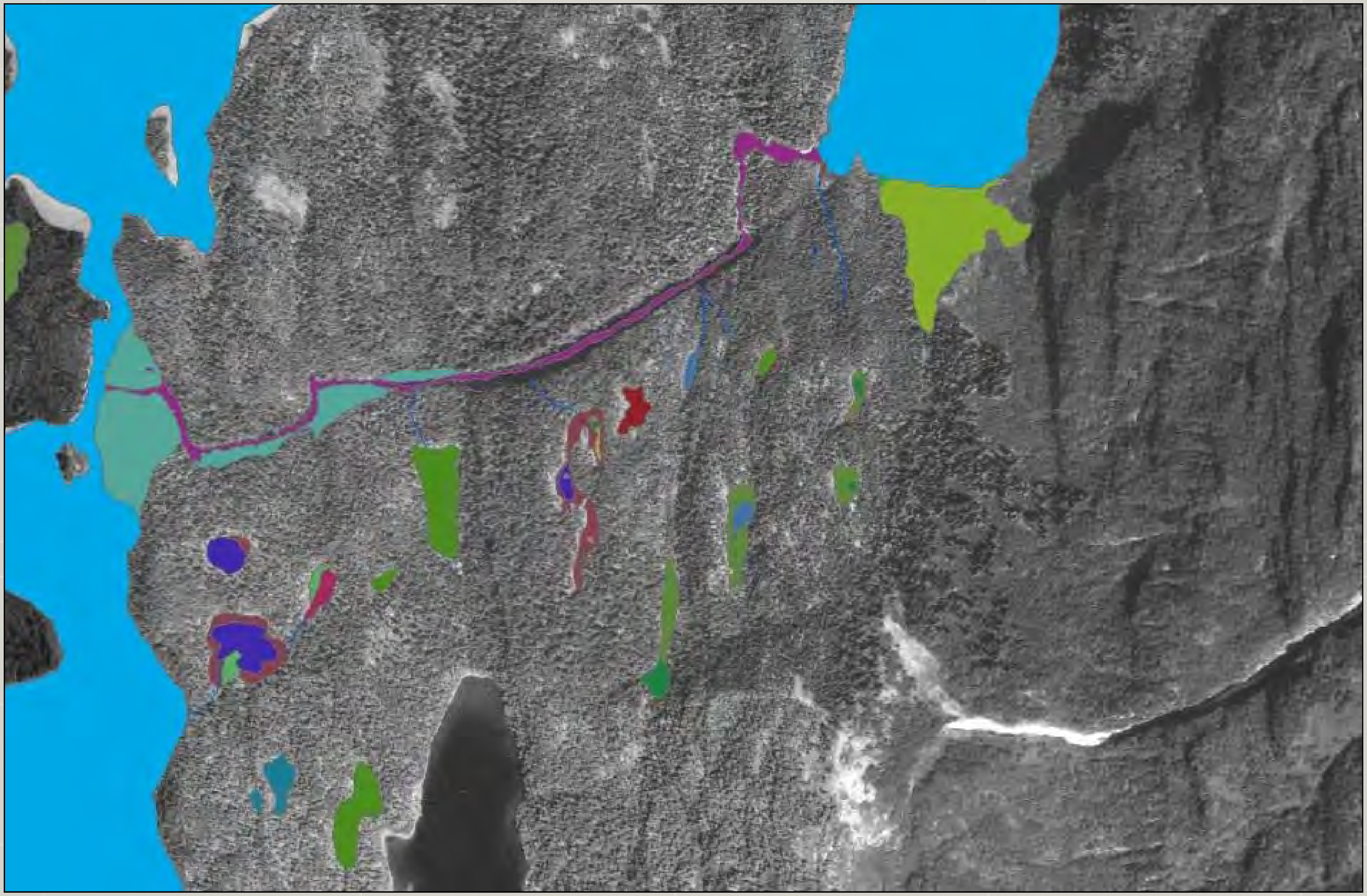
2013 Work
Wetlands and Waters Assessment Area



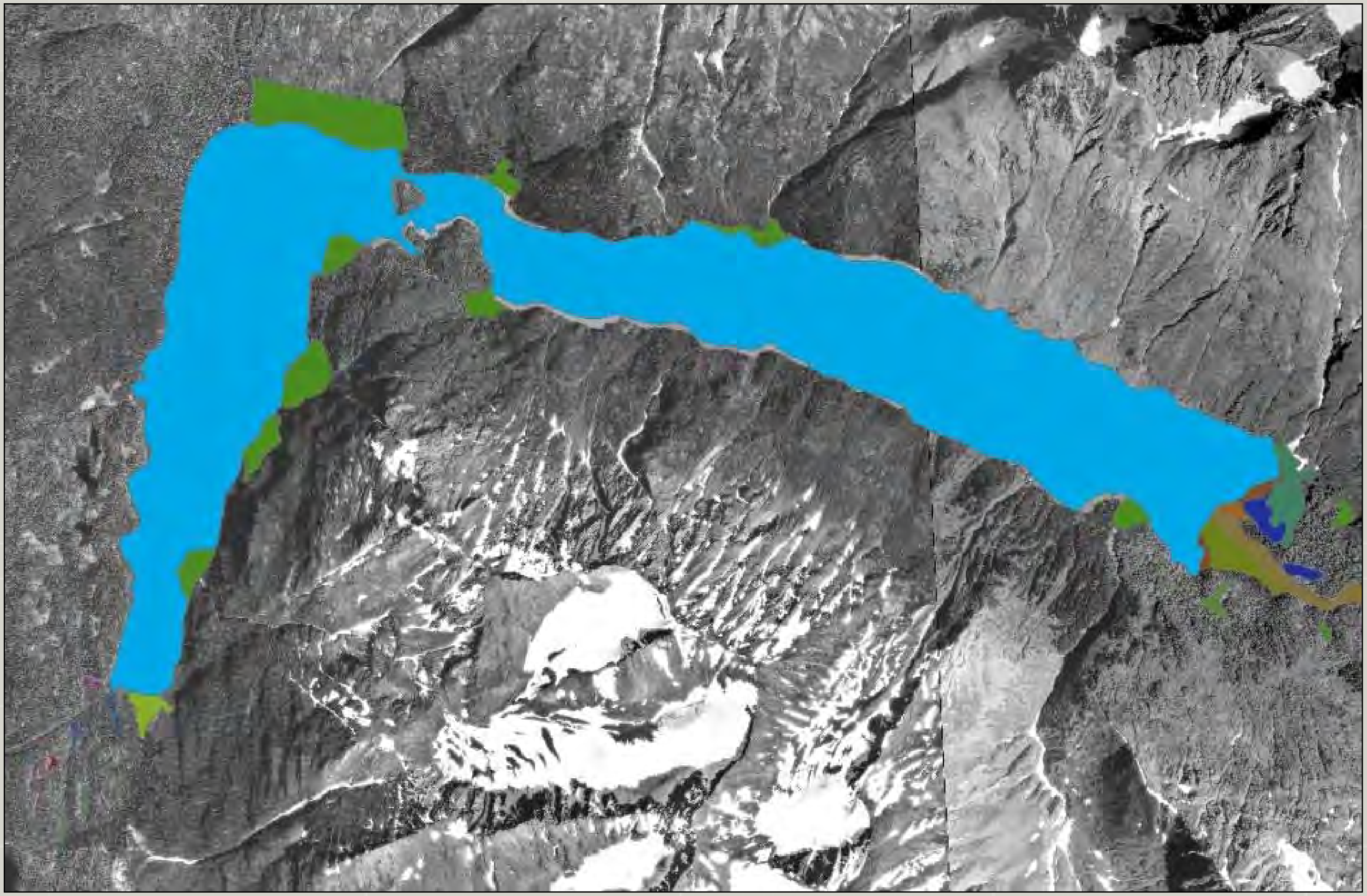
2013 Work: Methods Overview

- Wetland Mapping
  - Pre-mapping in GIS
  - Field-based wetland determination and mapping
  - Final wetland mapping in GIS
- Wetland Functional Assessment
  - Develop assessment method
  - Field-based assessment
  - Complete functional assessment
- Wetlands and Waters Report
- Wetlands and waters geodatabase

Methods
Wetlands Pre-mapping: Corridor Area



Methods
Wetlands Pre-mapping: Lake Area



Methods: Wetland Mapping

- Field points
  - Determination point: used USACE 1987 Manual and AK Supplement, GPS, field notes and photos
  - Observation point: GPS, field notes and photos
- Final desktop mapping in GIS
- Classified using NWI, and HGM class

Methods: Functional Assessment

- Used guidance in USACE AK District Regulatory Guidance Letter (RGL) 0901
- Field assessment
  - Completed functional assessment data form at each determination point

Methods: Functional Assessment

Functions Assessed:

Hydrologic

- Flood flow alteration
- Groundwater interchange
- Erosion control and stabilization

Biogeochemical

- Sediment removal
- Nutrient and toxicant removal
- Production and export of organic matter

Ecological

- General wildlife habitat suitability
- Fish habitat
- Native plant richness

Sociological

- Educational, scientific, recreational, or subsistence use
- Uniqueness and heritage

Functions adapted from USACE AK District RGL 0901

Methods: Functional Assessment

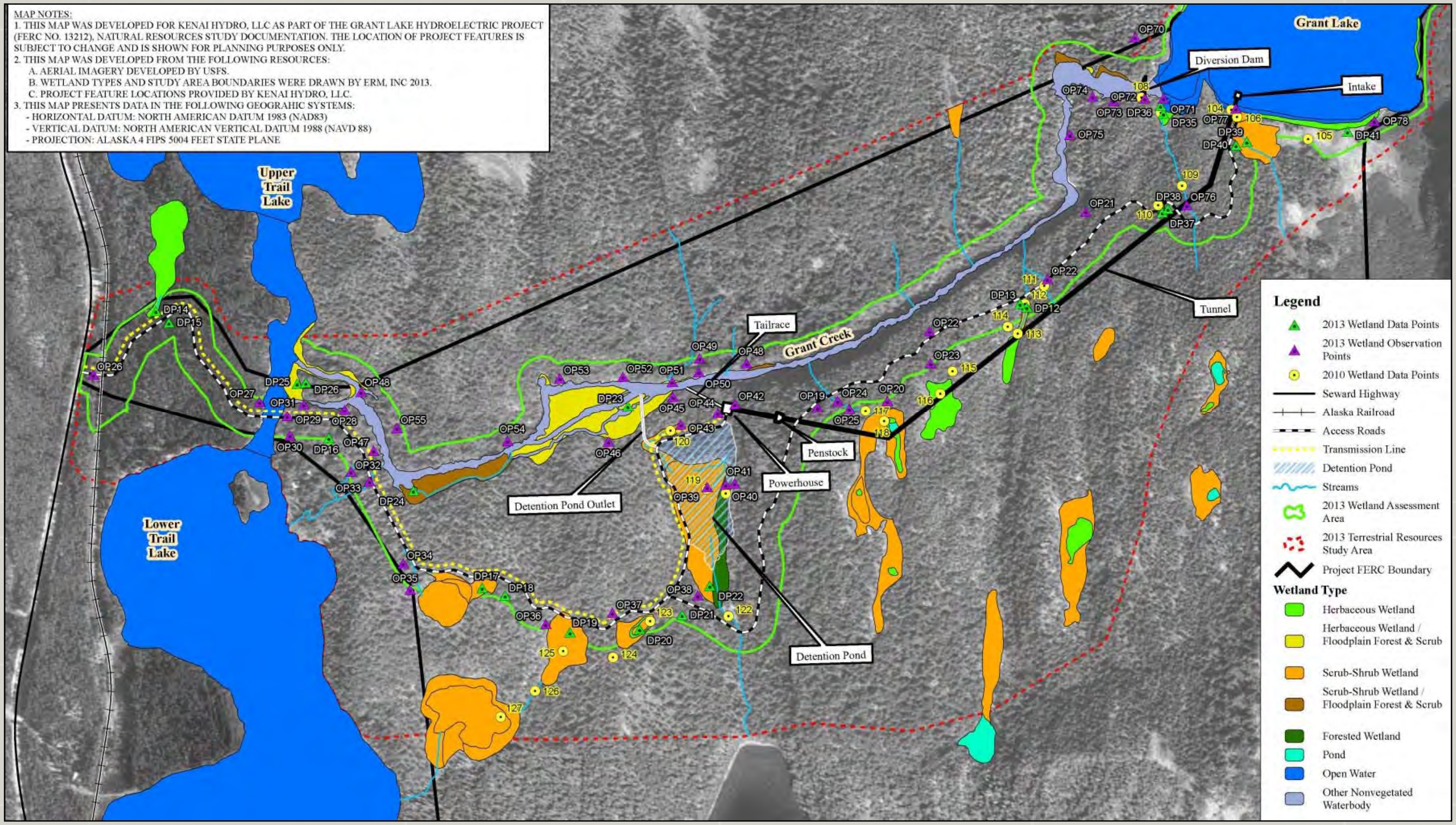
- Post-field assessment
  - Grouped wetlands into 15 ‘functional classes’ based on vegetation type, HGM position, and Project location
  - Assessed wetland functions at the level of the functional class, based on determination point data
  - Categorization: functional classes assigned to RGL 0901 functional category (I-IV)

Results: Wetland Mapping

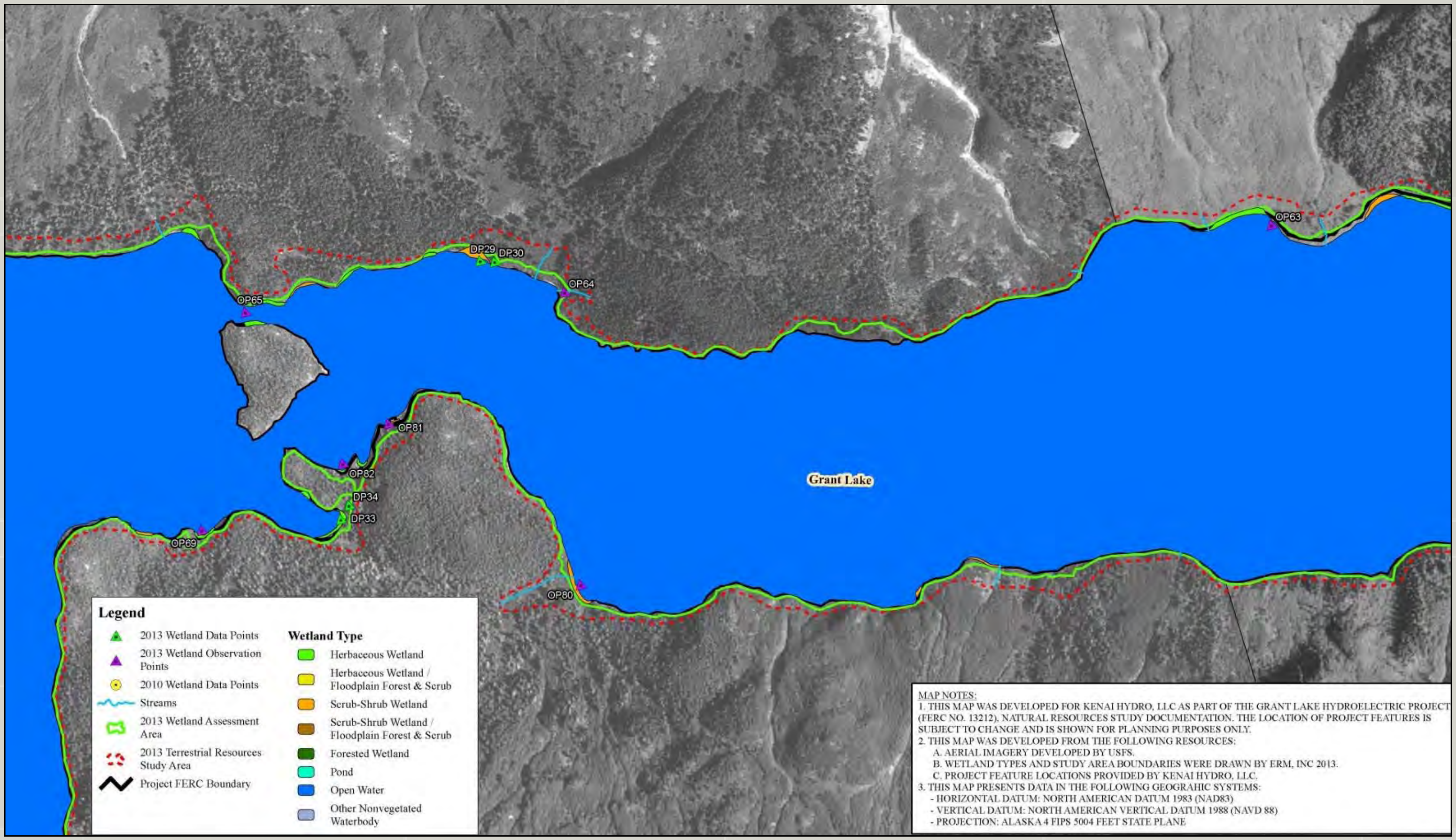
Vegetated wetland acres: 38 acres, 13% of vegetated area

Vegetated Wetland Communities	Acres	% Wetland Area
Herbaceous Wetlands	6	15%
Scrub-Shrub Wetlands	21	54%
Forested Wetlands	1	2%
Herbaceous Wetland / Floodplain Forest & Scrub	3	8%
Scrub-Shrub Wetland / Floodplain Forest & Scrub	8	21%
Vegetated Wetland Subtotals	**38**	
Non-Vegetated Waters	**Acres**	**% Waters Area**
Open Water - Lake	1650	99%
Open Water - Ponds	0	0%
Riverine	10	1%
Unvegetated Water Subtotals	**1660**	
WETLAND & WATER TOTALS	**1698**	

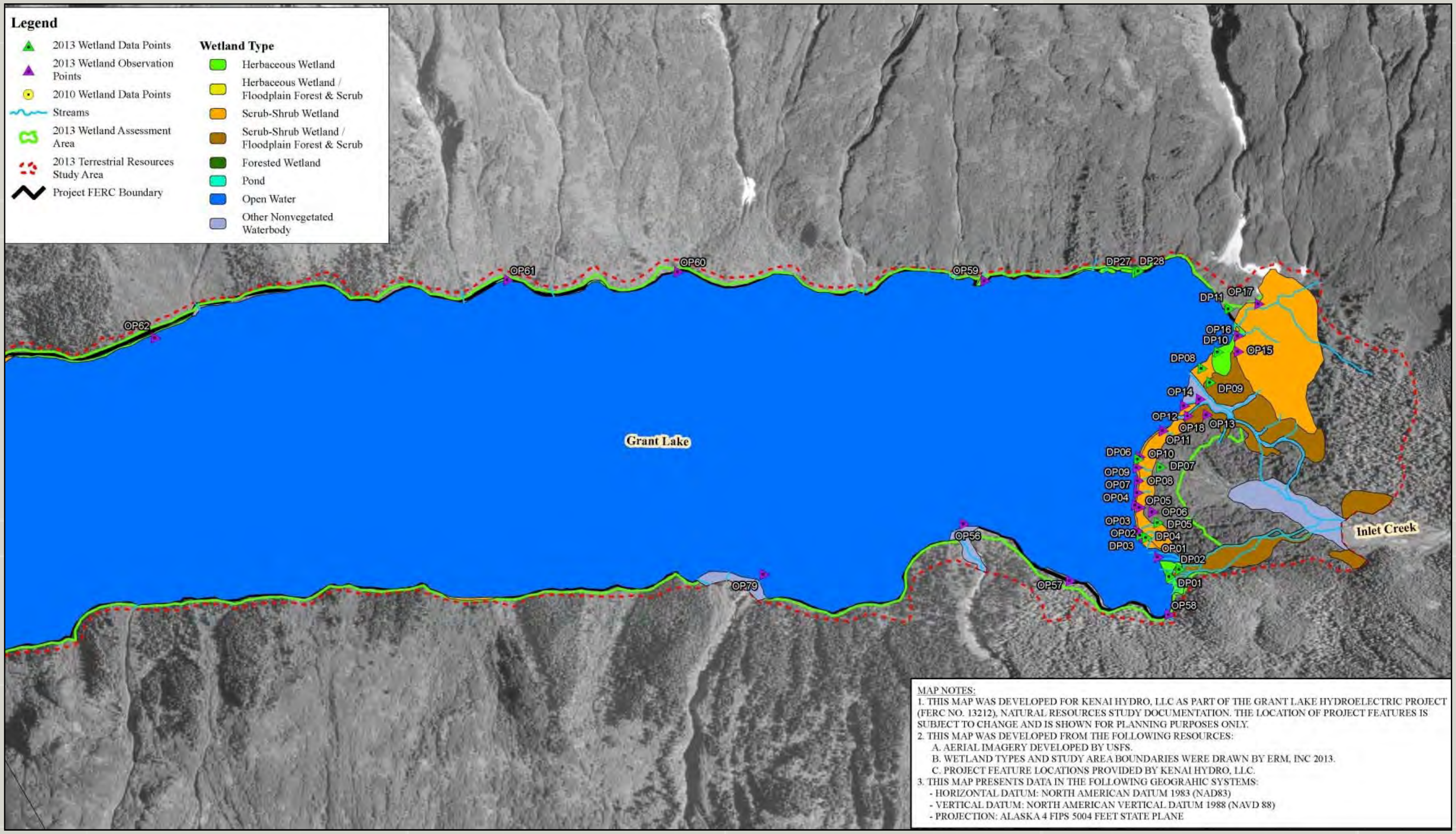
Results
Wetlands mapping: Corridor area



Results:
Wetlands mapping: Lake area



Results:
Wetlands mapping: Lake inlet area



Herbaceous wetlands

Herbaceous depressional

Herbaceous lacustrine

Scrub-shrub wetlands

Scrub shrub depressional

Scrub shrub lacustrine

Scrub shrub riverine

Forested wetlands

Forested slope wetland

Herbaceous wetland / Floodplain forest and scrub wetlands

Riverine wetland

Riverine wetland / non-wetland complex

Scrub-shrub wetland / Floodplain forest and scrub wetlands

Riverine wetland

Riverine wetland / non-wetland complex

Results: Functional Assessment

Functional Area		Functional Class	Wetland Cover Type	Hydrogeomorphic Position
Transmission Corridor / Facilities		Herbaceous depressional wetland	Herbaceous Wetland	Depressional
		Deciduous scrub shrub depressional wetland	Scrub Shrub Wetland	Depressional
		Broadleaved evergreen scrub shrub depressional wetland		
		Needle leaved evergreen scrub shrub depressional wetland		
		Small stream scrub shrub riparian		Riverine
		Forested slope wetland	Forested Wetland	Slope
Grant Creek Corridor		Grant Creek herbaceous riparian	Herbaceous Wetland / Floodplain Forest & Scrub	Riverine
		Grant Creek scrub shrub riparian	Scrub-Shrub Wetland / Floodplain Forest & Scrub	
Grant Lake	**Lake Inlet**	Grant Lake inlet herbaceous wetland	Herbaceous Wetland	Lacustrine
		Grant Lake inlet herbaceous inundated wetland		
		Grant Lake inlet scrub shrub wetland	Scrub Shrub Wetland	
		Grant Lake inlet scrub shrub riparian	Scrub-Shrub Wetland / Floodplain Forest & Scrub	Riverine
	Lake Shore	Grant Lake herbaceous lake fringe wetland	Herbaceous Wetland	Lacustrine
		Grant Lake scrub shrub lake fringe wetland	Scrub Shrub Wetland	
	Lake Outlet	Grant Lake outlet herbaceous wetland	Herbaceous Wetland	

Results: Functional Assessment

Functional Area	Functional Class	Representative Data Point(s)	Flood Flow Alteration	Sediment Removal	Nutrient, & Toxicant Removal	Erosion Control and Shoreline Stabilization	Production and Export of Organic Matter	General Wildlife Habitat Suitability	Fish Habitat	Native Plant Richness	Educational or Scientific	Groundwater Interchange	Uniqueness and Heritage
Transmission Corridor / Facilities	Herbaceous depressional wetland	DP14	Moderate	High	High	High	High	High	NA	Moderate	Moderate	High	Low
	Deciduous scrub shrub depressional wetland	DP22	Moderate	Moderate	High	NA	High	High	NA	High	Moderate	High	Low
	Broadleaved evergreen scrub shrub depressional wetland	DP17, DP20	Moderate	Moderate	High	NA	Moderate-High	High	NA	Moderate	Moderate	Moderate-High	Low
	Needle leaved evergreen scrub shrub depressional wetland	DP19	Moderate	Moderate	High	NA	High	High	NA	Moderate	Moderate	High	Low
	Small stream scrub shrub riparian	DP12, DP39	Moderate	Moderate-High	High	High	High	High	NA	Moderate-High	Moderate	Moderate-High	Low
	Forested slope wetland	DP37	Moderate	Moderate	Moderate	NA	Moderate	High	NA	High	Moderate	High	Low
Grant Creek Corridor	Grant Creek herbaceous riparian	DP23, DP25	Moderate	High	High	High	High	High	High	Moderate-High	Moderate	Moderate-High	Low
	Grant Creek scrub shrub riparian	DP24	Moderate	High	High	High	High	High	High	High	Moderate	High	Low
Lake Inlet	Grant Lake inlet herbaceous wetland	DP01	Moderate	Moderate	High	Low	High	High	NA	Moderate	Moderate	Moderate	Low
	Grant Lake inlet herbaceous inundated wetland	DP10	Moderate	High	High	Low	Moderate	Moderate	NA	Moderate	Moderate	Moderate	Low
	Grant Lake inlet scrub shrub wetland	DP03, DP04, DP06, DP08	Moderate-High	Moderate-High	High	High	High	High	NA	Moderate	Moderate	Moderate	Low
	Grant Lake inlet scrub shrub riparian	DP02, DP09	Moderate	Moderate-High	Moderate-High	High	Moderate-High	Moderate	NA	Moderate	Moderate	Moderate	Low
Lake Shore	Grant Lake herbaceous lake fringe wetland	DP27, DP33	Moderate	High	High	High	High	Moderate-High	NA	Moderate	Moderate	Moderate-High	Low
	Grant Lake scrub shrub lake fringe wetland	DP29, DP31	Moderate	Moderate-High	High	High	High	High	NA	Moderate	Moderate	Moderate-High	Low
Lake Outlet	Grant Lake outlet herbaceous wetland	DP35	Moderate	High	High	High	High	High	NA	Moderate	Moderate	High	Low

Results: Functional Assessment

- Categorization
  - Category I, highest quality; category IV, lowest quality/degraded

	Acres per Category			
Project Area	**I**	**II**	**III**	**IV**
Transmission Corridor / Facilities	0.0	4.7	1.6	0.0
Grant Creek Corridor	0.0	4.4	0.0	0.0
Grant Lake	0.0	19.0	8.6	0.0
Total Acres by Category	**0**	**28**	**10**	**0**

Wetlands: Potential Qualitative Construction Impacts (Short-Term)

Potential direct impacts

- Clearing/grubbing, soil disturbance, temporary water turbidity, changes to routing delivery (Grant Creek), shoreline/bank disturbance, reduced capacity to perform certain functions.

Potential Indirect Impacts

- Weed infestation, erosion, sedimentation, poor re-establishment of native veg, reduced capacity to perform certain functions

Wetlands: Potential Qualitative Operational Impacts (Long-Term)

Potential direct impacts

- Wetland excavation or fills; wetland inundation or sedimentation; altered bank, shoreline, or lakebed; permanent change in certain wetland functions

Potential indirect impacts

- General: change in functional capacity, sedimentation, weed infestation, erosion, water turbidity, poor re-establishment of native veg;
- Detention pond fluctuation: wetland expansion, inundation, sedimentation.
- Lake elevation fluctuation: wetland expansion, inundation, or drainage; shoreline erosion or deposition;
- Grant Creek flow regime: wetland expansion or loss

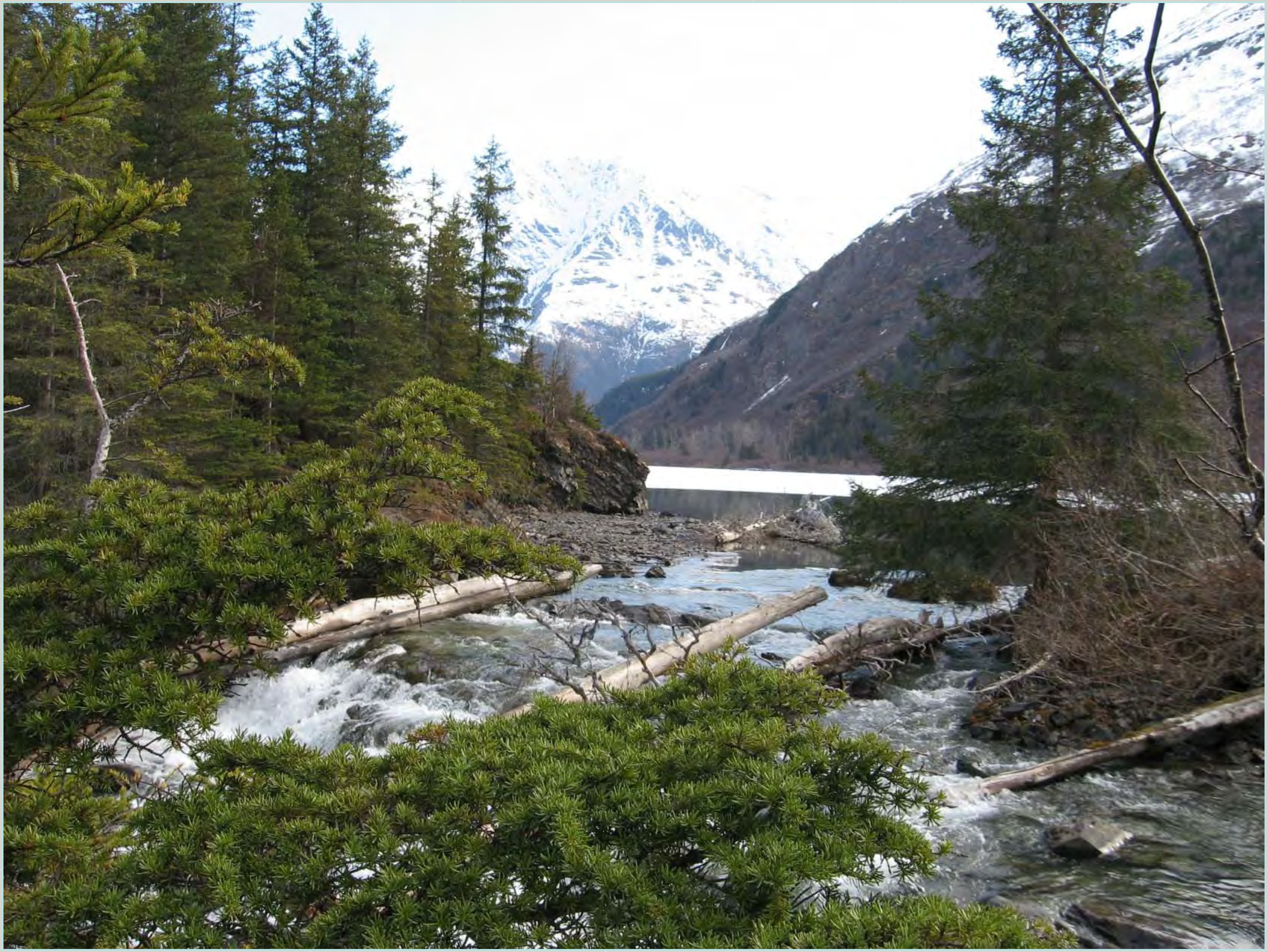
Deliverables and Next Steps:

- Deliverables
  - Final Wetlands and Waters Report
  - Final geodatabase

- Next steps for Project regarding wetlands
  - Assess potential impacts to wetlands and waters
  - Develop construction and operation BMP’s
  - Comprehensive Mitigation Plan

Questions?

Terrestrial Wildlife Studies



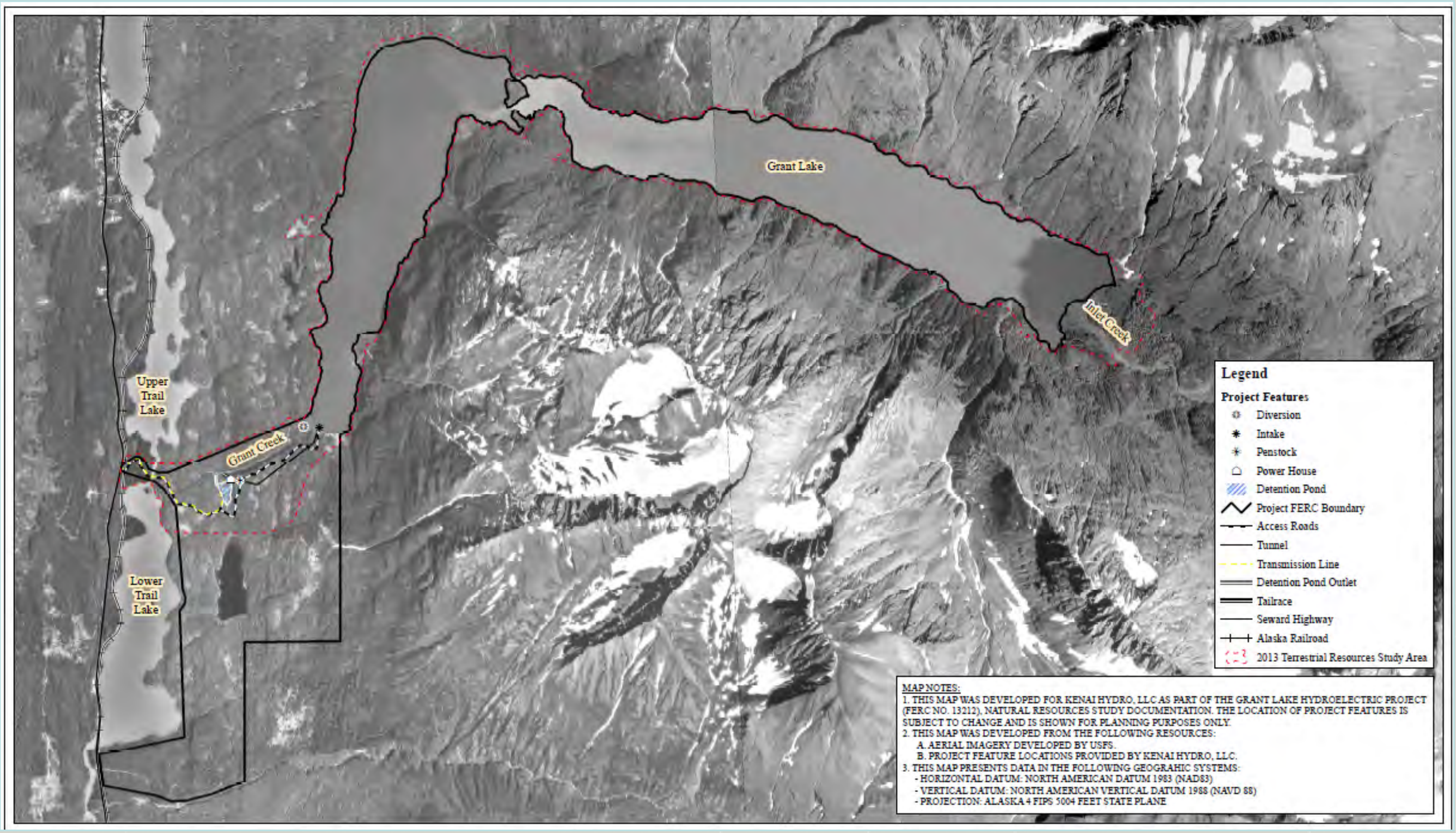
Terrestrial Wildlife Studies

Objectives

The 2013 Wildlife Study was conducted in accordance with the approved Study Plan (KHL 2013). The objectives the study were to:

- Document presence and distribution information to allow the Project to minimize or avoid impacts to protected species, including bald eagles and other raptors, shorebirds, waterbirds, and landbirds of special interest;
- Quantify the distribution and abundance of target wildlife species during key seasons of activity in the study area;
- Document the species composition of avian communities, particularly landbirds, shorebirds, and waterbirds; and
- Classify and map wildlife habitat in the study area in conjunction with the Botanical Resources Study.

Terrestrial Wildlife Studies



Terrestrial Wildlife Studies

Study Component #1 – Raptor Nesting Surveys

- **Raptor Nest Survey: Completed 2010**
- **Goshawk Nest Ground-Based Survey: 2013 Completed; June & early-July, 2014**

Study Component #2 – Breeding Landbirds and Shorebirds

- **Breeding Landbird and Shorebird Study: Completed 2010**
- **Breeding Landbird and Shorebird Study: Completed 2013**

Study Component #3 – Waterbirds

- **Waterbird Breeding Surveys: Completed 2010**
- **Harlequin Duck Surveys: Completed 2010**
- **Waterbird Brood-Rearing Survey: Completed 2010**
- **Winter Waterbird Survey: 2013 Completed; March 2014**

Study Component #4 – Terrestrial Mammals

- **Mountain goats and Dall sheep Survey: Complete 2010**
- **Bat Surveys: Complete 2010**
- **Bear: Complete 2010**
- **Winter Moose Surveys: 2013 Completed; March 2014**

Reviewed Documents & Resources

Grant Lake Hydroelectric Project Detailed Feasibility Analysis (1984)

2013-2014 Alaska Hunting Regulations · Brown Bear Management Report (2011) · Black Bear Management Report (2011) · Sheep Management Report (2011) · Mountain Goat Management Report (2012) · Wolf Management Report (2009) · Furbearer Management Report (2010)

Trail River Landscape Assessment (2008) · Kenai Lake – Black Mountain RNA (2007)

Bird Checklists of the United States: Kenai NWR; Chugach NF · Breeding Bird Habitat Associations on the Alaska BBS (2000)

Alaska Watchlist (2010)

Interagency Brown Bear Study Team (IBBST):
A Conservation Assessment of the Kenai Peninsula Brown Bear (2001) · Kenai Peninsula Brown Bear Conservation Strategy (2000)

Cumulative Kenai Birding Festival Kenai River Float Trip Bird List (2008 – 2012)

RAPTORS

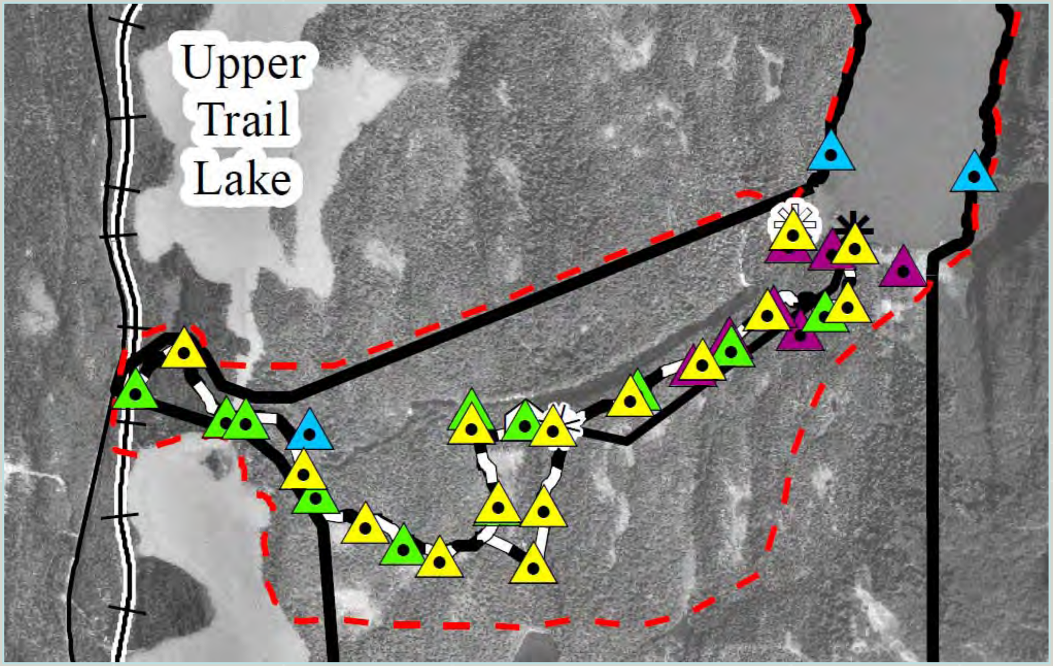
2010 Raptor Nest Surveys

- Coordinates and Shapefile for 2 BAEG nests, provided by USFS
- 2 BAEA incidental sightings (12th & 23rd July 2010)
- No NOGO recorded

RAPTORS

2013 & 2014 Northern Goshawk Broadcast Call Surveys

- Surveyed the Corridor Area
- 2013 Methods
  - Woodbridge et al. (2006)
  - 15 Points (spaced every 200m)
  - Adult Wail Call, Juvenile Begging Call



RAPTORS

2013 & 2014 Northern Goshawk Broadcast Call Surveys

- Results

15 Points Surveyed (16th & 17th June; 8th & 9th July)
1 Detection (AF based on size)

One adult female NOGO response was detected A / V June 16, 2013. The individual responded to an adult wail call during the first 3-call sequence.

The female was detected in a **coniferous hardwood** forest with False Azalea (Menziesia ferruginea), Dwarf Dogwood (Cornus canadensis), Devil's Club (Oplopanax horridus) and Nagoonberry (Rubus arcticus) dominant woody plant understory. Other non woody species included Pink Wintergreen (Pyrola asarifolia), Fireweed (Chamerion angustifolium), Oak Fern (Gymnocarpium dryopteris), Wood Fern (Dryopteris expansa), and moss species.

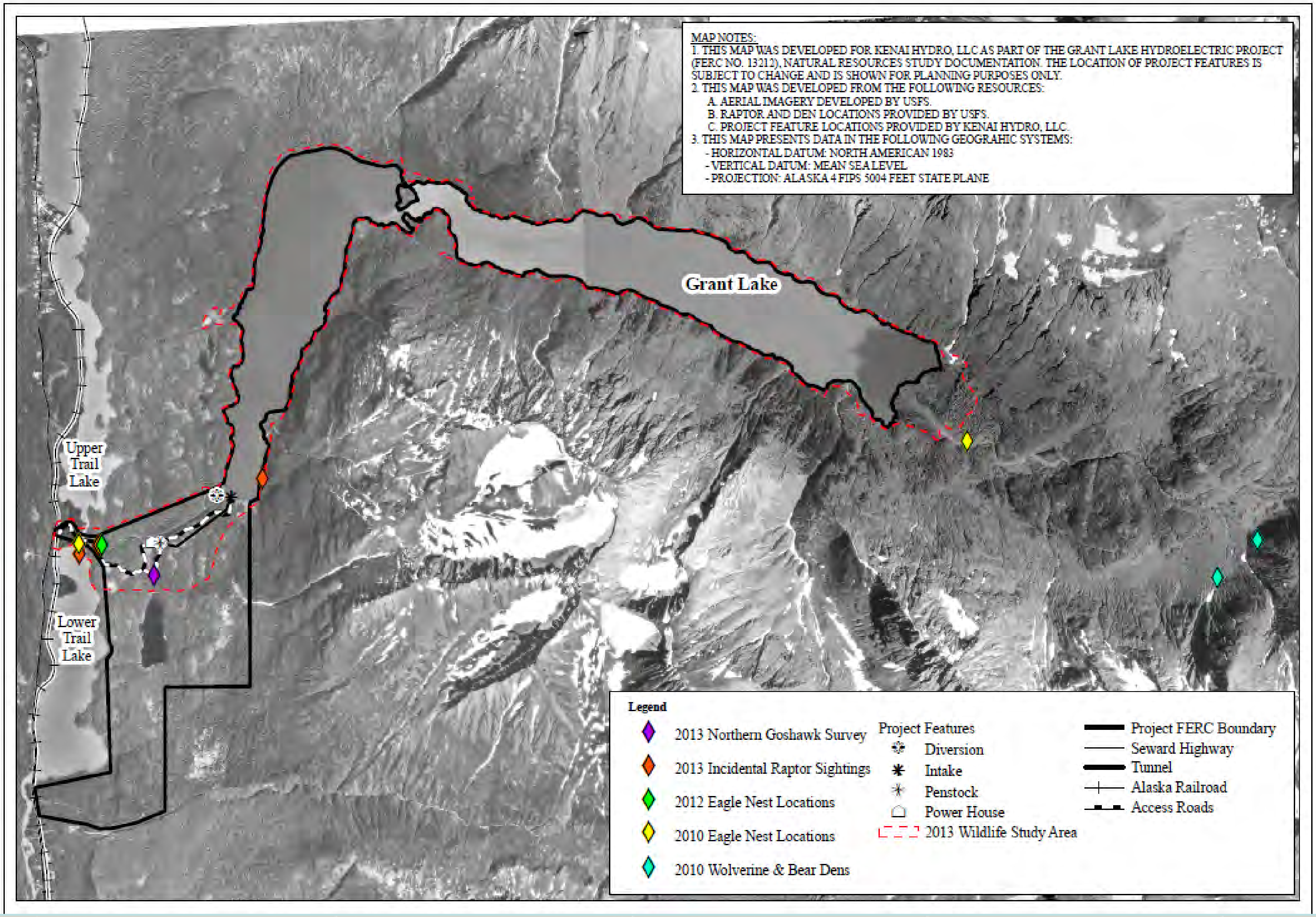
2013 Incidentals

BAEA * OSPR * MERL

RAPTORS




RAPTORS


MAP NOTES:
1. THIS MAP WAS DEVELOPED FOR KENAI HYDRO, LLC AS PART OF THE GRANT LAKE HYDROELECTRIC PROJECT (FERC NO. 13212), NATURAL RESOURCES STUDY DOCUMENTATION. THE LOCATION OF PROJECT FEATURES IS SUBJECT TO CHANGE AND IS SHOWN FOR PLANNING PURPOSES ONLY.
2. THIS MAP WAS DEVELOPED FROM THE FOLLOWING RESOURCES:
A. AERIAL IMAGERY DEVELOPED BY USFS.
B. RAPTOR AND DEN LOCATIONS PROVIDED BY USFS.
C. PROJECT FEATURE LOCATIONS PROVIDED BY KENAI HYDRO, LLC.
3. THIS MAP PRESENTS DATA IN THE FOLLOWING GEOGRAHIC SYSTEMS:
- HORIZONTAL DATUM: NORTH AMERICAN 1983
- VERTICAL DATUM: MEAN SEA LEVEL
- PROJECTION: ALASKA 4 FIPS 5004 FEET STATE PLANE
Grant Lake
Upper Trail Lake
Lower Trail Lake
Legend
2013 Northern Goshawk Survey
2013 Incidental Raptor Sightings
2012 Eagle Nest Locations
2010 Eagle Nest Locations
2010 Wolverine & Bear Dens
Project Features
Diversion
Intake
Penstock
Power House
2013 Wildlife Study Area
Project FERC Boundary
Seward Highway
Tunnel
Alaska Railroad
Access Roads

RAPTORS

Potential Raptors in the Project Area (Occurrence includes migration and/or residence).

Raptor	Breeding Habitat
Golden Eagle **Peregrine Falcon** **Rough-legged Hawk**	Coastal or inland cliffs, bluffs, or other steep terrain
Osprey **Bald Eagle** **Red-tailed Hawk**	Large trees for stick nest placement
Sharp-shinned Hawk **Northern Goshawk** **Great Horned Owl** **Northern Hawk Owl** **Boreal Owl**	Forest
Northern Harrier **Short-eared Owl**	Open meadows, marshes or tundra
Great Gray Owl **Merlin**	Semi-open country including open coniferous woodland
Black Merlin (Falco columbarius suckleyi)	Rivers and coastal areas, and possibly near alpine meadows; edges of forest habitat adjoining open areas, such as muskegs, ponds, and lakes
American Kestrel	Cavity nesters, utilizing natural holes in trees, abandoned woodpecker holes, holes in buildings or cliffs, abandoned magpie nests, and similar sites. This species is also found in alpine and tundra areas not far from treeline and in open spruce and mixed spruce/aspen forests (Alexander et al. 2003)

RAPTORS

Raptor Species Detected in Project Area	Study Year
Bald Eagle	Ebasco 1984, 2010 and 2013
Northern Goshawk	2013
Sharp-shinned Hawk	Ebasco 1984
Osprey	2013
American Kestrel	Ebasco 1984
Golden Eagle	Ebasco 1984
Merlin	2013

RAPTORS

USFS Sensitive Species and Species of Special Interest

Osprey: The osprey is a Region 10 sensitive species. Potential nesting and foraging habitat was observed in the study area during the 2013 field efforts. Ospreys are very individualistic and type specific with regards to tolerance to human activities (Poole 1981).

Bald Eagle: Approximately 80 percent of all detected bald eagle nests on the Seward Ranger District are located in mature cottonwood trees within 0.25 mile of an anadromous fish-bearing stream (USFS 2008). The breeding pair documented on Grant Creek in 2013 did not appear to be impacted by human activity and presence.

Northern Goshawks: This species is a year-round resident of the Chugach National Forest (USFS 1984). The majority of NOGO nests discovered on the Seward Ranger District have been documented in old growth hemlock-spruce stands characterized by a closed canopy, large average diameter, and an open understory (USFS 2008). The spruce bark beetle has affected approximately 95 percent of large conifer trees on the Kenai; a portion of these stands may yet provide nesting or foraging habitat, but the bark beetle is likely reducing the value of these stands for Northern goshawk nesting habitat as the canopy becomes more open (USFS 2008).

RAPTORS

Potential Impacts to Raptors:

- Disturbance during breeding season (direct)
  - Nesting
  - Foraging
- Removal or loss of vegetation (direct / indirect)
  - Nesting
  - Foraging

Movement:

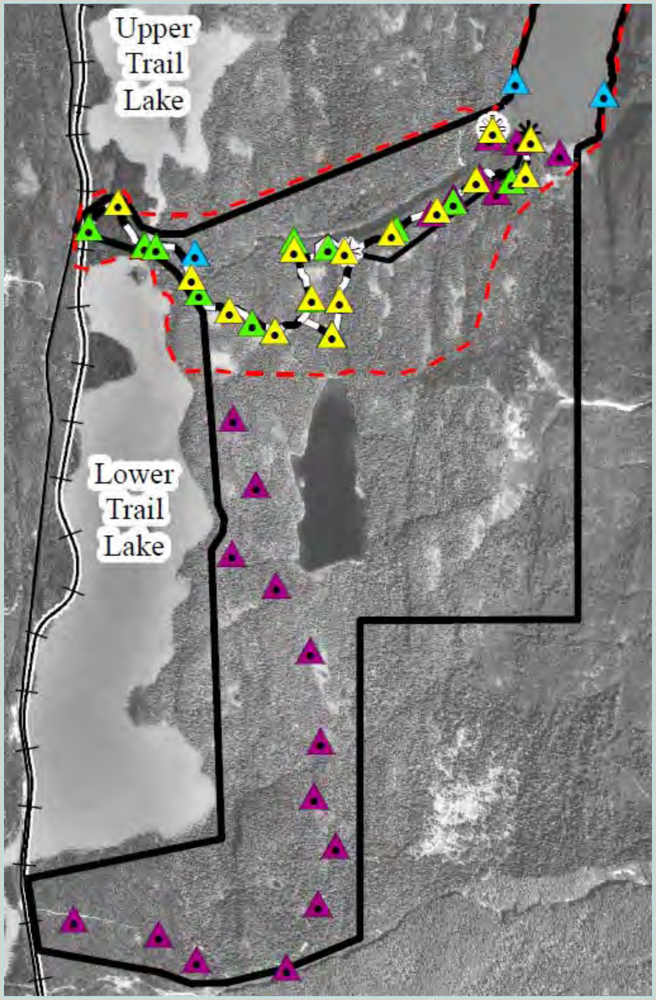
“Shy” species to other less disturbed areas

Species unable to acquire nesting and foraging habitat

BREEDING LANDBIRDS and SHOREBIRDS

2010 Breeding Landbirds and Shorebirds

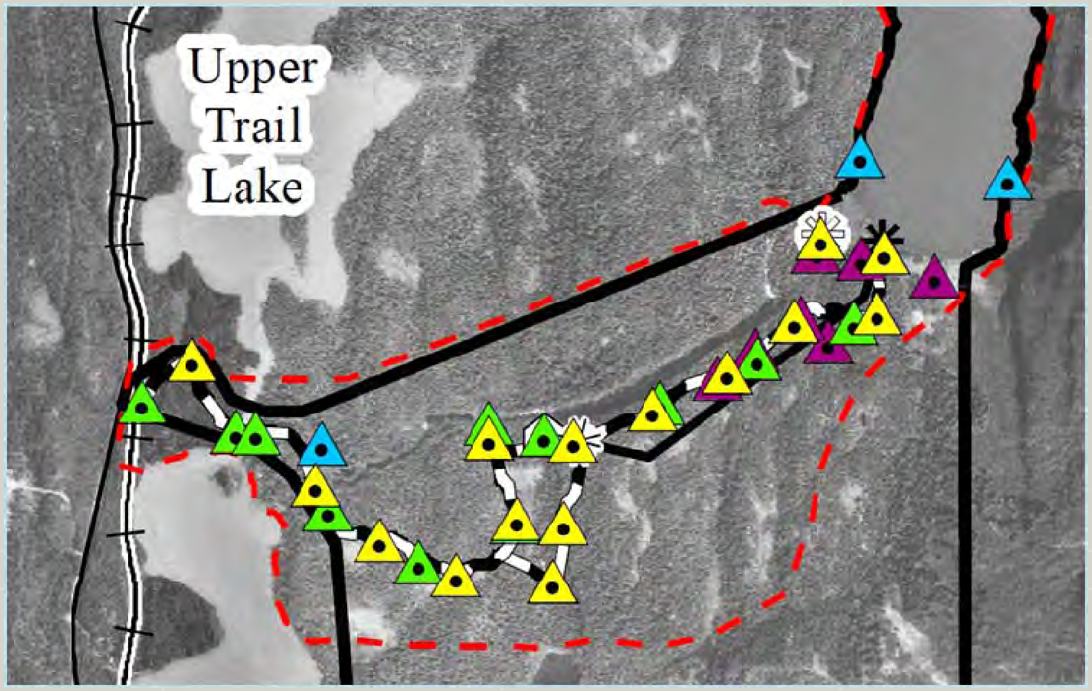
- 20 Breeding Bird Survey Points (232 Detections; 27 Species)
- Coordinates and Shapefile for Survey Points
- Incidental sightings (14 Species including OSFL & SOSA)



BREEDING LANDBIRDS and SHOREBIRDS

2013 Landbird Surveys

- Surveyed the Corridor Area
- 2013 Methods
  - ALMS (250 m)
  - Sampled Points 2 x's (residents & migrants)



BREEDING LANDBIRDS and SHOREBIRDS

2013 Landbird Surveys

- Results
  - 14 Points Surveyed (21th & 22nd May; 15th & 16th June)
  - 279 Detections; 31 Species
  - Vegetation Assessment for each Point (ALMS)

- Data Compilation
  - Birds
    - Ebasco (1984), 2010 and 2013 Field Work
    - Kenai Lake - Black Mountain RNA
    - BBS, USGS, AKNHP and Kenai Birding Festival

- Vegetation "Crosswalk"
  - USFS 2007 (Timber Type Coverage data 1978)
  - Ebasco (1984) Habitat x Kessel (1979) Associations
  - 2013 ALMS
  - 2013 Vegetation Type Classification

BREEDING LANDBIRDS and SHOREBIRDS

2013 Landbird Surveys

- Results

  Qualitative assessment of avian species presence in sampled 2013 wildlife study area vegetation classification.

2013 Vegetation Types	Grass-Forb Meadow	Coniferous Forest	Birch (Original USFS Classification)	Coniferous Deciduous Forest	Scrub Shrub Wetland	Herbaceous Wetland / Floodplain Forest & Scrub
Number of points sampled in Vegetation Class (33 for 2010 and 2013)	1	16	1	12	2	1
Selected Species Detected						
Townsend's Warbler (1984, 2010, 2013)		X		X	X	
Varied Thrush (1984, 2010, 2013)	X	X	X	X	X	X
Additional Selected Species that may be Present in 2013 Vegetation Class						
Lesser Yellowlegs (1984)		X			X	
Olive-sided Flycatcher (2010)		X		X	X	
Solitary Sandpiper (2010)		X			X	
Townsend's Warbler (1984, 2010, 2013)			X			X
Wandering Tattler (1984)		X	X	X	X	X
Blackpoll Warbler		X		X	X	X
Marbled Murrelet		X				

BREEDING LANDBIRDS and SHOREBIRDS

2013 Landbird Surveys

2013 Vegetation Types not Sampled	Alder Scrub	Forested Wetland	Herbaceous Wetland
Selected Species that may be Present			
Lesser Yellowlegs (1984)	X	X	
Olive-sided Flycatcher (2010)	X		
Solitary Sandpiper (2010)		X	X
Townsend's Warbler (1984, 2010, 2013)		X	
Varied Thrush (1984, 2010, 2013)		X	
Wandering Tattler (1984)		X	
Blackpoll Warbler	X	X	X

2013 Incidentals

BCCH * BOCH * BRCR * BEKI * SPGR * SPSA * VGSW * CORA * ALFL * TRSW * GRAJ * ARTE

BREEDING LANDBIRDS and SHOREBIRDS

USFS Species of Special Interest

Marbled Murrelet: Select mature or old growth conifers for nesting, and this habitat is found within the area in mature hemlock and spruce-hemlock forests. Marbled murrelets have not been observed in the Grant Lake area.

Townsend's Warbler: Detected during the Ebasco (1984), 2010, and 2013 Grant Lake surveys.

Alaska Audubon Red-Listed Species

Varied Thrush: Detected during the Ebasco (1984), 2010, and 2013 Grant Lake surveys.

Lesser Yellowlegs: Only detected during the Ebasco (1984) surveys.

Wandering Tattler: Detected during the Ebasco (1984) surveys; however, their habitat does not likely occur in the study area.

BREEDING LANDBIRDS and SHOREBIRDS

Alaska Audubon Red-Listed Species Cont.

Solitary Sandpiper: Detected during the 2010 surveys.

Kittlitz's Murrelet: Select areas of high elevation alpine areas, with little or no vegetative cover. Kittlitz's Murrelets have not been observed in the Grant Lake area and their habitat does not likely occur in the study area.

Olive-sided Flycatcher: Detected during the 2010 surveys and their habitat likely occurs in the study area.

Blackpoll Warbler: Blackpoll warblers have not been detected in the Grant Lake area; however, their habitat does occur in the study area. AKNHP indicates range is further west on Kenai "lowlands".

BREEDING LANDBIRDS and SHOREBIRDS

Potential Impacts to Breeding Landbirds and Shorebirds:

- Disturbance during breeding season (direct)
  - Nesting
  - Foraging
- Removal or loss of vegetation and / or shoreline (direct / indirect)
  - Nesting
  - Foraging

Movement:

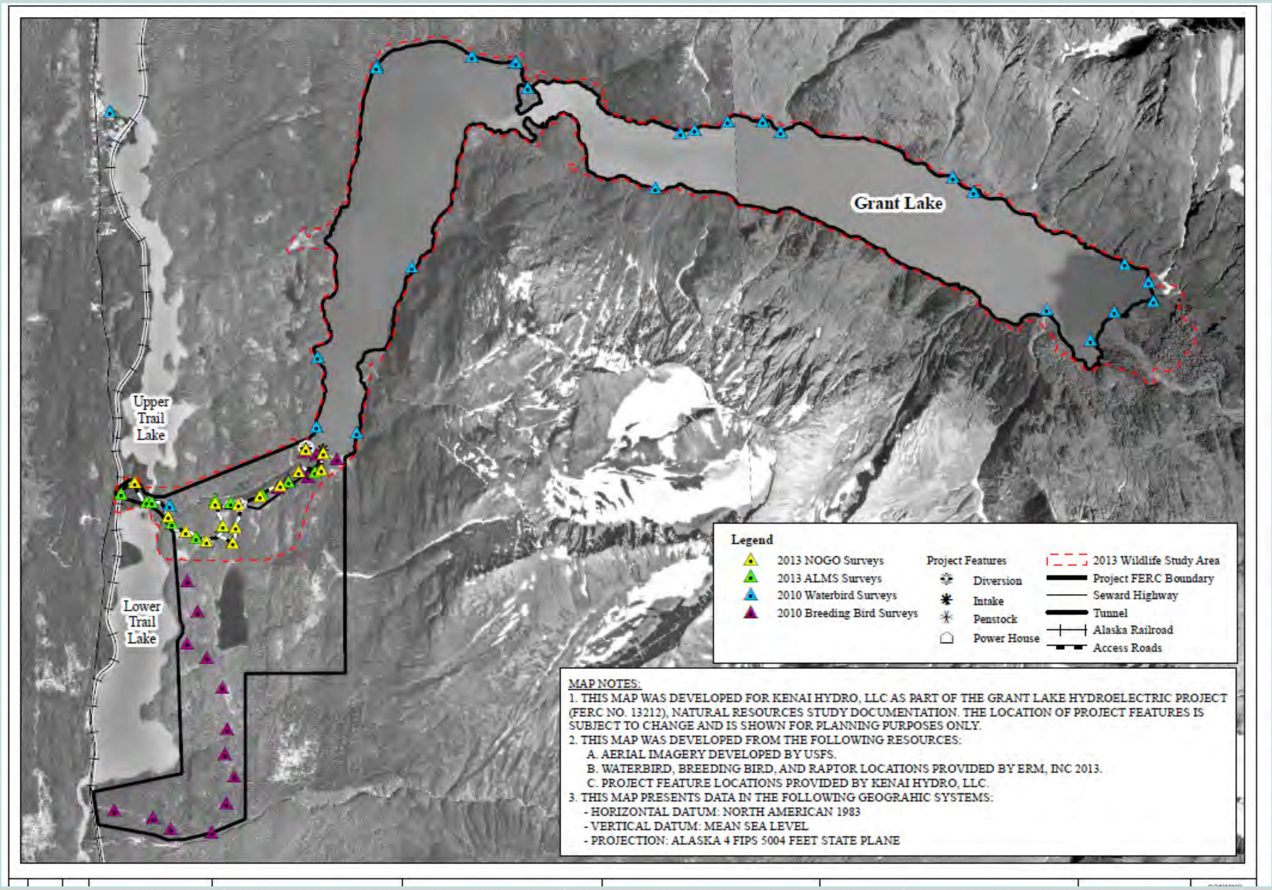
“Shy” species to other less disturbed areas

Species unable to acquire nesting, cover and foraging habitat

WATERBIRDS

2010 Waterbirds

- Four boat-based surveys on Grant Lake
- One foot survey of Grant Creek (HADU not detected)



WATERBIRDS

2013 Winter Waterbird Surveys

- 2013 Methods
  - Aerial Surveys
- 2013 Accomplishments
  - 1 survey completed
- Results
  - ʌ TRUS * Merganser Species

WATERBIRDS

2013 Winter Waterbird Surveys

WATERBIRDS

2013 Winter Waterbird Surveys

WATERBIRDS

2013 Winter Waterbird Surveys

WATERBIRDS

2010 Waterbirds Surveys

2010 Waterfowl Surveys	Adults	Pairs	Adult Females	Documented Broods
Barrow’s Goldeneye	X		X	X
Common Goldeneye	X		X	X
Common Loon	X			
Pacific Loon	X			
Common Merganser	X			
Red-breasted Merganser		X	X	X
Harlequin Duck * Grant Lake			X	
Mallard			X	

Ebasco (1984) AMWI * GWTE

2013 Incidentals

HADU * COLO * RBME * TRUS

WATERBIRDS

USFS Sensitive Species

Trumpeter Swan: Considered shy waterfowl, easily disturbed during nesting; however, once cygnets are mobile, adults become very protective. Trumpeter swans were observed north of the Grant Lake study area during USFS surveys (2008); however, no nests or cygnets were observed during these USFS (2008) surveys. Trumpeters were also sighted during spring 2013 below the Trail Lake narrows and during the December 2013 survey.

Alaska Audubon Red-Listed Species

Red-throated Loon: This species will typically select marshy islands for nest sites or on dry shores. They will nest on small oligotrophic lakes in diverse habitats, such as forests or tundra up to 1,070 meters (~3,510 feet) in elevation. The availability of freshwater fish limits this species’ distribution. Red-throated loons have not been observed in the Grant Lake area however their nesting habitat does occur in the study area.

Yellow-billed Loon and Greater White-fronted Goose: Both species are considered non-breeders in this area and warrant no further discussion as their primary breeding habitats also do not occur in this area.

WATERBIRDS

Potential Impacts to Waterbirds:

- Disturbance during breeding season (direct)
  - Nesting
  - Foraging
- Removal or loss of vegetation and / or shoreline (direct / indirect)
  - Nesting
  - Foraging

Movement:

“Shy” species to other less disturbed areas

Species unable to acquire nesting, cover and foraging habitat

TERRESTRIAL MAMMALS

2010 Terrestrial Mammals

- Bat Survey of the historic cabin on July 23 2010
- Coordinates and Shapefile for 1 brown bear and 1 wolverine den, provided by USFS
- Six mountain goats (5 adults, 1 kid) were noted
- Incidental sightings of 3 black bear, brown bear, moose, 3 beaver, a coyote, and a porcupine

2013 Winter Moose Surveys

- 2013 Methods
  - Aerial Surveys: Gasaway et al. (1986)
- 2013 Accomplishments
  - 1 survey completed
- Results
  - No Moose or trails detected

2013 Incidentals

Numerous moose sightings (including a cow / calf pair), black bear, beaver, and lynx

TERRESTRIAL MAMMALS

2013 Winter Moose Surveys

TERRESTRIAL MAMMALS

2013 Winter Moose Surveys

TERRESTRIAL MAMMALS

Potential Impacts to Mammals:

- Disturbance (direct / indirect)
  - Females with YOY
  - Foraging
- Removal or loss of vegetation and / or shoreline (direct / indirect)
  - Cover / Shelter from Predators
  - Cover / Thermoregulation
  - Foraging

Movements:

“Shy” species to other less disturbed areas

Unable to acquire cover and foraging habitat

May lead to increased human interactions (DLP)

Terrestrial Wildlife

Best Management Practices

- USFWS (2007) National Bald Eagle Management Guidelines. (Raptors); and
- USFWS (2005) Recommended Time Periods for Avoiding Vegetation Clearing in Alaska in order to Protect Migratory Birds. (All Birds).

2014 Field Study Timeline

Study Component		2014						
		Jan	Feb	Mar	Apr	May	June	July
Wildlife	Raptors (Northern Goshawk Broadcast Surveys)							
	Winter Waterbirds (Surveys)							
	Terrestrial Mammals (Moose Surveys)							

Results from the 2013 / 2014 Winter Moose surveys and 2014 Northern Goshawk Surveys will be provided to stakeholders for review and collaboration and incorporated into the DLA.

Questions?

Final Grant Lake Project Natural Resource Study Report Presentations

(March 18-20, 2014)

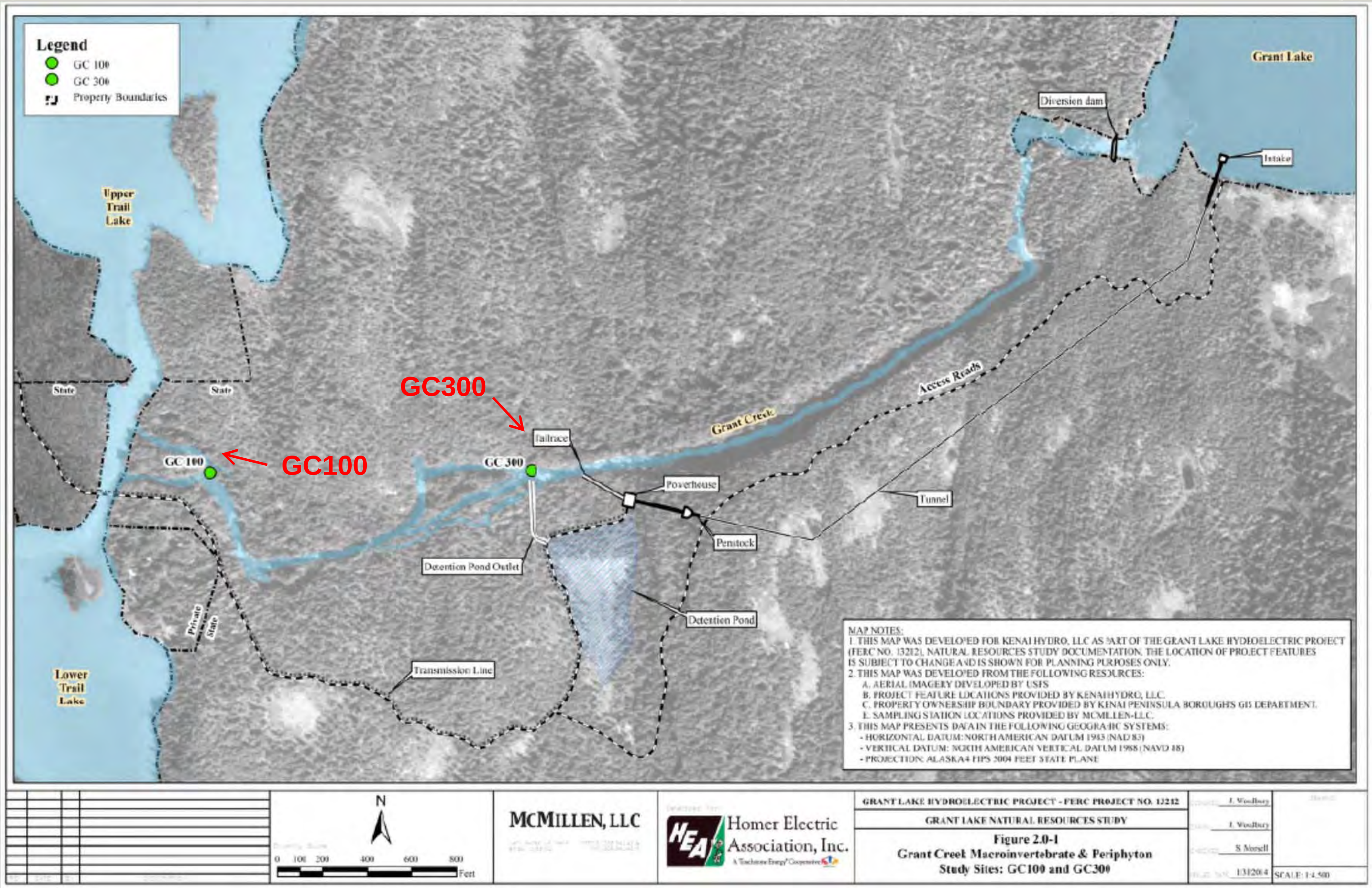
(Continued)

Grant Creek Macroinvertebrate and Periphyton Studies

2013 studies were conducted to complete data collection started in 2009 and to meet objectives stated in the study plan. Studies were designed to

- Provide a reliable measure of baseline stream productivity that can compared from year to year and with other stream systems.
- Provide some indication of the relative “health” of the Grant Creek ecosystem by employing standard measures that are comparable to other Alaska stream systems.

Grant Creek Macroinvertebrate and Periphyton Studies



Grant Creek Macroinvertebrate and Periphyton Studies

Sampling Site GC100: Looking cross channel from the north bank.

Grant Creek Macroinvertebrate and Periphyton Studies

Sampling Site GC300: Looking cross channel from the north bank.

Grant Creek Macroinvertebrate Study – Methods

- Sampling Methods:
  - Sampling in 2009 included both Alaska Stream Condition Index (ASCI), which is a modified EPA Rapid Bioassessment Protocol (RBP), and a quantitative method using Surber samplers
  - ASCI methods collect kick net samples from the range of habitats found in the sampling reach
  - Methods using Surber samplers in riffle habitats only, collect quantitative data that is more useful for monitoring purposes

Grant Creek Macroinvertebrate Study – Methods

- 2013 Field Work:
  - One sampling event on August 14, 2013 at GC100 and GC300
  - Employed Surber samplers in riffle habitats
  - Five replicates collected at each site
  - Samples placed in Nalgene bottles and preserved in alcohol

Grant Creek Macroinvertebrate Study – Methods

- Laboratory Work:
  - All organisms were sorted from the sample material
  - Preserved in alcohol
  - All organisms were identified to genus or next practicable taxon; Chironomidae only to family

Grant Creek Macroinvertebrate Study – Methods

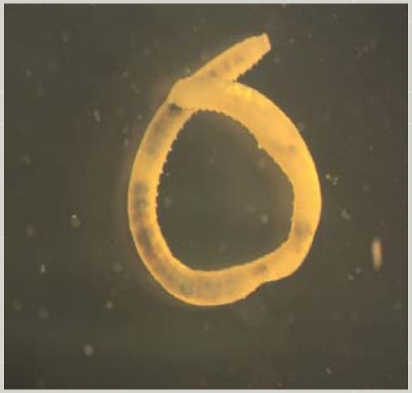
- Data Analysis – Metrics Calculated:
  - Population density as numbers/m2
  - Taxa richness metrics (overall taxa richness, Ephemeroptera taxa richness, Trichoptera taxa richness, Plecoptera taxa richness)
  - Taxonomic composition metrics (percent Ephemeroptera, percent Trichoptera, percent Plecoptera, percent Ephemeroptera/Plecoptera/Trichoptera (EPT), percent Chironomidae, percent dominant taxon)
  - Population trophic characteristics metrics (percent filterers, percent gatherers, percent predators, percent scrapers, percent shredders, filterer richness, gatherer richness, predator richness, scraper richness, shredder richness)
  - Hilsenhoff Biotic Index (HBI) scores (based on tolerance values assigned to each taxa)
  - Alaska Stream Condition Index, modified EPA RBP, (ASCI) habitat assessment scores

Grant Creek Macroinvertebrate Study – Results

Results

- 35 macroinvertebrate taxa collected in 2009 and 2013 samples
  - 26 insect taxa
  - 9 non-insect taxa (e.g. snails and oligochaetes)

Plecoptera - genus Suwallia



Oligochaeta

Grant Creek Macroinvertebrate Study – Results

- Metrics developed from the results of macroinvertebrate identifications indicated general similarity between sites and years
- It was notable that fewer Chironomidae were identified at GC300 in 2009 than in other samples
- Apparent trends are highlighted in the following tables of macroinvertebrate metrics

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate population density and taxa richness metrics, 2009 and 2013.

Sample Site	Date	Sample Type	Density (no. / m²)	Taxa Richness	Ephemeroptera Taxa Richness	Plecoptera Taxa Richness	Trichoptera Taxa Richness	EPT Taxa Richness
GC100	**08/06/09**	Surber[1]	12034 (4697)	19 (0.8)	6 (0.75)	3 (0.80)	3 (0.40)	12 (0.49)
GC100	**08/14/13**	Surber	19282 (7877)	20 (1.6)	6 (0.00)	3 (0.49)	2 (1.02)	12 (1.27)
GC300	**08/06/09**	Surber	2204 (1764)	15 (3.1)	4 (1.36)	3 (1.33)	3 (1.60)	10 (3.38)
GC300	**08/14/13**	Surber	12835 (3275)	22 (2.7)	6 (0.49)	4 (0.80)	3 (0.89)	12 (1.47)
GC100	**08/06/09**	ASCI[2]	2740	10	4	2	1	7
GC300	**08/06/09**	ASCI	530	12	1	2	1	4

Notes:
1. Data reported are averages (followed by + or - standard deviation in parentheses) of five replicate Surber samples.
2. Data reported are totals for composited samples.

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate population composition metrics, 2009 and 2013.

Sample Site	Date	Sample Type	% Ephemeroptera	% Plecoptera	% Trichoptera	% EPT	% Chironomidae	% Dominant Taxa
GC100	**08/06/09**	Surber[1]	3.9 (2.2)	2.6 (2.1)	1.3 (0.7)	7.7 (4.8)	84.7 (7.7)	84.7 (7.7)
GC100	**08/14/13**	Surber	2.6 (0.9)	1.4 (0.6)	0.4 (0.1)	4.4 (1.4)	88.5 (3.9)	88.5 (3.9)
GC300	**08/06/09**	Surber	18.0 (4.4)	8.9 (3.3)	4.6 (3.9)	31.5 (5.7)	41.0 (18.6)	48.4 (13.2)
GC300	**08/14/13**	Surber	6.4 (2.4)	1.8 (0.7)	0.5 (0.2)	8.7 (2.6)	83.3 (4.8)	82.3 (5.5)
GC100	**08/06/09**	ASCI	1.4	0.5	0.2	2.1	13.1	82.9
GC300	**08/06/09**	ASCI	1.3	1.6	0.7	3.6	7.5	77.8

Notes:
1. Data reported are averages (followed by + or - standard deviation in parentheses) of five replicate Surber samples.

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate functional feeding group metrics, 2009 and 2013.

Sample Site	Date	Sample Type	% Filterers	% Gatherers	% Predators	% Scrapers	% Shredders	Filterer Richness	Gatherer Richness	Predator Richness	Scraper Richness	Shredder Richness
GC100	**08/06/09**	Surber[1]	5	89	3	2	2	4	10	7	6	1
GC100	**08/14/13**	Surber	5	91	3	1	1	3	8	6	5	1
GC300	**08/06/09**	Surber	15	56	8	17	3	4	7	10	5	2
GC300	**08/14/13**	Surber	5	88	4	3	1	3	6	5	4	0
GC100	**08/06/09**	ASCI	83	14	2	1	0	1	3	4	3	1
GC300	**08/06/09**	ASCI	79	10	8	2	0	3	4	3	1	0

Notes:
1. Data reported are averages of five replicate Surber samples.

Grant Creek Macroinvertebrate Study – Results

Macroinvertebrate biotic indices and habitat assessment, 2009 and 2013.

Sample Site	Date	Sample Type	Hilsenhoff Biotic Index[1]	ASCI Habitat Assessment[2]
GC100	08/06/09	Surber	5.76	
GC100	08/14/13	Surber	5.81	
GC300	08/06/09	Surber	4.71	
GC300	08/14/13	Surber	5.61	
GC100	08/06/09	ASCI	7.5	200
GC300	08/06/09	ASCI	7.1	190

Notes:
1. Scale from 0-10, with 10 indicating greatest water body impairment.
2. Scale from 0-200, with 200 indicating most macroinvertebrate rich habitat

Grant Creek Macroinvertebrate Study – Results

- Analysis of variance calculated for several metrics
  - Comparison of variability between years and sites
  - Determine if results represent a reliable baseline condition
  - Found variance between years and sites insignificant (P> 0.05), except when comparisons were made to data collected at GC300 in 2009
  - These results may be explained by lower numbers of Chironomidae identified at GC300 in 2009 as compared to other samples
  - Variance in the metric ‘EPT taxa richness’ was insignificant both between sites and between years; this metric independent of Chironomidae data

Grant Creek Macroinvertebrate Study – Discussion

- Data useful for describing baseline:
  - Variability not significant except for metrics influenced by lower numbers of chironomids collected at GC300 in 2009
  - ANOVA indicates that GC100 could be used to monitor stream condition

Grant Creek Macroinvertebrate Study – Discussion

Predicted responses of several metrics to habitat impairment or perturbation (excerpted from EPA RBP, Barbour et al. 1999).

Metric	Definition	Predicted Response to Perturbation
Taxa Richness	Measures overall variety of the population	Decrease
EPT Taxa Richness	Number of taxa in the EPT orders	Decrease
% EPT	Percent of population in EPT orders	Decrease
% Scrapers	Percent of population that scrape or graze upon periphyton	Decrease
% Gatherers	Percent of population that “gather”	Variable
% Predators	Percent of population that are predators. Can be made restrictive to exclude omnivores.	Variable
Hilsenhoff Biotic Index	Uses tolerance values to weight abundance in an estimate of overall pollution. Originally designed to evaluate organic pollution	Increase

Grant Creek Macroinvertebrate Study – Discussion

- Data may be used for comparison to other streams in the Cook Inlet watershed and as an estimation of stream "health" and/or macroinvertebrate habitat quality
  - The challenge is to compare data collected using similar methods and stream categories
  - There is some data available for Cook Inlet and Upper Kenai where either Surber samplers or ASCI methods were used

Grant Creek Macroinvertebrate Study – Discussion

- Data collected using Surber samplers in riffle habitats
  - Grant Creek exhibits lower percent Ephemeroptera, Plecoptera, Trichoptera, shredders, scrapers, and predators, and higher percent Diptera/Chironomidae and gatherers than the mean for other Cook Inlet streams
  - Indicative of lower quality habitat or more stressful conditions: turbid water, variable flows, and flood/high velocities making substrate unstable

Grant Creek Macroinvertebrate Study – Discussion

Mean percent composition of the aquatic insect fauna in streams of the Cook Inlet Basin, Alaska [modified from Oswood and others (1995)] (excerpted from USGS 1999) and in Grant Creek, 2009 and 2013.

Fauna	Percent Composition Cook Inlet Watershed Streams	Percent Composition Grant Creek, 2009 and 2013 [1]
Taxonomic Structure		
Coleoptera	0.0	NA
Diptera	34.0	74.4 [2]
Ephemeroptera	41.3	7.7
Plecoptera	17.5	3.6
Trichoptera	7.2	1.7
Functional Group		
Shredders	11.6	1.8
Scrapers	11.2	5.8
Collector-filterers	6.6	7.5
Collector-gatherers	60.5	81.0
Predators	10.0	4.5

Notes:
1. Includes GC300 2009 which varies significantly from the other samples.
2. Chironomidae only.

Grant Creek Macroinvertebrate Study – Discussion

- Data collected using ASCI methods (employed on Grant Creek in 2009)
  - Comparison with other high gradient (> 2%) streams comprised mainly of riffle/run habitat in Kenai Peninsula Pacific Coastal Mountain Ecoregion
  - Indicates Grant Creek habitat relatively stressful for macroinvertebrate populations
  - ASCI scores based on core metrics result in a “poor” score for Grant Creek

ASCI scores based on core metrics (excerpted from ENRI 2000), and score for Grant Creek: average of GC100 and GC300, 2009.

		Score				**Grant Creek Score**
Ecoregion and Stream Type	Maximum	Very Good	Good	Poor	Very Poor	
Pacific Coastal Mountains						
All Stream Types	42	>29	20-29	10-19	<10	18

Grant Creek Periphyton Study - Methods

- Field Work:
  - One sampling event in August 2013 at GC100 and GC300
  - Used a modified EPA rapid bioassessment protocol
  - Ten samples collected within a single habitat type (riffles) to provide quantitative data for monitoring purposes
- Laboratory analysis of samples to determine chlorophyll *a* concentration

Grant Creek Periphyton Study - Results

- 2009 and 2013 results varied between sites and years

Average[1] concentrations of chlorophyll *a* from periphyton collected in Grant Creek, 2009 and 2013.

Sample Site	Date	Chlorophyll a Concentration (μg/cm^2)
GC100	**08/06/09**	34.79 (23.76)
GC100	**08/14/13**	5.85 (4.92)
GC300	**08/06/09**	12.70 (9.94)
GC300	**08/14/13**	4.4 (2.84)

Notes:
1. Averages, followed by standard deviation in parentheses, are of 10 replicate samples.

Grant Creek Periphyton Study - Results

- ANOVA of the data collected on Chorophyll *a* concentrations indicates significant variability ($P < 0.05$) between years at both sites and between sites in 2009.
- The difference in concentrations between GC100 and GC300 in 2013 was not significant ($P > 0.05$).

Grant Creek Periphyton Study - Discussion

- The data collected to date on periphyton chlorophyll a concentrations at the two sites in Grant Creek exhibits too much variability to be said to describe a baseline condition
- Grant Creek presents challenging conditions for periphyton, as well as benthic macroinvertebrates: turbidity from glacial influences, variable flows, and flood/high velocity flows
- Stabilization of flows could potentially improve conditions for periphyton and benthic macroinvertebrates

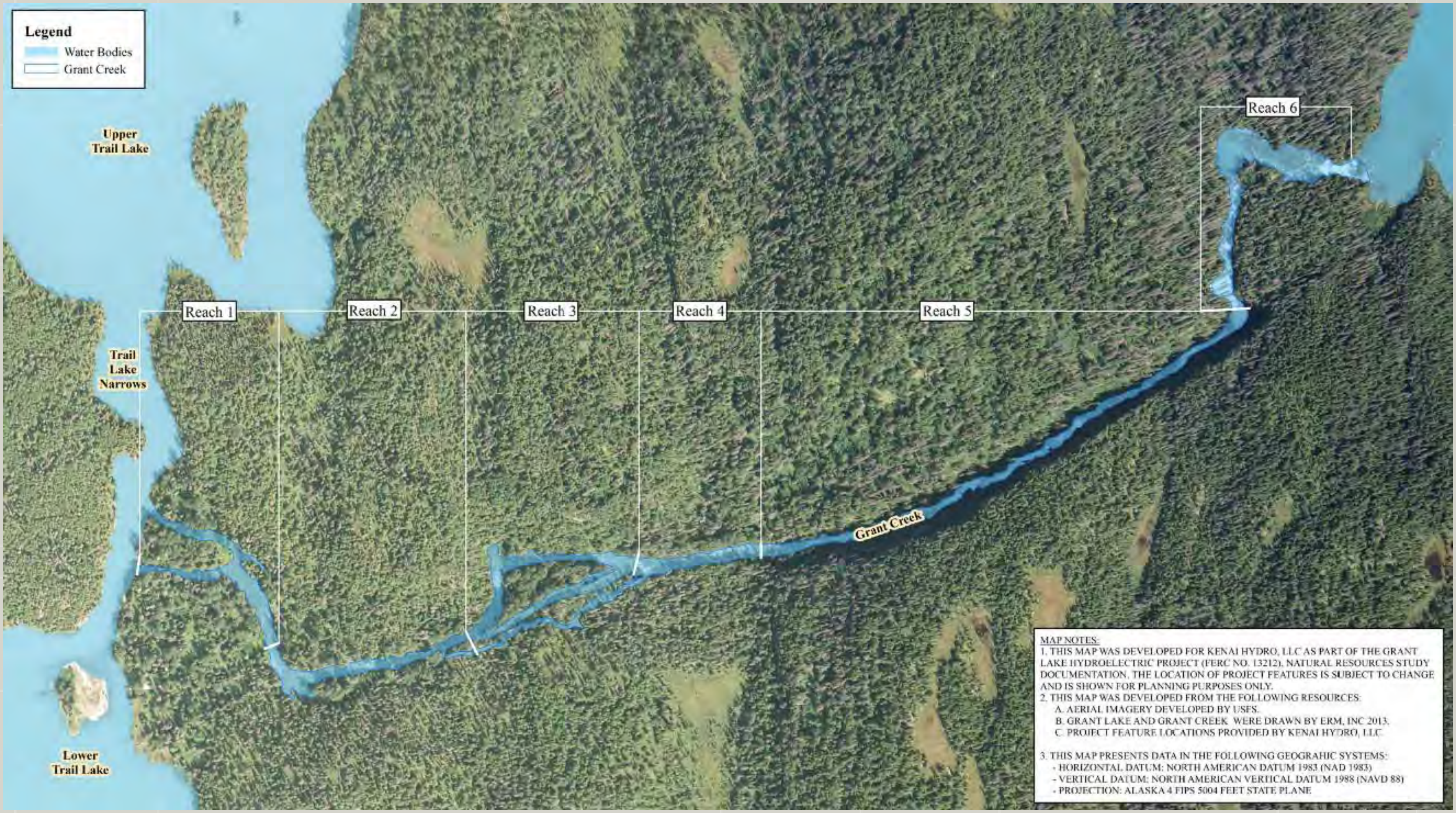
Grant Creek Fisheries Assessment Study Results

Grant Lake Hydroelectric Project (FERC No. 13212)

March 19-20, 2014 – Anchorage, AK

In Association with

Introduction – Study Area



Introduction – Study Objectives

- Grant Creek Salmon Spawning Distribution and Abundance
  - Salmon Escapement to Grant Creek
  - Distribution of Spawning Salmon
- Grant Creek Resident and Rearing Fish Abundance and Distribution
  - Adult Rainbow Trout Abundance, Distribution, and Spawning
  - Resident and Rearing Fish use of Reach 5
  - Resident and Rearing Fish use of Reaches 1-4
- Trail Lake Narrows Fish and Aquatic Habitats
  - Fish use in the Narrows at the Proposed Bridge Location

Methods

- Adult Weir
  - Foundation of 2013 Grant Creek Study
  - Located Approximately 200 meters Upstream of Confluence
  - Installed May 23 and Removed October 23
  - Perpendicular to Flow with Up and Downstream Trapping Facilities
  - Weir Design: Standard Steel and Aluminum A-Frame Picket Weir
    - 1.9 cm steel pickets spaced 2.54 cm apart

Methods

- Adult Weir - Continued
  - Weir Function:
    - Identify and Enumerate all Salmon Species Migrating Through the Weir – Up and Downstream
    - Collect Biological Samples/Data/Tagging:
      - Species
      - Sex
      - Length (Mid-Eye to Fork)
      - Weight (Grams)
      - Scales
      - Genetic Samples (Axillary Process)
      - Radio- and Floy-Tag
      - Recover and Process Carcasses
        - » Recover Radio and Floy Tags (Used to Estimate Stream Life)
        - » Document Egg Voidance in Females

Methods

- Radio Telemetry
  - Gastrically Implanted Transmitters in Chinook (n=9), Sockeye (n=65), and Coho (n=50)
  - Surgically Implanted Transmitters in Rainbow Trout (n=20) and Dolly Varden (n=1)

Methods

- Radio Telemetry – Continued
  - Monitored Fish Movement Using Two Fixed-Site Telemetry Stations
    - Underwater Array Near Grant Creek Confluence
    - Underwater Arrays at Reach 4/5 Break and in Reach 5
  - Conducted Two Mobile Surveys per Week

Methods

- Visual Surveys (Escapement)
  - Conducted Weekly
    - Typically Two Teams of Two – Each Bank
    - Conducted Under Similar Conditions Where Possible
    - Observations Recorded on Reach Maps (Species and Location)
- Redd Surveys (Spawning Distribution)
  - Conducted Weekly
    - Typically Two Teams of Two – Each Bank
    - Observations Recorded on Reach Maps (Species and Location)
- Carcass Surveys (Biological Sampling)
  - Conducted Weekly and During Daily Activities
  - Recovered Radio and Floy Tags
  - Carcasses Recovered and Processed at the Weir

Methods

- Juvenile Incline Plane Traps
  - Used to Assess Abundance and Distribution of Juvenile Salmonids
  - Enumerated Fish by Species and Collected Weight and Length Data
  - Released Dyed Fish to Ascertain Trap Efficiency (Lower Trap Only)
  - Upper Trap Located at the Reach 4/5 Break
    - Operated April 28 to May 30, and September 19 to October 16
  - Lower Trap Located at the Reach 1/2 Break
    - Operated April 30 to October 16
  - Traps Shut Down Intermittently Due to Flow and Debris
  - Surfaces Constructed with ¼ Inch Mesh or Perforated Plate

Methods

- Minnow Trapping
  - Trapping Occurred Monthly – April through October
  - Goal was to Deploy 10 Traps per Reach – Representing all Habitat Types
  - Deployed a Total of 382 Minnow Traps During Study
  - Baited with Cured and Sterilized Salmon Eggs
  - Fished for 24 hours
  - Calculated Catch Per Unit Effort (CPUE)

Methods

- Snorkel Surveys
  - Conducted Only in April and May (Due to High Flows and Poor Visibility)
  - Surveys Conducted at Night in Reaches 1-5
  - Goal was to Sample all Potential Rearing Habitats
  - Fish Classified by Species and within 20 mm Bins
  - Calculated Fish Density by Habitat Unit

Methods

- Beach Seining
  - Used 50’ Net with ¼” Mesh
  - Not Conducted in Reach 5 Due to Dominant Boulder Substrate
  - Sampled 5 Sites in Reaches 1-4; Only 3 Sites Suitable
  - Sampled the Narrows on July 23 – Three Sites
- Angling Surveys
  - Only Conducted in Narrows to Assess Species Composition and CPUE

Results

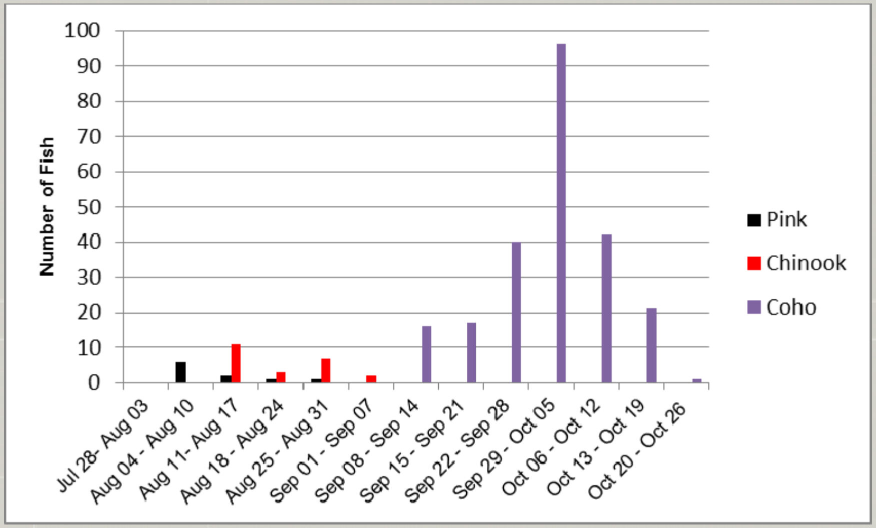
- Adult Weir Counts
  - Total of 1,439 Salmon Migrated Upstream of the Weir
    - Chinook – 35 (Floy-Tagged 33; Radio-Tagged 9)
    - Sockeye – 1,153 (Floy-Tagged 533; Radio-Tagged 65)
    - Coho – 239 (Floy-Tagged 176; Radio-Tagged 50)
    - Pink – 12 (Did Not Floy- or Radio-Tag)
  - Total of 52 Salmon Migrated Back Downstream – Net 1,387 Salmon
    - Chinook – 23
    - Sockeye – 1,117
    - Coho – 237
    - Pink – 10
  - Caveats
    - Does Not Include Fish Below the Weir – Spawners and Strays
    - Some Fish Migrated both Up and Downstream of the Weir Without Being Captured within the Facilities
    - Extent of Undocumented Passage Unknown

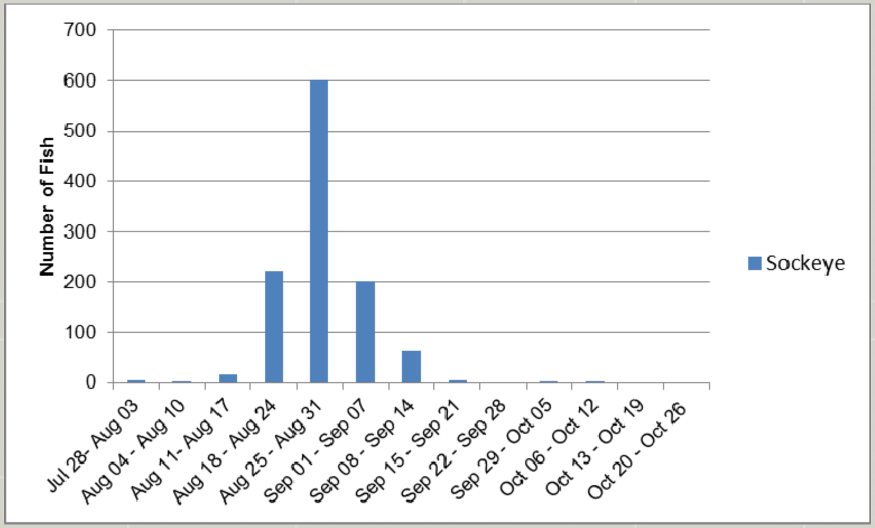
Results

- Adult Weir Counts
  - Total of 27 Resident Salmonids Migrated Upstream of the Weir
    - Rainbow Trout – 13 (Floy-Tagged 13; Radio-Tagged 4)
    - Dolly Varden – 14 (Floy-Tagged 14; Radio-Tagged 1)
  - Caveats
    - Does Not Include Fish Below the Weir – Spawners and Strays
    - Some Fish Migrated both Up and Downstream of the Weir Without Being Captured within the Facilities (Based on Radio Telemetry Observations)
    - Extent of Undocumented Passage Unknown

Results

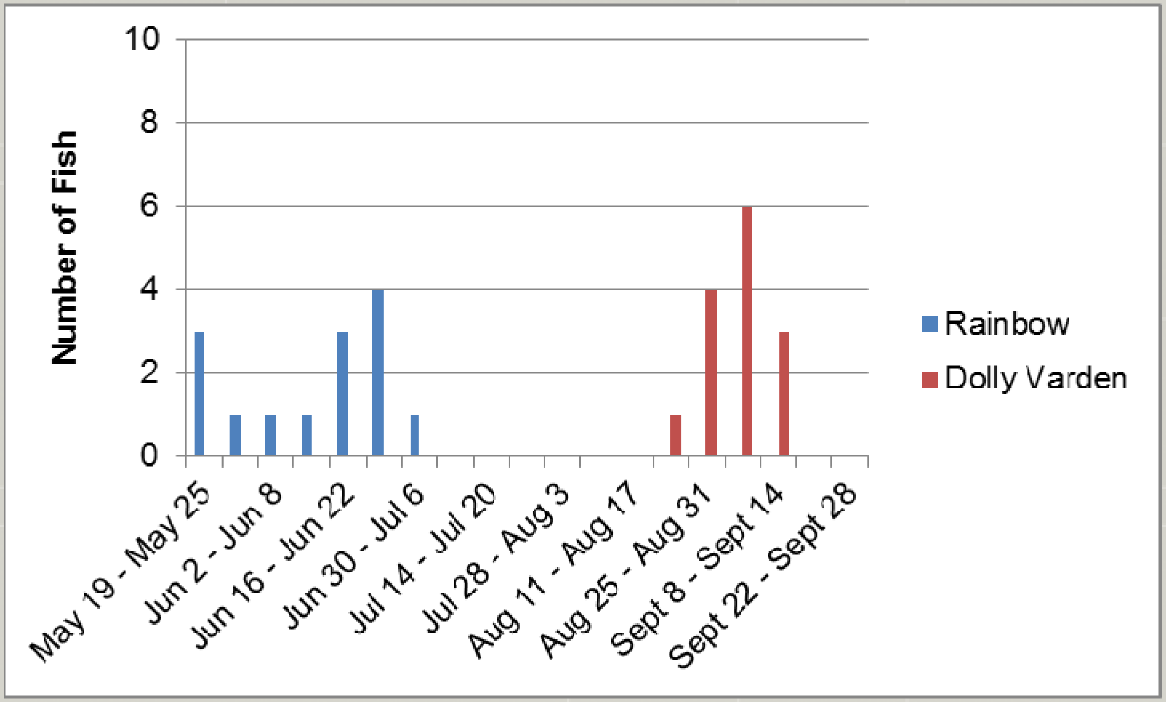
- Runtiming – Adult Anadromous Salmon
  - Pink – August 4 through August 25; Peak August 15
  - Chinook – August 11 through September 5; Peak August 16
  - Sockeye – July 29 through October 9; Peak August 29
  - Coho – September 8 through October 26; Peak October 3





Results

- Runtiming – Adult Resident Salmonids
  - Rainbow Trout – May 24 through July 3; No Discernable Peak
  - Dolly Varden – August 24 through September 11; Peak September 5



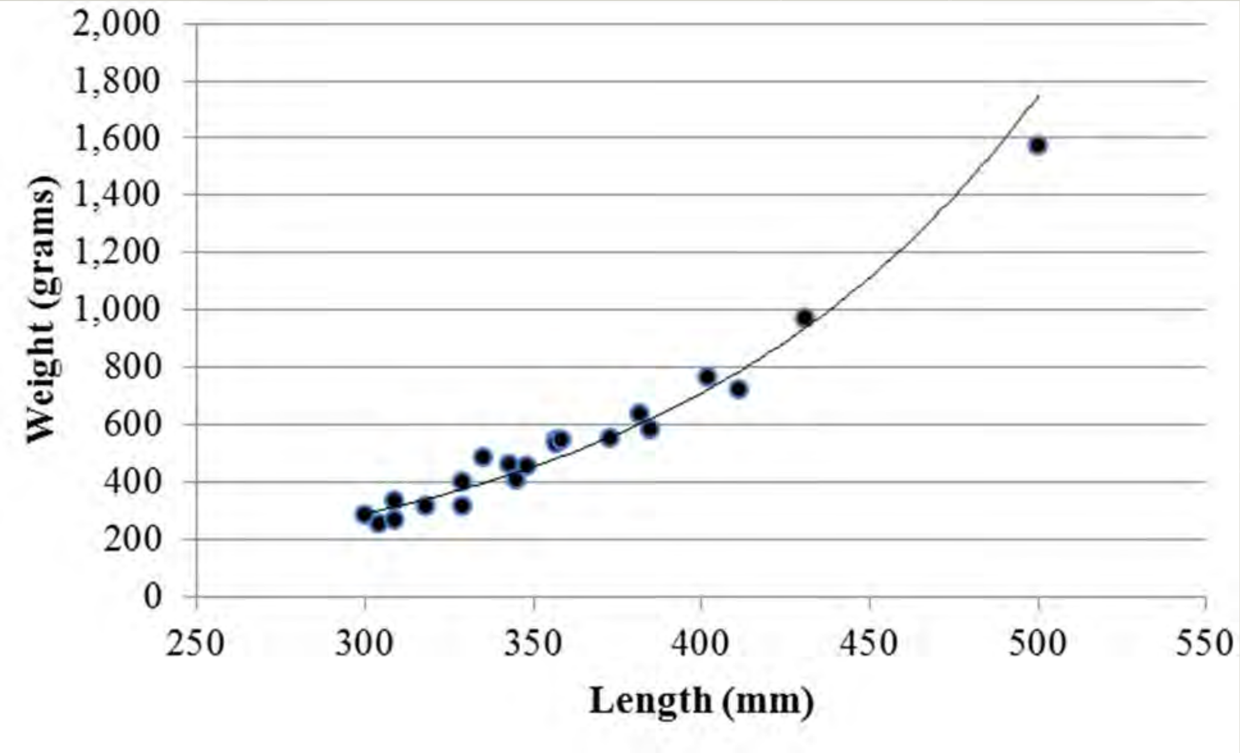
Results

- Fish Size – Anadromous Species

Species	Sex	Mean Length (cm)	Mean Weight (kg)
Chinook	Female	88	10.4
	Male	71	5.9
Coho	Female	59	3.3
	Male	58	3.5
Sockeye	Female	54	2.6
	Male	55	3.0
Pink	Female	42	1.0
	Male	45	1.3

Results

- Fish Size – Rainbow Trout
  - Mean Length – 358 mm
  - Mean Weight – 544 gm
  - Based on 4 Weir and 16 Angling Caught Trout



Results

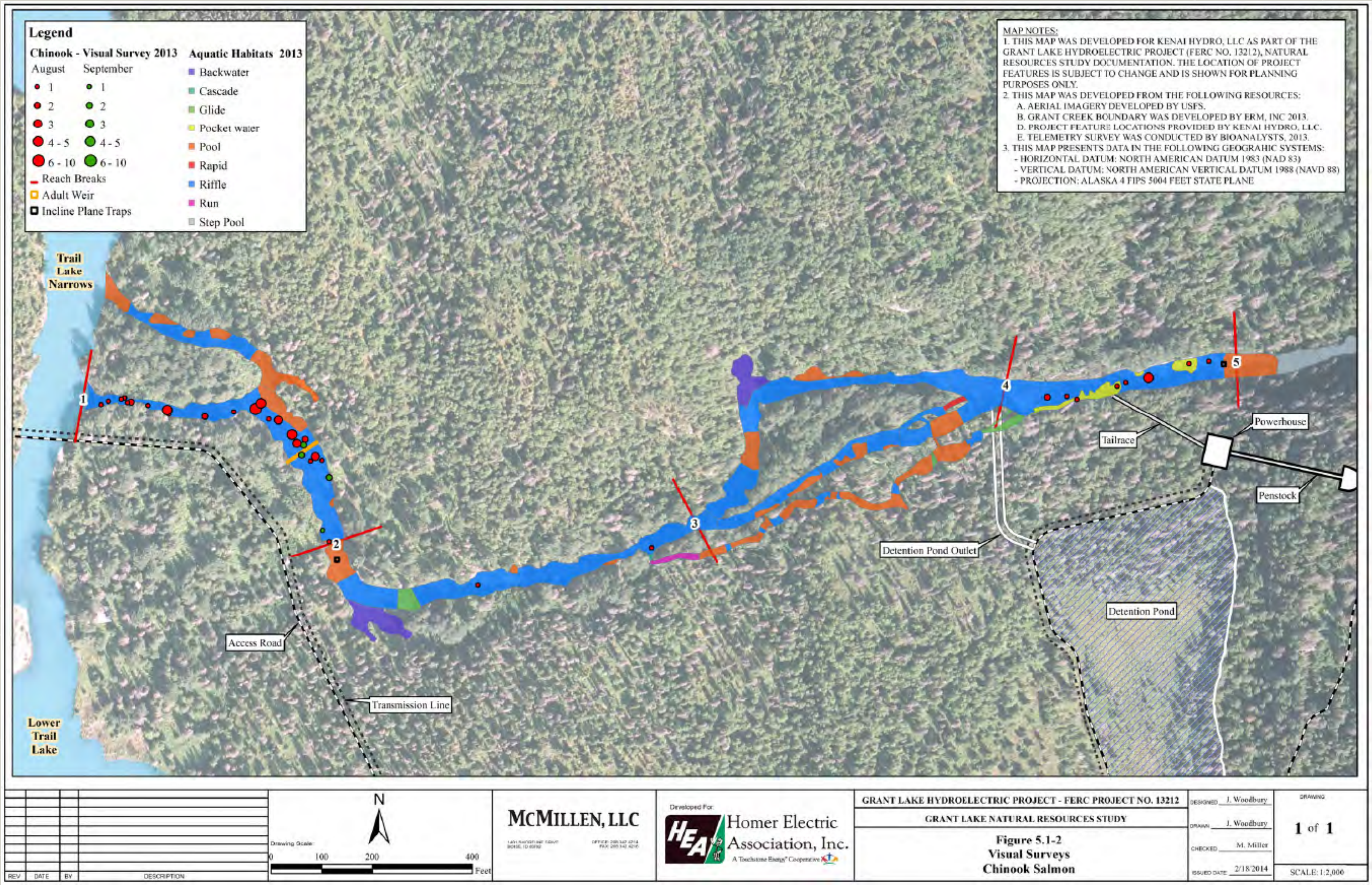
- Anadromous Salmonids - Age-at-Return – Total Age (Percent)

Species	Age-3	Age-4	Age-5	Age-6
Chinook	3.1	59.4	28.1	9.4
Coho	2.7	89.2	8.1	
Sockeye		3.0	95.0	2.0

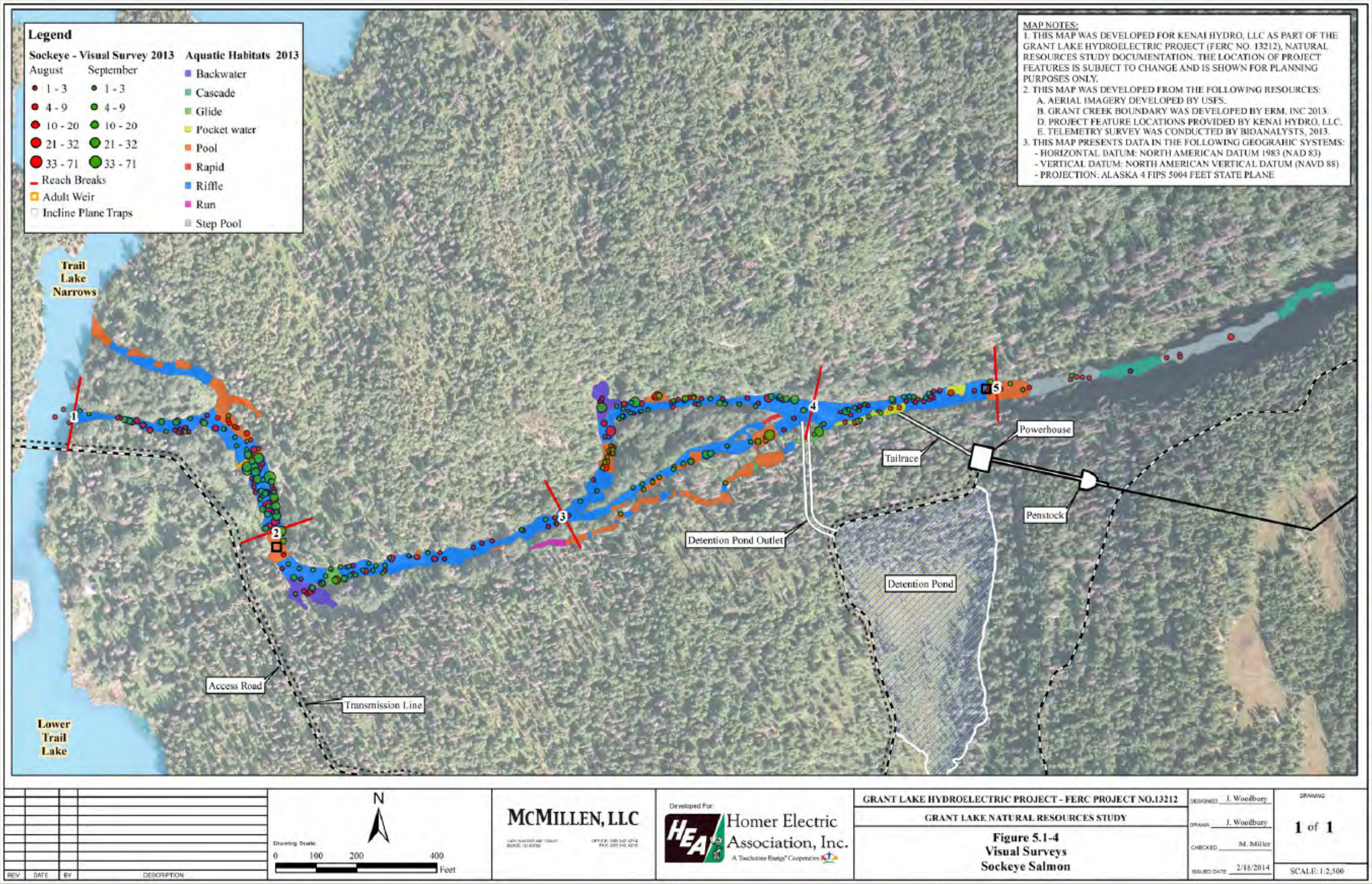
Results

- Estimate of Adult Salmonid Abundance
  - Based on Area-Under-the-Curve Calculations (Bue et al. 1998)
  - Requires an Estimate of Area-Under-the-Curve – Based on Visual Observations (English et al. 1992)
  - Requires an Estimate of Stream Life – Based on Floy and Radio Tag Data (From Telemetry and Carcass Surveys)
  - Requires an Estimate of Observer Efficiency – Based on Visual Surveys Counts Relative to Weir Counts

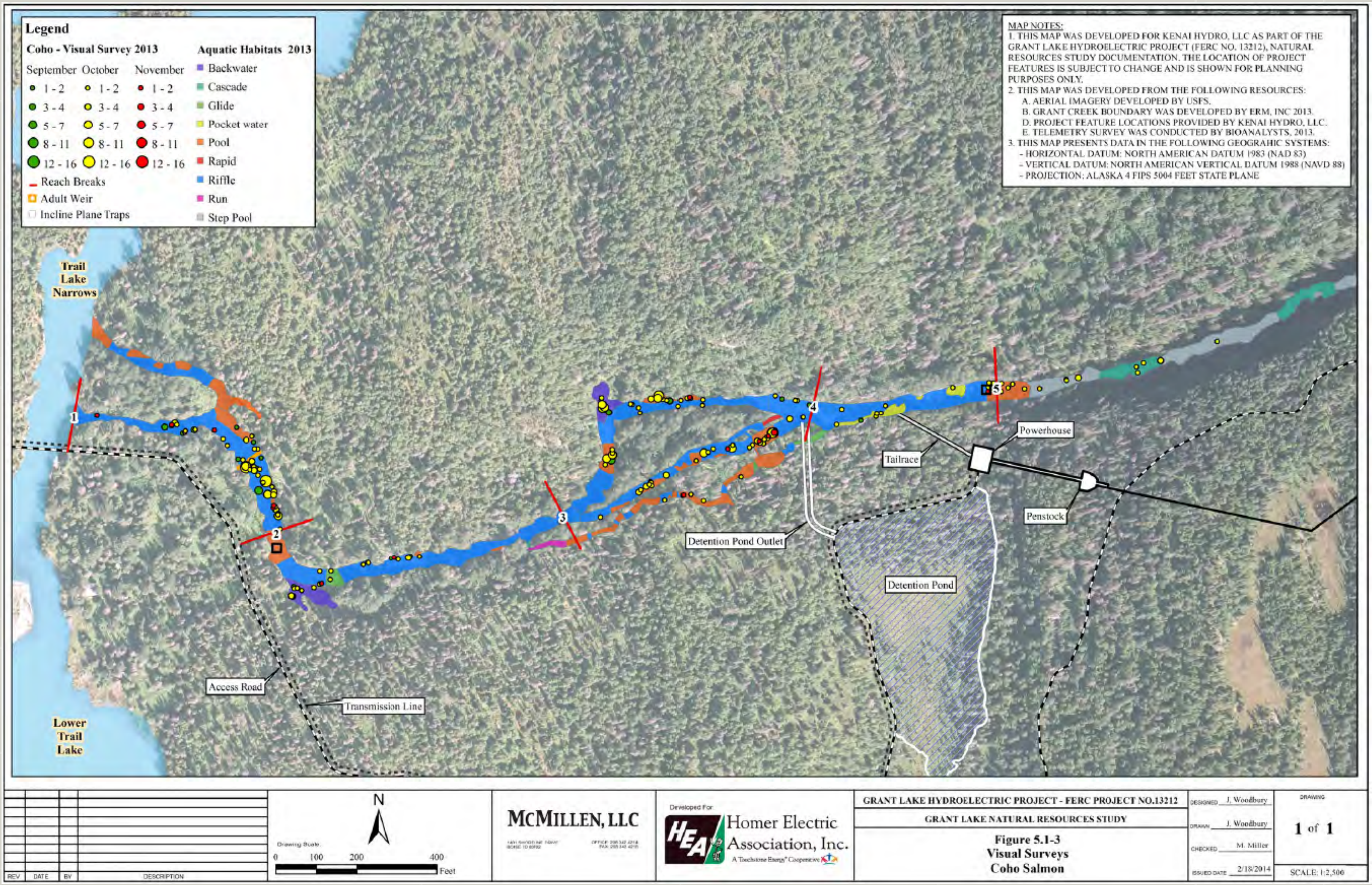
Results – Visual Surveys – Adult Chinook Distribution



Results – Visual Surveys – Adult Sockeye Distribution



Results – Visual Surveys – Adult Coho Distribution



Results

- Estimate of Adult Salmonid Abundance
  - Stream Life – Based on Both Floy and Radio Telemetry Data
  - Observer Efficiency – Based Visual Counts vs. Weir Counts

Species	AUC	Stream Life (Days)	Observer Efficiency	Estimate of Abundance		
				Above Weir	Below Weir	Grant Creek
Chinook	159	11	0.60	27	63	90
Sockeye	10,483	14	0.72	1,040	129	1,169
Coho	2,756	16	0.75	231	21	252

Results

- Adult Salmonid Abundance – Adjusted 2009 Estimates

Species	2009		2013		Estimate of Abundance		
	Stream Life (Days)	Observer Efficiency	Stream Life (Days)	Observer Efficiency	2009 Original	2009 Adjusted	2013
Chinook	14	0.30	11	0.60	231	148	90
Sockeye	9	0.50	14	0.72	6,293	2,705	1,169
Coho	---	---	16	0.75	---	---	252

Results

- Adult Salmonid Spawning – Number of Redds by Reach

Reach	Species				Total	Proportion
	Pink	Chinook	Sockeye	Coho		
1	2	4	144	18	168	0.433
2	0	0	52	7	59	0.152
3	0	1	102	38	141	0.363
4	0	1	7	7	15	0.039
5	0	0	3	2	5	0.013
Total	2	6	308	72	388	1.000

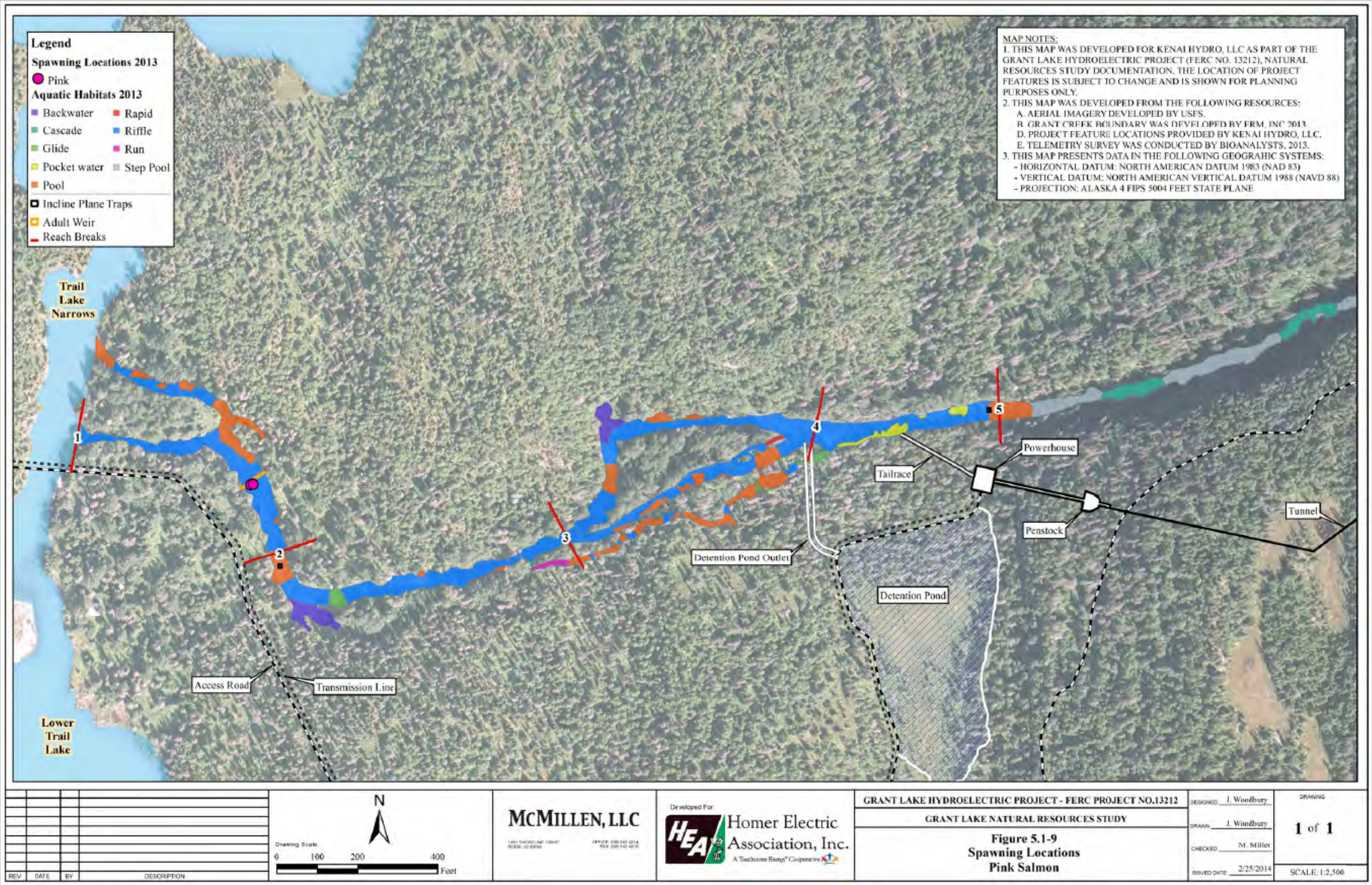
Note: No Rainbow or Dolly Varden Spawning was Observed

Results – Salmonid Spawning Locations

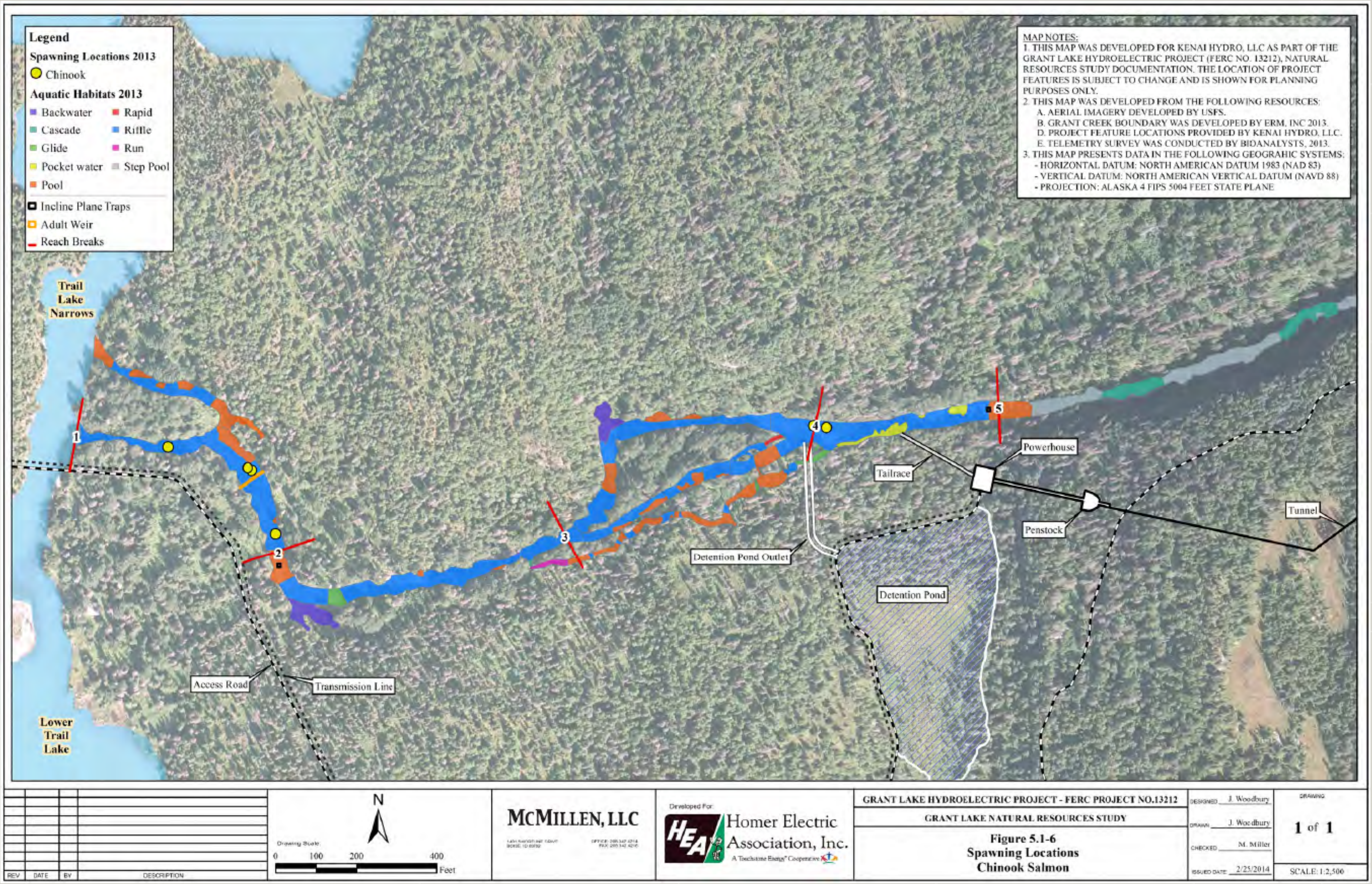
Species	Backwater Areas	Mainstem Areas	Side Channels	Total
Pink	0	2	0	2
Chinook	0	6	0	6
Sockeye	27	239	42	308
Coho	4	49	19	72
Total	31	296	61	388

Note: Primarily in Riffle (0.71) and Pool (0.19) Habitat

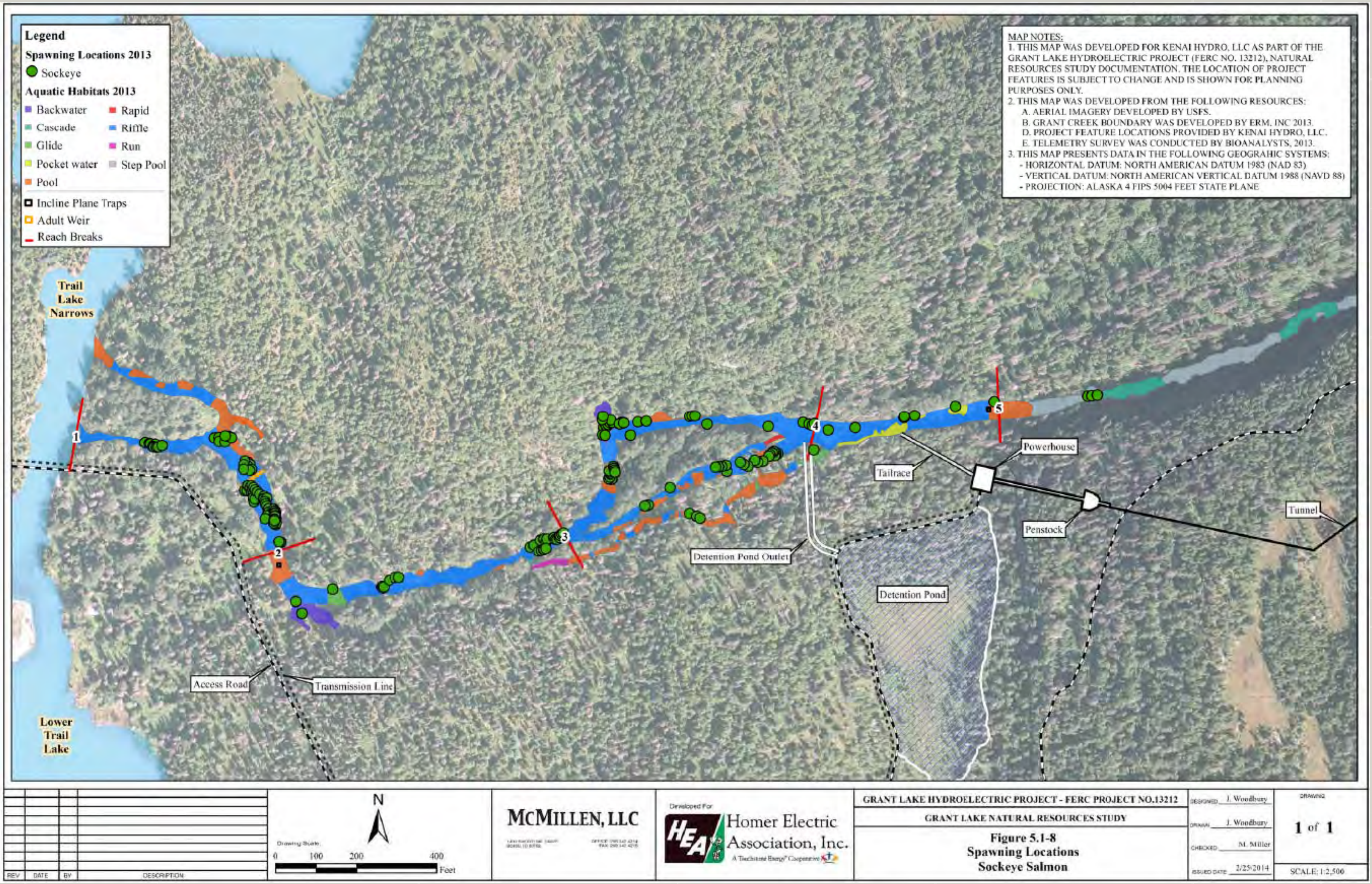
Spawning Locations – Pink Salmon



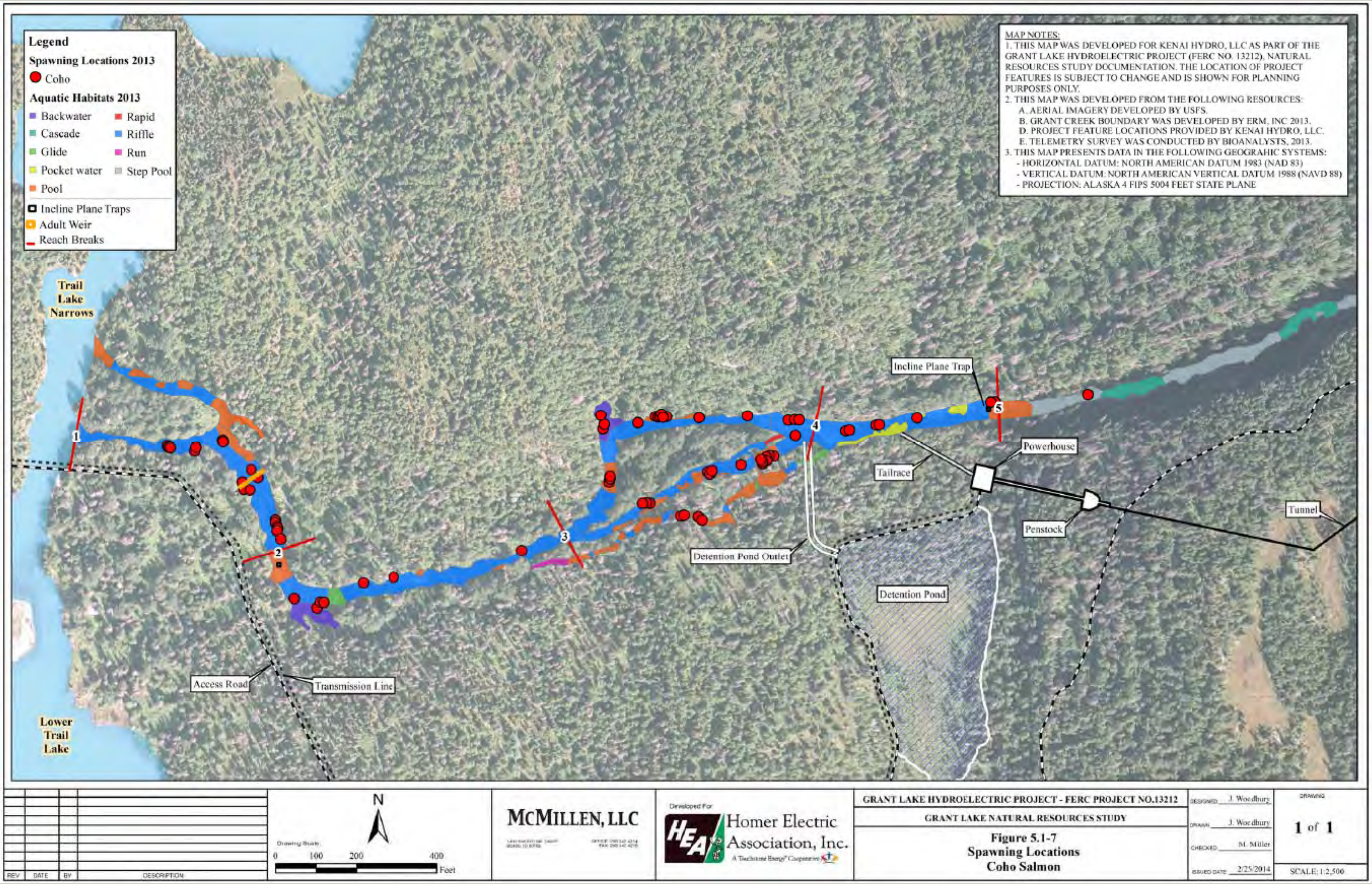
Spawning Locations – Chinook Salmon



Spawning Locations – Sockeye Salmon



Spawning Locations – Coho Salmon

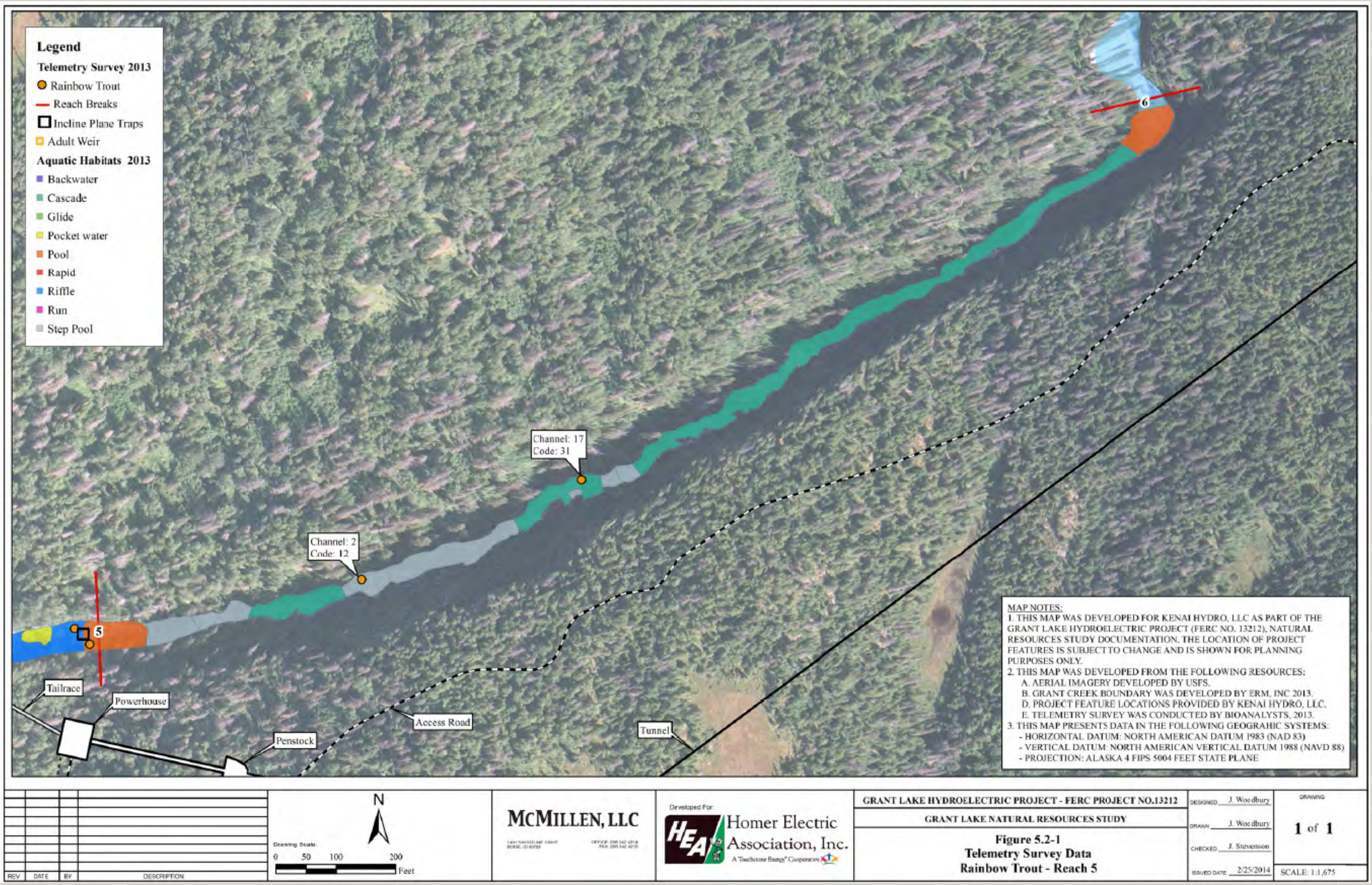


Results

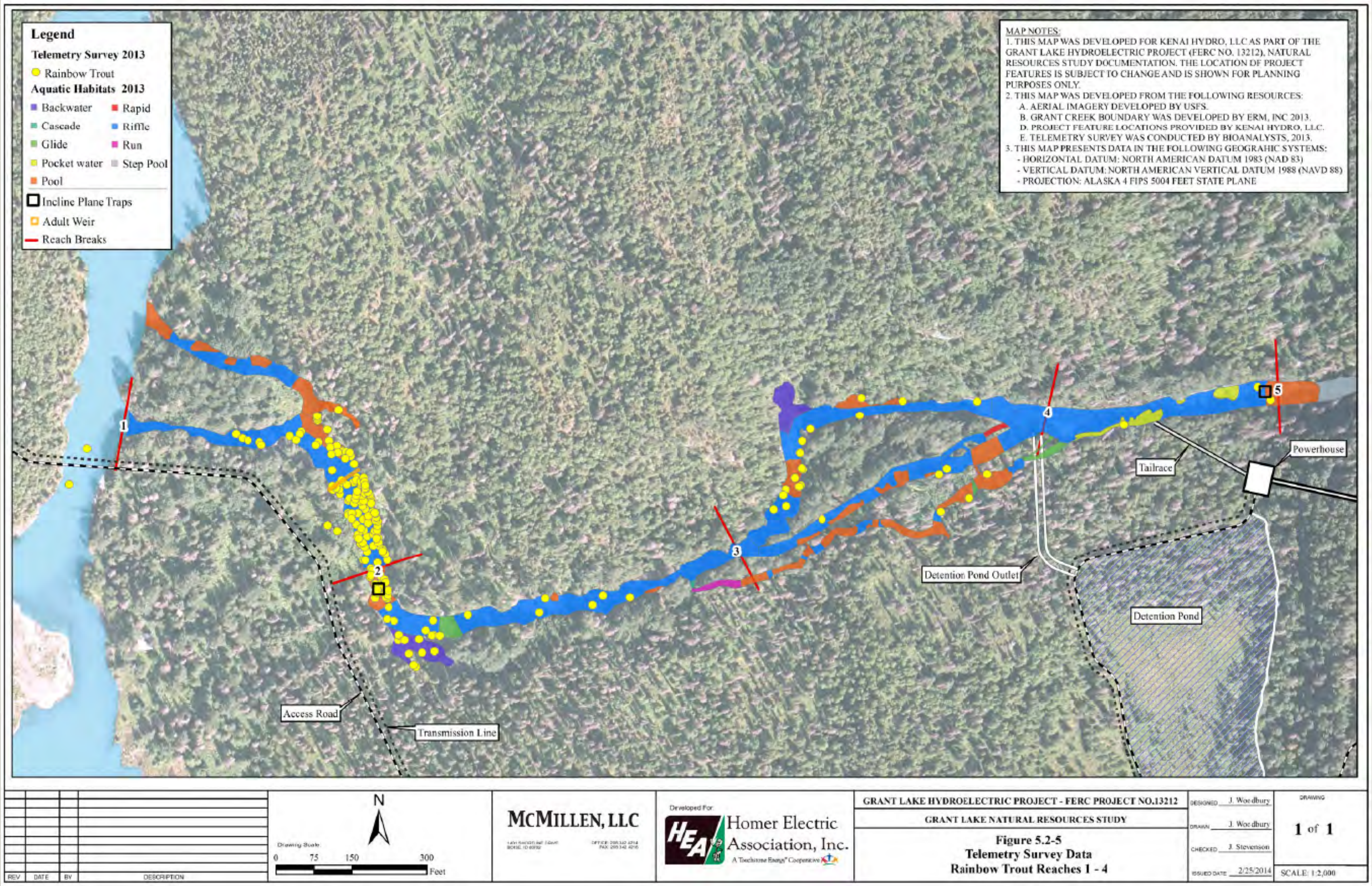
- Habitat Use by Adult Rainbow Trout – Number of Telemetry Detections by Reach and Habitat Type

Reach	Habitat Type				Total
	Pool	Riffle	Backwater	Pocket Water	
1 - Mainstem	23	101			124
2 - Mainstem	19	13	8		40
3 - Mainstem	9	11			20
3 - Predominant Side Channel	3	5			8
3 - Secondary Side Channel	3				3
4 - Mainstem	1	1		1	3
Total	58	131	8	1	198

Results – Location of Telemetry Detections for Adult Rainbow Trout – Reach 5



Results – Location of Telemetry Detections for Adult Rainbow Trout – Reaches 1-4

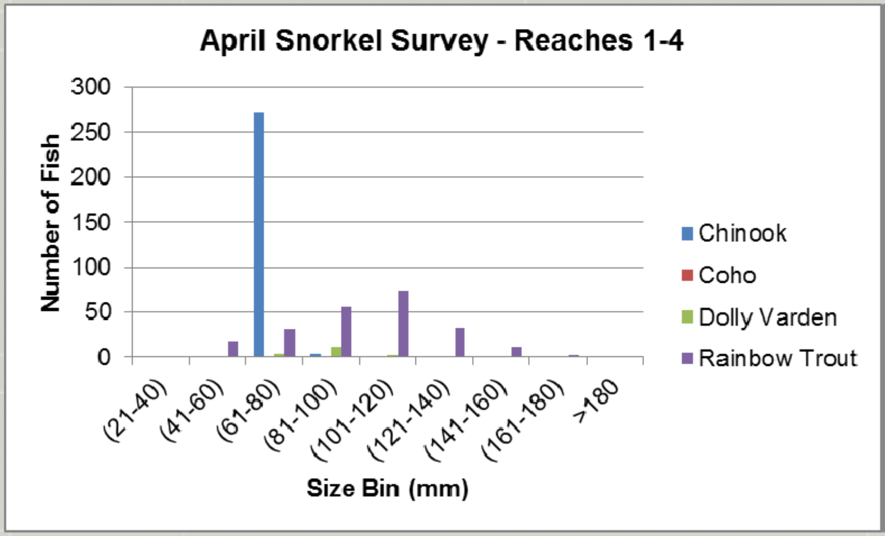


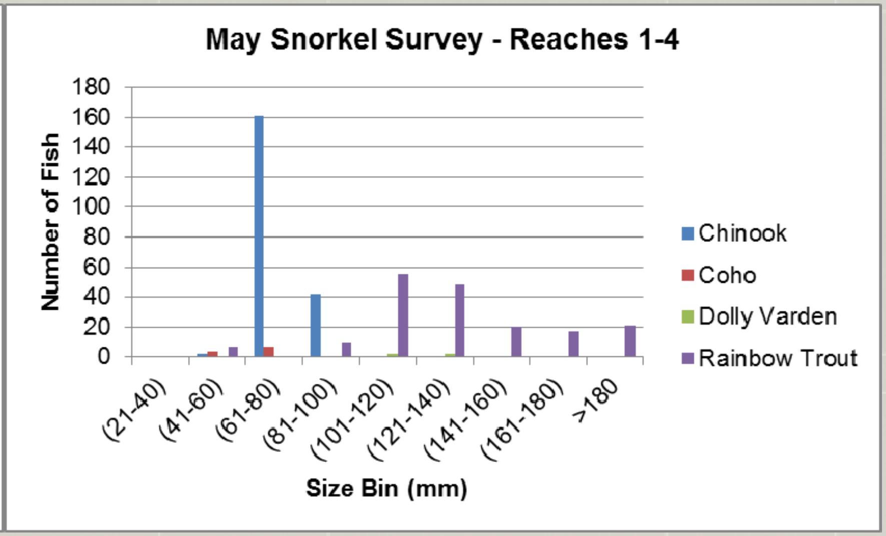
Results

- Adult Rainbow Trout Exodus from Grant Creek
  - Median Date: September 1
  - Earliest Date: June 17
  - Latest Date: October 26

Results

- Overwintering of Juvenile Salmonids
  - Age-1 Chinook Observed in April and May
  - Few Coho Observed in April and May
  - Multiple Age Classes of Juvenile Rainbow Trout and Dolly Varden
  - Snorkel Data and Incline Plane Trap Data Confirm Overwintering





Results

- Juvenile Distribution in Grant Creek
  - Assessed for Reach 5
    - Snorkel Surveys
    - Incline Plane Trap
    - Minnow Traps
  - Assessed for Reaches 1-4
    - Snorkel Surveys
    - Beach Seining – Marginal Success – Not Included in Summary
    - Minnow Traps
    - Incline Plane Trap

Results

- Juvenile Distribution in Grant Creek
  - Reach 5 Snorkel Surveys – Conducted in April and May
    - Access Limited to Lower Third of Reach 5
    - Temperatures 0.5 – 4.0° C
    - Flows were 18 cfs and 150 cfs in April and May, Respectively
    - Snorkeled Three Step Pools in April; Two Step Pools in May
    - Surveys not Conducted June through October Due to Limited Visibility
    - Total of 16 Fish were Observed during the Two Surveys – All 16 were Rainbow Trout (60 – 280 mm FKL)

Results

- Juvenile Distribution in Grant Creek
  - Upper Incline Plane Trap
    - Trap Operation: April 28 – May 30; September 19 – October 16
    - Trap Down May 30 – September 19 Due to High Flows
    - No Mark/Recapture Activities Conducted – Lack of Fish
    - Therefore, No Estimate of Abundance
    - Total of 172 Juveniles Captured at Upper Incline Plane Trap:
      - 8 Chinook
      - 1 Coho
      - 7 Dolly Varden
      - 5 Rainbow Trout
      - 19 Sculpin
      - 132 Stickleback

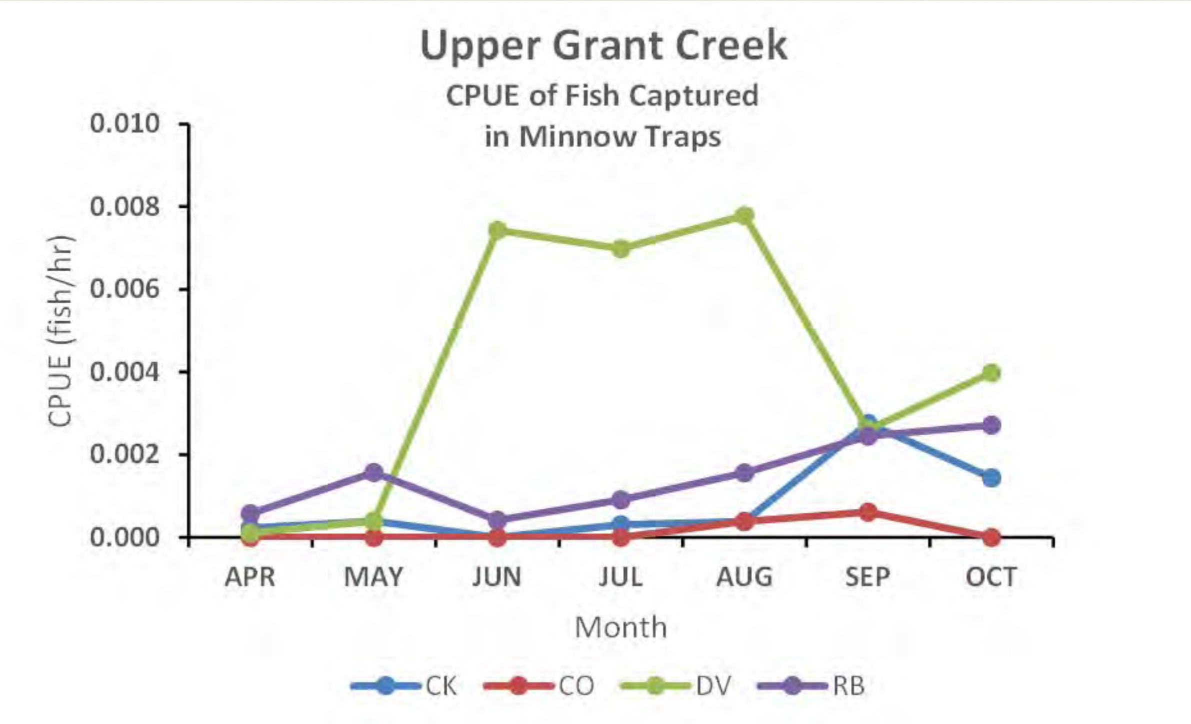
Results

- Juvenile Distribution in Grant Creek
  - Reach 5 Minnow Trapping – Conducted April through October
    - Primary Means for Assessing Juvenile Use of Reach 5
    - Seven Trapping Periods
    - Total of 57 Minnow Traps Sets
    - Total Trap Time of 1,318 Hours
    - Captured a total of 205 Fish

Species	Number	Proportion	CPUE (Fish/Hr.)
Chinook	31	0.15	0.024
Coho	5	0.02	0.004
Dolly Varden	102	0.50	0.077
Rainbow Trout	48	0.23	0.036
Sculpin	19	0.09	0.014
Total	205	1.00	0.156

Results

- Juvenile Distribution in Grant Creek – Reach 5 Minnow Trapping Cont.



Results

- Juvenile Distribution in Grant Creek
  - Reaches 1-4 Snorkel Surveys – Conducted in April and May
    - Flows were 18 cfs and 150 cfs in April and May, Respectively
    - Temperatures 0.5 – 4.0° C
    - Collectively Snorkeled 23 Sites
      - 2 Glides
      - 14 Pools
      - 7 Riffles

		April 2013 Snorkel Results		
Channel	Habitat	No. Fish	Area Sampled (m^2)	Density (Fish/100 m^2)
Mainstem	Glide	42	933	4.50
	Pool	357	7,193	4.96
	Riffle	39	8,463	0.46
Backwater	Pool	83	794	10.46
	Total	521	17,382	3.00

Results

- Juvenile Distribution in Grant Creek
  - Reaches 1-4 Snorkel Surveys – Cont.

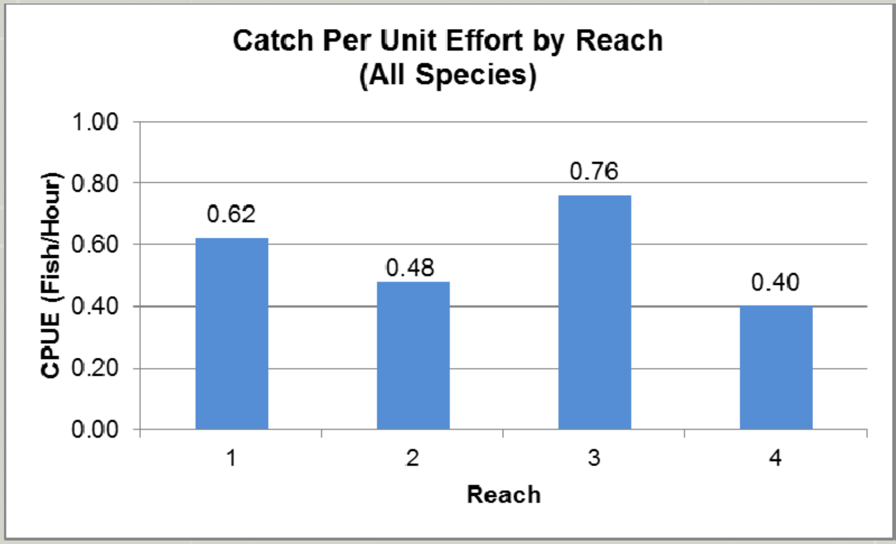
		May 2013 Snorkel Results		
Channel	Habitat	No. Fish	Area Sampled (m^2)	Density (Fish/100 m^2)
Mainstem	Pool	200	6,139	3.26
	Riffle	2	1,226	0.16
Side Channel	Pool	41	1,137	3.61
	Riffle	30	676	4.44
Backwater	Pool	127	1,111	11.43
	Total	400	10,290	3.89

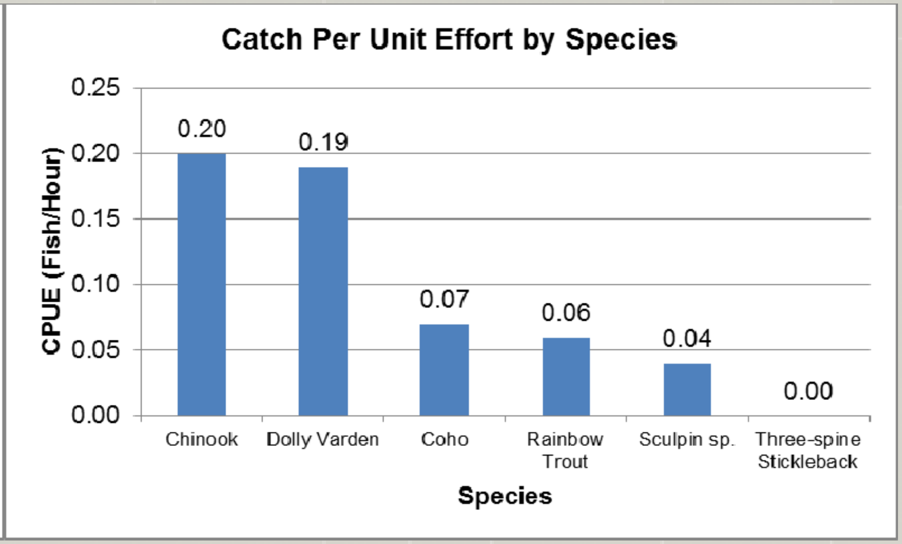
Results

- Reaches 1 – 4 Minnow Trapping
  - Conducted April through October (7 Sets)
  - Goal was to Set 10 Traps per Reach per Set
  - Represent all Potential Habitat Types
  - Set Total of 273 Traps
  - Total of 6,137 Trap Hours
  - Captured a Total of 3,468 Fish

Results

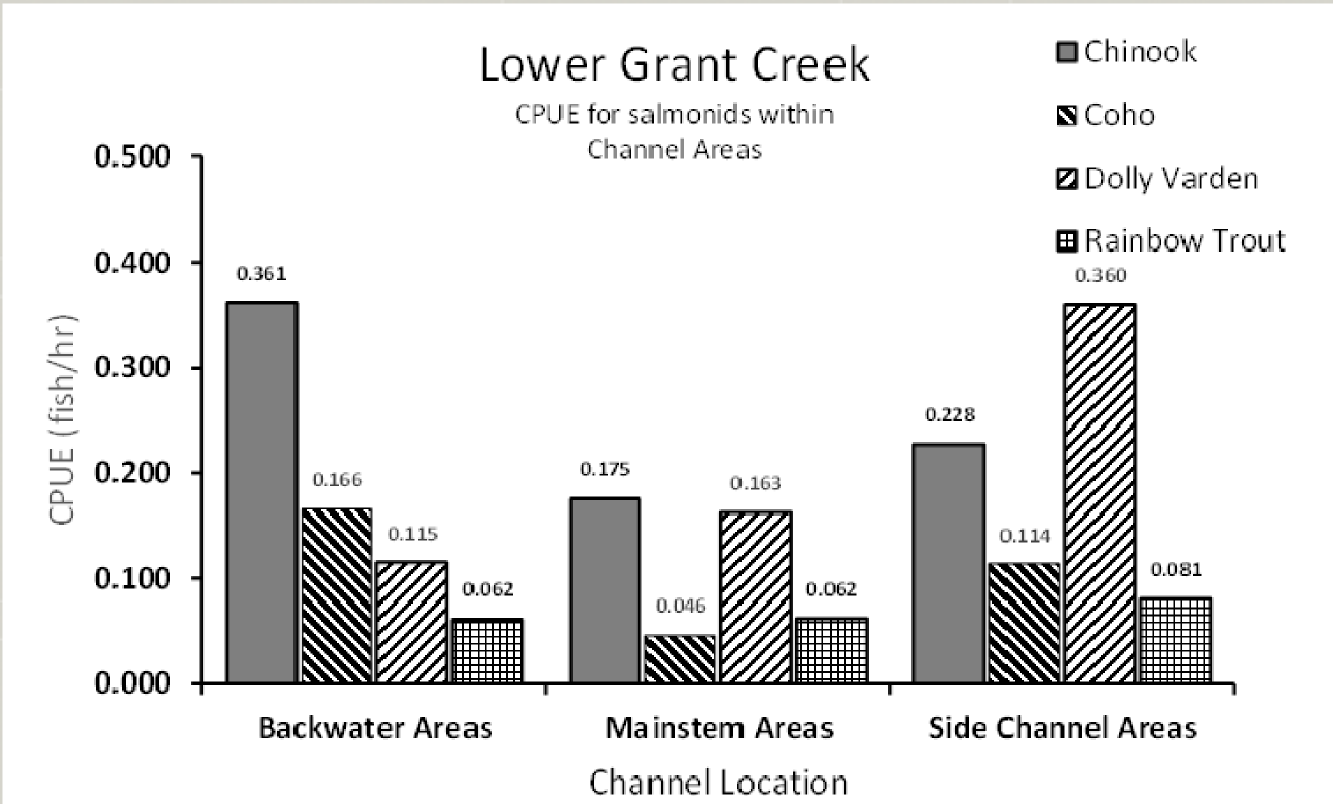
- Reaches 1 – 4 Minnow Trapping – CPUE by Reach and Species





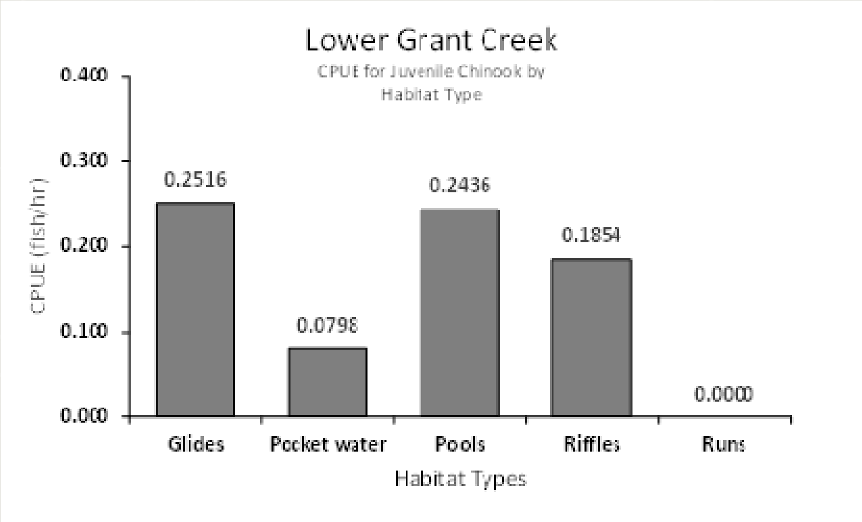
Results

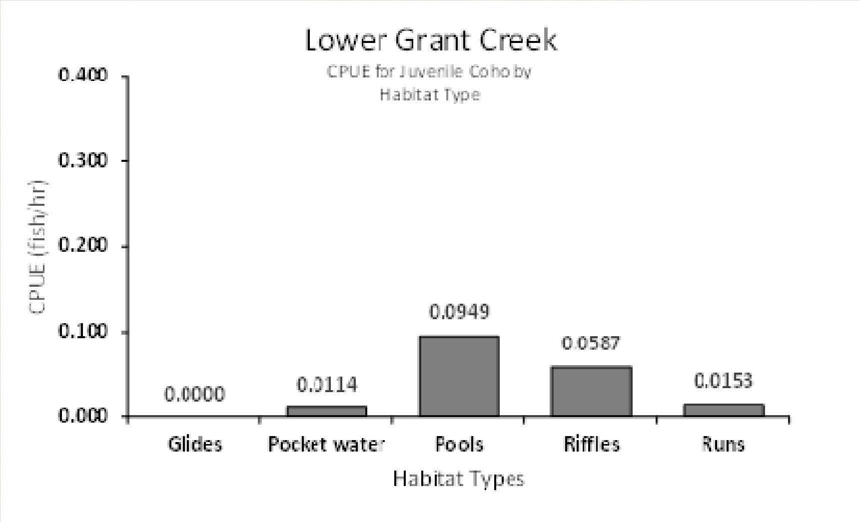
- Reaches 1-4 – Minnow Trapping – CPUE by Channel Area

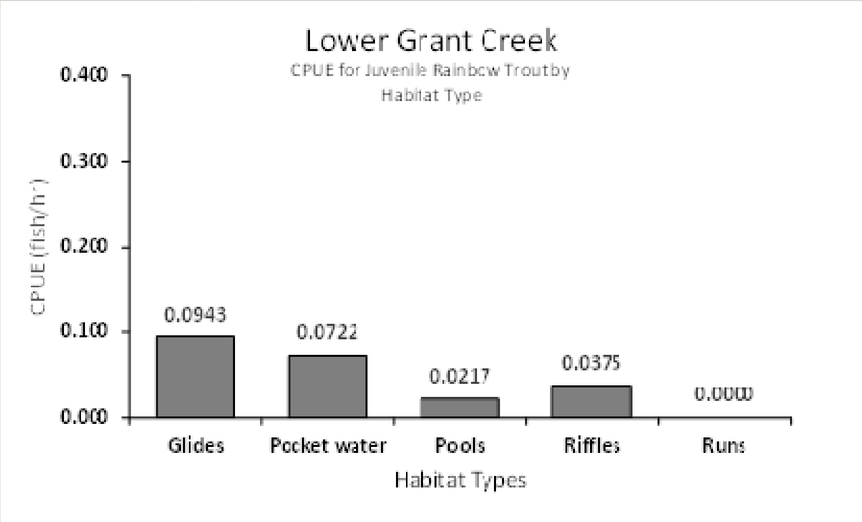


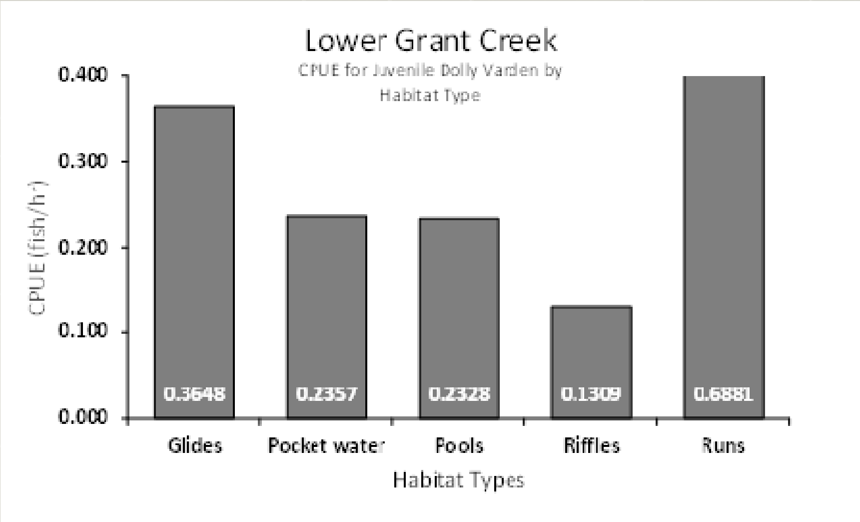
Results

- Reaches 1-4 – Minnow Trapping – CPUE by Habitat Types







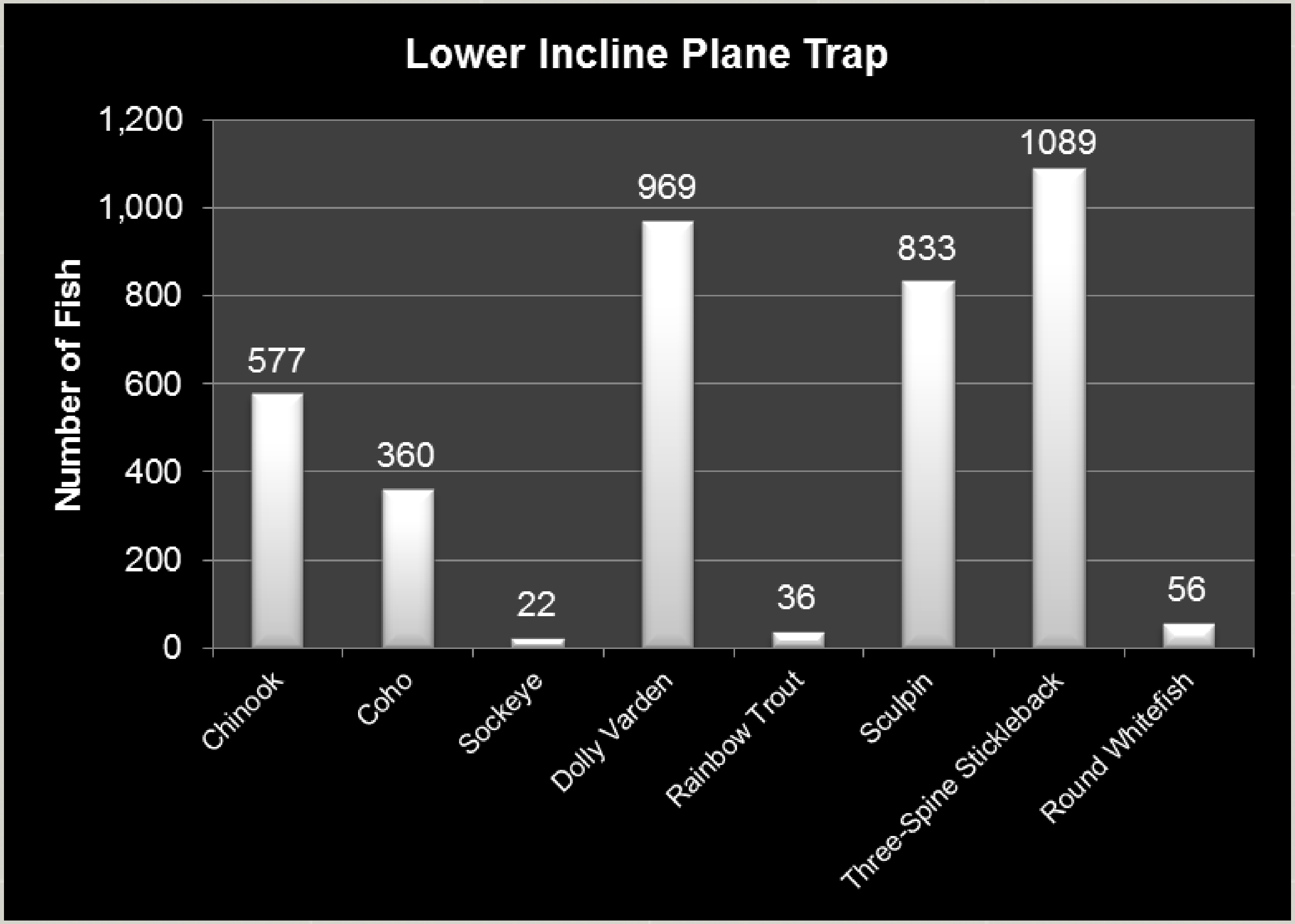


Results

- Lower Incline Plane Trap
  - Operated from April 30 – October 16
  - Operated Continuously with a Few Minor Exceptions
  - Intended to Provide Abundance for Reaches 1-4 (Assumed Continuous Operation of Upper Incline Plane Trap)
  - Due to Failure of Upper Incline Plane Trap – Abundance Estimate Represents all of Grant Creek Upstream of Lower Trap
  - Excludes Grant Creek Below Lower Trap (Area of Highest Concentration of Spawning)
  - Initially, Mesh Size Too Large – Excluded Fry-Sized Fish (< 50 mm)
    - Sockeye and Sub-Yearling Fish of all Species)
  - Abundance Estimate Represents Parr-Sized Fish and Larger

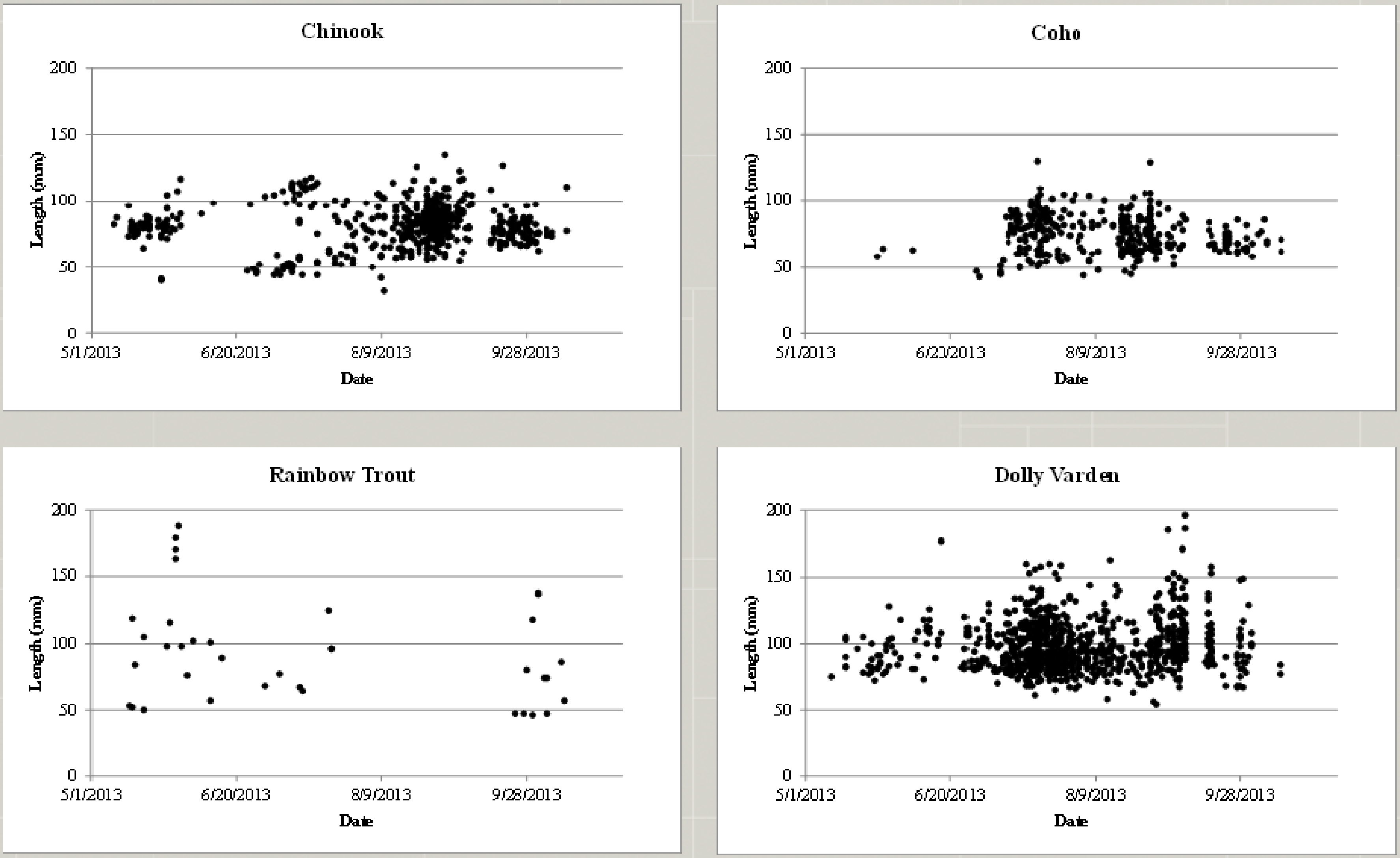
Results

- Lower Incline Plane Trap
  - Total of 3,942 Fish Captured in Trap



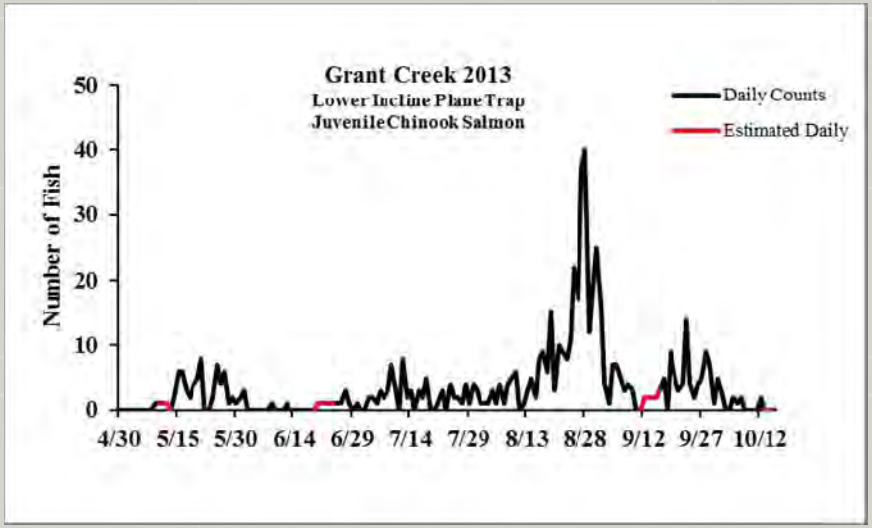
Results

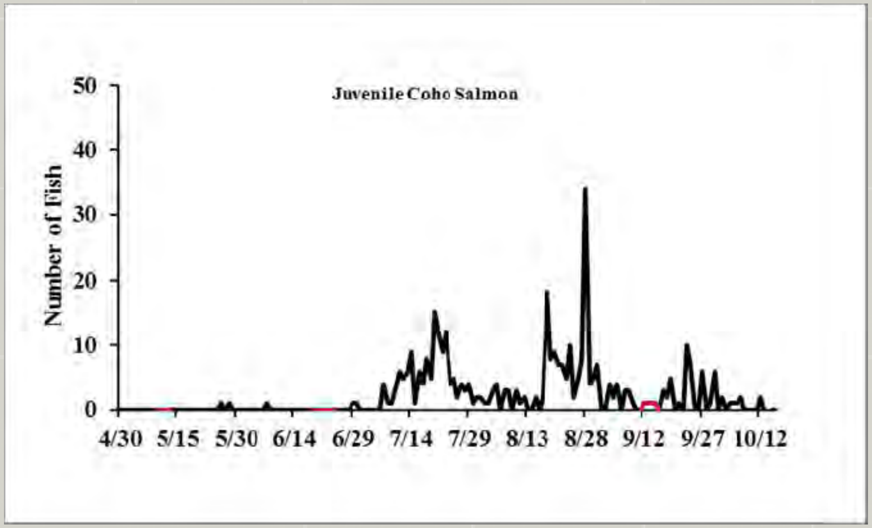
- Lower Incline Plane Trap – Distribution by Size and Date

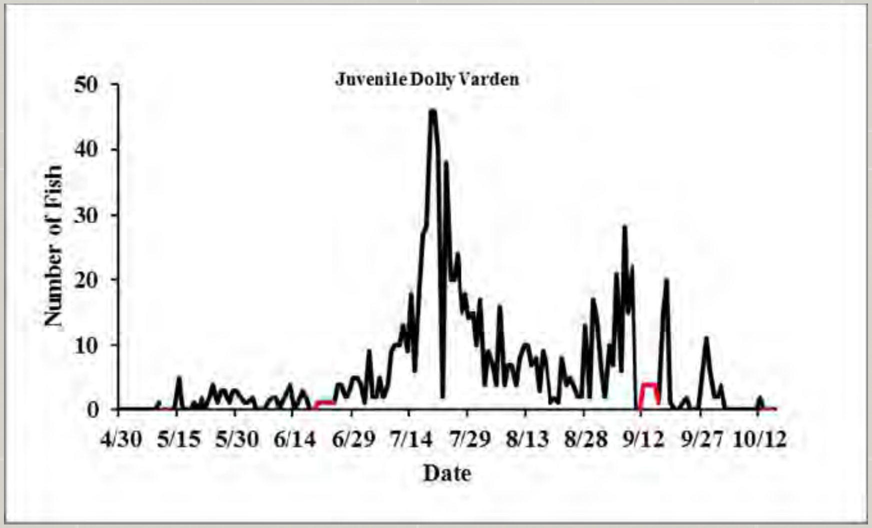


Results

- Lower Incline Plane Trap - Runtiming







Results

- Lower Incline Plane Trap – Estimate of Grant Creek Abundance – Trap Efficiency Tests
  - For Parr-Sized Fish
  - Upstream of Trap – Including Reach 5
  - Excludes Major Spawning Area Below Trap

Species	Low Flow Condition		High Flow Condition		Trap Efficiency	
	Release	Recapture	Release	Recapture	Low	High
Chinook	380	45	68	10	0.118	0.147
Coho	169	19	110	13	0.112	0.118
Sockeye	3	0	9	0	0.000	0.000
D.V.	248	2	571	41	0.008	0.0725
R.B.T	8	0	5	1	0.000	0.200

Results

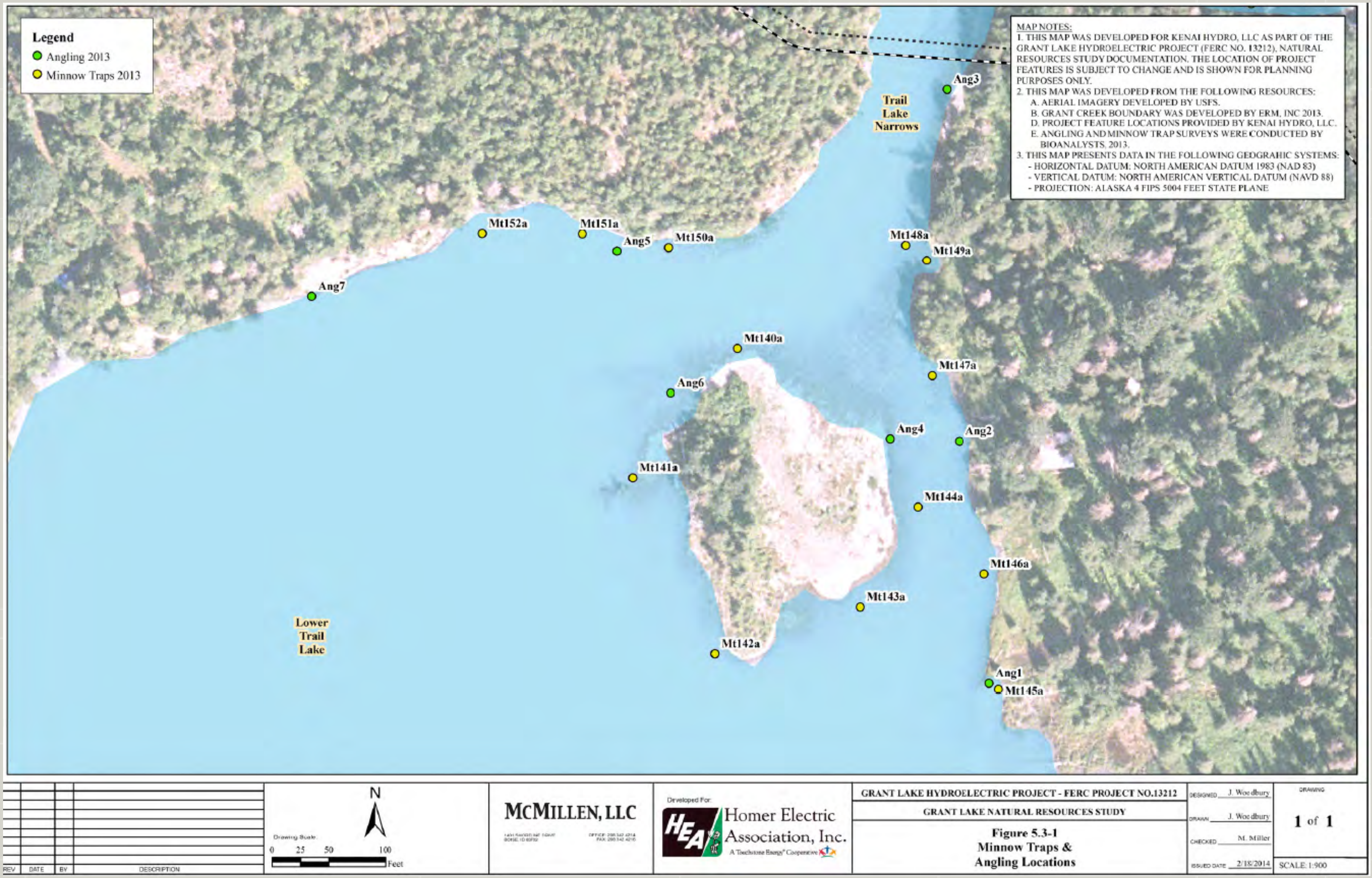
- Lower Incline Plane Trap – Estimate of Grant Creek Abundance
  - Conducted Test of Homogeneity – Chinook and Coho no Difference between High and Low Flow Conditions
    - Chinook – Used Efficiency of 0.123
    - Coho – Used Efficiency of 0.115
    - Flow Effect for Dolly Varden – Used 0.008 for Low Period; 0.072 for High Period

			Dolly Varden		
Statistic	Chinook	Coho	Low Flow	High Flow	Total
Observed n	577	360	296	673	---
Estimate of N	4,798	3,165	36,766	9,665	46,431
S.E. of N	603	546	25,980	1,471	26,021

Results

- Trail Lake Narrows – Sampled in July, and Included:
  - Minnow Trapping
  - Beach Seining
  - Angling Surveys for Adults

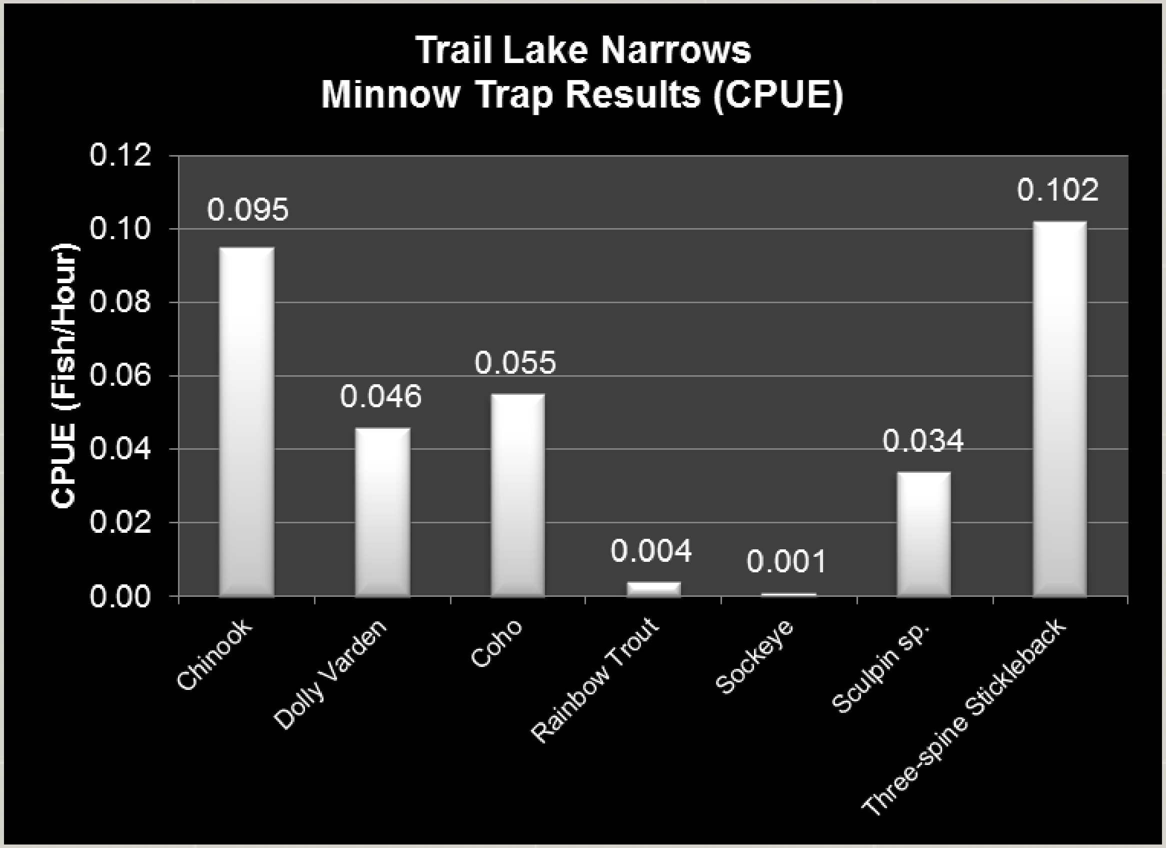
Results – Trail Lake Narrows



Results

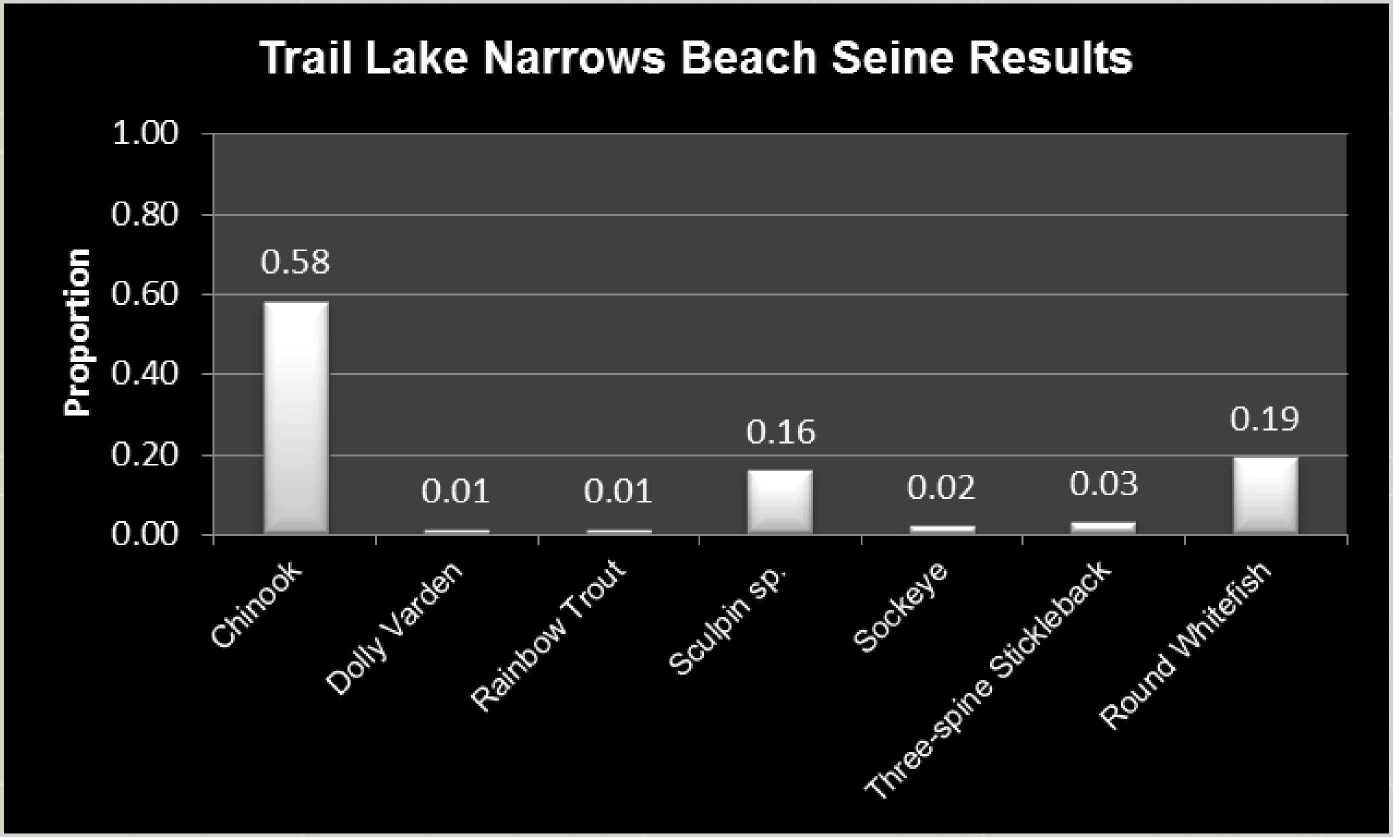
- Trail Lake Narrows – Minnow Trapping – Cont.

Reach	Number of Traps	Total Effort (Hours)	Number of Fish	CPUE (Fish/Hour)
Trail Lake Narrows	52	1,133	381	0.34



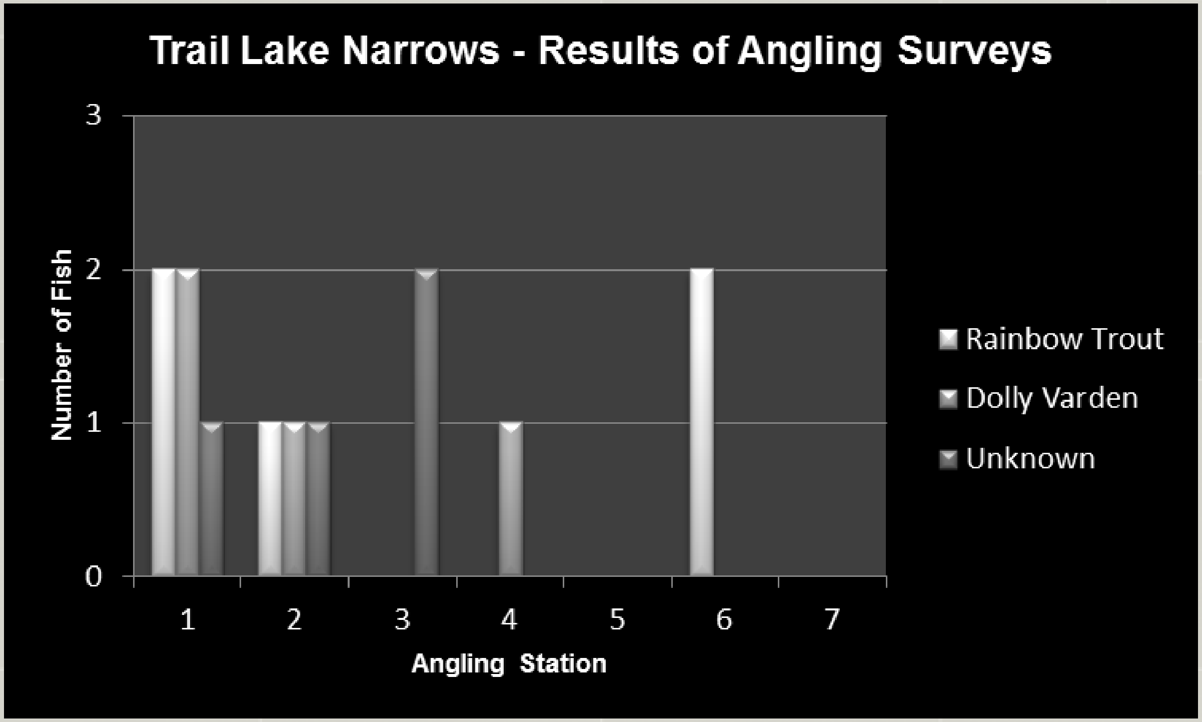
Results

- Trail Lake Narrows – Beach Seining Results
  - Conducted at Night
  - At Three Locations where Substrate and Flows were Conducive to Sampling



Results

- Angling Surveys – Conducted at 7 Angling Stations (1 Hours per Station)
  - Dominant Species was Rainbow Trout (n = 5)
  - Dolly Varden were Second Most Abundant (n = 4)
  - Four Additional Fish Could Not Be Identified (Broke Off Before Landing)



Potential Impacts

- Summary of Potential Impacts – Both Good and Bad
- Based on an Average Water Year
- Not Intended to Replaced Detailed Analysis at a Later Date
- Based on Professional Judgment – Degree of Impact Unknown
- Assumptions:
  - December thru April – P.H. at Minimum Operation
  - May – Lake Level Maintained
  - June/July – Refill Grant Lake – Then P.H. Peak Capacity
  - August thru November
  - Throughout Year – Base Flow through Reach 5

Potential Impacts

- Assumed Operations would Result In:
  - Lower Flows in Reach 5 Year Round
  - December thru April In Reaches 1-4 – Higher than Historically (except December)
  - In May, and August thru November – Reaches 1-4 at Historical Levels
  - June/July – Reaches 1-4 – Less than Historical Levels Unit Grant Lake Refills

Potential Impacts

- Reach 5 – Contains 1.3% of Documented Grant Creek Spawning
  - Anadromous Spawning
    - Lower Flows = Less Spawning Habitat – Potential Negative Impact
  - Resident Spawning
    - Lower Flows = Less Spawning Habitat – Potential Negative Impact
    - May Improve Access to Upper Reach 5 Due to Lower Flows – Potential Positive Impact
  - Egg Incubation
    - Decreased Flows will Result in More Exposure of Channel Bed and Bank – Fewer Eggs Deposited but No Change in Survival
    - Decreased Flow will likely Reduce Gravel Recruitment and Increased Deposition of Fines – Potential Negative Impact
    - Lower Flow Could Result in Less Scour Events (Redds) – Potential Positive Impact
  - Juvenile Rearing
    - Winter Rearing Habitat – Plenty of Step Pool Habitat Currently Exists during Winter – Likely No Change
    - Summer Rearing Habitat – Decreased Flow = Improved Habitat – Potential Positive Impact

Potential Impacts

- Reaches 1-4
  - Anadromous and Resident Spawning
    - No Change - Run-of-River Operations During Spawning Periods (Except Early June)
  - Egg Incubation
    - Mainstem
      - Increased Flows During Incubation – No Change
      - Areas of Dewatering – Likely Some Overwinter Survival Improvement – Potential Positive Impact
    - Reach 3 Side Channels – Likely Improved Overwinter Survival of Incubating Eggs in Areas that Ice Over and/or Dewater – Extent Unknown
    - Reach 1 and 2 Distributaries – No Change (No Spawning at These Locations)
  - Juvenile Rearing
    - Mainstem
      - Higher Winter Flows = More Overwinter Habitat – Possible Overwinter Survival Increase
      - Decreased Summer Peaks (June/July) – May Maintain More Rearing Habitat – Positive Benefit – During Extreme Peak Flows – Margin Habitat Lost – Likely Negative Impact

Potential Impacts

- Juvenile Rearing – Continued
  - Reach 3 Side Channels
    - Increased Winter Flows Would Increase Winter Habitat – Positive Impact
    - Spring, Summer, Fall – No Change
  - Reach 2 Distributary – Flow Alteration would Decrease Time this Channel is Watered – Loss of Prime Rearing Habitat – Negative Impact
  - Reach 1 Distributary – No Appreciable Change in Flow Dynamics – No Impact
- Global Issues
  - Development of Flow Regimes Should Consider Ramping Rates to Minimize the Potential for Stranding
  - All Construction Activities Should Follow Best Management Practices to Minimize Impacts

Grant Creek Aquatic Habitat Mapping and Instream Flow Study Results

Aspen Suites Hotel, Anchorage
March 19 - 20, 2014

MCMILLEN
DESIGN with Vision. BUILD with Integrity.

In Association with

Fisheries and Aquatics Studies

Grant Creek Studies

- Fish Weir Installation and Monitoring
- Salmon Spawning Distribution and Abundance
- Resident and Rearing Fish Abundance and Distribution
- Baseline Macroinvertebrate Studies
- Baseline Periphyton Studies
- Trail Lake Narrows Study – Fish and Aquatic Habitats
- ***Aquatic Habitat Mapping***
- ***Instream Flow Study***

Grant Creek Aquatic Habitat Mapping – Work Completed

- Field Work
  - Lower Grant Creek (Reaches 1 – 4) mapped key habitats mesohabitat categories in 2009
- Data Analysis by 2010, including spatial fish data from 2009 and 2010
- Reporting
  - Baseline studies report issued in 2009
- Consultation
  - HEA consulted with Work Groups 11 times in 2009

Grant Creek Aquatic Habitat Mapping Completed in 2013

- Ground Truthing of Aquatic Habitats
  - Revisions to existing maps after 2013 field season
- Quantification of Mesohabitats
  - Cascade, glide, pool, etc.
- Quantification of Aquatic Habitats
  - Overhead vegetation, undercut banks, Large Woody Debris

Grant Creek Instream Flow Study Work Completed (2009 – 2010)

- Field Work
  - 18 Transects approved by Instream Flow Work Group set up to model the most sensitive Lower Grant Creek areas with following measurements:
    - Middle Flow calibration measurement (175 – 184 cfs) with depth, velocity, water surface elevations (WSE)
    - Low flow WSE (92 – 169 cfs)
    - No High flow WSE
    - Substrate and cover across all transects
  - 18 Transects in lower 0.5 miles of Grant Creek = one every 150 ft
  - HEA consulted with Work Group 11 times in 2009

Grant Creek Instream Flow Study 2013 Field Season

- Field Work
  - Verified stability of the 18 existing transects (bed profile, stage of zero flow, substrate and cover)
    - If stable, used existing middle flow measurements taken in 2010 and used as high flow measurement
    - If not stable, redid those transects that had shifted (bed profiles, depth/velocities, WSE, substrate and cover, hydraulic control)
  - Took low/middle flow WSEs and discharges and calibration flows where needed
  - Collected higher WSE and discharges where neededed
  - Collected data for site-specific Habitat Suitability Index (HSI) curves

Grant Creek Instream Flow Study 2013 Field Season, cont'd

- Field Work
  - Implemented Connectivity study for Reach 5
- Data Analysis
  - Calibrated each transect
  - Used 3 – 5 WSEs and one velocity set (one flow model) to simulate the range of flows for Grant Creek:
    - WSE and discharges at low, middle, high/very high calibration flows
    - Depths and Velocities from high flow (approximately 200 cfs)

Grant Creek Instream Flow Study 2013 Field Season, cont'd

- HSI Curves: Use site-specific data to develop curves for Grant Creek (Coho and Sockeye Salmon) spawning life history stage
  - Supplemented with literature curves for other species and life history stages
- Added transect weighting
- Calculated Weighted Usable Area
  - Developed for target species and life stages at each transect and reach
- Developed reports

Reach 5 Connectivity

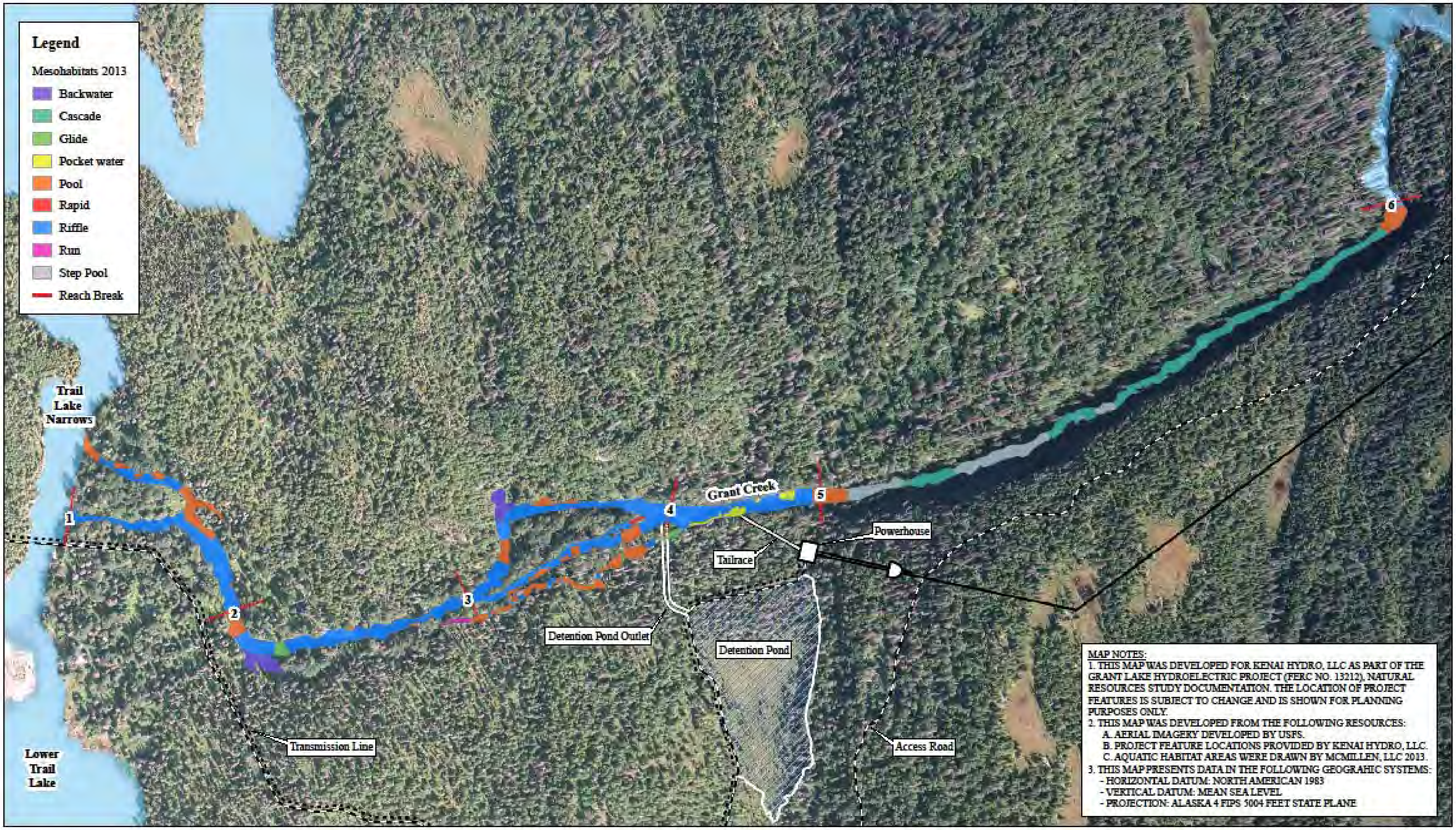
- At what flows are habitats in Reach 5 connected to areas downstream?
- Used Thompson (the Oregon Method). The passage flow is adequate when the depth criteria is met on at least:
  - 25 % of the wetted transect width, and
  - 10 % continuous portion.
- Depth Criteria:
  - Chinook Salmon: 0.8 ft
  - Coho and Sockeye Salmon: 0.6 ft
  - Dolly Varden Char and Rainbow Trout: 0.4 ft

Reach 5 Connectivity, cont'd

- Selected 2 transects which represented the more sensitive types of habitats within the canyon,
- Bed profiles surveyed
- Five WSEs at flows ranging from 17 cfs – 700 cfs
- Developed Stage/Discharge relationships for flows ranging from 7 cfs – 300 cfs. Calculated depths from these data at a range of flows

RESULTS
AQUATIC HABITAT MAPPING

- Developed maps for meso-habitat types
- Developed maps for aquatic habitats
- Calculated area per each reach and total



REV	DATE	BY	DESCRIPTION

N

Drawing Scale: 0 155 310 620 Feet

MCMILLEN, LLC

Developed for: Homer Electric Association, Inc.

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT #P-13212

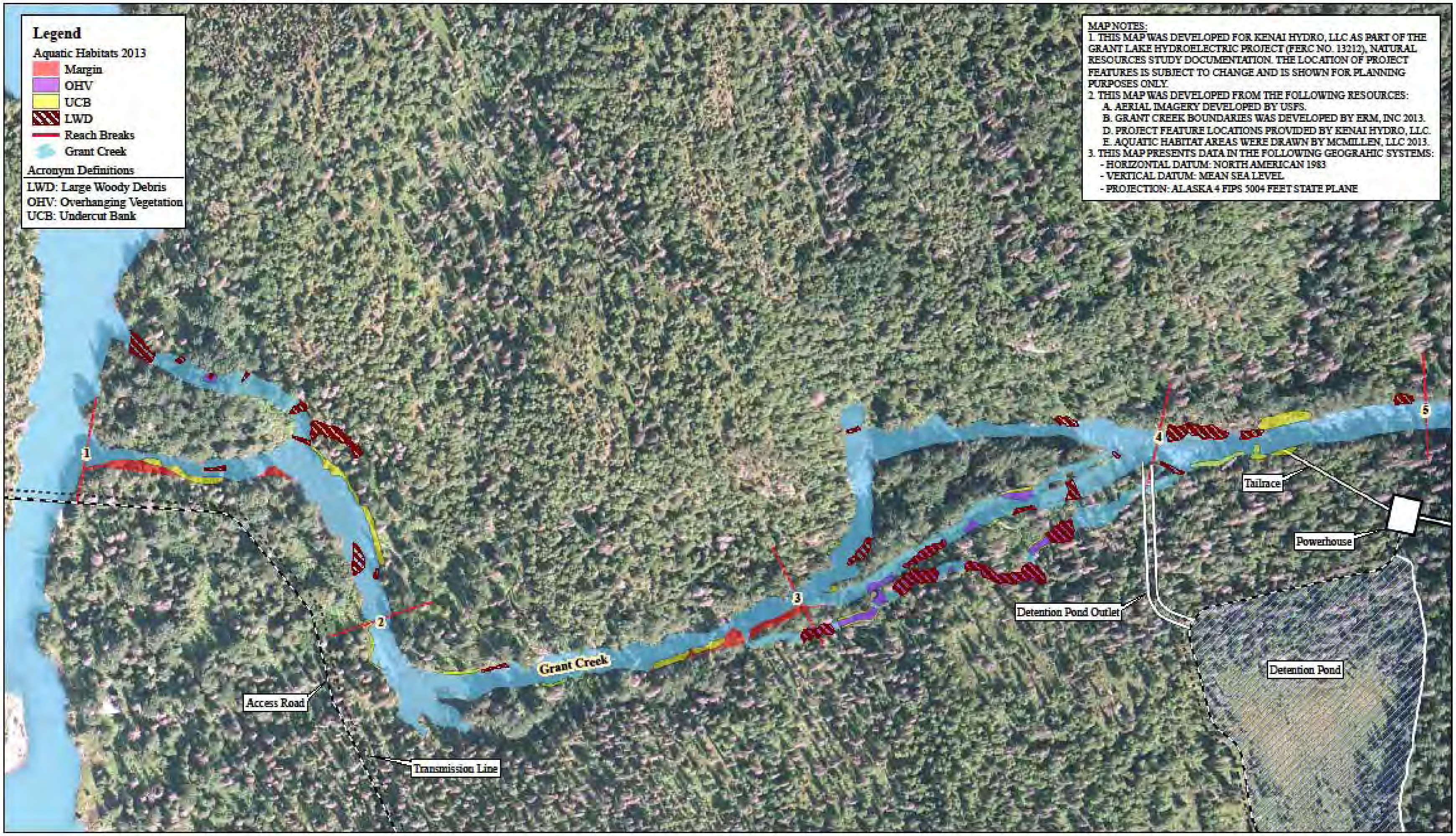
GRANT LAKE NATURAL RESOURCES STUDY

Grant Creek Mesohabitats
Reaches 1 - 5

DESIGNED: J. Woodbury
DRAWN: J. Woodbury
CHECKED: J. Blum
ISSUED DATE: 12/6/2013

DRAWING: 1 of 6

SCALE: 1:3,300



REV	DATE	BY	DESCRIPTION

N

Drawing Scale:
0 87.5 175 350 Feet

MCMILLEN, LLC

Developed for:
Homer Electric Association, Inc.

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

GRANT LAKE NATURAL RESOURCES STUDY

Aquatic Habitats
Grant Creek: Reaches 1-4

DESIGNED: J. Woodbury
DRAWN: J. Woodbury
CHECKED: J. Blum
ISSUED DATE: 12/6/2013

DRAWING
1 of 3

SCALE: 1:1,800

Mesohabitats Found in Grant Creek

Habitat Type	Total Area (Sq. Ft)	Reach 1 Distributary	Reach 1 Mainstem	Reach 2 Backwater Habitat	Reach 2 Mainstem	Reach 2 Secondary Channel	Reach 3 Backwater Habitat	Reach 3 Mainstem	Reach 3 Primary Side Channel	Reach 3 Secondary Channel	Reach 4 Mainstem	Reach 5 Mainstem
Backwater	8,534	0	0	4,837	0	0	3,697	0	0	0	0	0
Cascade	33,707	0	0	0	0	114	0	0	0	0	0	33,593
Glide	3,202	0	0	0	1,613	0	0	0	0	1,588	0	0
Pocket water	3,709	0	0	0	0	0	0	0	0	0	3,709	0
Pool	42,568	7,495	3,143	0	3,834	398	0	3,997	5,018	9,510	1,195	7,977
Rapid	511	0	0	0	0	0	0	0	511	0	0	0
Riffle	110,429	6,004	23,168	0	23,669	1,189	0	25,585	11,672	1,493	17,649	0
Run	576	0	0	0	0	0	0	0	0	576	0	0
Step Pool	16,858	0	0	0	0	0	0	0	0	0	0	16,858

Aquatic Habitats Found in Grant Creek

Habitat Type	Total Area (Sq. Ft)	Reach 1 Distributary	Reach 1 Mainstem	Reach 2 Backwater Habitat	Reach 2 Mainstem	Reach 2 Secondary Channel	Reach 3 Backwater Habitat	Reach 3 Mainstem	Reach 3 Primary Side Channel	Reach 3 Secondary Channel	Reach 4 Mainstem	Reach 5 Mainstem
Margin	7,214	0	3,343	0	3,871	0	0	0	0	0	0	0
Overhead Vegetation (OHV)	10,096	302	0	0	0	0	0	0	2,455	7,339	0	0
UCB	12,187	1,513	3,372	0	2,193	0	0	278	110	1,214	3,216	0
Large Woody Debris (LWD)	17,750	3,556	1,894	0	182	0	0	1,142	1,611	6,218	3,040	0

RESULTS
INSTREAM FLOW STUDY

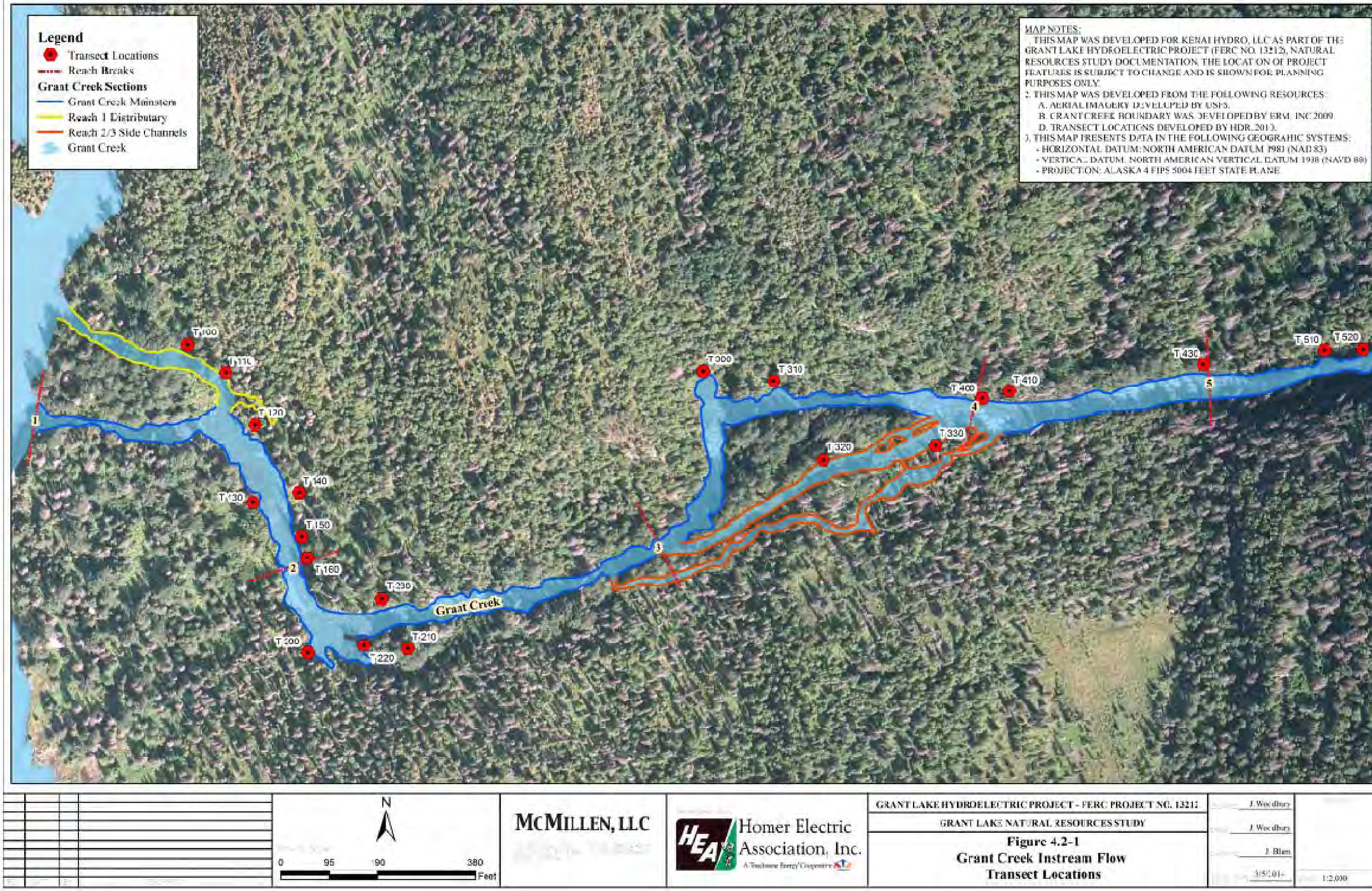
- Affected species and life history stages
- Transects and transect weighting
- Field data collection
- Model calibration
- HSI curves
- WUA

Affected Species and Life History Stages

Species	Spawning	Fry Rearing	Juvenile Rearing	Adult Rearing
Sockeye Salmon	✓			
Coho Salmon	✓	✓	✓	
Chinook Salmon	✓	✓		
Rainbow Trout	✓	✓	✓	✓
Dolly Varden Char	✓	✓	✓	✓

Transects and Transect Weighting

- 18 transects selected in 2009 (~1 every 150 ft)
- Each transect was modeled independently
  - – Given equal weighting
  - – Were then aggregated by
    - Reach
    - Distributary
    - Side Channel



McMILLEN, LLC

Homer Electric Association, Inc.
A Touchstone Energy Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

GRANT LAKE NATURAL RESOURCES STUDY

Figure 4.2-1
Grant Creek Instream Flow Transect Locations

J. Woodbury	
J. Woodbury	
J. Blum	
3/5/2014	1:2,000

Field Data Collection

Calibration Flows, 2013

Area	Measured Flows (cfs)					
	17	64	132	182	440	700
Main Channel	✓	✓	✓	✓		✓
Distributary	Dry/Frozen	Dry	Dry	✓	✓	✓
Reach 3 Side Channels	Frozen	✓	✓	✓	✓	✓

Flow Partitioning, Grant Creek Instream Flow Study

Transect	% Flow	r^2	Comments
T100/110	0.99%	0.951	Dry at flows < 190 cfs
Overflow Channel	~ 1.70%	N/A	Activates at ~ 450 cfs; affects Reach 1 main channel transects
T200	*8.94%*	N/A	% of main channel at calibration measurement
T210/230 Side Channel (SC)	0.00%	N/A	Backwater with no velocity; WSE is dependent upon T200
T300	1.71%	N/A	% of main channel at calibration measurement
T310	GC-T330	N/A	All Reach 2/3 side channels flow represented by T330
T320	15.81%	0.990	
T330-M	15.06%	0.986	Main Channel of T330
T330-2nd	0.0844 *x*T330-M	0.934	Secondary channel; percent of T330-M flow
T330-3rd	0.0219 *x*T330-M	0.839	Tertiary channel; percent of T330-M flow

Habitat Suitability Index (HSI) Curves

- Collected site-specific data for the following species and life history stages:
  - Sockeye Salmon spawning (n = 99)
  - Coho Salmon spawning (n = 47)
  - Chinook Salmon spawning (n = 4)

HSI Utilization Data Collection

HSI Habitat Availability Data Collection

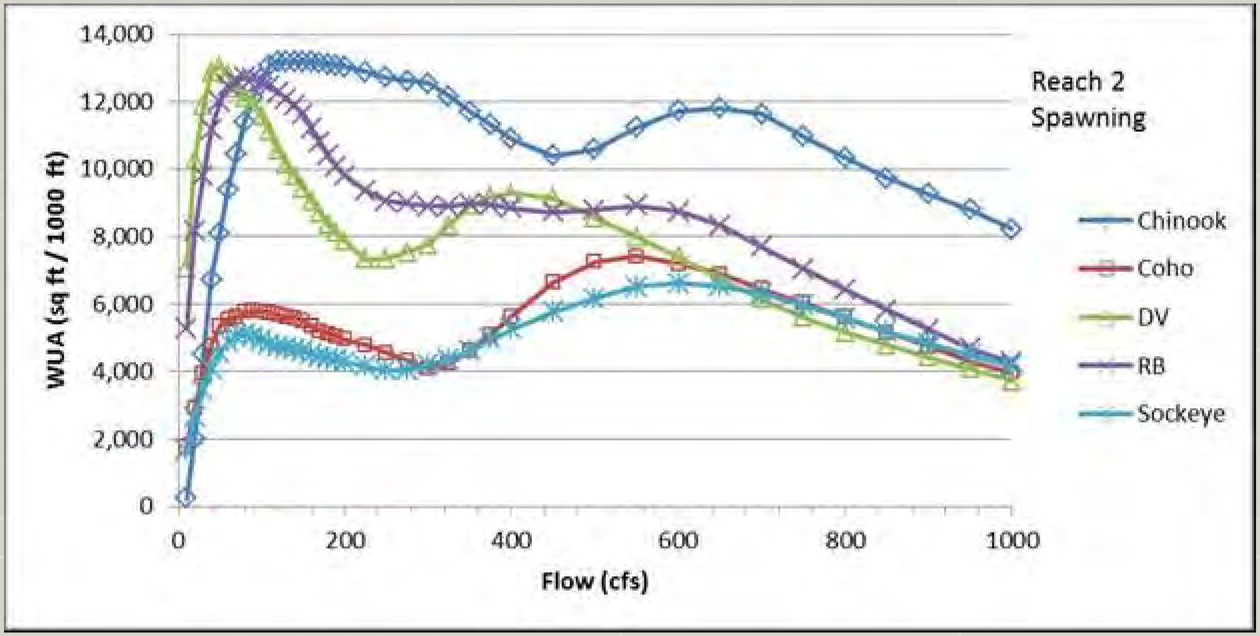
HSI Curves, cont'd.

- Developed site-specific depth and velocity HSI curves for Sockeye and Coho Salmon spawning
- Insufficient numbers of Chinook Salmon spawners to develop site-specific curves
- Literature-based HSI curves used for all other species and life history stages
- Proposed curves sent to AWG on December 18, 2013

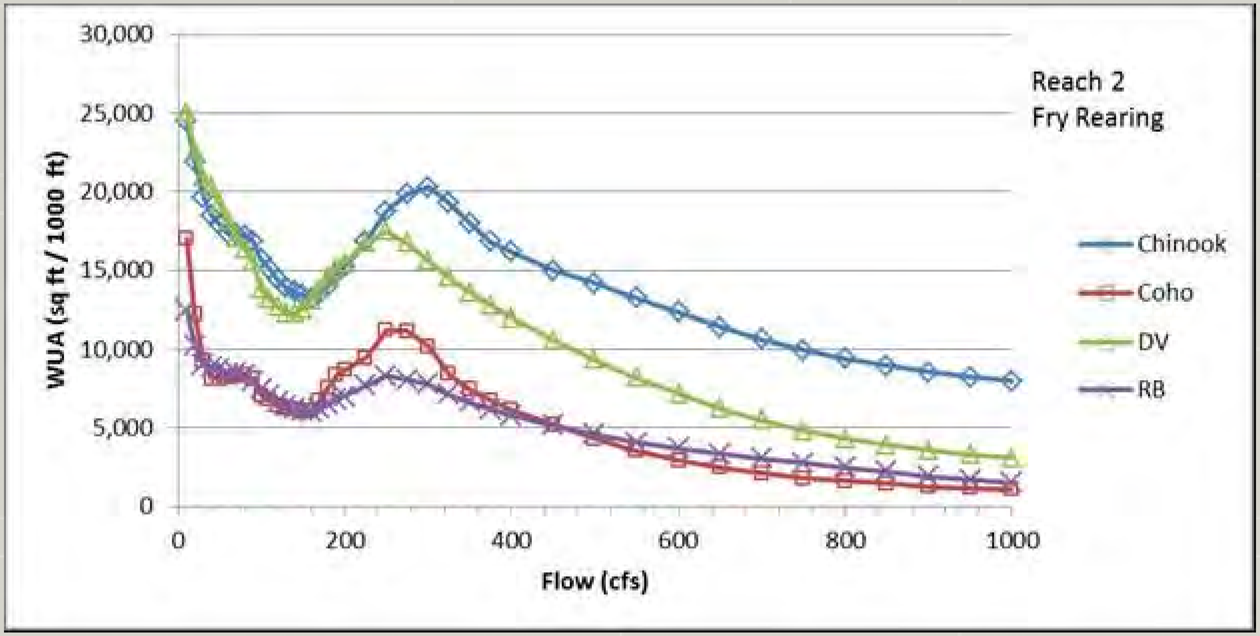
Model Calibration, Grant Creek Instream Flow Study

- Stage/Discharge relationship established for each transect
- Depths and velocities calibrated
- Input transect weighting and HSI curves
- WUA results from the one-velocity and depth calibration models were smoothed and averaged to produce one WUA table for each species and life stage at each transect (from 180 to 200 cfs upwards to 1,000 cfs)
- Transects run independently then aggregated by reach for WUA

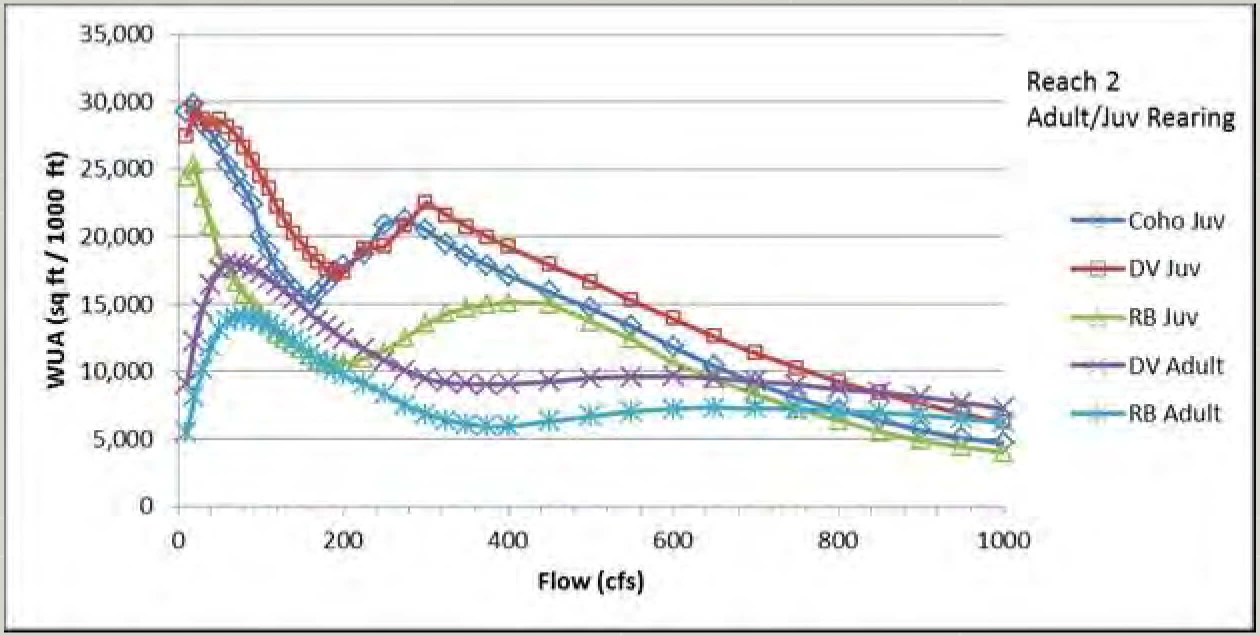
Reach 2, Spawning WUA



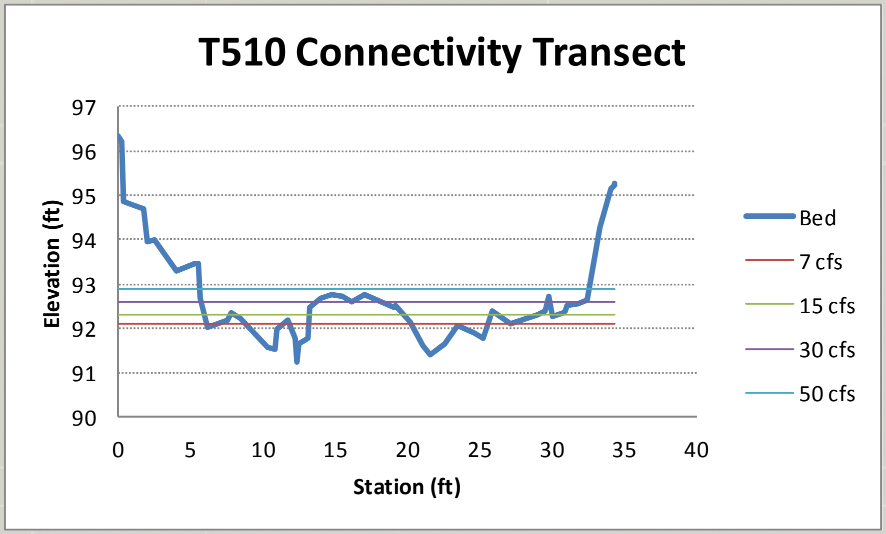
Reach 2 Fry Rearing WUA

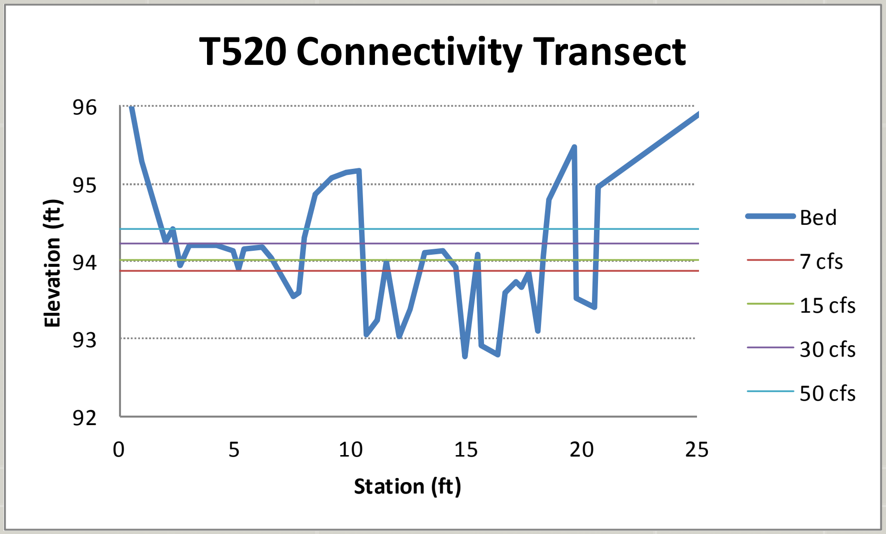


Reach 2 Juvenile/Adult Rearing WUA



Connectivity of Habitats in Reach 5





Transects 510 and 520

Transects 510 and 520

Connectivity in Reach 5

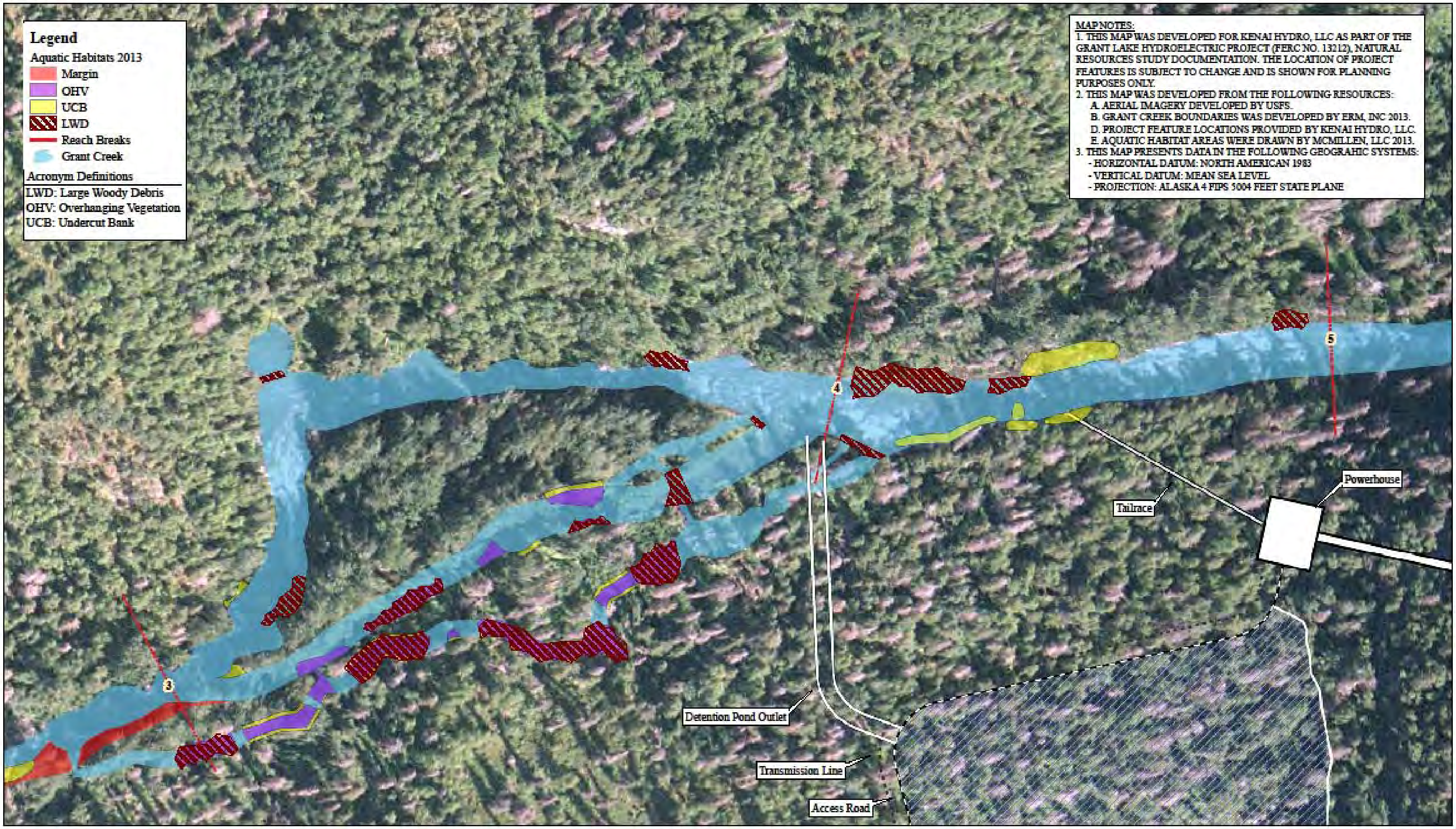
		Flow (cfs)		
Species	**Passage Criteria**	**T510**	**T520**	**Average**
Trout/Char	Total (25%)	7	7	7
	Continuous (10%)	7	7	7
	Both Criteria	7	7	7
Coho/Sockeye	Total (25%)	15	7	10
	Continuous (10%)	10	7	10
	Both Criteria	15	7	10
Chinook	Total (25%)	30	7	30
	Continuous (10%)	25	7	25
	Both Criteria	30	7	30

Operational Enhancements
Reach 2/3 Side Channels

- Large amount of high quality/diverse habitat
- Currently have low to no flows during the winter and other low flow periods
- Currently subject to freezing/snow/ice and drying out during low flow periods
- More stable flows with proposed project operation create opportunity for sustainable habitat in side channels

Reach 2/3 Side Channels

- Consists of two main channels that begin at the Reach 3/4 break
- Side channels constitute 21% of total length of Grant Creek, but contain:
  - 97% - OVH
  - 44% - LWD
  - 50% - Glide
  - 34% - Pool



REV	DATE	BY	DESCRIPTION

N

Drawing Scale:
0 45 90 180 Feet

MCMILLEN, LLC

Developed For:
Homer Electric Association, Inc.
A Touchstone Energy Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

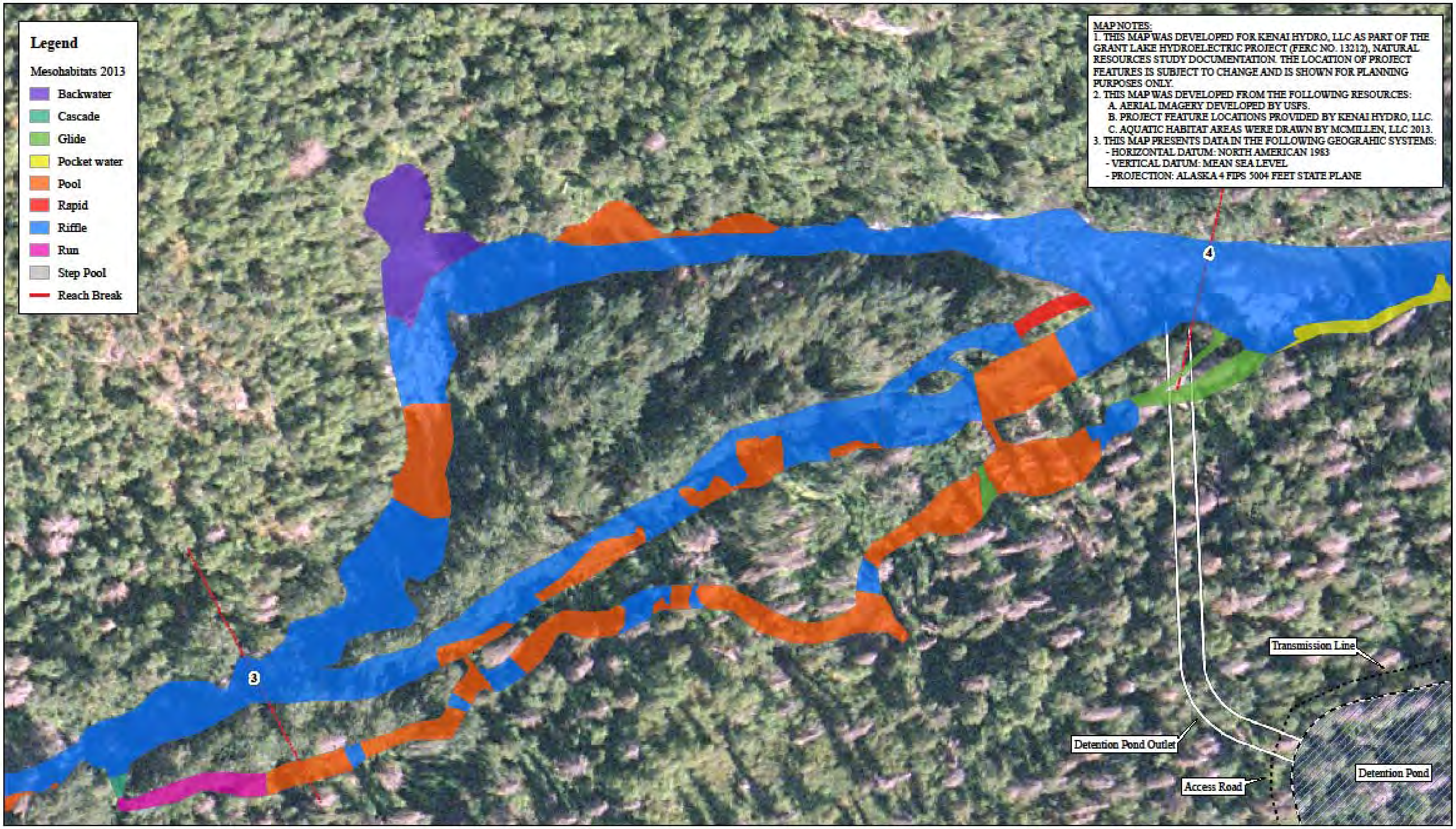
GRANT LAKE NATURAL RESOURCES STUDY

Aquatic Habitats
Grant Creek: Reaches 3 & 4

DESIGNED J. Woodbury
DRAWN J. Woodbury
CHECKED J. Blum
ISSUED DATE 12/6/2013

DRAWING
3 of 3

SCALE 1:1,000



REV	DATE	BY	DESCRIPTION

N

Drawing Scale: 0 30 60 120 Feet

McMILLEN, LLC

Developed For: Homer Electric Association, Inc.

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT #P-13212

GRANT LAKE NATURAL RESOURCES STUDY

Grant Creek Mesohabitats
Reach 3

DESIGNED J. Woodbury
DRAWN J. Woodbury
CHECKED J. Blum
ISSUED DATE 12/6/2013

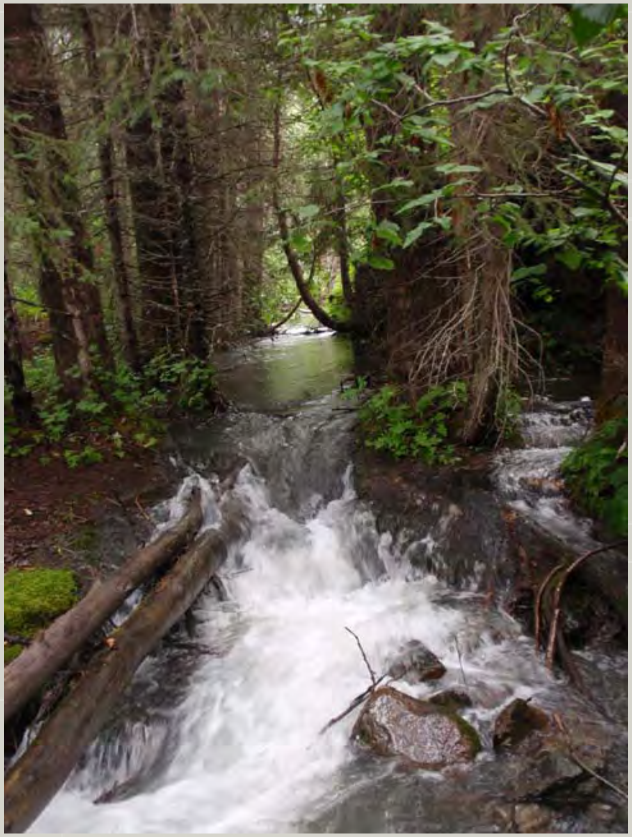
DRAWING 4 of 6

SCALE 1:700

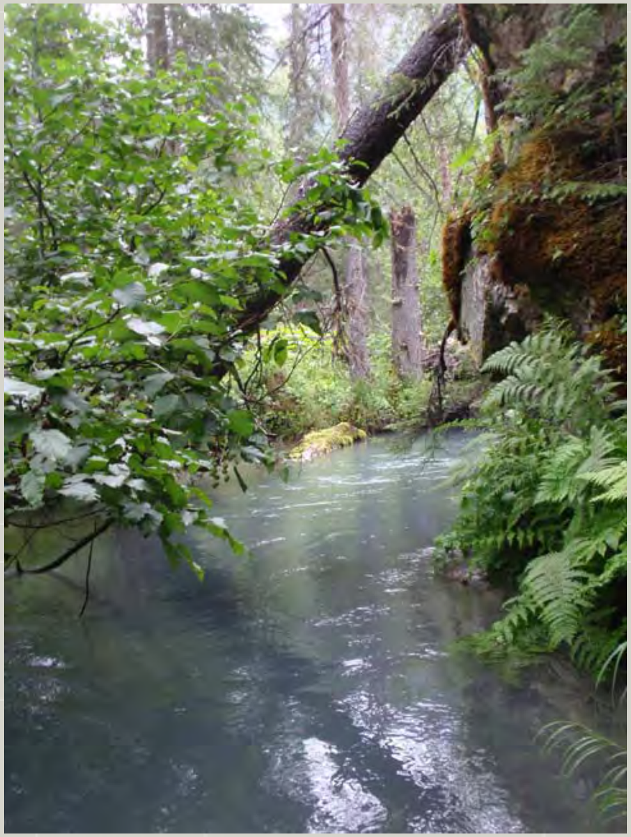
Side Channel Habitat, Reach 3

Pools in Side Channels, Reaches 2/3

Immediately upstream of gage

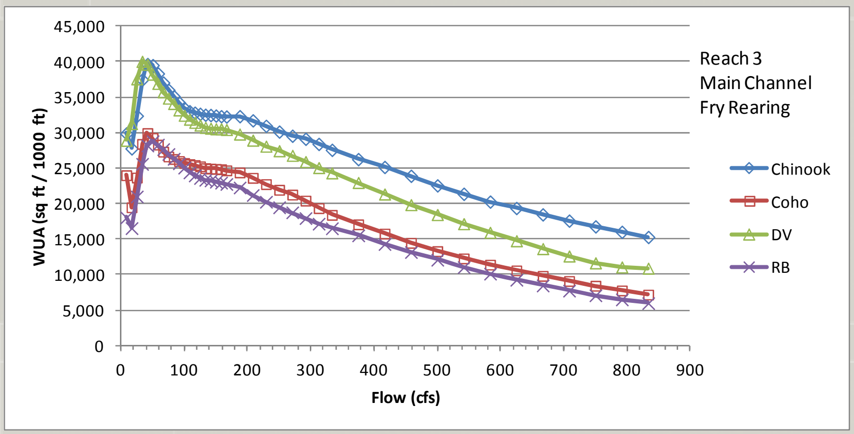


Reach 2/3 Side Channel

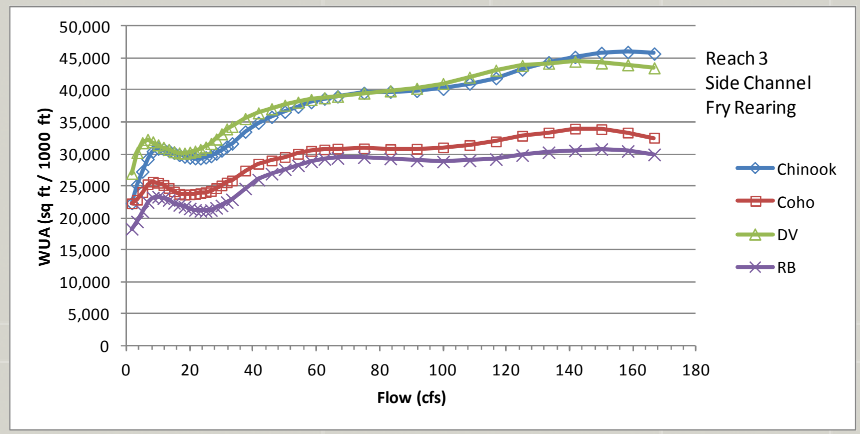


Reach 3 Mainstem vs. Side Channel WUA

R3 Mainstem – Fry WUA

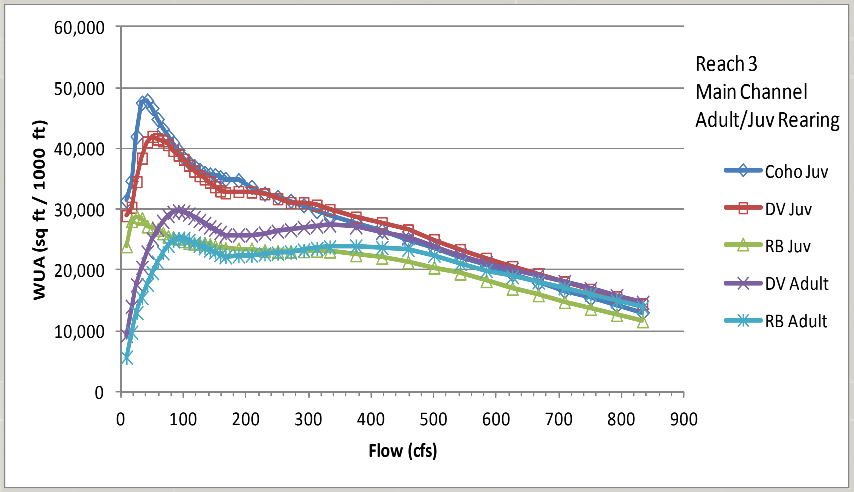


R3 Side Channel – Fry WUA

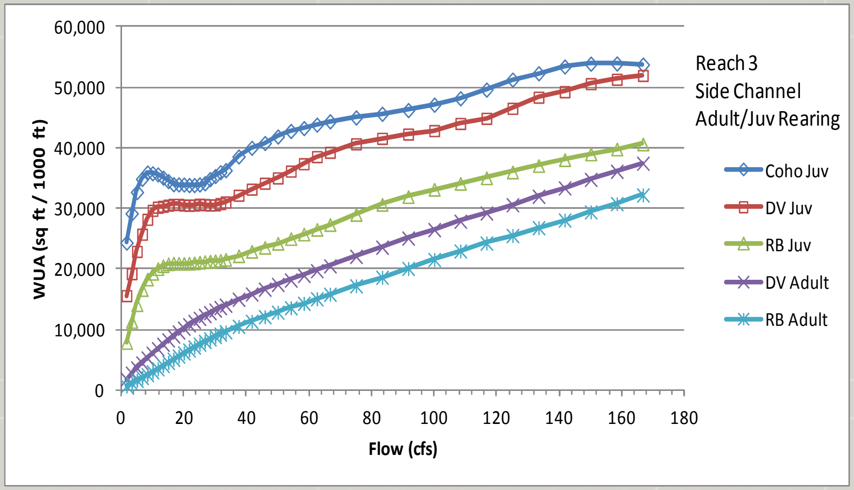


Reach 3 Mainstem vs. Side Channel WUA

R3 Mainstem – Juv/AD Rearing WUA

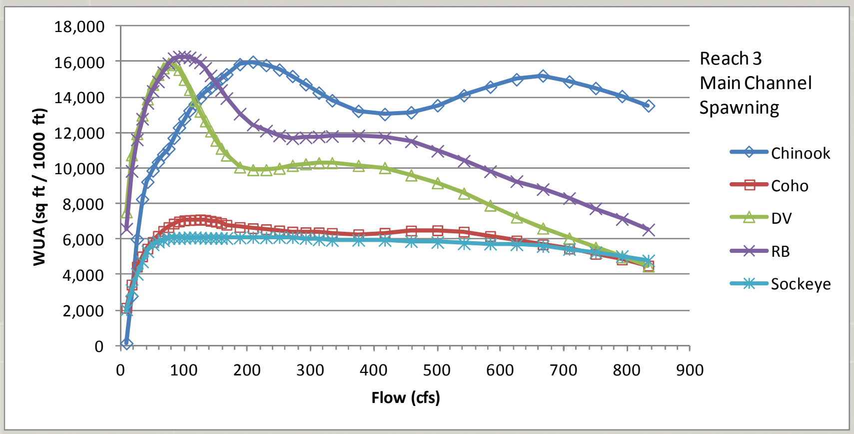


R3 Side Channel – Juv/AD Rearing WUA

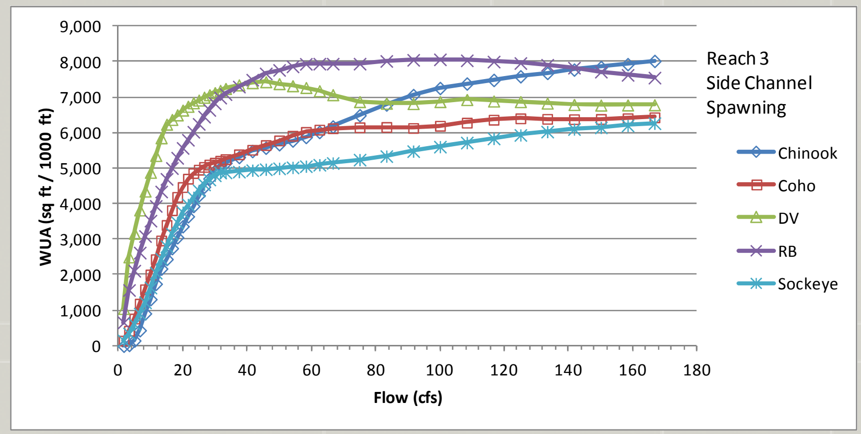


Reach 3 Mainstem vs. Side Channel WUA

R3 Mainstem – Spawning WUA



R3 Side Channel – Spawning WUA



Side Channel and Canyon Photos @ 132 cfs

Reach 3 Side Channel

Reach 5

Side Channel and Canyon Photos @ 700 cfs

Reach 3 Side Channel

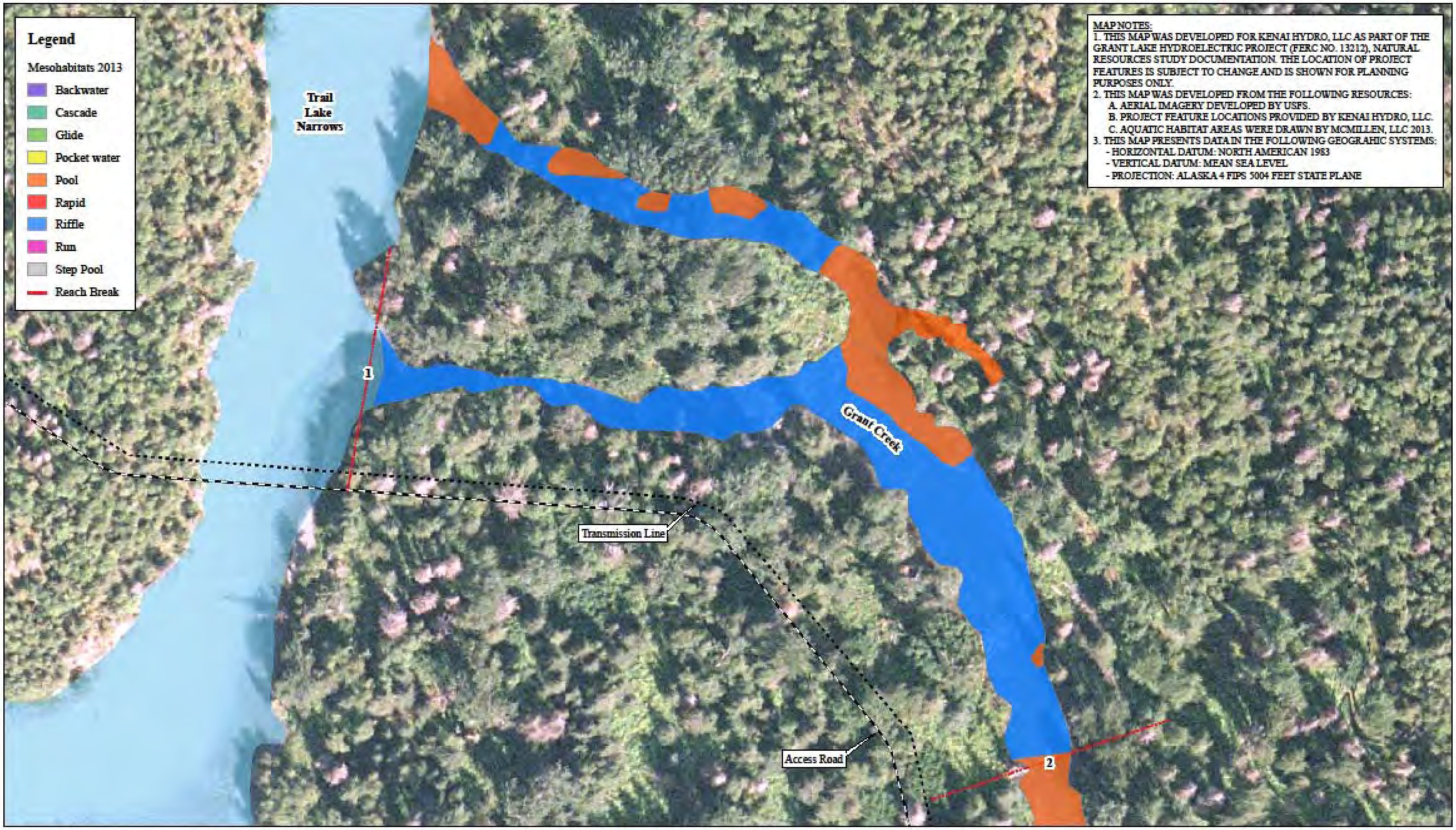
Reach 5

Potential Enhancement Opportunity - Reach 1 Distributary

- Currently distributary does not get wetted until Grant Creek flows reach ~ 180 - 190 cfs
- Analysis indicates T100 and T110 currently receive only about 1% of the water in Grant Creek once the distributary is activated
- Modeling of higher flows indicates that significant increases in WUA are possible with additional flow

Reach 1 Distributary, cont'd

- Reach 1 distributary constitutes only 5.6% of the stream length of Grant Creek, but has:
  - 17.6% of the pool habitat
  - 20% of the LWD
  - 12% of the undercut banks



REV | DATE | BY | DESCRIPTION

N

Drawing Scale:
0 37.5 75 150 Feet

MCMILLEN, LLC

Developed For:
Homer Electric Association, Inc.

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT #P-13212

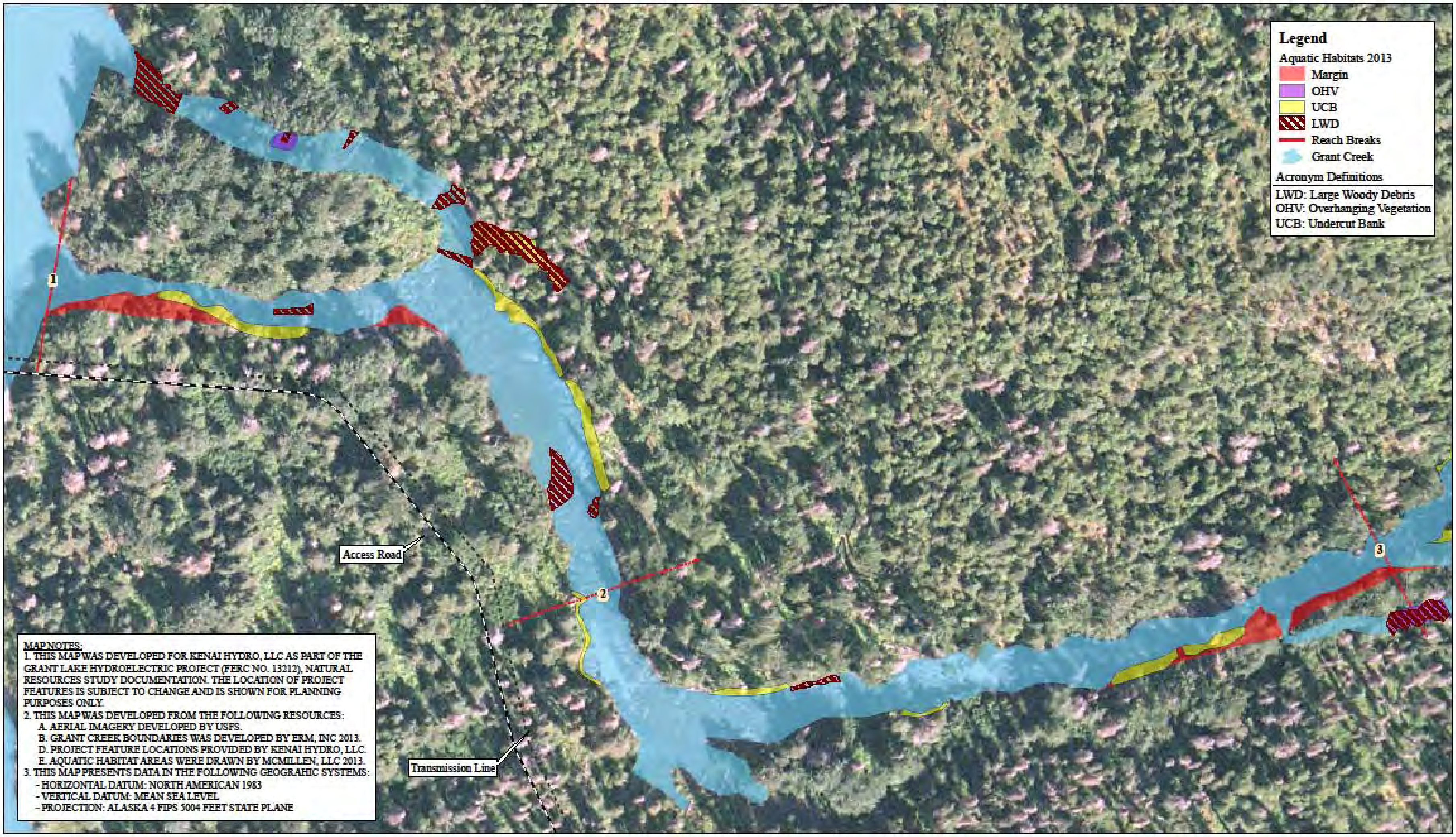
GRANT LAKE NATURAL RESOURCES STUDY

Grant Creek Mesohabitats
Reach 1

DESIGNED J. Woodbury
DRAWN J. Woodbury
CHECKED J. Blum
ISSUED DATE 12/6/2013

DRAWING 2 of 6

SCALE: 1:800



REV	DATE	BY	DESCRIPTION

N

Drawing Scale: 0 45 90 180 Feet

McMILLEN, LLC

Developed For: Homer Electric Association, Inc.

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

GRANT LAKE NATURAL RESOURCES STUDY

Aquatic Habitats
Grant Creek: Reaches 1 & 2

DESIGNED: J. Woodbury
DRAWN: J. Woodbury
CHECKED: J. Blum
ISSUED DATE: 12/6/2013

DRAWING: 2 of 3

SCALE: 1:1,000

Reach 1 Distributary

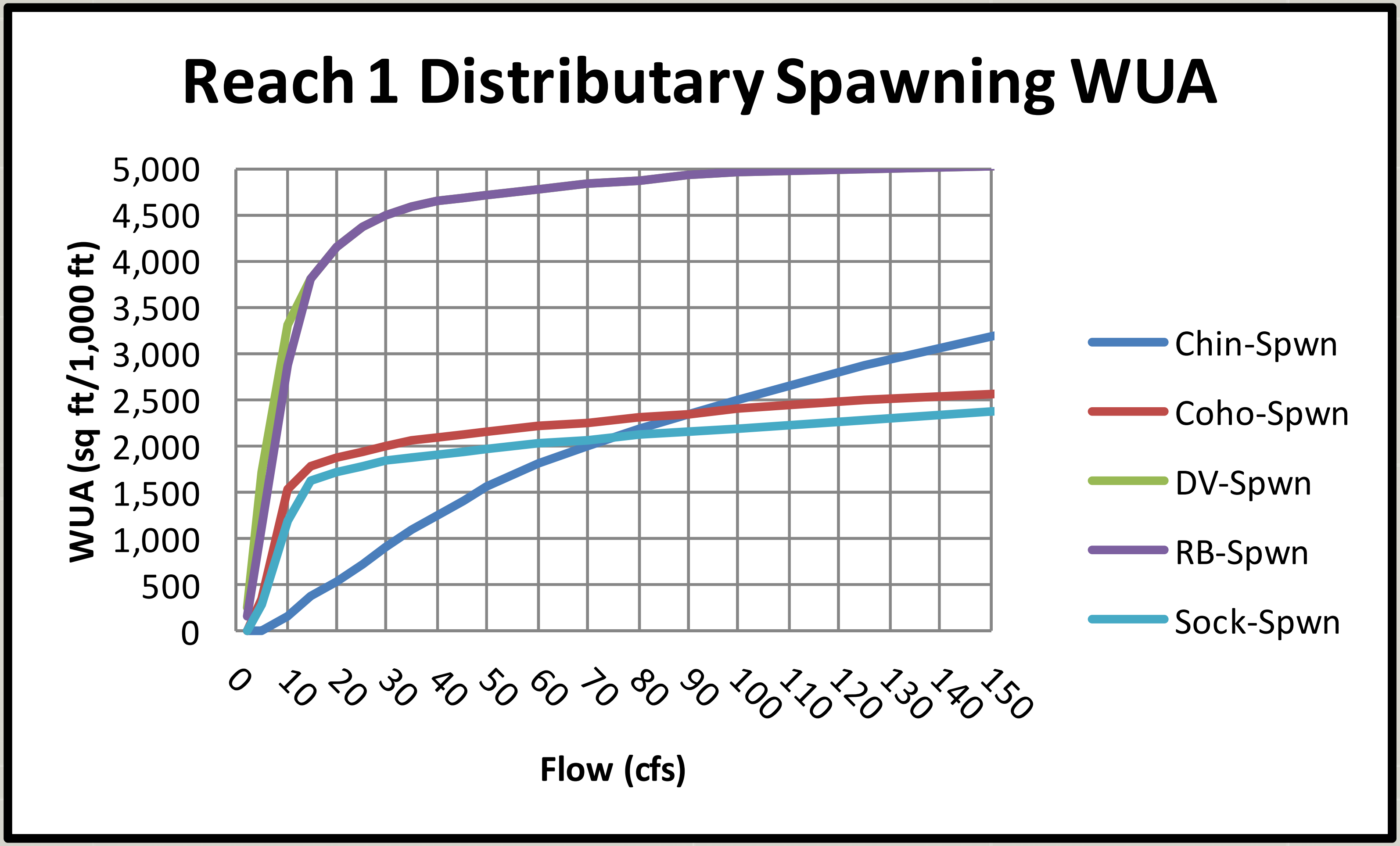
Distributary mouth @ Grant Creek flow of 131 cfs

Distributary mouth @ Grant Creek flow of 700 cfs

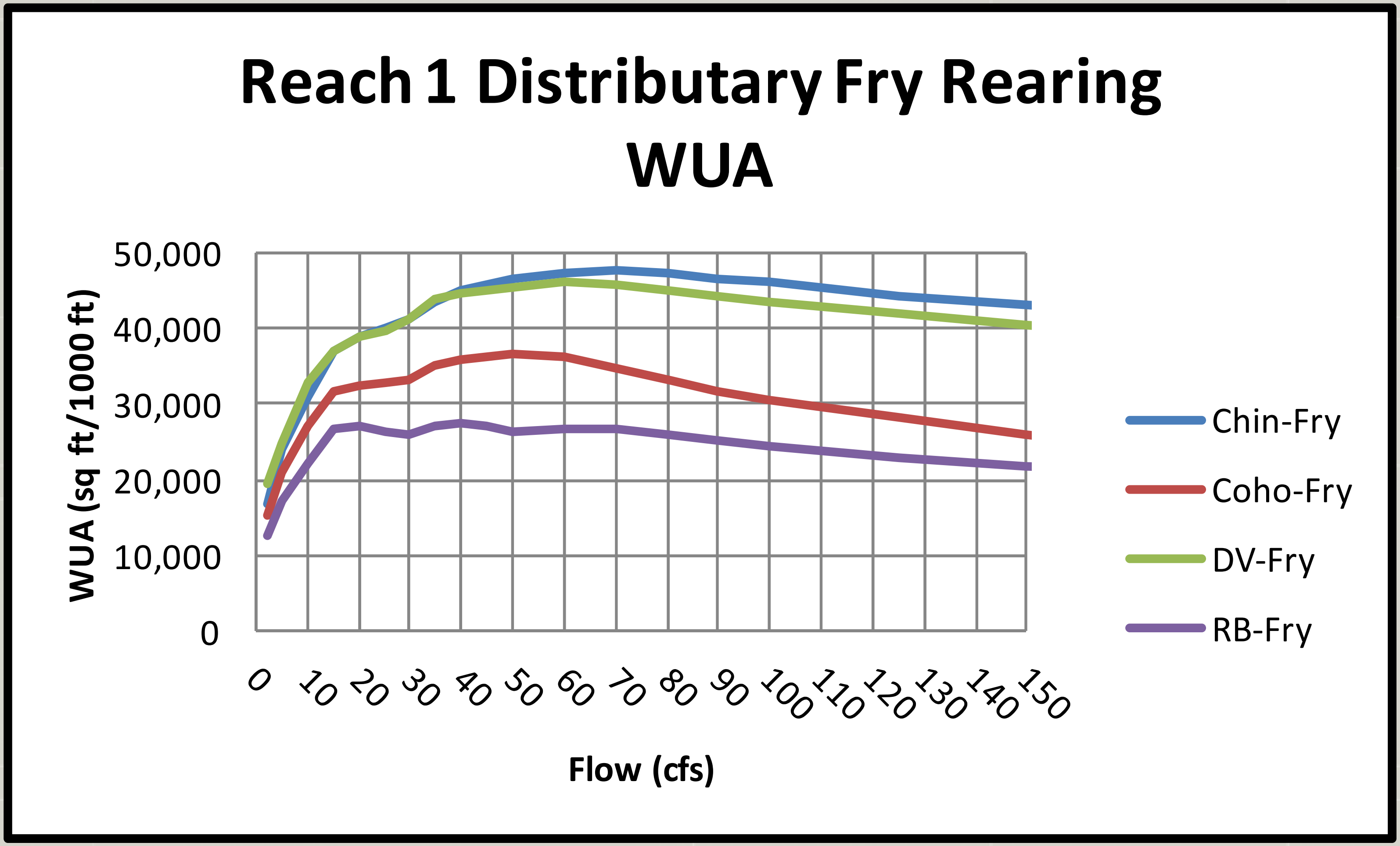
Distributary – Reach 1

LWD @ Grant Creek flow of 64 cfs

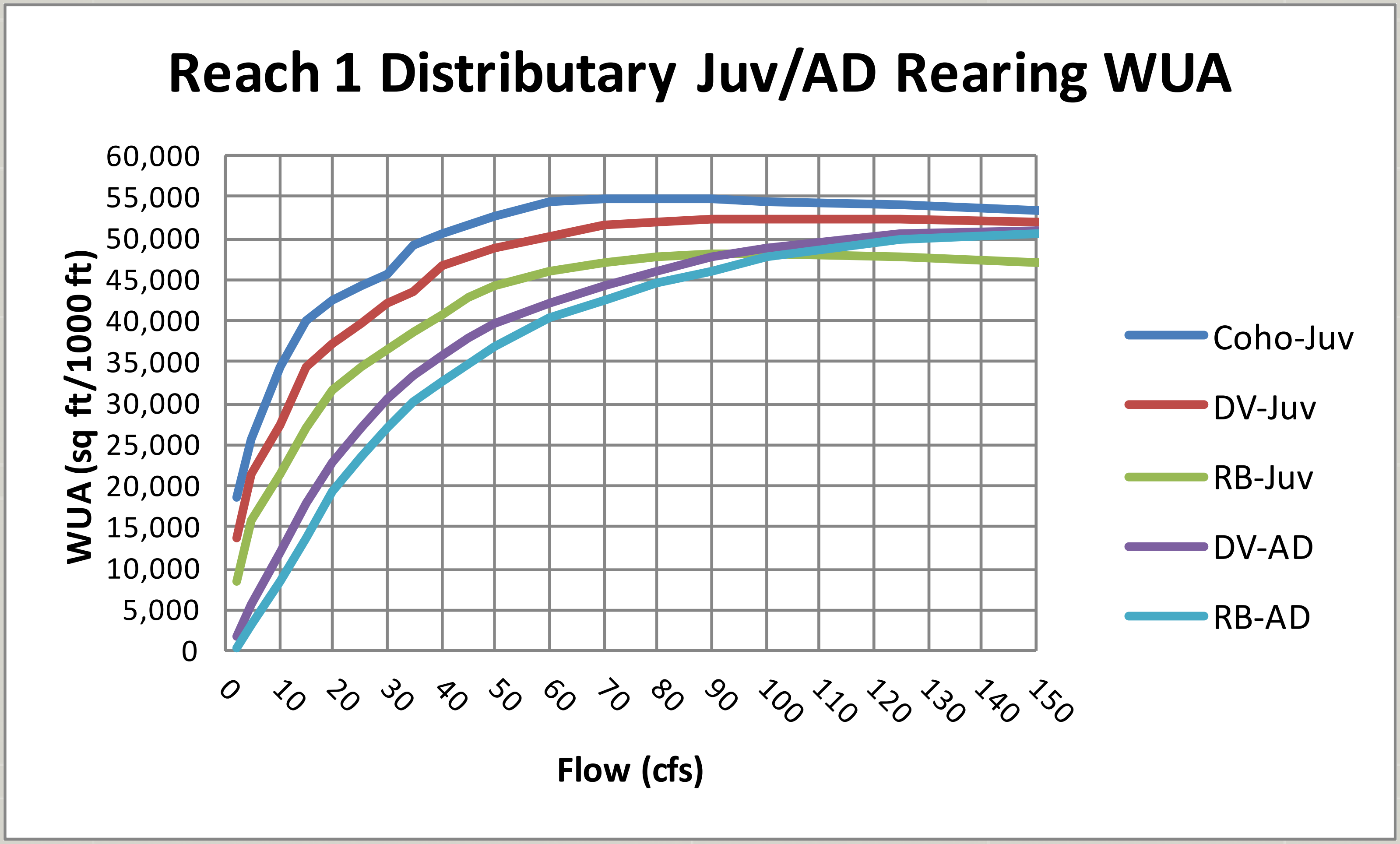
Distributary @ Grant Creek flow of 700 cfs (7 cfs in distributary)



16 – 300 ***TIMES*** more spawning habitat at 35 cfs than 2 cfs (flow in distributary when approximately 200 cfs in Grant Creek main channel)



2.2 – 2.6 ***TIMES*** more fry rearing habitat at 35 cfs than 2 cfs (flow in distributary when approximately 200 cfs in Grant Creek main channel)



2.7 – 75 ***TIMES*** more juvenile and adult rearing habitat at 35 cfs than 2 cfs (flow in distributary when approximately 200 cfs in Grant Creek main channel)

Where Do We Go From Here?

Aquatic Work Group to determine:

- Periodicity of species and life history stages
- Critical path(s) for species/life history stages/ months
- Determination of priority transects/reaches
- Integrate the hydrology, aquatic studies, geomorphology and engineering
- Development of PM&E measures

Final Grant Lake Project Natural Resource Study Report Comment Response Matrix

Summary of informal written comments on draft study reports for the Grant Lake Project (No. 13212) and Kenai Hydro, LLC (KHL) responses.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
Aquatic Habitat Mapping and Instream Flow Report				
1	4/30/2014	ADF&G	**1.1 Proposed Project Description** Comments to the proposed project description are given in ADF&G's comments on the Water Quality and Hydrology study report and are not repeated here.	Comment noted. A formal, consistent and collaboratively refined project description will be incorporated into the Draft License Application (DLA) for stakeholder review and comment.
2	4/30/2014	ADF&G	**1.2 Existing Information** ***Page 5:*** *"Collaboratively, the TWG and KHL decided to select an Instream Flow Study methodology based on the knowledge obtained from the summer 2009 aquatic resources and hydrology studies (HDR 2009a). Data and analyses from these studies were shared with the TWG in July and September. Based on the knowledge gained of Grant Creek's fish and hydrologic resources, KHL presented a proposed instream flow approach to the TWG on September 23 (HDR 2009a). 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. Where applicable, these data were used in the 2013 Instream Flow Study."* **Comment:** It is not clear from the report how data from these previous efforts were used in the 2013 Instream flow study. For example, the previous contractor (HDR) collected substantial habitat suitability information for spawning salmon and it does not appear that these data were used.	KHL field checked all the instream flow data that were collected during the 2009 study, including benchmarks, headpins, bed elevations, water surface elevations, calibration measurements, and substrate and cover coding. Where data were still good and not substantially changed, KHL used it. However, in many instances, there were significant changes to that data. Where there were significant changes in bed profiles (including the thalweg, or where the creek had altered the bed, as was the case in the Reach 3 side channel) or where the hydraulic control had shifted, invalidating the prior stage/discharge relationship, KHL collected new data. The prior 2009 data allowed KHL additional flexibility in modeling where the data were still valid. KHL is unaware of any habitat suitability information collected in 2009.
3	4/30/2014	ADF&G	**2.3 Specific Goals of the Instream Flow Study** ***Page 6:*** *"Assist impact analysis by modeling changes in key types of fish habitat relative to potential changes in stream flow."* **Comment:** The overarching goal of the ISF study, as stated in the 2014 report, was to "assist impact analysis by modeling changes in key types of fish habitat relative to potential	Per the comment, KHL has formed an "Instream Flow Sub-committee" to address the additional analytical needs of stakeholders related to instream flow and fisheries impacts issues. This group is currently meeting on a bi-weekly basis and two ADF&G representatives are active participants in these meetings. It is KHL's intent to utilize this collaborative group as the mechanism for addressing additional analytical needs that will ultimately result

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			changes in stream flow." This goal was not fully met because the applicant did not perform the analyses outlined in their 2012 Aquatic Resources Study Plan[1]. Specifically, they were to "identify important factors that influence fish use of key habitats for input to the instream flow analysis", assess "changes in the availability of microhabitat (depth, velocity, substrate, and cover) across a transect or at specific cells or groups of cells along the transect as a function of discharge", and assess changes in "lateral connectivity of main channel flow with side-channel, off-channel, or undercut bank habitats as a function of flow." Of these major objectives only the second, changes in depth and velocity as a function of discharge, was fully pursued. Based on recent presentations and ongoing discussions, the applicant may have collected data that would allow the other objectives to be addressed, and we encourage and are pursuing further exploration of this with them.	in further refinement of instream, aquatic impacts as a result of project operations in the DLA. Future meetings of the Instream Flow Sub-committee will focus on specific needs at individual transects. Once the Work Group has identified the specific work products that would be helpful for analysis, KHL will produce these.
4	4/30/2014	ADF&G	**4.1 Grant Creek Aquatic Habitat Mapping** ***Page 11:*** *"The team identified key fish habitats in Grant Creek, based on observed fish use. This was accomplished by analyzing the microhabitat fish use data collected in support of the habitat mapping study, data collected in support of the Instream Flow Study, and data collected in 2009 during the reconnaissance study (HDR 2009a)."* **Comment:** An overarching objective of the applicant's 2012 habitat mapping study plan[2] was to "identify important factors that influence fish use of key habitats for input to the instream flow analysis." This study plan also included the objective of characterizing the distribution of important habitat features, in both occupied and unoccupied habitats, as would be necessary to identify what factors influence fish use of habitat. This study didn't address this objective because such an assessment was not made. Habitat criteria were collected independently of habitat maps and without regard to a systematic protocol for recognizing and delineating habitat features. These data may exist, but they were not reported in the ISF study report. The macro and mesohabitat delineations are depicted on figures, but no descriptions are given. It is therefore unclear what habitat framework was used, and ultimately, what habitat features control the distributions of fish. A clear habitat delineation framework is needed to support fish surveys, analyses of habitat use, and the ISF study. All this information cannot entirely come from the figures, as the ISF study report currently stands. The lateral distributions of fish were not considered beyond side channels and channel-margin habitats were not included into the ISF study. Given the fact that spawning and rearing both tended to occur along the margins of all channel types,	Comment noted. Per Mr. Miller's note and based on the bi-weekly Instream Flow Sub-committee meetings, additional imagery has been developed that will alleviate a majority of the concern associated with this comment. KHL will integrate both this additional graphics as well as some additional text that further defines the macro and meso habitat delineations into the final report. As a note, this text and the additional graphics will also be incorporated into the DLA which ADF&G will have the opportunity to formally review and comment on.

[1] Kenai Hydro, LLC. 2012. Aquatic Resources Final Study Plan, November 2012
[2] Kenai Hydro, LLC. 2012. Aquatic Resources Final Study Plan, November 2012

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			this oversight is a major shortcoming of the study. It ultimately undermines the applicant's objective to identify habitat features controlling habitat selection and ultimately, the value of the site specific habitat suitability criteria (HSC). For the most part, spawning did not occur in riffles, or pools within the central portions of the main channel. Spawning was preferential to channel-margin habitats, as stated in the Fisheries study report. Only in the legends of the habitat maps is it apparent that some channel-margin habitats were considered, but no definitions are given in terms of a repeatable habitat delineation framework. In order to evaluate what habitat features are important to fish, we need to measure them in sufficiently detail and in a repeatable way. Monte Miller Note: Distribution of spawning fish by species was presented after draft reports were made available. Inclusion of the figures and associated supporting text in the final reports would clarify issues here. It is apparent that in Grant Creek the limiting factor for spawning (all species) is suitable spawning habitat. Because the stream is generally bedrock controlled, identified spawning occurred in niche habitat, behind boulders or where small pockets of suitable substrate has accumulated. There are not widespread spawning gravels available, therefore channel margin habitats with slower velocities and some gravel deposition are selected by spawners.	
5	4/30/2014	ADF&G	**4.2 Grant Creek Instream Flow Study** **General comment:** The need was to specifically link spatially explicit depths and velocities of known spawning habitat with flow. Given the turbulence of Grant Creek and the lack of coherence between spawning and channel hydraulics, the interagency technical working group was skeptical about the use of a 1-D hydraulic model (PHABSIM) to accurately simulate velocities on Grant Creek. The focus was then shifted to the use of interactive wetted perimeter modeling of depth and lateral connectivity. And the intention was to use this tool to model spatially explicit depths within specific portions of the wetted perimeter used for spawning. This analytical tool was further supported by the apparent lack of regard for site-specific hydraulics by salmon, an observation that has now been confirmed by the applicant. Monte Miller Note: Identification of use of niche habitat places this stream in a potential category of not following accepted normal and expected spawning conditions. Site specific hydraulics may not be as much of a factor as one would expect on other streams.	In its analysis, KHL stated that spawning salmonids didn't show the classic use of certain depths and velocities, as may be observed in streams with a different morphology, but rather were focused more on the available suitable substrate. One of the work products that KHL will produce, after consulting with the Instream Flow Sub-committee, will be a series of charts and tables that show locations of spawning substrates as positioned along the measured transects. These work products will allow the Instream Flow Sub-committee to examine location of spawning substrates in relation to position along the stream within the wetted perimeter, as well as its lateral connectivity.
6	4/30/2014	ADF&G	**4.2 Grant Creek Instream Flow Study** **General comment:** In the applicant's 2012 Aquatic Resources Study Plan[3], the use of an interactive wetted perimeter model was outlined to be the course of study, along with	Please see response to Comment 5.

[3] Kenai Hydro, LLC. 2012. Aquatic Resources Final Study Plan, November 2012

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			PHABSIM. Based on the applicants 2014 ISF report, only a PHABSIM analytical framework was utilized to assess flow habitat relationships. An Oregon Method was used to assess connectivity in Reach 5, but the use of an interactive wetted perimeter model to simulate depths and lateral connectivity was not included. Interactive water surface elevation graphics are reported in Appendix 4 of the 2014 ISF report, but this falls well short of what was originally requested and planned. Monte Miller Note: If the study plan was deviated from due to a new understanding of the stream and resource use of features, a discussion of how and why the study was adapted should be included.	
7	4/30/2014	ADF&G	**4.2 Grant Creek Instream Flow Study** ***Page 29:*** *"A number of different graphs can be provided and may include the "wetted perimeter versus flow" relationship, a static cross section of the channel showing substrate distribution and water surface at any flow, and/or a dynamic Excel graphic. A static example of the dynamic graphic is shown below in Figure 3. Changing the value in the "Discharge Window" will adjust the water level up or down corresponding to the stage/discharge formula imbedded in the worksheet. Wetted perimeter and average depth values in the lower right also change with the assigned discharge. Values such as percent of change in wetted perimeter can be easily added to the graphic. This type of dynamic graphic can be provided for any transect, as appropriate."* **Comment:** It would be helpful if the applicant could provide graphics, as described in this excerpt, displaying substrate suitability, spawning locations, and interactive wetted perimeter and depth so that lateral connectivity relationships for important channel margin spawning habitats can be assessed. Miller Note: The additional information on spawning locations of species and discussion of use should be included (previously stated).	Comment noted. KHL has created an extensive GIS data base that encompasses all resource areas and provides ample opportunity to create graphics of this nature. Based upon collaborative discussions with the Instream Flow Sub-committee, if additional graphics needs exist for documentation/analytical purposes they will be incorporated into the DLA for stakeholder review.
8	4/30/2014	ADF&G	**4.2.2 Habitat Availability and Transect Selection** **General comment:** Transects were placed at known spawning locations because there was high fidelity to spawning sites and the distribution of spawning was not coherent with the distribution of traditional habitat features. Even so, it would still be helpful if the locations of these transects were described, in terms of the applicant's habitat delineation framework, so we know which habitats are represented. Table 4.2-1 reports the transects and the represented mesohabitats, but these habitats are not summarized in the same terms as they were assessed in the 2013 studies. In other words, the habitat delineation framework is not the same. In addition, the position of spawning, along the transect, is not summarized. Since this was the basis for the selection of the transects, this information should be included.	Comment noted. Per Mr. Miller's note and based on the bi-weekly Instream Flow Sub-committee meetings, additional graphics has been and will continue to be developed (per discussions) that will alleviate a majority of the concern associated with this comment. KHL will integrate both this additional graphics as well as some additional text that further defines the macro and meso habitat delineations into the DLA which ADF&G will have the opportunity to formally review and comment on.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			Monte Miller Note: This information has been provided after the draft study reports were made available. Figures and discussions should be included in the reports. Transects have been identified in a figure and it is probably safe to say that while transects were first established to be associated with spawning activity, the number of transects on this relatively short stream, are sufficient to provide comprehensive inclusion of habitats.	
9	4/30/2014	ADF&G	**4.2.3 Habitat Utilization / Habitat Suitability Criteria** ***Page 14:*** *"The purpose of the habitat utilization component of the Instream Flow Study was to determine which meso- and microhabitat factors the fish in Grant Creek occupied to assess the impacts, if any, the Project would have on instream habitat. To maximize the knowledge of habitat selection factors for fish in Grant Creek, observations were made at the locations of the transects and fish habitat sites, as described in the previous section.* *Fish spawning and rearing microhabitat values were recorded at programmatically-selected sites in Reaches 1 through 4. Measured microhabitat use parameters varied by habitat units. During the Instream Flow TWG meeting on September 23, 2009, Table 4.2-2 was developed with input from TWG members.* *In 2013, measurements of 99 spawning pairs of sockeye were taken at flows ranging from 338 cfs – 469 cfs in the mainstem and 28 cfs – 74 cfs in the side channels. Measurements of 47 coho spawning pairs were taken at flows ranging from 169 cfs – 285 cfs; however, all but 4 of the observed coho spawning occurred at flows ranging from 169 cfs – 179 cfs. For this reason, McMillen extended the probability of use curves to reflect the upper end of optimum utilization (i.e., value of 1.0) in the Cooper Creek curves. Only three Chinook Salmon pairs were observed spawning; these were discarded and literature-based curves were used."* **Comment:** Habitat suitability criteria (HSC) for spawning sockeye salmon were collected at flows ranging from 338 – 469 cfs, in the main channel. In order to evaluate the representativeness of these HSC, we need to know when and where they were collected, in reference to a specific habitat delineation framework or set of repeatable habitat features. We need to know the longitudinal position (what transect and what stream reach), and the proximity to the stream bank (lateral position). These details are not given in the 2014 ISF Report. We also need to know whether each observation represent a redd or a cluster of redds, and how many measurements were taken in each definable cluster of redds. It would also be helpful if HSC were presented in reference to a habitat delineation	KHL collected site-specific data for each redd that was observed. These data included depth, velocity, and substrate. Using techniques described in WDFW/WDOE (2013)[4], KHL measured where fish were present; this was the habitat utilization portion of the study. In addition, KHL also measured habitat availability, which sampled upstream, downstream and in the vicinity of the measured redds. When fish were observed in the area of the transects, KHL used those transects to identify availability at the given flow; this provided extensive and calibrated information surrounding those redds. Where there were no transects in the immediate vicinity of redds, KHL collected availability data on temporary transects above, across, and below the measured redds. Locations of redds, in relation to transects or known features, was noted. Dates and flows were also recorded at the time of measurements.

[4] WDFW (Washington Department of Fish and Wildlife) and WDOE (Washington Department of Ecology). 2013. Instream flow study guidelines: technical and habitat suitability issues including fish preference curves. Updated April 1, 2013.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			framework. This omission will help us identify what habitat features are important to consider when conditioning HSC. HSC are only relevant when they are considered within those features that actually control habitat selection, and this analysis was not performed, though it was planned in the 2012 Study Plan. We look forward to continued discussions with the applicant's contractors to utilize what existing data can be used to identify the context and representativeness of the site-specific HSC for this project. Monte Miller Note: The selection of niche habitat for spawning may cause difficulties in use of a habitat delineation framework. The study appears to have moved past the study plan and discussion of change in plan should be discussed.	
10	4/30/2014	ADF&G	**4.2.3 Habitat Utilization / Habitat Suitability Criteria** ***Page 14:*** *"In 2013, measurements of 99 spawning pairs of sockeye were taken at flows ranging from 338 cfs – 469 cfs in the mainstem and 28 cfs – 74 cfs in the side channels. Measurements of 47 coho spawning pairs were taken at flows ranging from 169 cfs – 285 cfs; however, all but 4 of the observed coho spawning occurred at flows ranging from 169 cfs – 179 cfs. For this reason, McMillen extended the probability of use curves to reflect the upper end of optimum utilization (i.e., value of 1.0) in the Cooper Creek curves. Only three Chinook Salmon pairs were observed spawning; these were discarded and literature-based curves were used. Information relating to site-specific HSC was developed from these data and used in combination with HSC curves available in the existing literature and professional judgment to determine final HSC curves to be used in modeling."* **Comment:** HSC data collected by the applicant's previous contractor do not appear to have been considered in the 2013 efforts. These data may eliminate the need to utilize literature-based curves developed on lower-gradient alluvial streams that may or may not be transferrable to this stream. Monte Miller Note: If information was collected over redds, to include velocity and depth, then a comparison can be completed. Again, caution should be exercised since the spawning choices in this system may be first limited to niche habitat containing suitable gravels, with depth and velocity factors at those sites being secondary. Success of spawning may be affected by all factors at a redd site. Use of literature generated HSC's may be limited because fish in this system may be forced to utilize more extreme conditions, resulting in a wider set of curves for this specific system.	Comment noted. It is anticipated that KHL's ongoing discussions with the Instream Flow Sub-committee will continue to define the parameters with which the habitat suitability analysis is conducted. These additional analyses and associated results will all be documented in the DLA and provided to the stakeholders for review. Please also see response to Comment 2. If HSC data were collected in 2009, KHL is unaware of these data, nor do they have records or copies of them.
11	4/30/2014	ADF&G	**4.2.7.1 Hydraulic Modeling** **General comment:** <u>*Bracketing the instream flow question:*</u> It is assumed that the technical working group is most interested in the importance of	Comment noted and KHL agrees with this assessment.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			low – medium flows to support salmonid habitat in this system. Grant Creek is also bedrock controlled and resistant to channel change, which minimizes the issue of channel maintenance. This exclusion of channel maintenance flows allows the instream flow question to be bracketed within a range of flows that are most important to seasonal uses of habitat by salmonids. This is important because it narrows the focus of hydraulic modeling and model performance to a specific range of flows.	
12	4/30/2014	ADF&G	**4.2.7.1 Hydraulic Modeling** **General comment:** <u>*Hydraulic modeling challenges:*</u> It can be a challenge to get PHABSIM hydraulic models to calibrate well in turbulent streams. In order to evaluate the performance of the hydraulic models applied on Grant Creek, a comparison of measured and modeled flows and velocities could be made. In the ISF report, however, only measurements for the single velocity calibration flow are provided. It would be helpful if velocities could be provided for flows within each flow range of interest. Good hydraulic model performance requires accurate simulations, of which velocity is the most problematic. To simulate velocities in the interested discharge range, two velocity calibration sets are usually the minimum recommendation, especially within irregular channel morphology (see Waddle 2001[5]). Grant Creek is certainly irregular in its morphology, so evaluation of the velocity simulations is important. According to Waddle (2012; **emphasis is added**). "In those instances in which a single velocity set has been used in the simulations, it is a **matter of professional judgment as to the quality of the simulations**, assuming that any erroneous velocity errors have been accounted for. However, if during a review of the channel characteristics for the cross sections it is determined that gross changes in channel geometry occur at some "threshold" water surface elevation (i.e., discharge), then the velocity simulations should be carefully examined to determine if the distribution across the change in channel geometry makes rational sense. This situation often arises where only a single velocity set was collected at a low flow or alternatively at only the high flow and a large "floodplain" type geometry exists. **It is unlikely (but not impossible) that a standard application of the single calibration velocity set will reflect the velocity magnitudes and distributions across such a radical change in channel geometry.** Modification of the velocity simulations using professional judgment is the only real option if the collection of an additional velocity calibration set(s) cannot be accomplished under the constraints of the project.	<u>*Simulated velocities over a range of flows:*</u> Calibration details that show velocity distributions across the range of modeled flows for each transect are provided in Appendix 3. For example, Table A.3-16 shows simulated and measured velocities at the calibration flow (182 cfs) as well as simulations ranging from 10 cfs – 700 cfs for the "1 flow" model. Table A.3-17 shows the measured and a series of simulated flows, ranging from 182 cfs – 1,000 cfs for both the "1 flow" model, as well as the depth calibration model. These simulations of velocities allow professional judgment as to whether or not these velocities appear reasonable. One velocity models are commonly used for instream studies. KHL contractors have previously conduced 1-flow models in Washington, California, and North Carolina. One-flow models typically model better in a downward direction; for that reason, often both one velocity models and depth calibration models are used to model in an upward direction (T.A. Payne, pers. communication w/John Blum, McMillen LLC)[6].

[5] Citation: Waddle, T.J., ed., 2012, PHABSIM for Windows: User's Manual and Exercises: Fort Collins, CO, U.S. Geological Survey, 288 p.
[6] John Blum (McMillen LLC) personal communication with Thomas Payne Normandeau Associates, Inc. (date unspecified).

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			In those instances where multiple velocity sets have been collected, the user can easily check the validity of the velocity simulations by comparing the predicted velocities to one or more of the other calibration velocity sets. In the event that the predicted versus observed velocity profiles are not within an acceptable range, then one or more of the other calibration velocity sets should be used for the appropriate range of discharge. Channel geometry changes in this situation can often provide guidance to the analyst for the water surface elevation and hence discharge ranges, that a particular velocity calibration set might be most appropriate. Again, any VAF functional relationship which deviates from the "expected" relationship should have a physical justification based on site-specific characteristics.” On Grant Creek, the applicant has used a single velocity calibration set and a method using depth calibration. The depth calibration method uses Manning’s equation to solve for the velocities at a uniform roughness coefficient (n-value), but this method is usually only intended for prototype channels not found in nature, where roughness is uniform and known. The channel of Grant Creek is plagued with irregularities in roughness and USGS does not recommend the use of this method, except in extreme cases where field conditions or equipment failures prevented the collection of velocity profiles. The use of a single velocity calibration set is also not recommended for irregular channels with high roughness. It is recommended that at least two velocity calibration sets are collected to represent the range in flow that is most important to fish habitat. The applicant’s collection of a single velocity calibration set is somewhat problematic, in that model performance was not the best at flows that were immediately higher or lower than the flow at which the velocity calibration set was collected (180-200 cfs). This can be seen from the velocity adjustment factors (VAFs) provided in the ISF study report (see Appendix 3). The applicant’s VAFs reveal a rather high degree of variation in the difference between measured and modeled flows and, by default, velocities. Over the range of simulated flows, this difference is far greater than 20%, with the highest differences in the low discharge range (< 50 cfs). As an example, in reach 1, modeled flows are universally higher (3-4 times higher) in this range of flows. This makes it questionable whether the simulated velocities are realistic in this flow range. In order to evaluate this, we’d need to compare simulated velocities with measured velocities, if they were obtainable and are available.	As stated in the draft report, the restriction to variance in VAFs of 20% +/- is applicable for three flow regression models only. The range of tolerances is much greater for 1-velocity set models. The VAFs shown in Appendix 3 are within tolerances for a 1-flow model.
13	4/30/2014	ADF&G	**4.2.7.3 Hydraulic Model Calibration** ***Page 19:*** *“Velocity Adjustment Factors (VAFs) are generally a measure of how well a model simulates the actual velocities. In a one velocity set model, however, the VAFs are actually adjustment factors of discharge, not velocities, and a wider range of values is acceptable.”*	Comment noted. As previously mentioned, collaboration and ongoing data analysis is being conducted via the discussions with the Instream Flow Sub-committee. VAF’s will continue to be a topic and the analysis will be tailored toward an acceptable range.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			Comment: As stated previously, the VAFs, by default, represent the velocities of the stream, even if they are a ratio of computed and measured discharge. And if a wider range of values is acceptable, then we recommend discussions on what that acceptable range is. We are seeing rather extreme VAFs which indicate that the difference between measured and modeled flows is quite high, in some situations.	Please also see response to Comment 12.
14	4/30/2014	ADF&G	**4.2.7.4 Transect Weighting** **General comment:** Based on ongoing conversations with the applicant's contractors, we understand that the transect weighting process will be based on continued discussions, with regard to the seasonal distributions of fish.	Comment noted.
15	4/30/2014	ADF&G	**4.2.8 Measured Flows for Grant Creek** **General comment:** In this section, the range of flows used for depth calibration is given. It would be helpful if velocities collected within this range of flows could be used to assess hydraulic model performance above and below the single velocity calibration set.	Calibration details that show velocity distributions at a range of flows for each transect are provided in Appendix 3. For example, Table A.3-16 shows simulated and measured velocities at the calibration flow (182 cfs) as well as simulations ranging from 10 cfs – 700 cfs for the "1 flow" model. Table A.3-17 shows the measured and a series of simulated flows, ranging from 182 cfs – 1,000 cfs for both the "1 flow" model, as well as the depth calibration model.
16	4/30/2014	ADF&G	**5.1 Grant Creek Aquatic Habitat Mapping** *"Table 5.1-1 summarizes mesohabitats found in Grant Creek. Riffle habitats were predominant, accounting for 50 percent of all habitats. This was consistent throughout all reaches, with the exception of the secondary channel in Reach 3. Riffle habitats were followed by pools (19.3 percent) and cascades (15.3 percent); all of the cascades were found in the canyon (Reach 5).* *Table 5.1-2 shows habitat types (stream margin, overhead vegetation, undercut banks, and LWD) found in Grant Creek. LWD was sparse in the mainstem of Grant Creek. High flows in Grant Creek move LWD downstream and eventually into the Trail Lakes. In the side channels and distributaries, where flows and velocities are much less than the main channel, LWD is relatively abundant."* **Comment:** It would be helpful if this information was provided for the transects and the site-specific HSC. This information is needed to focus and condition the analysis of microhabitat data.	Additional work products for the Instream Flow Sub-committee have included transects in relation to habitat features. Please also see response to Comment 9.
17	4/30/2014	ADF&G	**6.2.1 Grant Creek Habitat** **Page 81:** *"Preliminary results from the Instream Flow Study indicate that spawning is limited in Grant Creek due to lack of suitable spawning substrate; the substrate that is*	Comment noted. Please also see response to Comment 5.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			present is recruited from Reaches 5 and 6 (Canyon). Substrates did not tend to be rounded, as observed in most high quality salmonid streams. The sediment from the canyon consists mostly of slate and greywacke (i.e., sandstone). When slate fractures, it tends to be platy (i.e., broad and flat), while greywacke fractures tend to be angular in nature (KHL 2014b). *Spawning appears to be opportunistic and activity more directed by the presence of spawning sediment rather than by water depths and velocities. For example, KHL observed sockeye salmon spawning in 1 foot of depth and 1 foot per second velocities, while spawning activity was also observed about 30 feet away in the middle of the channel where depths of 3 to 4 feet and velocities up to 6 feet per second were noted."* **Comment:** These observations mirror all those made since the origin of this project, and over four spawning cycles. They also encourage the use of interactive modeling of depth and lateral connectivity to model spatially explicit depths within specific portions of the wetted perimeter used for spawning.	
18	4/30/2014	ADF&G	**7.0 Variances from FERC-approved study plan and proposed modifications** Monte Miller Note: There are several comments by Jason Mouw which indicate that either parts/tasks of study plans were either not completed or were modified. Please make sure that all changes from the proposed study plans are documented and discussed to provide justification.	KHL will utilize ADF&G's comments and review the study plan to fully document any variances that occurred. Please also see responses to Comments 5 and 9.
Fisheries Assessment Report				
19	4/30/2014	ADF&G	**1.1 Proposed Project Description** Comments to the proposed project description are given in ADF&G's comments on the Water Quality and Hydrology study report and are not repeated here.	Comment noted. A formal, consistent and collaboratively refined project description will be incorporated into the DLA for stakeholder review and comment.
20	4/30/2014	ADF&G	**1.3.1.1 Grant Creek Fish Resources** **Page 6:** *"Upper Grant Creek is impassable to salmon 0.5 mile (Ebasco 1984) to 1 mile (Johnson and Klein 2009) upstream of the mouth; fish habitat is most likely concentrated within the lower portion of stream."* **Comment:** It is a bit inaccurate to state that Grant Creek is impassible to salmon ½ to 1 mile upstream of the mouth. The applicant's recent studies reveal that salmon passage	Comment noted. The citation was simply intended to provide additional background on historical studies that had been completed in Grant Creek. The results in this report clearly state that passage is available to the barrier falls at the top of Reach 5 (approximately RM 1.0). This clarity will be restated in the DLA as well. The statement was intended to summarize previous

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			extends into the canyon (reach 5), which is beyond 1 mile upstream.	research, and while the summary was correct, the conclusion of Ebasco (1984)[7] was inaccurate. The language has been revised to state that Grant Creek is impassable at the base of the falls, which is at the top of Reach 5 and one mile upstream of the confluence.
21	4/30/2014	ADF&G	**1.3.3 Need for Additional Information** ***Page 11:*** *"The field studies conducted in 2013 were intended to provide information on the following general topics. Specific objectives for study components will be described below for each component.* • *Juvenile fish use of winter habitats.* • *Better definition of fish use of micro-habitats and overall species composition and relative abundances in Reaches 1 through 4.* • *Extent of rainbow trout spawning in Grant Creek.* • *Use of Reach 5 by juvenile and adult fish, with additional emphasis on spawning Chinook salmon use of Reach 5.* • *Delineation of aquatic habitats available in Grant Creek; identify key habitats for fish and describe and distinguish the factors that may influence fish use of the key habitats over those habitat units not occupied by fish in Grant Creek.* • *Estimation of salmon spawning escapement in Grant Creek.* • *Examination of how important individual habitat units may be affected by changes in flow due to the operation of the proposed Project using instream flow assessment methods.* • *Fish resources and habitat use of the Trail Lake Narrows at the proposed bridge site."* • **Comment:** Aquatic habitats were delineated, but not in a way that captured the most commonly utilized habitats, channel margins or shallow shoreline areas. This could be reconciled if the lateral position, or distance from the channel margin, was recorded when habitat suitability criteria (HSC) were collected, but this is not apparent from either the IFIM report or the Fisheries report. If channel margin habitat units weren't delineated, or the lateral positions of HSC were not collected, flow-habitat relationships cannot be developed for these most heavily utilized habitat features. They can't be distinguished by microhabitat factors (HSC) alone. In other words, HSC don't discriminate or differ between those portions of the wetted perimeter that	Comment noted and per response to Comment #10 above, it is anticipated that KHL's ongoing discussions with the Instream Flow Sub-committee will continue to define the parameters with which the habitat suitability analysis is conducted. These additional analyses and associated results will all be documented in the DLA and provided to the stakeholders for review.

[7] Ebasco (Ebasco Services, Inc.). 1984. Grant Lake Hydroelectric Project Detailed Feasibility Analysis. Volume 2. Environmental Report. Rep. from Ebasco Services Incorporated, Bellevue, Washington.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			are utilized for spawning, year after year, and those that weren't. The microhabitat of utilized habitats was surveyed, but unoccupied habitat units weren't. As such, it may be difficult to identify key habitats, factors influencing their use, and estimate flow-habitat relationships. In the ISF report (on the bottom of page 81) the observation that stream depth and velocity were not influential to spawning habitat selection was made. This could be examined quantitatively if both occupied and unoccupied habitats were surveyed, and it may be possible to conduct such an analysis with the transect data, if HSC were collected along them in a spatially explicit manner. But the fact that site-specific depths and velocities didn't seem to matter, highlights the importance of a habitat delineation framework that sets apart channel margin habitat, so that instream flow relationships can be developed for them.	
22	4/30/2014	ADF&G	**2.1.2 Distribution of Spawning Salmon in Grant Creek** ***Page 12:*** *"Identify critical spawning habitats as required for general assessment of Project impacts."* **Comment:** This objective wasn't clearly addressed in the Fisheries report. It would be helpful to identify the longitudinal and lateral positions that were most important to spawning. This might best be accomplished by identifying which instream flow transects represented the highest use and have the necessary habitat information summarized for these transects. Monte Miller Note: The figures and discussions provided following release of the draft report should be incorporated in the report.	Comment noted. Per ongoing discussion and collaboration with the Instream Flow Sub-committee, "important" spawning areas have been further delineated via GIS mapping exercises. Those maps have been made available to the group and will be incorporated into the DLA and utilized in upcoming discussions with stakeholders.
23	4/30/2014	ADF&G	**4.1.3 Distribution of Spawning Salmon in Grant Creek** ***Page 33:*** *"The distribution of spawning salmon in Grant Creek was documented during spawning (redd) surveys and radio telemetry surveys. During redd surveys, the location and number of redds were recorded on maps of Grant Creek. For radio telemetry surveys, the location of tagged fish were also noted on maps of Grant Creek. The combination of both survey techniques is useful in defining spawning habitat especially when turbidity precludes observations of spawning in deeper water. The primary goal of these surveys was to identify sensitive spawning habitats in Grant Creek."* **Comment:** During redd surveys, the location and number of redds was recorded on maps. As stated in the report, the primary goal of these surveys was to identify sensitive spawning habitats in Grant Creek. Unfortunately, very little information on spawning habitat is given. The locations are depicted on maps, but it is difficult to	Comment noted. Need for additional documentation related to habitat delineation will be assessed with the Instream Flow Sub-committee and detailed in the DLA.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			obtain much detail from these depictions. Monte Miller Note: See previous comments on inclusion in the report of additional figures and discussions. In order to assess the sensitivity of these habitats to operation of the proposed project, detailed information about spawning habitat is needed. This information includes the dates of spawning, lateral position (proximity to the shoreline), and mesohabitat type. The maps, presented in the report, overlay spawning locations upon mesohabitats but the mesohabitats aren't defined. In many cases, the spawning symbols occlude the habitat layer and the lateral position of the redd. There is also a bit of confusion on the definitions of habitat categories used to structure habitat and fish distribution surveys. Table 5.1-15 summarizes fish use of macro habitat types (backwaters, mainstem, and side channels) and Table 5.1-16 summarizes fish use by selected mesohabitats, but this overall delineation does not include the lateral habitat types that were most important to some species, like sockeye. In the text, these habitats were referred to as "stream margins" (e.g. bottom of page 75), but these lateral habitat features were not delineated from habitats about the thalweg. They also weren't integrated with the collection microhabitat features that should be conditioned by association with utilized hydraulic features, if they are to be effective at describing habitat use.	
24	4/30/2014	ADF&G	**4.2.1 Adult Rainbow Trout Abundance, Distribution, and Spawning in Grant Creek** ***Page 34:*** *"Radio-tagged trout were tracked twice per week for the duration of the study period, and their location at the time of detection was determined using triangulation techniques. Those positions were recorded on maps of the study area."* **Comment:** As with all species and life stages, this section needs to be more explicit, in terms of habitat features. The habitat delineation used for rainbow trout is also different than it was for salmon. The macro habitat types were excluded and, based on Table 5.2-7, the mesohabitat delineation was different.	The habitat delineation used for rainbow trout was the same as that used for anadromous salmonids. Table 5.2-7 did not include some macro-habitats because no detections of tagged fish occurred at those locations. However, for consistency those habitat types have been added to Table 5.2-7.
25	4/30/2014	ADF&G	**4.2.3 Resident and Rearing Fish Use of Open Water Habitats in Lower Grant Creek** ***Page 6:*** *"Habitat for juvenile fish exists mainly in stream margins, eddies, deep pools, and side channels offering reduced velocities (Ebasco 1984)."* **Comment:** Though all species and life stages utilized stream margins, eddies, and off channels, there weren't habitat categories encompassing any of these hydraulic features.	Grant Creek has an extremely variable and flashy natural flow regime that fluctuates significantly both seasonally and from year to year. As such, spawning in the creek is primarily done in an opportunistic fashion laterally across the stream. While some focus by fish was placed on certain marginal areas, depending on the year and/or seasonal flow, these same areas may be dewatered during key spawning times. KHL believes that the project can provide a more stable flow regime

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			Habitat features were depicted on the figure 3.1-1 (map), but no descriptions for these features was given in the text, and there is no apparent overlap with any of the omitted habitat features. Habitat features are used to structure surveys of habitat, fish distribution and habitat use, and assessment of flow-habitat relationships. We are limited in our ability to assess the sensitivity of utilized habitats to proposed project operations unless we can be explicit about some aspect of habitat with a definable relationship to flow. The omission of important habitat features from this study may ultimately prevent effective quantification of flow-habitat relationships used to assess the environmental impact of proposed operations.	during these peak times and potentially sustain more habitat (marginal and otherwise) than is currently perpetuated annually. Ongoing collaboration related to the specifics of the proposed operational scenario will continue with the Instream Flow Sub-committee and broader stakeholder work groups during the July 2014 workshop and all details and associated agreements will be documented for review in the DLA.
26	4/30/2014	ADF&G	**5.1.3 Distribution of Spawning Salmon in Grant Creek** **General comment**: The figures depicting the distributions of spawning salmon (5.1-6-5.1-12) are really sharp and very helpful, and the distributions are also summarized, by macro and mesohabitats, in tables 5.1-15 and 5.1-16. These two data sources specifically illustrate the inadequacy of the applicant's habitat delineation framework. In the figures (5.1-6-5.1-12), the majority of the spawning locations are clearly along the channel margin, or in lateral habitat features, such as backwaters and side channels. This is especially true for sockeye salmon. Yet in the tables, there is no habitat category for channel margins.	Comment noted. Need for additional documentation related to habitat delineation will be assessed with the Instream Flow Sub-committee and detailed in the DLA.
27	4/30/2014	ADF&G	**5.1.3.3 Spawning Habitat** ***Page 75:*** *'In mainstem areas, spawning usually occurred along the stream margins or in areas protected from the main current. Chinook were the exception, building redds mid-channel within the stronger current. In side channels, salmon spawned throughout the width of the channel and in backwater areas, salmon usually selected locations close to the mainstem where suitable stream velocity and substrate were present. The majority of redds in Grant Creek were located in riffle (71 percent) and pool (19 percent) habitat (Table 5.1-16). In Reach 1, spawning for pink, sockeye and coho salmon most often occurred in riffle and pool habitat along the stream margins in the mainstem areas away from the thalweg and the highest stream velocities. Chinook spawned only in riffle habitat most often mid-channel where higher velocity and larger spawning substrates occurred. In Reach 2, most spawning occurred in mainstem riffle habitat along the stream margins for sockeye and coho salmon. Irregularities along the stream margin (large woody debris [LWD], bedrock, boulders) of riffle habitat created areas of lower velocity and suitable spawning substrate. Sockeye and coho also spawned in the stream margins of some pool habitat (lateral scour pool) of Reach 2."* **Comment:** Clearly most of the spawning occurred in channel margin areas, *adjacent to* riffles.	Comment noted. Need for additional documentation related to habitat delineation will be assessed with the Instream Flow Sub-committee and detailed in the DLA.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			It could be argued that this categorical selection is driven by the availability of suitable substrate, but this analysis was not performed, because the applicant's objective of comparing used and avoided habitat was not conducted. Even if the use of channel margins was conditioned by substrate, the use of hydraulics to model flow-habitat relationships is questioned, given the general observation that indicated the incoherence of spawning with depth and velocity.	
28	4/30/2014	ADF&G	**5.2.3 Resident and Rearing Fish Use of Open Water Habitats in Lower Grant Creek** ***Page 95:*** *"The detections of fish in Reach 1 and 2 occurred throughout the period radio-tagged rainbow trout were detected within Grant Creek (May 25 through October 17), whereas detections in Reach 3 occurred primarily shortly after tagging (June 20 through August 15); and the single detection in Reach 4 occurred on June 28. As discussed in Section 5.2.2.1, no rainbow trout redds were observed in Grant Creek in 2013. However, due to the poor water clarity and high flows, that was not unexpected. Detections primarily in Reach 3 shortly after tagging, coupled with suitable pockets of gravel at the locations of detection suggest that the majority of rainbow trout spawning likely occurred in Reach 3; including both the mainstem of Grant Creek and the secondary channel. The location of detections in Reach 3 for rainbow trout correspond with the location of observed redds for both sockeye and coho. And while spawning substrates for the three species varies to some degree, the observations for Chinook, sockeye, and coho indicate that due to the limited amount of spawning gravel in Grant Creek, the fish will spawn in what visually appears to be marginal spawning habitat."* **Comment:** These detections may or may not represent spawning habitats, and most likely represent rearing and feeding habitats, especially during the periods when adult salmon are present. Good spawning gravel and shoreline areas are also expected to be good locations for feeding on both terrestrial and aquatic food sources. As with salmon spawning, these shoreline areas need to be delineated from thalweg positions, so that flow-habitat relationships can be independently developed within them.	As stated within the report, while KHL believes that many of the rainbow trout that were tagged were likely non-spawners due to the timing of the weir installation, their collection and tagging, KHL also knows that some tagged trout were sexually mature. As also stated, detections in Reach 3 occurred primarily during the period of June 20 through August 15, whereas spawning by anadromous species at those locations didn't begin until August 25 to any degree. While rainbow may well have been in Reach 3 feeding on terrestrial and aquatic organisms, it is interesting that they migrated downstream into Reach 1 before their main food source (salmon eggs) were available. While conjecture, this indicates that it is very likely that some of those fish were in Reach 3 to spawn given that the substrate most conducive to rainbow spawning was within that reach. While we believe the statements in the report to be accurate and justified given timing and conditions, we have provided a caveat that rainbow presence within Reach 3 at the specified time may have been due to feeding behavior.
Water Quality and Hydrology Report				
29	4/30/2014	ADF&G	**1.0 INTRODUCTION** **General comment:** One objective of this study was to estimate how lake level fluctuations and operation of the intake structure and diversion tunnel would affect hydrology and water quality below the tailrace. At this point, however, uncertainties associated with the design and operation of the project prevented such an assessment. The potential design concepts are as follows: Monte Miller Note: The final designs and project operation scenarios will be made	Comment noted. Per the collaborative discussion during the March 2014 study report work group meetings (and after), the next set of meetings in July 2014 will more specifically outline project infrastructure, operations and the integration of those aspects with current natural resource conditions, potential impacts (positive and negative) and any potential protection, mitigation and

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			available in the next few months. Until then, all evaluation is speculative in nature and subject to revision, as necessary.	enhancement (PM&E) measures that may be considered. Once this discussion and any associated agreements have been made all documentation and associated project information will be described in the DLA and formally provided to the stakeholders for review.
30	4/30/2014	ADF&G	***Page 2:*** *"Two concepts are currently being evaluated for water control at the outlet of Grant Lake. The first option would consist of a natural lake outlet that would provide control of flows out of Grant Lake. A new low level outlet would be constructed on the south side of the natural outlet to release any required environmental flows when the lake is drawdown below the natural outlet level.* *In the second option, a concrete gravity diversion structure would be constructed near the outlet of Grant Lake. The gravity diversion structure would raise the pool level by a maximum height of approximately 2 feet (from 703 to 705 feet NAVD 88), and the structure would have an overall width of approximately 120 feet. The center 60 feet of the structure would have an uncontrolled spillway section with a crest elevation at approximately 705 feet NAVD 88. Similar to the first option, a low level outlet would be constructed on the south side of the natural outlet to release any required environmental flows when the lake is drawn down below the natural outlet level."* **Comment:** Until the hydraulic control of the outlet is designed and reservoir-level operations are finalized, it will be difficult to address potential environmental impacts along the shoreline of Grant Lake. Likewise, the operation of the diversion structure and tunnel, and the location of the tailrace are also needed to assess hydrology and water quality in the bypass reach and below the tailrace.	Comment noted. Per the collaborative discussion during the March 2014 study report work group meetings (and after), the next set of meetings in July 2014 will more specifically outline project infrastructure, operations and the integration of those aspects with current natural resource conditions, potential impacts (positive and negative) and any potential PM&E measures that may be considered. Once this discussion and any associated agreements have been made all documentation and associated project information will be described in the DLA and formally provided to the stakeholders for review.
31	4/30/2014	ADF&G	**2.0 STUDY OBJECTIVES** **General comment:** This study addressed baseline hydrology and water quality, but the objectives could not be addressed because the operations of the project remain to be finalized.	Comment noted. Per the collaborative discussion during the March 2014 study report work group meetings (and after), the next set of meetings in July 2014 will more specifically outline project infrastructure, operations and the integration of those aspects with current natural resource conditions, potential impacts (positive and negative) and any potential PM&E measures that may be considered. Once this discussion and any associated agreements have been made all documentation and associated project information will be described in the DLA and formally provided to the stakeholders for review.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
32	4/30/2014	ADF&G	**4.1 Water Quality and Temperature** ***Page 23:*** *"Six sites were monitored in 2013 on Grant Creek. They included four previously established sites (GC100, GC200. GC250, GC300), two new upstream sites (GC500 and GC600) in the canyon reach and two off channel sites (ISF 230 and ISF 300) selected based on observed fish utilization."* **Comment:** Typically, alluvial streams exhibit high spatial variability in water quality, especially intragravel conditions. Normally, a data collection network needs to be diversified to account for this variability, by placing intragravel temperature loggers that account for geomorphic variability. In this situation, the geomorphic variability of Grant Creek is relatively low and bedrock controlled. As such, spatial variability in water quality is expected to be low. The study reach is also quite short. The water quality data collection network on Grant Creek consisted of 3 sensor locations, one just above the confluence with Trail Lake (GC 100), one at the historic USGS gage location (GC 200), and another at the head of reach 3 (GC 300). This network seems a bit sparse, but the placement of sensors does seem to account for the distribution of spawning. GC 100 corresponds with the most important spawning location, in reach1, and GC 300 is just upstream of the most important spawning locations, in the vicinity of the island complex. GC 200 is a good central location between these two sites and is positioned at the confluence of the side channels from reach 3. There were two off-channel temperature stations, GC 250 and GC 200. These locations demonstrated significant seasonal differences in temperature, which leads to the question of intragravel water quality at the most important spawning locations. These are the temperatures most relevant to spawning site selection and egg incubation. It would also have been helpful to assess these intragravel water temperatures because off-channel variability suggests the influence of groundwater. Monte Miller Note: The nature of this stream is one of bedrock control. As such, gravel deposits are limited in depth and location. With that in mind, intragravel temperatures would not seem to be likely to differ from water temperatures.	Comment noted. Per the collaborative discussions during the March 2014 study report work group meetings (and after), KHL communicated that thermologgers were strategically placed in a series of redds in Grant Creek to assess intragravel temperatures. That data will be preliminarily discussed with stakeholders at the July 2014 meeting and further documented in the DLA. That said, the preliminary data suggests that Mr. Millers assessment in the comment in correct and that very little variability in temperature exists between ambient stream temperatures and those measured in the redds.
33	4/30/2014	ADF&G	***Page 24:*** *"Winter temperature data was collected at one site (GC200)."* **Comment:** It would also have been helpful to have collected Grant Creek temperature data year around. It's unclear why the temperature loggers were retrieved from the stream prior to winter. Temperature data are important to our evaluation of impacts to salmon egg incubation and our assessment of the environmental impact of project operations. Monte Miller Note: Year long temperature data is useful in determining the timing of	All temperature loggers were left in Grant Lake and Grant Creek to continue collecting data through the winter of 2013-14. Preliminary results from these data will be presented at the July meetings and summarized in the DLA. In addition, a relict temperature logger from site GC 250 was recovered during 2013 field efforts. This recovered logger was deployed in October of 2009 and provides daily mean temperature data for 2 winter seasons before reaching memory capacity on February 6, 2011

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			emergence of salmonid alevin from the gravels. Year round temperature date should be presented. It was stated that data loggers were recovered in the lake and successfully downloaded. During a recent meeting, I believe that it was also stated that a data logger was recovered from a pool in reach 3-4 when water levels were low. Was this correct and was that data logger downloadable?	(Refer to Appendix 1c; Tables A.1c3-A.1c5) .
34	4/30/2014	ADF&G	**5.1 Water Quality and Temperature** ***Page 15 (Trail Lake Narrows):*** *"Three sampling events were conducted at this site (June, August, and September 2013)."* ***Page 16:*** *"There were three sampling sites on Grant Creek, all located below the canyon reach. Each site was sampled once in August 2013."* **Comment:** Water quality was sampled 3 times (in June, August, and September) in Trail Lake Narrows, but it was only sampled once on Grant Creek (in August). It would have been helpful to have reversed the level of effort and it would have been helpful to include a sample at base flow, in April. A base flow measurement is most relevant to incubation, the least influenced by snow and glacier melt, and the most influenced by regional groundwater. Monte Miller Comment: This sampling may provide information on water quality in the Trail Lake Narrows, but without sampling at the same time in both Grant Creek and either Trail Lake or the narrows above the influence of Grant Creek, is impossible to identify specific sources causing any issues with water quality.	Since water quality data were not available for Trail Lakes Narrows, 3 sampling events were agreed to in an effort to establish baseline conditions. The August 2013 sampling in Grant Creek was design to dovetail with results from earlier study efforts in 2009 and 2010. Since most water quality analytes are in low concentrations or below detection limits, the August sampling was designed to assess temporal trends from previous samplings of Grant Lake and Grant Creek dating back to the 1980's. Base flows in Grant Creek are driven by spill over the outlet of Grant Lake. As shown in the accretion study, all of this water is conveyed downstream with little to no accretion. Therefore, groundwater influences are minimal, even during baseflow conditions. In fact, a March 2014 field visit to service temperature loggers showed that the 2 off-channel rearing locations were frozen solid.
Terrestrial Resources Report				
35	3/27/14	USACE	In addition to wetlands, waters of the U.S. (WOUS) generally also include any streams that exhibit an ordinary high water mark, and open waters that exhibit an ordinary high water mark. I'll need a description of all the non-wetland waters in the wetland study area, these include Grant Creek, Grant Lake, the tributary streams of Grant Creek and Grant Lake, and the Trail Lakes narrows. The description should include information on flow regime, the indicators of the presence of an ordinary high water mark, and general channel dimensions. For further guidance on what information to provide, please see Special Public Notice 2010-45 (located here: http://www.poa.usace.army.mil/Portals/34/docs/regulatory/specialpns/SPN-201045.pdf).	For Grant Creek, Grant Lake, the tributary streams of Grant Creek and Grant Lake, and the Trail Lakes Narrows, KHL will add the following information to a table in the Wetlands and Waters section of the Terrestrial Report: flow regime (using National Wetlands Inventory [NWI] water regime modifier), the indicators of the presence of an ordinary high water mark, and general channel dimensions.
36	3/27/14	USACE	In addition to a functional assessment of the wetland areas, we also need information on the functions provided by Grant Creek, Grant Lake, the tributary streams of Grant Creek and Grant Lake, and in the Trail Lakes narrows.	For Grant Creek, Grant Lake, the tributary streams of Grant Creek and Grant Lake, and the Trail Lakes Narrows, KHL will add functional assessment information to the Wetlands and Waters section of the Terrestrial Report.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
37	3/27/14	USACE	The USACE is responsible for determining which waters are subject to our jurisdiction (i.e. are WOUS). We can proceed through permitting with a Preliminary Jurisdictional Determination (PJD) wherein all wetlands that exhibit the three criteria are assumed to be jurisdictional and all non-wetland waters that exhibit an ordinary high water mark are assumed to be jurisdictional. The applicant would then be responsible for avoiding, minimizing, and then providing compensatory mitigation, as appropriate, for all the waters in the project area. Alternatively, we can make an Approved Jurisdictional Determination (JD), wherein we specifically identify all waters that are jurisdictional and all waters that are not jurisdictional. If there are waters which the applicant believes are not jurisdictional because they do not have a surface or shallow sub-surface connection to downstream waters (i.e. are isolated), and the applicant would like an Approved JD, please provide maps, including but not limited to any available topographic, aerial or LiDAR, ground level photography, and any other information that you have to demonstrate that there is no surface or shallow subsurface connection to Grant Creek or Grant Lake. While an approved JD may remove some waters from our permit evaluation, the process of making a determination that a wetland is isolated does require coordination up to our Headquarters level and with USEPA, and requires more time than a PJD. The applicant can request an Approved JD at any time, even if a PJD is issued.	KHL appreciates the information on our options and we anticipate continued collaboration with the U.S. Army Corps of Engineers (USACE) related to these options and our application process over the course of the next few months leading up to the DLA distribution.
38	3/27/14	USACE	In reference to the two slides in the wetlands presentation titled "Wetlands: Potential Qualitative Construction Impacts (Short-Term)" and "Wetlands: Potential Qualitative Operational Impacts (Long-Term)": We define a loss of WOUS as Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. *Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody.* The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. *If the following activities occur inside the boundary of a jurisdictional wetland or below the ordinary high water mark of a stream or lake, we would likely consider them to be a loss of waters: any permanent discharge of rock, soil, concrete, or other material, as well as any mechanical land clearing, grading, inundation or dewatering, excavation, bank stabilization, culvert installation, and/or stream channelization*. There are some impacts listed as indirect on the slides that we would consider to be direct impacts, such as dewatering portions of Grant Creek, and inundation of wetlands/streams by raised Grant Lake levels.	KHL will edit the "Potential Wetland and Waters Impacts" table, and any associated text to reflect the definitions of permanent direct adverse impacts described in this comment.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
39	3/27/14	USACE	Is any backwater effect expected in wetlands and streams along the lake, and which would be located upstream/upslope of those waters that would be directly impacted by flooding? We would consider the resulting backwater to be an indirect impact.	Per our collaborative discussions during our March meetings, KHL indicated that Grant Lake fluctuation with the project in place would deviate minimally (if at all) from natural conditions. As such, no backwatering effect is expected. Our next set of meetings in July will more specifically outline project infrastructure, operations and the integration of those aspects with current natural resource conditions, potential impacts (positive and negative) and any potential PM&E measures that may be considered. Once this discussion and any associated agreements have been made all documentation and associated project information will be described in the DLA and formally provided to the stakeholders for review.
40	3/27/14	USACE	As the access road or the Iditarod Trail are re-routed, as always, take every opportunity to avoid waters crossings or minimize waters crossings. Try to maintain as natural operation of wetlands in detention pond as possible.	Comment noted. KHL will remain committed to minimizing impacts to all natural resources within the project area.
41	3/27/14	USACE	When an application is submitted to us, please fill out the attached spreadsheets with the requested information. This will allow us to more efficiently evaluate the application.	Comment noted. KHL appreciates you providing the spreadsheets.
42	4/30/2014	ADF&G	**General comments:** Environmental impacts to shoreline fishery and wildlife resources primarily depend on lake-level regulation. The morphology and function of the lake shore, where it is not bedrock controlled, is maintained by a fluctuating lake level that seasonally spreads out wave energy. The vegetation of the lake's shoreline has similarly adapted to the seasonal pattern of lake-level variability. In areas of the shoreline where wave energy is low and depth is shallow, aquatic and wetland plant species develop. In areas where the wave energy is high, species with a high tolerance of disturbance, such as willow and alder, establish and are maintained. Tributaries further diversify the shoreline by providing alluvium and plant propagules that develop and maintain alluvial fans. The materials transported by these streams and the wave action of the lake's shoreline interact to provide unique forested and shoreline wetlands. Alteration of the lake level and lake-level variability can lead to significant changes to the morphology and habitat functions of the lake shore. Elevation of the lake's stage leads to inundation of riparian vegetation. Unnatural draw down of the lake level leads to lake-shore incision and incision of tributary channels. Unnatural fluctuation of the lake shore (in terms of fluctuation frequency, duration, and timing) can disrupt the natural equilibrium between the lake's hydrology and the ecology of plant and animal species.	Comment noted. Per the collaborative discussions during the March 2014 study report work group meetings, KHL indicated that Grant Lake fluctuation with the project in place would deviate minimally from natural conditions. This combined with the fact that a significant amount of the Grant Lake shoreline consists of steep, bedrock slopes lead KHL to determine that any impacts to the natural resource specifics discussed in your comment would be minor. The next set of meetings in July 2014 will more specifically outline project infrastructure, operations and the integration of those aspects with current natural resource conditions, potential impacts (positive and negative) and any potential PM&E measures that may be considered. Once this discussion and any associated agreements have been made all documentation and associated project information will be described in the DLA and formally provided to the stakeholders for review.

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			Riparian plants that are important to moose and bear for food, have reproductive cycles that are timed with the natural pattern of fluctuation of the lake level. The ecology of furbearers and waterbirds are equally adapted to the lakes natural flow variability. At this point, the applicant has yet to finalize a lake-level design concept and a diversionary operations model. These details are necessary to predict the environmental impacts of this project to shoreline resources. Both the level of the lake and the regulation of lake-level variability are important. Operation within the natural range of variability in lake level will lead to relatively minor changes to shoreline resources, provided the lake level is regulated to follow the natural hydrography of Grant Lake. Removal of this variability can lead to erosion of the shoreline and can disconnect the lake from the resources it has developed along the shoreline.	
Cultural Resources Report				
43	4/23/14	FERC	State whether described materials are within the APE and what their status is (historic, significant, and/or eligible for the National Register)	Comment noted. Additional information will be incorporated into the Final Cultural Resources Report to be distributed per the Section 106 Process and appended to the DLA for stakeholder review.
44	4/23/14	FERC	Clearly state whether the Case mine is a district and, if so, differentiate contributing and non-contributing properties.	Comment noted. The report section on the Case Mine will be revised to state that it is a historic district. Additional information will be incorporated into the Final Cultural Resources Report to be distributed per the Section 106 Process and appended to the DLA for stakeholder review.
45	4/23/14	FERC	Include more description of the site.	Comment noted. Any available additional information on this site will be incorporated into the Final Cultural Resources Report to be distributed per the Section 106 Process and appended to the DLA for stakeholder review.
46	4/23/14	FERC	Be clearer on Alaska Railroad status.	Comment noted. Additional information on the eligibility status of the Alaska Railroad will be incorporated into the Final Cultural Resources Report to be distributed per the Section 106 Process and appended to the DLA for stakeholder review.
47	4/23/14	FERC	Discuss Case Mine as an historic district and describe the contributing and non-contributing properties.	Comment noted. The Case Mine section will be revised and additional information will be incorporated into the Final Cultural Resources Report to be distributed per the Section 106 Process and appended to the DLA for stakeholder review.
48	4/23/14	FERC	I think this section needs to be beefed-up more. Basically use Table 5.1-1 and 5.2.1	Comment noted. These two tables and report

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
			to integrate what you want to say the potential project-related effects could be to each of the eligible properties. I would also break down your effects descriptions by areas, and among the properties within the areas, as you did in Chapter 4. This way, there's more symmetry between Chapter 4 and 5. May also want to describe that there could be other adverse effects to the other properties, but nonetheless, these properties are considered not eligible.	sections will be revised and incorporated into the Final Cultural Resources Report to be distributed per the Section 106 Process and appended to the DLA for stakeholder review.
49	4/23/14	FERC	The proposed project will have adverse effects on historic properties, which in turn, will need an HPMP to resolve all the adverse effects. The HPMP will also need to be filed with the draft license application (if there is one), and the final license application. Of course, the HPMP would co-ordinate with site-specific resolutions of adverse effects, as you describe in Chapter 5 involving the adverse effects.	Comment noted. A HPMP will be drafted for inclusion with the DLA to resolve any adverse effects.
50	4/23/14	FERC	Remove "recommendations" from report. Although you're the contractor, you still can be more direct and say that you consider things eligible or not, and that such and such effects would be potentially adverse, and so on. I would recommend that you remove all of your recommendations throughout the text, and simply state that you consider such and such is, or is not.	Comment noted. The recommended changes will be incorporated into the Final Cultural Resources Report to be distributed per the Section 106 Process and appended to the DLA for stakeholder review.
51	5/1/14	SHPO / OHA	As presently defined the APE primarily encompasses the geographic areas within which historic properties may experience direct and immediate effects. We recommend that the APE be revisited and, if necessary, revised to allow for the consideration of potential indirect and cumulative effects.	Comment noted. Potential indirect and cumulative effects will be addressed per the Section 106 Process and in the Final Cultural Resources Report to be appended to the DLA for stakeholder review.
52	5/1/14	SHPO / OHA	We strongly recommend that the APE be expanded to include consideration of any historic properties that may be directly impacted in the footprint/location proposed for the INHT re-route.	Comment noted. The area of potential effort (APE) will be expanded to include the proposed Iditarod National Historic Trail (INHT) re-route. Additional information on the new route and the results of any field assessments will be addressed per the Section 106 Process and in the Final Cultural Resources Report to be appended to the DLA for stakeholder review.
53	5/1/14	SHPO / OHA	We look forward to continued consultation on the subject undertaking and to formally reviewing the determinations of eligibility and finding of effect for the project. Thank you for the opportunity to comment.	Thank you for your continuing involvement in the project.
54	5/9/14	Mark Luttrell	An archaeological monitor should be on site during ground disturbing activities.	A Historic Properties Management Plan (HPMP) for the project will include site-specific resolutions for any adverse effects. A draft of the HPMP will be included with the DLA for stakeholder review and comment.
55	5/9/14	Mark Luttrell	A monitor should assess and inventory the lake bed near sites as it emerges. And figure what to do with exposed objects.	A HPMP for the project will include site-specific resolutions for any adverse effects. A draft of the HPMP will be included with the DLA for stakeholder review and comment.

Study report comment/response table

Comment Number	Date	Affiliation	Comment	Kenai Hydro, LLC (KHL) Response
56	5/9/14	Mark Luttrell	Periodic monitoring of the sites should be done annually to assess condition and threats.	A HPMP for the project will include site-specific resolutions for any adverse effects. A draft of the HPMP will be included with the DLA for stakeholder review and comment.
57	5/9/14	Mark Luttrell	Mitigation measures should be funded up front with a bond or separate account.	To the extent possible and per the collaborative approach employed to date with stakeholders, any potential PM&E measures proposed by KHL will be discussed with stakeholders and incorporated into the DLA for stakeholder review.

Grant Lake Project Engineering Workshop Meeting Minutes

(July 7, 2014)

Grant Lake Hydroelectric Project (FERC No. 13212)
Grant Lake Project Operations Workshop
Aspen Suites Hotel, 100 E. Tudor Rd., Anchorage, AK
July 7, 2014, 9:00 am to 5:00 pm

In Attendance

Andre Ball, McMillen
Mort McMillen, McMillen
John Stevenson, BioAnalysts
John Blum, McMillen
Mike Salzetti, Kenai Hydro, LLC (KHL)
Jeff Anderson, U.S. Fish and Wildlife Service (USFWS)
Hal Shepherd, Center for Water Rights Advocacy (CWRA) *[via phone]*
Angela Coleman, U.S. Forest Service (USFS) *[via phone]*
Patti Berkhahn, (USFWS) *[via phone]*
Mark Miller, BioAnalysts *[via phone]*
Cassie Thomas, National Park Service
Jason Mouw, Alaska Department of Fish and Wildlife (ADF&G)
Betsy McCraken, USFWS *[via phone]*
Lesli Schick, Alaska Department of Natural Resources (ADNR) *[via phone]*
Audrey Alstrom, Alaska Energy Authority (AEA)
Robert Stovall, USFS *[via phone]*
Monte Miller, ADF&G
Dara Glass, CIRI *[via phone]*
Cory Warnock, McMillen

Meeting Summary

Introductions and Agenda

Cory Warnock (McMillen) opened the meeting by welcoming everyone and thanking them for their attendance. He then conducted a quick run-through of the agenda. Cory stated that a bulk of KHL's time since the last Stakeholder meeting in March had been spent integrating natural resource study results with engineering specifics to more adequately assess impacts (positive and negative) and developing an operational regime that meets the needs for both the natural environment and the project itself. Cory went on to state that this particular proceeding was intended to be more of a workshop where hopefully substantive discussion and collaborative discourse could result in fundamental agreements on priority aspects of the project in advance of the development of the FERC Draft License Application (DLA). While not a required step, Cory stated that KHL believed this collaborative effort would result in a better product, and would hopefully eliminate any surprises by the Stakeholders when they conducted their formal review of the DLA.

Mike Salzetti (KHL) stated how encouraged he was by the results of the natural resource studies and the engineering/operations progress that had been made. Mike stated that KHL believes the collaborative process that has been developed along with the results from the assessments will result in the development of a quality DLA.

Cory stated that there would be two presentations; the first on Instream Flow, and the second concerning a description of the Operational Scenario. The intent of the agenda was to spend a majority of the morning discussing the instream flows and then the afternoon would be spent addressing KHL's preferred operational scenario.

Project Aquatic and Operations Analysis

John Blum (McMillen) presented the instream flow proposal and potential instream enhancement opportunities.

- *Comment:* Monte Miller stated that July 31st (Slide 6) seemed a little late to continue with 5 cfs in the bypass reach.
- *Response:* John Blum stated that it would be a talking point at the end of the presentation.

- *Comment:* Monte Miller requested clarification that the project would not be operated as run of river.
- *Response:* Mort McMillen stated that that was correct, and that for periods of the year (spring, fall and winter), the lake would be used for storage. He went on to note that a modification to the infrastructural design had been made and that there would be no diversion. However, KHL would like to draw the lake down an additional 2 ft. to accommodate additional storage.

- *Comment:* Jeff Anderson (USFWS) commented that the Technical Memo stated only 5 fish were seen in Reach 5 in 2014, yet the presentation stated that those were actually redds.
- *Response:* John Blum acknowledged the error in the tech memo and that the presentation was correct.

- *Comment:* Betsy McCraken (USFWS) asked what proportion of the various anadromous salmonid redds were documented in the respective reaches.
- *Response:* John Stevenson noted that sockeye redds were most prevalent in Reach 1, coho in Reach 3 and Chinook in Reach 1.

- *Comment:* With regard to the proposed enhancement opportunity in the Reach 1 (Slide 22) Distributary, Monte noted that gravel supplementation may also assist in providing additional habitat if some flow is routed that way.

- *Comment:* Monte asked if the 12-20 cfs flow identified as being optimal for habitat in the distributary took depth into consideration.
- *Response:* John Blum stated that it did.

- *Comment:* Jeff Anderson asked what the natural flows in the table (Slide 23) represented.
- *Response:* Andre Ball (McMillen) stated that they were mean daily flows from the 66 year ‘composite’ Grant Creek streamflow record. (Composite record includes observed Grant Creek streamflow and extended record streamflow based on Kenai River at Cooper Landing record.)

- *Comment:* Monte Miller inquired as to why Chinook were the driver for the flow proposal increase in August and September if none were observed in Reach 5.
- *Response:* John Blum stated that it was to allow for the potential of Chinook presence in subsequent years.

- *Comment:* Betsy McCracken asked if the idea behind the Reach 1 Distributary enhancement was to provide additional habitat in this area to make up for losses in other sections of the stream.
- *Response:* Cory Warnock stated that as opposed to the Reach 1 enhancement being mitigation for losses in other areas, KHL looked at it as a potential addition to existing habitat availability in the system, given that project operations along with a small amount of wood removal (at the confluence of the distributary with the mainstem of Grant Creek) would facilitate an opening of additional quality habitat for Grant Creek. Monte expanded on this by explaining to Betsy that Reach 1 as a whole contained a high level of rearing potential and that the distributary had “tons” of habitat if it could get water. He stated that this opportunity wasn’t really to make up for something lost elsewhere; rather, it was an enhancement opportunity. John Stevenson stated that the distributary was also in close proximity to a high amount of spawning activity and opening it up might facilitate additional spawning. Monte stated that both the rearing and spawning potential would primarily be an opportunity for Chinook and coho salmon, Dolly Varden char and rainbow trout.

- *Comment:* Monte stated that he noticed the tailrace configuration and entry point had been moved upstream to the Reach 4/5 break and that it reduced his concerns related to fish impacts in that area.

- *Comment:* Monte reiterated his thought on the potential for gravel supplementation in the Reach 1 Distributary.
- *Response:* Cory stated that he could envision an adaptive management approach over the first few years of the license to determine whether additional gravel was needed and if so, how much. Monte agreed that it could be an iterative process and commented that the Reach 1 Distributary enhancement also made good sense to the relative ease of getting equipment to the area as opposed to needing to do something further upstream.

- *Comment:* Jeff Anderson asked about the potential for the new instream flow regime to limit sediment transport out of Reach 5 and downstream to the rest of the system.
- *Response:* Cory Warnock stated that per the Geomorphology Report, Reach 5 geology dictates that very limited sediment transport occurs and its frequency is episodic. When those infrequent major episodes do occur, the sediment that is transported is very angular, slate-type material with very low quality as it relates to spawning for the species that utilize Grant Creek. Mort McMillen noted that on a periodic basis, the natural outlet to Grant Lake would still overtop during high runoff events, resulting in some amount of channel maintenance flows. Mike Salzetti added that as opposed to conducting channel maintenance flows, KHL would like to explore the possibility of doing gravel augmentation near the powerhouse to supplement existing conditions in Reaches 1-4, the primary quality habitat areas.

- *Comment:* Jeff Anderson asked if the peaks in the hydrograph on Grant Creek were associated with high rainfall events.
- *Response:* Andre Ball stated that they were associated with both snow runoff and high rainfall events, the latter being primarily in the fall.

- *Comment:* Monte noted that 2012 was a very high runoff year. Jason Mouw (ADF&G) confirmed and stated he was on Grant Creek when 2,000 cfs was running down the channel.

- *Comment:* Jeff Anderson asked if any Chinook were observed in Reach 5.
- *Response:* John Stevenson stated that he didn't recall any observations of Chinook in Reach 5.

- *Comment:* Monte inquired about the amount of drawdown in Grant Lake and asked if waterfowl nesting would be impacted.
- *Response:* Mike Salzetti stated that KHL has always intended to have an 11-13 foot drawdown and that the only thing that has changed is that the proposal would draw the lake down an additional two feet, as opposed to putting a two foot diversion structure in place to raise the lake. Based on the studies that were done, this option looks like a better alternative from a natural resources perspective. Monte commented that this type of scenario could actually have a positive impact on the waterfowl nesting by not flooding things out.

- *Comment:* Cassie Thomas (NPS) inquired about how stable ice formation would continue to be facilitated on Grant Lake with the project in place. Would the operations be tweaked annually to allow for this?
- *Response:* Mort McMillen stated that ice formation was being looked at and there are limitations to what can be done, but KHL wants to have a predictable tool in place. Mike stated that there was precedent for other local projects to deal with the issue.
-

- *Comment:* Monte Miller asked Cassie if she was concerned about ice formation as it related to recreation.
- *Response:* Cassie said yes. Mike Salzetti asked how Cooper Lake or Bradley Lake dealt with this issue and Cassie stated that it wasn't much of an issue there but KHL should talk with Chugach Electric.

- *Comment:* Jeff Anderson asked if Grant Creek iced over in the winter and how ice will potentially impact the creek during the winter.
- *Response:* John Stevenson stated that he was out there during a significant section of the cold period and that the creek does not ice over completely. Some shelf ice will form on the margins. John Blum stated that the creek was free of all ice in April. John Stevenson stated that ice was still present through a good portion of April. Monte added that temperature monitors from the 2009/2010 studies were recovered so winter data was available and documented.

- *Comment:* Jeff Anderson asked if increased flows in the side channels would prevent icing in the side channels.
- *Response:* John Blum stated that with the doubling of the flows in the winter, he would think that the primary side channels would stay unfrozen. Monte added that the increase in flow would reduce stranding potential in the side channels. Jeff stated that if they stayed frozen, the weighted usable area (WUA) numbers presented would likely be lower. Monte stated that the side channels were relatively channelized and steep on the margins so decreases to WUA may be minimal if frozen.

- *Comment:* Jason Mouw made the statement that main leads in the main channel of Grant Creek likely never freeze because of turbulence. He said that he would share Jeff's concern related to freezing if there was a lot of flow fluctuation with winter operations but it appeared that flows would remain relatively stable.

- *Comment:* Jeff Anderson asked if there was more rearing in the side channels or the mainstem.
- *Response:* John Stevenson stated that based on density (CPUE), the side channels have more rearing habitat than the mainstem.

- *Comment:* Jeff Anderson asked if there were a high number of fish seen during snorkel surveys in the mainstem.
- *Response:* John Stevenson stated that isolated pockets of rearing fish were observed in the margins of the mainstem and that rearing fish were observed in higher numbers in the side channels.

- *Comment:* Jeff Anderson asked how much rearing currently occurred in the side channels during the winter.
- *Response:* John Stevenson stated that under current (natural) conditions, none due to the side channels freezing over. John Blum stated that the largest side channel was frozen on the surface but had flowing water underneath. With the project in place, there would likely be quite a bit of rearing since the primary side channels would stay open.

- *Comment:* Betsy McCraken inquired about the locations of the thermologgers in the creek.
- *Response:* Cory Warnock stated that a thermologger was located in each reach of the creek as well as in selected redds. Mike Salzetti stated that there was also a thermistor string located in Grant Lake. Mort noted that there was a period in the fall just prior to ice formation when KHL would have to pull water from near the surface to match temperatures in the lake. A variable depth intake structure was being evaluated and, based on similar type projects elsewhere, he is confident in its application to Grant Creek.

- *Comment:* Hal Shepherd (CWRA) stated that it appeared that with the project in place, flows would only be increasing and asked if there would be any decreases.

- *Response:* John Blum stated that increases and decreases would be occurring, depending upon the season.

- *Comment:* Hal Shepherd asked how flow increases were going to be able to be consistent, given maintenance of ramping rates and how the project will deliver to the grid.
- *Response:* Mort McMillen stated that the intent in the winter was to operate at a base level and occasionally peak but not go down quickly from those levels. He continued by saying that in the winter, the lake would be drawn down to develop a base and then peaking would occasionally occur depending on demand, but KHL would never go below that base. In the spring, the goal will be to store as much as possible in the lake so that everything above the 385 cfs capacity of the project could be utilized at a later time.

- *Comment:* Monte Miller stated that ramping rates may be impacted by the ability of the detention pond to attenuate and limit the amount of ramping the creek actually experiences.

- *Comment:* Cory Warnock asked if it would help if Hal Shepherd heard about KHL's operational intent with the project.
- *Response:* Hal stated that it would and turned the floor over to Mike Salzetti, who summarized KHL's intent with the project to have a renewable resource in their portfolio that would be a small piece of their overall generation puzzle but could still assist in meeting the needs of their participants. Mike stated that this project was viewed by KHL as a win/win due to the fact that they could provide some very cost-effective long-term power while, based on the studies, also benefit habitat by providing a flow scenario and enhancement package that increases habitat during critical times.

- *Comment:* Jeff Anderson requested clarification that the creek would only be operated in a run of river fashion at certain times of the year below Reach 5.
- *Response:* Cory Warnock stated that was correct.

- *Comment:* Jason Mouw asked when the 50% emergence timing for sockeye was based upon the temperature analysis that was conducted.
- *Response:* John Blum stated that emergence took place from March – May with the bulk occurring in May.

- *Comment:* Jeff Anderson commented that there were differences in timing of escapement between Grant Creek and fish acquired by the Trail Lakes Hatchery and cautioned about comparing the two stocks.

- *Comment:* Jeff Anderson asked if taking the peaks off of the high flows down Grant Creek could impact smolt outmigration.
- *Response:* John Stevenson stated that the cue to migrate would still be present; however, the high flow would just be lower. Andre Ball added that flows would be increasing during that time as power production picked up.

- *Comment:* Jeff Anderson stated that spawning coho salmon would be moving into Grant Creek in Sept./Oct. and asked if any peaks in flow would still be occurring during this time frame.
- *Response:* Mort stated that the project would be run of river during this time frame, so there would be no change over natural conditions.

- *Comment:* Jeff Anderson asked if the rain events during Sept./Oct. would be captured in the lake.
- *Response:* Mort stated that the lake will likely be full during this period so spill would likely occur if the event was significant enough. John Stevenson added that in 2013, coho salmon returned from September 8 – October 26th during the run of river period.

- *Comment:* Jeff Anderson asked if there were any isolated events related to fish migration type movements.
- *Response:* John Stevenson stated that he would go back to the data and assess. As conversation continued, John reviewed the report and his figures and showed Jeff that there was nothing to suggest that migration was correlated to specific flow events. Jeff stated that that answered his question.

- *Comment:* Betsy McCracken asked what the periodicity related to fish movement looked like.
- *Response:* Cory Warnock stated that all that information was in the study reports, inquired if she had reviewed them and committed to getting her the reports.

- *Comment:* Cassie Thomas asked if winter ice had been monitored over multiple seasons.
- *Response:* Cory Warnock stated that it had not. Mort McMillen stated that reviewing how the other local projects dealt with ice formation would likely prove more valuable than assessing ice conditions over multiple years.

- *Comment:* Jeff Anderson asked what the most important reach for overwintering in the mainstem was.
- *Response:* Mark Miller (BioAnalysts) stated that Reach 3 was likely the most important. Some pools in Reach 4 and backwaters in Reach 2 were also key.

- *Comment:* Jeff Anderson asked if these key overwintering areas would be the same habitat type at higher flows.
- *Response:* John Blum stated that based on the analysis, habitat types would remain the same and the weighted usable area actually increases with flow. John Stevenson agreed.

- *Comment:* Jeff Anderson asked if there were any thoughts on other near shore habitats and what would happen with flows increasing in winter.
- *Response:* John Blum used T-220 as an example and stated that weighted usable area peaked at 100 cfs and held steady until around 200 cfs.

- *Comment:* Jeff Anderson asked if data documenting overwintering weighted usable area could be put in a table.
- *Response:* John Blum stated that that could be done for the next instream flow call.

<<LUNCH BREAK>>

Grant Lake Infrastructure and Operations

Andre Ball (McMillen) presented the Grant Lake Infrastructure and Operations presentation.

- *Comment:* Andre provided some general clarification to the charts provided on slides 13 and 14.

- *Comment:* Angela Coleman (USFWS) inquired about how sediment mobility would be impacted as a result of the highest flows being in the summer.
- *Response:* Cory Warnock and Mike Salzetti gave a brief summary of the findings related to Grant Creek being a sediment-starved system and suggested Angela review the Geomorphology Report for further detail. Monte Miller supplemented this response by stating that periodic overtopping events were likely from the lake, which would facilitate flushing flows to some degree.

- *Comment:* Angela Coleman stated that the Grant Creek historic gauge record took place during the cold PDO and wondered how the hydrograph would be impacted during warmer periods.
- *Response:* Andre Ball stated that this was the primary reason for supplementing the gauge record with the Kenai River data. Monte added to this by stating that the Stakeholders had requested this supplemental work, KHL did it, it correlated very well with the Kenai River gage at Cooper Landing and that they are satisfied.

- *Comment:* Jeff Anderson asked about the outliers on the chart associated with the correlation between Kenai River data and the Grant Creek data.
- *Response:* Andre suggested that the outliers could be the result of local glacial outbursts but that they were rare. Despite the outliers, the correlation between the two gages was still excellent considering that there is approximately a factor of 10 between the flows in Grant Creek and the Kenai River.

- *Comment:* Jason stated that on Slide 13 it appeared that the project was ramping and asked for additional daily specifics for the winter period.
- *Response:* Andre Ball stated that the generation model is currently modeling a daily timestep. The apparent 'ramping' Jason referred to was just the difference between daily energy productions based on the change in daily flows and the efficiency curve assumptions.

- *Comment:* Jeff Anderson asked what the shift in March on Slide 14 was related to.

- *Response:* Andre Ball stated that that was the time when the reservoir was finished drafting (based on an initial Rule Curve assumption). After March 1st the streamflows dropped and corresponded to the natural lake outflow.

- *Comment:* Based on the prior response, Jeff Anderson asked if the reduction in flows during the March storage would impact eggs in the gravel of Grant Creek.
- *Response:* Mort McMillen state that since March, the upper limit for plant flow related to generation had been defined as 385 cfs and that was the right number. That number and the associated operational regime was then integrated into the natural resource data and they took average daily flows and used them to create the operational model. The next step is to refine the model based on discussions with the Stakeholders.

- *Comment:* Jason Mouw stated that he was concerned in how significant the drop-off in stream flows would be during the March period and how eggs and emergence might be impacted.
- *Response:* Mort stated that there was a good amount of flexibility from an operational standpoint now that this type of dialogue had occurred. Winter time has the most flexibility and refinements can take place.

- *Comment:* Monte Miller asked how certain everyone was that the instream flows proposed for Reach 5 would provide connectivity.
- *Response:* John Blum stated that based upon the analysis, trout were afforded connectivity at 5 cfs, 10 cfs for coho and sockeye salmon and 25 – 30 cfs cfs for Chinook.

- *Comment:* Monte Miller asked why the transmission line didn't more closely follow the access road.
- *Response:* Mort stated that the figure was old and that the actual T-line would likely follow the road much more closely. Mike Salzetti added that KHL was still evaluating the practicality of burying the T-line vs. running it overhead. He added that KHL was currently leaning toward taking 24 KV to the highway, then to the Lawing substation.

- *Comment:* Monte Miller asked if the detention pond would be screened.
- *Response:* Mort McMillen stated that was up to the work group; the primary focus had been on integrating with natural resources, developing the generation model, developing the geotech and generation tech memos and mapping the powerhouse location. Now that this dialogue has taken place, the next steps will be to optimize the tunnel alignment (shallow vs. deep), develop the intake structure and tower plans, develop the powerhouse footprint, look at transmission line routing and establish the plans for tailrace barrier and the detention pond exclusion.

- *Comment:* Monte Miller stated that some management plans would be needed to address avian species issues and that ADF&G would be deferring to the USFWS plans.
- *Response:* Cory Warnock stated that KHL understood that a series of management plans would be required and that they would be detailed/developed as part of the DLA.

- *Comment:* Mike Salzetti asked how much infrastructural detail the Stakeholders would like to see in the DLA.
- *Response:* Monte Miller stated that the more detail provided the better, and if it came in advance of the DLA, it would be appreciated.

- *Comment:* Cory Warnock asked if it would be helpful to have a call to discuss infrastructural refinements once KHL has things further developed.
- *Response:* Monte Miller said it would be helpful and that the finalized plans are what the Stakeholders need to evaluate.

- *Comment:* Monte stated that it would be helpful to have a meeting approximately 30 days prior to the DLA submittal to go over the infrastructure and discuss all refinements.

- *Comment:* Jeff Anderson asked what the water temperature issue at the lake was.
- *Response:* Cory Warnock displayed the water resources slides from the March study report meetings and stated that between January and April there was a discrepancy in lake and creek temperatures. Mort explained that technology has advanced now to a point where with variable ports, withdrawing water from the necessary depth was possible and could be developed for this project. He used a project on the Willamette River as an example of something with a much larger operational range that was using a similar intake as the one planned for Grant Lake.

- *Comment:* Monte Miller stated that he would like to see the remainder of the water temperature data from the winter period in the lake.
- *Response:* Mike Salzetti committed to getting him that data.

- *Comment:* Betsy McCracken asked if there would be a temperature monitoring plan submitted as part of the DLA.
- *Response:* Mort McMillen stated that temperature would be tracked at the intake and a plan for tracking would be included in the operational plan. Mike Salzetti stated that he was excited to see what could be done with the intake to match creek temperatures during the priority period and that he thought a good option could be developed.

- *Comment:* Monte Miller asked whether the intake would be multi-port or variable.
- *Response:* Mort McMillen stated that the plan was still being refined but the system will be flexible and able to withdraw water from a variety of depths. The Plan will be refined over the next two to three months.

- *Comment:* Cassie Thomas asked if there were current examples of moveable systems that work.
- *Response:* Mort stated that there were and the relatively minimal lake fluctuation of 13ft. was helpful.

- *Comment:* Robert Stovall (USFS) asked for a general definition of the need for the detention pond.

- *Response:* Mike Salzetti explained the definition of spin and why KHL would prefer to be able to provide supplemental power if another project tripped offline.

- *Comment:* Mike Salzetti stated that it would be great if a detention pond could be part of the infrastructure of the overall project but not if it was to its financial detriment. KHL needs to run the economics prior to determining if it will be incorporated.

- *Comment:* Robert Stovall asked if the tunnel from the intake went through any wetlands.
- *Response:* Cory Warnock stated that it would not.

- *Comment:* Cory Warnock describe KHL's next proposed steps;

  - Instream flow call to finalize remaining analysis
  - Engineering to refine infrastructure/operations and hold meeting
  - Management plans to be itemized and developed
  - DLA
  - Iditarod National Historic Trail Re-route to continue progression
  - Public meeting to be held

- *Comment:* Cory Warnock asked if Robert Stovall remained the best USFS contact going forward.
- *Response:* Robert Stovall stated that he was.

- *Comment:* Cassie Thomas asked if recreational aspects of the project would be discussed in the DLA.
- *Response:* Cory Warnock stated that it would.

- *Comment:* Dara Glass (CIRI) asked for Cory Warnock to call her.
- *Response:* Cory committed to doing so.

<<ADJOURN 3:00PM>>

Attachments

Attachments will be available on the July 7, 2014 Natural Resources Study Report Meetings page at www.kenaihydro.com.

Attachment 1: Meeting Agenda
Attachment 2: Grant Lake Aquatic and Operational Analysis presentation
Attachment 3: Grant Lake Infrastructure and Operations presentation

Grant Lake Project Engineering Workshop Presentations

(July 7, 2014)

Grant Lake Infrastructure and Operations

July 7-8, 2014

MCMILLEN

DESIGN with Vision. BUILD with Integrity.

In Association with

HEA

Presentation Outline

- Review the Proposed Infrastructure and Layout
- Review the Updated Hydrologic Analysis
- Review the Updated Hydraulic Analysis
- Present the Operating Assumptions
- Present the Operational/Generation Model
- Review the Operational/Generation Model Results
- Discuss any Additional Engineering Questions

Proposed Infrastructure

- An intake structure in Grant Lake.
- A tunnel extending from the lake intake to just east of the powerhouse.
- A penstock and surge tank located at the west end of the tunnel.
- A powerhouse with two Francis turbines providing an anticipated combined 5-Megawatt output. The maximum design flow will be approximately 385 cfs.
- Tailrace channel returning powerhouse flow to Grant Creek.

Proposed Infrastructure - continued

- Tailrace detention pond and return channel.
- Switchyard with disconnect switch and step-up transformer.
- An overhead or underground transmission line.
- A pole mounted disconnect switch where the transmission line intersects the main power distribution line.
- Access road from the Seward Highway to the powerhouse and extending up to the intake structure.

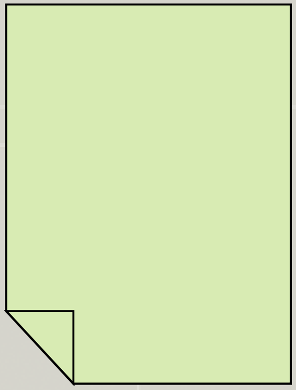
Grant Creek Project Layout

Hydrologic Analysis Review

- 66-year 'composite' daily streamflow record developed for Grant Creek
  - Calendar Years 1948-2013
  - USGS gage record
  - Intermittent streamflow records from engineering studies
  - Record extension based on Kenai River at Cooper Landing
- Used for Hydraulic, Generation, and Habitat Analyses
- Summarized in Technical Memo 001: Grant Creek Hydrologic Analysis

Hydrologic Analysis Review

- Technical Memo 001: Grant Creek Hydrologic Analysis

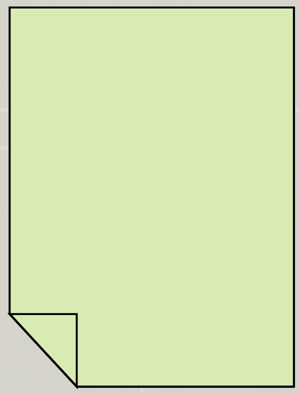


Hydraulic Analysis Review

- HEC-RAS model geometry developed based on IFIM cross sections.
- Flood flows based on from hydrologic analysis.
- Tailwater elevations computed for the tailrace location.

Hydraulic Analysis Review

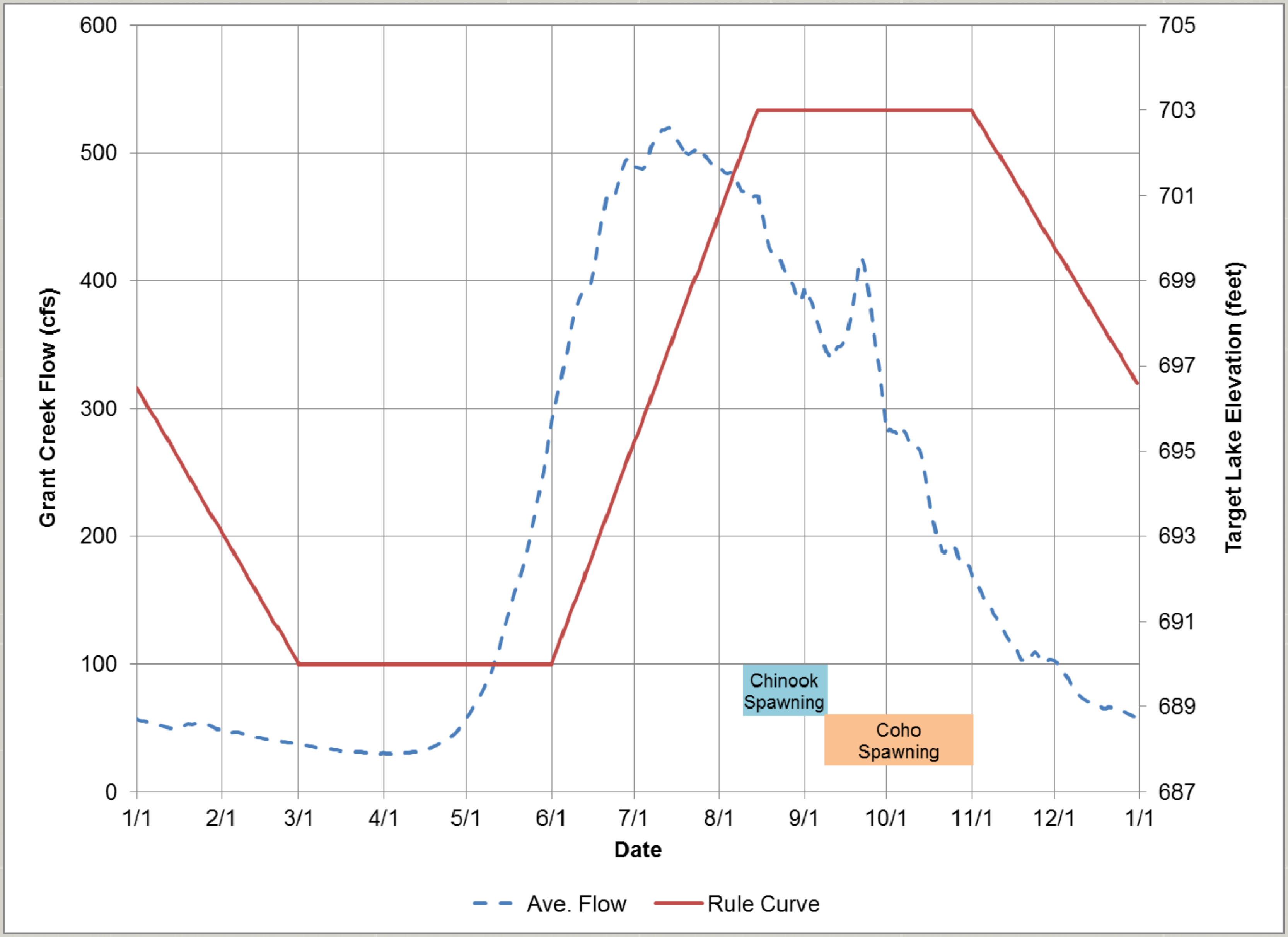
- Technical Memo 002: Grant Creek Hydraulic Analysis



Operating Assumptions

- Assuming no dam, natural storage only
- Reservoir Operating Range: 703-690 feet (13 feet)
- Approximate Tailwater Elevation: 518 feet
- Peak Powerhouse Discharge: 385 cfs
- Minimum Powerhouse Discharge: 23 cfs
- Turbines: 1 MW and 4 MW Francis Units
- Instream Flow Releases in Reach 5:
  - 10 cfs during Chinook spawning (Aug – Sept)
  - 7 cfs during Coho spawning (Sept – Oct)
  - 5 cfs for the remainder of the year

Operating Assumptions



Operational/Generation Model

- Developed to estimate energy production under various operational scenarios
- Utilizes composite streamflow record to calculate daily power production
- Includes instream flow requirements
- Allows powerhouse size and unit configuration to be varied as well as tunnel and penstock size optimization

Operational/Generation Model

GRANT CREEK HYDROELECTRIC PROJECT

PLANT ENERGY OUTPUT MODEL - Drawdown

prepared Jan 2014 by Andre Ball, McMillen-LLC

Two 2.5 MW Units - Operation Efficiency
1 and 4 MW Units - Operation Efficiency : Prioritized 4MW Unit Operating
1 and 4 MW Units - Operation Efficiency : Prioritized 4MW Unit Operating

Variables Table- change here and they change throughout the whole spreadsheet				
Plant Capacity (kW)	(computed)	4974.7		
Starting Reservoir Elev. (ft, NAVD88)		703		
Average tailwater Elev. (ft, NAVD88)		518.5		
Plant Full Load Flow (cfs)		385.0		
Full Load headloss in Penstock (ft)		13.39		
Maximum Drawdown (ft)		13		
Number Hours per day on peak		16		
Number Hours per day off peak		8		
Starting Reservoir Volume Ac ft		18791		
Run turbine off peak if intake pond is above el.		690	feet and	
and inflow rate is above 30% of smallest unit		23.10	cfs	
Revenue- Energy Price		not used	$USD	
Estimated % downtime, annual average		3.0%		
Estimated Station Service average load		10.0	kW	
Transformer and T-line losses		3.0%		
Mean Annual Run-off (cfs)	207	IFR		1
	% of MAR	cfs		
Instream Flow Release (cfs) Jan	2%	5.00		
Instream Flow Release (cfs) Feb	2%	5.00		
Instream Flow Release (cfs) Mar	2%	5.00		
Instream Flow Release (cfs) April	2%	5.00		
Instream Flow Release (cfs) May	2%	5.00		
Instream Flow Release (cfs) June	2%	5.00		
Instream Flow Release (cfs) July	2%	5.00		
Instream Flow Release (cfs) Aug	5%	10.00		
Instream Flow Release (cfs) Sept 1-7	5%	10.00		
Instream Flow Release (cfs) Sept 8-30	3%	7.00		
Instream Flow Release (cfs) Oct	2%	5.00		
Instream Flow Release (cfs) Nov	2%	5.00		
Instream Flow Release (cfs) Dec	2%	5.00		

Efficiency Table (combined) 2

1 and 4 MW Units - Operation Efficiency : Prioritized 4MW Unit Operating

	Total Load	Unit 1 1 MW	Unit 2 4 MW	Unit 1 1 MW	Unit 2 4 MW	
	%	*% Total Load*	*% Total Load*	*Efficiency*	*Efficiency*	
	0%	0%	0%	0.0000	0.0000	0.0
184.5	6%	6%	0%	0.3319	0.0000	23.1
	8%	8%	0%	0.5744	0.0000	30.8
	10%	10%	0%	0.7726	0.0000	38.5
	12%	12%	0%	0.8032	0.0000	46.2
	14%	14%	0%	0.8581	0.0000	53.9
	16%	16%	0%	0.8785	0.0000	61.6
	18%	18%	0%	0.8895	0.0000	69.3
	20%	20%	0%	0.8911	0.0000	77.0
	24%	0%	24%	0.0000	0.3319	92.4
	32%	0%	32%	0.0000	0.5744	123.2
	40%	0%	40%	0.0000	0.7726	154.0
	48%	0%	48%	0.0000	0.8032	184.8
	56%	0%	56%	0.0000	0.8581	215.6
	64%	0%	64%	0.0000	0.8785	246.4
	72%	0%	72%	0.0000	0.8895	277.2
	80%	0%	80%	0.0000	0.8911	308.0
	86%	6%	80%	0.3319	0.8911	331.1
	96%	16%	80%	0.8785	0.8911	369.6
	100%	20%	80%	0.8911	0.8911	385.0

Grant Lake Stage-Storage Relationship

	Slope	Intercept
Vol (AF) -> Elev (ft)	0.000692	690
Elev (ft) -> Vol (AF)	1445.5	-997364

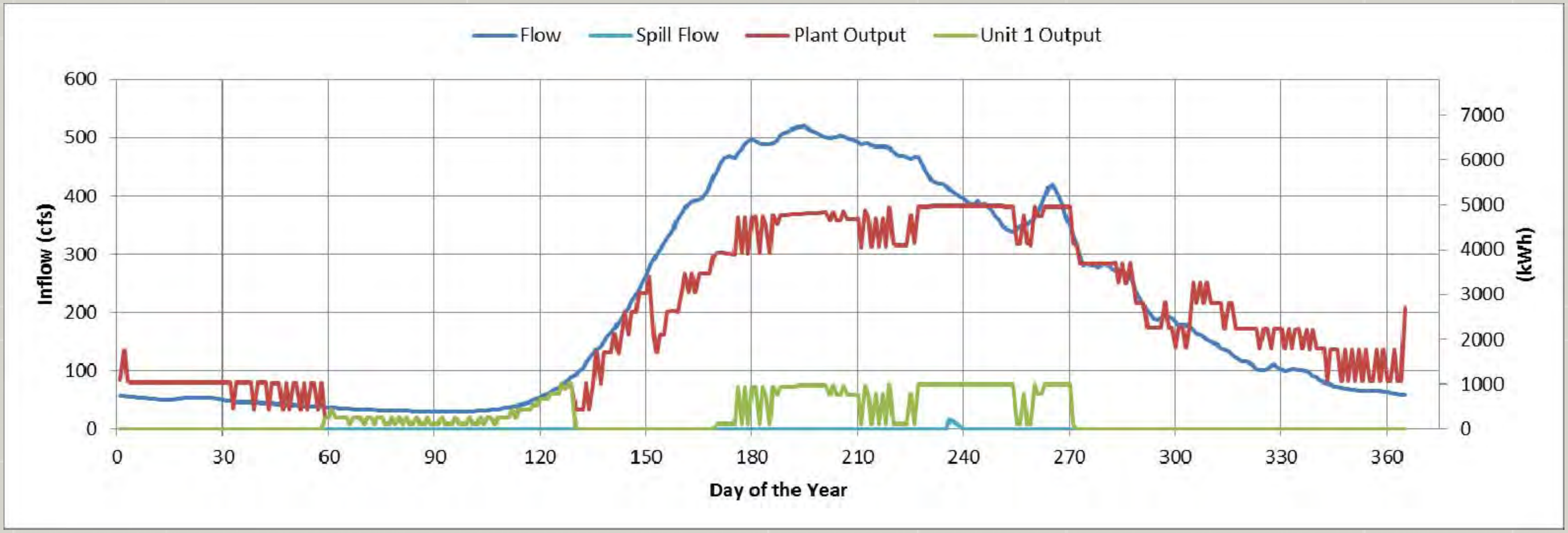
	Elev (ft)	Active Vol (AF)		
Max (2' dam)	705	21682	18791	**ac-ft/day->cfs**
Max (Natural	703	18791		1.9834711
Min (11' Draf	692	2891		
Min (13' Draf	690	0		

Grant Creek Flow Data / Efficiency and HLH calcs / Head Loss / IFR / Rule Curve / **Energy Macro** / Macro Summary / Flow Analysis

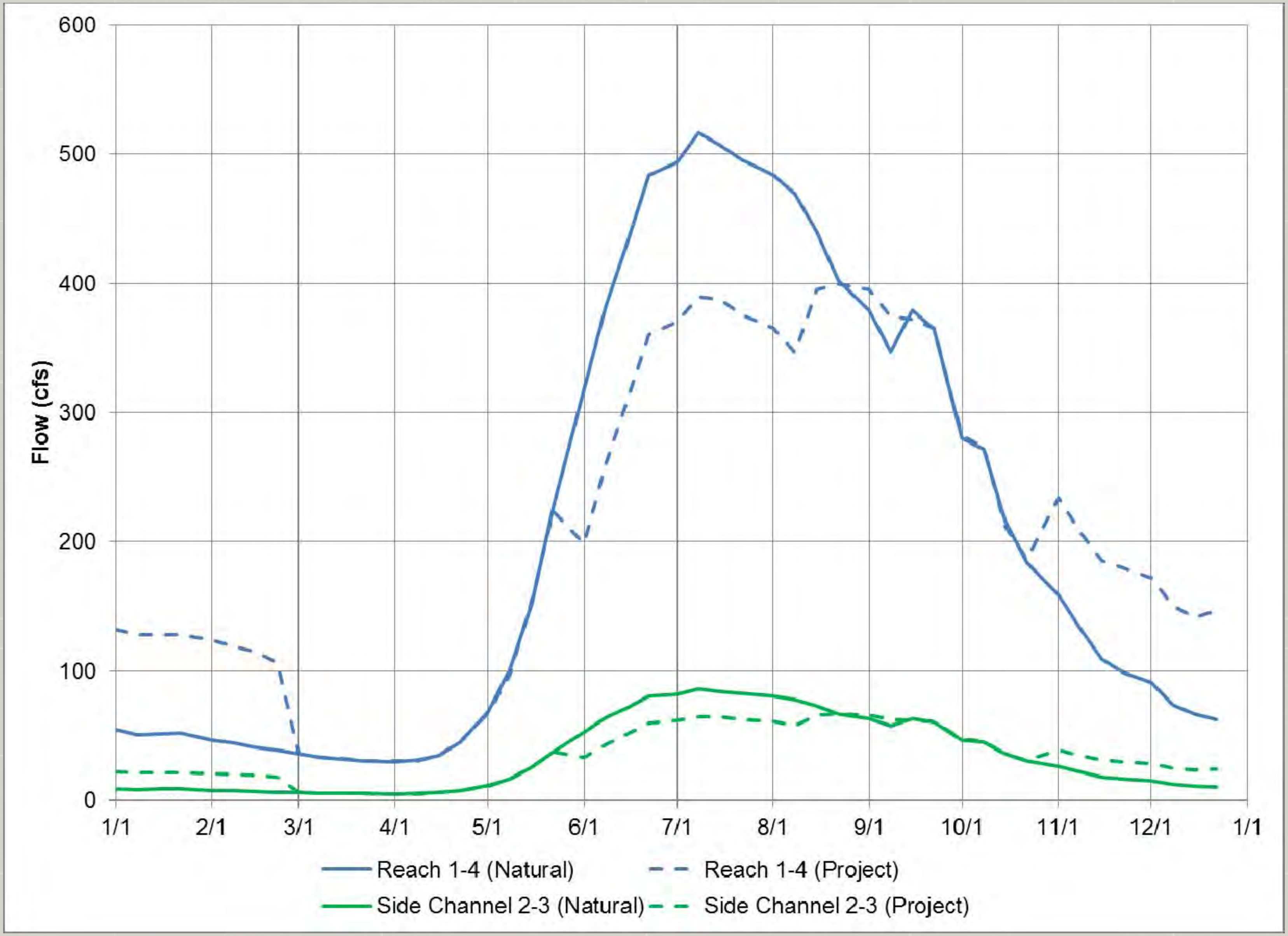
Ready

Generation Model Results

- Energy Production :19,500 MW-Hours Annually (based on Average Daily Flows)
- Plant Factor: 0.45



Project Alteration to Streamflows



Next Steps

- Refine operational model based upon dialogue today
- Continue infrastructure design tasks to support DLA submittal

Questions/Comments

Grant Lake Project Aquatic and Operations Analysis

Aspen Suites Hotel, Anchorage
July 7 – 8, 2014

MCMILLEN
DESIGN with Vision. BUILD with Integrity.

In Association with
HEA

Review of Information Presented in March, 2014 Meeting

- Aquatic Habitat Mapping Results
- Instream Flow Results
- Connectivity Results in Reach 5
- Enhancement Opportunities:
  - Reach 2/3 Side Channel
  - Reach 1 Distributary
- Next Steps

Formed an Instream Flow Work Group

- Had 4 calls to provide data and provide discussion for outstanding issues
- Information was provided in the areas of:
  - Periodicity (resolved with exception of incubation and emergence of Sockeye salmon fry)
  - DTUs for sockeye salmon incubation and emergence
  - Synthesized record of natural hydrology for Grant Creek (1/1/57 – 12/31/13 based upon Kenai River at Cooper Landing (USGS Gage 15258000)
  - Synthesized record of "with-Project" flows for the same period

Information Provided (cont'd)

- Maps of spawning in relation to Instream Flow transects
- Maps of rearing in relation to Instream Flow transects
- CPUE for Chinook and Coho salmon and Dolly Varden char and Rainbow trout juveniles in traps
- Wetted Perimeter vs Flow
- Ramping Rates
- Number of redds by transect

Outstanding Information

- Effective Spawning Analysis (complete)
- Transect Weighting
- Habitat Time Series

HEA Proposed Instream Flow Regime

- Mimic natural flows during the spring (March – May) and fall (September – October)
- Increased flows in the winter period (November – February)
- Decreased flows in the summer period (June – August)
- Decreased, stable flows in Reach 5 (Canyon)

Proposed Reach 5 Flows

- 5 cfs
  - January 1 – July 31; Nov 1 – Dec 31
    - Rainbow trout spawning May 16 – June 30
- 10 cfs
  - August 1 – September 7
    - Chinook and Sockeye salmon spawning
    - Dolly Varden char spawning
- 7 cfs
  - September 8 – October 31
    - Sockeye and Coho salmon spawning
    - Dolly Varden char spawning

Proposed Flow Regime

- More stable flows throughout the year
- Increased flows and habitat in the Reach 2/3 side channel
- Decreased flows in summer when peak flows become less suitable for spawning and rearing
- Flows decreased in Reach 5
  - Has the lowest habitat utilization in Grant Creek
  - 5 of 388 salmon redds observed in Reach 5 (1.3%)

Proposed Enhancement Measures

- Increased flows and habitat in the Reach 2/3 side channel
- Removal of flow obstruction at the upstream end of Reach 1 Distributary to allow more water at lower flows

Reach 2/3 Side Channels

- Large amount of high quality/diverse habitat
- Currently have low to no flows during the winter and other low flow periods
- Currently subject to freezing/snow/ice and drying out during low flow periods
- Potential for freezing and desiccation of redds
- More stable flows with proposed project operation create opportunity for sustainable habitat in side channels

Side Channel Habitat, Reach 3

Reach 2/3 Side Channel (cont'd)

- Consists of two main channels that begin at the Reach 3/4 break
- Side channels constitute 21% of total length of Grant Creek, but contain:
  - 97% - OVH
  - 44% - LWD
  - 50% - Glide
  - 34% - Pool

Reach 2/3 Side Channel (cont'd)

- Proposed regime would increase flows by 104% in the side channels during the winter period
  - These increased flows would help prevent freezing and desiccation of redds, and increase overwintering rearing habitat.
- Flows would be decreased by 23% in the summer period
  - Peak flows would be removed, and spawning and rearing flows would be more stable during the summer
- Flows would remain the same in spring and fall as pre-project

Changes in WUA for rearing salmonids in the Reach 2/3 side channels (pre-project vs. proposed post-project flows)

Species	Jan	Feb	Nov	Dec	Mean
Chinook Juvenile	167.8%	178.6%	129.9%	150.2%	***156.6%***
Coho Juvenile	94.4%	96.7%	108.1%	96.8%	***99.0%***
Dolly Varden Juvenile	106.9%	116.0%	102.2%	101.5%	***106.7%***
Rainbow Juvenile	112.9%	123.0%	103.4%	105.1%	***111.1%***
Mean	***120.5%***	***128.6%***	***110.9%***	***113.4%***	***118.3%***

Reach 2/3 Side Channel (cont'd)

- Winter rearing WUA ranging from 94% - 179% of the pre-project WUA
- Mean 18% increase in WUA for the 4-month period
- During June – August, 3%, 9% and 16% decrease in fry, juvenile, and adult rearing WUA, respectively in the side channels
- No change in WUA in spring and fall

Potential Enhancement Opportunity - Reach 1 Distributary – Flow Additions

- Modify existing upstream entrance to the Distributary to allow flows there at a lower discharge
- Currently distributary does not get wetted until Grant Creek flows reach ~ 180 - 190 cfs
  - Dry during winter, early spring and late fall
- Analysis indicates T100 and T110 currently receive only about 1% of the water in Grant Creek once the distributary is activated
- Modeling of higher flows indicates that significant increases in WUA are possible with additional flow

Reach 1 Distributary, cont'd

- Reach 1 distributary constitutes only 5.6% of the stream length of Grant Creek, but has:
  - 17.6% of the pool habitat
  - 20% of the LWD
  - 12% of the undercut banks

Reach 1 Distributary

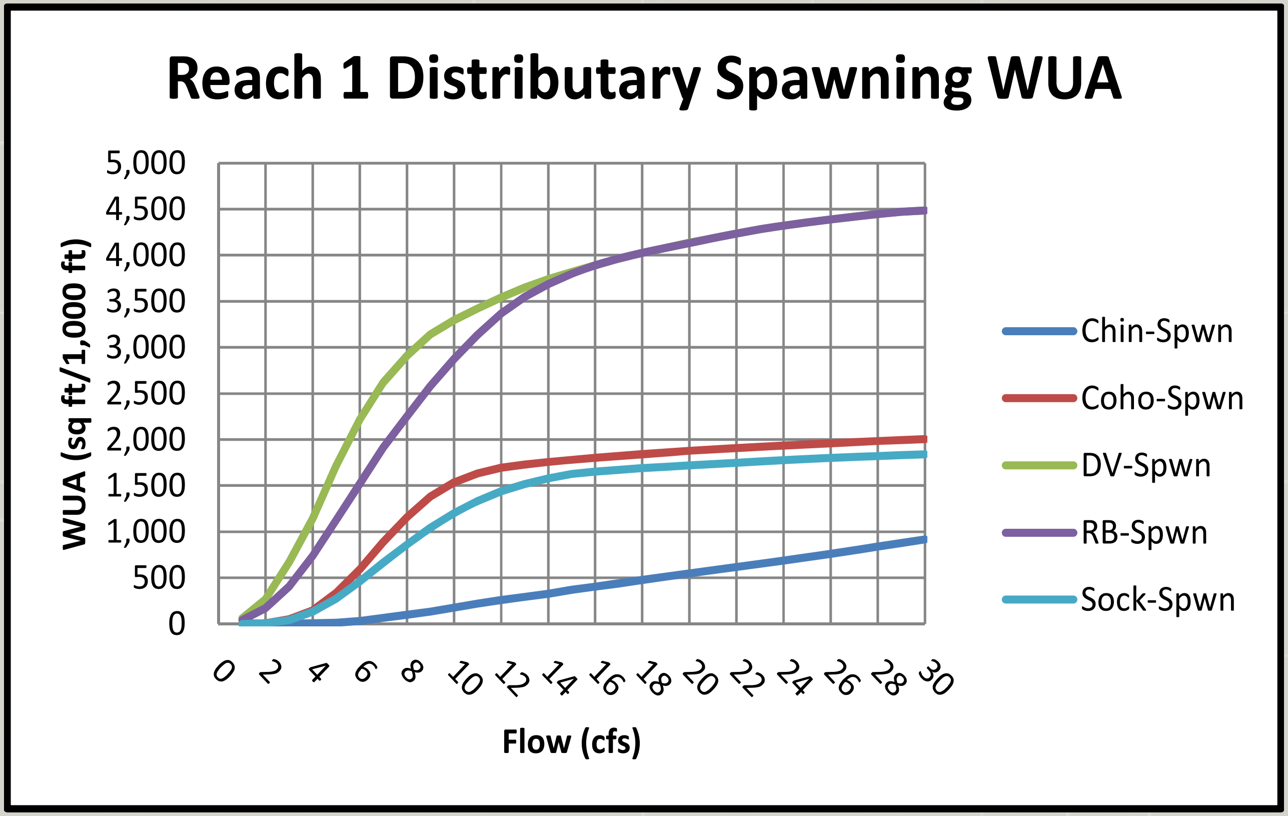
Distributary mouth @ Grant Creek flow of 131 cfs

Distributary mouth @ Grant Creek flow of 700 cfs

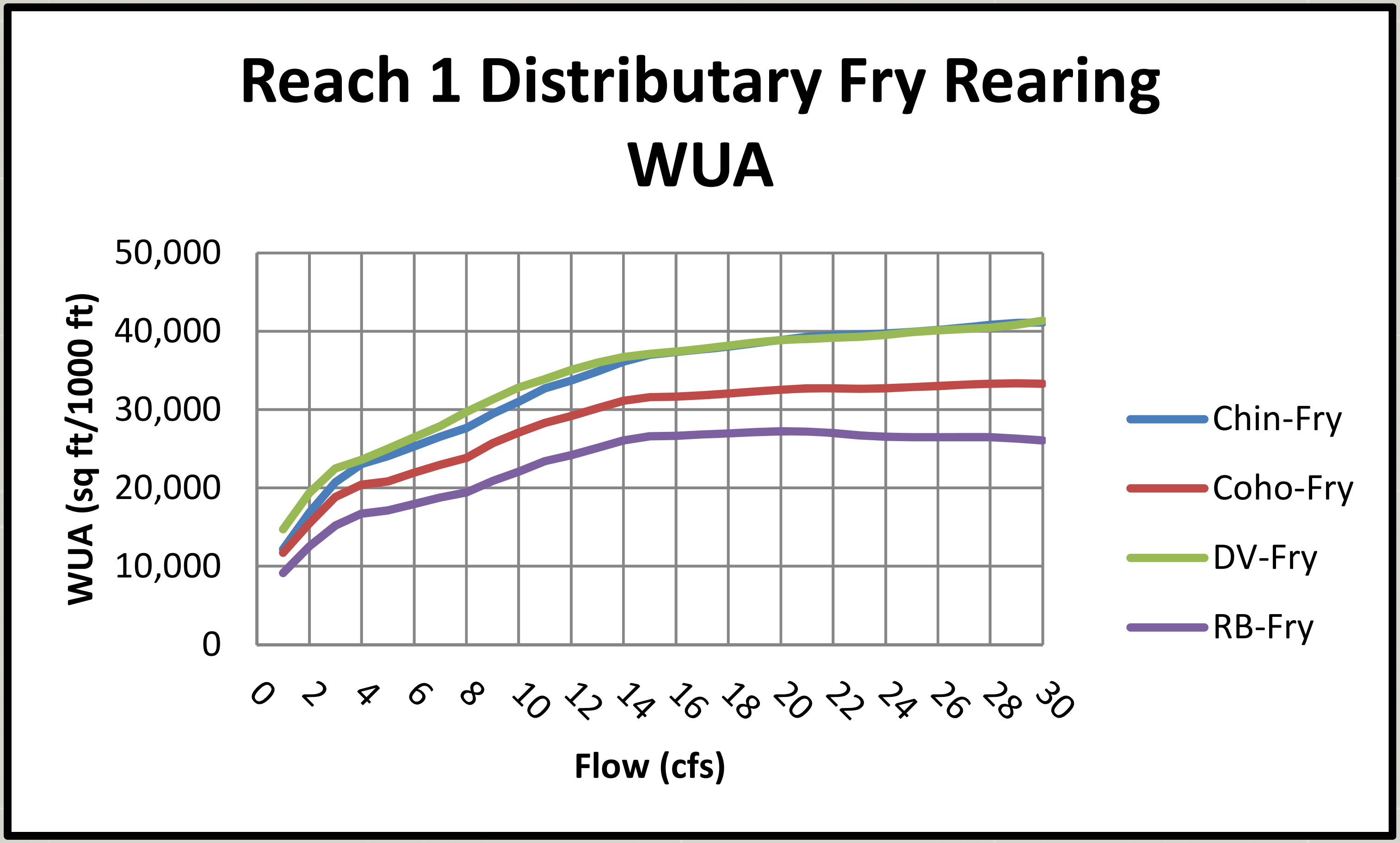
Distributary – Reach 1

LWD @ Grant Creek flow of 64 cfs

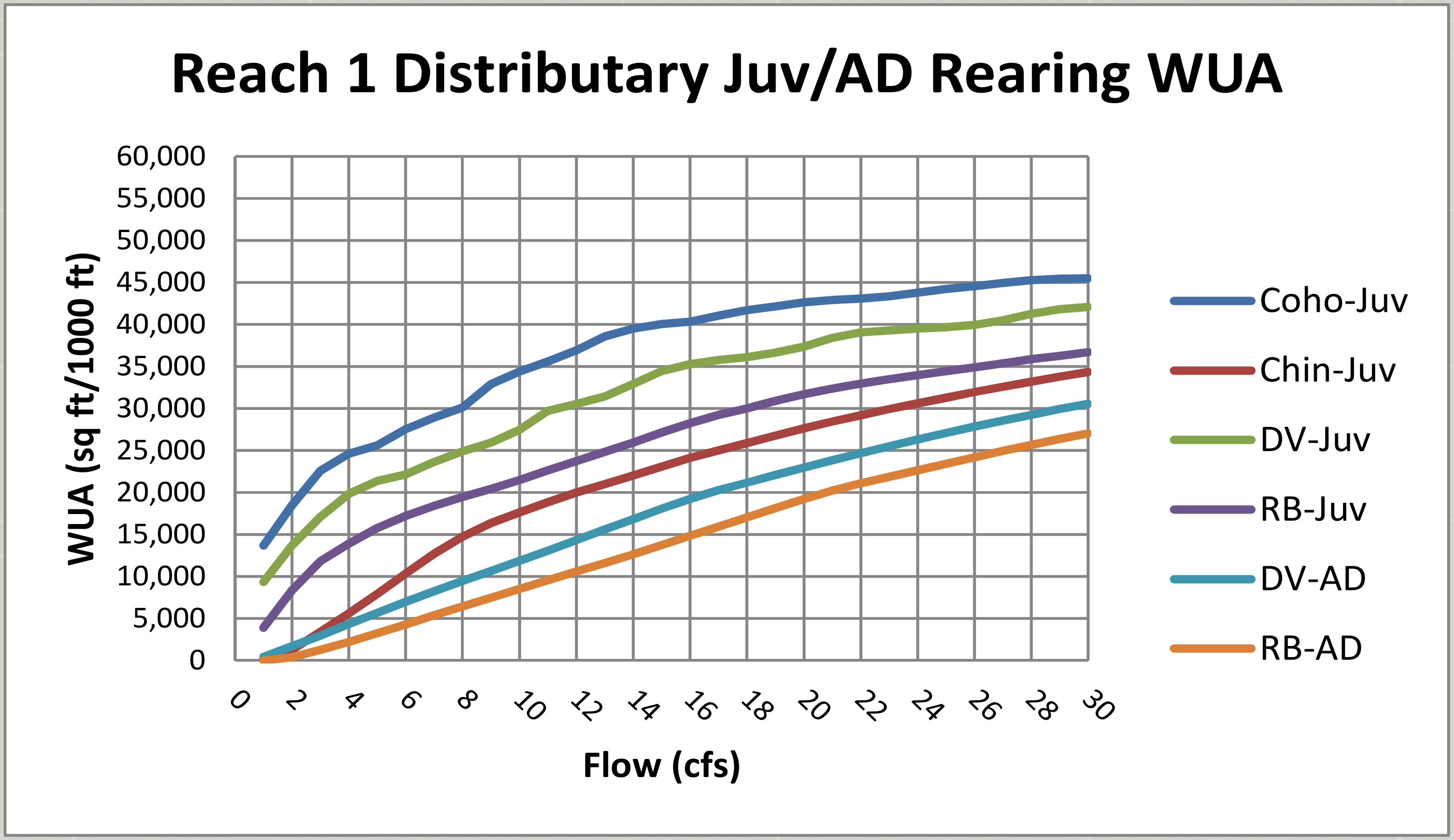
Distributary @ Grant Creek flow of 700 cfs (7 cfs in distributary)



Significant increases in spawning habitat at 20 cfs as compared to 2 cfs (flow in distributary when approximately 200 cfs in Grant Creek main channel)

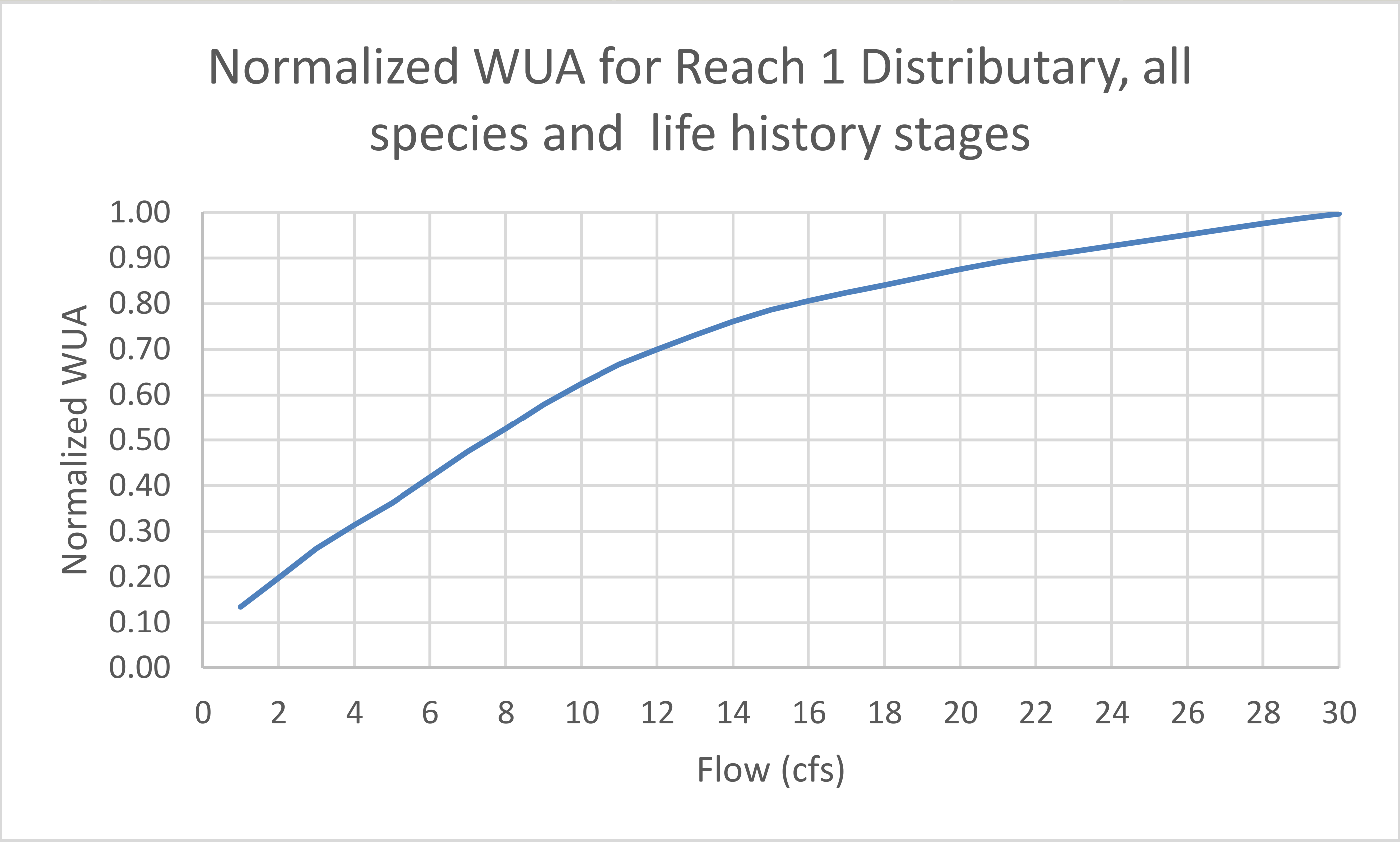


2.0 – 2.3 ***TIMES*** more fry rearing habitat at 20 cfs than 2 cfs (flow in distributary when approximately 200 cfs in Grant Creek main channel)



2.3 – 48 ***TIMES*** more juvenile and adult rearing habitat at 20 cfs than 2 cfs (flow in distributary when approximately 200 cfs in Grant Creek main channel)

What's a good flow? 12 – 20 cfs



HEA Proposed Flows

Instream Flow Release (Reach 5)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Main Channel Flow (Reach 1-4) Natural	55	51	51	52	47	45	41	39	36	34	32	31	30	31	35	45
Main Channel Flow (Reach 1-4) w/Project	133	128	128	128	124	119	115	106	36	34	33	30	30	30	35	46
Approx. Reach 2/3 Natural Side Channel Flow	9.2	8.5	8.6	8.6	7.8	7.4	6.8	6.4	6	5.6	5.3	5.1	5	5.2	5.8	7.6
Approx. Reach 2/3 Side Channel Flow w/Project	22	21	21	21	21	20	19	18	6	5.6	5.4	5.1	5	5	5.8	7.7

HEA Proposed Flows, cont'd

	May				June				July				August			
Instream Flow Release (Reach 5)	5	5	5	5	5	5	5	5	5	5	5	5	10	10	10	10
Main Channel Flow (Reach 1-4) Natural	69	101	152	227	318	382	431	483	494	517	507	496	484	469	440	402
Main Channel Flow (Reach 1-4) w/Project	68	97	155	224	199	260	310	360	370	390	388	375	365	347	395	399
Approx. Reach 2/3 Natural Side Channel Flow	12	17	25	38	53	64	72	81	82	86	84	83	81	78	73	67
Approx. Reach 2/3 Side Channel Flow w/Project	11	16	26	37	33	43	52	60	62	65	65	63	61	58	66	67

HEA Proposed Flows, cont'd

	September				October				November				December			
Instream Flow Release (Reach 5)	10	7	7	7	7	7	7	7	5	5	5	5	5	5	5	5
Main Channel Flow (Reach 1-4) Natural	379	347	379	364	280	272	216	184	159	133	109	99	92	74	67	63
Main Channel Flow (Reach 1-4) w/Project	395	374	372	365	282	273	212	187	234	207	185	180	172	150	141	147
Approx. Reach 2/3 Natural Side Channel Flow	63	58	63	61	47	45	36	31	26	22	18	16	15	12	11	10
Approx. Reach 2/3 Side Channel Flow w/Project	66	62	62	61	47	46	35	31	39	35	31	30	29	25	24	24

Comparison of Impacts and Enhancements

Impacts

- Reach 5:
  - Reduced flows in Reach 5
  - Limited use by adult salmonids (1.3% of redds in 2013)
  - Limited Habitat

Habitat Type	Sq Ft	Percentage
Cascades	33,593	57.5%
Pool	7,977	13.7%
Step Pool	16,858	28.9%
Total	**58,428**	

  - Reduction in Wetted Perimeter (from inflexion point):
    - 5 cfs: 43%
    - 7 cfs: 36%
    - 10 cfs: 24%

Comparison of Impacts and Enhancements, cont’d

- Reach 2/3 Side Channels
  - Overall 18% increase in winter juvenile rearing habitat
  - More stable, higher flows during this period, with likely less freezing and desiccation of redds and increased winter rearing habitat
  - More stable flows during the balance of the year as well

Comparison of Impacts and Enhancements, cont'd

Reach 1 Distributary

- Currently dry during late fall, winter and early spring
- Proposed 12 – 20 cfs in Distributary Reach 1:
  - Change in winter rearing WUA from 0 to 111k – 140k ft^2/1000 ft of stream
- 5 cfs in winter nets an increase from 0 – 70k ft^2 WUA

	Juvenile Rearing WUA			
Species	**Currently**	**5 cfs**	**12 cfs**	**20 cfs**
Coho	0	25,608	36,959	42,629
Chinook	0	7,908	19,988	27,674
Dolly Varden	0	21,370	30,544	37,364
Rainbow	0	15,784	23,774	31,690
Total	**0**	**70,670**	**111,265**	**139,356**

Document Content(s)