
From: Kenneth Hogan <kenneth.hogan@ferc.gov>
Sent: Wednesday, April 02, 2014 4:45 AM
To: Cory Warnock
Cc: Salzetti, Mikel; Emily Andersen
Subject: Re: Grant Lake Meetings (P-13212)

You must file for the extension at least 30 days prior to the expiration of the permit.

Kenneth J. Hogan
Fishery Biologist
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426
202-502-8434

On Tue, Apr 1, 2014 at 5:07 PM, Cory Warnock <cory.warnock@mcmillen-llc.net> wrote:

Thanks for the follow-up and the call, Ken. Sorry I missed your call back, I was on another call. One follow-up question to your email below.....

Assuming we choose to make our substantive case and apply for an extension of some period, what is the timeframe for doing that? How many days in advance of our current permit expiring should we apply for the extension?

Again, thanks and I'll talk to you soon,

Cory

From: Kenneth Hogan [mailto:kenneth.hogan@ferc.gov]
Sent: Tuesday, April 01, 2014 1:30 PM
To: Salzetti, Mikel; Cory Warnock
Subject: RE: Grant Lake Meetings (P-13212)

Mike & Cory,

Regarding your question about a potential extension of time for the permit term, please understand that there are no guarantees and I have no way of knowing what policies or practices will be in play a year from now; but currently, we are reviewing each requested extension on a project-by-project basis where a showing of due-diligence is critical. That said, your best guarantee is to file your license application before the expiration of the permit.

Hope this helps.

Ken

From: Salzetti, Mikel [mailto:MSalzetti@HomerElectric.com]
Sent: Tuesday, April 01, 2014 12:22 PM
To: Cory Warnock; Kenneth Hogan
Cc: Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

Call in phone number: 877-578-8633

Access Code: 5180

From: Cory Warnock [mailto:cory.warnock@mcmillen-llc.net]
Sent: Monday, March 31, 2014 10:15 AM
To: Kenneth Hogan
Cc: Salzetti, Mikel; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

We'll shoot it along to you tomorrow in advance of the call.

From: Kenneth Hogan [<mailto:kenneth.hogan@ferc.gov>]
Sent: Monday, March 31, 2014 11:06 AM
To: Cory Warnock
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

Are you setting up a conference line?

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]
Sent: Monday, March 31, 2014 2:02 PM
To: Kenneth Hogan
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

Yep. I'll send an invite to all.

Thanks and talk to you tomorrow.

From: Kenneth Hogan [<mailto:kenneth.hogan@ferc.gov>]
Sent: Monday, March 31, 2014 10:53 AM
To: Cory Warnock
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

I am available at 3:30 tomorrow afternoon. Will that work for you?

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]
Sent: Monday, March 31, 2014 1:13 PM
To: Kenneth Hogan
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

Hi Ken,

Mike was out so I couldn't coordinate schedules too well last week. Mike is available for a call tomorrow but given that he is in AK, his 8 is your noon and it appears as though you only have the morning available. If you could give me a few alternate times later in the week (and next) that will work, I'll work with Mike and be much more expedient about locking in a date/time.

Thanks,

Cory

From: Kenneth Hogan [<mailto:kenneth.hogan@ferc.gov>]
Sent: Wednesday, March 26, 2014 2:08 PM
To: Cory Warnock
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

Cory, I am available Monday all day and the morning of Tuesday April 1st.

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]
Sent: Wednesday, March 26, 2014 4:53 PM
To: Kenneth Hogan
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

Hi Ken,

Now that we're all back in our offices from a week of meetings and have had a chance to digest the proceedings for a couple days, Mike and I are hoping we can have a call with you to discuss a few topics. We've identified either April 1st (Monday) or the morning of April 2nd as potential times. Please let me know if either of these will work for you and if not, some alternative options to consider.

Thanks and look forward to talking to you soon,

Cory

From: Kenneth Hogan [<mailto:kenneth.hogan@ferc.gov>]
Sent: Thursday, March 06, 2014 7:01 AM
To: Cory Warnock
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Meetings (P-13212)

Cory,

I am available March 26-28 from 9 AM – 3:30 pm eastern. I will also try to have some participation during the study report meetings on the 18th, 19th, and 20th. Thanks for keeping me in the loop.

Ken

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]
Sent: Wednesday, March 05, 2014 7:29 PM
To: Ken Hogan
Cc: Mike Salzetti; Emily Andersen
Subject: Grant Lake Meetings (P-13212)

Hi Ken,

Just checking in with you to see if you were planning on calling in to the Grant Lake Resource Report Meetings. I wanted to get you copies of the agendas so that you had the information if you had the inclination to join at some point. I fully appreciate that three straight days listening to the meetings may not fit into your existing schedule! Regardless, Mike Salzetti (HEA) and I would also like to set up a time to talk the week after the meetings to give you a general summary of how they went and have a bit of process discussion. If you could give me an idea of a day/time that might work during the week of March 24th, Mike and I will coordinate our schedules and I'll get a reminder sent out. In the meantime, let me know if you have any questions about the attached agendas or anything else.

From: Cory Warnock
Sent: Thursday, April 03, 2014 9:12 AM
To: Emily Andersen
Subject: FW: Revised Grant Creek Periodicity Chart

From: Mouw, Jason E B (DFG) [mailto:jason.mouw@alaska.gov]
Sent: Wednesday, April 02, 2014 2:56 PM
To: John Blum

Cc: 'Mark Miller'; 'Mike Salzetti'; Cory Warnock; 'John Stevenson'; Miller, Monte D (DFG); jeffry_anderson@fws.gov
Subject: RE: Revised Grant Creek Periodicity Chart

Hi John,

Thanks for the updated periodicity table.

The question of whitefish has been raised here, within ADF&G. I think the question is more informational than it is based on a concern over the table. Grant Creek doesn't seem like the best whitefish habitat, but we are interested in potential spawning activity and how this stream fits into their life history.

Thanks,

Jason

From: John Blum [mailto:john.blum@mcmillen-llc.com]
Sent: Friday, March 28, 2014 1:52 PM
To: 'Eric Rothwell'; Klein, Joseph P (DFG); Miller, Monte D (DFG); Mouw, Jason E B (DFG); jeffry_anderson@fws.gov; dglass@ciri.com
Cc: 'Mark Miller'; 'Emily Andersen'; 'Mike Salzetti'; 'Cory Warnock'; 'John Stevenson'
Subject: Revised Grant Creek Periodicity Chart

Good afternoon:

Mark Miller just sent me a revised Grant Creek periodicity chart. Please use this one for editing, and please add the date to the chart, so we can track its progress.

Thanks, and have a good weekend!

John

John Blum
Sr. Fisheries Scientist

From: Mouw, Jason E B (DFG) <jason.mouw@alaska.gov>
Sent: Thursday, April 03, 2014 11:19 AM
To: John Blum; Klein, Joseph P (DFG); Miller, Monte D (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; 'Eric Rothwell'
Cc: 'Mark Miller'; Emily Andersen; 'Mike Salzetti'; Cory Warnock; 'John Stevenson'
Subject: RE: Revised Grant Creek Periodicity Chart
Attachments: Saltveit and Brabrand (2013) incubation and groundwater.pdf

John et al.,

In our teleconference the other day, I agreed to forward a paper discussing incubation (see attached). The following sentence from the abstract is what caught my attention:

“Eggs placed in boxes in ground water seepage areas during winter in the dewatered river bed survived even when covered by ice and snow.”

Saltveit and Brabrand (2013) performed egg-box experiments to evaluate embryonic dynamics, as related to intragravel flow, which they refer to as groundwater. This study might be worth the groups consideration.

Just FYI,

Jason

From: John Blum [mailto:john.blum@mcmillen-llc.com]
Sent: Friday, March 28, 2014 1:52 PM
To: 'Eric Rothwell'; Klein, Joseph P (DFG); Miller, Monte D (DFG); Mouw, Jason E B (DFG); jeffry_anderson@fws.gov; dglass@ciri.com
Cc: 'Mark Miller'; 'Emily Andersen'; 'Mike Salzetti'; 'Cory Warnock'; 'John Stevenson'
Subject: Revised Grant Creek Periodicity Chart

Good afternoon:

Mark Miller just sent me a revised Grant Creek periodicity chart. Please use this one for editing, and please add the date to the chart, so we can track its progress.

Thanks, and have a good weekend!

John

John Blum
Sr. Fisheries Scientist



Incubation, hatching and survival of eggs of Atlantic salmon (*Salmo salar*) in spawning redds influenced by groundwater[☆]



Svein Jakob Saltveit*, Åge Brabrand

Freshwater Ecology & Inland Fisheries Laboratory, Natural History Museum, University of Oslo, Boks 1172 Blindern, 0318 Oslo, Norway

ARTICLE INFO

Article history:

Received 1 November 2012

Accepted 20 May 2013

Available online 1 July 2013

Key words:

Atlantic salmon
river regulation
groundwater
egg development
egg survival

ABSTRACT

Many west coastal and northern Norwegian rivers run through deep, confined valleys with permeable layers of glacial and alluvial deposits. Groundwater flows through these permeable layers and enter lakes and rivers as underwater seepage and springs. Groundwater inflow to inland Norwegian rivers may constitute 40–100% of total water discharge during low flow periods in late summer and winter. Juvenile salmonids may take advantage of groundwater upwellings and actively seek out such patches. In regulated rivers groundwater influx may create refuges during low flow or hydropeaking episodes. The importance of groundwater for salmon redd site selection and egg survival is also clear, although less known and documented in regulated rivers.

Eggs of Atlantic salmon (*Salmo salar*) are deposited in redds in river bed gravels lacking fine sediments and with high oxygen levels. Egg development is therefore dependent on the interaction of a number of environmental factors such as groundwater influx, oxygen and temperature. Atlantic salmon in the regulated River Suldalslågen, Western Norway, spawn relatively late compared to other Norwegian rivers, with a peak in early January. Newly emerged fry are found from the end of May to the beginning of June, i.e. “swim up” one month earlier than expected using models for egg and alevin development and river water temperatures. The most plausible explanation is that groundwater has a higher and more stable temperature than surface river water. In field experiments, fertilized salmon eggs were placed in boxes close to natural spawning redds in the river bed at sites influenced and those not influenced by groundwater. A difference of up to 40 days in 50% hatching was found, and “swim up” occurred at the end of May in boxes influenced by groundwater.

Preliminary studies have revealed that groundwater also plays an important role in survival of salmon eggs in the River Suldalslågen when dewatered in winter. Eggs placed in boxes in groundwater seepage areas during winter in the dewatered river bed survived even when covered by ice and snow. The survival from fertilization until 30 April, one month before hatching, was 91%, the same survival as found for eggs placed in boxes in the wetted river bed. However, mortality from fertilization to hatching was higher compared to the eggs placed in wetted river bed, 57 and 91% respectively.

Groundwater creates a horizontal and vertical mosaic of temperatures in spawning redd areas leading to potentially greater variation in spawning sites, time of hatching and “swim up”. This is likely to increase egg survival during low flow periods in regulated rivers. In conclusion, the interaction between groundwater and surface river water should therefore be considered when managing fish populations in regulated rivers.

© 2013 Elsevier GmbH. All rights reserved.

Introduction

Many west coastal and northern Norwegian rivers run through deep confined valleys with permeable layers of glacial and

alluvial deposits. The runoff from the valley sides fills the pore spaces in these glacial-alluvial valley deposits with water, which then flows through the permeable layers and enter lakes and rivers as underwater seepage and springs, largely dependent on bottom substrate characteristics and hinterland topography (Koestler and Brabrand, 2001). Geological heterogeneity will produce a potential for local underwater sites of groundwater flux, and hyporheic substrates in terms of sediment grain size and rock fracturing will determine microspatial influx sites (Heggenes et al., 2010), thus creating a heterogeneity in habitat and spawning sites with regards to flow, temperature and oxygen (Power et al., 1999).

[☆] This article is part of a Special Issue entitled 9th International Symposium on Ecohydraulics 2012.

* Corresponding author at: Freshwater Ecology & Inland Fisheries Laboratory, Natural History Museum, University of Oslo, P.O. Box 1172 Blindern, 0318 Oslo, Norway. Tel.: +47 22851724; fax: +47 22851837.

E-mail address: s.j.saltveit@nhm.uio.no (S.J. Saltveit).

Groundwater may constitute 40–100% of total water discharge during low flow periods in late summer and winter to inland Norwegian rivers, while the total groundwater inflow is usually lower, or shows higher variation in West coastal rivers, due to steeper topography (Colleuille et al., 2005). It is known that juvenile salmonid species may take advantage of groundwater upwellings and actively seek out such patches as thermal refugia both in winter and summer (Douglas, 2006). In lake-spawning brown trout (*Salmo trutta*) populations, high numbers of spawning redds have been found in areas with high groundwater influx (Brabrand et al., 2002). In regulated rivers, groundwater influxes create refuges for juveniles during low flow or hydropeaking episodes (Saltveit et al., 2001). It has been documented that juvenile Chinook salmon (*Oncorhynchus tshawytscha*) may burrow in substrate with groundwater upwelling (Douglas, 2006). Small streams in alpine environments may freeze to the bottom in winter, causing juvenile fish mortality and ensuing recruitment failure (Borgström and Museth, 2005), although groundwater inflows may provide stable (temperatures and flow) and ice-free habitats for overwintering fish and eggs (Heggnes et al., 2010).

The active use of the hyporheic zone by salmonids has been studied with respect to redd site selection, egg deposition and survival, as well as fry development and the use of favourable groundwater inflow sites for spawning and juvenile fish survival (reviewed by Heggnes et al., 2010). Salmonids often spawn in habitats where groundwater inflows occur, and their spawning success may be dependent on such habitats (Hansen, 1975; Garrett et al., 1998; Baxter and McPhail, 1999). Egg of fall-spawners may freeze in cold areas and during low flow periods in late winter. This may also occur in regulated rivers with large variation in river discharge and has been documented for Atlantic salmon (*Salmo salar*) by Skoglund et al. (2012). However, where there are groundwater inputs, freezing of eggs and egg mortality in winter can be minimized since groundwater is typically warmer than surface water. A significantly higher survival rate for kokanee (*Oncorhynchus nerka*) and bull trout (*Salvelinus confluentus*) embryos has been documented in habitats influenced by discharging groundwater and they clearly selected such sites for spawning (Garrett et al., 1998; Baxter and McPhail, 1999).

Suitable reproductive habitats are a prime necessity for population sustainability, and river regulation may reduce the abundance and quality of spawning habitat, thus directly affecting recruitment of salmonid populations. Even though importance of groundwater for salmon redd site selection and egg survival appears obvious (Soulsby et al., 2005), and that the use of groundwater upwelling sites for spawning has been reported for several salmonids species (e.g. Garrett et al., 1998), there is little data to substantiate the idea that groundwater outflows directly affect spawning site selection (Baxter and McPhail, 1999). Varying patterns of groundwater–surface water interactions may generate a spatial and temporal mosaic and consequently complex conditions for egg survival (Malcolm et al., 2009), egg development and spawning time. During low flow periods in regulated rivers, there may therefore be an increase in the relative importance of groundwater for salmonid survival.

Eggs of Atlantic salmon are deposited in redds in the river bed gravels, lacking fine sediments and with high oxygen levels. The most decisive variables for redd site selection in addition to current velocity are depth and substrate (Crowder and Diplas, 2002). Atlantic salmon normally spawn in autumn and the eggs develop in the gravel throughout the winter. In the regulated River Suldalslågen, Western Norway, however, Atlantic salmon spawn relatively late compared to other Norwegian rivers, with a peak in early January (Heggberget, 1988). Based on models for egg and alevin development (Crisp, 1981, 1988; Jensen et al., 1989, 1991), spawning in the beginning of January leads to “swim up” between 17 June

and 4 July, i.e. one month later than can be observed in situ in the river (Saltveit et al., 1995).

If spawning occurs in January, the most plausible explanation for an early emergence in the River Suldalslågen is that groundwater provides higher and more stable temperature to spawning redds than surface river water. However, as newly emerged fry are found in the river until the end of June (Saltveit et al., 1995), there is clearly a heterogeneity in spawning habitats and/or spawning time, leading to a non-synchronous emergence period. Reduced synchrony may spread mortality risk and act as a buffer against single events that may cause mortality, such as episodes of high discharge during emergence (Jensen and Johnsen, 1999), or against a mismatch between phenology and optimal conditions for offspring caused by the regulation of this river.

Prior to its regulation, the River Suldalslågen had very large seasonal variations in discharge. The mean spring flood was ca. $400 \text{ m}^3 \text{ s}^{-1}$, but a winter flow as low as $3 \text{ m}^3 \text{ s}^{-1}$ indicates that redds also could be dewatered and desiccated under natural conditions in periods during winter if spawning had occurred at higher winter flows. We therefore hypothesize that groundwater influx in spawning area is crucial in reducing egg mortality from freezing during low flow periods in wintertime. A preliminary study was therefore conducted to show if the river was suited as an experimental site for a more thorough study of the survival of eggs exposed to dewatered areas during winter, also in respect to groundwater inputs. The main objective of this study was, however, to evaluate the time development of salmon eggs exposed to groundwater and surface river water, and to explain the early “swim up” observed in the river, Suldalslågen.

Materials and methods

Study site

The river, Suldalslågen, western Norway, is 22 km long, running from the lake Suldalsvatn (65 m a.s.l. and 29 km^2), to the inner part of the Ryfylkefjord (Fig. 1). The Suldalslågen produces anadromous fish, Atlantic salmon and brown trout, along its entire length. The mean annual unregulated flow was ca. $90 \text{ m}^3 \text{ s}^{-1}$, with very large seasonal variations; winter flow some years as low as $3 \text{ m}^3 \text{ s}^{-1}$ and a mean spring flood of ca. $400 \text{ m}^3 \text{ s}^{-1}$. The Suldalslågen is now regulated for hydropower by transferring water directly from the lake, Suldalsvatn, to a power station located on the fjord with outlet directly to the sea. During winter, from 15 December to 1 May, the minimum flow released from the lake, Suldalsvatn, is now ca. $12 \text{ m}^3 \text{ s}^{-1}$.

The study was carried out from January to June in 2008, 2009 and 2011 in the uppermost part of the river, ca. 1 km below the lake, Suldalsvatn (Fig. 1).

Egg development

In 2008, egg development in spawning redds influenced by groundwater influx was estimated from temperature recordings in the redds and compared with estimates of egg development based on temperature measured on the substrate surface above the redds, i.e. simulating redds influenced by river water temperature. Redds with groundwater influx were found using a digital thermometer with a long probe penetrating down into the substrate of the redds. Temperature in the redds was recorded at one hourly intervals using Tiny-Tag recorders. The loggers were placed in small iron tubes and marked with an orange line. The egg development time from fertilization to hatching was estimated according to the equation in Crisp (1981). Wallace and Heggberget (1988) concluded that Crisp's equation also satisfactorily described the time from



Fig. 1. The river, Suldalslügen, Western Norway, from the outlet of the lake, Suldalsvatn (dam indicated), to the sea at Sand. The study reach (●) in the river is indicated.

fertilization to hatching at temperatures close to zero. Further, development time from hatching to 50% initial feeding (swim up) was estimated from the model published by Jensen et al. (1989).

In 2009 a similar study to 2008 was performed, but in addition to temperature loggers, Atlantic salmon eggs were placed in two-compartment Whitlock–Vibert boxes (Whitlock, 1977) in spawning redds and in the substrate above each redd. Egg development time was based on observations of hatching, although time from hatching to swim-up was estimated from models (see below).

Eggs from Atlantic salmon were acquired from the local hatchery. Eggs from two females were fertilized by sperm from a single male one week ahead of starting the experiments. To be able to study the effects of groundwater, three Whitlock–Vibert boxes, each containing 100 eggs, were either placed approximately 30 cm down into gravel areas with influx of groundwater or 30 cm into the gravel in areas lacking groundwater influx. The sites, i.e. groundwater/non-groundwater, were as in 2008 selected using a digital thermometer with a long probe. At each sites three boxes were placed just below the substrate surface as reference for surface water temperature. All boxes were numbered and marked. The eggs were planted in early January.

The idea of placing three boxes at each site was to study the hatching time by removing a single box at different times to follow progress in development. As it was difficult to sample the boxes after 1 May due to high flows causing the larvae to leave the boxes and also because of problems putting the boxes back into place, time from hatching to emergence and first feeding, i.e. “swim up” was estimated, based on Jensen et al. (1989).

Temperature was recorded at 3 hourly intervals using Tiny-Tag recorders placed adjacent to the egg boxes. Unfortunately not all of these loggers functioned throughout the experimental period due to leakage. Therefore, in 2008, only results from two redds are presented, while three sites are included in the 2009 study.

Egg survival

The preliminary experiments on survival of eggs during dewatering were conducted in 2011 at the same location using two two-compartment Whitlock–Vibert boxes, each containing 55 Atlantic salmon eggs from the local hatchery. One box was placed within the dry river bed, approx. 10 cm below the substrate surface, in the drawdown zone lacking surface water before 1 May, but with influx of groundwater. The box was placed in the gravel so that the eggs were situated just above the surface of the groundwater. It was then covered by substrate and snow. The dry river bed were covered by a 10 cm layer of snow when the eggs were introduced. The air temperature was about -5°C . The other box was placed just below the substrate surface in the river as reference for survival under permanent flow conditions.

Eggs were fertilized on 10 January 2011 and placed in the river on 13 January. Temperature was recorded at 3 hourly intervals using Tiny-Tag recorders placed adjacent to each of the egg boxes. The boxes were controlled on 28 April and 1 June for survival until hatching. When removing the boxes on 1 June a net was held below the box to collect the larvae drifting from the boxes.

No measurements of air temperature exist from the study site area. Air temperatures were therefore taken from the nearest station of the Norwegian Meteorological Institute at Sauda, ca. 50 km from the study site. Even if these measurements are not on site, the climatic differences between the two sites are small.

Results

Groundwater and egg development

In 2008, only one of the temperature loggers in groundwater redds functioned throughout the study period, while three in those without groundwater worked. The estimate of difference in egg development and hatching time is therefore based on two recordings, one with groundwater and one in the surface water above the redd (Fig. 2).

The temperature in the redd with groundwater influx was high and very stable and only varied between 5.6 and 5.8°C during the study period. In the redd with dominance of surface river water the temperature was far lower at the start of the experiment on 10 January and until mid March, when it started to rise gradually to above 6°C at the beginning of May. The temperature in this spawning redd also showed more variation.

The eggs in the redd with groundwater influx were estimated to hatch (50%) as early as 6 April after 497 degree days, while those experiencing mainly river water hatched (50%) 40 days later on 16 May after 432 degree days (Fig. 2). The “swim up” from the groundwater influenced redd was estimated to occur around 28 May, but probably occurred earlier according to observations.

In 2009, results were obtained from three boxes/loggers. Two of these were from redds placed shallowly and one redd deeper in the substrate. Two shallow locations are shown because the temperature measurements showed that one of these had the highest and more stable temperature during winter, which also demonstrates the creation by groundwater influxes of a horizontal and vertical mosaic in winter temperatures (Fig. 3).

One of the boxes in one of two the shallow redds had the highest temperature from start of the experiments and until mid April, seldom falling below 4°C (Fig. 3). The lowest temperature was recorded in the other shallow redd, while a somewhat higher temperature was recorded at the box in the redd deeper in the substrate. The temperature in this deeper redd also showed higher variation in temperature, indicating a greater influence from surface water. In the eggs in the box with the highest temperature

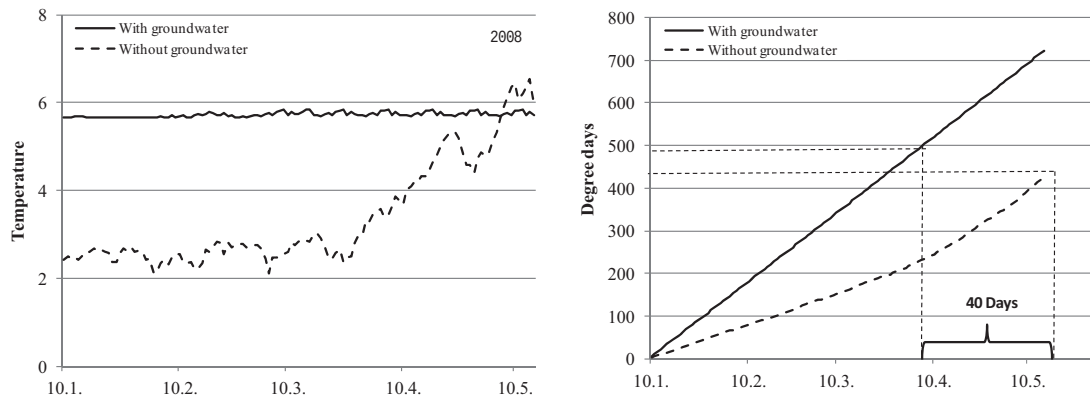


Fig. 2. Temperature and estimated hatching time in a redd with groundwater influx and in substrate with surface river water in the river, Suldalslågen, Western Norway.

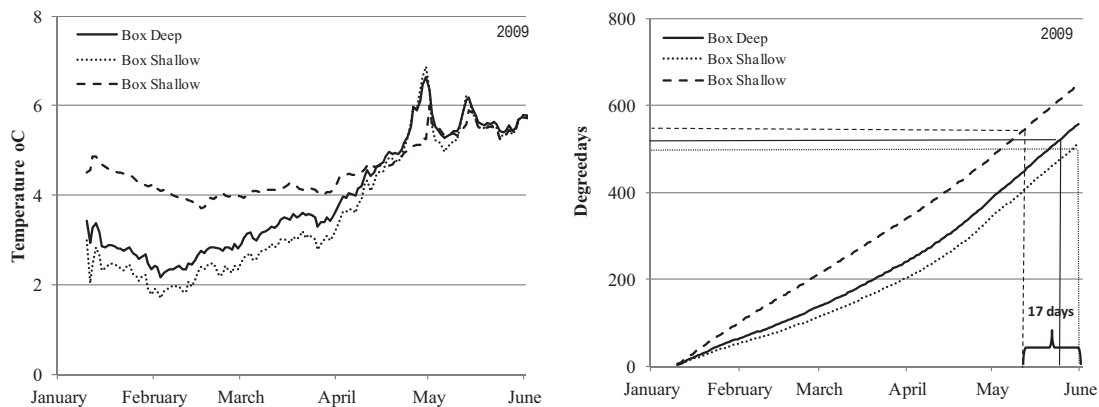


Fig. 3. Temperature and hatching time in three two-compartment Whitlock–Vibert boxes within (deep) and above (shallow) spawning redds in the river, Suldalslågen, Western Norway.

during winter, hatching were observed on 29 April after 473 degree days, while the two others hatched (estimated) on 11 May (443 degree days) and 15 May (429 degree days), respectively, a difference of 17 days between the first and the last to hatch. “Swim up” was estimated to occur between 24 June and 30 June.

Survival of eggs

The water level was very stable during the whole study period from 10 January to 1 May, only increasing ca. 7 cm for a short period at the end of March, which means that the eggs in the dry river bed were not inundated before 1 May (Fig. 4). Then the first artificial spring flow of $40 \text{ m}^3 \text{ s}^{-1}$ increased the water level by ca. 55 cm, inundating the eggs placed in the dry river until the experiment was terminated on 1 June.

The air temperature during the study period varied from -8°C at the end of January to $+18^\circ\text{C}$ in the beginning of May, although below zero for long periods in January, February and March (Fig. 4). River water temperature was fairly stable from start of the experiments until the beginning of April, only varying between 1.5 and 2.5°C , subsequently slightly increasing to 6°C in the end of April, then declining due to the increase in flow.

The temperature measured close to the egg box in the dry river bed was between air temperature and temperature in the groundwater from the start of the experiment until 1 May, reaching a maximum of ca. 10°C at the end of April. Thereafter the temperatures by the egg box were close to the temperature of the river water. Temperatures below zero by the egg box in a 14-day period in February were due to a slight spatial difference (about 2 cm) in the placement of the logger and the surviving eggs in the gravel.

Approximately the same number of eggs in the dry river bed box as in the box within the river survived from fertilization until the end of April, 49 and 50 live eggs, respectively. For larvae at the eye stage, there was ca. 91% survival in both boxes (Table 1). However, the eggs in the dry river bed showed a higher mortality towards hatching. Of 49 eggs reaching the eye stage, 25 had hatched by 1

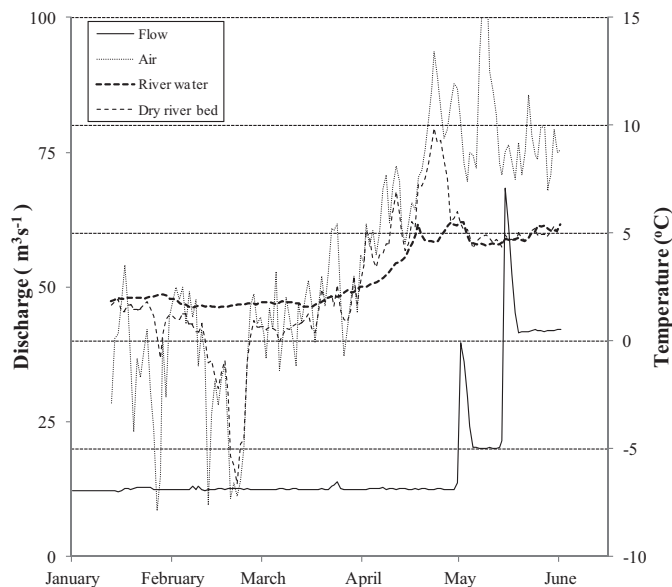


Fig. 4. Discharge, air temperature, river water temperature and temperature in the dewatered river bed in the river, Suldalslågen, from mid January to 1 June 2011.

Table 1

Number and percentage of eggs surviving from fertilization to eye stage and hatching in a dry river bed with groundwater influx and within the river (as reference) during a permanent drawdown period from 13 January to 30 April in the river, Suldalslågen. One egg in the dry river bed box was dead and removed before initiation of the experiment.

SITE	Fertilized	Eye stage		Hatching	
	<i>n</i>	<i>n</i>	%	<i>n</i>	%
Dry river bed	54	49	90.7	31	57.4
River water	55	50	90.9	50	90.9

June, while the remaining 6 hatched on 2 June, i.e. a survival rate of 57% from fertilizing to hatching (Table 1). The eggs in the river had no additional mortality towards hatching, i.e. a survival rate of 91% from fertilization until hatching.

Discussion

In general, Atlantic salmon spawn in the autumn by burying their eggs in river gravels, the eggs hatching in spring when a particular heat sum has been reached. The alevins stay in the gravel until they have absorbed their yolk-sac and then emerge from the substratum, ready for external feeding. Furthermore, to ensure the optimal time for external feeding, the time of peak spawning must be linked to incubation time. It might be expected that time of spawning is an adaptation to local river temperature conditions, meaning that salmon living in cold rivers spawn earlier than those living in warmer rivers. In Norway, considerable variation in spawning time has been found even within relatively small geographical areas (Heggberget, 1988), indicating variation in thermal regimes in rivers depending on the local environment. The influx of groundwater might be one local factor of decisive importance, varying with local quaternary geological structures and hinterland topography. There might be local adaptations in spawning time to particular temperature regimes, a crucial factor for individual breeding success (Godin, 1982; Heggberget, 1988; Jensen et al., 1991). This more or less fixed spawning time probably has a genetic basis, rendering salmon populations vulnerable to environmental impacts that lead to changes in water temperature, like river regulation and climate change.

Of 16 studied Norwegian rivers, there were none with a salmon population spawning later than in the Suldalslågen (Heggberget, 1988). Peak spawning was reported to occur between 5 and 12 January, but with a spawning period of 27 days. Late spawning is probably an adaptation to the fact that Suldalslågen is a winter warm river, with a mean winter temperature (January–April) before regulation of 2.6 °C. The high temperature is probably due to its coastal position, but also to the fact that it receives water from the large lake, Suldalsvatn, and probably also from groundwaters. A similar adaptation to the winter thermal regime to ensure optimal time of hatching and initial feeding of the young salmon is also seen in the river Vosso, where peak spawning occurs in December and is related to a mean temperature during incubation of 2.4 °C from December to April (Lura and Sægrov, 1993).

Based on data from the local hatchery, egg development from fertilizing to hatching and swim up of the Suldalslågen salmon population are in accordance with the models of Crisp (1981, 1988) and Jensen et al. (1989). From these models Jensen et al. (1991) estimated swim up in Suldalslågen to occur as late as between 27 June and 4 July, based on spawning in the beginning of January and surface river water temperature. However, based on the finding of eyed eggs and yolk sac alevins in the spawning redds at the end of April, a “swim up” should occur in the beginning of June (Saltveit et al., 1995). This estimate is in accordance with *in situ* observations of the first free swimming YoY in the river. In 1962–1964, before its

regulation, free living alevins with yolk sac remains were present in Suldalslågen at the end of May, early June (Lillehammer, 1973) and drifting juveniles were recorded at the same time in 1991–2003 (Saltveit et al., 1995). Newly emerged fry still had remains of yolk sac and with a size between 26 and 30 mm (mean 28.5 ± 0.3 mm) were found in the Suldalslågen from the end of May to the beginning of June. Thus, the alevins of salmon start to emerge from the gravel far earlier than estimated from models using surface river water temperature.

The first regulation of the river Suldalslågen in 1966–1967 resulted in a small increase in temperature, ca. 100 degree days, mainly during winter due to an increase in flow (Magnell et al., 2004), while the second regulation in 1980 gave a decrease during winter (Tvede, 1995), on a year basis 200 degree days lower relative to upregulated conditions. Despite this, the emergence period of juvenile salmon in Suldalslågen seemed to remain constant. Based on this stability one can conclude that there are no temperature effects on emergence, and that no changes in emergence time will result from possible climate change.

The most obvious explanations to the divergence between observed and model estimated hatching and “swim up” is the higher temperature in spawning redds (compared to surface river water) due to influx of groundwater. Groundwater is also the most plausible explanation for the stability in emergence despite a changing temperature regime due to the regulations. In contrast to surface river water, characterized by varying discharge and temperatures, alluvial groundwater systems are more stable (e.g. Brunke and Gonser, 1997; Power et al., 1999; Sear et al., 1999). There are no measurement of hyporheic temperatures from Suldalslågen. Using the same models for a back calculation from observed “swim up”, the temperature in the spawning redds with emergence in the end of May must be 2–3 °C higher than in the surface river water with spawning in January (Jensen and Tvede, 2003). It is reasonable to believe that groundwater seepage during egg incubation in the winter months gives a higher temperature with less variation. In earlier times local people have linked the early hatching of juvenile Atlantic salmon in Suldalslågen to groundwater influx areas within the river (Slagstad, pers. com.).

When emerging from the gravel at the end of May/beginning of June, the alevins avoid being swept away during the mountain snowmelt flood ($>500\text{--}600\text{ m}^3\text{ s}^{-1}$) during the second half of June. The benefit of early emergence may be an intrinsic measure against the risk of encountering harsh conditions early in the season (Letcher et al., 2004). However, there are many other ecological implications that favour an earlier emergence. Since mortality appears to be highest for small fry and for the latest fry to emerge from the gravel, it might also be advantageous to initiate feeding as early as possible during ontogenetic development, and increase the chance of maintaining territory (Einum and Fleming, 2000). Traits affecting emergence phenology may therefore evolve to optimize environmental and competitive conditions. Such adaptations have been suggested to cause the observed variation in spawning times among salmon populations in Norway (Heggberget, 1988), causing juveniles in rivers with contrasting thermal regimes to experience relatively similar seasonal conditions at emergence (Jensen et al., 1991).

For Atlantic salmon, the timing of hatching and emergence from the gravel will depend largely upon spawning time and the temperature conditions during egg incubation. Environmental perturbations like hydropower development and climate change may affect seasonal parameters important to Atlantic salmon life cycle events, and may in the case of incubation and emergence time cause a mismatch to optimal feeding conditions for offspring (Skoglund et al., 2011b,c). If river winter temperatures increase due to hydropower regulation, this may cause earlier emergence from the redds and at lower water temperatures, given that spawning

time is the same. In contrast, a decrease in water temperature may delay hatching and shorten the growth season. Thus, both scenarios may possibly negatively affect survival (Einum and Fleming, 2000).

The effects of temperature on fish embryos and larval development are well described (Kamler, 1992), but less is known on temperature effects on the success of initial exogenous feeding. Mean daily river water temperature during emergence in Suldalslågen varied between years from 5.2 to 9.1 °C, minimum temperatures from 4.2 to 7.9 °C (Saltveit et al., 1995). Temperature has a strong effect on activity, feeding, and growth in Atlantic salmon (Forseth et al., 2001; Jonsson et al., 2001). Low temperatures, as those found in Suldalslågen during emergence, do not represent any physiological limitation for initiation of feeding or exhibiting any other appropriate behaviours for the alevins (Skoglund et al., 2011b). Further, lower temperatures experienced prior to emergence from the redds caused fry to emerge at a smaller size but with a larger yolk sac, and hence with more endogenous energy reserves. This response may be an important mechanism when dealing with inter-annual environmental variation (Skoglund et al., 2011c). It has also been shown that early emerging Atlantic salmon offspring outperformed later emerging juveniles in both semi-natural environments and in the wild, and that the performance advantage of early emerging offspring increased with increasing density (Skoglund et al., 2011a). They also suggest that low temperatures during emergence from redds do not represent a strong selective force against early juvenile emergence. For Suldalslågen this implies that those alevins with an earlier emergence at lower temperature have the same or even probably a greater change of survival than those with emergence late in June.

Many, perhaps most rivers and streams are characterized by both vertical and longitudinal spatial heterogeneity within the streambed, with surface waters and groundwaters closely connected in the hyporheic ecotone (e.g. Malard et al., 2002; Boulton, 2007). Leek et al. (2009) concluded that this high level of spatial heterogeneity, directly affecting surface- and groundwater exchange, can have ecological implications for reproduction of gravel spawning fish. Groundwater creates a horizontal and vertical mosaic of temperatures in spawning redd areas leading to a greater variation in selection of spawning sites. For Suldalslågen this is probably the explanation for the large variation found in time of hatching and “swim up” of eggs spawned at the same time. This variation is an advantage for this population living in a harsh environment characterized by the considerable variation in flood timing and magnitude, by spreading population risk.

High flows during spawning may lead salmon to spawn in areas that become dewatered when the flow declines. Normally this will cause increased mortality due to desiccation or freezing. Even if not dewatered, low flows may also increase mortality due to low current speed and oxygen deficit (Gibson and Myers, 1988). In the regulated river Bjoreio, Western Norway, the number of dewatered redds and egg survival was a direct function of flow regime from spawning in December to “swim up” the following spring (Skoglund et al., 2012). In this river the mortality was 100% in those redds that became stranded during the incubation period. Redds may also become stranded for longer or shorter periods during hydropeaking situations in regulated rivers.

Groundwater is certainly not a requirement for redd site selection and egg survival (Acornley, 1998). Groundwater may in some cases be relatively poor in oxygen and decrease egg survival (Soulsby et al., 2005), while in other cases provide oxygen combined with a benign thermal environment and thereby increase survival (Garrett et al., 1998; Baxter and McPhail, 1999; Hannah et al., 2004; Greig et al., 2007). Much of the water in Norwegian rivers derives from groundwater (Colleuille et al., 2005), and in low flow periods groundwater may constitute 40–100% of the total river run off,

which is significant for water quality and water temperature. During low flows the interface between surface and groundwater will therefore change, with groundwater becoming more important.

As groundwater influx to spawning redds is likely to increase egg survival for kokanee (*O. nerka*) and bull trout (*S. confluentus*) embryos (Garrett et al., 1998; Baxter and McPhail, 1999), we therefore suggest that groundwater influx by providing sufficient flow and oxygen to spawning sites, could reduce egg mortality from freezing during low flow periods or during longer and shorter desiccation events during drawdown periods, such as wintertime hydropeaking.

The unregulated Suldalslågen had very large seasonal variations in discharge, with a minimum discharge during winter as low as 3 m³ s⁻¹. The lowest flow occurred in general during late winter, normally in February–March, i.e. after the spawning in January. In general the flow was higher in January during spawning then later in the winter, meaning that areas with spawning nests could be dewatered, with egg mortality as the consequence. Also, the natural lowest flow in most Norwegian rivers usually occurs during late winter, and may in some rivers be extremely low. Egg freezing was therefore a possible consequence for Atlantic salmon in Suldalslågen during winter, but the embryo mortality was probability minimized where spawning occurred in a location with groundwater influx.

River regulation changes the relative importance of groundwater and surface water interaction. This crucial knowledge needs to be used actively in the management of regulated rivers, not only to reduce egg mortality, but also to achieve optimal hatching time for salmonids. Thus, the interaction between groundwater and surface river water should be actively considered when managing fish populations in regulated rivers.

Acknowledgements

We are grateful to the staff at the Suldal River Owner's Association, Øyvind Vårvik and Sigmund Vårvik, for providing the eggs for this study, and to Henning Pavels for assistance in the field and to John E. Brittain for comments and improving the language. The research programme Centre for Environmental Design of Renewable Energy (CEDREN), financed by major Norwegian energy companies and the Research Council of Norway – RCN Contract 201779, provided the financial support.

References

- Acornley, R.M., 1998. Water temperatures within spawning beds in two chalk streams and implications for salmonid egg development. *Hydrol. Proc.* 13, 439–446.
- Baxter, J.S., McPhail, J.D., 1999. The influence of redd site selection groundwater upwelling, and over-winter incubation temperature on survival of bull trout (*Salvelinus confluentus*) from egg to alevin. *Can. J. Zool.* 77, 1233–1239.
- Borgström, R., Museth, J., 2005. Accumulated snow and summer temperature – critical factors for recruitment to high mountain populations of brown trout (*Salmo trutta*). *Ecol. Freshw. Fish* 14, 375–384.
- Boulton, A.J., 2007. Hyporheic rehabilitation in rivers: restoring vertical connectivity. *Freshw. Biol.* 52, 632–650.
- Brabrand, Å., Koestler, A.G., Borgström, R., 2002. Lake spawning of brown trout related to groundwater influx. *J. Fish Biol.* 60, 751–763.
- Brunke, M., Gonser, T., 1997. The ecological significance of exchange processes between rivers and groundwater. *Freshw. Biol.* 37, 1–33.
- Colleuille, H., Dimakis, P., Wong, W.K., 2005. Elv og grunnvann. Sluttrapport-Oppsummering og anbefalinger. In: NVE rapport Miljøbasert vannføring 8-2005, 39 pp. (in Norwegian).
- Crisp, D.T., 1981. A desk study of the relationship between temperature and hatching time for the eggs of five species of salmonid fishes. *Freshw. Biol.* 11, 361–368.
- Crisp, D.T., 1988. Prediction from temperature, of eyeing, hatching and swim up times for salmonid embryos. *Freshw. Biol.* 19, 41–48.
- Crowder, D.W., Diplas, P., 2002. Vorticity and circulation: spatial metrics for evaluating flow complexity in stream habitats. *Can. J. Fish. Aquat. Sci.* 59, 633–645.
- Douglas, T., 2006. Review of Groundwater–Salmon Interactions in British Columbia Vancouver. Watershed Watch Salmon Society and Water & Duncan Gordon Foundation.

- Einum, S., Fleming, I.A., 2000. Implications of stocking: ecological interactions between wild and released salmonids. *Nordic J. Freshw. Res.* 75, 56–70.
- Forseth, T., Hurley, M.A., Jensen, A.J., Elliott, J.M., 2001. Functional models for growth and food consumption of Atlantic salmon parr, *Salmo salar*, from a Norwegian river. *Freshw. Biol.* 46, 173–186.
- Garrett, J.W., Bennett, D.H., Clarke, L.R., 1998. Enhanced incubation success for kokanee spawning in groundwater upwelling sites in a small Idaho stream. *N. Am. J. Fish. Manage.* 18, 925–930.
- Godin, J.-G.J., 1982. Migrations of salmonid fishes during early life history phases: daily and annual timing. In: Brannon, E.L., Salo, E.O. (Eds.), *Proceedings of the Salmon and Trout Migratory Behavior Symposium*. Seattle, WA, University of Washington, pp. 22–50.
- Gibson, R.J., Myers, R.A., 1988. Influence of seasonal river discharge on survival of juvenile Atlantic salmon, *Salmo salar*. *Can. J. Fish. Aquat. Sci.* 45, 344–348.
- Greig, S.M., Sear, D.A., Carling, P.A., 2007. A review of factors influencing the availability of dissolved oxygen to incubating salmonid embryos. *Hydrol. Proc.* 21, 323–334.
- Hansen, E.A., 1975. Some effects of groundwater on brown trout redds. *Trans. Am. Fish. Soc.* 104, 100–110.
- Hannah, D.M., Malcolm, I.A., Soulsby, C., Youngson, A.F., 2004. Heat exchanges and temperatures within a salmon spawning stream in the Cairngorms, Scotland. Seasonal and subseasonal dynamics. *River Res. Appl.* 20, 635–652.
- Heggberget, T.G., 1988. Timing of spawning in Norwegian Atlantic Salmon (*Salmo salar*). *Can. J. Fish. Aquat. Sci.* 45, 845–849.
- Heggenes, J., Bremset, G., Brabrand, Å., 2010. Groundwater, critical habitats, and behaviour of Atlantic salmon, brown trout and Arctic char in streams. In: NINA Rapport 654, p. 28.
- Jensen, A.J., Johnsen, B.O., 1999. The functional relationship between peak spring floods and survival and growth of juvenile Atlantic Salmon (*Salmo salar*) and Brown Trout (*Salmo trutta*). *Funct. Ecol.* 13, 778–785.
- Jensen, A.J., Johnsen, B.O., Saksgård, L., 1989. Temperature requirements in Atlantic salmon (*Salmo salar*) brown trout (*Salmo trutta*), and Arctic char (*Salvelinus alpinus*) from hatching to initial feeding compared with geographic distribution. *Can. J. Fish. Aquat. Sci.* 46, 786–789.
- Jensen, A.J., Johnsen, B.O., Heggberget, T.G., 1991. Initial feeding time of Atlantic salmon, *Salmo salar*, alevins compared to river flow and water temperature in Norwegian streams. *Environ. Biol. Fishes* 30, 379–385.
- Jensen, C.S., Tvede, A.M., 2003. Laks, ørret og vanntemperatur i Suldalslågen. In: Suldalslågen-Miljørapport 21, 25 pp. (in Norwegian).
- Jonsson, B., Forseth, T., Jensen, A.J., Næsje, T.F., 2001. Thermal performance of juvenile Atlantic salmon, *Salmo salar* L. *Funct. Ecol.* 15, 701–711.
- Kamler, E., 1992. *Early Life History of Fish: An Energetics Approach*. Chapman and Hall, London, UK.
- Koestler, A.G., Brabrand, Å., 2001. Grunnvann som mulig årsak til mislykkede rotenonbehandlinger. *Vann* 1, 29–35 (in Norwegian).
- Leek, R., Wu, J.Q., Wang, L., Hanrahan, T.P., Barber, B.E., Qiu, H., 2009. Heterogeneous characteristics of streambed saturated hydraulic conductivity of the Touchet River, south eastern Washington, USA. *Hydrol. Proc.* 23, 1236–1246.
- Letcher, B.H., Dubreuil, T., O'Donnell, M.J., Obedzinski, M., Griswold, K., Nislow, K.H., 2004. Long-term consequences of variation in timing and manner of fry introduction on juvenile Atlantic salmon (*Salmo salar*) growth, survival, and life-history expression. *Can. J. Fish. Aquat. Sci.* 61, 2288–2301.
- Lillehammer, A., 1973. An investigation of food of one to four month old salmon fry (*Salmo salar* L.) in the river Suldalslågen, West Norway. *Norw. J. Zool.* 21, 17–24.
- Lura, H., Sægrov, H., 1993. Timing of spawning in cultured and wild Atlantic salmon (*Salmo salar*) and brown trout (*Salmo trutta*) in the River Vosso, Norway. *Ecol. Freshw. Fish* 2, 167–172.
- Magnell, J.-P., Sandsbråten, K., Kvambekk, Å.S., 2004. Hydrologiske forhold i Suldalsvassdraget. Sluttrapport prøvereglement. In: Suldalslågen-Miljørapport 38, 100 pp. (in Norwegian).
- Malard, F., Tockner, K., Dole-Olivier, M.-J., Ward, J.V., 2002. A landscape perspective on surface–subsurface hydrological exchanges in river corridors. *Freshw. Biol.* 47, 621–640.
- Malcolm, I.A., Soulsby, C., Youngson, A.F., Tetzlaff, D., 2009. Fine scale variability of hyporheic hydrochemistry in salmon spawning gravels with contrasting groundwater–surface water interactions. *Hydrogeol. J.* 17, 161–173.
- Power, G., Brown, R.S., Imhof, J.G., 1999. Groundwater and fish – insights from northern North America. *Hydrol. Proc.* 13, 401–422.
- Saltveit, S.J., Bremnes, T., Landaas, O.R., 1995. Effect of sudden increase in discharge in a large river on newly emerged Atlantic salmon (*Salmo salar*) and brown trout (*Salmo trutta*) fry. *Ecol. Freshw. Fish* 4, 168–174.
- Saltveit, S.J., Halleraker, J.H., Arnekleiv, J.V., Harby, A., 2001. Field experiments on stranding in juvenile Atlantic salmon (*Salmo salar*) and brown trout (*Salmo trutta*) during rapid flow decreases caused by hydropeaking. *Regul. Rivers: Res. Manage.* 17, 609–622.
- Sear, D.A., Armitage, P.D., Dawson, F.H., 1999. Groundwater dominated rivers. *Hydrol. Proc.* 13, 255–276.
- Skoglund, H., Einum, S., Robertsen, G., 2011a. Competitive interactions shape offspring performance in relation to seasonal timing of emergence in Atlantic salmon. *J. Anim. Ecol.* 80, 365–374.
- Skoglund, H., Einum, S., Forseth, T., Barlaup, B.T., 2011b. Phenotypic plasticity in physiological status at emergence from nests as a response to temperature in Atlantic salmon (*Salmo salar*). *Can. J. Fish. Aquat. Sci.* 68, 1470–1479.
- Skoglund, H., Einum, S., Forseth, T., Barlaup, B.T., 2011c. The penalty for arriving late in emerging salmonid juveniles: differences between species correspond to their interspecific competitive ability. *Funct. Ecol.* 26, 104–111.
- Skoglund, H., Barlaup, B.T., Gabrielsen, S.-E., Lehmann, G.B., Halvorsen, G.A., Wiers, T., Skår, B., Pulg, U., Vollset, K.W., 2012. Fiskebiologiske undersøkelser i Eidfjordvassdraget–sluttrapport for perioden 2004–2012. LFI-Unifob Rapport 203, 108 pp. (in Norwegian).
- Soulsby, C., Malcolm, I.A., Youngson, A.F., Tetzlaff, D., Gibbins, C.N., Hannah, D.M., 2005. Groundwater–surface water interactions in upland Scottish rivers: hydrological hydrochemical and ecological implications. *Scott. J. Geol.* 41, 39–49.
- Tvede, A.M., 1995. Vanntemperaturen i Suldalslågen. Forholdet mellom vanntemperatur, vannføring og værforhold i perioden 15. april–15. juni. In: Rapport Lakseforsterkningsprosjektet 6, 16 pp. (in Norwegian).
- Wallace, J.C., Heggberget, T.G., 1988. Incubation of eggs of Atlantic salmon (*Salmo salar*) from different Norwegian streams at temperatures below 1 °C. *Can. J. Fish. Aquat. Sci.* 45, 193–196.
- Whitlock, D., 1977. *The Whitlock Vibert Box Handbook*. Federation of Fly Fisherman, West Yellowstone.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Thursday, April 03, 2014 4:33 PM
To: 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; 'Miller, Monte D (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; 'Eric Rothwell'; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'
Cc: Emily Andersen; 'Mike Salzetti'; Cory Warnock
Subject: Next meeting if Instream Flow Workgroup
Attachments: Final minutes for IFWG meeting 03-27-2014.docx

Good afternoon:

Jason, thanks for sending along a copy of the article on incubation. Should make for interesting reading!

Here are final meeting minutes for our conference call last week. We have been working on revising several study requests and compiling the information that has been requested.

Will everyone look at their schedules and see if a next conference call would work for any of these dates: April 17, 18, 23, 24 or 25.

Thanks very much.

John

John Blum
Sr. Fisheries Scientist

From: Mouw, Jason E B (DFG) [<mailto:jason.mouw@alaska.gov>]
Sent: Thursday, April 03, 2014 11:19 AM
To: John Blum; Klein, Joseph P (DFG); Miller, Monte D (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; 'Eric Rothwell'
Cc: 'Mark Miller'; 'Emily Andersen'; 'Mike Salzetti'; 'Cory Warnock'; 'John Stevenson'
Subject: RE: Revised Grant Creek Periodicity Chart

John et al.,

In our teleconference the other day, I agreed to forward a paper discussing incubation (see attached). The following sentence from the abstract is what caught my attention:

“Eggs placed in boxes in ground water seepage areas during winter in the dewatered river bed survived even when covered by ice and snow.”

Saltveit and Brabrand (2013) performed egg-box experiments to evaluate embryonic dynamics, as related to intragravel flow, which they refer to as groundwater. This study might be worth the groups consideration.

Just FYI,

Jason

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Friday, March 28, 2014 1:52 PM

To: 'Eric Rothwell'; Klein, Joseph P (DFG); Miller, Monte D (DFG); Mouw, Jason E B (DFG); jeffry_anderson@fws.gov; dglass@ciri.com

Cc: 'Mark Miller'; 'Emily Andersen'; 'Mike Salzetti'; 'Cory Warnock'; 'John Stevenson'

Subject: Revised Grant Creek Periodicity Chart

Good afternoon:

Mark Miller just sent me a revised Grant Creek periodicity chart. Please use this one for editing, and please add the date to the chart, so we can track its progress.

Thanks, and have a good weekend!

John

John Blum

Sr. Fisheries Scientist

Final
Conference call with the Grant Creek Instream Flow Work Group
March 27, 2014

Those attending via conference call:

- Eric Rothwell (NOAA)
- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- Jeff Anderson (USFWS)
- Mark Miller (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 10:00 am PDT. John mentioned that the purpose of this, and subsequent meetings, was to provide data to the resource managers to answer questions related to the proposed Grant Lake Hydroelectric Project. It is KHL's intent to provide this information in a timely fashion, so that subsequent meetings with the Aquatic Work Group (AWG), to be held in June/July, can focus on different operating scenarios and potential PM&E measures, rather than use the meetings to present data.

To start the process, John sent out a draft agenda on Wednesday, March 26. Agenda items are briefly detailed below.

PERIODICITY OF GRANT LAKE SALMONIDS

Mark Miller reviewed the periodicity chart that he had put together for Grant Creek; these data were derived from Grant Creek observations in 2009 and 2013. Jeff requested that Sockeye Salmon fry be added to the periodicity chart. *[Note: draft periodicity for Sockeye Salmon fry from mid-May through the end of the first week of August.]*

Emergence Timing: Unsure of emergence timing for Sockeye Salmon fry; DTU's to be determined.

Coho juvenile rearing: Jeff stated his concern that we still don't know where juvenile Coho are located nor do we know what habitat types they are using. This is an unresolved issue. Monte said that since we have made Coho juvenile rearing to extend year round, we are taking a conservative approach and that addresses ADFG's concerns.

To Do:

- Mark to add row for Sockeye Salmon fry to periodicity chart

- Jason to provide Robert Begich a copy of the periodicity chart, so that Robert can tweak it. Jason will then provide this revised table to the group
- Jason to ask Robert Begich about Kenai River Sockeye Salmon DTUs for incubation
- Monte to ask Hatchery group about Sockeye Salmon DTUs, and
- John to ask Tom Prochazka (CIAA Trail Lakes Hatchery) re: Trail Lakes Sockeye Salmon DTUs

PRIORITY SPECIES

Discussion centered on developing a priority species list, with the goal of streamlining the analysis process. The group agreed that, for different time periods, different species and life stages may take precedence, and that providing flows that maximized spawning habitat, for example, might be deleterious to other life history stages. It was determined that, for the time being, John would run all species and life stages for the time periods (to be established once the periodicity chart is finalized); once that is done, the group would then make decisions re: priority species and life history stages.

TRANSECT SELECTION AND WEIGHTING

One of John's questions was how to weight and consider different transects. As an initial cut, John produced WUA curves for all species and life history stages at all transects. John asked if there were priority transects, and a way that we could drill down into the data and produce information the group wanted.

Jason suggested that, for spawning, a broad brush overview would be a good starting point. Cory mentioned that our database allows us to superimpose layers of spawning salmonids over the transects, to determine where the majority of the spawning was occurring, and which transects were most important (from a spawning perspective). Once that was done, John will produce transect profiles, showing the bed, locations of spawning substrates and spawning salmonids. This will provide information re: how heavily spawned areas are, as well as impacts (i.e., potential susceptibility of eggs deposited along the margins to reduction in flows).

Eric also asked that we use the IFIM data to put Grant Creek juvenile habitat in context. One area of examination is the ability to have lateral connectivity during the summer, although it may not be as important in the winter with the reduced flows.

To Do:

- Cory to produce GIS layers superimposing Grant Creek spawning over IFIM transects
- Mark, John Stevenson and John B to get together to refine those layers and select transects and areas of most importance (both for spawning and juvenile rearing)
- John B to produce cross sectional detail re: position of spawners in location to stream (i.e., along banks, middle of the channel, etc.)

- John B to produce the same analysis for juveniles, with special attention to lateral connectivity, and
- John B to provide Wetted Perimeter (WP) vs. flow graphs for each transect.

EFFECTIVE SPAWNING ANALYSIS

There was a good discussion, lead by Monte and Jason re: effective spawning analysis in streams in Alaska, where winter ice provides pressure across the entire stream and provides inter-gravel flow even when there is little surface water. Monte mentioned that sockeye eggs are typically deposited about 1.2 ft below the stream bed's surface, and in other systems, fry may burrow down to a depth of 3 feet prior to emergence. That may not be the case here, however, due to stream armoring.

John mentioned that there are several components that need to be in place before the effective spawning analysis can be conducted:

- We will need spawning periodicity finalized, so that we can break out those time periods
- Hydrologic record
- Incubation periodicity for all species

John mentioned that he would like to be able to examine effective spawning analysis over a range of flows. He suggested that there were likely wet, normal and dry years, and that he'd like to the three scenarios for the group. He suggested looking at Grant Lake hydrology, and running the 20%, 50% and 80% exceedance values to cover the range of extremes that might be encountered.

There was the concern expressed that the period of record for Grant Creek (11 years historically, and the current year of data) should be expanded. Monte suggested using the Kenai River gage, since it had a strong correlation to Grant Creek and has an overlapping 60 year period of record. Another option might be the use of the Trail River data; however, the period of record is longer for the Kenai River. Joe Klein had also recommended this at the meeting last week.

To Do:

- McMillen to expand the period of record for Grant Creek.
- John to produce effective spawning analysis once periodicity, transects, and hydrology have been finalized.
- Jason to provide a copy of the study examining ice pressure and incubation on Alaska streams.

RAMPING RATES

John asked if there was a standard in Alaska for ramping rates for salmonids. Both Monte and Eric stated that usually, projects ended up using Hunter (1992) for ramping rate analyses in Alaska. John said he had a copy of this report and would use it for the analysis, once the operational plan and flows were established. Even though Grant Creek has a fairly stable base flow, which would lessen the impacts, the bigger issue might be spin.

To Do:

- John will use Hunter (1992) to examine ramping rates for the Grant Creek project. He will conduct the analysis once the range of operational flows are established.

HABITAT TIME SERIES

John agreed to do a habitat time series analysis for the species and life history stages that the group wants analyzed. In order to do this analysis, he will need:

- Finalized periodicity for the species and life history stages of concern in Grant Creek
- Identified transects to use for spawning and rearing
- Long term synthesized hydrologic record, and
- Long term synthesized hydrologic record for operational flows.

OTHER DATA REQUIRED BY INSTREAM FLOW WORK GROUP

- Operational Plan. Monte requested a copy of the operational plan as it is developed
- Tailrace Impacts on Reach 4. The last series of maps (presented at the meeting last week) indicated that the return flows from the powerhouse could impact the upper extent of rearing in spawning in Grant Creek.

INCLUSION IN THE INSTREAM FLOW WORK GROUP

- Eric requested that Sue Walker be added to the Instream Flow Work Group
- Monte was going to check with Robert Begich and Jenny Litchfield to find out if they wanted to be part of this group as well.

NEXT MEETING

John suggested that the next meeting be held sometime during the week of April 14; due to potential conflicts with another project (April 15 – 17), this might have to be delayed.

To Do:

- John will send out a notice for the next meeting, asking when people will be available

From: Anderson, Jeffry <jeffry_anderson@fws.gov>
Sent: Friday, April 04, 2014 10:58 AM
To: John Blum
Cc: Mouw, Jason E B (DFG); Klein, Joseph P (DFG); Miller, Monte D (DFG); Eric Rothwell; susan.walker@noaa.gov; Mark Miller; John Stevenson; Emily Andersen; Mike Salzetti; Cory Warnock; Dara Glass
Subject: Re: Next meeting if Instream Flow Workgroup

Hi John. Unfortunately, I have conflicts for both of those weeks and won't be able to participate in the next meeting.

-- Jeff

Jeffry Anderson
Field Supervisor
USFWS, Kenai Fish & Wildlife Field Office
43655 Kalifornsky Beach Road, Soldotna, AK 99669
Office: 907-260-0132
Cell: 907-252-4896

On Thu, Apr 3, 2014 at 3:44 PM, Dara Glass <dglass@ciri.com> wrote:

April 18 or April 23 work for me.

I appreciate you asking!

Dara Glass

CIRI Land Manager

Direct: 907.263.5140

Cell: 907.229.7052

From: John Blum [mailto:john.blum@mcmillen-llc.com]
Sent: Thursday, April 03, 2014 3:33 PM
To: 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; 'Miller, Monte D (DFG)'; jeffry_anderson@fws.gov; Dara Glass; 'Eric

Rothwell'; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'

Cc: 'Emily Andersen'; 'Mike Salzetti'; 'Cory Warnock'

Subject: Next meeting if Instream Flow Workgroup

Good afternoon:

Jason, thanks for sending along a copy of the article on incubation. Should make for interesting reading!

Here are final meeting minutes for our conference call last week. We have been working on revising several study requests and compiling the information that has been requested.

Will everyone look at their schedules and see if a next conference call would work for any of these dates: April 17, 18, 23, 24 or 25.

Thanks very much.

John

John Blum

Sr. Fisheries Scientist

From: Mouw, Jason E B (DFG) [<mailto:jason.mouw@alaska.gov>]

Sent: Thursday, April 03, 2014 11:19 AM

To: John Blum; Klein, Joseph P (DFG); Miller, Monte D (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; 'Eric Rothwell'

Cc: 'Mark Miller'; 'Emily Andersen'; 'Mike Salzetti'; 'Cory Warnock'; 'John Stevenson'

Subject: RE: Revised Grant Creek Periodicity Chart

John et al.,

In our teleconference the other day, I agreed to forward a paper discussing incubation (see attached). The following sentence from the abstract is what caught my attention:

“Eggs placed in boxes in ground water seepage areas during winter in the dewatered river bed survived even when covered by ice and snow.”

Saltveit and Brabrand (2013) performed egg-box experiments to evaluate embryonic dynamics, as related to intragravel flow, which they refer to as groundwater. This study might be worth the groups consideration.

Just FYI,

Jason

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Friday, March 28, 2014 1:52 PM
To: 'Eric Rothwell'; Klein, Joseph P (DFG); Miller, Monte D (DFG); Mouw, Jason E B (DFG); jeffry_anderson@fws.gov; dglass@ciri.com
Cc: 'Mark Miller'; 'Emily Andersen'; 'Mike Salzetti'; 'Cory Warnock'; 'John Stevenson'
Subject: Revised Grant Creek Periodicity Chart

Good afternoon:

Mark Miller just sent me a revised Grant Creek periodicity chart. Please use this one for editing, and please add the date to the chart, so we can track its progress.

Thanks, and have a good weekend!

John

John Blum
Sr. Fisheries Scientist

Subject: Grant Lake Bi-Weekly Instream Flow Workgroup Call

Start: Fri 4/18/2014 9:00 AM
End: Fri 4/18/2014 11:00 AM
Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Organizer: Cory Warnock
Required Attendees: Monte Miller; Jason Mouw; Joe Klein; Jeffry Anderson (Jeffry_Anderson@fws.gov); dglass@ciri.com; Susan Walker; John Stevenson; John Blum; Mike Salzetti; Emily Andersen

1. Please join my meeting.

<https://global.gotomeeting.com/join/164896661>

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

Dial +1 (786) 358-5420

Access Code: 164-896-661

Audio PIN: Shown after joining the meeting

Meeting ID: 164-896-661

GoToMeeting®

Online Meetings Made Easy®

Not at your computer? Click the link to join this meeting from your iPhone®, iPad®, Android® or Windows Phone® device via the GoToMeeting app.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Wednesday, April 09, 2014 7:18 AM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; 'Eric Rothwell'; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'
Cc: Emily Andersen; 'Mike Salzetti'; Cory Warnock
Subject: RE: Next meeting if Instream Flow Workgroup

Good Morning:

Based on the responses I have received, the best day for the next call re: the instream flow study at Grant Creek is next Friday, April 18th. Would 8am (AK), 9 am (WA) and 10 am(Boise) work or everyone? Jeff, I'm sorry you can't make the call, but when you get back to the office, let me know and I'll call you.

Thanks very much. I will have an agenda sent out to you early next week.

John

John Blum
Sr. Fisheries Scientist

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Wednesday, April 09, 2014 1:55 PM
To: Susan Walker
Subject: Grant Lake

Hi Sue,

Had a good call with Eric this morning where he relayed to me that he'll be leaving his post soon and that you'll be taking over at the representative for the Grant Lake Project. I know that Eric has briefed you to some extent on where we are in the process but wanted to offer to have a phone call with you to catch you up on things and provide you with any data/reports/presentations that you might find helpful. I saw your acceptance come through for the upcoming bi-weekly instream flow call so that should help in that regard. But, if you have interest in a more global, project-related call, let me know some days and times that will work for you and I'll make myself available.

Thanks!

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Thursday, April 10, 2014 1:21 PM
To: rstovall@fs.fed.us; jeavis@fs.fed.us; 'Lesli Schick'; Cassie Thomas; dglass@ciri.com
Cc: Mike Salzetti; Dwayne Adams; Kim Graham; Emily Andersen
Subject: Additional Grant Lake Recreation Study Effort
Attachments: Grant Lake Trail Camera Locations.pdf

Hi all,

During our NRWG meeting on March 18th in Anchorage we heard some members of the group (included here) express the desire for some additional recreation monitoring near the Moose Pass/Grant Lake Project Area to more comprehensively document recreational activities that are taking place. The initial discussion revolved around having a phone call to further define the parameters of the additional data collection. As the discussion at the meeting progressed however, a clear picture of the preferred objective developed. As such and in the vein of collecting data during as much of the activity period as possible, HEA implemented additional measures two weeks ago to further document recreational activities in the area.

Since this meeting, USKH has been able to install a total of (4) trail cameras. The cameras are manufactured by Bushnell, and feature motion-activated images. These cameras have been installed and secured at the following locations: Vagt lake trailhead, Grant Lake Trail near the railroad trestle, Saddle Trail at Upper Trail Lake, Saddle Trail at Grant lake. Please see the attached graphic for locations. It is the intention that these cameras will be able to record the number of trail users and the frequency of use. Currently, the cameras will be checked every 2 weeks for battery levels and memory usage until it is agreed they are no longer needed. The collected data will be periodically processed in accordance with the 2 week check-ups.

Data collection and associated analysis will be finalized in advance of the development of the Draft License Application and all information will be formally incorporated in this document for review by all of you and the rest of the stakeholder group. Unless any of you disagree, HEA doesn't see the need to have the call that was initially discussed at the meeting given the comprehensive direction that has been taken. If any of you feel differently and would like to have a call to discuss, please let me know and we'll get it set up.

Thank You,

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264



Record of Conversation

WO#: 1371300

PROJECT: Grant Lake Hydro

DATE: April 15, 2014

TIME: 1:17pm

PHONE #: 907-714-2471

TALKED TO: KRSMA, Pamela Russell

BY: Dwayne Adams

SUBJECT: Permit for Camera Recorders

Conversation:

Pamela explained that Kenai River Special Management Area is managed as a State Park and DNR Lands has nothing to do with the permitting of use within Parks. At the meeting, DNR would not have provided input with respect to whether permits were required for placement of cameras. She regrets missing the last agency meetings and had hoped a replacement could fill in but the replacement was not available at the last minute.

We must apply for a permit through her and she will send a form for us to fill out and return. We will need to provide maps of proposed locations for cameras. She asked when we would want to place them and I explained that in order to meet concerns of the agencies we had rushed out there to get them in place as soon as possible and they were in place at present. She was okay with that but wants paperwork for the permit as soon as possible.

She asked who wanted these cameras placed and what we expected to get out of it. I explained that NPS and USFS had both asked for this and DNR (Lesli Schick) seemed to think it would be valuable as well. Pam didn't think we were going to get what we needed. She said there would be little King Salmon fishing due to closures and that tourism on the Peninsula is largely a result of the presence of a King Salmon fishery. Their office, which reviews all applications for commercial operations on the river has seen few requests and that is a good indication that there will be little activity in the area. She does not think this summer will be representative of use in the area.

Pam suggested we contact agencies and see what data they have. I explained that we have tried that and they have little information. Further ADF&G only reports hunting within the game management unit so that wasn't helpful either.

ACTION REQUIRED:

Apply for permit for posting of cameras

RECORD OF CONVERSATION / MEMO TO FILE

From: Dwayne Adams <dadams@uskh.com>
Sent: Tuesday, April 15, 2014 11:44 AM
To: pamela.russell@alaska.gov
Cc: Cory Warnock; Emily Andersen; Mike Salzetti (msalzetti@HomerElectric.com); Kim Graham
Subject: Additional Grant Lake Recreation Study Effort
Attachments: 2012-11-27-State DNR.DOTX

Importance: High

Pam

I apologize for not contacting you with respect to gaining a permit to install the cameras requested by agencies. I felt that it did not fall into the category of anything like a fish weir or camp (see attached memo) that Cliff Larson indicated would require a permit. Also, given that it was requested by the agencies in attendance that day and that Lesli Schick was part of the conversation, I assumed that if a permit were required someone would have raised an issue.

Regardless, we will submit a permit request per your direction. Should we be using the Land Use Permit from Division of Mining, Land and Water? Also, should we fill out the supplemental questionnaire under "temporary structures" or will the site description in the base permit suffice? Lastly, given that this was requested by agencies, will we need to pay the \$100 filing fee?

Thanks
Dwayne Adams

From: Russell, Pamela J (DNR) [<mailto:pamela.russell@alaska.gov>]
Sent: Monday, April 14, 2014 2:46 PM
To: Cory Warnock; Mike Salzetti
Cc: Emily Andersen
Subject: RE: Additional Grant Lake Recreation Study Effort
Importance: High

Cory,

I was unable to attend the meetings. This does not constitute you having the authority to conduct activities without our authorization. A permit application with the details and map of the placement of the cameras is required before I am able to authorize this activity.

Pamela Russell
Div. of Parks and Outdoor Recreation
Natural Resource Specialist III
514 Donald E Gilman River Center
Soldotna, AK 99669

907-714-2471

From: Cory Warnock [cory.warnock@mcmillen-llc.net]
Sent: Monday, April 14, 2014 1:02 PM
To: Russell, Pamela J (DNR); Mike Salzetti
Cc: Emily Andersen
Subject: RE: Additional Grant Lake Recreation Study Effort

Hi Pam,

My apologies for not involving you. I was just going by the list we established at the meetings. Some of the cameras are on State Land. Is this an issue?

From: Russell, Pamela J (DNR) [<mailto:pamela.russell@alaska.gov>]
Sent: Friday, April 11, 2014 5:21 PM
To: Cory Warnock
Subject: FW: Additional Grant Lake Recreation Study Effort

Cory this is Pam Russell from State Parks I may need to be involved in this project. I have not read the whole e-mail but the cameras may be in the park?

Pamela Russell
Div. of Parks and Outdoor Recreation
Natural Resource Specialist III
514 Donald E Gilman River Center
Soldotna, AK 99669
907-714-2471

From: Schick, Leslie J (DNR)
Sent: Friday, April 11, 2014 2:47 PM
To: Russell, Pamela J (DNR)
Subject: Fwd: Additional Grant Lake Recreation Study Effort

Hi Pam,
Below is a email string that it looks like KRSMA wasn't cc'd on. It appears that maybe you are not on the distribution list??

Let me know if you have any questions,
-lesli

Lesli Schick
Iditarod Trail Easements
Department of Natural Resources
550 W 7th Ave, Suite 900C
Anchorage, AK 99501
Phone: (907) 334-2679, Fax: (907) 269-8930
Email: lesli.schick@alaska.gov

Begin forwarded message:

From: "Eavis, John -FS" <jeavis@fs.fed.us>

Date: April 11, 2014, 2:02:45 PM AKDT

To: "Thomas, Cassie" <cassie_thomas@nps.gov>, Cory Warnock <cory.warnock@mcmillen-llc.com>

Cc: "Stovall, Robert -FS" <rstovall@fs.fed.us>, Lesli Schick <lesli.schick@alaska.gov>, "dglass@ciri.com" <dglass@ciri.com>, Mike Salzetti <msalzetti@homerelectric.com>, Dwayne Adams <dadams@uskh.com>, Kim Graham <kgraham@uskh.com>, Emily Andersen <emily.andersen@mcmillen-llc.net>

Subject: RE: Additional Grant Lake Recreation Study Effort

I would agree with Cassie's thoughts on characterizing the nature of recreational resources and use of the area. In addition I would mention that the cameras should be maintained through next winter to capture a complete sample of the use of the area. Winter activities have largely been suspended for this season. I could be available for a call if one is organized.

John Eavis
Seward Ranger District

From: Thomas, Cassie [mailto:cassie_thomas@nps.gov]

Sent: Thursday, April 10, 2014 12:57 PM

To: Cory Warnock

Cc: Stovall, Robert -FS; Eavis, John -FS; Lesli Schick; dglass@ciri.com; Mike Salzetti; Dwayne Adams; Kim Graham; Emily Andersen

Subject: Re: Additional Grant Lake Recreation Study Effort

Great news, Cory. The cameras should provide us with much more objective, detailed data about recreational visits than incidental observations gathered by field staff who were in parts of the project area for other purposes.

However, in order to adequately characterize the project area's baseline recreational resources, I think we still need to know more about what kinds of experiences and opportunities various visitors are seeking, and which area attributes are most important to them. E.g. are they hoping to get away from other users for a wilderness-type experience (opportunities for solitude, self-reliance, etc.) or are they just looking for a place to run their snow machines or do some catch-and-release fly fishing close to the road network? Do they need firm ice on Grant Lake? Do they care whether there are formal trails in the area, and if so, what kind of trails do they want? Where would they go if the project area's character changed and it no longer provided the kinds of recreation they seek? Such questions are usually answered by a user survey.

At last month's meeting we also talked about the need to determine whether there are existing or probable (project-related) recreational conflicts in the area, and the need to address visitor safety in the design of the project. So, based on these issues and what I perceive as a need to do a user survey, I think a call would still be a good idea.

I am traveling out of state for the next two weeks, but would be available for a call from 4/28 on.

Thanks --

Cassie Thomas
Program Analyst

WASO Park Planning & Special Studies Division
[Park Planning Website](#)

AK Coordinator, NPS Hydropower Assistance Program
[NPS Hydropower Program website](#) (NOTE: the contact info for me on this website is outdated. Please use the phone number below, instead.)

11081 Glazanof Dr. Rm. 108
Anchorage AK 99507

Work Cell 907 350-4139 Note: Alaska is four hours behind Eastern time

~::~~::~~::~~::~~::~~::~><(((^>`~::~~::~~::~~::~~::~~::~~::~

On Thu, Apr 10, 2014 at 12:20 PM, Cory Warnock <cory.warnock@mcmillen-llc.com> wrote:
Hi all,

During our NRWG meeting on March 18th in Anchorage we heard some members of the group (included here) express the desire for some additional recreation monitoring near the Moose Pass/Grant Lake Project Area to more comprehensively document recreational activities that are taking place. The initial discussion revolved around having a phone call to further define the parameters of the additional data collection. As the discussion at the meeting progressed however, a clear picture of the preferred objective developed. As such and in the vein of collecting data during as much of the activity period as possible, HEA implemented additional measures two weeks ago to further document recreational activities in the area.

Since this meeting, USKH has been able to install a total of (4) trail cameras. The cameras are manufactured by Bushnell, and feature motion-activated images. These cameras have been installed and secured at the following locations: Vagt lake trailhead, Grant Lake Trail near the railroad trestle, Saddle Trail at Upper Trail Lake, Saddle Trail at Grant lake. Please see the attached graphic for locations. It is the intention that these cameras will be able to record the number of trail users and the frequency of use. Currently, the cameras will be checked every 2 weeks for battery levels and memory usage until it is agreed they are no longer needed. The collected data will be periodically processed in accordance with the 2 week check-ups.

Data collection and associated analysis will be finalized in advance of the development of the Draft License Application and all information will be formally incorporated in this document for review by all of you and the rest of the stakeholder group. Unless any of you disagree, HEA doesn't see the need to have the call that was initially discussed at the meeting given the comprehensive direction that has been taken. If any of you feel differently and would like to have a call to discuss, please let me know and we'll get it set up.

Thank You,

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC

Record of Conversation

WO#: 1371300

PROJECT: Grant Lake Hydro

DATE: 11/27/2012

TIME: 12:58

PHONE #:

TALKED TO: Alaska DNR, Cliff Larson

BY: Dwayne Adams

SUBJECT: Permit Requirements

Conversation:

I asked whether a permit would be required for the work anticipated for visual/recreational survey/site work that will take place in February/March and this summer. I explained we would be skiing/snowshoeing/snowmachining and using trails for access to the Grant Lake and the general project area. We would anticipate no camps, clearing, or permanent installations as part of our work. It would include one or two people.

Response: The lakeshore of Upper Kenai Lake lies within the Kenai River Special Management Area (KRSMA). As long as no permanent structures will be required (gaging stations or docks would be examples) and we would have fewer than 50 people, our proposed use would be considered "generally allowed use".

ACTION REQUIRED:

None

RECORD OF CONVERSATION / MEMO TO FILE

----- Forwarded message -----

From: **Frank Winchell** <frank.winchell@ferc.gov>

Date: Wed, Apr 16, 2014 at 11:39 AM

Subject: review of draft cultural resources report for Grant Lake

To: Michael R Yarborough <mry@crcalaska.com>

Mike:

I tried to send you by email comments/edits on the draft cultural resources report for Grant Lake, but it didn't take. (Probably too big of a file). So I copied it on a DVD and put it in the mail to you. Should get to you tomorrow, or the next day.

Almost all of my review involves comments I made in track-changes. (See comments in right-hand column).

Take care,

From: Cory Warnock
Sent: Wednesday, April 16, 2014 4:14 PM
To: Emily Andersen
Subject: FW: Grant Lake Water Tests
Attachments: Paul Torgerson Letter.pdf

FYI

From: Salzetti, Mikel [mailto:MSalzetti@HomerElectric.com]
Sent: Wednesday, April 16, 2014 4:12 PM
To: Grant Lake Mining
Cc: Cory Warnock
Subject: RE: Grant Lake Water Tests

Mr. Torgerson:

Please see the attached letter in response to questions posed within this email chain.

Regards,

Mike Salzetti
(907) 283-2375 *work*
(907) 398-5073 *Mobile*

From: Grant Lake Mining [mailto:paul@grantlakemining.com]
Sent: Wednesday, January 08, 2014 2:14 PM
To: Cory Warnock
Subject: RE: Grant Lake Water Tests

Cory,

Did you sample the water at surface level and at the 20' depth you intend to draw down the lake to construct the intake for the dam? Copper, as a heavy metal did not appear at the surface in significant quantities but was very significant at depths of 10-20 feet. We were told that was why the copper hasn't killed the fish in Grant Creek. Left to run normally, the surface water does not have enough copper in it to kill fish as the copper ions concentrate lower in the water. Drawing down the lake 20' for construction or during normal hydro dam operation could be a different matter altogether. I am concerned that if you intend to draw down the lake below the normal 2-3' that evaporate during summer that it will kill the fish in Grant Creek and possibly Trail Creek. I agree with your assessment that fish do return to Grant Creek "as-is". I am not talking about that. I am talking about you changing the quality of the water supply coming into Grant Creek from the lake. The turbulence that stirs up the water to greater depths could be a major factor I would think

If you would, could you send me copies of the reports you referred too concerning the stocking program or tell me where I can order them? I know that the powers that be back in the 80's got a real black eye over the stocking results. I work a lot with DOE and am very familiar with the government says that if you don't get the results you expect, change the targets. That is why the results from the

70's were repeated. I am interested to see how they summarized the stocking program. I can tell you this, it didn't take a rocket scientist to paddle around in a canoe amongst the dead fish floating on the surface to know something was wrong. If you say the copper isn't there, simply fly over the area. Every other lake in the area is glacier grey in color while Grant Lake is deep green from the copper.

There was a bright side from the 80's stocking program. After noting the results from dumping fish in several spots in the lake, the last drops they did dumped fish right above the falls. This acclimated the smolt to the smell of the water as they went over the falls into the creek. I imagine this is a major factor in why there are fish in Grant Creek.

I worked for Jack Merrington from the early 80's. He owned the mine from 1945 until his death in 1997. He bought it from Case and Whitney. They discovered it in 1911. I was partners with Thor Brant-Erikson from 1997 until his death in 2006, and I am a partner with Tom Harkreader now. We currently own the mine. I think we can prove that it has been a continuous chain of ownership (other than short periods following deaths of principles) since 1911 when Case and Whitney discovered gold on the claim group. As a group, we have worked since 1911 on sections 28, 29, 30 and 31, and Jack also worked on the Solar mine at the headwaters of the lake. He built cabins at the headwaters to allow him to explore for the copper deposit. It should be obvious that we are not going away as 103 years of claim ownership proves. We intend to mine our claims and follow the vein structures until they end whether on our claims or not. This is allowed under mining law. My point is that as mine owners we have seen Homer Electric interrupt mining activities since the 60's and you still have no dam. Your latest permit has closed down staking for over five years. Even FERC has said it should not have been your intent to impede other industries.

I have experience with hydro's having help design and worked closely with USCOE in construct management on one of the largest dam's in the US, and I know what minor changes in water quality can do to fish smolt, having helped design the fish hatchery at Fort Richardson. I am not anti-hydro by any means. I am against any utility that uses a FERC permitting process to close down other job creating business enterprises. Your statements in one of your earlier letters that you need all the snow melt water from the entire watershed proves the marginal viability of the project. Grant Lake is ideal for mining because the lake is dead – not commercial or recreational fish. Any water our mining activities discharges back into the lake creates a zero negative effect. You can't kill an already dead lake. Plus any silt we would discharge has over two miles to settle before your intake.

In conclusion, we need to complete staking on the continuations of the five major veins on the claims in sections 28, 29, 30 and 31 (minimum) to make a major core drilling project to block out total reserves most cost effectively. We have already traced several veins for over 2 miles. We also need the opportunity to buy the power from the hydro to power our milling plant, so you can see we would like to see the dam proceed. If it does not proceed, 3 miles of 69kV transmission lines to our mill site is not that expensive, so as you can see we will go forward either way. If you can see your way clear to remove the restriction on staking on the four sections we need to proceed at optimum levels, we will create long-term jobs in the area. A 20 ton per day mine would employ upwards to 20 full time employees. Add to this, the PR gained by saying the mine would buy the power that helps create those jobs. This would be a win-win for both our interests. You might want to consider this approach. It is a very easy fix. Just let us coexist in peace and support each other.

This has been a very good dialog.

Very Best Regards,

Paul Torgerson

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]
Sent: Wednesday, January 08, 2014 11:46 AM
To: Grant Lake Mining
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Grant Lake Water Tests

Hi Paul,

Maybe I wasn't completely clear in my previous email. When I said that all of our study planning, technical work, analysis and report preparation was and is being conducted by professional limnologists and hydrologists that are intimately familiar with both these types of studies and hydro licensing/relicensing, it was not meant to imply that the water samples themselves were analyzed by our in-house limnologists and hydrologists. As is standard in our industry, when water quality samples are collected and subsequent analysis is needed, we always have the samples assessed and quantified for the respective variables at an accredited water testing laboratory. In this case, our lab of choice was located in Anchorage which allowed us to collect the samples and always deliver them (with the associated chain of custody information) well within the delivery and analysis parameters associated with this kind of work. Again this type of approach is the standard and widely accepted for assessments such as this.

As for the stocking program you speak of in the 80's, I've become quite familiar with that effort as a result of my involvement on this project. In the discussions that I've had with pertinent individuals and the literature I've read on the topic, it is my understanding that there are some natural variables that precluded the success of the stocking attempt. I am not familiar with anything that documented a "100% fish kill". Based upon the literature I've read, anadromous returns to Grant Creek as a result of the stocking programs were documented (in low numbers) in subsequent years. In all of my discussions and reading, copper was never raised as a potential issue. Once the Water Resources Report is in its final draft form, I will be happy to share a copy with you.

In the interim, if you have any more questions, let me know.

Cory

From: Grant Lake Mining [<mailto:paul@grantlakemining.com>]
Sent: Wednesday, January 08, 2014 1:14 AM
To: Cory Warnock
Subject: RE: Grant Lake Water Tests

Cory,

I was told by a retired BLM geologist, that was familiar with Grant Lake's water quality, that only a licensed geochemist would normally run the tests that would show the high copper content in the water in Grant Lake. The high copper content of the water was why the fish stocking programs in the 70's and 80's resulted in 100% fish kill of the trout and salmon smolt they attempted to stock Grant Lake with.

Many of the locals that worked on the stocking project still live in the Moose Pass area. I was working at Grant Lake in the 80's when that stocking attempt was undertaken. The fish biologists working with the stocking program told us a great deal about the problem and it's being caused by a copper deposit at the headwaters flowing into the lake. We were told not to drink or swim in the water because the copper would make us sick.

Am I to understand that a limnologist or hydrologist will perform the same chemical examinations for heavy metals that a geochemist would?

Please give me your thoughts.

Best regards and thanks for the quick response.

Paul Torgerson

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]

Sent: Tuesday, January 07, 2014 8:50 PM

To: Grant Lake Mining

Cc: Mike Salzetti; Emily Andersen

Subject: Re: Grant Lake Water Tests

Hi Paul,

Our Water Resources Report will discuss our water sampling results along with a myriad of other analyses conducted in association with this component of our natural resource effort. The report is currently going through our internal review process after which, it will be distributed to stakeholders for their review in advance of our 2013 study results meetings. This distribution will take place in the next month. As is standard with this type of technical work, all of our study planning, technical work, analysis and report preparation was and is being conducted by professional limnologists and hydrologists that are intimately familiar with both these types of studies and hydro licensing/relicensing.

As always, if you have further questions, don't hesitate to let me know.

Cory

On Jan 6, 2014, at 2:44 PM, "Grant Lake Mining" <paul@grantlakemining.com> wrote:

Cory,

I was wondering when the Grant Lake water sampling analysis results you mentioned will be completed? I assume this work is being completed by licensed geochemists. You stated they would be completed by early 2014.

Please get back to me via email or phone.

Very Best Regards,

Paul T. Torgerson
White Rock Mine
Phone: (907) 222-7685
paul@grantlakemining.com

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4259 / Virus Database: 3658/6974 - Release Date: 01/03/14

Kenai Hydro, LLC

3977 Lake Street
Homer, AK 99603

Paul Torgerson
White Rock Mine
(907) 222-7685

Mr. Torgerson:

Kenai Hydro (KHL) knows of no data that indicates elevated levels of copper in Grant Lake. Our studies in 2013 were consistent with all existing data in that no elevated levels of copper were documented. If you have verifiable test results indicating otherwise we would welcome further dialogue to resolve any discrepancies. Our final Water Resources Report will be filed soon if you'd like to review further.

In previous correspondence, KHL has explained the project boundary and the FERC licensing process. KHL is simply following the Federal Energy Regulatory Commission's (FERC) process to determine the feasibility of a hydroelectric project on Grant Lake / Grant Creek and if appropriate, submit a license application for the FERC's consideration. If you believe that this process somehow restricts your mining operation, please contact the appropriate governmental agencies to resolve your issues. The individual that is assigned to our project from the FERC is Ken Hogan. His email address is kenneth.hogan@ferc.gov. I have copied him on this email/letter to apprise him of our correspondence.

With regard to the stocking efforts in the 1980's, it is KHL's understanding that the stocking program was a cooperative effort between the U.S. Forest Service (USFS) and the Alaska Department of Fish and Game (ADF&G). You might consider contacting these entities for information regarding that stocking effort.

Sincerely:



Mike Salzetti
Project Manager
Kenai Hydro, LLC
3977 Lake Street Homer,
AK 99603
(907) 283-2375

cc:

- Kimberly D. Bose, Secretary (FERC)
- Ken Hogan, Grant Lake Representative (FERC)

Kenai Hydro, LLC

3977 Lake Street
Homer, AK 99603

Paul Torgerson
White Rock Mine
(907) 222-7685

Mr. Torgerson:

Kenai Hydro (KHL) knows of no data that indicates elevated levels of copper in Grant Lake. Our studies in 2013 were consistent with all existing data in that no elevated levels of copper were documented. If you have verifiable test results indicating otherwise we would welcome further dialogue to resolve any discrepancies. Our final Water Resources Report will be filed soon if you'd like to review further.

In previous correspondence, KHL has explained the project boundary and the FERC licensing process. KHL is simply following the Federal Energy Regulatory Commission's (FERC) process to determine the feasibility of a hydroelectric project on Grant Lake / Grant Creek and if appropriate, submit a license application for the FERC's consideration. If you believe that this process somehow restricts your mining operation, please contact the appropriate governmental agencies to resolve your issues. The individual that is assigned to our project from the FERC is Ken Hogan. His email address is kenneth.hogan@ferc.gov. I have copied him on this email/letter to apprise him of our correspondence.

With regard to the stocking efforts in the 1980's, it is KHL's understanding that the stocking program was a cooperative effort between the U.S. Forest Service (USFS) and the Alaska Department of Fish and Game (ADF&G). You might consider contacting these entities for information regarding that stocking effort.

Sincerely:



Mike Salzetti
Project Manager
Kenai Hydro, LLC
3977 Lake Street Homer,
AK 99603
(907) 283-2375

cc:

- Kimberly D. Bose, Secretary (FERC)
- Ken Hogan, Grant Lake Representative (FERC)

From: Cory Warnock
Sent: Wednesday, April 16, 2014 3:24 PM
To: Eavis, John -FS; Thomas, Cassie; pamela.russell@alaska.gov; rstovall@fs.fed.us; 'Lesli Schick (lesli.schick@alaska.gov)'; dglass@ciri.com
Cc: Mike Salzetti; Dwayne Adams; Kim Graham; Emily Andersen
Subject: RE: Additional Grant Lake Recreation Study Effort

Hi all,

Thank you Cassie, John and Pam for your responses. Per the Traditional Licensing Process (TLP), HEA went through formal scoping in 2009/2010 during which all of the environmental study plans were formally reviewed and commented upon. In addition and as you all know, HEA initiated a subsequent delay in study activity based upon these comments in an effort to revise the study plans and make them much more quantitative in nature. Unique to this approach, HEA held a second meeting on December 12, 2012 during which it solicited another round of comments. While informal in nature (per the TLP), many of these comments were also incorporated into the respective study plans. HEA is confident in both the comprehensive nature of the study plans and the methodology with which they were carried out. Based upon the data that was collected with respect to recreational use, we are confident that it can be characterized as light recreational use. Per your recommendation, HEA elected to conduct some additional field work to further characterize recreational use in/near the Project Area. With State Parks permission, HEA's intent is to continue documenting use per the description below until we develop the Draft License Application (DLA). All data associated with the additional work will be incorporated into the DLA for your formal review. In addition to this and based upon a long standing internal schedule, HEA plans to hold a series of public forums between now and the DLA development. These forums will be held in various locations around the Peninsula (Kenai, Seward, etc.) and will culminate with a true public meeting in Moose Pass. The intent of these forums and meeting are to further communicate to the public the Project plan, the results of our natural resource study efforts, engineering design, operational and feasibility information and address questions and concerns that the public may have. Per your suggestion, HEA will use these meetings to distribute surveys to gather additional information regarding the kind of recreational use users prefer for this area. At this point, HEA feels that conducting these additional efforts along with all of the recreational work documented in the 2013 report will more than adequately meet the requirements of the license application process. HEA is more than happy to have additional dialogue with respect to how these tasks are carried out and look forward to continuing the collaborative discussion.

Cory

From: Eavis, John -FS [mailto:jeavis@fs.fed.us]
Sent: Friday, April 11, 2014 3:03 PM
To: Thomas, Cassie; Cory Warnock
Cc: Stovall, Robert -FS; Lesli Schick; dglass@ciri.com; Mike Salzetti; Dwayne Adams; Kim Graham; Emily Andersen
Subject: RE: Additional Grant Lake Recreation Study Effort

I would agree with Cassie's thoughts on characterizing the nature of recreational resources and use of the area. In addition I would mention that the cameras should be maintained through next winter to capture a complete sample of the use of the area. Winter activities have largely been suspended for this season. I could be available for a call if one is organized.

John Eavis

Hi all,

During our NRWG meeting on March 18th in Anchorage we heard some members of the group (included here) express the desire for some additional recreation monitoring near the Moose Pass/Grant Lake Project Area to more comprehensively document recreational activities that are taking place. The initial discussion revolved around having a phone call to further define the parameters of the additional data collection. As the discussion at the meeting progressed however, a clear picture of the preferred objective developed. As such and in the vein of collecting data during as much of the activity period as possible, HEA implemented additional measures two weeks ago to further document recreational activities in the area.

Since this meeting, USKH has been able to install a total of (4) trail cameras. The cameras are manufactured by Bushnell, and feature motion-activated images. These cameras have been installed and secured at the following locations: Vagt lake trailhead, Grant Lake Trail near the railroad trestle, Saddle Trail at Upper Trail Lake, Saddle Trail at Grant lake. Please see the attached graphic for locations. It is the intention that these cameras will be able to record the number of trail users and the frequency of use. Currently, the cameras will be checked every 2 weeks for battery levels and memory usage until it is agreed they are no longer needed. The collected data will be periodically processed in accordance with the 2 week check-ups.

Data collection and associated analysis will be finalized in advance of the development of the Draft License Application and all information will be formally incorporated in this document for review by all of you and the rest of the stakeholder group. Unless any of you disagree, HEA doesn't see the need to have the call that was initially discussed at the meeting given the comprehensive direction that has been taken. If any of you feel differently and would like to have a call to discuss, please let me know and we'll get it set up.

Thank You,

Cory Warnock

Senior Licensing and Regulatory Consultant

McMillen, LLC

www.mcmillen-llc.com

5771 Applegrove Ln.

From: Dwayne Adams <dadams@uskh.com>
Sent: Thursday, April 17, 2014 6:19 PM
To: Russell, Pamela J (DNR)
Cc: Mike Salzetti (msalzetti@HomerElectric.com); Cory Warnock; Emily Andersen; Kim Graham
Subject: RE: Additional Grant Lake Recreation Study Effort
Attachments: 2014-04-17_TrailCameraPermit.pdf

Pam,

Thanks for the application. I think it has the data you need. We may change the locations of the cameras from that shown at some point but aren't sure if and where at this point in time.

Let me know if more information is necessary.

Dwayne Adams, FASLA

Principal

Landscape Architecture and Community Planning

USKH Inc.
Celebrating
40 years

2515 A Street
Anchorage, AK 99503
main: 907.276.4245
direct: 907.343.5248
cell: 907.441.4948
www.uskh.com
[Facebook](#) | [Twitter](#) | [LinkedIn](#)
paper = trees

From: Russell, Pamela J (DNR) [mailto:pamela.russell@alaska.gov]
Sent: Tuesday, April 15, 2014 4:23 PM
To: Dwayne Adams
Subject: RE: Additional Grant Lake Recreation Study Effort

Hi Dwayne,

Here it the application per our phone conversation.

Let me know if you have any questions.

Pamela Russell
Div. of Parks and Outdoor Recreation
Natural Resource Specialist III
514 Donald E Gilman River Center
Soldotna, AK 99669

907-714-2471

From: Dwayne Adams [dadams@uskh.com]
Sent: Tuesday, April 15, 2014 11:08 AM
To: Russell, Pamela J (DNR)
Subject: RE: Additional Grant Lake Recreation Study Effort

Sounds good Pam. I have a noon lunch and should be able to call just a bit after 1pm.

From: Russell, Pamela J (DNR) [<mailto:pamela.russell@alaska.gov>]
Sent: Tuesday, April 15, 2014 10:53 AM
To: Dwayne Adams
Subject: RE: Additional Grant Lake Recreation Study Effort

Dwayne,

Can you please call me so we may discuss this. I will be available at 1pm today.

Thanks

Pamela Russell
Div. of Parks and Outdoor Recreation
Natural Resource Specialist III
514 Donald E Gilman River Center
Soldotna, AK 99669
907-714-2471

From: Dwayne Adams [dadams@uskh.com]
Sent: Tuesday, April 15, 2014 10:44 AM
To: Russell, Pamela J (DNR)
Cc: Cory Warnock; Emily Andersen (emily.andersen@mcmillen-llc.net); Mike Salzetti (msalzetti@HomerElectric.com); Kim Graham
Subject: Additional Grant Lake Recreation Study Effort

Pam

I apologize for not contacting you with respect to gaining a permit to install the cameras requested by agencies. I felt that it did not fall into the category of anything like a fish weir or camp (see attached memo) that Cliff Larson indicated would require a permit. Also, given that it was requested by the agencies in attendance that day and that Lesli Schick was part of the conversation, I assumed that if a permit were required someone would have raised an issue.

Regardless, we will submit a permit request per your direction. Should we be using the Land Use Permit from Division of Mining, Land and Water? Also, should we fill out the supplemental questionnaire under "temporary structures" or will the site description in the base permit suffice? Lastly, given that this was requested by agencies, will we need to pay the \$100 filing fee?

Thanks
Dwayne Adams

From: Russell, Pamela J (DNR) [<mailto:pamela.russell@alaska.gov>]
Sent: Monday, April 14, 2014 2:46 PM
To: Cory Warnock; Mike Salzetti
Cc: Emily Andersen
Subject: RE: Additional Grant Lake Recreation Study Effort
Importance: High

Cory,

I was unable to attend the meetings. This does not constitute you having the authority to conduct activities without our authorization. A permit application with the details and map of the placement of the cameras is required before I am able to authorize this activity.

Pamela Russell
Div. of Parks and Outdoor Recreation
Natural Resource Specialist III
514 Donald E Gilman River Center
Soldotna, AK 99669
907-714-2471

From: Cory Warnock [cory.warnock@mcmillen-llc.net]
Sent: Monday, April 14, 2014 1:02 PM
To: Russell, Pamela J (DNR); Mike Salzetti
Cc: Emily Andersen
Subject: RE: Additional Grant Lake Recreation Study Effort

Hi Pam,

My apologies for not involving you. I was just going by the list we established at the meetings. Some of the cameras are on State Land. Is this an issue?

From: Russell, Pamela J (DNR) [<mailto:pamela.russell@alaska.gov>]
Sent: Friday, April 11, 2014 5:21 PM
To: Cory Warnock
Subject: FW: Additional Grant Lake Recreation Study Effort

Cory this is Pam Russell from State Parks I may need to be involved in this project. I have not read the whole e-mail but the cameras may be in the park?

Pamela Russell
Div. of Parks and Outdoor Recreation
Natural Resource Specialist III
514 Donald E Gilman River Center
Soldotna, AK 99669
907-714-2471

From: Schick, Lesli J (DNR)
Sent: Friday, April 11, 2014 2:47 PM
To: Russell, Pamela J (DNR)
Subject: Fwd: Additional Grant Lake Recreation Study Effort

Hi Pam,

Below is a email string that it looks like KRSMA wasn't cc'd on. It appears that maybe you are not on the distribution list??

Let me know if you have any questions,
-lesli

Lesli Schick
Iditarod Trail Easements
Department of Natural Resources
550 W 7th Ave, Suite 900C
Anchorage, AK 99501
Phone: (907) 334-2679, Fax: (907) 269-8930
Email: lesli.schick@alaska.gov

Begin forwarded message:

From: "Eavis, John -FS" <jeavis@fs.fed.us>
Date: April 11, 2014, 2:02:45 PM AKDT
To: "Thomas, Cassie" <cassie_thomas@nps.gov>, Cory Warnock <cory.warnock@mcmillen-llc.com>
Cc: "Stovall, Robert -FS" <rstovall@fs.fed.us>, Lesli Schick <lesli.schick@alaska.gov>, "dglass@ciri.com" <dglass@ciri.com>, Mike Salzetti <msalzetti@homerelectric.com>, Dwayne Adams <dadams@uskh.com>, Kim Graham <kgraham@uskh.com>, Emily Andersen <emily.andersen@mcmillen-llc.net>
Subject: RE: Additional Grant Lake Recreation Study Effort

I would agree with Cassie's thoughts on characterizing the nature of recreational resources and use of the area. In addition I would mention that the cameras should be maintained through next winter to capture a complete sample of the use of the area. Winter activities have largely been suspended for this season. I could be available for a call if one is organized.

John Eavis
Seward Ranger District

From: Thomas, Cassie [mailto:cassie_thomas@nps.gov]
Sent: Thursday, April 10, 2014 12:57 PM
To: Cory Warnock
Cc: Stovall, Robert -FS; Eavis, John -FS; Lesli Schick; dglass@ciri.com; Mike Salzetti; Dwayne Adams; Kim Graham; Emily Andersen
Subject: Re: Additional Grant Lake Recreation Study Effort

Great news, Cory. The cameras should provide us with much more objective, detailed data about recreational visits than incidental observations gathered by field staff who were in parts of the project area for other purposes.

However, in order to adequately characterize the project area's baseline recreational resources, I think we still need to know more about what kinds of experiences and opportunities various visitors are seeking, and which area attributes are most important to them. E.g. are they hoping to get away from other users for a wilderness-type experience (opportunities for solitude, self-reliance, etc.) or are they just looking for a place to run their snow machines or do some catch-

and-release fly fishing close to the road network? Do they need firm ice on Grant Lake? Do they care whether there are formal trails in the area, and if so, what kind of trails do they want? Where would they go if the project area's character changed and it no longer provided the kinds of recreation they seek? Such questions are usually answered by a user survey.

At last month's meeting we also talked about the need to determine whether there are existing or probable (project-related) recreational conflicts in the area, and the need to address visitor safety in the design of the project. So, based on these issues and what I perceive as a need to do a user survey, I think a call would still be a good idea.

I am traveling out of state for the next two weeks, but would be available for a call from 4/28 on.

Thanks --

Cassie Thomas
Program Analyst

WASO Park Planning & Special Studies Division
[Park Planning Website](#)

AK Coordinator, NPS Hydropower Assistance Program
[NPS Hydropower Program website](#) (NOTE: the contact info for me on this website is outdated. Please use the phone number below, instead.)

11081 Glazanof Dr. Rm. 108
Anchorage AK 99507

Work Cell 907 350-4139 Note: Alaska is four hours behind Eastern time

~::~~::~~::~~::~~::~~::~><(((^>~::~~::~~::~~::~~::~~::~

On Thu, Apr 10, 2014 at 12:20 PM, Cory Warnock <cory.warnock@mcmillen-llc.com> wrote:
Hi all,

During our NRWG meeting on March 18th in Anchorage we heard some members of the group (included here) express the desire for some additional recreation monitoring near the Moose Pass/Grant Lake Project Area to more comprehensively document recreational activities that are taking place. The initial discussion revolved around having a phone call to further define the parameters of the additional data collection. As the discussion at the meeting progressed however, a clear picture of the preferred objective developed. As such and in the vein of collecting data during as much of the activity period as possible, HEA implemented additional measures two weeks ago to further document recreational activities in the area.

Since this meeting, USKH has been able to install a total of (4) trail cameras. The cameras are manufactured by Bushnell, and feature motion-activated images. These cameras have been installed and secured at the following locations: Vagt lake trailhead, Grant Lake Trail near the railroad trestle, Saddle Trail at Upper Trail Lake, Saddle Trail at Grant lake. Please see the attached graphic for locations. It is the intention that these cameras will be able to record the number of trail users and the frequency of use. Currently, the cameras will be checked every 2

weeks for battery levels and memory usage until it is agreed they are no longer needed. The collected data will be periodically processed in accordance with the 2 week check-ups.

Data collection and associated analysis will be finalized in advance of the development of the Draft License Application and all information will be formally incorporated in this document for review by all of you and the rest of the stakeholder group. Unless any of you disagree, HEA doesn't see the need to have the call that was initially discussed at the meeting given the comprehensive direction that has been taken. If any of you feel differently and would like to have a call to discuss, please let me know and we'll get it set up.

Thank You,

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

This electronic communication (including all attachments) is intended only for the named addressee(s) and may contain confidential information. It has not passed through our standard review process. Design data and recommendations included herein are provided as a matter of convenience and should not be used for final design. RELY ONLY ON THE FINAL HARDCOPY MATERIALS BEARING THE CONSULTANT'S ORIGINAL SIGNATURE AND SEAL. If you are not the named addressee(s), any use, dissemination, distribution or copying of this communication is prohibited. If you have received this communication in error, please notify the sender immediately by return e-mail and delete the original communication from your system. This e-mail and all other electronic (including voice) communications from the sender's firm are not intended by the sender to constitute an electronic record, an electronic signature or any agreement to conduct a transaction by electronic means. Any such intention or agreement is hereby expressly disclaimed unless otherwise specifically indicated.

This electronic communication (including all attachments) is intended only for the named addressee(s) and may contain confidential information. It has not passed through our standard review process. Design data and recommendations included herein are provided as a matter of convenience and should not be used for final design. RELY ONLY ON THE FINAL HARDCOPY MATERIALS BEARING THE CONSULTANT'S ORIGINAL SIGNATURE AND SEAL. If you are not the named addressee(s), any use, dissemination, distribution or copying of this communication is prohibited. If you have received this communication in error, please notify the sender immediately by return e-mail and delete the original communication from your system. This e-mail and all other electronic (including voice) communications from the sender's firm are not intended by the sender to constitute an electronic record, an electronic signature or any agreement to conduct a transaction by electronic means. Any such intention or agreement is hereby expressly disclaimed unless otherwise specifically indicated.

This electronic communication (including all attachments) is intended only for the named addressee(s) and may contain confidential information. It has not passed through our



Alaska State Parks Special Park Use Permit Application

Please note that a non-refundable application fee may be required for Special Park Use Permits.
Make check payable to the State of Alaska. Call park office listed for facility for more information.

Applicant: Dwayne Adams on behalf of Mike Salzetti
Organization: Kenai Hydro
Address: c/o Homer Electric Assn. Phone Number: 907 343 5248 (Adams)
3977 Lake St, Homer AK 99603 Fax Number: 907 258 4653
Email: dadams@oskh.com

Park Facility Name or Location of Activity (attach map if necessary) _____
Trail Lakes area, see map.

Is this for reserved and exclusive use of this park facility? No
From: March 30 2014 to October 1 2014
Date and Time am/pm Date and Time am/pm

Description of Activity (attach additional information if necessary) Attachment of
4 minicameras to trees to detect movement
that assists in quantifying trail use.

Number of People: 0 Adults 0 Children

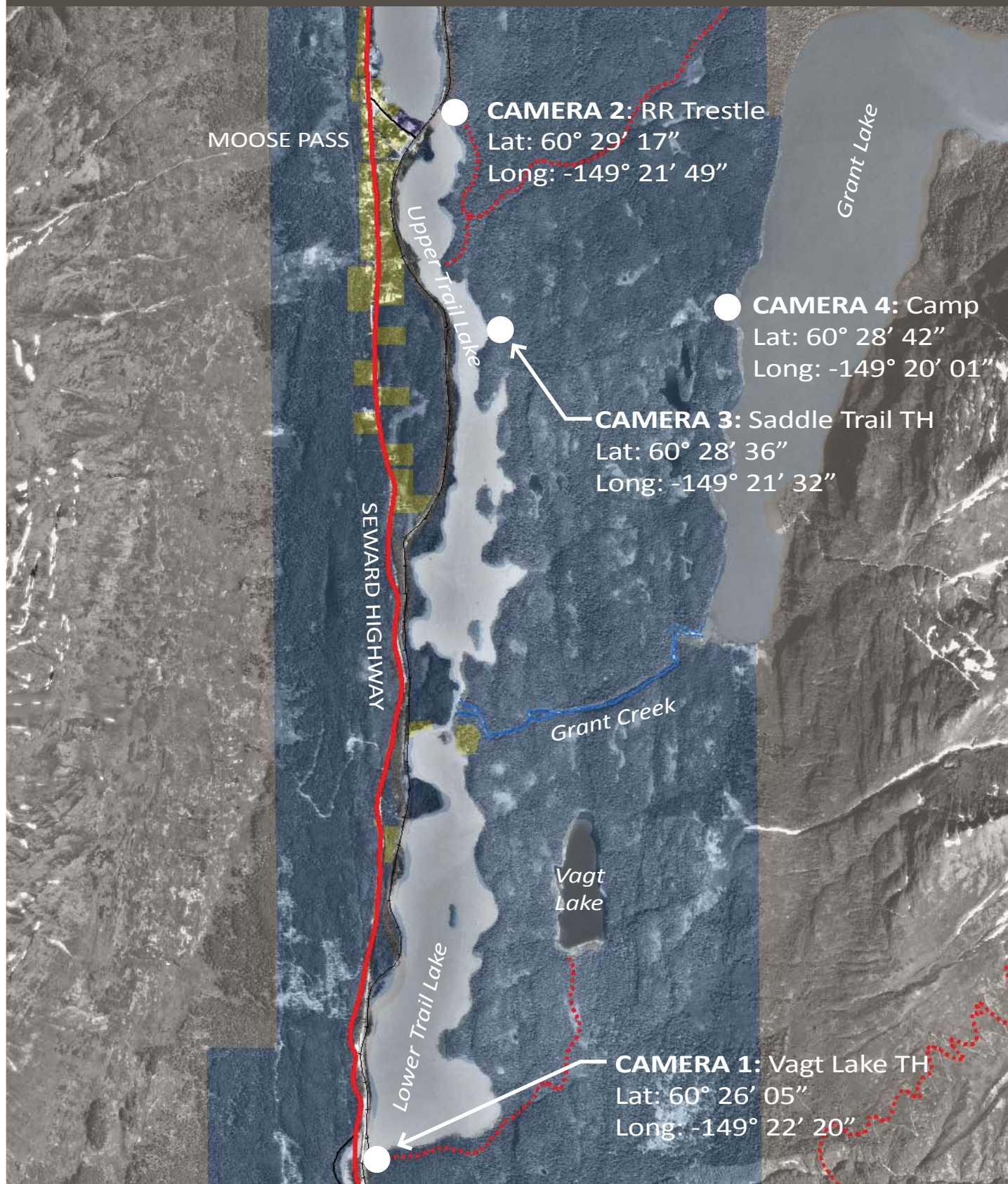
Other Comments: All work is in the vicinity
of Grant Lake

M. Adams
Applicant's Signature

4/17/2014
Date

GRANT LAKE

TRAIL CAMERAS



NOT TO SCALE

Prepared by: **USKH**

GRANT LAKE

TRAIL CAMERAS



CAMERA 1 - VAGT LAKE TRAILHEAD

Camera has been placed 6' above ground, with underbrush of the same level.

All cameras have been secured within a steel housing having a separate padlock, and secured to the tree with an adjustable nylon strap and steel lockable cable.



CAMERA 2 - RR TRESTLE

Camera has been placed 4' above ground, approximately 20' from trail, with a view of trail connection to railroad tracks.

GRANT LAKE

TRAIL CAMERAS



CAMERA 3 - SADDLE TRAIL TRAILHEAD

Camera has been placed 12' off of trail within underbrush. Camera angle includes view of lake to additionally capture shoreline movement.



CAMERA 4 - CAMP

Camera has been placed 7' above the ground, and 20' north of the camp, allowing a full view of the camping area.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Thursday, April 17, 2014 2:05 PM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: Agenda and attachments for the Grant Creek Instream Flow Work Group Meeting.
Attachments: Grant Creek Periodicity 3-28-14.xlsx; Sockeye DTUs.xlsx; Transect_Spawning_Maps_RED_04092014.pdf; Transect_Rearing_All_Red_041714.pdf; MinT Locates By Transect Red 041714.pdf; Draft App 4_GL IFIM_Mar2014 PD 03-31-14.pdf

Importance: High

Good Afternoon:

Please find attached the agenda for our conference call tomorrow, as well as documents that we will be referencing in our discussions. The call will take place at 8 am (AK), 9 am (WA) and 10 am (ID) time.

Thanks very much; I look forward to our call.

John

John Blum
Sr. Fisheries Scientist

McMillen, LLC
1155 North State Street, Suite 700, Bellingham, WA 98225
direct 360.483.2807 | p 360.734.5915 x 281
f 360.734.5918 | c 360.220.0694
john.blum@mcmillen-llc.com | www.mcmillen-llc.com

AGENDA FOR GRANT CREEK INSTREAM FLOW WORK GROUP MEETING APRIL 18, 2014

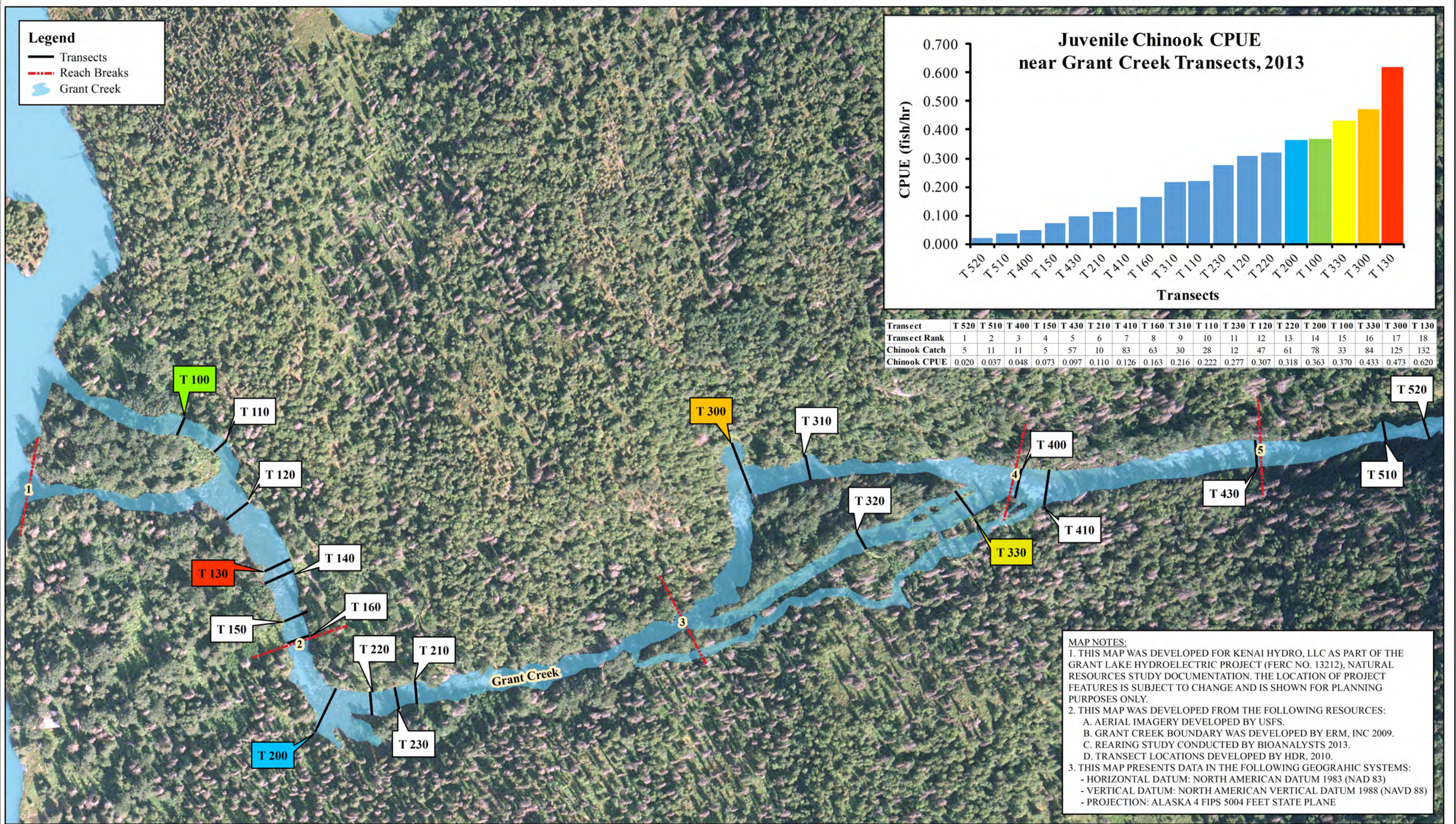
- Introduction
- Review of Grant Creek periodicity (see grant creek periodicity 3-28-14.xlsx)
 - DTU's for sockeye salmon incubation and emergence (see sockeye DTUs.xlsx - to be revised with additional input)

- Transect Selection and Weighting
 - Spawning in relation to Instream Flow Transects (see Transect spawning Maps RED 04092014.pdf)
 - Rearing in Relation to Instream Flow Transects (see MinT Locates By Transect Red 041714.pdf and Transect rearing all Red 041714.pdf)
 - CPUE for Chinook, Coho, Rainbow Trout and Dolly Varden Rearing
 - Wetted Perimeter vs. Flow graphs for Instream Flow transects (see Draft App 4_GL IFIM March 2014 PD 03-31-14)
 - Remaining:
 - Location of spawning/rearing on transects
 - Discussion
- Effective Spawning Analysis
 - Hydrologic Record - extended
 - Review of Saltveit and Brabrand (2013)
 - Discussion
- Other
- Set next Work Group meeting
- Discussion of dates for next Stakeholder meeting
- Adjourn

Proposed Periodicity for Grant Creek Salmonids

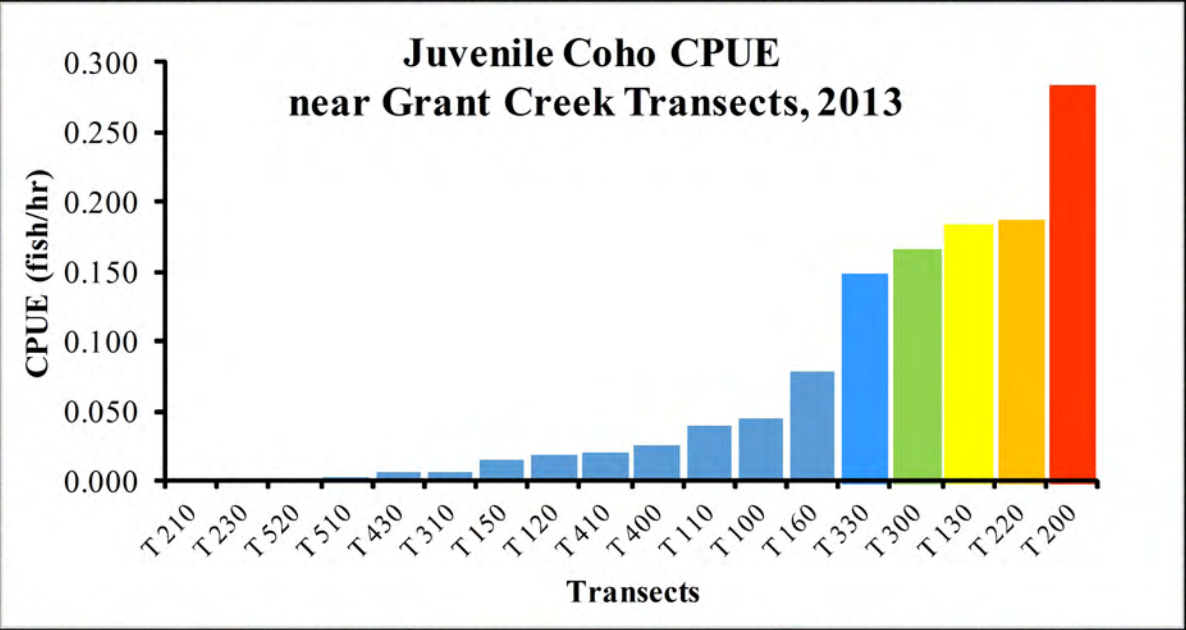
[illegible]

Review of Daily Temperature Units (°C) for Sockeye Salmon Fry and Emergence				
Source:	Location	Hatch	Emergence	Emergence Timing
T. Prochazka (CIAA)	AK	600-650	950-1,000	early March - early May
Taylor & Heard, ADFG	AK	650	1100 ^{1/}	
Pieper et al. (1982)	Unknown	666	1,000	
Hendry et al. (1998)	WA	615	950	
^{1/} Fry fully developed.				

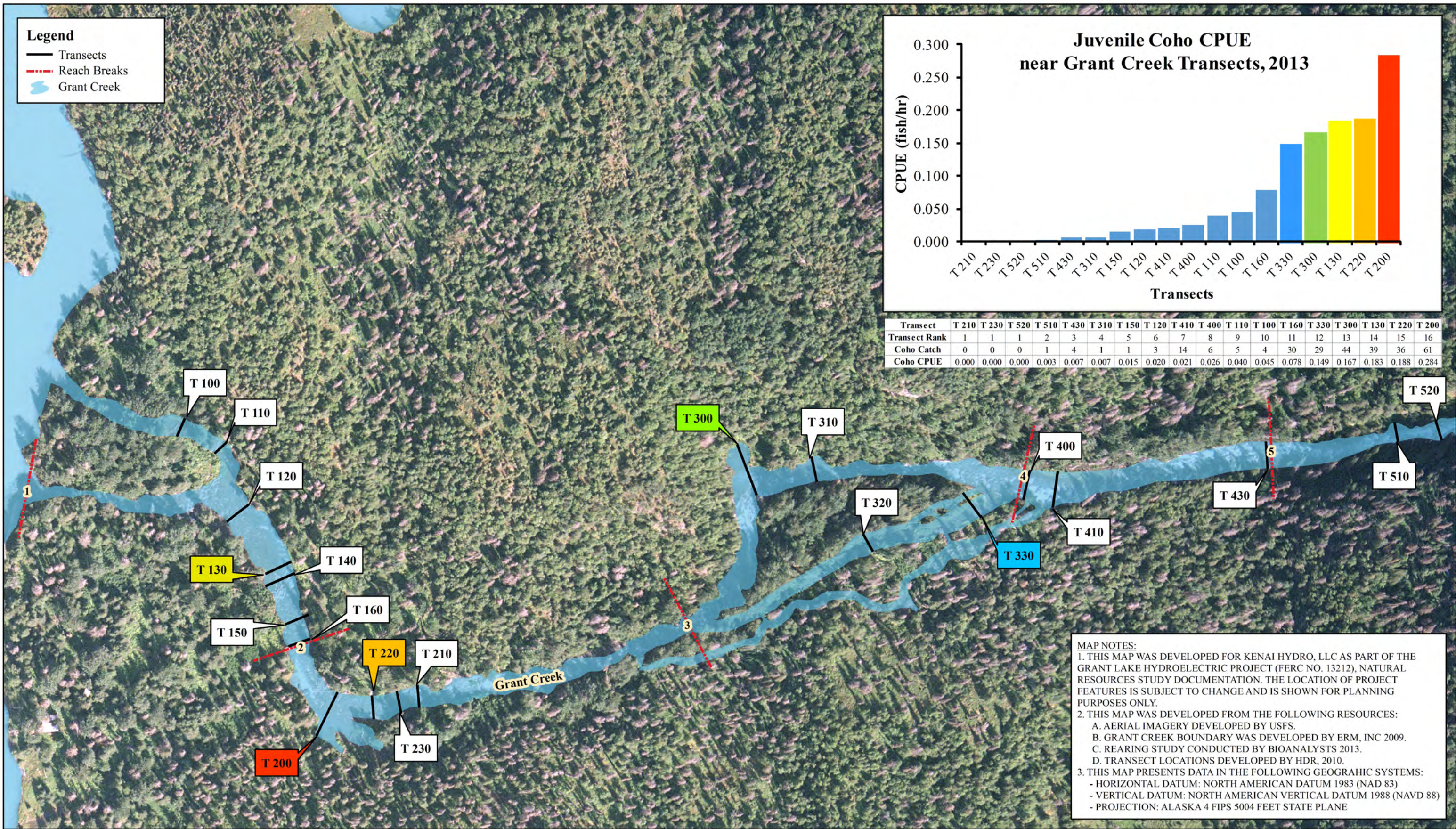


Legend

- Transects
- Reach Breaks
- Grant Creek



Transect	T 210	T 230	T 520	T 510	T 430	T 310	T 150	T 120	T 410	T 400	T 110	T 100	T 160	T 330	T 300	T 130	T 220	T 200
Transect Rank	1	1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Coho Catch	0	0	0	1	4	1	1	3	14	6	5	4	30	29	44	39	36	61
Coho CPUE	0.000	0.000	0.000	0.003	0.007	0.007	0.015	0.020	0.021	0.026	0.040	0.045	0.078	0.149	0.167	0.183	0.188	0.284



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. GRANT CREEK BOUNDARY WAS DEVELOPED BY ERM, INC 2009.
- C. REARING STUDY CONDUCTED BY BIOANALYSTS 2013.
- D. TRANSECT LOCATIONS DEVELOPED BY HDR, 2010.

3. THIS MAP PRESENTS DATA IN THE FOLLOWING GEOGRAPHIC SYSTEMS:

- HORIZONTAL DATUM: NORTH AMERICAN DATUM 1983 (NAD 83)
- VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88)
- PROJECTION: ALASKA 4 FIPS 5004 FEET STATE PLANE

REV	DATE	BY	DESCRIPTION

North Arrow

Drawing Scale:

0 95 190 380 Feet

McMILLEN, LLC

THE SONNA BUILDING 910 MAIN ST. SUITE 255 BOISE, ID 83702 OFFICE: 208.342.4214 FAX: 208.342.4216

Developed For:

Homer Electric Association, Inc.

A Touchstone Energy® Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

GRANT LAKE NATURAL RESOURCES STUDY

Coho Salmon Rearing Habitat By Transect

DESIGNED: J. Woodbury

DRAWN: J. Woodbury

CHECKED: J. Blum

ISSUED DATE: 4/17/2014

SCALE: 1:2,000

Legend

Spawning Locations 2013

- Coho
- Transect Locations
- Reach Breaks
- Grant Creek

MAP NOTES:

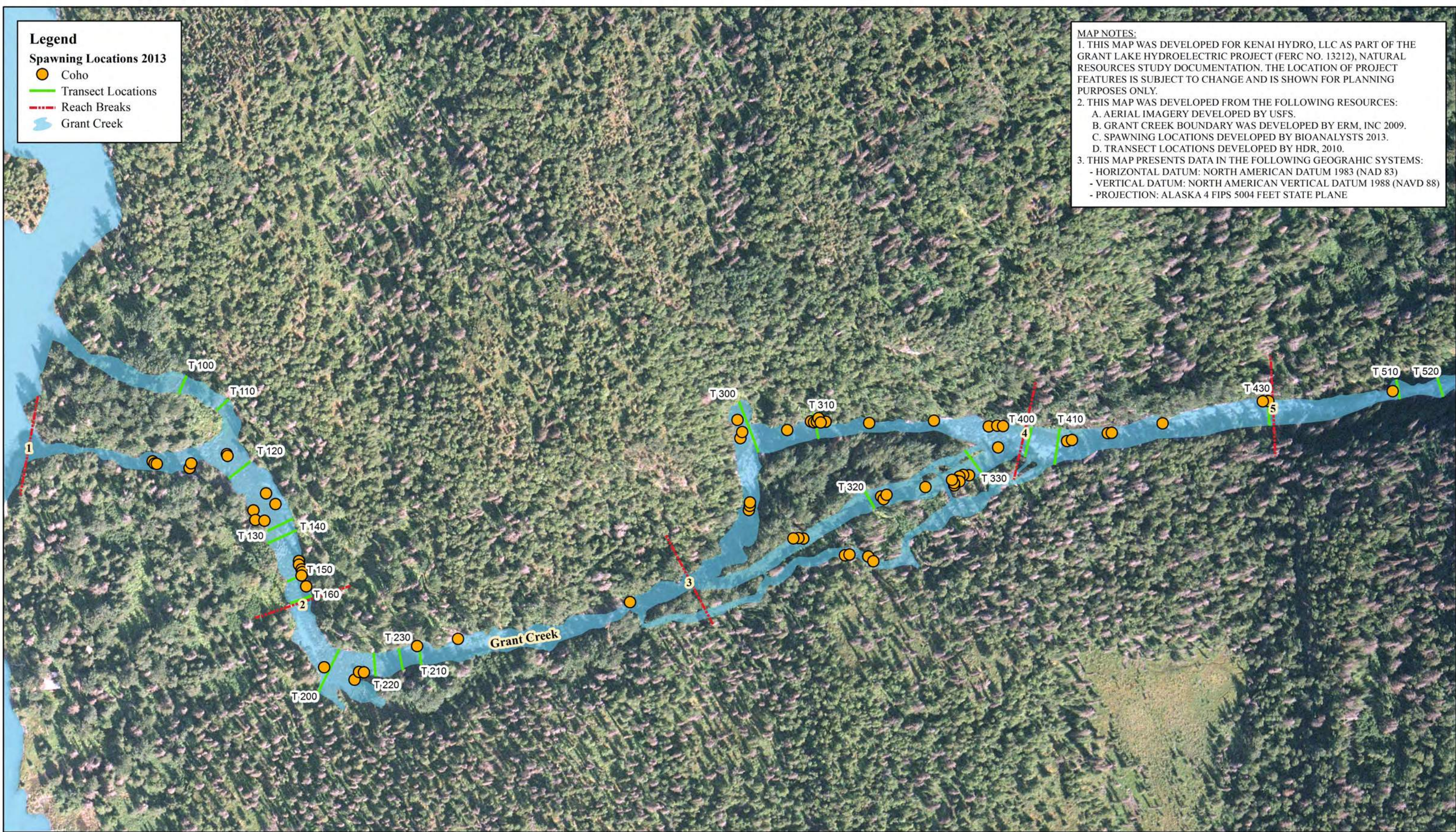
1. THIS MAP WAS DEVELOPED FOR KENAI HYDRO, LLC AS PART OF THE GRANT LAKE HYDROELECTRIC PROJECT (FERC NO. 13212), NATURAL RESOURCES STUDY DOCUMENTATION. THE LOCATION OF PROJECT FEATURES IS SUBJECT TO CHANGE AND IS SHOWN FOR PLANNING PURPOSES ONLY.

2. THIS MAP WAS DEVELOPED FROM THE FOLLOWING RESOURCES:

- A. AERIAL IMAGERY DEVELOPED BY USFS.
- B. GRANT CREEK BOUNDARY WAS DEVELOPED BY ERM, INC 2009.
- C. SPAWNING LOCATIONS DEVELOPED BY BIOANALYSTS 2013.
- D. TRANSECT LOCATIONS DEVELOPED BY HDR, 2010.

3. THIS MAP PRESENTS DATA IN THE FOLLOWING GEOGRAPHIC SYSTEMS:

- HORIZONTAL DATUM: NORTH AMERICAN DATUM 1983 (NAD 83)
- VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM 1988 (NAVD 88)
- PROJECTION: ALASKA 4 FIPS 5004 FEET STATE PLANE



REV	DATE	BY	DESCRIPTION

N

Drawing Scale:

0

95

190

380

Feet

McMILLEN, LLC

THE SONNA BUILDING
910 MAIN ST. SUITE 200
BOISE, ID 83702

OFFICE: 208.342.4214
FAX: 208.342.4216

Developed For:

Homer Electric Association, Inc.

A Touchstone Energy® Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT NO. 13212

GRANT LAKE NATURAL RESOURCES STUDY

Transect Locations & Coho Spawning Locations

DESIGNED: J. Woodbury

DRAWN: J. Woodbury

CHECKED: J. Blum

ISSUED DATE: 4/9/2014

DRAWING

SCALE: 1:2,000

Appendix 4: Cross Sections, WSE and Flow Hydraulics

- Appendix 4a. Reach 1 Main Channel
- Appendix 4b. Reach 1 Side Channel
- Appendix 4c. Reach 2
- Appendix 4d. Reach 3 Main Channel
- Appendix 4e. Reach 3 Side Channel
- Appendix 4f. Reach 4

Appendix 4a Reach 1 Main Channel

This sub-appendix contains the following figures:

- Figure A.4a-1. Transect T120 bed profile and Water Surface Elevation (WSE), 10–1,000 cfs.
- Figure A.4a-2. Transect T130 bed profile and WSE, 10–1,000 cfs.
- Figure A.4a-3. Transect T140 bed profile and WSE, 10–1,000 cfs.
- Figure A.4a-4. Transect T150 bed profile and WSE, 10–1,000 cfs.
- Figure A.4a-5. Transect T160 bed profile and WSE, 10–1,000 cfs.
- Figure A.4a-6. Reach 1 main channel wetted perimeter vs flow.
- Figure A.4a-7. Reach 1 main channel wetted width vs flow.
- Figure A.4a-8. Reach 1 main channel hydraulic radius vs flow.
- Figure A.4a-9. Reach 1 main channel average depth vs flow.

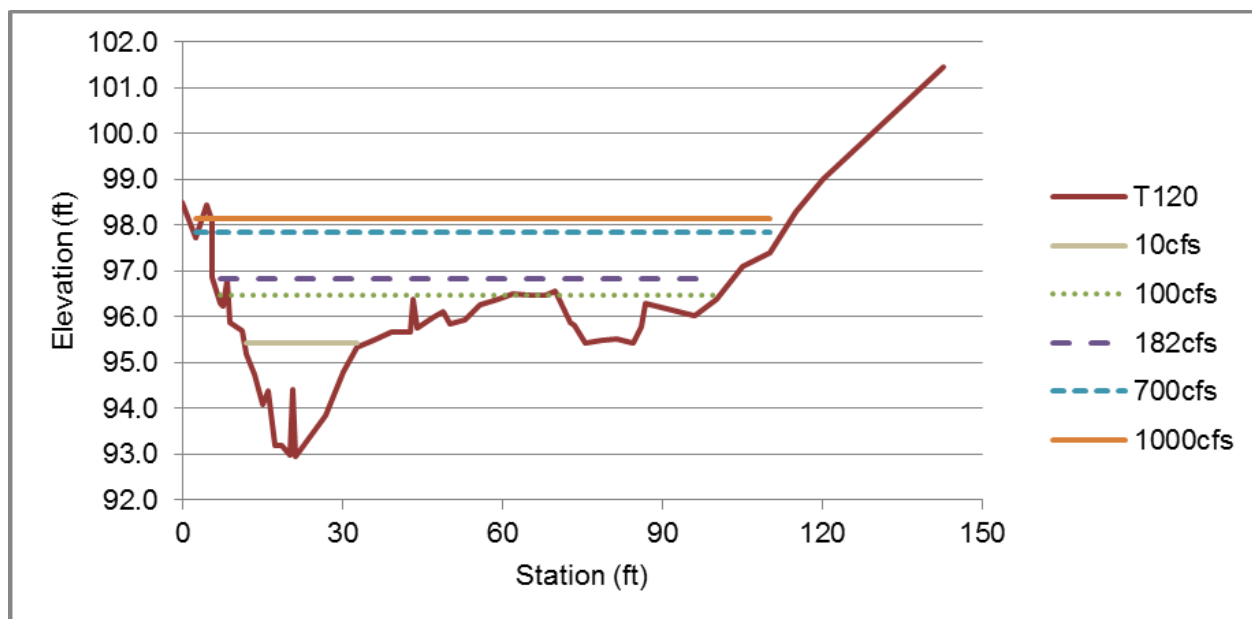


Figure A.4a-1. Transect T120 bed profile and Water Surface Elevation (WSE), 10–1,000 cfs.

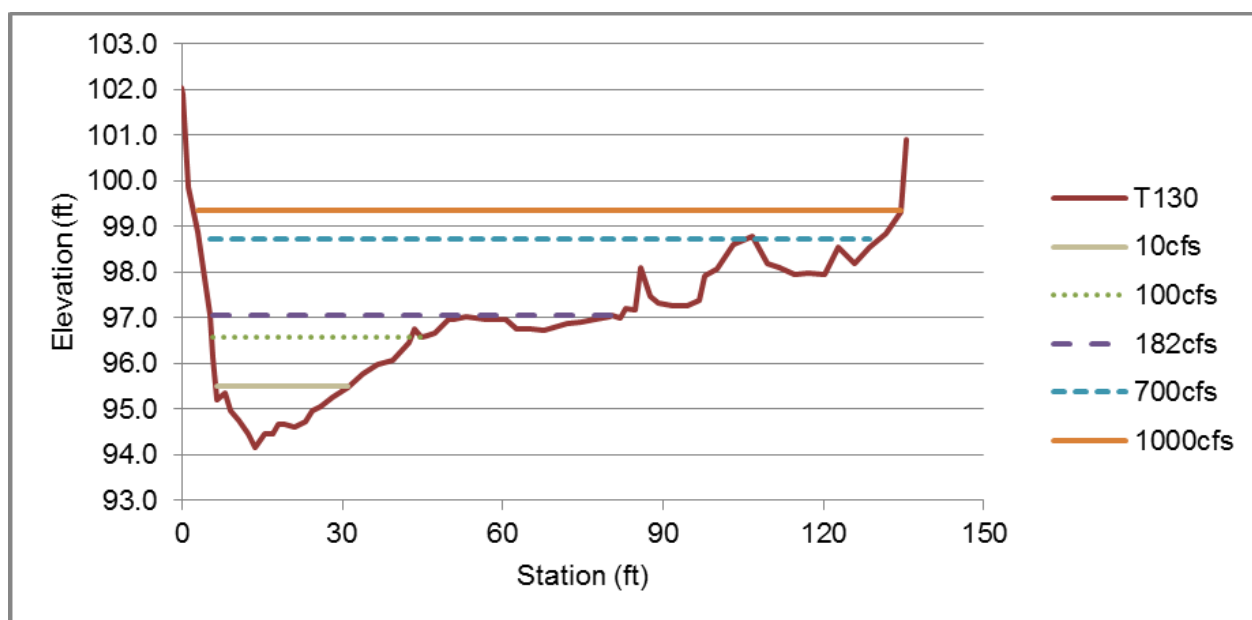


Figure A.4a-2. Transect T130 bed profile and WSE, 10–1,000 cfs.

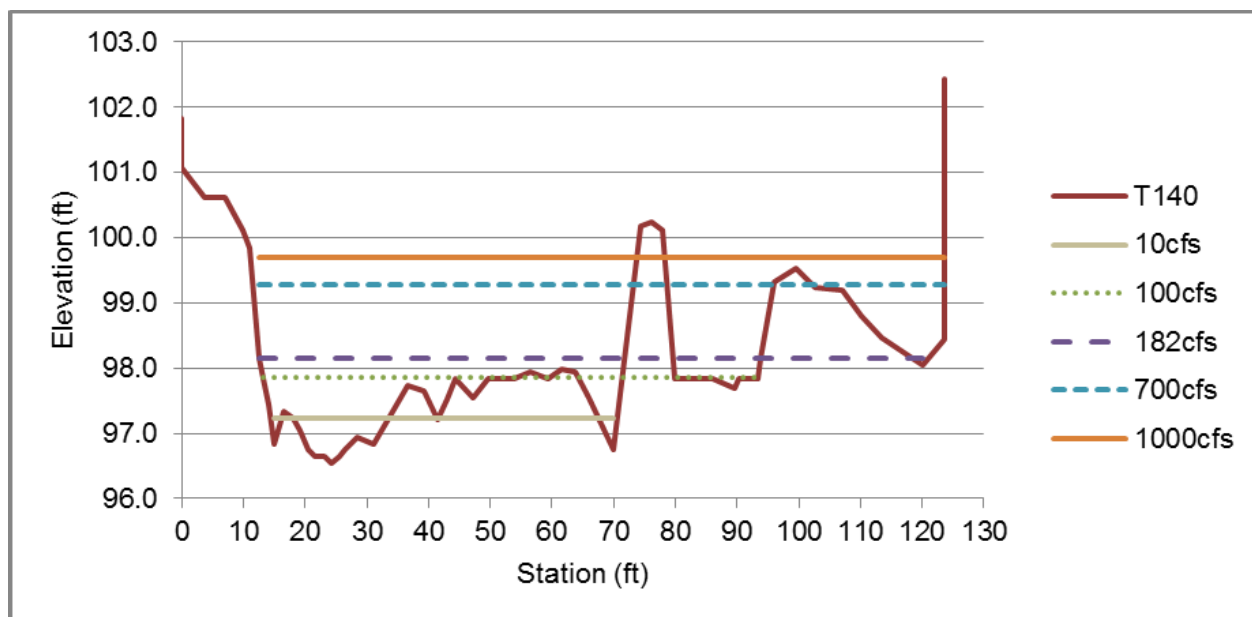


Figure A.4a-3. Transect T140 bed profile and WSE, 10-1,000 cfs.

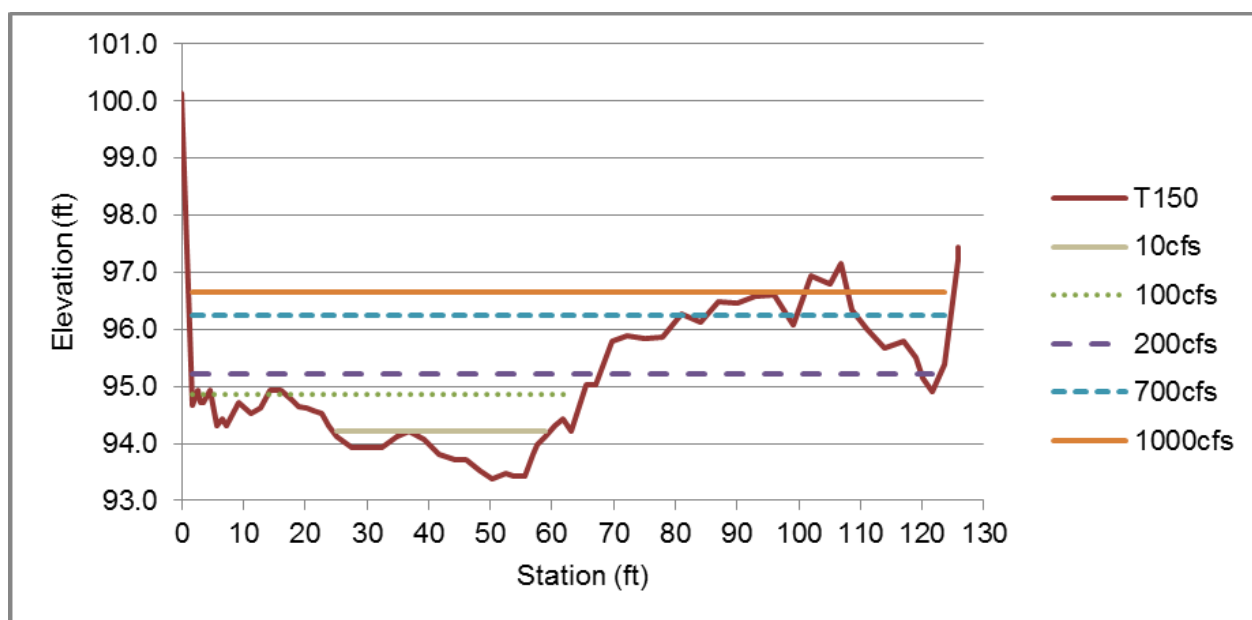


Figure A.4a-4. Transect T150 bed profile and WSE, 10-1,000 cfs.

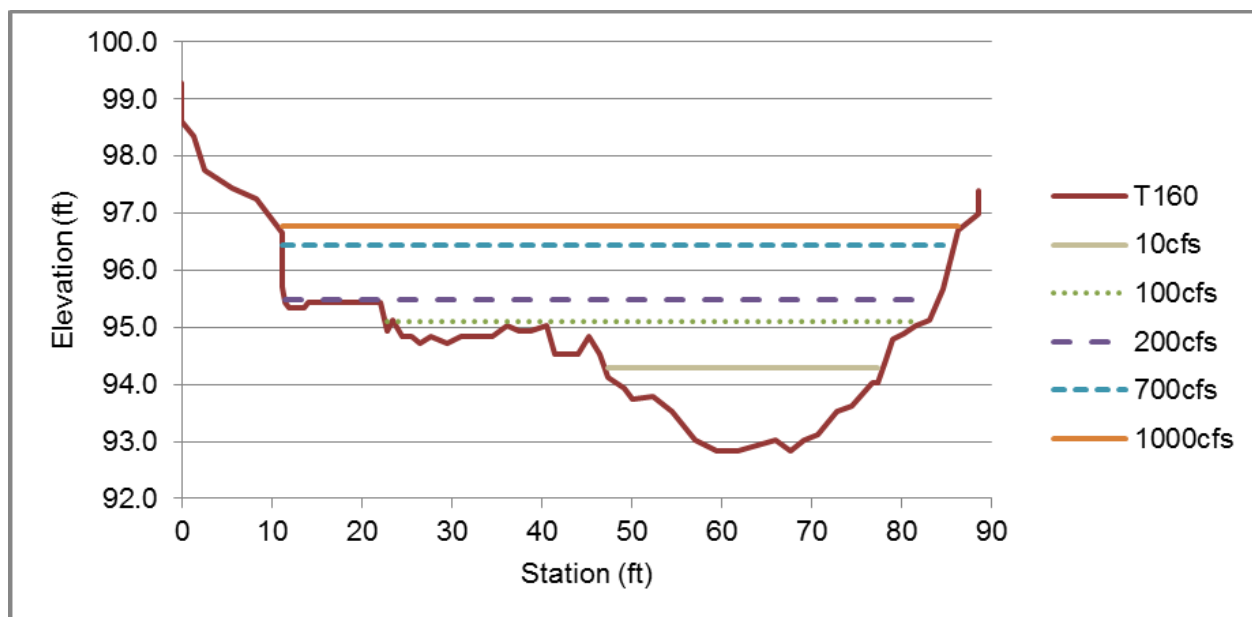


Figure A.4a-5. Transect T160 bed profile and WSE, 10-1,000 cfs.

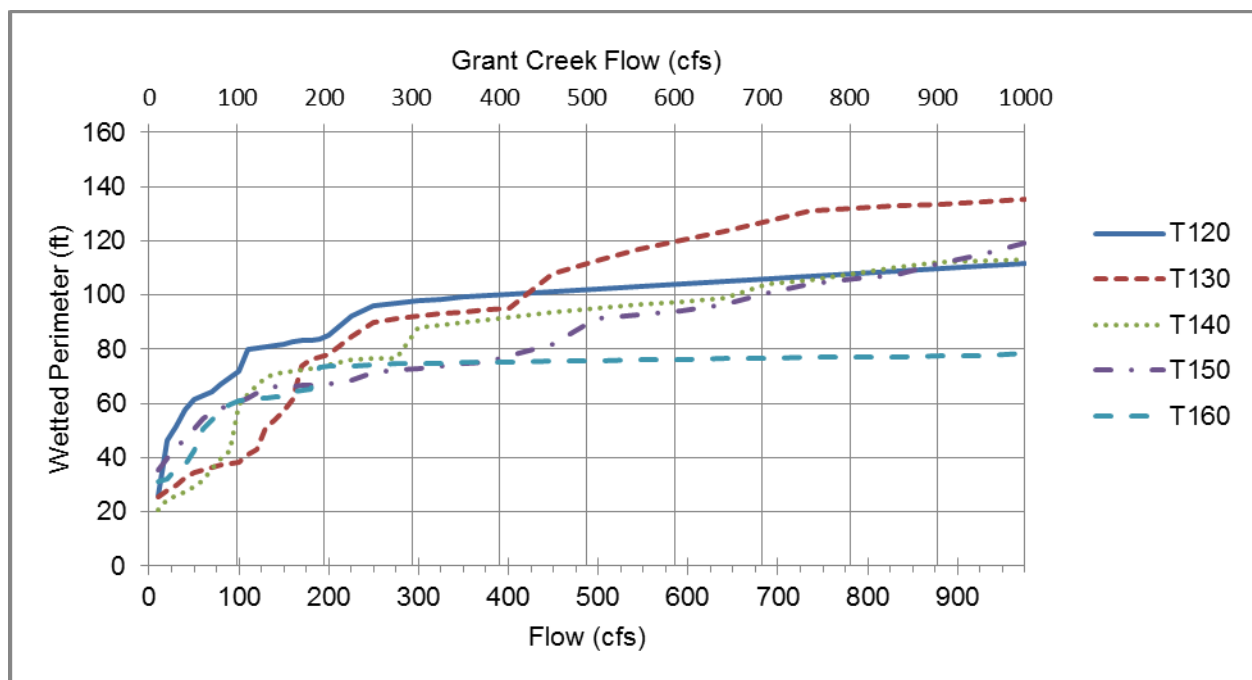


Figure A.4a-6. Reach 1 main channel wetted perimeter vs flow.

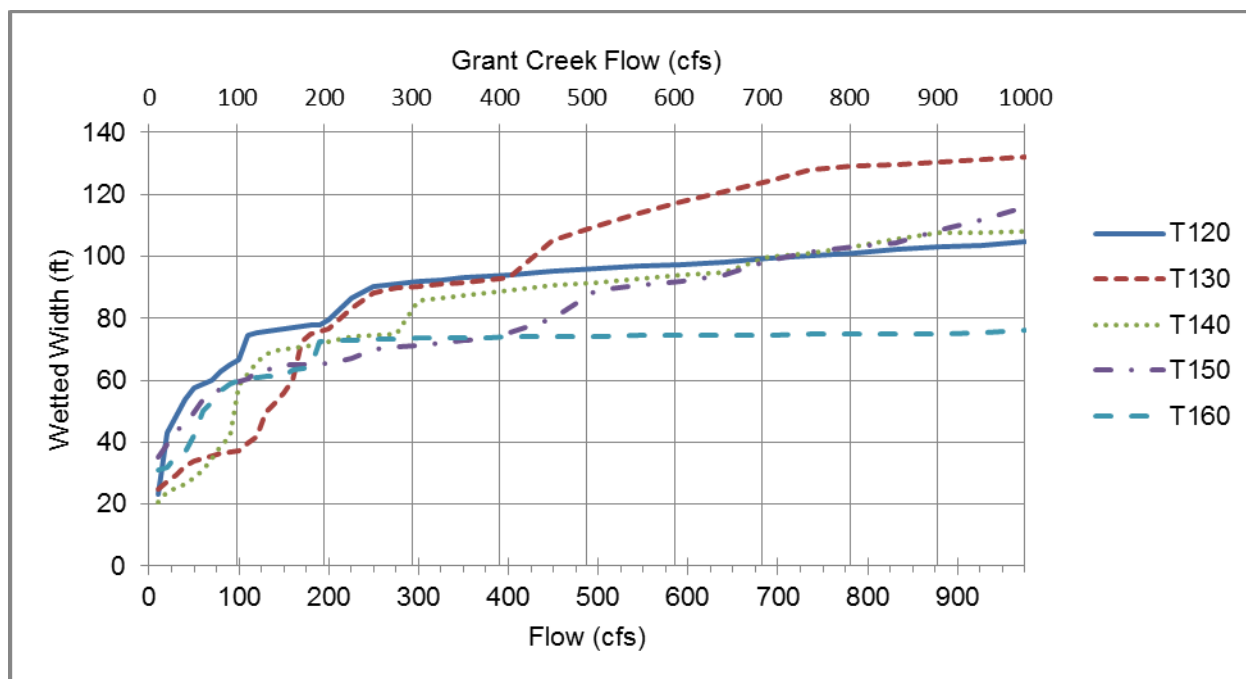


Figure A.4a-7. Reach 1 main channel wetted width vs flow.

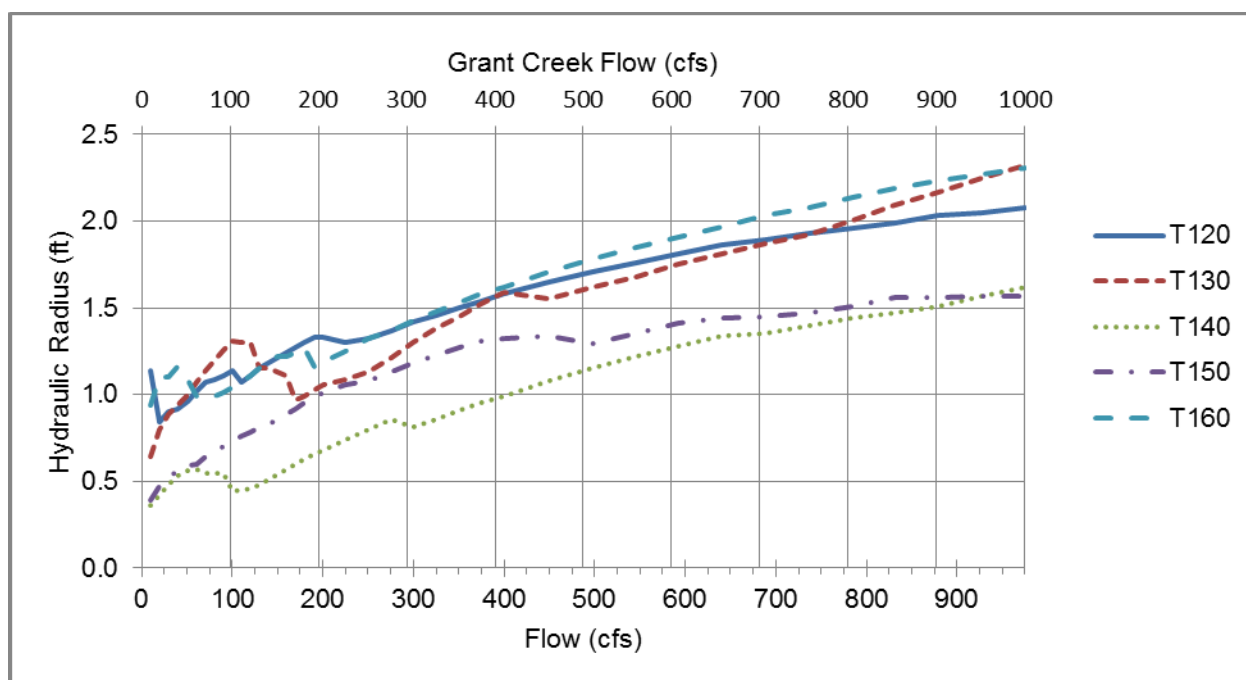


Figure A.4a-8. Reach 1 main channel hydraulic radius vs flow.

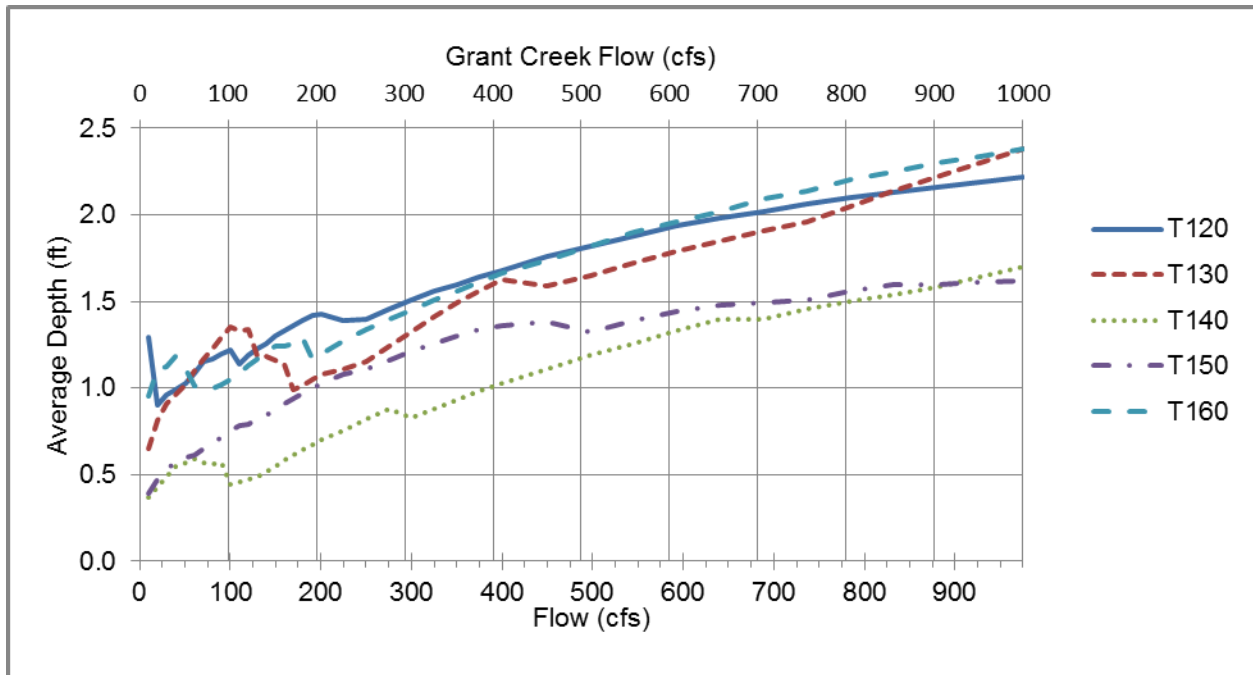


Figure A.4a-9. Reach 1 main channel average depth vs flow.

[This page intentionally left blank.]

Appendix 4b Reach 1 Side Channel

This sub-appendix contains the following figures:

- Figure A.4b-1. Transect T100 bed profile and WSE, 0.1-20 cfs.
- Figure A.4b-2. Transect T110 bed profile and WSE, 0.1-20 cfs.
- Figure A.4b-3. Reach 1 side channel wetted perimeter vs flow.
- Figure A.4b-4. Reach 1 side channel wetted width vs flow.
- Figure A.4b-5. Reach 1 side channel hydraulic radius vs flow.
- Figure A.4b-6. Reach 1 side channel average depth vs flow.

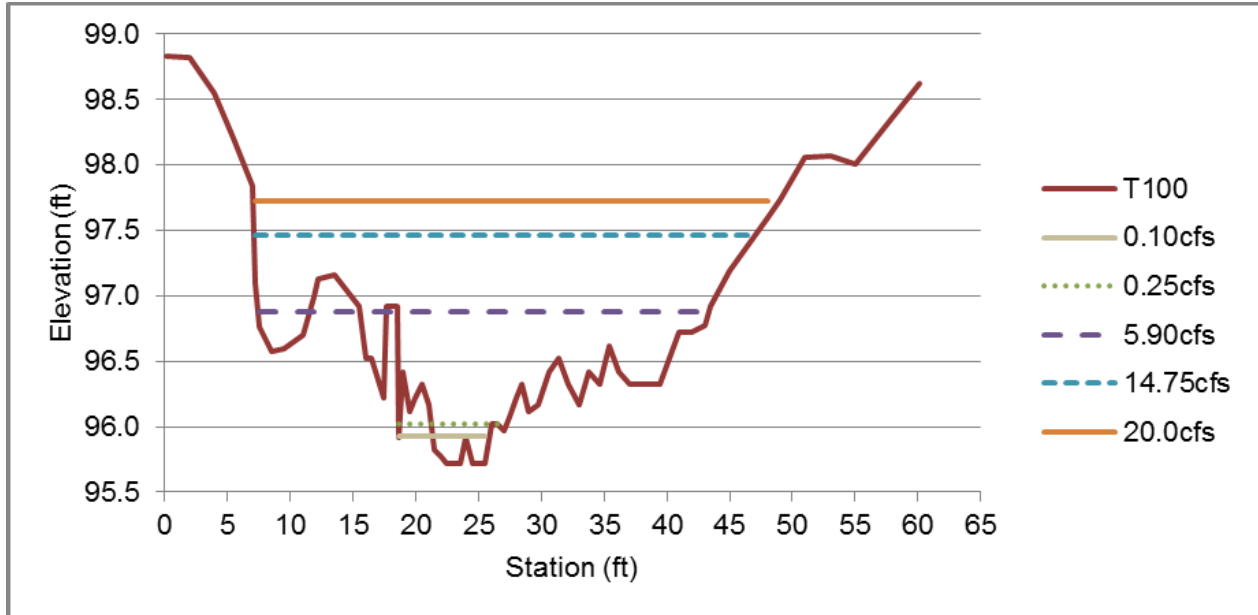


Figure A.4b-1. Transect T100 bed profile and WSE, 0.1-20 cfs.

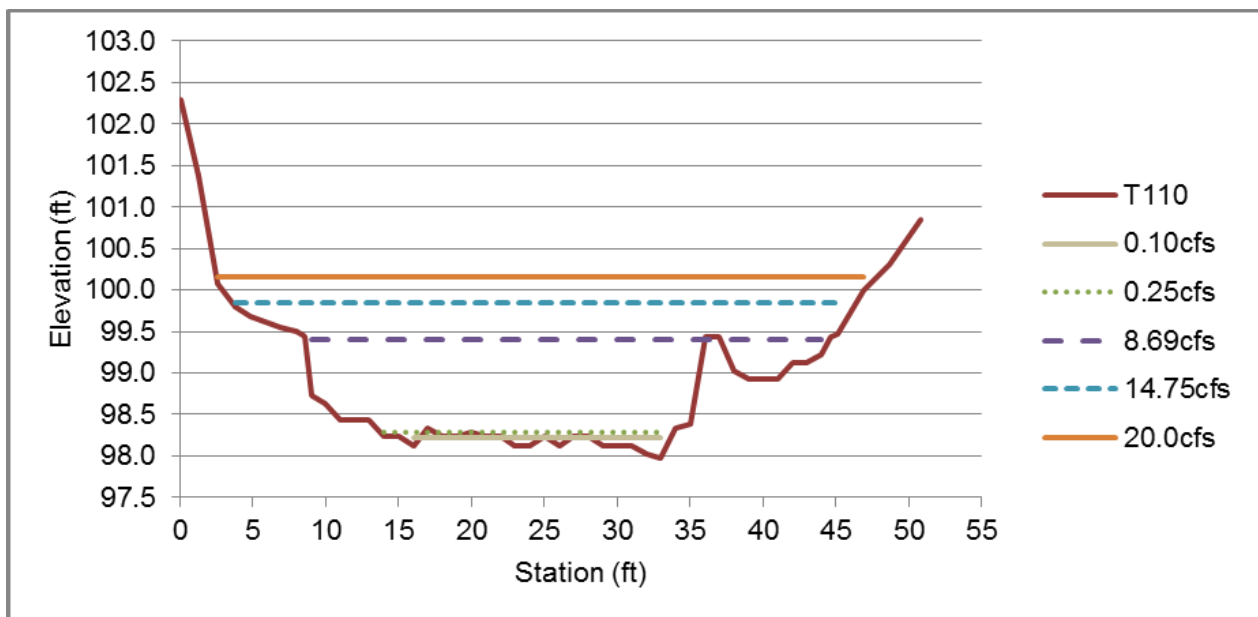


Figure A.4b-2. Transect T110 bed profile and WSE, 0.1-20 cfs.

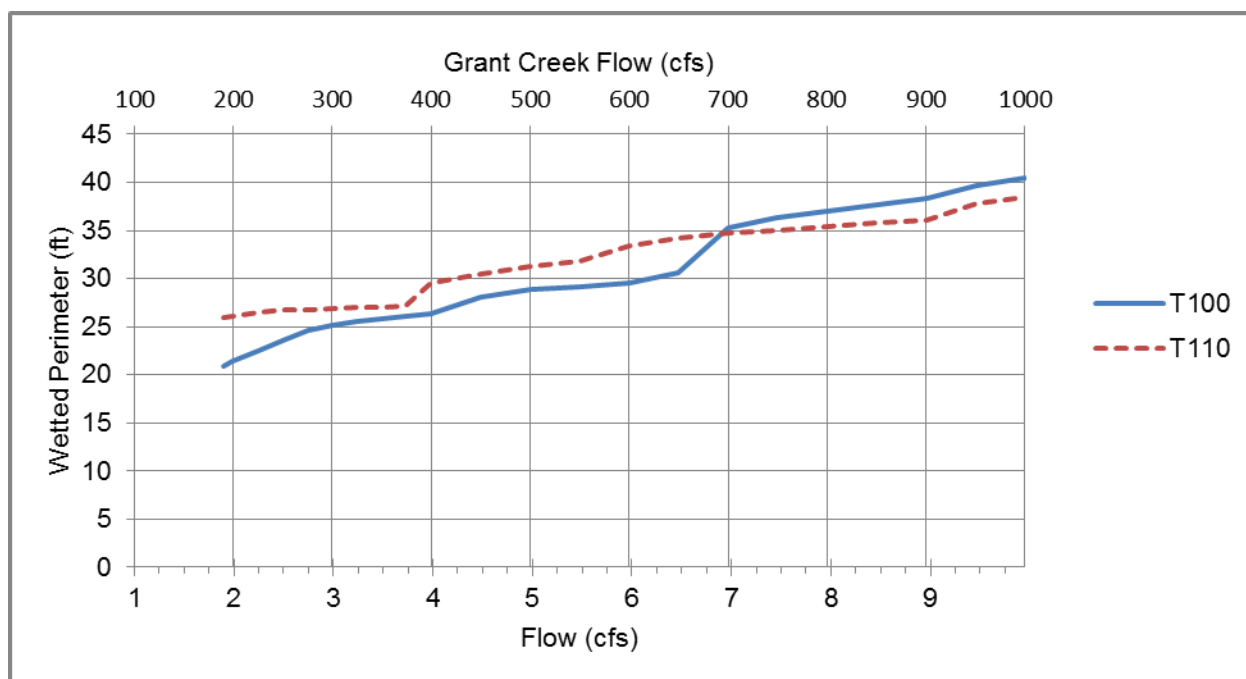


Figure A.4b-3. Reach 1 side channel wetted perimeter vs flow.

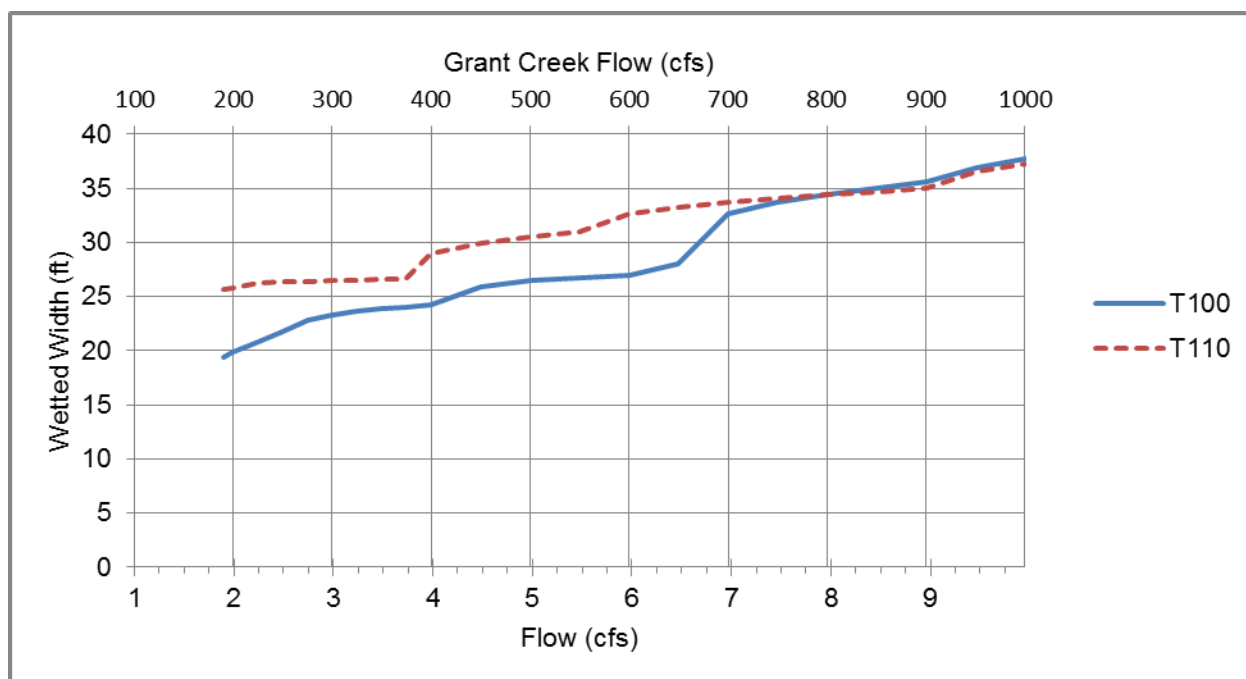


Figure A.4b-4. Reach 1 side channel wetted width vs flow.

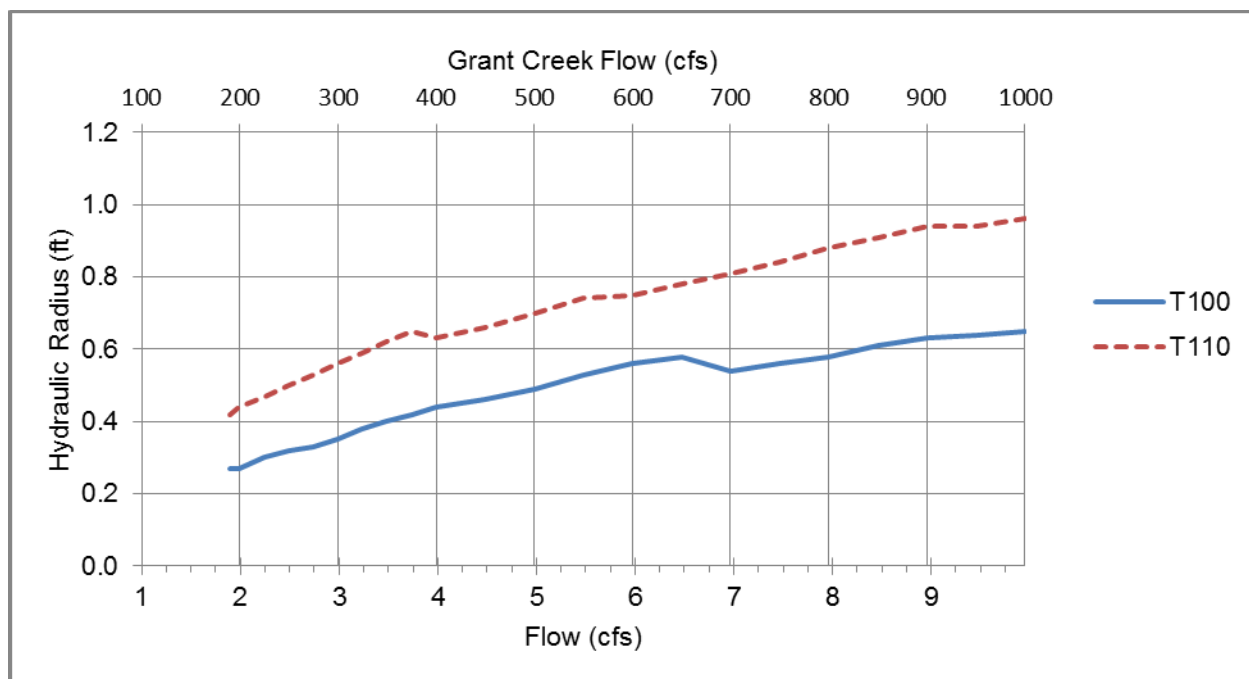


Figure A.4b-5. Reach 1 side channel hydraulic radius vs flow.

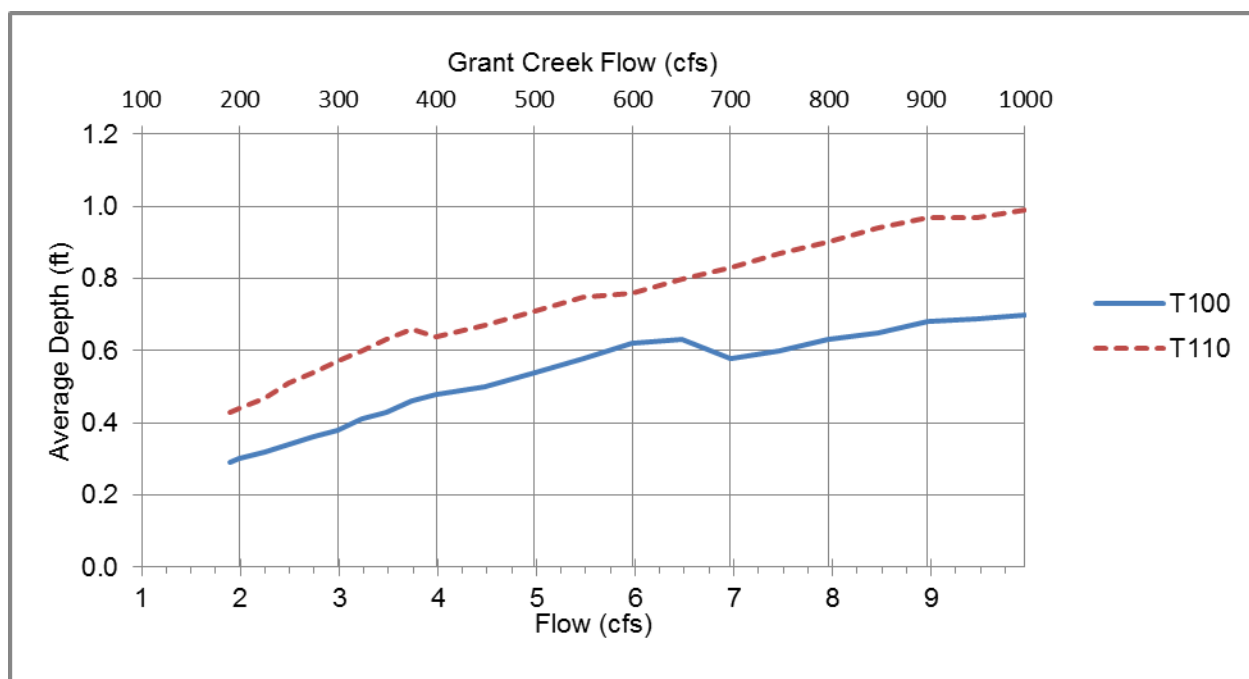


Figure A.4b-6. Reach 1 side channel average depth vs flow.

[This page intentionally left blank.]

Appendix 4c Reach 2

This sub-appendix contains the following figures:

- Figure A.4c-1. Transect T200 bed profile and WSE, 0.89–89 cfs.
- Figure A.4c-2. Transect T210 bed profile and WSE, 10–1,000 cfs.
- Figure A.4c-3. T200 side lobe wetted perimeter vs flow.
- Figure A.4c-4. T200 side lobe wetted width vs flow.
- Figure A.4c-5. T200 side lobe hydraulic radius vs flow.
- Figure A.4c-6. T200 side lobe average depth vs flow.
- Figure A.4c-7. Reach 2 wetted perimeter vs flow.
- Figure A.4c-8. Reach 2 wetted width vs flow.
- Figure A.4c-9. Reach 2 hydraulic radius vs flow.
- Figure A.4c-10. Reach 2 average depth vs flow.

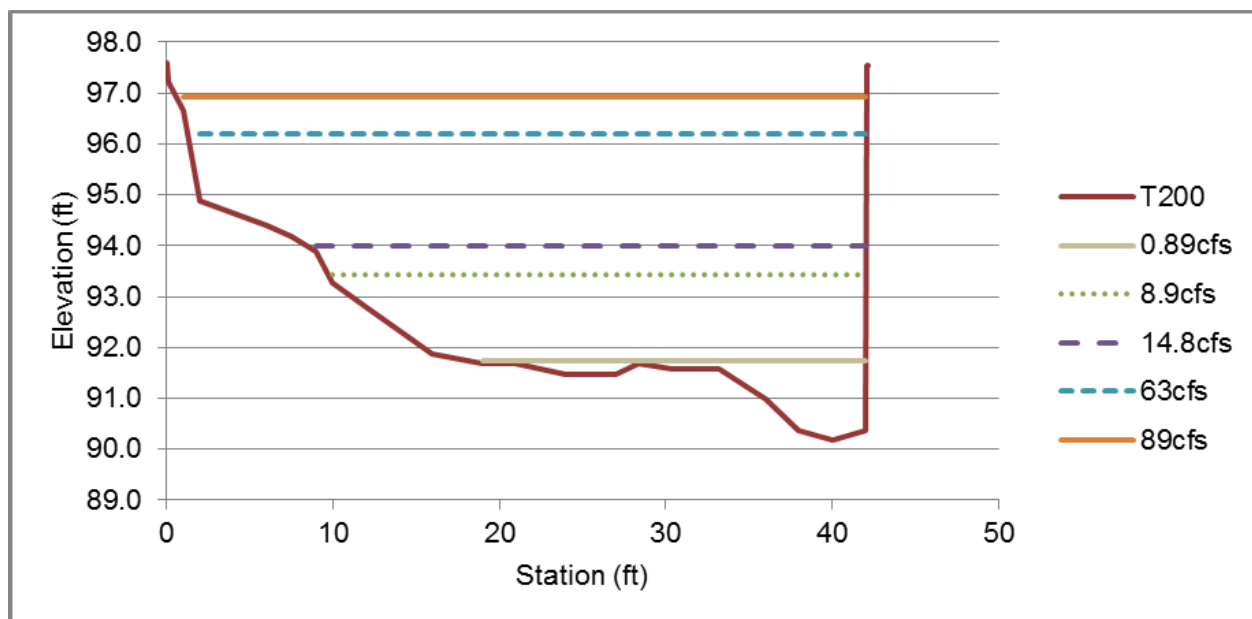


Figure A.4c-1. Transect T200 bed profile and WSE, 0.89–89 cfs.

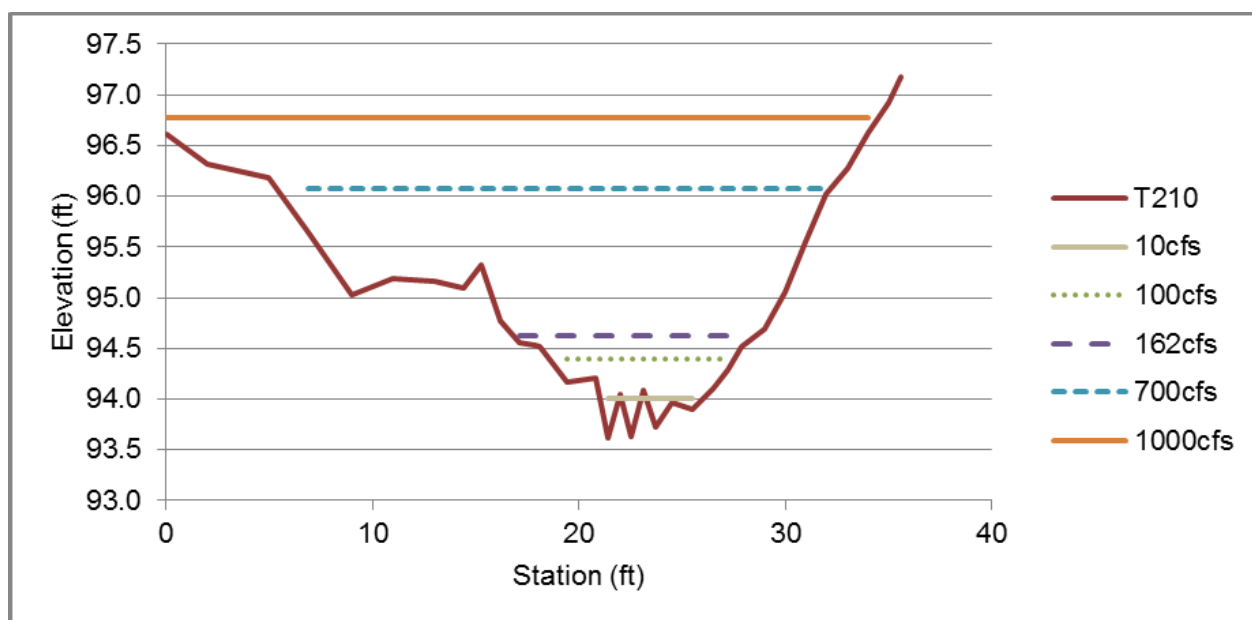


Figure A.4c-2. Transect T210 bed profile and WSE, 10–1,000 cfs.

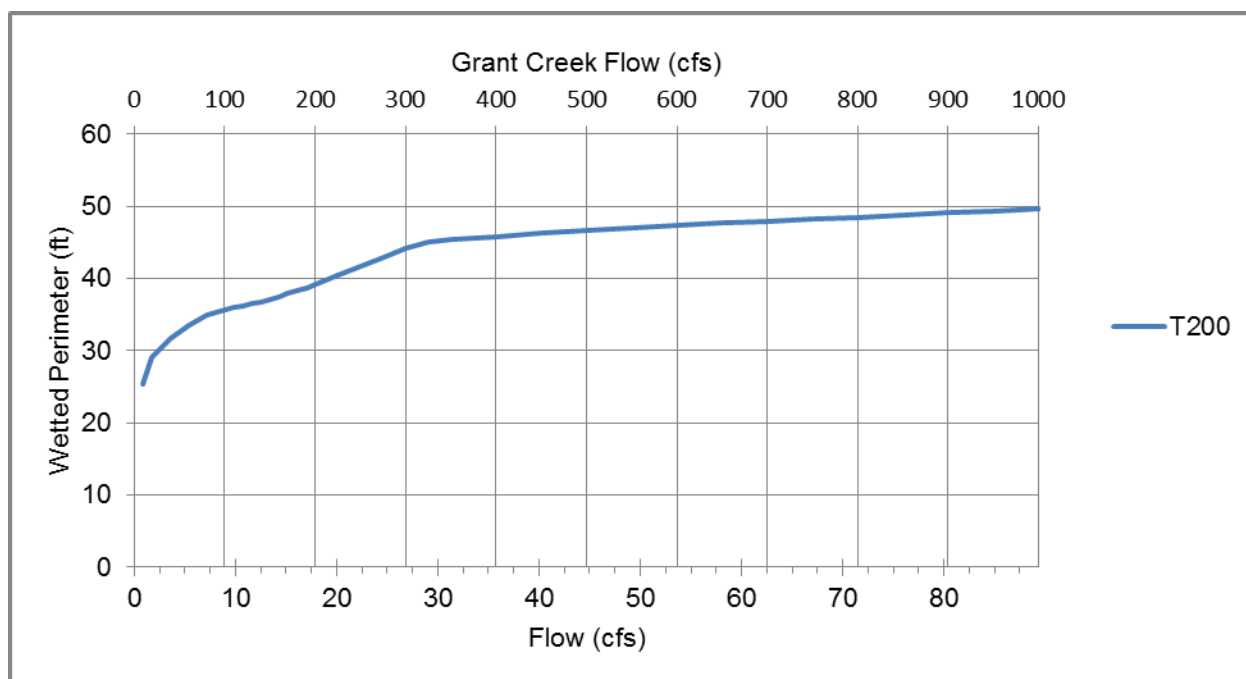


Figure A.4c-3. T200 side lobe wetted perimeter vs flow.

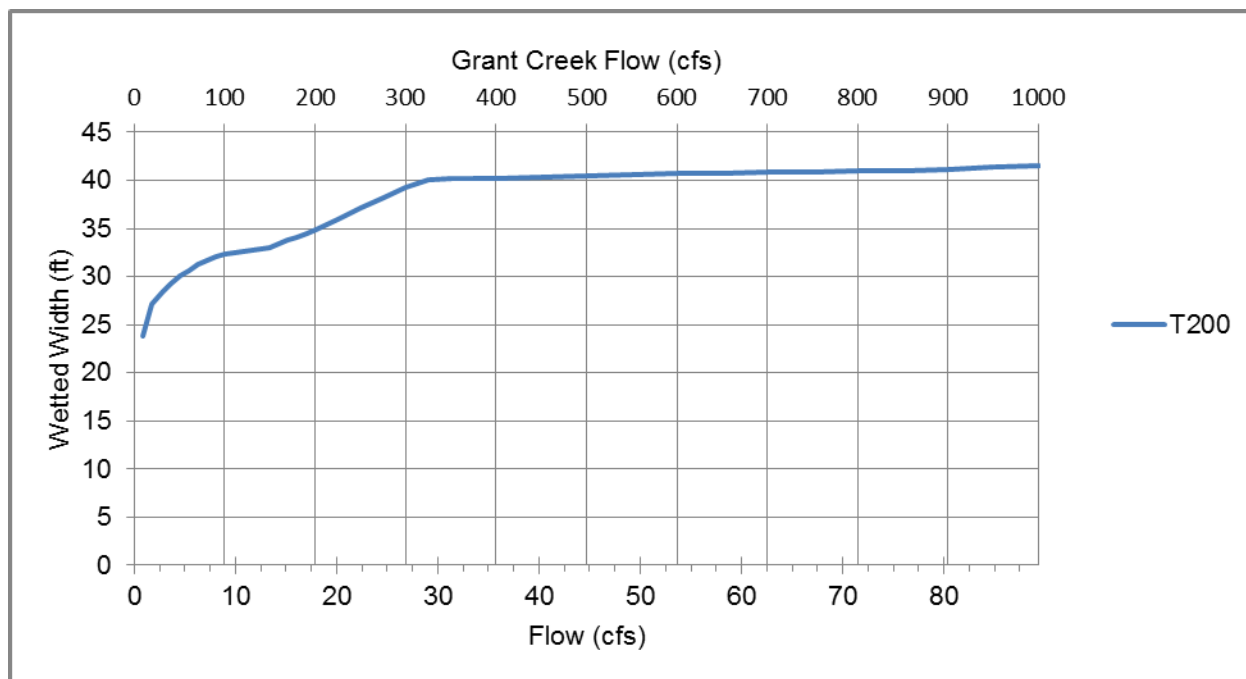


Figure A.4c-4. T200 side lobe wetted width vs flow.

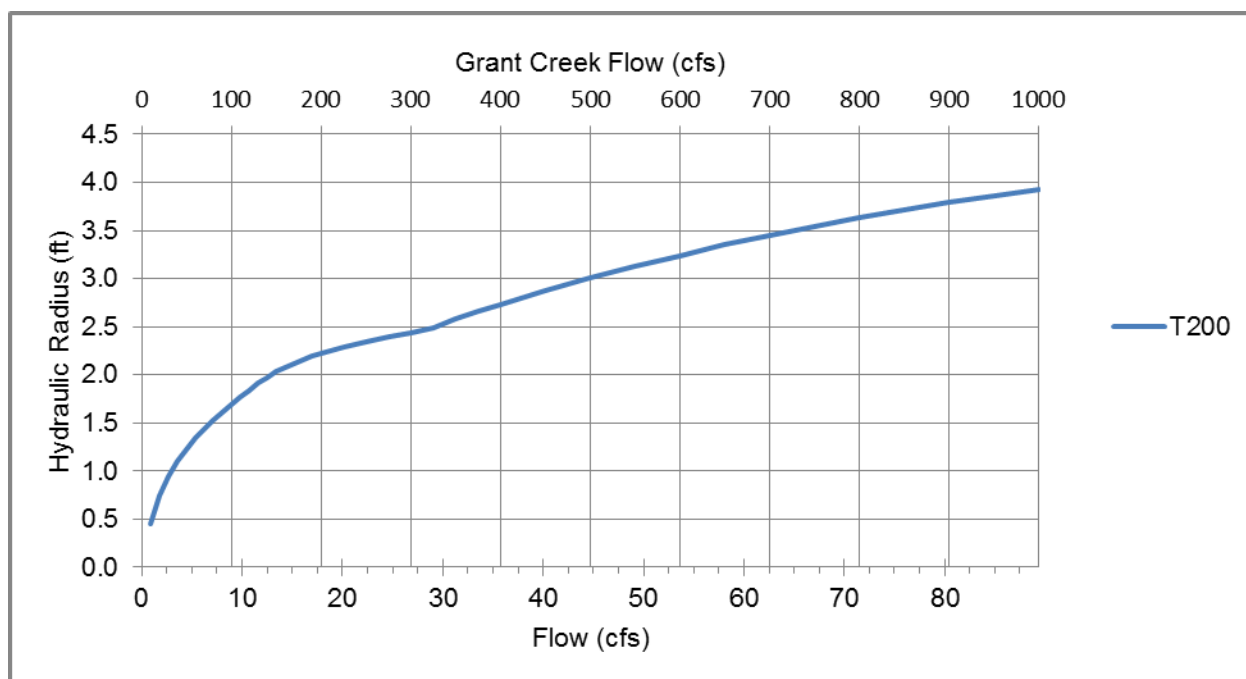


Figure A.4c-5. T200 side lobe hydraulic radius vs flow.

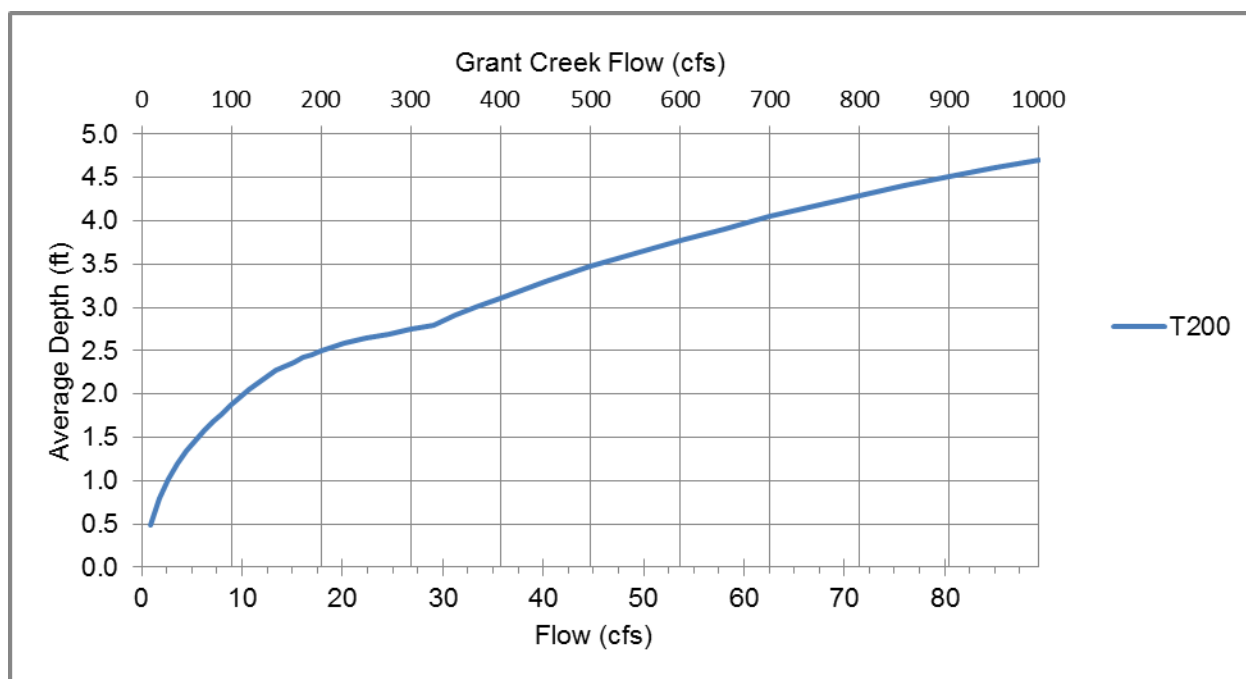


Figure A.4c-6. T200 side lobe average depth vs flow.

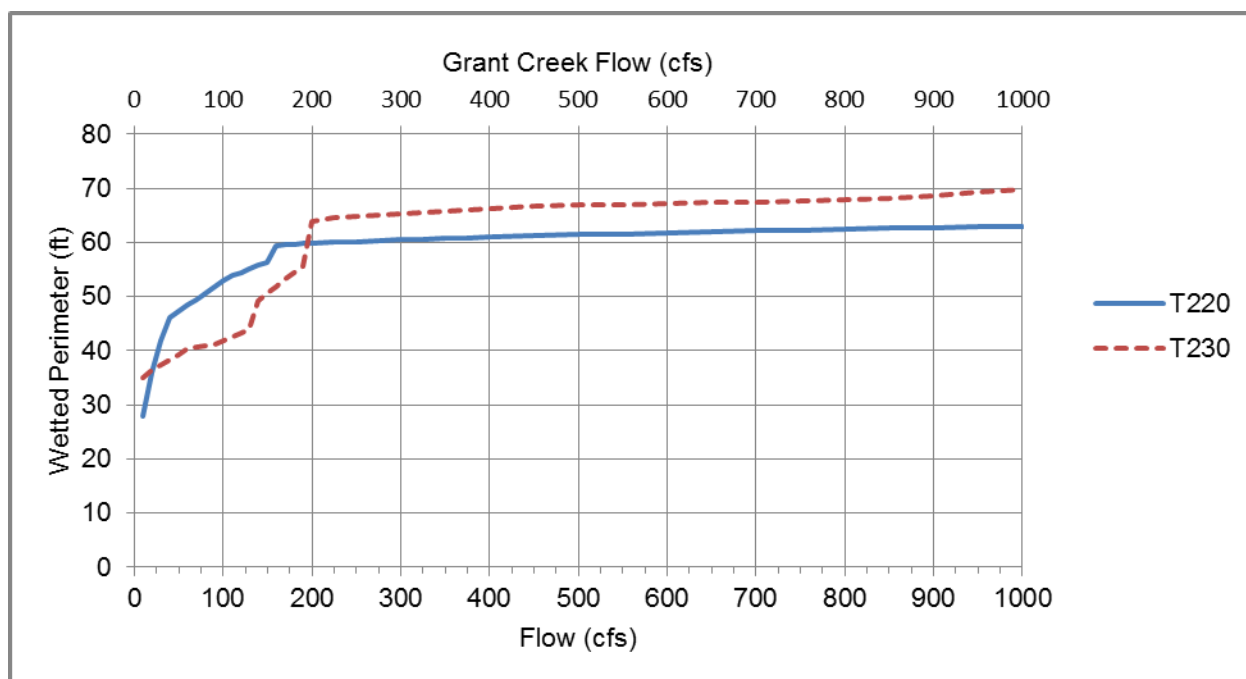


Figure A.4c-7. Reach 2 wetted perimeter vs flow.

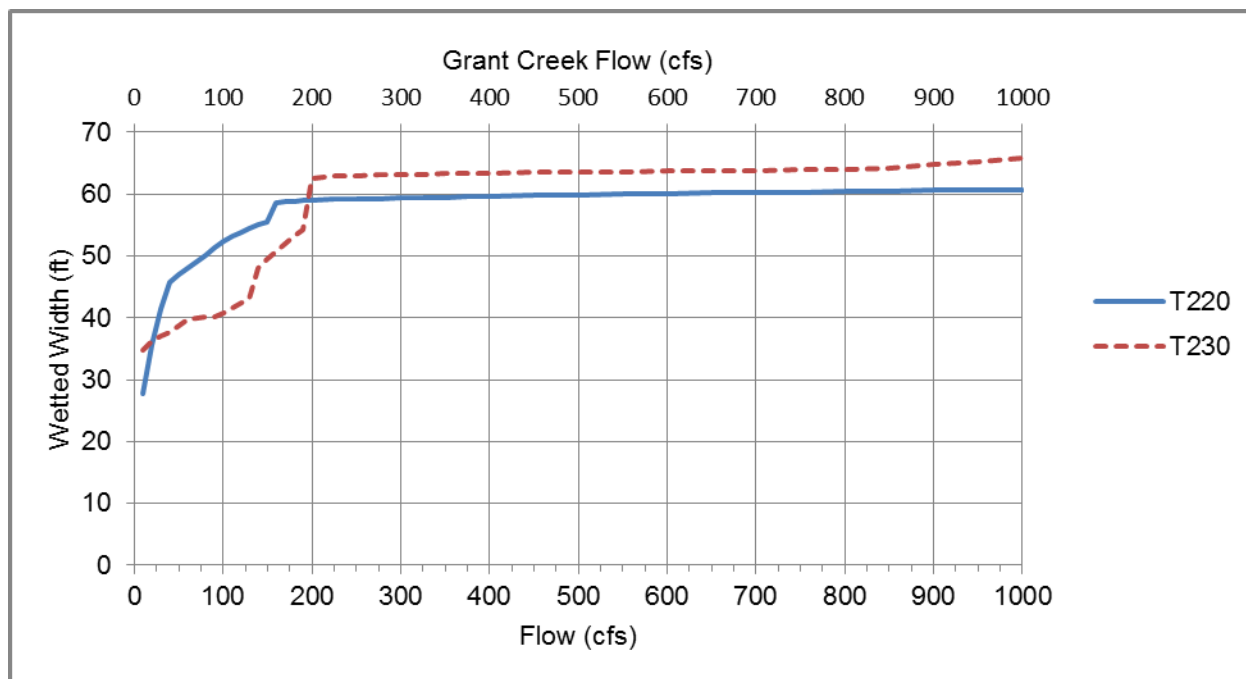


Figure A.4c-8. Reach 2 wetted width vs flow.

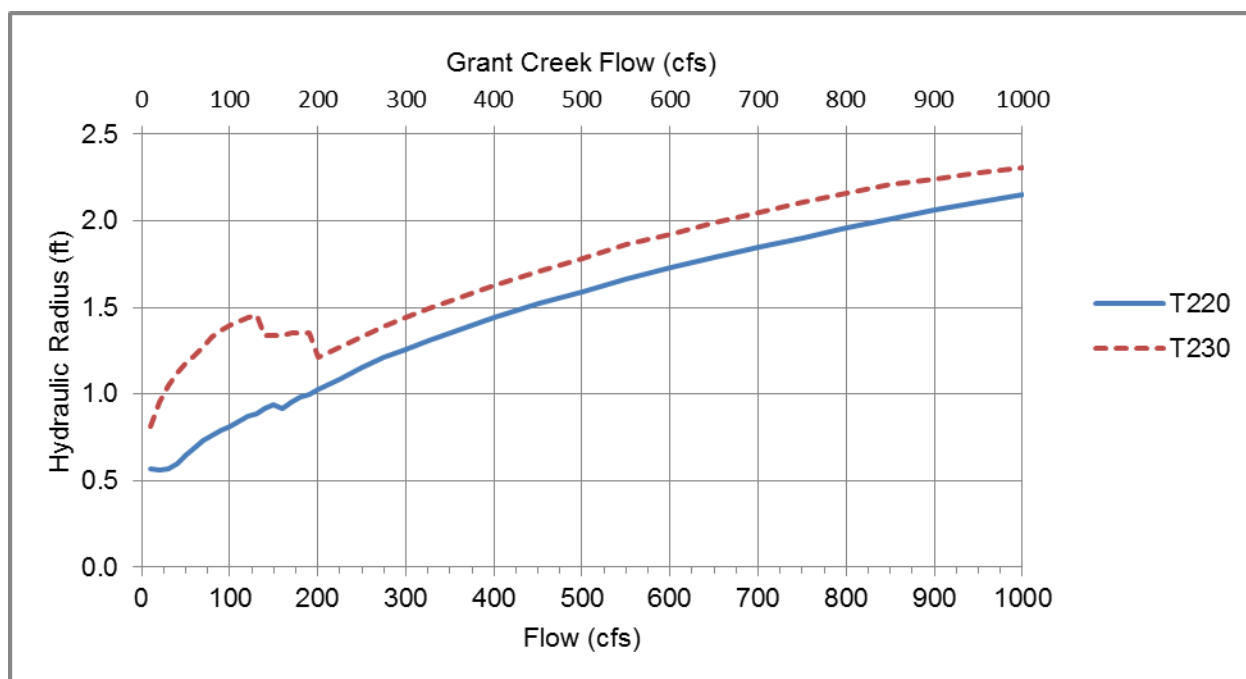


Figure A.4c-9. Reach 2 hydraulic radius vs flow.

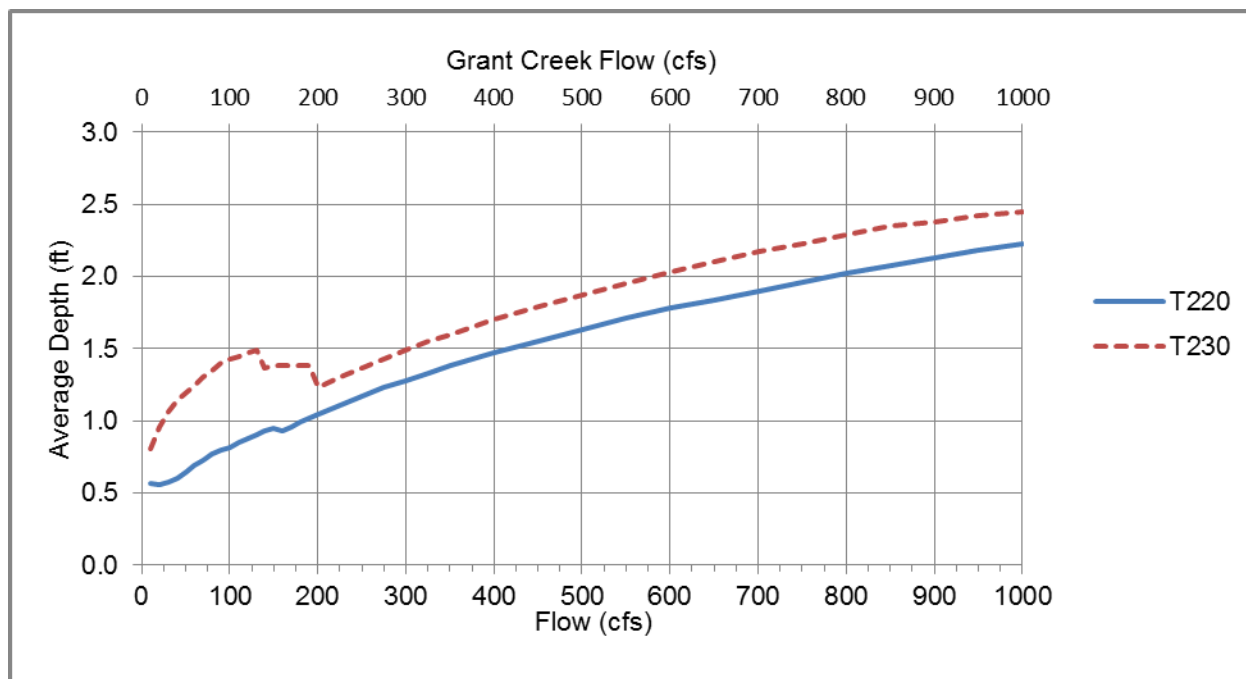


Figure A.4c-10. Reach 2 average depth vs flow.

[This page intentionally left blank.]

Appendix 4d Reach 3 Main Channel

This sub-appendix contains the following figures:

- Figure A.4d-1. Transect T300 bed profile and WSE, 0.17–17 cfs.
- Figure A.4d-2. Transect T310 bed profile and WSE, 10–1,000 cfs.
- Figure A.4d-3. T300 side lobe wetted perimeter vs flow.
- Figure A.4d-4. T300 side lobe wetted width vs flow.
- Figure A.4d-5. T300 side lobe hydraulic radius vs flow.
- Figure A.4d-6. T300 side lobe average depth vs flow.
- Figure A.4d-7. Reach 3 main channel wetted perimeter vs flow.
- Figure A.4d-8. Reach 3 main channel wetted width vs flow.
- Figure A.4d-9. Reach 3 main channel hydraulic radius vs flow.
- Figure A.4d-10. Reach 3 main channel average depth vs flow.

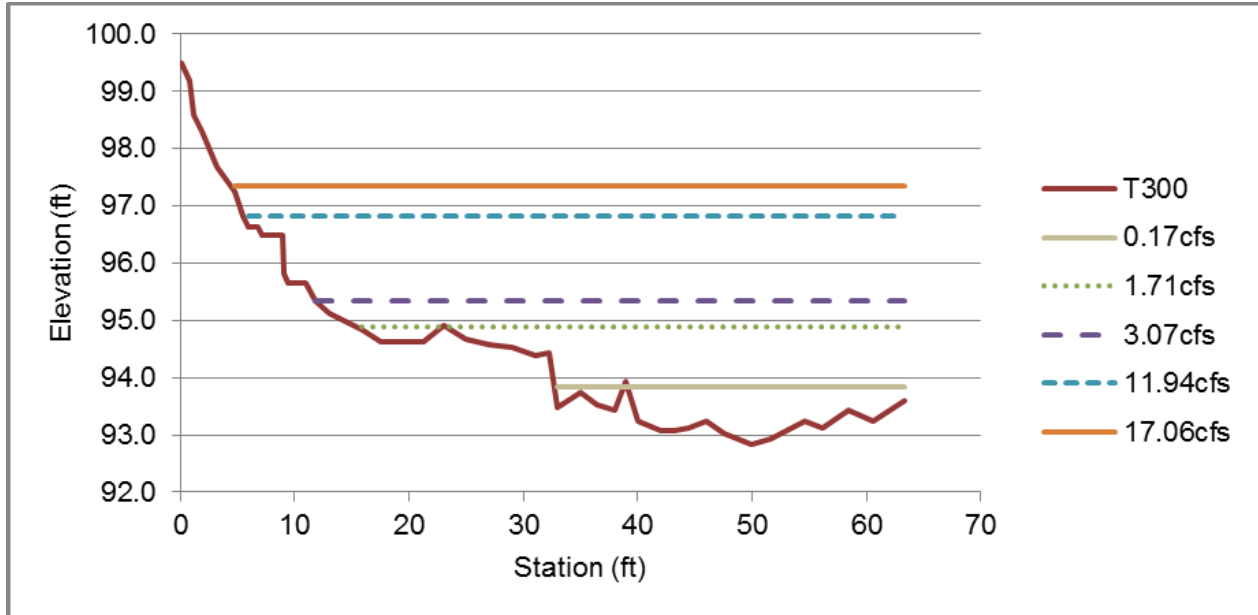


Figure A.4d-1. Transect T300 bed profile and WSE, 0.17–17 cfs.

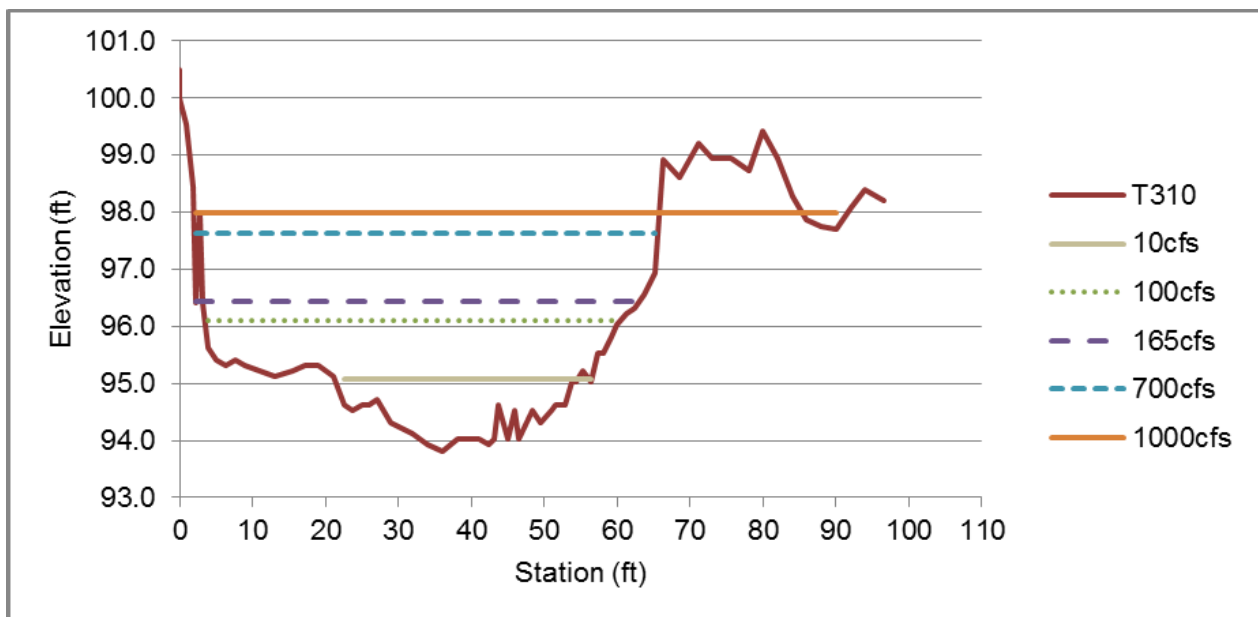


Figure A.4d-2. Transect T310 bed profile and WSE, 10–1,000 cfs.

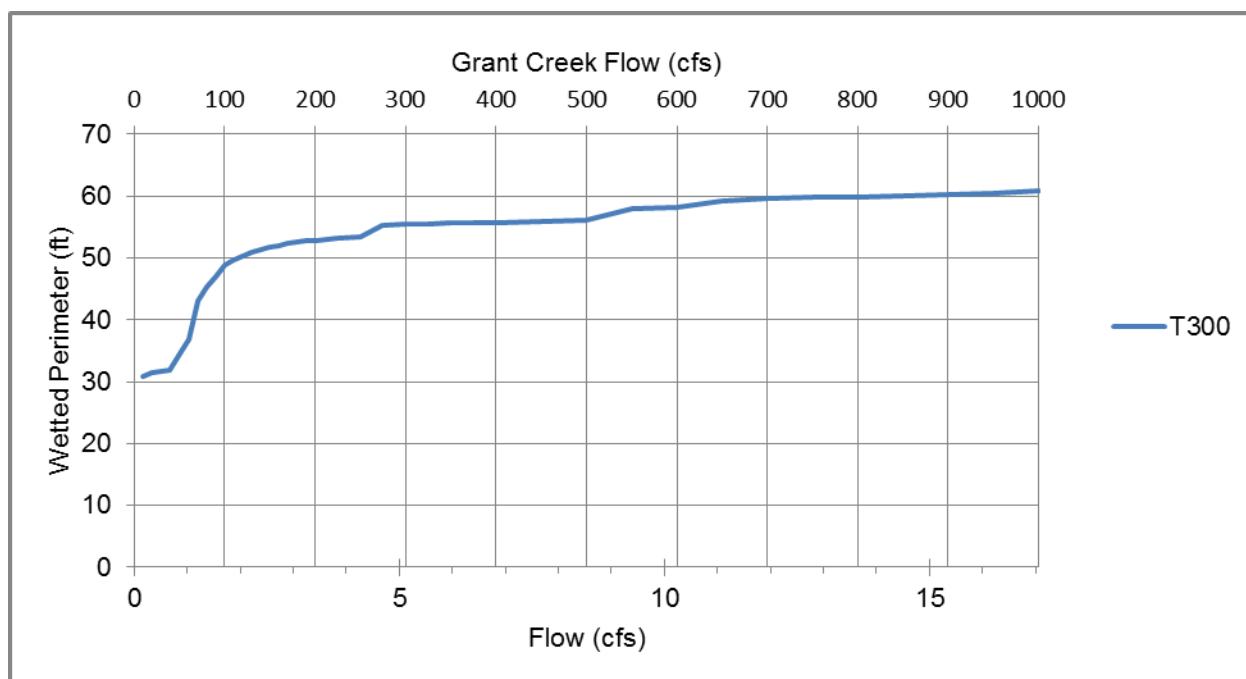


Figure A.4d-3. T300 side lobe wetted perimeter vs flow.

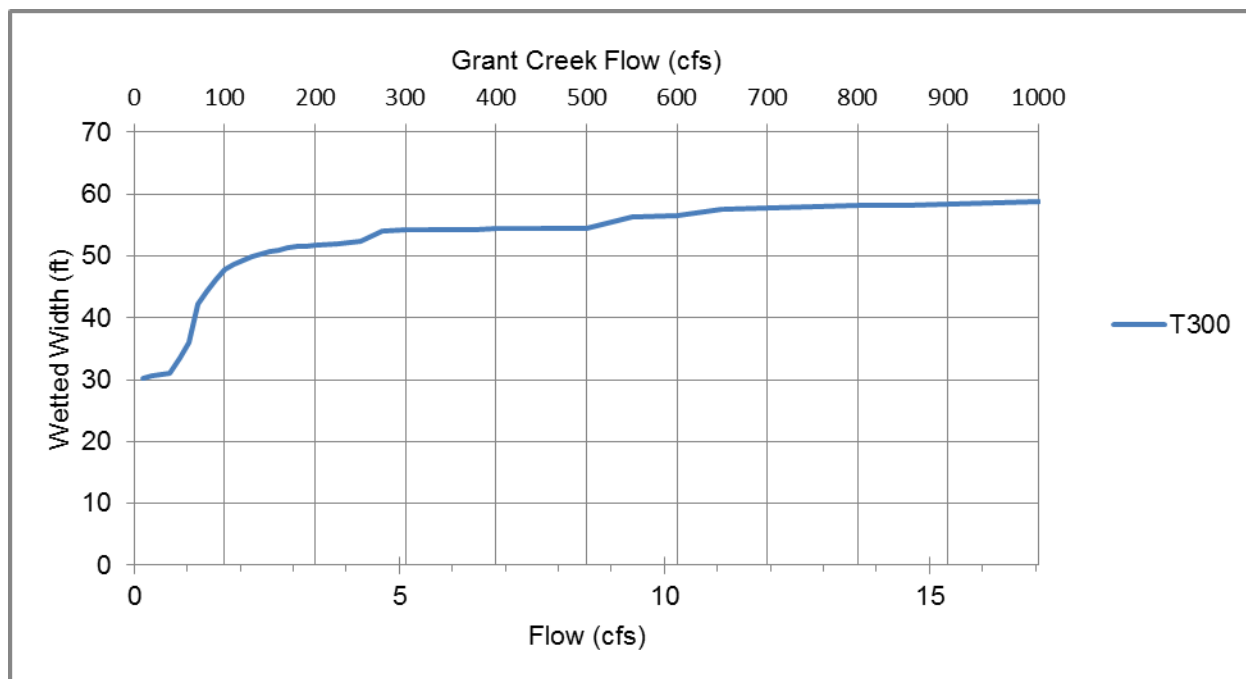


Figure A.4d-4. T300 side lobe wetted width vs flow.

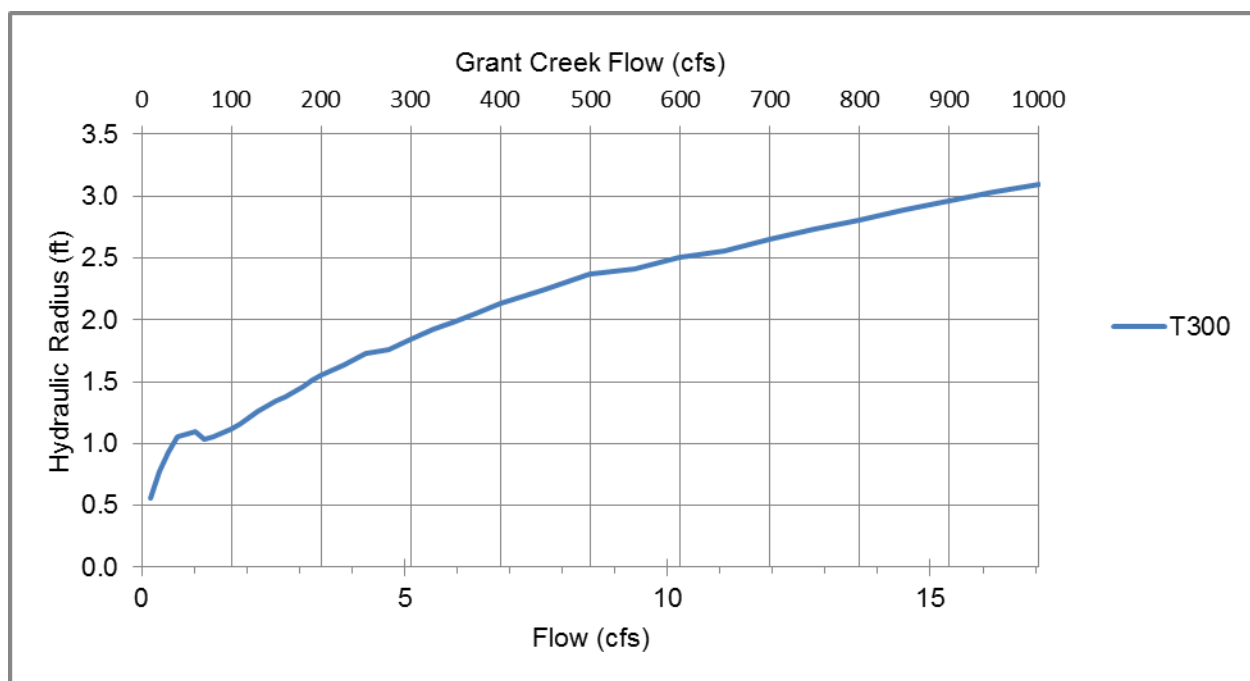


Figure A.4d-5. T300 side lobe hydraulic radius vs flow.

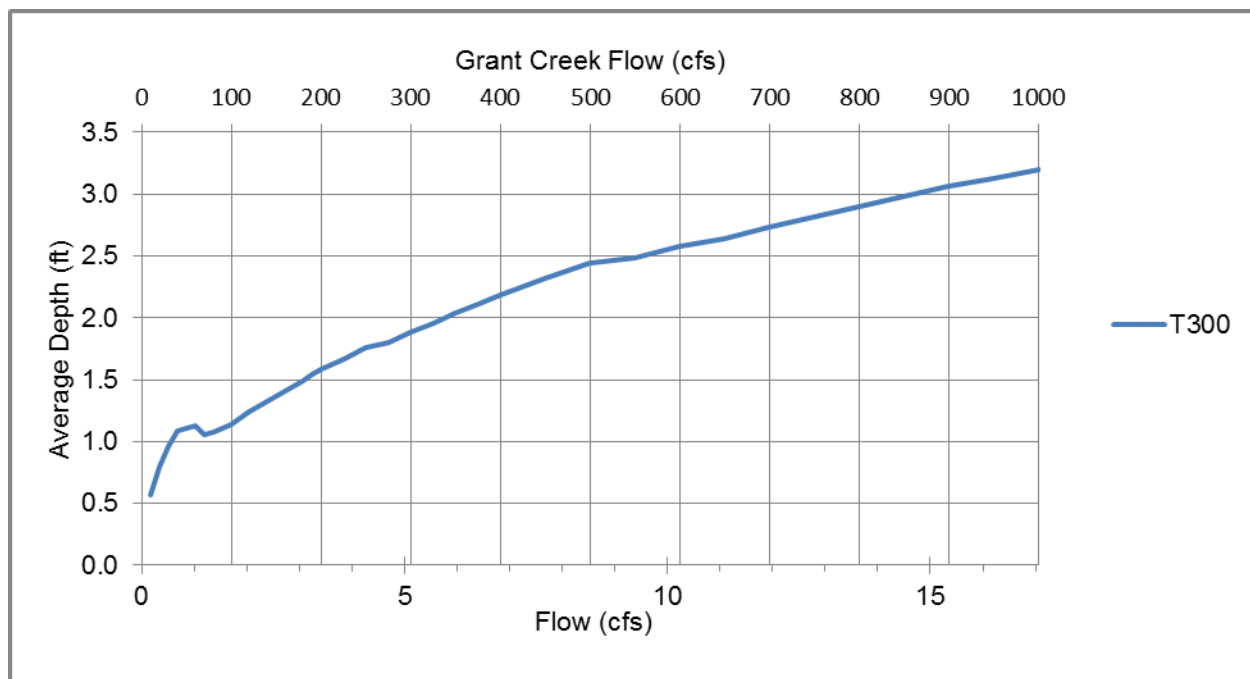


Figure A.4d-6. T300 side lobe average depth vs flow.

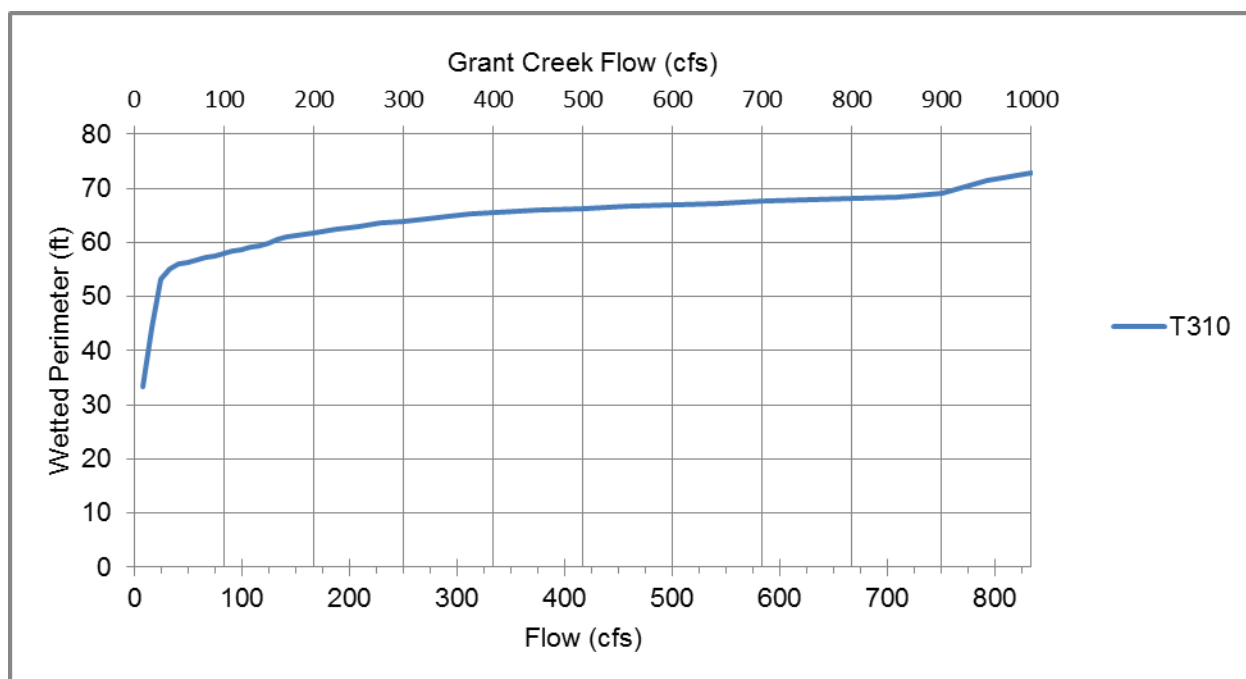


Figure A.4d-7. Reach 3 main channel wetted perimeter vs flow.

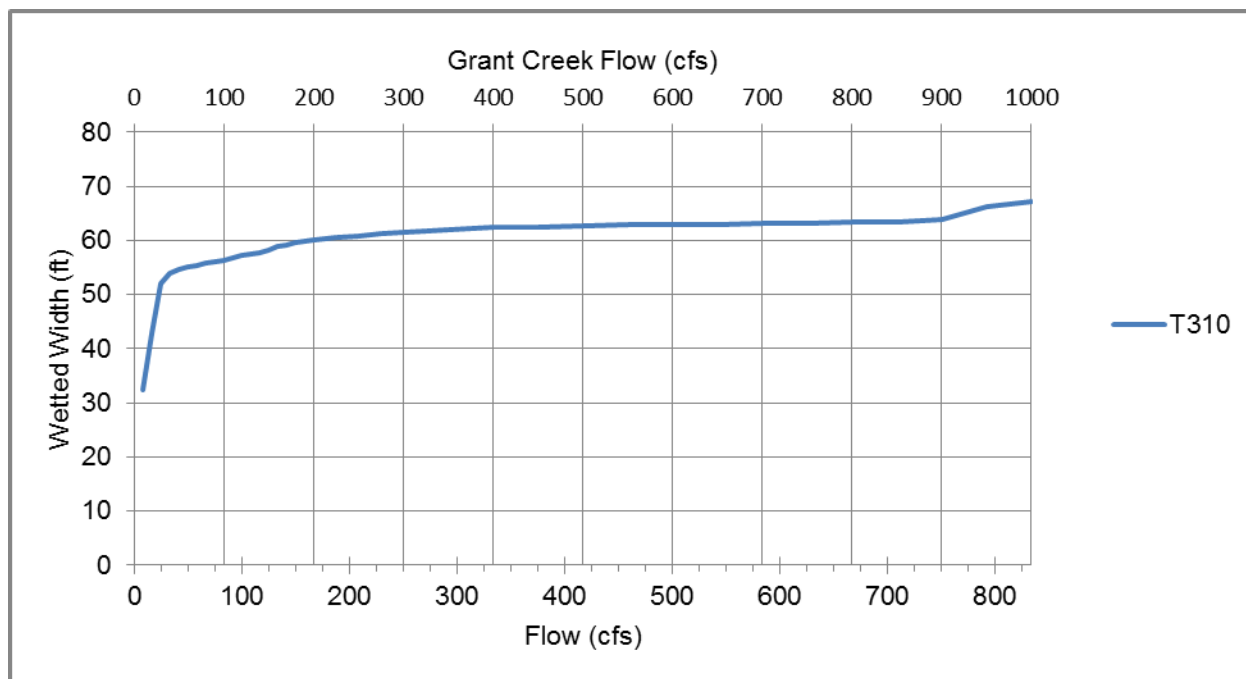


Figure A.4d-8. Reach 3 main channel wetted width vs flow.

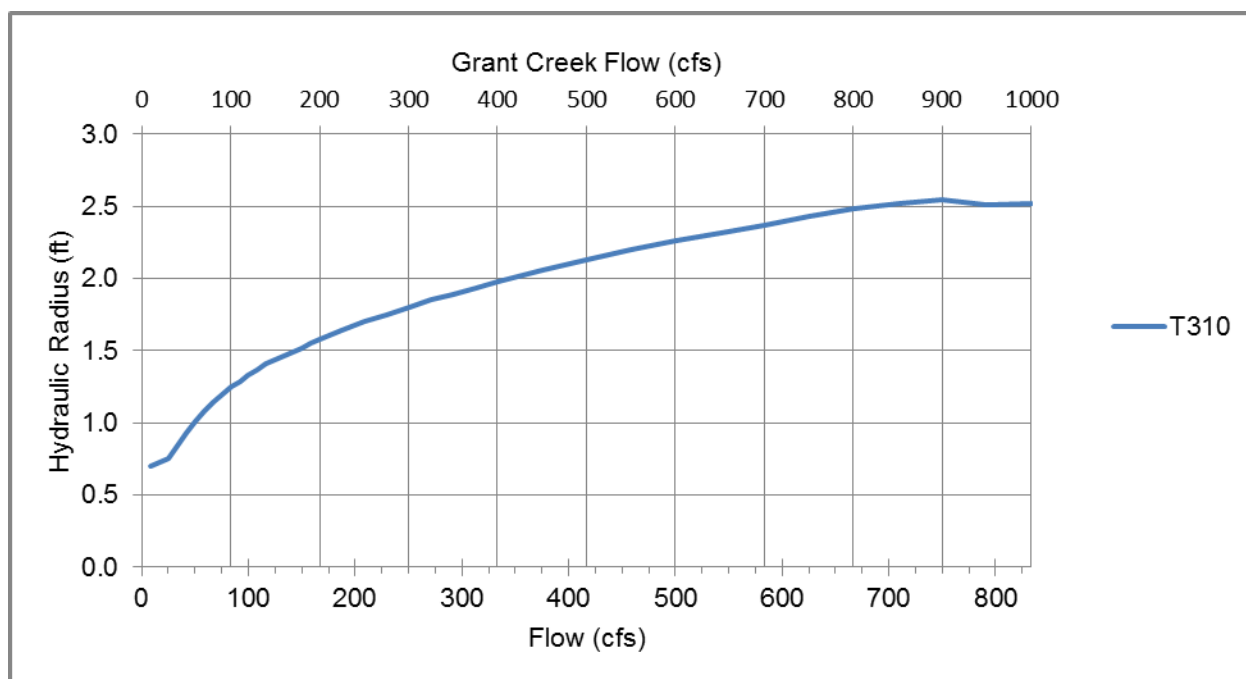


Figure A.4d-9. Reach 3 main channel hydraulic radius vs flow.

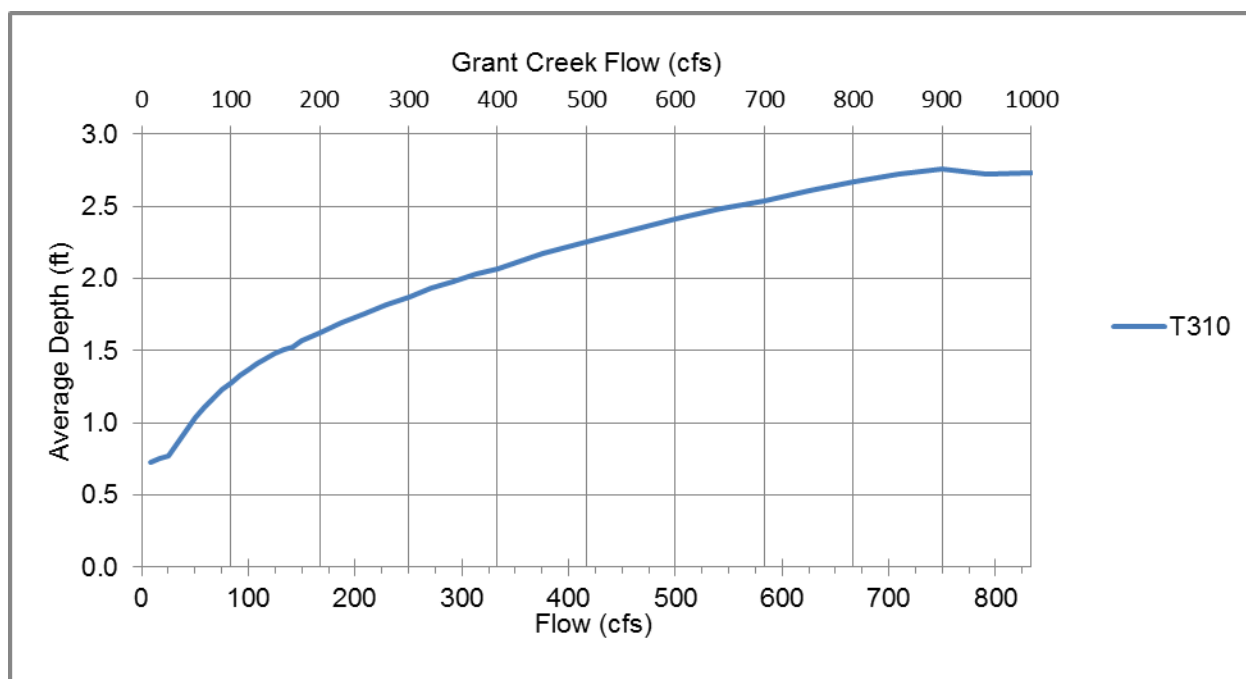


Figure A.4d-10. Reach 3 main channel average depth vs flow.

[This page intentionally left blank.]

Appendix 4e Reach 3 Side Channel

This sub-appendix contains the following figures:

- Figure A.4e-1. Transect T320 bed profile and WSE, 1.6–158 cfs.
- Figure A.4e-2. Transect T330 primary bed profile and WSE, 1.5–151 cfs.
- Figure A.4e-3. Transect T330 secondary bed profile and WSE, 0.13–12.7 cfs.
- Figure A.4e-4. Transect T330 tertiary bed profile and WSE, 0.13–97 cfs.
- Figure A.4e-5. Transect T320 wetted perimeter vs flow.
- Figure A.4e-6. Transect T320 wetted width vs flow.
- Figure A.4e-7. Transect T320 hydraulic radius vs flow.
- Figure A.4e-8. Transect T320 average depth vs flow.
- Figure A.4e-9. Transect T330 primary wetted perimeter vs flow.
- Figure A.4e-10. Transect T330 primary wetted width vs flow.
- Figure A.4e-11. Transect T330 primary hydraulic radius vs flow.
- Figure A.4e-12. Transect T330 primary average depth vs flow.
- Figure A.4e-13. Transect T330 secondary wetted perimeter vs flow.
- Figure A.4e-14. Transect T330 secondary wetted width vs flow.
- Figure A.4e-15. Transect T330 secondary hydraulic radius vs flow.
- Figure A.4e-16. Transect T330 secondary average depth vs flow.
- Figure A.4e-17. Transect T330 Tertiary wetted perimeter vs flow.
- Figure A.4e-18. Transect T330 tertiary wetted width vs flow.
- Figure A.4e-19. Transect T330 tertiary hydraulic radius vs flow.
- Figure A.4e-20. Transect T330 tertiary average depth vs flow.

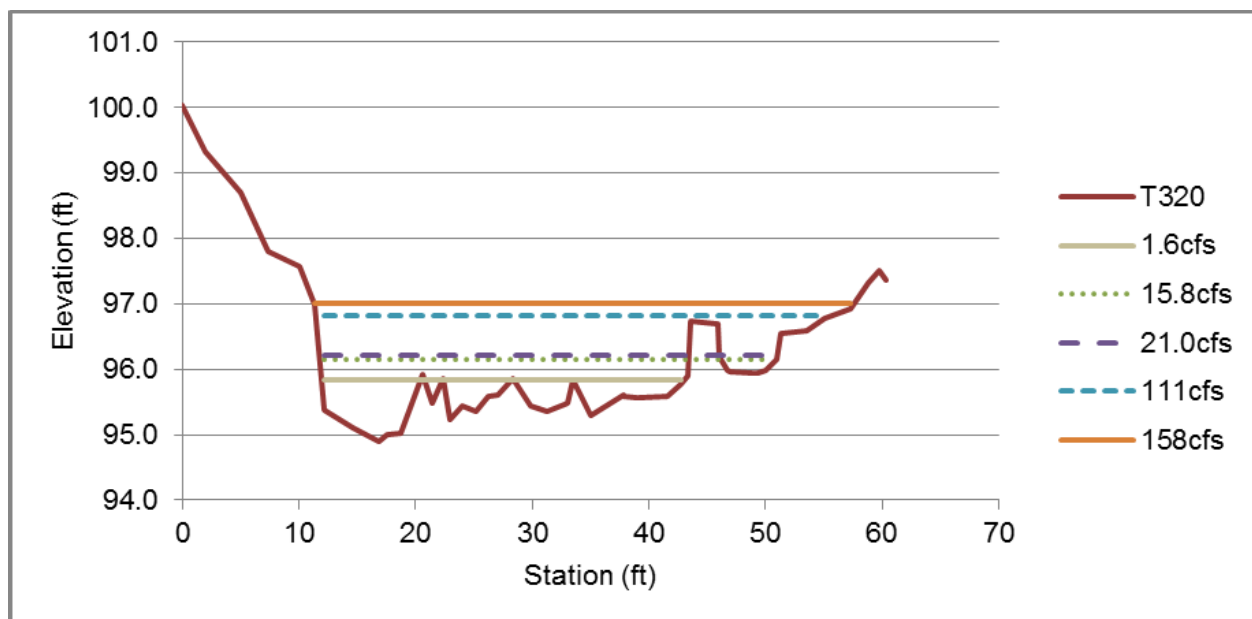


Figure A.4e-1. Transect T320 bed profile and WSE, 1.6–158 cfs.

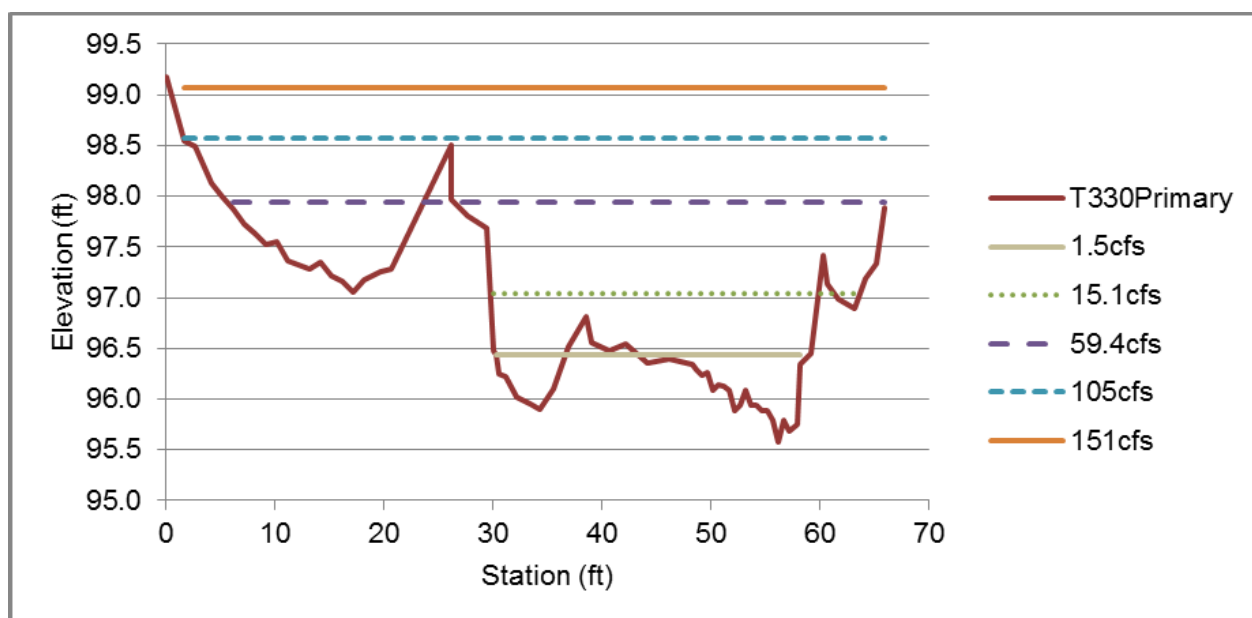


Figure A.4e-2. Transect T330 primary bed profile and WSE, 1.5–151 cfs.

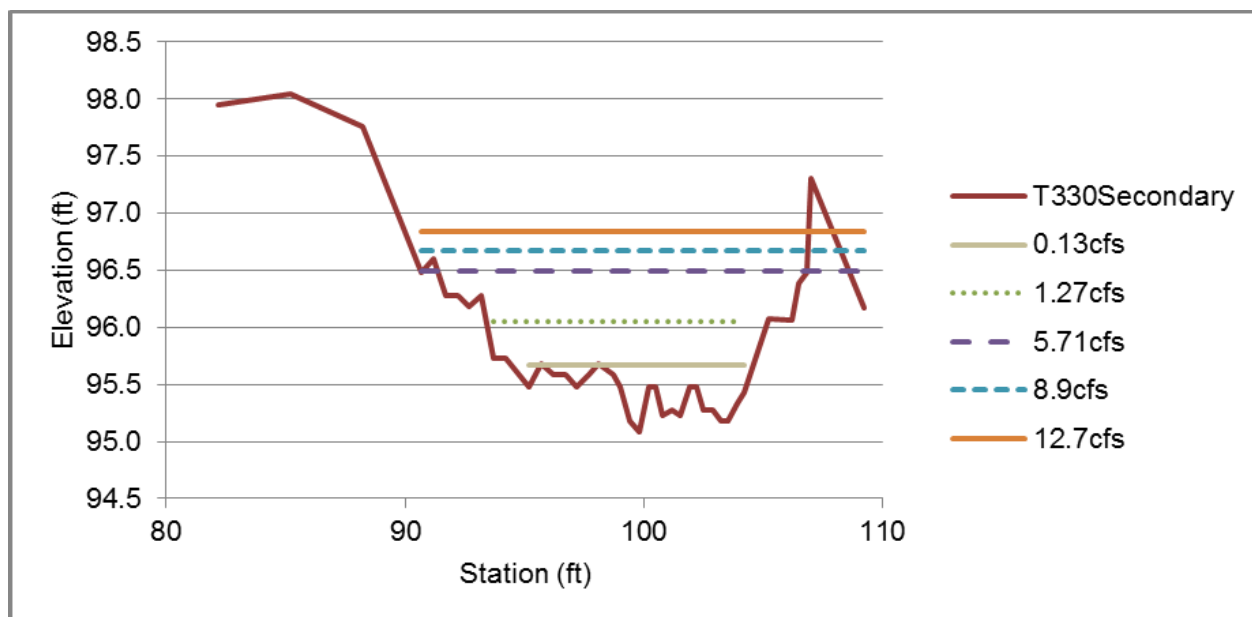


Figure A.4e-3. Transect T330 secondary bed profile and WSE, 0.13–12.7 cfs.

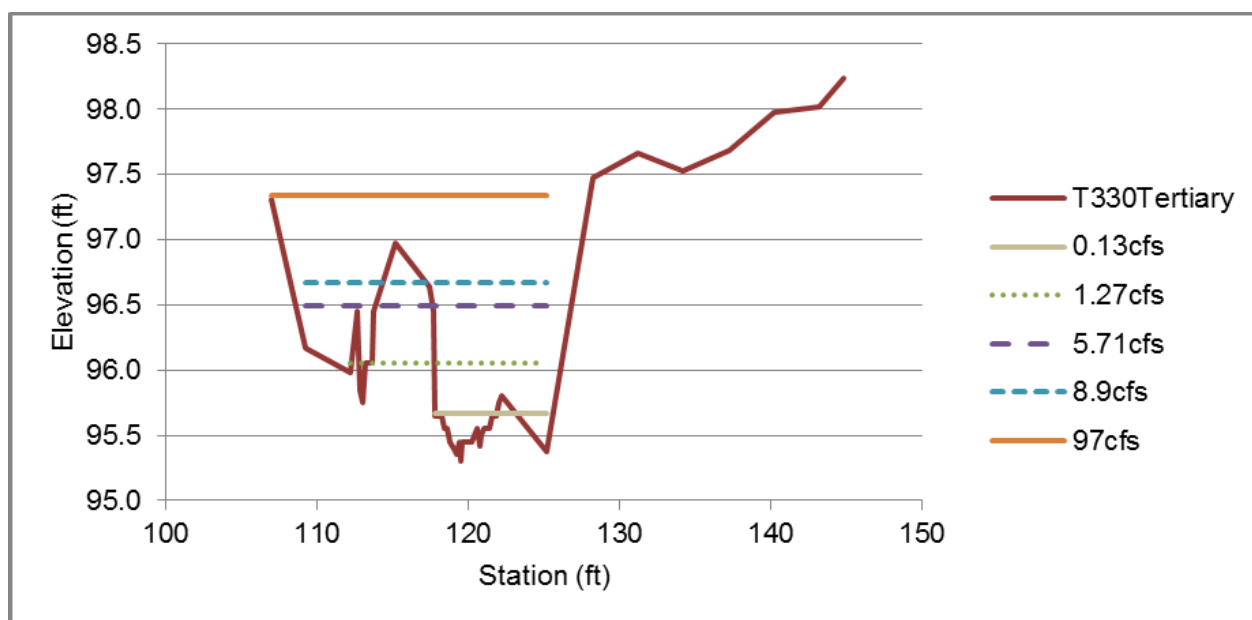


Figure A.4e-4. Transect T330 tertiary bed profile and WSE, 0.13–97 cfs.

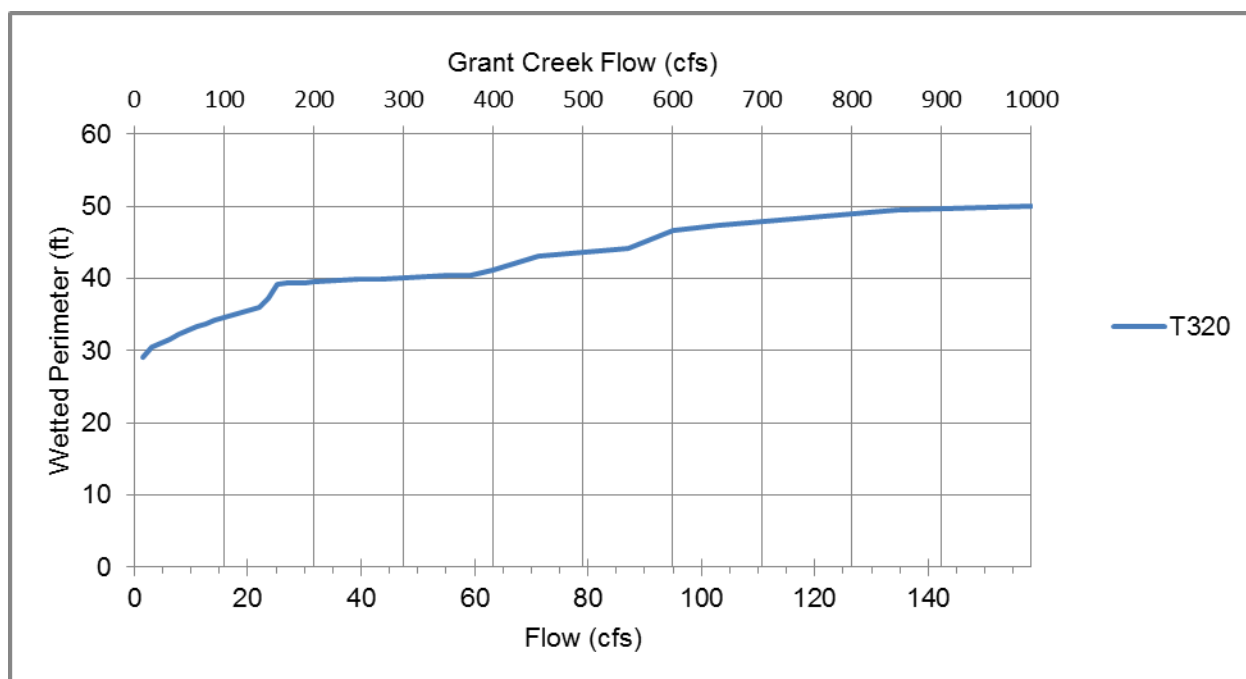


Figure A.4e-5. Transect T320 wetted perimeter vs flow.

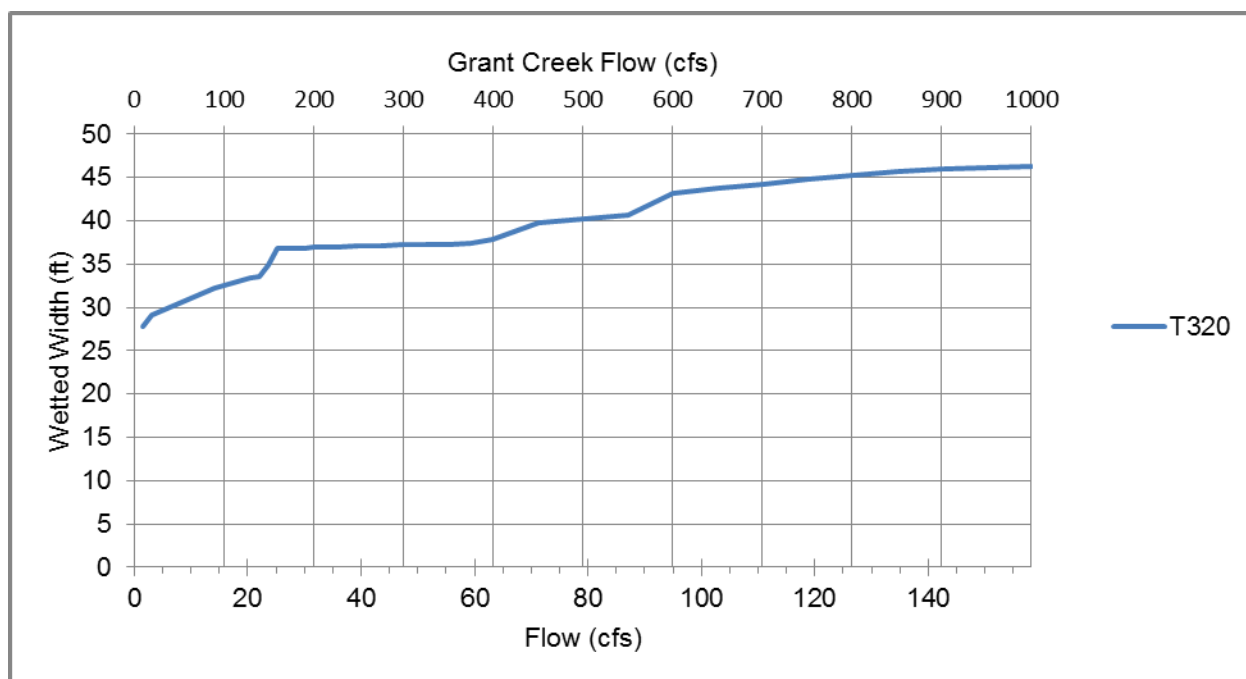


Figure A.4e-6. Transect T320 wetted width vs flow.

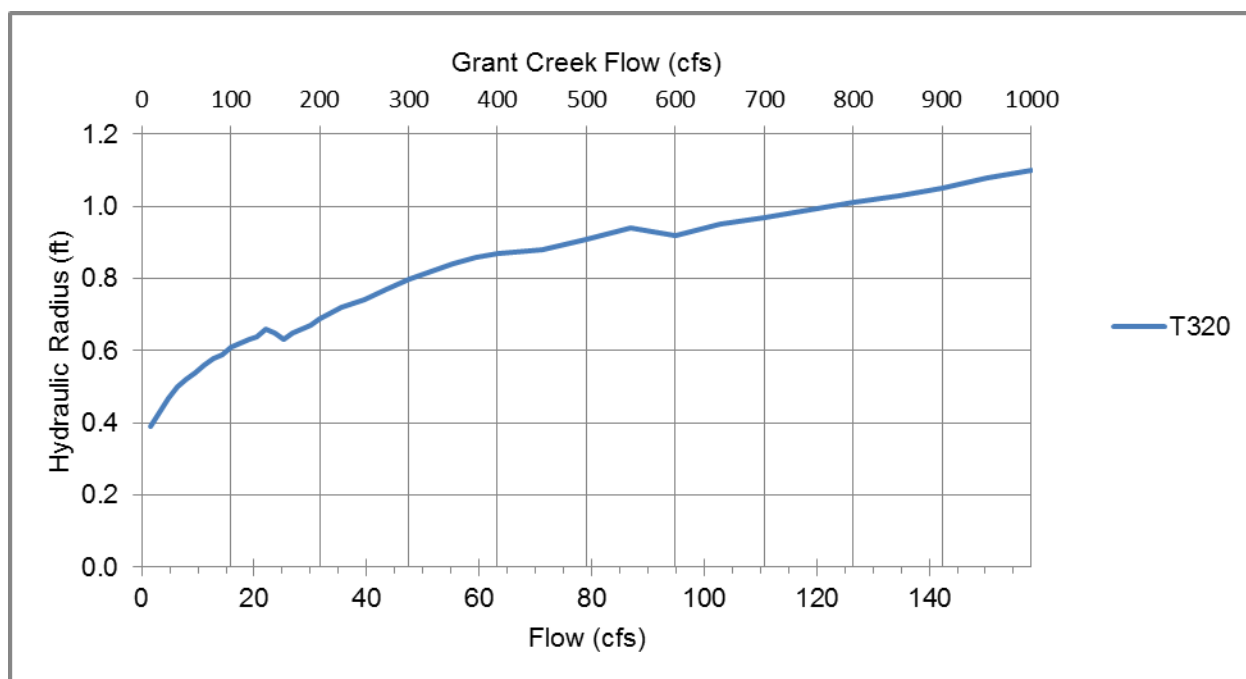


Figure A.4e-7. Transect T320 hydraulic radius vs flow.

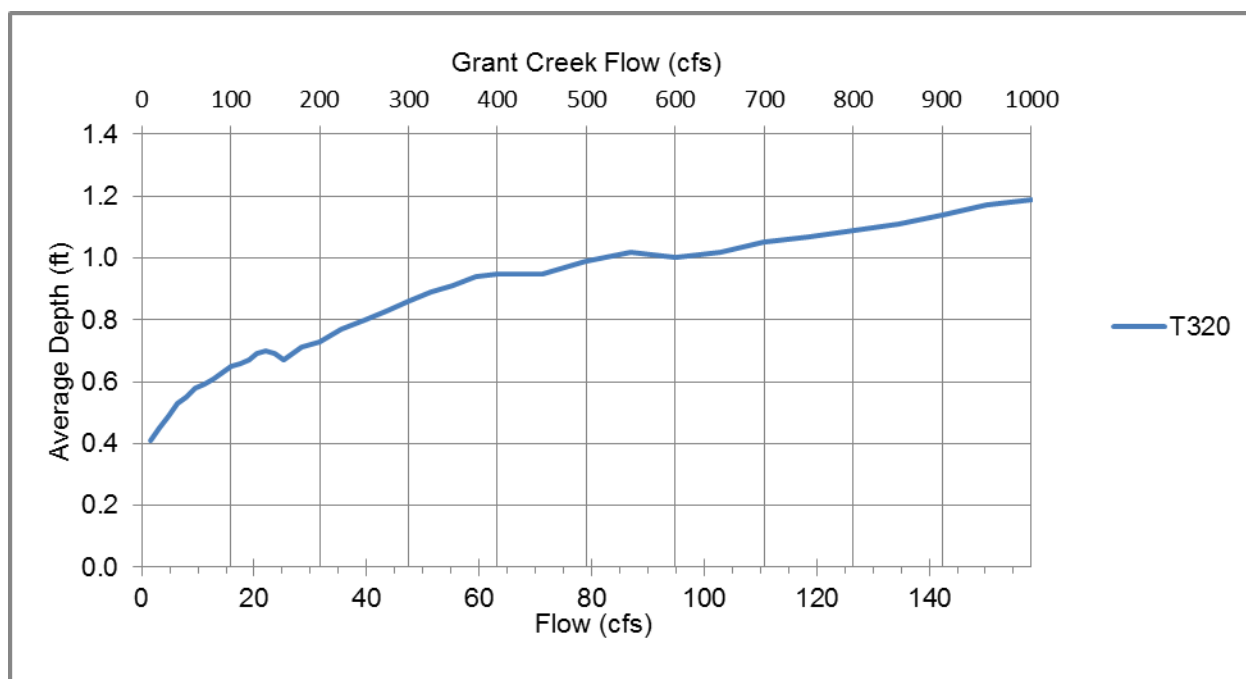


Figure A.4e-8. Transect T320 average depth vs flow.

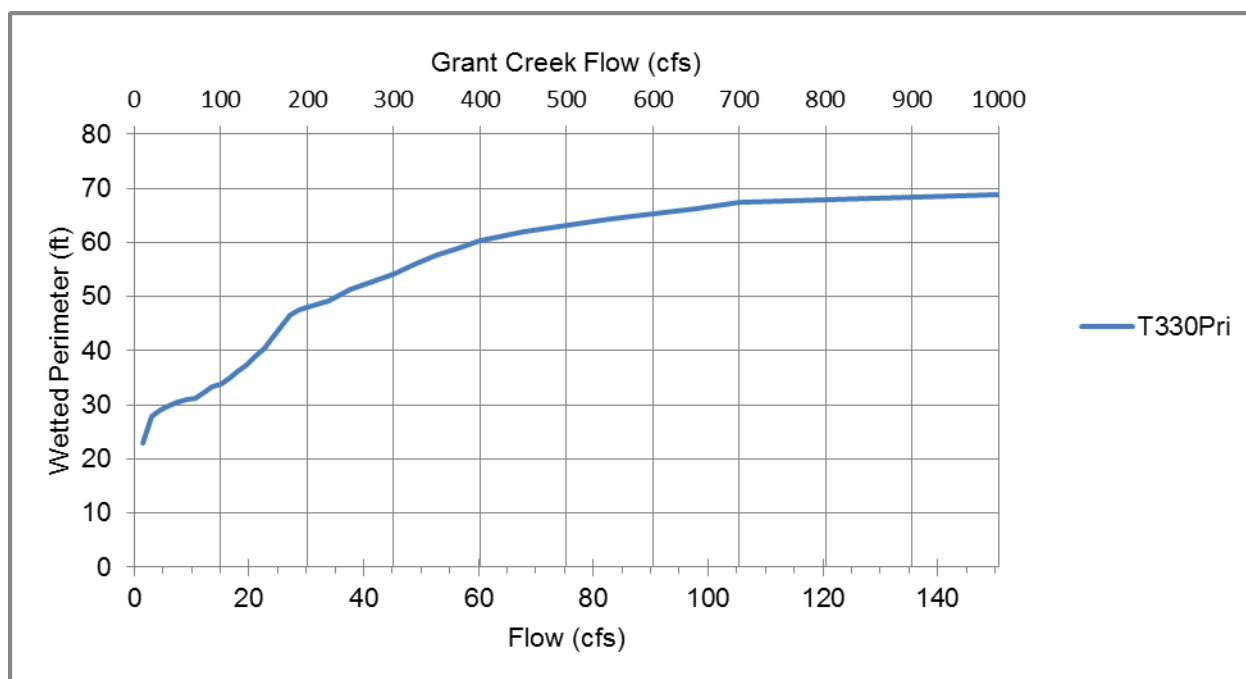


Figure A.4e-9. Transect T330 primary wetted perimeter vs flow.

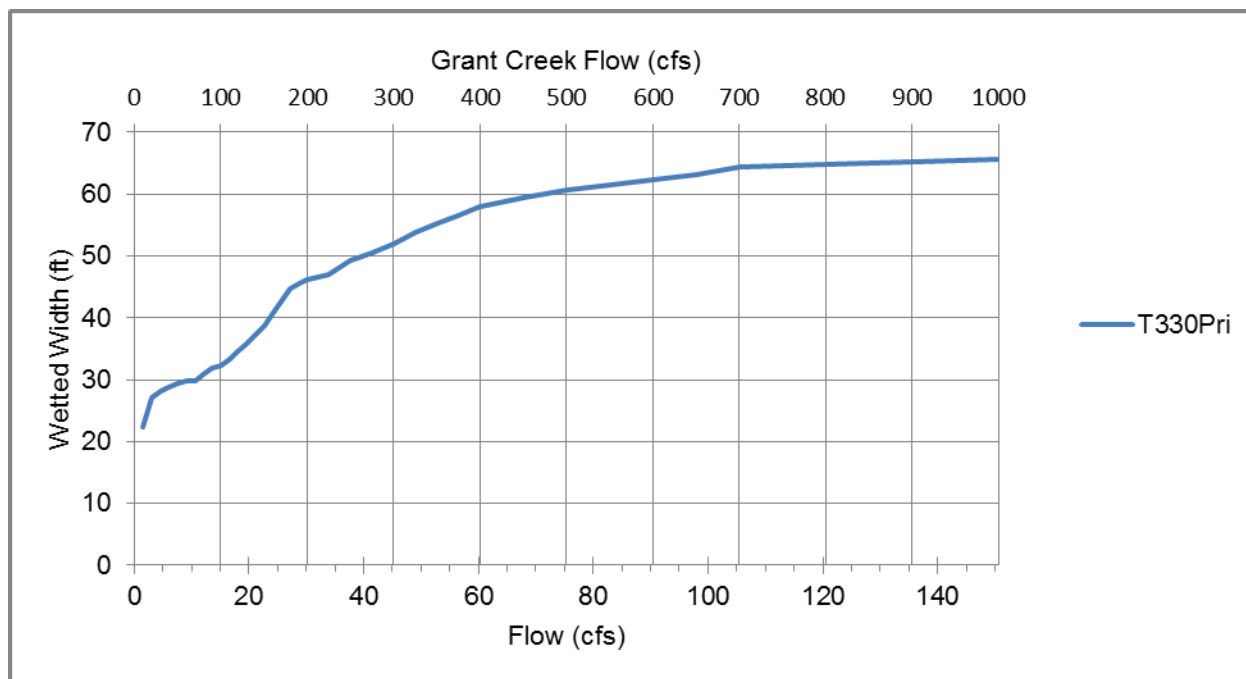


Figure A.4e-10. Transect T330 primary wetted width vs flow.

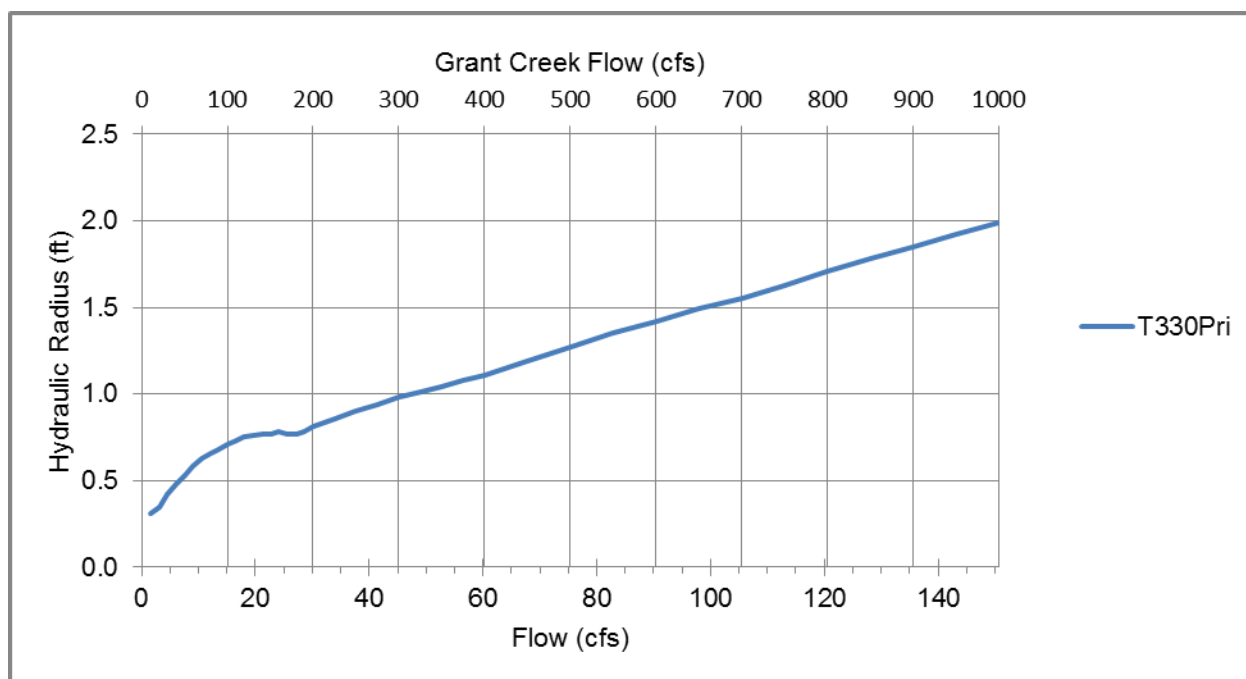


Figure A.4e-11. Transect T330 primary hydraulic radius vs flow.

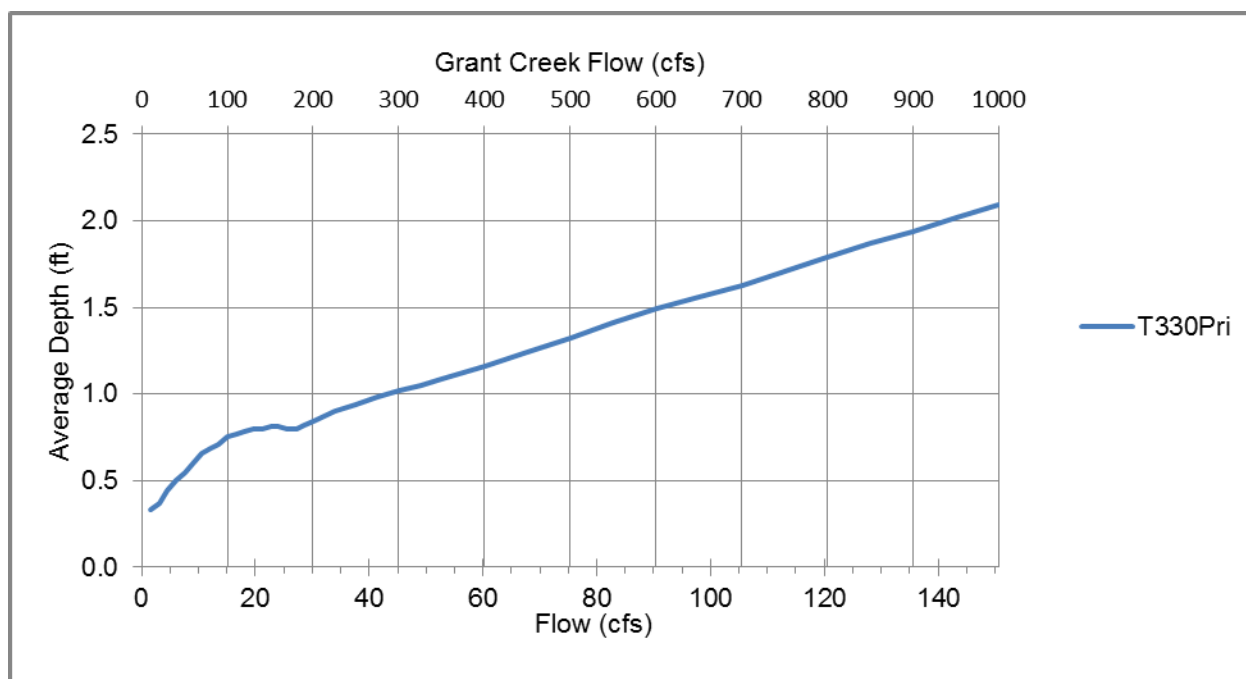


Figure A.4e-12. Transect T330 primary average depth vs flow.

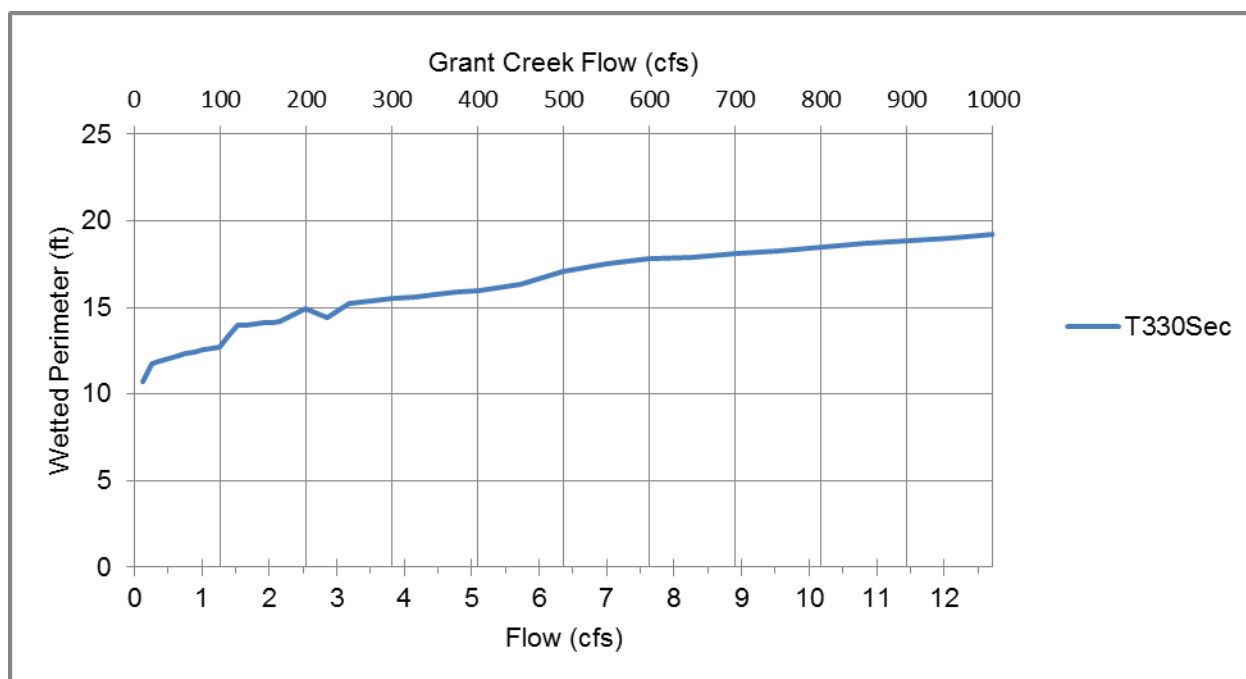


Figure A.4e-13. Transect T330 secondary wetted perimeter vs flow.

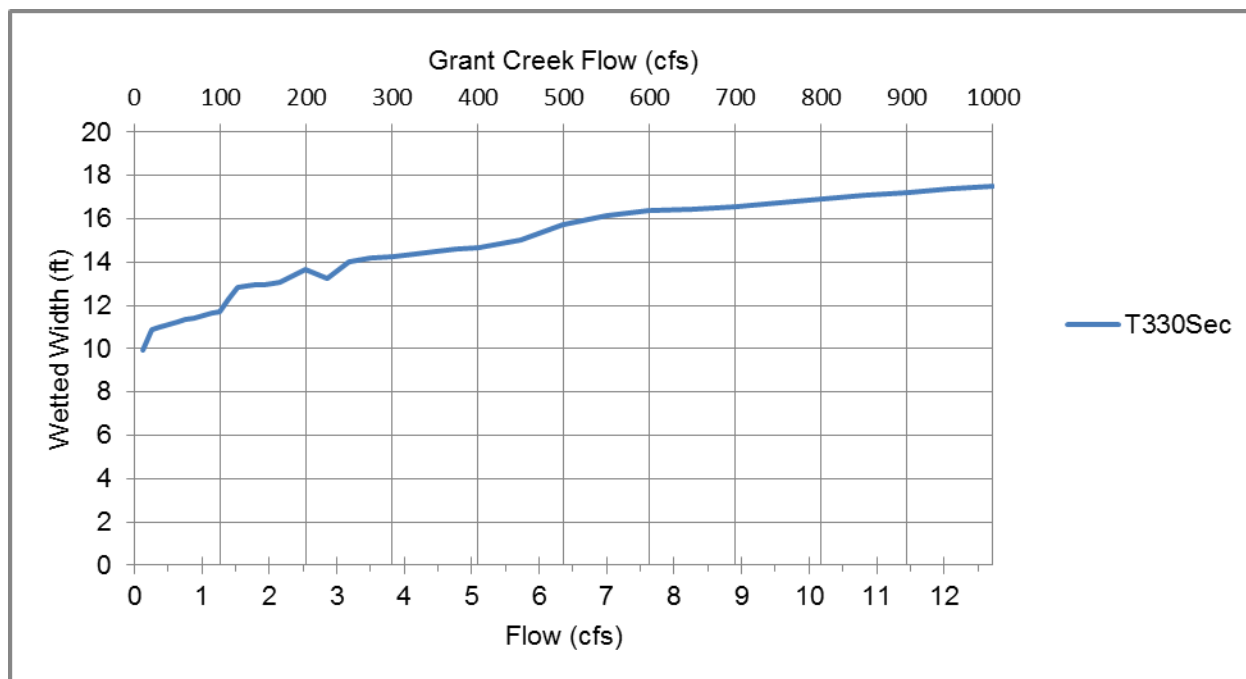


Figure A.4e-14. Transect T330 secondary wetted width vs flow.

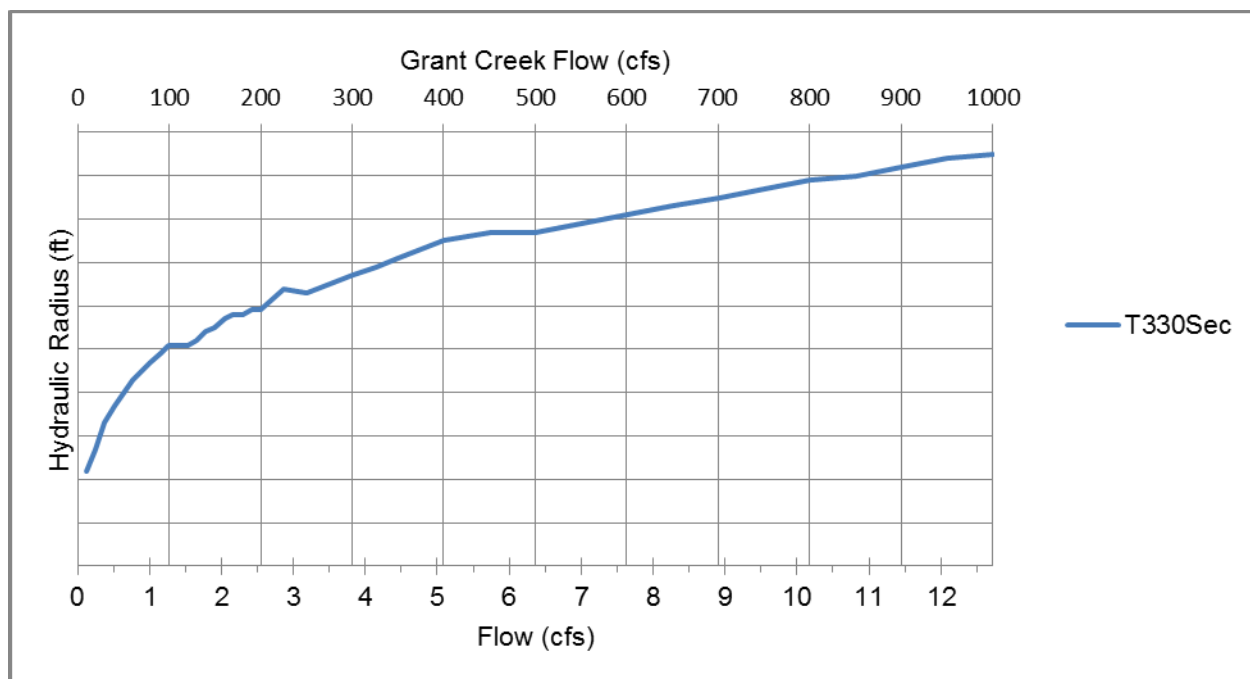


Figure A.4e-15. Transect T330 secondary hydraulic radius vs flow.

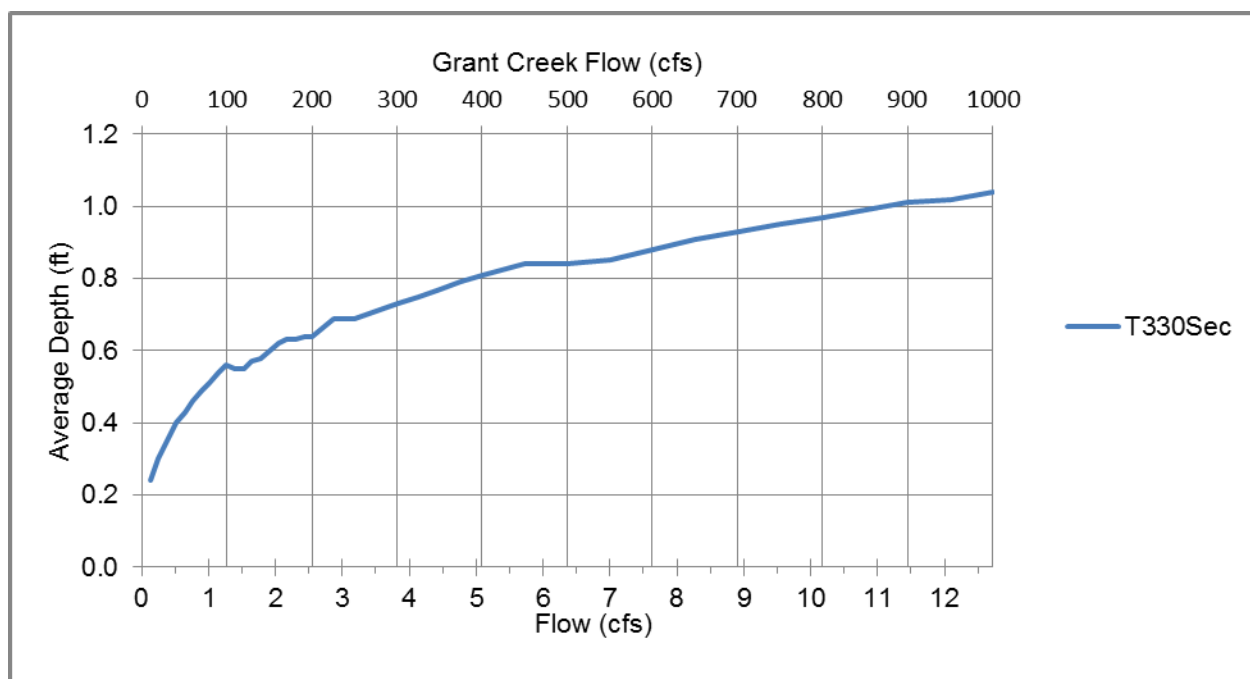


Figure A.4e-16. Transect T330 secondary average depth vs flow.

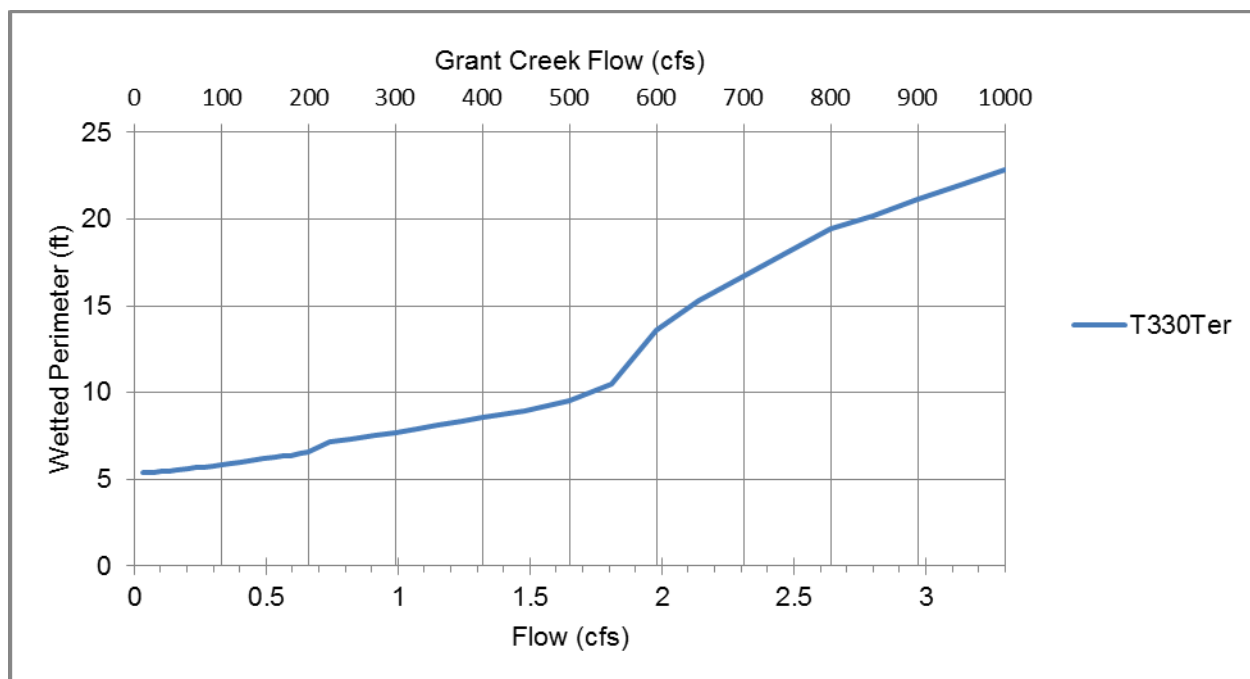


Figure A.4e-17. Transect T330 Tertiary wetted perimeter vs flow.

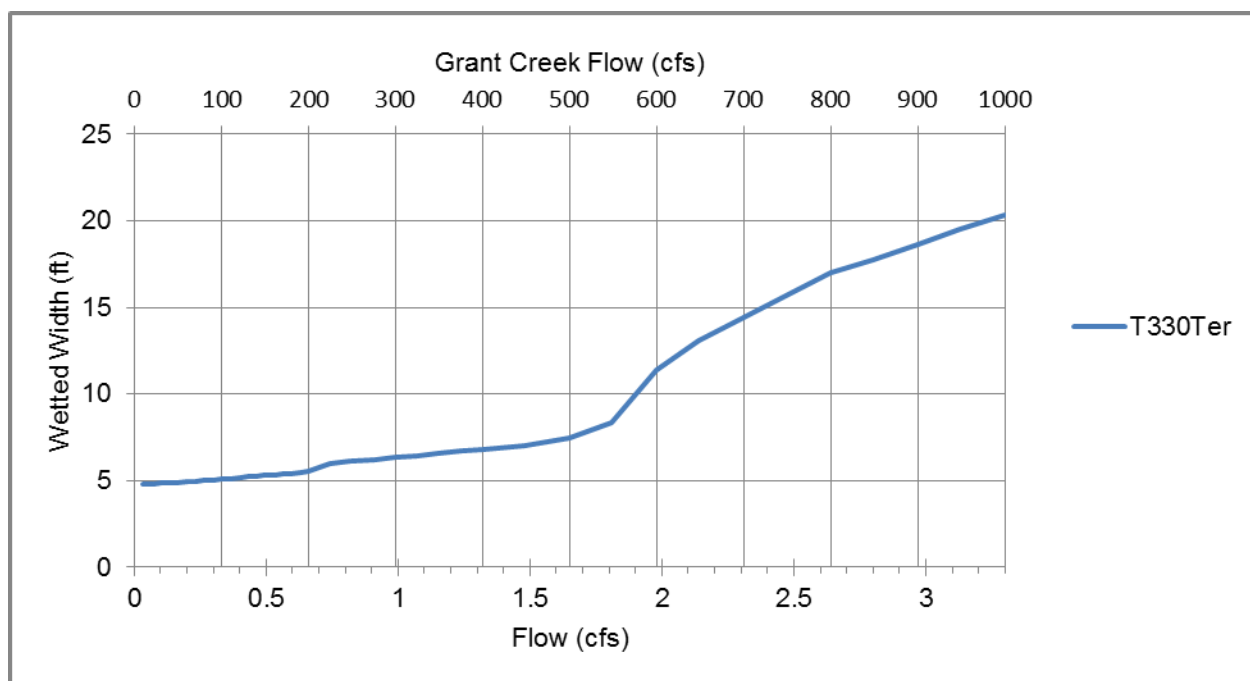


Figure A.4e-18. Transect T330 tertiary wetted width vs flow.

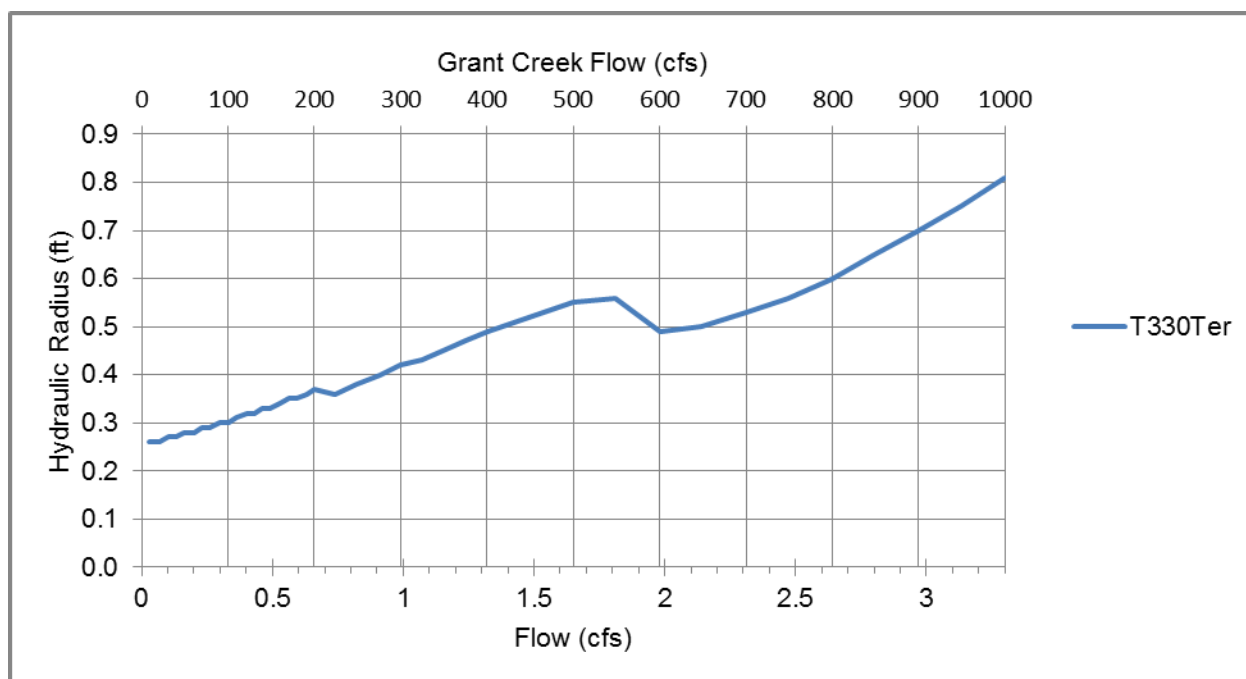


Figure A.4e-19. Transect T330 tertiary hydraulic radius vs flow.

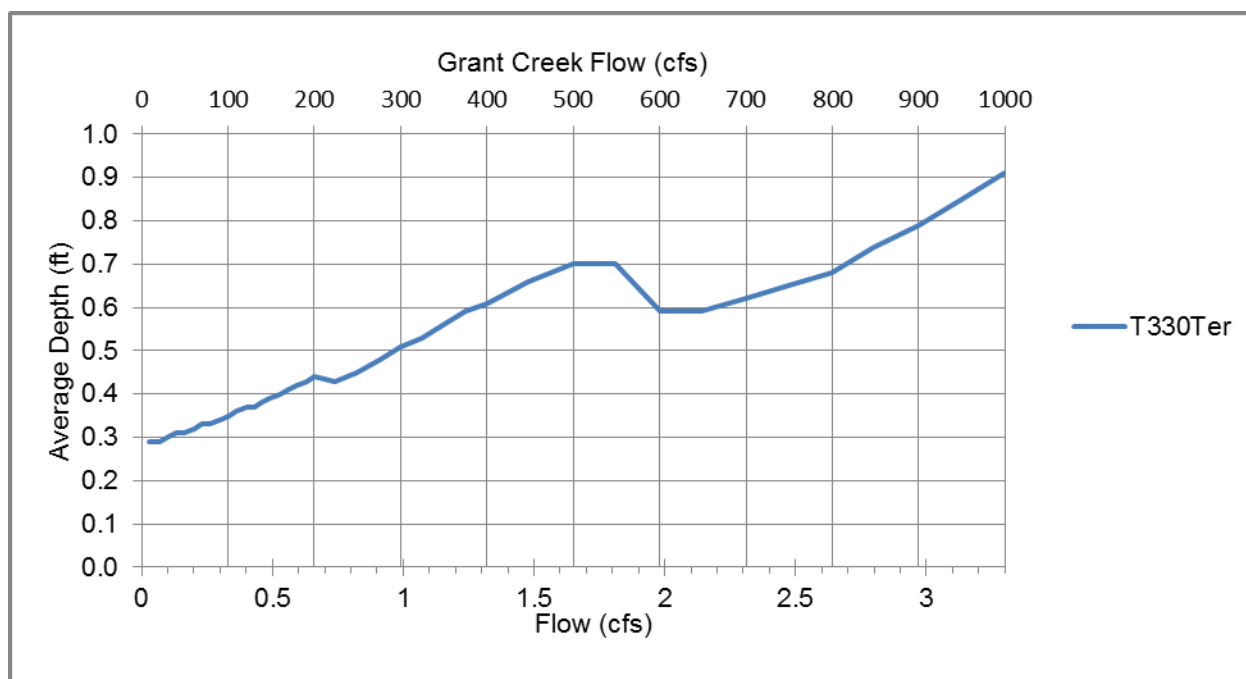


Figure A.4e-20. Transect T330 tertiary average depth vs flow.

Appendix 4f Reach 4

This sub-appendix contains the following figures:

- Figure A.4f-1. Transect 400 bed profile and WSE, 10–1,000 cfs.
- Figure A.4f-2. Transect T410 bed profile and WSE, 10–1,000 cfs.
- Figure A.4f-3. Transect T430 bed profile and WSE, 10–1,000 cfs.
- Figure A.4f-4. Reach 4 wetted perimeter vs flow.
- Figure A.4f-5. Reach 4 wetted width vs flow.
- Figure A.4f-6. Reach 4 hydraulic radius vs flow.
- Figure A.4f-7. Reach 4 average depth vs flow.

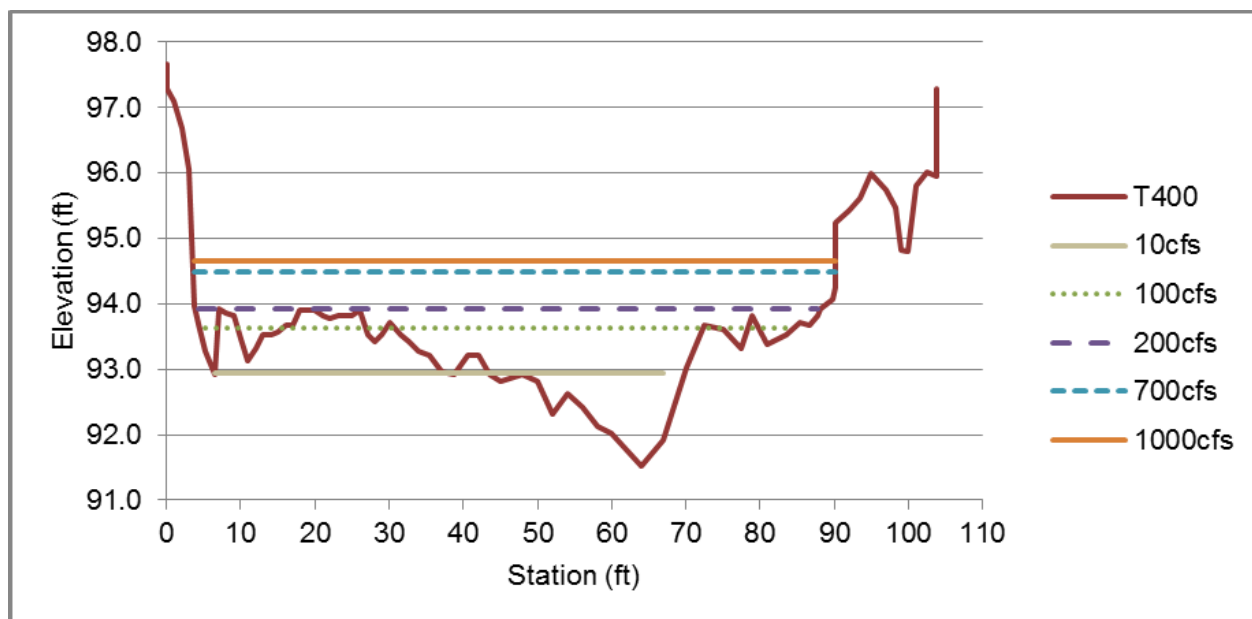


Figure A.4f-1. Transect 400 bed profile and WSE, 10–1,000 cfs.

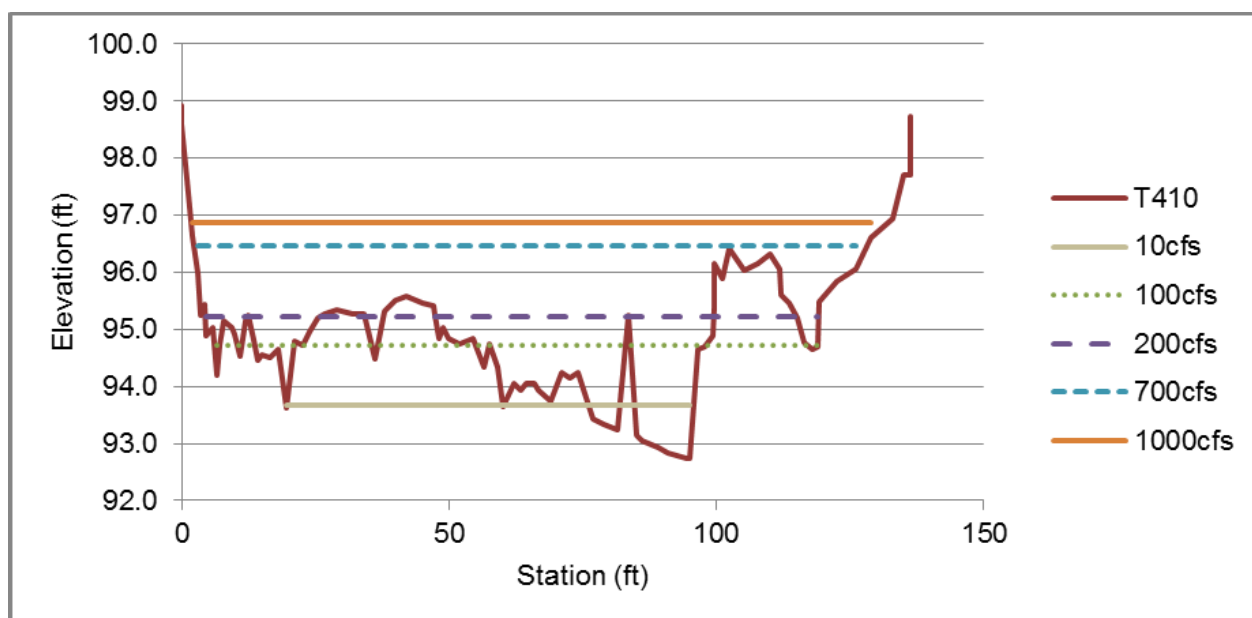


Figure A.4f-2. Transect T410 bed profile and WSE, 10–1,000 cfs.

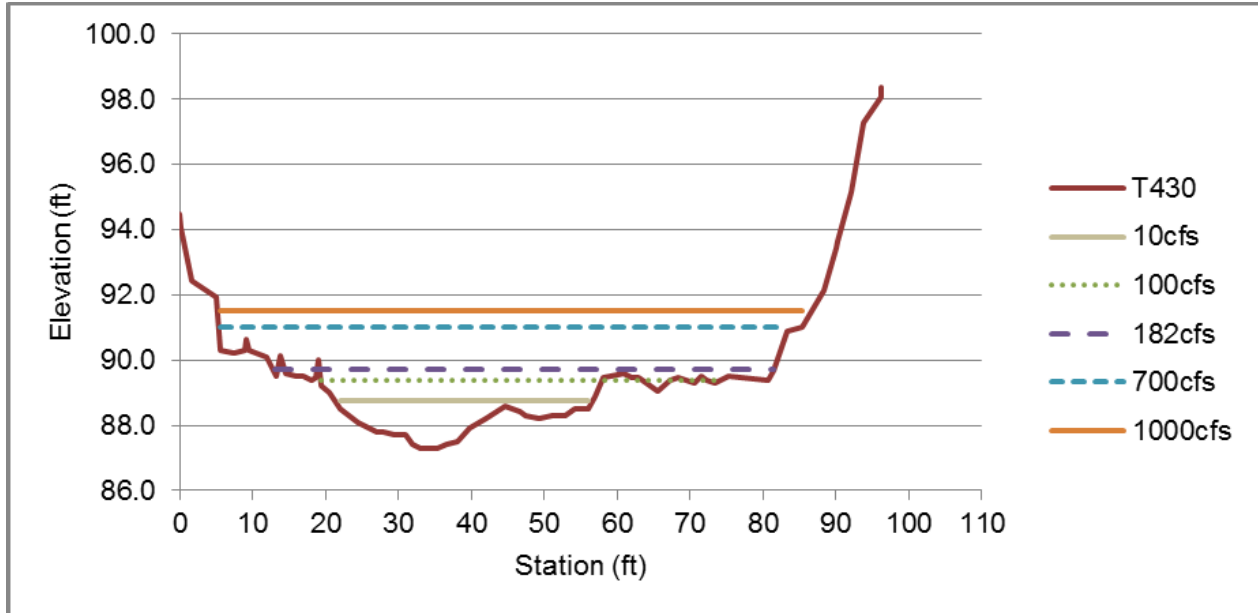


Figure A.4f-3. Transect T430 bed profile and WSE, 10–1,000 cfs.

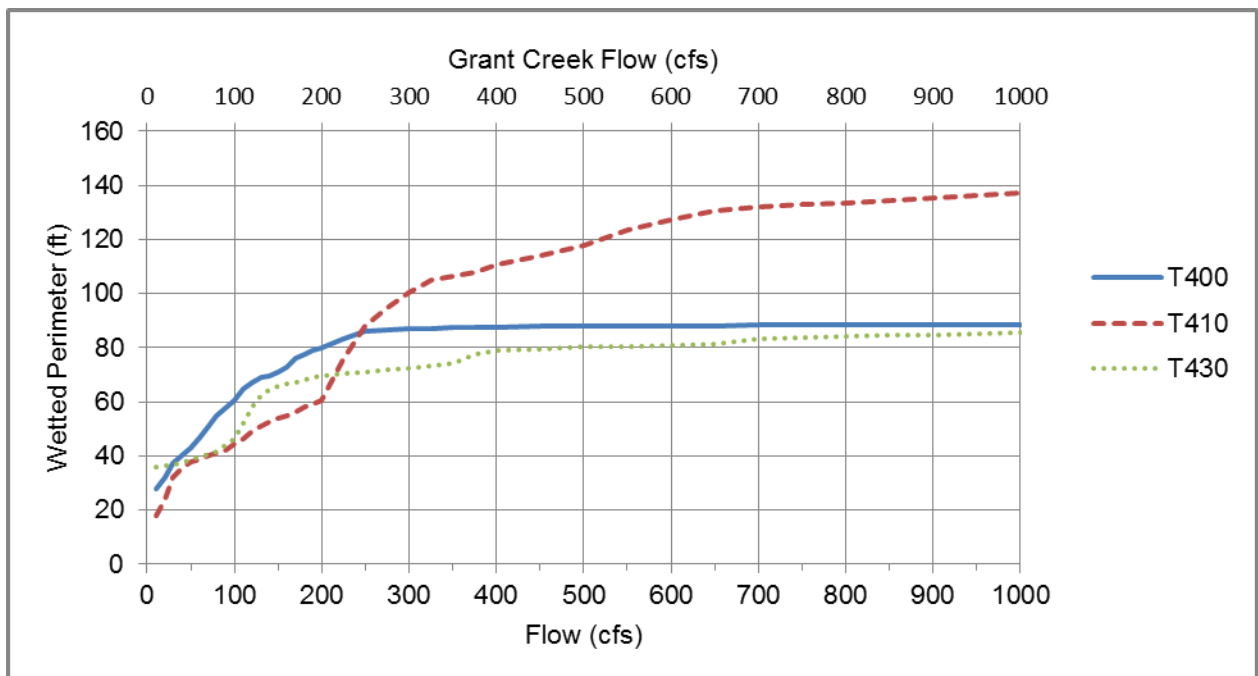


Figure A.4f-4. Reach 4 wetted perimeter vs flow.

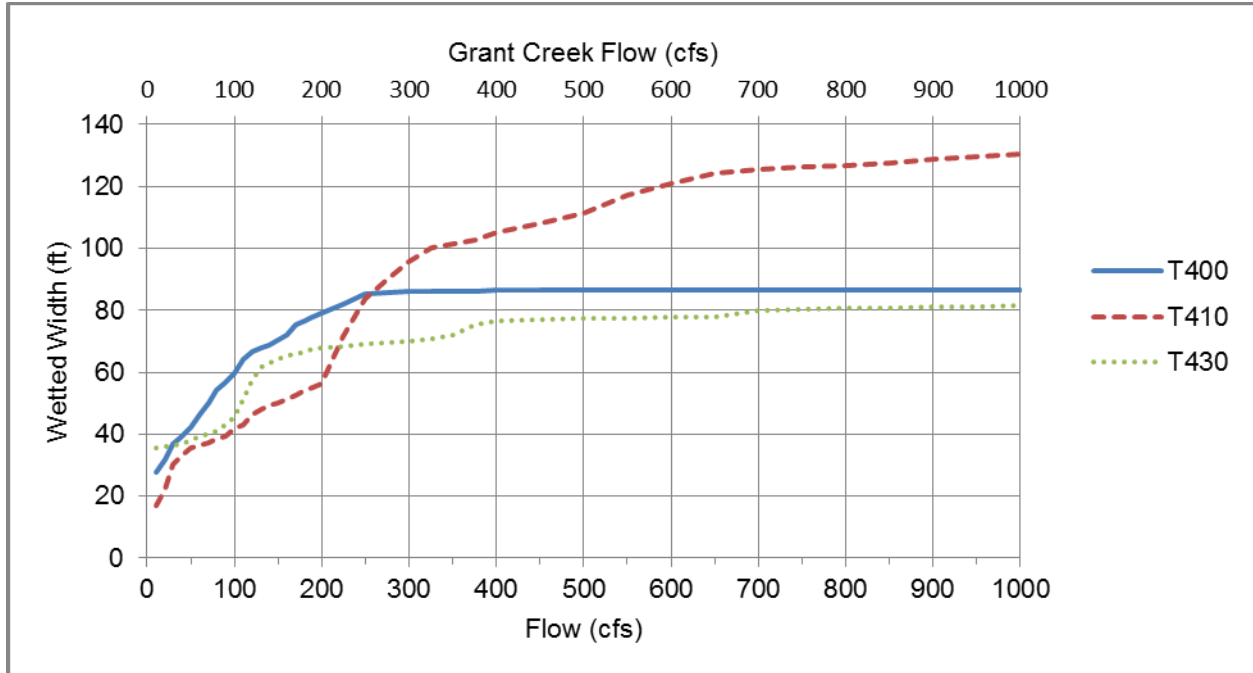


Figure A.4f-5. Reach 4 wetted width vs flow.

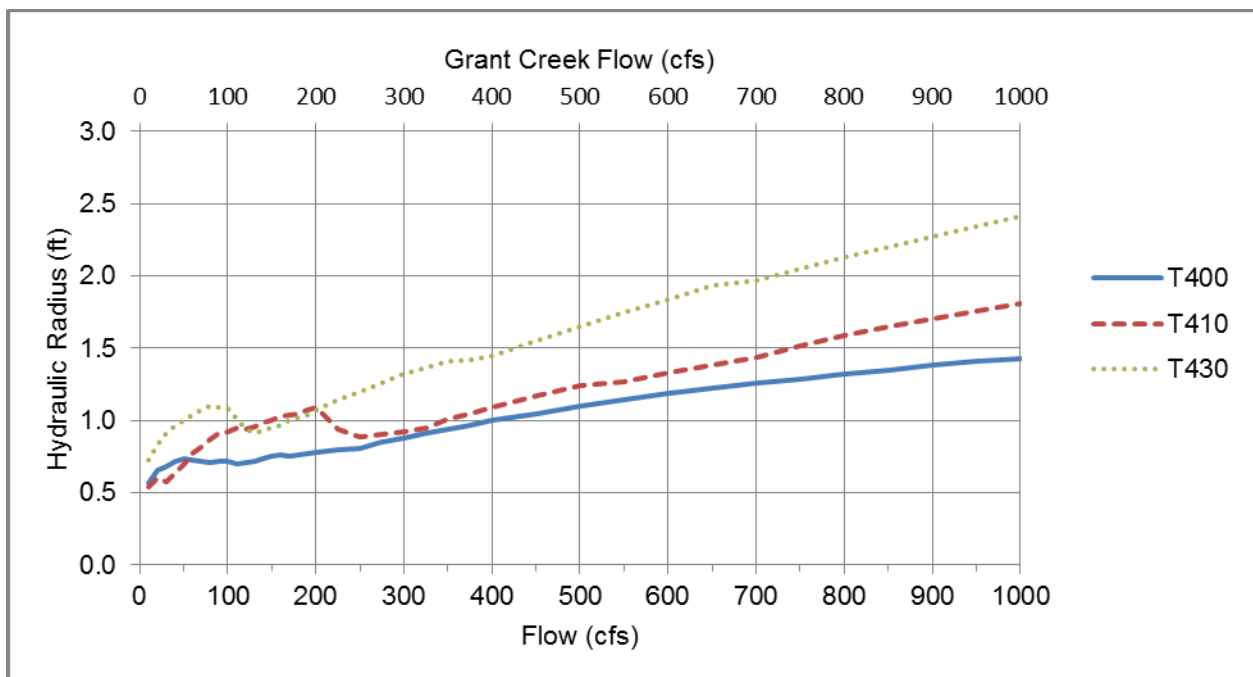


Figure A.4f-6. Reach 4 hydraulic radius vs flow.

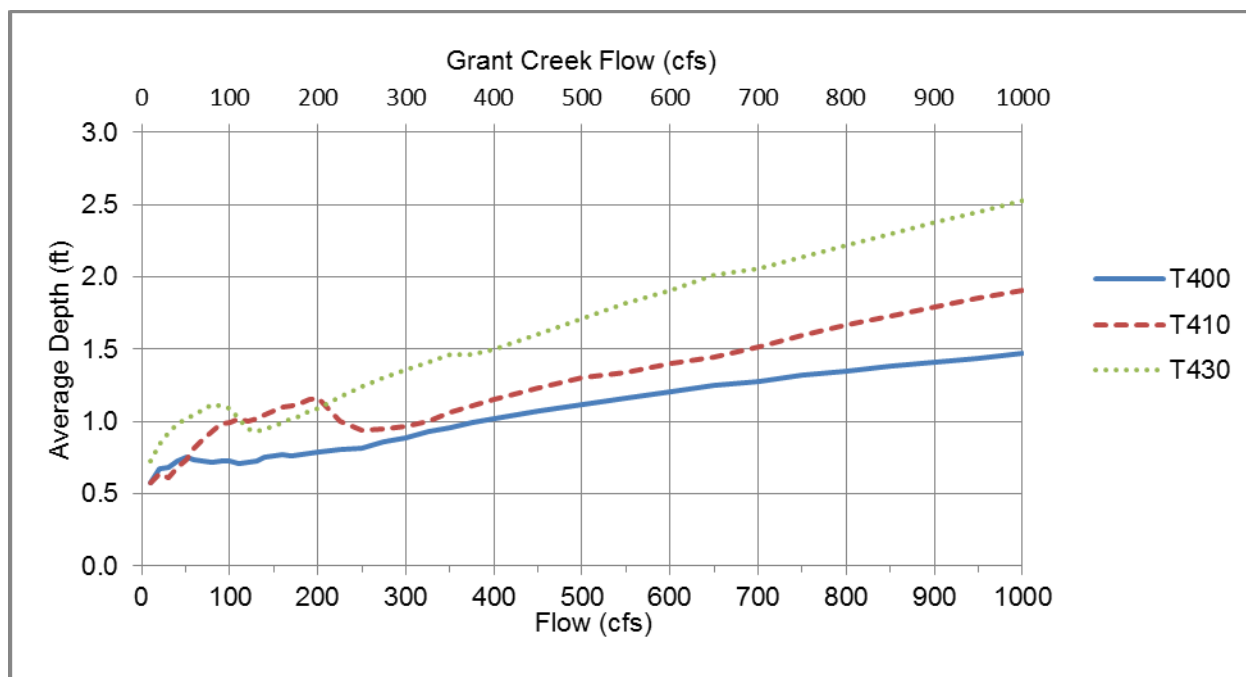


Figure A.4f-7. Reach 4 average depth vs flow.

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Friday, April 18, 2014 10:15 AM
To: dglass@ciri.com
Cc: Emily Andersen
Subject: RE: KHL Website

And I'm an idiot!! Forgot the link.

Sorry!!

<http://www.kenaihydro.com/>

From: Cory Warnock [mailto:cory.warnock@mcmillen-llc.com]
Sent: Friday, April 18, 2014 10:13 AM
To: dglass@ciri.com
Cc: Emily Andersen
Subject: KHL Website

Hi Dara,

Below is the link to Kenai Hydro's website. As you have time and dig around, if any questions come up, let me know. On another note, I'll have Mike get it touch with you about setting up a meeting with Mr. Shutt (sp?).

Thanks for being on the call and I'll talk to you soon,

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

Final
Conference call with the Grant Creek Instream Flow Work Group
April 18, 2014

Those attending via conference call:

- Susan Walker (NMFS)
- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- Dara Glass (CIRI)
- Mark Miller (BioAnalysts)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 9:00 am PDT. This was the first call after the introductory meeting to develop deliverables for the Work Group to answer questions related to the proposed Grant Lake Hydroelectric Project. As stated earlier, it is KHL's intent to provide this information in a timely fashion, so that subsequent meetings with the Aquatic Work Group (AWG), to be held in June/July, can focus on different operating scenarios and potential PM&E measures, rather than use the meetings to present data.

John Blum sent out a draft agenda and some work products to the Work Group on April 17 via email. Agenda items are briefly detailed below.

PERIODICITY OF GRANT LAKE SALMONIDS

John Blum distributed the periodicity chart that Mark Miller revised subsequent to the last conference call (grant creek periodicity 3-28-14.xlsx). This revision included sockeye salmon fry, which had not been on the previous chart. With the exception of the timing of sockeye fry emergence, the Work Group approved the periodicity table.

Jason, John Stevenson and John Blum reviewed Daily Temperature Units (DTUs; in °C) for sockeye salmon hatch and emergence. Jason also consulted with Robert Begich to get his input regarding temperature units and timing. All literature sources indicated that 600 – 650 DTUs were required for sockeye salmon hatching, and 950 – 1,000 DTUs for emergence. It appeared that, based on the experience at the CIAA Trail Lake Hatchery, sockeye fry emergence could occur between mid-March and mid-July; however, water temperatures at the hatchery were more consistent and warmer.

John Blum stated that we had the 2013 spawning timing data, and once the thermographs were downloaded this summer, that we could then calculate fry emergence timing for last year;

although we have daily water temperatures for last year, the last download was mid-March and we would need the water temperatures from the next download (scheduled for late June – early July) to complete the picture. John Stevenson suggested we also look at the 2009 sockeye spawning timing from the HDR reports (which was 10 days – 2 weeks different than 2013). John Stevenson also suggested that we use the data from last spring (2013) to “trend” the water temperatures for this year. That will give us estimates of when hatch and emergence could occur. Once we have the remaining 2014 water temperature data that we need, then we can adjust the hatch and emergence timing accordingly. The Work Group agreed.

To Do:

- John Blum to look at 2009 and 2013 sockeye salmon spawning timing. He will use the 2013-2014 water temperature data and the DTUs shown above to estimate hatch and emergence timing for Grant Creek Sockeye salmon.

TRANSECT SELECTION AND WEIGHTING/PRIORITY SPECIES

As requested at the last meeting, Mark Miller, John Stevenson, Jake Woodbury and John Blum compiled GIS maps which included the following:

- Spawning in relation to Instream Flow Transects (file Transect spawning Maps RED 04092014.pdf, sent on April 17)
- Rearing in Relation to Instream Flow Transects (files MinT Locates By Transect Red 041714.pdf and Transect rearing all Red 041714.pdf, sent on April 17)
- CPUE for Chinook, Coho, Rainbow Trout and Dolly Varden Rearing (provided on file Transect rearing all Red 041714.pdf, sent on April 17), and
- Wetted Perimeter vs. Flow graphs for Instream Flow transects (file Draft App 4_GL IFIM March 2014 PD 03-31-14.pdf, sent on April 17)

Data analysis of locations of spawning/rearing on the transects still has to be completed.

To Do:

- John requested that the Work Group review these data and use it in order to determine which transects should be used, how they should be weighted, and if there were priority species and life history stages for certain times of the year. This information will be used to conduct the additional instream flow analysis requested by the Work Group.

EFFECTIVE SPAWNING/HABITAT TIME SERIES ANALYSES

John Blum stated that Andre Ball (McMillen) had taken the suggestion of the Work Group and used data from the USGS gage on the Kenai River at Cooper Landing to extend the hydrologic record for Grant Creek. The relationship was robust, and Andre was able to build a record of actual and synthesized daily flows that extended from May 1, 1947, through December 31,

2013 [Note: the gage on Grant Creek is operating and the actual flows are being used since the gage was re-established].

With the hydrology now in place (for flows without the project), and the periodicity established (with the exception of sockeye salmon fry emergence), several of the pieces needed to run effective spawning and habitat duration analyses are now in place. Once transects are prioritized and weighted, and operational flows are established over the period of record, John will be able to run these analyses, so input from the Work Group are

OTHER

Monte Miller would like to see an analysis of the effects of the tailrace and flows on Reaches 4 and 5, since the exact siting of the tailrace has not yet been completed. He suggested a vertical profile of the tailrace, along with operational ideas and concepts. Cory Warnock stated that HEA will be working on integrating the natural resource data with the engineering information (including operational scenarios) over the next couple months and the intent is to have a series of viable scenarios prepared to present at the next meeting. These scenarios will be accompanied by potential instream flow scenarios, potential impacts as a result of the particular scenario (negative and positive) and potential mitigation and enhancement measures that may assist in maximizing natural resource value with respect to the particular scenario.

NEXT WORK GROUP MEETING

Along with the draft meeting minutes, John will ask which days the week of May 19th that would work for our next call.

To Do:

- John will send out a notice for the next meeting, asking when people will be available

STAKEHOLDER MEETING

Cory Warnock said that they were proposing a Stakeholders' Meeting the week of July 7th. He was proposing a Public meeting to be held at the Moose Pass Community Center on July 7th, to be followed by a 2-day meeting with the Stakeholders on July 8th and 9th. Monte Miller suggested that the Stakeholder meeting be held prior to the Public meeting, so that if the Stakeholders were asked questions by the public, that everyone would be on the same page. With that in mind, Cory was going to recommend that the Stakeholder meeting be held on July 7th – 8th, with the Public meeting to be convened on July 9th. He will be sending out a notification/invitation soon.

From: Cory Warnock
Sent: Thursday, April 24, 2014 4:10 PM
To: Emily Andersen
Subject: Fwd: INHT Field Trip
Attachments: 2014-04-24-INHT Trail Walk.pdf; ATT00001.htm

FYI

Begin forwarded message:

From: Dwayne Adams <dadams@uskh.com>
Date: April 24, 2014 at 3:59:38 PM PDT
To: "<rstovall@yahoo.com>" <rstovall@yahoo.com>, "Russell, Pamela J (DNR)" <pamela.russell@alaska.gov>, "<kvanmassenhove@fs.fed.us>" <kvanmassenhove@fs.fed.us>, "<lesli.schick@alaska.gov>" <lesli.schick@alaska.gov>, "Eavis, John -FS (<jeavis@fs.fed.us>)" <jeavis@fs.fed.us>, "Duvall, Shina A (DNR) (<shina.duvall@alaska.gov>)" <shina.duvall@alaska.gov>
Cc: "Mike Salzetti (<msalzetti@HomerElectric.com>)" <msalzetti@HomerElectric.com>, Cory Warnock <cory.warnock@mcmillen-llc.net>, Kim Graham <kgraham@uskh.com>
Subject: INHT Field Trip

Hi folks,

We're proposing a field trip to review possible INHT routing for May 21. Could you check your calendars and see if this might work for you? Also, let me know if there are others who should be invited to participate.

Thanks

Dwayne Adams, FASLA
Principal
Landscape Architecture and Community Planning

USKH Inc.
Celebrating
40 years

2515 A Street
Anchorage, AK 99503
main: 907.276.4245
direct: 907.343.5248
cell: 907.441.4948
www.uskh.com
[Facebook](#) | [Twitter](#) | [LinkedIn](#)
paper = trees

This electronic communication (including all attachments) is intended only for the named addressee(s) and may contain confidential information. It has not passed through our standard review process. Design data and recommendations included herein are provided as a matter of convenience and should not be used for final design. RELY ONLY ON THE FINAL HARDCOPY MATERIALS BEARING THE CONSULTANT'S ORIGINAL SIGNATURE AND SEAL. If you are

April 24, 2014

Robert Stovall, USFS
John Eavis, USFS
Kathy Van Massenhove, USFS
Pam Russell, ADNR/KRSMA
Lesli Schick, ADNR
Shina du Vall, ADNR

Subject: INHT Field Trip, Moose Pass

Kenai Hydro, LLC would like to follow through on our discussions concerning a field trip to review possible alternative alignments of the Iditarod National Historic Trail (INHT) in the proximity of Moose Pass. We propose that we conduct the field trip on Wednesday, May 21, when snow should be gone and before full leaf-out. This should provide for relatively easy travel through the forest and good views through the forest to evaluate possible alignments.

We suggest that we meet just south of Moose Pass at approximately 9am at a pull out near the proposed Kenai Lake crossing that has been discussed as part of our ongoing FERC licensing efforts (Milepost 27). KHL will arrange for a boat to ferry everyone across the lake after we make a short hike through the trees.

Please let us know if this might work for you. We will send more particulars about the trip once we have confirmation in hand.

Sincerely,
USKH Inc.



Wm. Dwayne Adams, Jr., FASLA

c: Mike Salzetti, KHL, Cory Warnock, McMillen

Work Order: 1371300

From: Cory Warnock
Sent: Thursday, April 24, 2014 4:20 PM
To: Emily Andersen
Subject: Fwd: INHT Trail Walk

FYI

Begin forwarded message:

From: Dwayne Adams <dadams@uskh.com>
Date: April 24, 2014 at 4:17:56 PM PDT
To: "mmueller@borough.kenai.ak.us" <mmueller@borough.kenai.ak.us>
Subject: INHT Trail Walk

Marcus,

I am working with Kenai Hydro LLC with respect to the proposed hydro project at Grant Lake. As part of that we are looking at possible alternative alignments for the Iditarod National Historic Trail that could avoid possible conflicts that might occur should the project be developed. We have met with agencies and are now proposing a walk to look at possible alternatives. Lesli Schick suggested that you attend.

Might you be available to join us—Wednesday May 21?

Dwayne Adams, FASLA
Principal
Landscape Architecture and Community Planning

USKH Inc.

Celebrating

40 years

2515 A Street
Anchorage, AK 99503
main: 907.276.4245
direct: 907.343.5248
cell: 907.441.4948
www.uskh.com
[Facebook](#) | [Twitter](#) | [LinkedIn](#)
paper = trees

This electronic communication (including all attachments) is intended only for the named addressee(s) and may contain confidential information. It has not passed through our standard review process. Design data and recommendations included herein are provided as a matter of convenience and should not be used for final design. RELY ONLY ON THE FINAL HARDCOPY MATERIALS BEARING THE CONSULTANT'S ORIGINAL SIGNATURE AND SEAL. If you are not the named addressee(s), any use, dissemination, distribution or copying of this communication is prohibited. If you have received this communication in error, please notify the sender immediately by return e-mail and delete the original communication from your system. This e-mail and all other electronic (including voice) communications from the sender's firm are not intended by the sender to constitute an electronic record, an electronic signature or any agreement to conduct a transaction by electronic means. Any such intention or agreement is hereby expressly disclaimed unless otherwise specifically indicated.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, April 25, 2014 1:20 PM
To: 'John Blum'; 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: Draft Meeting Minutes/Next meeting
Attachments: Draft minutes for IFWG meeting 04-18-2014.docx; Spawning and rearing locations Grant Creek.xlsx

Importance: High

Good afternoon:

I have attached the draft meeting minutes from our conference call last Friday, April 18th. Please review these and get back to me with your comments.

Per our discussions related to spawning and rearing use of transects, I have provided a simple spreadsheet that summarizes utilization (for the spawning life stage) and CPUE for rearing life stage. You probably have your own tools to evaluate the transects, but I thought I would provide this as well.

The last item is to set a meeting date in May to for the next round. It appears from our discussions that the week of May 19th is best for everyone. I am not available the 19th, but am the rest of the week. Please let me know which dates (20th - 23rd) work best for you.

Thanks very much for your participation on the Work Group. Have a good weekend!

John

John Blum
Sr. Fisheries Scientist

McMillen, LLC
1155 North State Street, Suite 700, Bellingham, WA 98225
direct 360.483.2807 | p 360.734.5915 x 281
f 360.734.5918 | c 360.220.0694
john.blum@mcmillen-llc.com | www.mcmillen-llc.com

Final
Conference call with the Grant Creek Instream Flow Work Group
April 18, 2014

Those attending via conference call:

- Susan Walker (NMFS)
- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- Dara Glass (CIRI)
- Mark Miller (BioAnalysts)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 9:00 am PDT. This was the first call after the introductory meeting to develop deliverables for the Work Group to answer questions related to the proposed Grant Lake Hydroelectric Project. As stated earlier, it is KHL's intent to provide this information in a timely fashion, so that subsequent meetings with the Aquatic Work Group (AWG), to be held in June/July, can focus on different operating scenarios and potential PM&E measures, rather than use the meetings to present data.

John Blum sent out a draft agenda and some work products to the Work Group on April 17 via email. Agenda items are briefly detailed below.

PERIODICITY OF GRANT LAKE SALMONIDS

John Blum distributed the periodicity chart that Mark Miller revised subsequent to the last conference call (grant creek periodicity 3-28-14.xlsx). This revision included sockeye salmon fry, which had not been on the previous chart. With the exception of the timing of sockeye fry emergence, the Work Group approved the periodicity table.

Jason, John Stevenson and John Blum reviewed Daily Temperature Units (DTUs; in °C) for sockeye salmon hatch and emergence. Jason also consulted with Robert Begich to get his input regarding temperature units and timing. All literature sources indicated that 600 – 650 DTUs were required for sockeye salmon hatching, and 950 – 1,000 DTUs for emergence. It appeared that, based on the experience at the CIAA Trail Lake Hatchery, sockeye fry emergence could occur between mid-March and mid-July; however, water temperatures at the hatchery were more consistent and warmer.

John Blum stated that we had the 2013 spawning timing data, and once the thermographs were downloaded this summer, that we could then calculate fry emergence timing for last year;

although we have daily water temperatures for last year, the last download was mid-March and we would need the water temperatures from the next download (scheduled for late June – early July) to complete the picture. John Stevenson suggested we also look at the 2009 sockeye spawning timing from the HDR reports (which was 10 days – 2 weeks different than 2013). John Stevenson also suggested that we use the data from last spring (2013) to “trend” the water temperatures for this year. That will give us estimates of when hatch and emergence could occur. Once we have the remaining 2014 water temperature data that we need, then we can adjust the hatch and emergence timing accordingly. The Work Group agreed.

To Do:

- John Blum to look at 2009 and 2013 sockeye salmon spawning timing. He will use the 2013-2014 water temperature data and the DTUs shown above to estimate hatch and emergence timing for Grant Creek Sockeye salmon.

TRANSECT SELECTION AND WEIGHTING/PRIORITY SPECIES

As requested at the last meeting, Mark Miller, John Stevenson, Jake Woodbury and John Blum compiled GIS maps which included the following:

- Spawning in relation to Instream Flow Transects (file Transect spawning Maps RED 04092014.pdf, sent on April 17)
- Rearing in Relation to Instream Flow Transects (files MinT Locates By Transect Red 041714.pdf and Transect rearing all Red 041714.pdf, sent on April 17)
- CPUE for Chinook, Coho, Rainbow Trout and Dolly Varden Rearing (provided on file Transect rearing all Red 041714.pdf, sent on April 17), and
- Wetted Perimeter vs. Flow graphs for Instream Flow transects (file Draft App 4_GL IFIM March 2014 PD 03-31-14.pdf, sent on April 17)

Data analysis of locations of spawning/rearing on the transects still has to be completed.

To Do:

- John requested that the Work Group review these data and use it in order to determine which transects should be used, how they should be weighted, and if there were priority species and life history stages for certain times of the year. This information will be used to conduct the additional instream flow analysis requested by the Work Group.

EFFECTIVE SPAWNING/HABITAT TIME SERIES ANALYSES

John Blum stated that Andre Ball (McMillen) had taken the suggestion of the Work Group and used data from the USGS gage on the Kenai River at Cooper Landing to extend the hydrologic record for Grant Creek. The relationship was robust, and Andre was able to build a record of actual and synthesized daily flows that extended from May 1, 1947, through December 31,

2013 [Note: the gage on Grant Creek is operating and the actual flows are being used since the gage was re-established].

With the hydrology now in place (for flows without the project), and the periodicity established (with the exception of sockeye salmon fry emergence), several of the pieces needed to run effective spawning and habitat duration analyses are now in place. Once transects are prioritized and weighted, and operational flows are established over the period of record, John will be able to run these analyses, so input from the Work Group are

OTHER

Monte Miller would like to see an analysis of the effects of the tailrace and flows on Reaches 4 and 5, since the exact siting of the tailrace has not yet been completed. He suggested a vertical profile of the tailrace, along with operational ideas and concepts. Cory Warnock stated that HEA will be working on integrating the natural resource data with the engineering information (including operational scenarios) over the next couple months and the intent is to have a series of viable scenarios prepared to present at the next meeting. These scenarios will be accompanied by potential instream flow scenarios, potential impacts as a result of the particular scenario (negative and positive) and potential mitigation and enhancement measures that may assist in maximizing natural resource value with respect to the particular scenario.

NEXT WORK GROUP MEETING

Along with the draft meeting minutes, John will ask which days the week of May 19th that would work for our next call.

To Do:

- John will send out a notice for the next meeting, asking when people will be available

STAKEHOLDER MEETING

Cory Warnock said that they were proposing a Stakeholders' Meeting the week of July 7th. He was proposing a Public meeting to be held at the Moose Pass Community Center on July 7th, to be followed by a 2-day meeting with the Stakeholders on July 8th and 9th. Monte Miller suggested that the Stakeholder meeting be held prior to the Public meeting, so that if the Stakeholders were asked questions by the public, that everyone would be on the same page. With that in mind, Cory was going to recommend that the Stakeholder meeting be held on July 7th – 8th, with the Public meeting to be convened on July 9th. He will be sending out a notification/invitation soon.

Transects with Most Evidence of Spawning

Transect	Chinook	Coho	Sockeye	Pink
100				
110				
120	✓	✓	✓	✓
130	✓	✓	✓	✓
140			✓	
150	✓	✓	✓	
160		✓	✓	
200		✓	✓	
210		✓		
220			✓	
230		✓		
300		✓	✓	
310		✓		
320		✓	✓	
330		✓	✓	
400	✓		✓	
410		✓	✓	
430		✓	✓	

Transects with Most Evidence of Salmonid Rearing

Transect	Chinook	Coho	Dolly Varden	Rainbow
100	0.370	0.045	0.381	0.000
110	0.222	0.040	0.079	0.000
120	0.307	0.020	0.163	0.078
130	0.620	0.183	0.225	0.089
140				
150	0.073	0.015	0.147	0.029
160	0.163	0.078	0.329	0.026
200	0.363	0.284	0.126	0.056
210	0.110	0.000	0.033	0.044
220	0.318	0.188	0.120	0.057
230	0.277	0.000	0.415	0.069
300	0.473	0.167	0.117	0.121
310	0.216	0.007	0.022	0.036
320				
330	0.433	0.149	0.263	0.124
400	0.048	0.026	0.148	0.087
410	0.126	0.021	0.228	0.062
430	0.097	0.007	0.174	0.060
510	0.037	0.003	0.100	0.087
520	0.020	0.000	0.090	0.024

	Highest CPUE/species
	2nd Highest CPUE/species
	3rd Highest CPUE/species
	4th Highest CPUE/species
	5th Highest CPUE/species
	Balance of transects

From: Anderson, Jeffry <jeffry_anderson@fws.gov>
Sent: Friday, April 25, 2014 2:00 PM
To: John Blum
Cc: Miller, Monte D (DFG); Mouw, Jason E B (DFG); Klein, Joseph P (DFG); dglass@ciri.com; susan.walker@noaa.gov; Mark Miller; John Stevenson; Cory Warnock; Mike Salzetti; Emily Andersen
Subject: Re: Draft Meeting Minutes/Next meeting
Categories: Green Category

Hi John. I am unavailable the week of May 19th, but appreciate the minutes and notes.

-- Jeff

Jeffry Anderson
Field Supervisor
USFWS, Kenai Fish & Wildlife Field Office
43655 Kalifornsky Beach Road, Soldotna, AK 99669
Office: 907-260-0132
Cell: 907-252-4896

On Fri, Apr 25, 2014 at 12:20 PM, John Blum <john.blum@mcmillen-llc.com> wrote:

Good afternoon:

I have attached the draft meeting minutes from our conference call last Friday, April 18th. Please review these and get back to me with your comments.

Per our discussions related to spawning and rearing use of transects, I have provided a simple spreadsheet that summarizes utilization (for the spawning life stage) and CPUE for rearing life stage. You probably have your own tools to evaluate the transects, but I thought I would provide this as well.

The last item is to set a meeting date in May for the next round. It appears from our discussions that the week of May 19th is best for everyone. I am not available the 19th, but am the rest of the week. Please let me know which dates (20th - 23rd) work best for you.

Thanks very much for your participation on the Work Group. Have a good weekend!

John

John Blum
Sr. Fisheries Scientist

McMillen, LLC
1155 North State Street, Suite 700, Bellingham, WA 98225

direct 360.483.2807 | p 360.734.5915 x 281

f 360.734.5918 | c 360.220.0694
john.blum@mcmillen-llc.com | www.mcmillen-llc.com

From: Michael Yarborough <salvagerecovery@gmail.com>
Sent: Tuesday, April 29, 2014 3:23 PM
To: Judy Bittner; Frank Winchell; Duvall, Shina A (DNR); Sherry D Nelson; Lesli Schick; Dara Glass; Mark Luttrell
Cc: Salzetti, Mikel; Cory Warnock; Emily Andersen; Dwayne Adams; Sarah Meitl
Subject: Grant Lake Hydroelectric Project (FERC No. 13212) Cultural Resources Stakeholder Group:
Attachments: 03-21-14 CRWG Meeting Summary draft.pdf

Hi all,

KHL has put together the attached meeting minutes based upon our Cultural Resource proceedings in late March in Anchorage. If you could review and provide and clarifying comments you may have by Wednesday May 14th, it would be appreciated. Per my communication at the meeting, KHL will then develop a comprehensive package consisting of meeting agendas, minutes, presentations and final reports and file with FERC.

On another note, KHL would like to schedule the next stakeholder meeting. As discussed in March, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. With that and the understanding that no time in the summer is a good time, I'd like to propose our meeting to take place in Anchorage on July 7th and 8th (Monday/Tuesday) in Anchorage. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. That said, I'd prefer to err on the side of caution and get enough time on the calendar to ensure that we get through what we need to. In addition, to the two day stakeholder workshop, KHL will be holding a public meeting in Moose Pass sometime in early July as well to share details related to development and to discuss questions/concerns that the local public may have about the project. You all are obviously invited to attend this meeting as well. Details related to all of the meetings will follow after we confirm that folks are available to attend. So for now, if you all could please respond and confirm/deny your availability, I'd appreciate it.

Thanks and look forward to hearing from you soon,

Mike

--

Michael R. Yarborough
Senior Archeologist
Cultural Resource Consultants LLC
3504 E. 67th Avenue
Anchorage, Alaska 99507
Anchorage: [\(907\) 349-3445](tel:(907)349-3445)
Cell: [\(907\) 306-6069](tel:(907)306-6069)

NOTE: Because of the potentially sensitive nature of the information regarding Cultural Resources, the draft March 21, 2014 Cultural Resources Work Group (CRWG) meeting notes attached to the April 29, 2014 email is not being distributed to the general public. This document may be obtained by request to Homer Electric Association (HEA) or Federal Energy Regulatory Commission (FERC), subject to confidentiality provisions.

From: [Dwayne Adams](#)
To: [Stovall, Robert -FS](#); [Russell, Pamela J \(DNR\)](#); kvanmassenhove@fs.fed.us; lesli.schick@alaska.gov; [Eavis, John -FS \(jeavis@fs.fed.us\)](mailto:Eavis, John -FS (jeavis@fs.fed.us)); [Duvall, Shina A \(DNR\) \(shina.duvall@alaska.gov\)](mailto:Shina, Duvall A (DNR) (shina.duvall@alaska.gov)); [Fitzpatrick, Mike -FS](#); [Fitzpatrick, Mike -FS](#); [Kime, Sherry D -FS](#); mmueller@borough.kenai.ak.us; judy.bittner@alaska.gov
Cc: [Mike Salzetti \(msalzetti@HomerElectric.com\)](mailto:Mike.Salzetti@HomerElectric.com); [Cory Warnock](#); [Kim Graham](#)
Subject: RE: INHT Field Trip
Date: Tuesday, April 29, 2014 3:23:44 PM

We're doing a lot of juggling trying to get the parties together. I know we'll miss some folks regardless of how we schedule but I'd like to get as many as possible.

Which of the following work for you?

May 9
May 12
May 19
May 20
May 22
May 26
May 27
May 28
May 29

Thanks for your patience
Dwayne Adams

From: Dwayne Adams
Sent: Tuesday, April 29, 2014 9:03 AM
To: 'rstovall@yahoo.com'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; Eavis, John -FS (jeavis@fs.fed.us); Duvall, Shina A (DNR) (shina.duvall@alaska.gov); Fitzpatrick, Mike -FS; Fitzpatrick, Mike -FS; Kime, Sherry D -FS; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'
Cc: Mike Salzetti (msalzetti@HomerElectric.com); Cory Warnock; Kim Graham
Subject: RE: INHT Field Trip

We have been discussing a walk of potential alternative locations for the Iditarod National Historic Trail in proximity to Grant Lake/Moose Pass as part of the FERC licensing for hydroelectric development at Grant Lake. We had discussed May 21 as a possible date. Unfortunately, one of the agencies is generally unavailable on that date. Would either Thursday June 5 or Friday June 6 work?

For the uninitiated, attached is a graphic that illustrates the alternatives identified thus far.

Thanks
Dwayne

From: Dwayne Adams
Sent: Thursday, April 24, 2014 2:58 PM
To: 'rstovall@yahoo.com'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; Eavis, John -FS (jeavis@fs.fed.us); Duvall, Shina A (DNR)

(shina.duvall@alaska.gov)

Cc: Mike Salzetti (msalzetti@HomerElectric.com); Cory Warnock; Kim Graham

Subject: INHT Field Trip

Hi folks,

We're proposing a field trip to review possible INHT routing for May 21. Could you check your calendars and see if this might work for you? Also, let me know if there are others who should be invited to participate.

Thanks

Dwayne Adams, FASLA

Principal

Landscape Architecture and Community Planning

USKH Inc.

Celebrating

40 years

2515 A Street
Anchorage, AK 99503
main: 907.276.4245
direct: 907.343.5248
cell: 907.441.4948
www.uskh.com
[Facebook](#) | [Twitter](#) | [LinkedIn](#)
paper = trees

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Tuesday, April 29, 2014 1:30 PM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; Jeffry Anderson; 'Patricia Berkhahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; Schade, David W (DNR); mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; Charles Sauvageau; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough
Subject: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)
Attachments: 03-18-14 NRWG Meeting Summary draft.pdf; 03-19-14 ARWG Meeting Summary draft.pdf; 03-20-14 ARWG Meeting Summary draft.pdf

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

KHL has put together the attached meeting minutes based upon our Natural Resource proceedings in late March in Anchorage. If you could review and provide and clarifying comments you may have by Wednesday May 14th, it would be appreciated. Per my communication at the meeting, KHL will then develop a comprehensive package consisting of meeting agendas, minutes, presentations and final reports and file with FERC.

On another note, KHL would like to schedule the next stakeholder meeting. As discussed in March, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. With that and the understanding that no time in the summer is a good time, I'd like to propose our meeting to take place in Anchorage on July 7th and 8th (Monday/Tuesday) in Anchorage. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. That said, I'd prefer to err on the side of caution and get enough time on the calendar to ensure that we get through what we need to. In addition, to the two day stakeholder workshop, KHL will be holding a public meeting in Moose Pass sometime in early July as well to share details related to development and to discuss questions/concerns that the local public may have about the project. You all are obviously invited to attend this meeting as well. Details related to all of the meetings will follow after we confirm that folks are available to attend. So for now, if you all could please respond and confirm/deny your availability, I'd appreciate it.

Thanks and look forward to hearing from you soon,

Cory

Cory Warnock

**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 6¹*), 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 °C 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 Berkahn, 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 26¹*), 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 be 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 Berkahn, 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 12¹*), 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 tributary 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

From: Cory Warnock
Sent: Wednesday, April 30, 2014 2:49 PM
To: Mike Salzetti
Cc: Emily Andersen
Subject: FW: Grant Creek comments
Attachments: Review of 2014 Grant Lake and Creek Environmental Baseline Studies_JM_4 16 14.docx

From: Miller, Monte D (DFG) [mailto:monte.miller@alaska.gov]
Sent: Wednesday, April 30, 2014 2:40 PM
To: Cory Warnock
Subject: RE: Grant Creek comments

Cory,

Attached are the reviews of the draft study reports prepared by Jason Mouw. My additional notes have been added in a red text. Again, I appreciate the additional time allowed.

Monte D. Miller
Statewide FERC Hydropower Coordinator
Alaska Department of Fish and Game
Division of Sport Fish / RTS
333 Raspberry Road
Anchorage, Alaska, 99518-1565

907 267-2312

From: Cory Warnock [mailto:cory.warnock@mcmillen-llc.net]
Sent: Wednesday, April 30, 2014 10:11 AM
To: Miller, Monte D (DFG); John Blum (john.blum@mcmillen-llc.com); Cory Warnock
Subject: RE: Grant Creek comments

Hi Monte,

Just checking in on your comments.

Do you have an idea of when I might be seeing those?

Thanks!

From: Miller, Monte D (DFG) [mailto:monte.miller@alaska.gov]
Sent: Friday, April 25, 2014 3:43 PM
To: John Blum (john.blum@mcmillen-llc.com); Cory Warnock
Subject: Grant Creek comments

Comments on the study reports are due today, Unfortunately, mine won't be ready until sometime Monday or Tuesday of next week. I have comments from Jason Mouw in hand, but feel that I need to reconcile his comments with the additional information which has been provided so that we provide the most up to date requests, etc. I had planned on getting these to you today, unfortunately I have to play nurse for my wife following her surgery yesterday. I hope to be able to spend short periods over today and the weekend to complete our comments to you. I apologize for my delay, however I am not comfortable sending the comments given to me without acknowledging additional information provided in teleconferences, held since the report/s were presented.

Thanks for your understanding.

Monte D. Miller
Statewide FERC Hydropower Coordinator
Alaska Department of Fish and Game
Division of Sport Fish / RTS
333 Raspberry Road
Anchorage, Alaska, 99518-1565

907 267-2312

Review of 2014 Grant Lake and Creek Draft Study Reports

This review covers the 2014 Grant Creek Draft Resources Study Reports recently provided by Kenai Hydro, LLC (the applicant). These reports cover the applicant's 2013 baseline resources studies, pursuant to their intent to file an application for an original license under a preliminary permit for FERC project No. 13211, hereafter referred to as "Project" or "Grant Lake Project". The structure of this review is the same as each of the draft reports, including each section, noting where comments are made and not.

Each draft report is reviewed separately, under the respective report title. Specific comments are made to specific sectional excerpts, which are set apart by page number, *italic font*, and "quotes". The specific comments follow in normal print. General comments are also given and set apart as "General Comments". Where necessary, requests for clarification and additional information are stated and data gaps are reported. These comments are intended to guide ongoing collaborative work with the applicant's consultants on data needs and analysis of impacts related to the proposed project.

There were no comments made on the Recreational and Visual Resources, Geomorphology, and Macro-invertebrate and Periphyton studies.

Draft Review of 2014 Aquatic Resources - Grant Creek Aquatic Habitat Mapping and Instream Flow Study Draft Report: Grant Lake Hydroelectric Project (FERC No. 13212)

1.0 INTRODUCTION

No comments.

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.

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.

2.0 STUDY OBJECTIVES

2.1 Overall Goals Identified During Project Scoping

No comments.

2.2 Specific Goals of Aquatic Habitat Mapping

No comments.

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.”

Comments:

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 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 Plan¹. 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.

3.0 STUDY AREA

No comments.

4.0 METHODS

4.1 Grant Creek Aquatic Habitat Mapping

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

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).”

An overarching objective of the applicant’s 2012 habitat mapping study plan² 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, 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.

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.

4.2 Grant Creek Instream Flow Study

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

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.

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 the applicant's 2012 Aquatic Resources Study Plan³, the use of an interactive wetted perimeter model was outlined to be the course of study, along with 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.

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.

Following is an excerpt on what was planned, from the 2012 Final Study Plan:

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:

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

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).

4.2.1 Overview of PHABSIM Methodology

No comment.

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.

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.

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 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.

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.

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.

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.

4.2.4 Affected Species and Life Stages

No comment.

4.2.5 Field Methods

No comment.

4.2.6 Connectivity of Habitats within Reach 5

No comment.

4.2.7 Data Analysis

See specific comments below.

4.2.7.1 Hydraulic Modeling

General comment:

Bracketing the instream flow question:

It is assumed that the technical working group is most interested in the importance of 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.

Hydraulic modeling challenges:

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 2001⁴). 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.

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

⁴ Citation: Waddle, T.J., ed., 2012, PHABSIM for Windows: User’s Manual and Exercises: Fort Collins, CO, U.S. Geological Survey, 288 p.

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.

4.2.7 Data Analysis

No comments.

4.2.7.2 Hydraulic Modeling Procedures

No comments.

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:

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.

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.

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.

4.2.9 Flow Partitioning in Grant Creek

No comment.

4.2.10 Production of Weighted Usable Area

No comment.

5.0 RESULTS

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.

5.2 Grant Creek Instream Flow Study

5.2.1 Weighted Usable Area

No comments.

5.2.2 Reach 5 Connectivity

No comments.

6.0 CONCLUSIONS

6.1 Grant Creek Aquatic Habitat Mapping

No comments.

6.2 Grant Creek Instream Flow Study

No comments.

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 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.

6.2.2 Connectivity

No comments.

7.0 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

No comments.

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.

**Draft Review of 2014 Aquatic Resources Study – Grant Creek, Alaska Fisheries Assessment
Draft Report: Grant Lake Hydroelectric Project (FERC No. 13212)**

1.0 INTRODUCTION

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.

1.2 Overall Goals Identified During Project Scoping

No comments.

1.3 Existing Information

1.3.1 Pre-2009 Studies

No comments.

1.3.1.1 Grant Creek Fish Resources

No comments.

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."

It is a bit inaccurate to state that Grant Creek is impassable to salmon ½ to 1 mile upstream of the mouth. The applicant's recent studies reveal that salmon passage extends into the canyon (reach 5), which is beyond 1 mile upstream.

1.3.1.2 Grant Lake Fish Resources

No comments.

1.3.1.3 Instream Flow

No comments.

1.3.2 2009 and 2010 Aquatic Resources Studies

No comments.

1.3.2.1 Fish Resources

No comments.

1.3.2.2 Instream Flow

No comments.

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 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.

2.0 STUDY OBJECTIVES

2.1 Grant Creek Salmon Spawning Distribution and Abundance

No comments.

2.1.1 Salmon Escapement to Grant Creek-Relative Species Abundance

No comments.

2.1.2 Distribution of Spawning Salmon in Grant Creek

Page 12:

“Identify critical spawning habitats as required for general assessment of Project impacts.”

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.

Miller Note: The figures and discussions provided following release of the draft report should be incorporated in the report.

2.2 Grant Creek Resident and Rearing Fish Abundance and Distribution

No comments.

2.2.1 Adult Rainbow Trout Abundance, Distribution, and Spawning in Grant Creek

No comments.

2.2.2 Resident and Rearing Fish Use of Reach 5

No comments.

2.2.3 Resident and Rearing Fish Use of Open Water Habitats in Lower Grant Creek

No comments.

2.3 Trail Lake Narrows Fish and Aquatic Habitats

No comments.

3.0 STUDY AREA

No comments.

4.0 METHODS

4.1 Grant Creek Salmon Spawning Distribution and Abundance

No comments.

4.1.1 Salmon Escapement to Grant Creek

No comments.

4.1.1.1 Escapement Estimate: Area-under the Curve (AUC)

No comments.

4.1.1.1.1 Stream Life

No comments.

4.1.1.1.2 Observer Efficiency

No comments.

4.1.1.1.3 Area-Under-the-Curve (Visual Surveys)

No comments.

4.1.1.1.4 Telemetry and Carcass Surveys

No comments.

4.1.2 Life History Characteristics

No comments.

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 obtain much detail from these depictions.

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.

4.2 Grant Creek Resident and Rearing Fish Abundance and Distribution

No comments.

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."

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.

4.2.2 Resident and Rearing Fish Use of Reach 5

No comments.

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).”

Though all species and life stages utilized stream margins, eddies, and off channels, there weren't habitat categories encompassing any of these hydraulic features. 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.

4.3 Trail Lake Narrows Fish and Aquatic Habitats

No comments.

5.0 RESULTS

5.1 Grant Creek Salmon Spawning Distribution and Abundance

No comments.

5.1.1 Salmon Escapement to Grant Creek – Relative Species Abundance

No comments

5.1.1.1 Weir Count

No comments

5.1.1.2 Escapement Estimate: Area under the curve (AUC)

No comments

5.1.1.2.1 Stream Life

No comments

5.1.1.2.2 Observer Efficiency

No comments

5.1.1.2.3 Estimated Escapement: AUC

No comments

5.1.2 Life History Characteristics

No comments

5.1.2.1 Run Timing

No comments

5.1.2.2 Size (length and weight)

No comments

5.1.2.3 Age Structure

No comments

5.1.2.4 Egg Voidance

No comments

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.

5.1.3.1 Time of Spawning

No comments.

5.1.3.2 Spawning Distribution

No comments.

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. 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.

5.2 Grant Creek Resident and Rearing Fish Abundance and Distribution

No comments.

5.2.1 Adult Rainbow Trout Abundance, Distribution, and Spawning in Grant Creek

No comments.

5.2.2 Resident and Rearing Fish Use of Reach 5

No comments.

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."

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.

5.3 Trail Lake Narrows Fish and Aquatic Habitats

No comments.

6.0 CONCLUSIONS

No comments.

7.0 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

No comments.

Draft Review of 2014 Water Resources Study – Water Quality, Temperature, and Hydrology Draft Report: Grant Lake Hydroelectric Project (FERC No. 13212)**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:

Miller Note: The final designs and project operation scenarios will be made available in the next few months. Until then, all evaluation is speculative in nature and subject to revision, as necessary.

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.

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.

2.1 Water Quality and Temperature

No Comment.

2.2 Hydrology

No Comment.

3.0 STUDY AREA

No Comment.

4.0 METHODS

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.”

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.

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.

Page 24:

“Winter temperature data was collected at one site (GC200).”

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.

Miller Note: Year long temperature data is useful in determining the timing of emergence of salmonid alevin from the gravels. Year round temperature data 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?

4.1.1 Sampling Procedure

No Comment.

4.1.2 Field Sampling Quality Assurance Procedures

No Comment.

4.2 Hydrology

No Comments.

5.0 RESULTS

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.

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.

5.2 Hydrology

No Comments.

6.0 CONCLUSIONS

No comments.

7.0 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

No Comments

Draft Review of 2014 Terrestrial Resources Study Draft Report: Grant Lake Hydroelectric Project (FERC No. 13212)

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.

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.

From: Cory Warnock
Sent: Wednesday, April 30, 2014 2:12 PM
To: McCafferty, Katherine A POA
Cc: Emily Andersen
Subject: RE: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212) (UNCLASSIFIED)

Thanks, Katie.

Depending on other responses, we may end up holding the meeting on the 7th and 8th. If we do, I'll be more than happy to run through everything with you via phone call at your convenience.

Thanks and I wish I was going to the Aleutians!!

-----Original Message-----

From: McCafferty, Katherine A POA [mailto:Katherine.A.McCafferty2@usace.army.mil]
Sent: Tuesday, April 29, 2014 1:37 PM
To: Cory Warnock
Subject: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212) (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Cory,
I'm traveling to the Aleutians on the 7th through the 11th. I cannot attend on July 7th and 8th.

Also for your info, I'll be out of the office from June 22nd through July 4th and May 12 through May 23rd.

Katie McCafferty
Project Manager
Regulatory Division, Kenai Field Office
U.S. Army Corps of Engineers
phone: 907-283-3562
fax: 907-283-3981

Check out our website for more info: <http://www.poa.usace.army.mil/Missions/Regulatory.aspx>

-----Original Message-----

From: Cory Warnock [mailto:cory.warnock@mcmillen-llc.com]
Sent: Tuesday, April 29, 2014 12:30 PM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; McCafferty, Katherine A POA; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; Jeffry Anderson; 'Patricia Berkahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; Schade, David W (DNR); mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; Charles Sauvageau; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough
Subject: [EXTERNAL] Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

KHL has put together the attached meeting minutes based upon our Natural Resource proceedings in late March in Anchorage. If you could review and provide and clarifying comments you may have by Wednesday May 14th, it would be appreciated. Per my communication at the meeting, KHL will then develop a comprehensive package consisting of meeting agendas, minutes, presentations and final reports and file with FERC.

On another note, KHL would like to schedule the next stakeholder meeting. As discussed in March, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. With that and the understanding that no time in the summer is a good time, I'd like to propose our meeting to take place in Anchorage on July 7th and 8th (Monday/Tuesday) in Anchorage. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. That said, I'd prefer to err on the side of caution and get enough time on the calendar to ensure that we get through what we need to. In addition, to the two day stakeholder workshop, KHL will be holding a public meeting in Moose Pass sometime in early July as well to share details related to development and to discuss questions/concerns that the local public may have about the project. You all are obviously invited to attend this meeting as well. Details related to all of the meetings will follow after we confirm that folks are available to attend. So for now, if you all could please respond and confirm/deny your availability, I'd appreciate it.

Thanks and look forward to hearing from you soon,

Cory

Cory Warnock

Senior Licensing and Regulatory Consultant

McMillen, LLC

From: Cory Warnock
Sent: Wednesday, April 30, 2014 9:20 AM
To: Anderson, Jeffry; Cory Warnock
Cc: Emily Andersen
Subject: RE: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)

Thanks for the quick response Jeff, I'll get the minutes modified accordingly. As for the public meeting, we will be setting that date once we confirm the 7th and 8th will work for the stakeholder meeting. I'll keep you posted.

Cory

From: Anderson, Jeffry [mailto:jeffry_anderson@fws.gov]
Sent: Wednesday, April 30, 2014 9:15 AM
To: Cory Warnock
Subject: Re: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)

Hi Cory. I have one clarifying comment for the 3/19 notes. My comment that was captured:
"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."

Please clarify as follows, underline indicates altered text:

"Jeff Anderson asked if the relatively low number of radio-tagged Dolly Varden (Slide 14) could be due to the picket spacing on the adult weir that tend to allow smaller sized fish to pass through the weir without being observed."

Thanks.

Also, right now I am free on July 7/8, and I am very interested in attending the public meeting in Moose Pass when you have that date finalized.

-- Jeff

Jeffry Anderson
Field Supervisor
USFWS, Kenai Fish & Wildlife Field Office
43655 Kalifornsky Beach Road, Soldotna, AK 99669
Office: 907-260-0132
Cell: 907-252-4896

On Tue, Apr 29, 2014 at 12:30 PM, Cory Warnock <cory.warnock@mcmillen-llc.com> wrote:

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

KHL has put together the attached meeting minutes based upon our Natural Resource proceedings in late March in Anchorage. If you could review and provide and clarifying comments you may have by Wednesday May 14th, it would be appreciated. Per my communication at the meeting, KHL will then develop a comprehensive package consisting of meeting agendas, minutes, presentations and final reports and file with FERC.

On another note, KHL would like to schedule the next stakeholder meeting. As discussed in March, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. With that and the understanding that no time in the summer is a good time, I'd like to propose our meeting to take place in Anchorage on July 7th and 8th (Monday/Tuesday) in Anchorage. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. That said, I'd prefer to err on the side of caution and get enough time on the calendar to ensure that we get through what we need to. In addition, to the two day stakeholder workshop, KHL will be holding a public meeting in Moose Pass sometime in early July as well to share details related to development and to discuss questions/concerns that the local public may have about the project. You all are obviously invited to attend this meeting as well. Details related to all of the meetings will follow after we confirm that folks are available to attend. So for now, if you all could please respond and confirm/deny your availability, I'd appreciate it.

Thanks and look forward to hearing from you soon,

Cory

Cory Warnock

Senior Licensing and Regulatory Consultant

McMillen, LLC

www.mcmillen-llc.com

5771 Applegrove Ln.

Ferndale, Wa. 98248

O – 360-384-2662

C – 360-739-0187

F – 360-542-2264

From: Frank Winchell <frank.winchell@ferc.gov>
Sent: Thursday, May 01, 2014 12:19 PM
To: Michael Yarborough; Judy Bittner; Duvall, Shina A (DNR); Sherry D Nelson; Lesli Schick; Dara Glass; Mark Luttrell
Cc: Salzetti, Mikel; Cory Warnock; Emily Andersen; Dwayne Adams; Sarah Meitl
Subject: RE: Grant Lake Hydroelectric Project (FERC No. 13212) Cultural Resources Stakeholder Group:

Mike, I'll see if I can come up to Alaska, but in any case, I can always patch in by telephone. I think anytime in July should work.

As we talked about it the last time, I'll make sure and put the meeting date in my calendar.

And my apologies to everyone for spacing-out on the last meeting, and missing it.

The good news is that I was able to review Mike's work, and sent him back my edits.

Thanks,

Frank

From: Michael Yarborough [mailto:salvagerecovery@gmail.com]
Sent: Tuesday, April 29, 2014 6:23 PM
To: Judy Bittner; Frank Winchell; Duvall, Shina A (DNR); Sherry D Nelson; Lesli Schick; Dara Glass; Mark Luttrell
Cc: Salzetti, Mikel; Cory Warnock; Emily Andersen; Dwayne Adams; Sarah Meitl
Subject: Grant Lake Hydroelectric Project (FERC No. 13212) Cultural Resources Stakeholder Group:

Hi all,

KHL has put together the attached meeting minutes based upon our Cultural Resource proceedings in late March in Anchorage. If you could review and provide and clarifying comments you may have by Wednesday May 14th, it would be appreciated. Per my communication at the meeting, KHL will then develop a comprehensive package consisting of meeting agendas, minutes, presentations and final reports and file with FERC.

On another note, KHL would like to schedule the next stakeholder meeting. As discussed in March, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. With that and the understanding that no time in the summer is a good time, I'd like to propose our meeting to take place in Anchorage on July 7th and 8th (Monday/Tuesday) in Anchorage. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. That said, I'd prefer to err on the side of caution

and get enough time on the calendar to ensure that we get through what we need to. In addition, to the two day stakeholder workshop, KHL will be holding a public meeting in Moose Pass sometime in early July as well to share details related to development and to discuss questions/concerns that the local public may have about the project. You all are obviously invited to attend this meeting as well. Details related to all of the meetings will follow after we confirm that folks are available to attend. So for now, if you all could please respond and confirm/deny your availability, I'd appreciate it.

Thanks and look forward to hearing from you soon,

Mike

--

Michael R. Yarborough
Senior Archeologist
Cultural Resource Consultants LLC
3504 E. 67th Avenue
Anchorage, Alaska 99507
Anchorage: [\(907\) 349-3445](tel:9073493445)
Cell: [\(907\) 306-6069](tel:9073066069)

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Thursday, May 01, 2014 4:38 PM
To: 'John Blum'; 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: Next Meeting
Importance: High

Good Afternoon:

I have only heard back from a few folks re: our next meeting. Would Thursday, May 22nd, work for those available that week? I would like to avoid Friday the 23rd, in case some are planning on taking an extra day for the Memorial Day weekend. Would 11/10/9 am work for ID\WA\AK , respectively.

Thanks - hope everyone is having a good week!

John

John Blum
Sr. Fisheries Scientist

McMillen, LLC
1155 North State Street, Suite 700, Bellingham, WA 98225
direct 360.483.2807 | p 360.734.5915 x 281
f 360.734.5918 | c 360.220.0694
john.blum@mcmillen-llc.com | www.mcmillen-llc.com

From: Duvall, Shina A (DNR) <shina.duvall@alaska.gov>
Sent: Thursday, May 01, 2014 4:54 PM
To: Cory Warnock
Cc: Salzetti, Mikel; Emily Andersen; Dwayne Adams; Sarah Meitl; Michael Yarborough; Bittner, Judith E (DNR); Frank Winchell; Sherry D Nelson; Schick, Lesli J (DNR); Dara Glass; Mark Luttrell
Subject: Comments on Grant Lake Hydro Draft Cultural Report
Importance: High
Categories:

All,

We've finally had a chance to collectively review the preliminary draft cultural resource inventory report for the Grant Lake Hydro Project. Thank you for your patience. The committee agreed that the report is well-written and provides the information that our office will need to complete our formal review of DOEs when requested to do so.

Our primary comment at this time relates to the definition of the project's area of potential effect (APE). As presently defined, it appears to primarily encompass the geographic areas within which historic properties may experience direct and immediate effects that may result from the project's implementation. However, we recommend that the APE be revisited and if necessary, revised to allow for the consideration of potential indirect and cumulative effects as well (e.g., increased access, traffic, and potential induced development in the future) if those types of effects are anticipated to result from the project.

Also, 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, once it has been finalized. There may be significant cultural resources in that area that could be affected by the re-route.

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. Do not hesitate to contact us if we may be of further assistance. Please forward these comments along as appropriate.

Best regards,
Shina

Shina duVall, RPA
Archaeologist, Review and Compliance Coordinator
Alaska State Historic Preservation Office / Office of History and Archaeology
550 W. 7th Ave., Suite 1310
Anchorage, Alaska 99501
907-269-8720 (phone) 907-269-8908 (fax)
shina.duvall@alaska.gov

From: Stovall, Robert -FS [mailto:rstovall@fs.fed.us]
Sent: Thursday, May 01, 2014 1:02 PM
To: Cory Warnock
Cc: DeCleva, Ed -FS; Workshop@exmf017-1.msoutlookonline.net; P-13212
Subject: RE: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder

Cory:

I wanted to let you know that I am still gathering comments from the various FS Specialists who were tasked with reviewing these studies. I plan to have a FS Response letter to you by 14th signed by our Forest Sup (Terri). To date most comments have been positive with the exception of Cultural resources. They do have some concerns with potential flooding of cultural sites on the lake shore. They have been in discussions with Michael Yarborough about these concerns and may respond separately. Please let me know if this timeframe for the FS response is unacceptable and I will try to make adjustments.

I can't be sure about folks schedules during your suggested time frame for meetings in July as they will indeed be busy. Tom and I along with the Forest Leadership Team will be hosting our Regional Office Leadership during that week in July so we will not be able to attend.

Thank you for the very thorough notes.

Robert

Deputy District Ranger
Chugach NF, Seward RD
Po Box 390, 334 Fourth Ave.
Seward, AK 99664
Seward office # 907 743-9474; KLWC # 288-7707
Gov. Cell # 907 399-3966

From: Cory Warnock [mailto:cory.warnock@mcmillen-llc.com]
Sent: Tuesday, April 29, 2014 12:30 PM
To: Eavis, John -FS; Joe Klein; Laves, Kevin -FS; 'Katherine McCafferty'; Monte Miller; Jason Mouw; susan.walker@noaa.gov; 'Lesli Schick'; Stovall, Robert -FS; Cassie Thomas; Jeffry Anderson; 'Patricia Berkahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; Schade, David W (DNR); mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; Charles Sauvageau; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough
Subject: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

KHL has put together the attached meeting minutes based upon our Natural Resource proceedings in late March in Anchorage. If you could review and provide and clarifying comments you may have by Wednesday May 14th, it would be appreciated. Per my communication at the meeting, KHL will then develop a comprehensive package consisting of meeting agendas, minutes, presentations and final reports and file with FERC.

On another note, KHL would like to schedule the next stakeholder meeting. As discussed in March, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. With that and the understanding that no time in the summer is a good time, I'd like to propose our meeting to take place in Anchorage on July 7th and 8th (Monday/Tuesday) in Anchorage. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. That said, I'd prefer to err on the side of caution and get enough time on the calendar to ensure that we get through what we need to. In addition, to the two day stakeholder workshop, KHL will be holding a public meeting in Moose Pass sometime in early July as well to share details related to development and to discuss questions/concerns that the local public may have about the project. You all are obviously invited to attend this meeting as well. Details related to all of the meetings will follow after we confirm that folks are available to attend. So for now, if you all could please respond and confirm/deny your availability, I'd appreciate it.

Thanks and look forward to hearing from you soon,

Cory

Cory Warnock

Senior Licensing and Regulatory Consultant

McMillen, LLC

www.mcmillen-llc.com

5771 Applegrove Ln.

Ferndale, Wa. 98248

O – 360-384-2662

C – 360-739-0187

F – 360-542-2264

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, May 02, 2014 10:25 AM
To: 'Mouw, Jason E B (DFG)'; 'Miller, Monte D (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: RE: Next Meeting

Thanks, Jason!

John

John Blum
Sr. Fisheries Scientist

From: Mouw, Jason E B (DFG) [<mailto:jason.mouw@alaska.gov>]
Sent: Friday, May 02, 2014 9:19 AM
To: Miller, Monte D (DFG); John Blum; Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'
Cc: 'Mike Salzetti'; 'Emily Andersen'
Subject: RE: Next Meeting

John,

Please also consider me in.

Thanks,

Jason

From: Miller, Monte D (DFG)
Sent: Thursday, May 01, 2014 3:41 PM
To: John Blum; Mouw, Jason E B (DFG); Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'
Cc: 'Mike Salzetti'; 'Emily Andersen'
Subject: RE: Next Meeting

John,

That date and time will work for me.

Monte D. Miller
Statewide FERC Hydropower Coordinator
Alaska Department of Fish and Game
Division of Sport Fish / RTS
333 Raspberry Road
Anchorage, Alaska, 99518-1565

907 267-2312

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]

Sent: Thursday, May 01, 2014 3:38 PM

To: 'John Blum'; Miller, Monte D (DFG); Mouw, Jason E B (DFG); Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'

Cc: 'Mike Salzetti'; 'Emily Andersen'

Subject: Next Meeting

Importance: High

Good Afternoon:

I have only heard back from a few folks re: our next meeting. Would Thursday, May 22nd, work for those available that week? I would like to avoid Friday the 23rd, in case some are planning on taking an extra day for the Memorial Day weekend. Would 11/10/9 am work for ID\WA\AK, respectively.

Thanks - hope everyone is having a good week!

John

John Blum

Sr. Fisheries Scientist

McMillen, LLC

1155 North State Street, Suite 700, Bellingham, WA 98225

direct 360.483.2807 | p 360.734.5915 x 281

f 360.734.5918 | c 360.220.0694

john.blum@mcmillen-llc.com | www.mcmillen-llc.com

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4570 / Virus Database: 3931/7427 - Release Date: 05/01/14

Subject: Grant Lake IFIM Call

Start: Thu 5/22/2014 10:00 AM

End: Thu 5/22/2014 11:00 AM

Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Organizer: Cory Warnock

Required Attendees: Monte Miller; Jason Mouw; Joe Klein (mailto:joe.klein@alaska.gov); Jeffry Anderson (Jeffry_Anderson@fws.gov); dglass@ciri.com; Susan Walker; 'Mark Sanchez' (mark.sanchez@mcmillen-llc.com); John Stevenson; John Blum; Mike Salzetti; Emily Andersen

1. Please join my meeting.

<https://global.gotomeeting.com/join/835808181>

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

Dial +1 (213) 493-0606

Access Code: 835-808-181

Audio PIN: Shown after joining the meeting

Meeting ID: 835-808-181

GoToMeeting®

Online Meetings Made Easy®

Not at your computer? Click the link to join this meeting from your iPhone®, iPad®, Android® or Windows Phone® device via the GoToMeeting app.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Monday, May 05, 2014 1:10 PM
To: Emily Andersen; Cory Warnock
Subject: FW: Next Meeting

Sorry, Emily: I have a brand new computer (as of an hour or so ago), and it didn't show your address, just your name. It was the old longview (go figure!). In any event, here's the email correspondence with Jeff.

Thanks

John

John Blum
Sr. Fisheries Scientist

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Monday, May 05, 2014 2:06 PM
To: Emily Andersen; 'Cory Warnock'
Subject: FW: Next Meeting

FYI

John

John Blum
Sr. Fisheries Scientist

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Friday, May 02, 2014 11:25 AM
To: 'Anderson, Jeffry'
Subject: RE: Next Meeting

Hi, Jeff:

Thanks for the note - sorry you can't make it as well. Let me know if you'd like me to call you to go over everything, or if the notes are sufficient for you.

Have a good weekend!

John

John Blum
Sr. Fisheries Scientist

From: Anderson, Jeffry [mailto:jeffry_anderson@fws.gov]
Sent: Thursday, May 01, 2014 4:55 PM

To: John Blum
Subject: Re: Next Meeting

Sorry, John. I can't make it. Please send the notes again after the meeting. Thanks.

-- Jeff

Jeffrey Anderson
Field Supervisor
USFWS, Kenai Fish & Wildlife Field Office
43655 Kalifornsky Beach Road, Soldotna, AK 99669
Office: 907-260-0132
Cell: 907-252-4896

On Thu, May 1, 2014 at 3:37 PM, John Blum <john.blum@mcmillen-llc.com> wrote:

Good Afternoon:

I have only heard back from a few folks re: our next meeting. Would Thursday, May 22nd, work for those available that week? I would like to avoid Friday the 23rd, in case some are planning on taking an extra day for the Memorial Day weekend. Would 11/10/9 am work for ID\WA\AK , respectively.

Thanks - hope everyone is having a good week!

John

John Blum
Sr. Fisheries Scientist

McMillen, LLC
1155 North State Street, Suite 700, Bellingham, WA 98225

direct 360.483.2807 | p 360.734.5915 x 281

f 360.734.5918 | c 360.220.0694
john.blum@mcmillen-llc.com | www.mcmillen-llc.com

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4570 / Virus Database: 3931/7425 - Release Date: 05/01/14

From: [Dwayne Adams](#)
To: "[Dwayne Adams](#)"; "[Stovall, Robert -FS](#)"; "[Russell, Pamela J \(DNR\)](#)"; "[kvanmassenhove@fs.fed.us](#)"; "[lesli.schick@alaska.gov](#)"; "[Eavis, John -FS \(jeavis@fs.fed.us\)](#)"; "[Duvall, Shina A \(DNR\) \(shina.duvall@alaska.gov\)](#)"; "[Fitzpatrick, Mike -FS](#)"; "[Fitzpatrick, Mike -FS](#)"; "[Kime, Sherry D -FS](#)"; "[mmueller@borough.kenai.ak.us](#)"; "[judy.bittner@alaska.gov](#)"
Cc: "[Mike Salzetti \(msalzetti@HomerElectric.com\)](#)"; "[Cory Warnock](#)"; "[Kim Graham](#)"
Subject: RE: INHT Field Trip
Date: Wednesday, May 07, 2014 3:11:00 PM

So far I've only received a confirmation from a couple people. Could you folks check and see if the dates below work? The first two don't work anymore so it's between May 19 and May 29.

Please respond to this email as my email address has changed.

Thanks much
Dwayne Adams

From: Dwayne Adams [mailto:dadams@uskh.com]
Sent: Tuesday, April 29, 2014 3:24 PM
To: Stovall, Robert -FS; Russell, Pamela J (DNR); kvanmassenhove@fs.fed.us; lesli.schick@alaska.gov; Eavis, John -FS (jeavis@fs.fed.us); Duvall, Shina A (DNR) (shina.duvall@alaska.gov); Fitzpatrick, Mike -FS; Fitzpatrick, Mike -FS; Kime, Sherry D -FS; mmueller@borough.kenai.ak.us; judy.bittner@alaska.gov
Cc: Mike Salzetti (msalzetti@HomerElectric.com); Cory Warnock; Kim Graham
Subject: RE: INHT Field Trip

We're doing a lot of juggling trying to get the parties together. I know we'll miss some folks regardless of how we schedule but I'd like to get as many as possible.

Which of the following work for you?

May 9
May 12
May 19
May 20
May 22
May 26
May 27
May 28
May 29

Thanks for your patience
Dwayne Adams

From: Dwayne Adams
Sent: Tuesday, April 29, 2014 9:03 AM
To: 'rstovall@yahoo.com'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; Eavis, John -FS (jeavis@fs.fed.us); Duvall, Shina A (DNR) (shina.duvall@alaska.gov); Fitzpatrick, Mike -FS; Fitzpatrick, Mike -FS; Kime, Sherry D -FS; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'
Cc: Mike Salzetti (msalzetti@HomerElectric.com); Cory Warnock; Kim Graham

Subject: RE: INHT Field Trip

We have been discussing a walk of potential alternative locations for the Iditarod National Historic Trail in proximity to Grant Lake/Moose Pass as part of the FERC licensing for hydroelectric development at Grant Lake. We had discussed May 21 as a possible date. Unfortunately, one of the agencies is generally unavailable on that date. Would either Thursday June 5 or Friday June 6 work?

For the uninitiated, attached is a graphic that illustrates the alternatives identified thus far.

Thanks

Dwayne

From: Dwayne Adams

Sent: Thursday, April 24, 2014 2:58 PM

To: 'rstovall@yahoo.com'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; Eavis, John -FS (jeavis@fs.fed.us); Duvall, Shina A (DNR) (shina.duvall@alaska.gov)

Cc: Mike Salzetti (msalzetti@HomerElectric.com); Cory Warnock; Kim Graham

Subject: INHT Field Trip

Hi folks,

We're proposing a field trip to review possible INHT routing for May 21. Could you check your calendars and see if this might work for you? Also, let me know if there are others who should be invited to participate.

Thanks

Dwayne Adams, FASLA

Principal

Landscape Architecture and Community Planning

USKH Inc.

Celebrating

40 years

2515 A Street
Anchorage, AK 99503
main: 907.276.4245
direct: 907.343.5248
cell: 907.441.4948
www.uskh.com
[Facebook](#) | [Twitter](#) | [LinkedIn](#)
paper = trees

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Monday, May 12, 2014 12:55 PM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: Final Meeting Minutes (April 22)
Attachments: Final minutes for IFWG meeting 04-18-2014.docx

Good afternoon:

Please find attached final meeting minutes from our call on April 18. There were no comments received, so I will call these final.

Thanks very much, and look forward to talking with you on May 22.

John

John Blum
Sr. Fisheries Scientist

Final
Conference call with the Grant Creek Instream Flow Work Group
April 18, 2014

Those attending via conference call:

- Susan Walker (NMFS)
- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- Dara Glass (CIRI)
- Mark Miller (BioAnalysts)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 9:00 am PDT. This was the first call after the introductory meeting to develop deliverables for the Work Group to answer questions related to the proposed Grant Lake Hydroelectric Project. As stated earlier, it is KHL's intent to provide this information in a timely fashion, so that subsequent meetings with the Aquatic Work Group (AWG), to be held in June/July, can focus on different operating scenarios and potential PM&E measures, rather than use the meetings to present data.

John Blum sent out a draft agenda and some work products to the Work Group on April 17 via email. Agenda items are briefly detailed below.

PERIODICITY OF GRANT LAKE SALMONIDS

John Blum distributed the periodicity chart that Mark Miller revised subsequent to the last conference call (grant creek periodicity 3-28-14.xlsx). This revision included sockeye salmon fry, which had not been on the previous chart. With the exception of the timing of sockeye fry emergence, the Work Group approved the periodicity table.

Jason, John Stevenson and John Blum reviewed Daily Temperature Units (DTUs; in °C) for sockeye salmon hatch and emergence. Jason also consulted with Robert Begich to get his input regarding temperature units and timing. All literature sources indicated that 600 – 650 DTUs were required for sockeye salmon hatching, and 950 – 1,000 DTUs for emergence. It appeared that, based on the experience at the CIAA Trail Lake Hatchery, sockeye fry emergence could occur between mid-March and mid-July; however, water temperatures at the hatchery were more consistent and warmer.

John Blum stated that we had the 2013 spawning timing data, and once the thermographs were downloaded this summer, that we could then calculate fry emergence timing for last year;

although we have daily water temperatures for last year, the last download was mid-March and we would need the water temperatures from the next download (scheduled for late June – early July) to complete the picture. John Stevenson suggested we also look at the 2009 sockeye spawning timing from the HDR reports (which was 10 days – 2 weeks different than 2013). John Stevenson also suggested that we use the data from last spring (2013) to “trend” the water temperatures for this year. That will give us estimates of when hatch and emergence could occur. Once we have the remaining 2014 water temperature data that we need, then we can adjust the hatch and emergence timing accordingly. The Work Group agreed.

To Do:

- John Blum to look at 2009 and 2013 sockeye salmon spawning timing. He will use the 2013-2014 water temperature data and the DTUs shown above to estimate hatch and emergence timing for Grant Creek Sockeye salmon.

TRANSECT SELECTION AND WEIGHTING/PRIORITY SPECIES

As requested at the last meeting, Mark Miller, John Stevenson, Jake Woodbury and John Blum compiled GIS maps which included the following:

- Spawning in relation to Instream Flow Transects (file Transect spawning Maps RED 04092014.pdf, sent on April 17)
- Rearing in Relation to Instream Flow Transects (files MinT Locates By Transect Red 041714.pdf and Transect rearing all Red 041714.pdf, sent on April 17)
- CPUE for Chinook, Coho, Rainbow Trout and Dolly Varden Rearing (provided on file Transect rearing all Red 041714.pdf, sent on April 17), and
- Wetted Perimeter vs. Flow graphs for Instream Flow transects (file Draft App 4_GL IFIM March 2014 PD 03-31-14.pdf, sent on April 17)

Data analysis of locations of spawning/rearing on the transects still has to be completed.

To Do:

- John requested that the Work Group review these data and use it in order to determine which transects should be used, how they should be weighted, and if there were priority species and life history stages for certain times of the year. This information will be used to conduct the additional instream flow analysis requested by the Work Group.

EFFECTIVE SPAWNING/HABITAT TIME SERIES ANALYSES

John Blum stated that Andre Ball (McMillen) had taken the suggestion of the Work Group and used data from the USGS gage on the Kenai River at Cooper Landing to extend the hydrologic record for Grant Creek. The relationship was robust, and Andre was able to build a record of actual and synthesized daily flows that extended from May 1, 1947, through December 31,

2013 [Note: the gage on Grant Creek is operating and the actual flows are being used since the gage was re-established].

With the hydrology now in place (for flows without the project), and the periodicity established (with the exception of sockeye salmon fry emergence), several of the pieces needed to run effective spawning and habitat duration analyses are now in place. Once transects are prioritized and weighted, and operational flows are established over the period of record, John will be able to run these analyses, so input from the Work Group are

OTHER

Monte Miller would like to see an analysis of the effects of the tailrace and flows on Reaches 4 and 5, since the exact siting of the tailrace has not yet been completed. He suggested a vertical profile of the tailrace, along with operational ideas and concepts. Cory Warnock stated that HEA will be working on integrating the natural resource data with the engineering information (including operational scenarios) over the next couple months and the intent is to have a series of viable scenarios prepared to present at the next meeting. These scenarios will be accompanied by potential instream flow scenarios, potential impacts as a result of the particular scenario (negative and positive) and potential mitigation and enhancement measures that may assist in maximizing natural resource value with respect to the particular scenario.

NEXT WORK GROUP MEETING

Along with the draft meeting minutes, John will ask which days the week of May 19th that would work for our next call.

To Do:

- John will send out a notice for the next meeting, asking when people will be available

STAKEHOLDER MEETING

Cory Warnock said that they were proposing a Stakeholders' Meeting the week of July 7th. He was proposing a Public meeting to be held at the Moose Pass Community Center on July 7th, to be followed by a 2-day meeting with the Stakeholders on July 8th and 9th. Monte Miller suggested that the Stakeholder meeting be held prior to the Public meeting, so that if the Stakeholders were asked questions by the public, that everyone would be on the same page. With that in mind, Cory was going to recommend that the Stakeholder meeting be held on July 7th – 8th, with the Public meeting to be convened on July 9th. He will be sending out a notification/invitation soon.

Grant Lake Hydroelectric Project (FERC No. 13212) Licensing

Consultation Record

Phone/E-mail/One-on-One Meeting Log

Contact Name: Scott Ayers

Agency/Organization: ADF&G

Phone No./E-mail Address: --

Date: May 13, 2014

Time: --

Grant Lake Licensing Team Contact:

John Stevenson, BioAnalysts

Summary of Conversation and/or E-mail Exchange:

I called Scott Ayers to confirm Kenai Hydro, LLC's (KHL) obligation to send him the Aquatics report by May 31, 2014. I explained that due to some delays in the editing process by the Stakeholders, we are running a bit behind as far as completion of the report; rather than being complete with the finalization by May 31, we will probably be done June 4 and the report sent to him on June 5. He said that would be fine, but requested that we send him the draft by May 31 as a placeholder and send the final report when it is done.

From: Grant Lake Mining [mailto:paul@grantlakemining.com]
Sent: Wednesday, May 14, 2014 11:31 AM
To: 'Salzetti, Mikel'
Cc: Cory Warnock; Kenneth Hogan
Subject: RE: Grant Lake Water Tests
Importance: High

Mike,

When will your water test results from Grant Lake be ready for viewing? Cory previously said they would be ready after the first of the year. Is there a projected release date? As you know, heavy metal ions will not be found when performing surface sampling but will concentrate below the surface. I am still interested in knowing if you sampled Grant Lake to the 20' depth you intend to draw down the lake.

Please let me know.

Best Regards,

Paul Torgerson
The Case Mine
Grant Lake Mining
(907) 222-7685
paul@grantlakemining.com

From: Salzetti, Mikel [mailto:MSalzetti@HomerElectric.com]
Sent: ~~Wednesday, April 16, 2014~~ 3:12 PM
To: Grant Lake Mining
Cc: Cory Warnock (cory.warnock@mcmillen-llc.net)
Subject: RE: Grant Lake Water Tests

Mr. Torgerson: _____

Please see the attached letter in response to questions posed within this email chain.

Regards,

Mike Salzetti

From: Grant Lake Mining [<mailto:paul@grantlakemining.com>]
Sent: Wednesday, January 08, 2014 2:14 PM
To: Cory Warnock
Subject: RE: Grant Lake Water Tests

Cory,

Did you sample the water at surface level and at the 20' depth you intend to draw down the lake to construct the intake for the dam? Copper, as a heavy metal did not appear at the surface in significant quantities but was very significant at depths of 10-20 feet. We were told that was why the copper hasn't killed the fish in Grant Creek. Left to run normally, the surface water does not have enough copper in it to kill fish as the copper ions concentrate lower in the water. Drawing down the lake 20' for construction or during normal hydro dam operation could be a different matter altogether. I am concerned that if you intend to draw down the lake below the normal 2-3' that evaporate during summer that it will kill the fish in Grant Creek and possibly Trail Creek. I agree with your assessment that fish do return to Grant Creek "as-is". I am not talking about that. I am talking about you changing the quality of the water supply coming into Grant Creek from the lake. The turbulence that stirs up the water to greater depths could be a major factor I would think

If you would, could you send me copies of the reports you referred too concerning the stocking program or tell me where I can order them? I know that the powers that be back in the 80's got a real black eye over the stocking results. I work a lot with DOE and am very familiar with the government says that if you don't get the results you expect, change the targets. That is why the results from the 70's were repeated. I am interested to see how they summarized the stocking program. I can tell you this, it didn't take a rocket scientist to paddle around in a canoe amongst the dead fish floating on the surface to know something was wrong. If you say the copper isn't there, simply fly over the area. Every other lake in the area is glacier grey in color while Grant Lake in deep green from the copper.

There was a bright side from the 80's stocking program. After noting the results from dumping fish in several spots in the lake, the last drops they did dumped fish right above the falls. This acclimated the smolt to the smell of the water as they went over the falls into the creek. I imagine this is a major factor in why there are fish in Grant Creek.

I worked for Jack Merrington from the early 80's. He owned the mine from 1945 until his death in 1997. He bought it from Case and Whitney. They discovered it in 1911. I was partners with Thor Brant-Erikson from 1997 until his death in 2006, and I am a partner with Tom Harkreader now. We currently own the mine. I think we can prove that it has been a continuous chain of ownership (other than short periods following deaths of principles) since 1911 when Case and Whitney discovered gold on the claim group. As a group, we have worked since 1911 on sections 28, 29, 30 and 31, and Jack also worked on the Solar mine at the headwaters of the lake. He built cabins at the headwaters to allow him to explore for the copper deposit. It should be obvious that we are not going away as 103 years of claim ownership proves. We intend to mine our claims and follow the vein structures until they end whether on our claims or not. This is allowed under mining law. My point is that as mine owners we have seen Homer Electric interrupt mining activities since the 60's and you still have no dam. Your latest permit has closed down staking for over five years. Even FERC has said it should not have been your intent to impede other industries.

I have experience with hydro's having help design and worked closely with USCOE in construct management on one of the largest dam's in the US, and I know what minor changes in water quality can do to fish smolt, having helped design the fish hatchery at Fort Richardson. I am not anti-hydro by any means. I am against any utility that uses a FERC permitting process to close down other job creating business enterprises. Your statements in one of your earlier letters that you need all the snow melt water from the entire watershed proves the marginal viability of the project. Grant Lake is ideal for mining because the lake is dead – not commercial or recreational fish. Any water our mining activities discharges back into the lake creates a zero negative effect. You can't kill an already dead lake. Plus any silt we would discharge has over two miles to settle before your intake.

In conclusion, we need to complete staking on the continuations of the five major veins on the claims in sections 28, 29, 30 and 31 (minimum) to make a major core drilling project to block out total reserves most cost effectively. We have already traced several veins for over 2 miles. We also need the opportunity to buy the power from the hydro to power our milling plant, so you can see we would like to see the dam proceed. If it does not proceed, 3 miles of 69kV transmission lines to our mill site is not that expensive, so as you can see we will go forward either way. If you can see your way clear to remove the restriction on staking on the four sections we need to proceed at optimum levels, we will create long-term jobs in the area. A 20 ton per day mine would employ upwards to 20 full time employees. Add to this, the PR gained by saying the mine would buy the power that helps create those jobs. This would be a win-win for both our interests. You might want to consider this approach. It is a very easy fix. Just let us coexist in peace and support each other.

This has been a very good dialog.

Very Best Regards,

Paul Torgerson

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]

Sent: Wednesday, January 08, 2014 11:46 AM

To: Grant Lake Mining

Cc: Mike Salzetti; Emily Andersen

Subject: RE: Grant Lake Water Tests

Hi Paul,

Maybe I wasn't completely clear in my previous email. When I said that all of our study planning, technical work, analysis and report preparation was and is being conducted by professional limnologists and hydrologists that are intimately familiar with both these types of studies and hydro licensing/relicensing, it was not meant to imply that the water samples themselves were analyzed by our in-house limnologists and hydrologists. As is standard in our industry, when water quality samples are collected and subsequent analysis is needed, we always have the samples assessed and quantified for the respective variables at an accredited water testing laboratory. In this case, our lab of choice was located in Anchorage which allowed us to collect the samples and always deliver them (with the associated chain of custody information) well within the delivery and analysis parameters associated with this kind of work. Again this type of approach is the standard and widely accepted for assessments such as this.

As for the stocking program you speak of in the 80's, I've become quite familiar with that effort as a result of my involvement on this project. In the discussions that I've had with pertinent individuals and the literature I've read on the topic, it is my understanding that there are some natural variables that precluded the success of the stocking attempt. I am not familiar with anything that documented a "100% fish kill". Based upon the literature I've read, anadromous returns to Grant Creek as a result of the stocking programs were documented (in low numbers) in subsequent years. In

all of my discussions and reading, copper was never raised as a potential issue. Once the Water Resources Report is in its final draft form, I will be happy to share a copy with you.

In the interim, if you have any more questions, let me know.

Cory

From: Grant Lake Mining [<mailto:paul@grantlakemining.com>]
Sent: Wednesday, January 08, 2014 1:14 AM
To: Cory Warnock
Subject: RE: Grant Lake Water Tests

Cory,

I was told by a retired BLM geologist, that was familiar with Grant Lake's water quality, that only a licensed geochemist would normally run the tests that would show the high copper content in the water in Grant Lake. The high copper content of the water was why the fish stocking programs in the 70's and 80's resulted in 100% fish kill of the trout and salmon smolt they attempted to stock Grant Lake with.

Many of the locals that worked on the stocking project still live in the Moose Pass area. I was working at Grant Lake in the 80's when that stocking attempt was undertaken. The fish biologists working with the stocking program told us a great deal about the problem and it's being caused by a copper deposit at the headwaters flowing into the lake. We were told not to drink or swim in the water because the copper would make us sick.

Am I to understand that a limnologist or hydrologist will perform the same chemical examinations for heavy metals that a geochemist would?

Please give me your thoughts.

Best regards and thanks for the quick response.

Paul Torgerson

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]
Sent: Tuesday, January 07, 2014 8:50 PM
To: Grant Lake Mining
Cc: Mike Salzetti; Emily Andersen
Subject: Re: Grant Lake Water Tests

Hi Paul,

Our Water Resources Report will discuss our water sampling results along with a myriad of other analyses conducted in association with this component of our natural resource effort. The report is currently going through our internal review process after which, it will be distributed to stakeholders for their review in advance of our 2013 study results meetings. This distribution will take place in the next month. As is standard with this type of technical work, all of our study planning, technical work, analysis and report preparation was and is being conducted by professional limnologists and hydrologists that are intimately familiar with both these types of studies and hydro licensing/relicensing.

As always, if you have further questions, don't hesitate to let me know.

Cory

On Jan 6, 2014, at 2:44 PM, "Grant Lake Mining" <paul@grantlakemining.com> wrote:

Cory,

I was wondering when the Grant Lake water sampling analysis results you mentioned will be completed? I assume this work is being completed by licensed geochemists. You stated they would be completed by early 2014.

Please get back to me via email or phone.

Very Best Regards,

Paul T. Torgerson
White Rock Mine
Phone: (907) 222-7685
paul@grantlakemining.com

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4259 / Virus Database: 3658/6974 - Release Date: 01/03/14

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4259 / Virus Database: 3658/6986 - Release Date: 01/08/14

From: [Dwayne Adams](#)
To: ["Dwayne Adams"](#); ["Dwayne Adams"](#); ["Stovall, Robert -FS"](#); ["Russell, Pamela J \(DNR\)"](#); ["kvanmassenhove@fs.fed.us"](#); ["lesli.schick@alaska.gov"](#); ["Eavis, John -FS \(jeavis@fs.fed.us\)"](#); ["Duvall, Shina A \(DNR\) \(shina.duvall@alaska.gov\)"](#); ["Fitzpatrick, Mike -FS"](#); ["Fitzpatrick, Mike -FS"](#); ["Kime, Sherry D -FS"](#); ["mmueller@borough.kenai.ak.us"](#); ["judy.bittner@alaska.gov"](#)
Cc: ["Mike Salzetti \(msalzetti@HomerElectric.com\)"](#); ["Cory Warnock"](#); ["Kim Graham"](#)
Subject: RE: INHT Field Trip
Date: Wednesday, May 14, 2014 3:24:00 PM

I've already had enough input that yet again, I need to try different dates.

How about either:

10-13 June

Or

14-18 July?

Dwayne

From: Dwayne Adams [mailto:wdadams@earthscope.alaska.com]
Sent: Wednesday, May 14, 2014 1:38 PM
To: 'Dwayne Adams'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Duvall, Shina A (DNR) (shina.duvall@alaska.gov)'; 'Fitzpatrick, Mike -FS'; 'Fitzpatrick, Mike -FS'; 'Kime, Sherry D -FS'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'
Cc: 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'Cory Warnock'; 'Kim Graham'
Subject: RE: INHT Field Trip

Folks,

None of the dates I tried for in May worked for key people who really needed to be on a field trip for the INHT. So, I'd like to try for something in the 3rd or 4th week in June.

How does that work for your schedules? Those dates would be the 16-20 June, 23-27 June

Please respond to this email as I have a new address and email address.

Thanks much

Dwayne Adams
Landscape Architect

Earthscope
wdadams@earthscope.alaska.com
(907) 279.2688
1343 G. St.

Anchorage, AK 99501

From: [Dwayne Adams](#)
To: ["Duvall, Shina A \(DNR\)"; "Stovall, Robert -FS"; "Russell, Pamela J \(DNR\)"; "kvanmassenhove@fs.fed.us"; "lesli.schick@alaska.gov"; "Fitzpatrick, Mike -FS"; "Eavis, John -FS \(jeavis@fs.fed.us\)"; "Kime, Sherry D -FS"; "Mike Salzetti \(msalzetti@HomerElectric.com\)"; "mmueller@borough.kenai.ak.us"; "judy.bittner@alaska.gov"; "Cory Warnock"; "Kim Graham"](#)
Subject: INHT Meeting

When: Tuesday, July 15, 2014 9:00 AM-4:00 PM (GMT-09:00) Alaska.
Where: Grant Lake

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*

From the looks of it, this works for almost everyone. Bring spray for critters large and small.

Dwayne

From: [Van Massenhove, Katherine B -FS](#)
To: [Dwayne Adams](#)
Cc: [Mike Salzetti \(msalzetti@HomerElectric.com\)](mailto:msalzetti@HomerElectric.com)
Subject: RE: INHT Field Trip
Date: Thursday, May 15, 2014 9:40:22 AM
Attachments: [image002.png](#)
[image003.png](#)

Hi Dwayne,

Yes, John is the key person for the Forest Service. I haven't been to the project area, and that was my main objective in attending. I would like to get out there some point this summer, just to familiarize myself with the project area so that I can more efficiently process any special use authorizations needed if the project receives a FERC license. I've just recently been assigned the hydro power permits. It would probably be best for me to schedule a site visit with Mike Salzetti. He's my contact for the permit holder, Kenai Hydro. Thanks for the update.



Kathy Van Massenhove
Special Uses Team Leader

Forest Service
Alaska Region

p: 907-743-9542
kvanmassenhove@fs.fed.us

161 East 1st Ave, Door 8
Anchorage, AK 99501

www.fs.fed.us



Caring for the land and serving people

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, May 14, 2014 4:06 PM
To: Van Massenhove, Katherine B -FS
Subject: RE: INHT Field Trip

You should get an invite. I know it doesn't work for you but it was the only thing that worked for John Eavis, Shina, and Lesli. Robert Stovall seemed to think John was the key USFS person who HAD to be there.

I can make a second trip if we need to (earlier or later) but want to lock in John Eavis.

Thanks for your patience Katherine.

Dwayne

From: Van Massenhove, Katherine B -FS [<mailto:kvanmassenhove@fs.fed.us>]

Sent: Wednesday, May 14, 2014 3:35 PM
To: Dwayne Adams
Subject: RE: INHT Field Trip

Hi Dwayne,

I am available on June 10, 11 or 13' am not available on June 12th. I am not available for any of the dates in July, I am out of town from 7/8 thru 7/24.



Kathy Van Massenhove
Special Uses Team Leader

Forest Service
Alaska Region

p: 907-743-9542
kvanmassenhove@fs.fed.us

161 East 1st Ave, Door 8
Anchorage, AK 99501
www.fs.fed.us



Caring for the land and serving people

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, May 14, 2014 3:24 PM
To: 'Dwayne Adams'; 'Dwayne Adams'; Stovall, Robert -FS; 'Russell, Pamela J (DNR)'; Van Massenhove, Katherine B -FS; lesli.schick@alaska.gov; Eavis, John -FS; 'Duvall, Shina A (DNR)'; Fitzpatrick, Mike -FS; Fitzpatrick, Mike -FS; Kime, Sherry D -FS; mmueller@borough.kenai.ak.us; judy.bittner@alaska.gov
Cc: 'Mike Salzetti'; 'Cory Warnock'; 'Kim Graham'
Subject: RE: INHT Field Trip

I've already had enough input that yet again, I need to try different dates.

How about either:

10-13 June

Or

14-18 July?

Dwayne

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, May 14, 2014 1:38 PM
To: 'Dwayne Adams'; Stovall, Robert -FS; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us';

'lesli.schick@alaska.gov'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Duvall, Shina A (DNR) (shina.duvall@alaska.gov)'; 'Fitzpatrick, Mike -FS'; 'Fitzpatrick, Mike -FS'; 'Kime, Sherry D -FS'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'
Cc: 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'Cory Warnock'; 'Kim Graham'
Subject: RE: INHT Field Trip

Folks,

None of the dates I tried for in May worked for key people who really needed to be on a field trip for the INHT. So, I'd like to try for something in the 3rd or 4th week in June.

How does that work for your schedules? Those dates would be the 16-20 June, 23-27 June

Please respond to this email as I have a new address and email address.

Thanks much

Dwayne Adams
Landscape Architect

Earthscape
wdadams@earthscape.alaska.com
(907) 279.2688
1343 G. St.
Anchorage, AK 99501

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Monday, May 19, 2014 10:14 AM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkhahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; 'Schade, David W (DNR)'; mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; Charles Sauvageau; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough
Subject: RE: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

Based upon the responses that I've received, we are moving forward with a stakeholder workshop for the Grant Lake Project to be held in Anchorage on July 7th and 8th. This will be followed by a public meeting (likely in Moose Pass) on the night of July 8th. While logistical details are currently being worked out for both the workshop and public meeting, I wanted to get this note out so everyone could get the finalized dates on their calendars. As I stated below, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. In advance of our meeting, we'll be distributing some materials for you all to review related to infrastructural/operational refinements, environmental conditions and KHL's preferred approaches in hopes that everyone will come ready to collaborate and hopefully reach some agreements on some high level topics that will ultimately facilitate a more seamless formal review of a Draft License Application in the near future. In short, KHL heard and agrees with your hopes for continued transparency and collaboration related to project development and we think this workshop will facilitate that nicely.

For now, please get the dates on the calendar if you'd like to attend. As always, we'll provide call-in information and webinar services for those who can't be there in-person. Again, more details (times/locations, etc.) to follow and please let me know if you have any questions or concerns.

Thanks,

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

From: Cory Warnock [mailto:cory.warnock@mcmillen-llc.com]
Sent: Tuesday, April 29, 2014 1:30 PM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves (klaves@fs.fed.us)'; 'Katherine McCafferty (katherine.a.mccafferty2@usace.army.mil)'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick (lesli.schick@alaska.gov)'; rstovall@fs.fed.us; Cassie Thomas; Jeffry Anderson; 'Patricia Berkahn (patricia.berkahn@alaska.gov)'; 'carl.reese@alaska.gov'; 'Kim Sager'; 'hshepherd@uci.net'; 'dglass@ciri.com'; 'David Griffin (david.griffin@alaska.gov)'; 'pamela.russell@alaska.gov'; Schade, David W (DNR); 'mcooney@arctic.net'; 'Audrey Alstrom (aalstrom@aidea.org)'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; Charles Sauvageau; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough
Subject: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

KHL has put together the attached meeting minutes based upon our Natural Resource proceedings in late March in Anchorage. If you could review and provide and clarifying comments you may have by Wednesday May 14th, it would be appreciated. Per my communication at the meeting, KHL will then develop a comprehensive package consisting of meeting agendas, minutes, presentations and final reports and file with FERC.

On another note, KHL would like to schedule the next stakeholder meeting. As discussed in March, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. With that and the understanding that no time in the summer is a good time, I'd like to propose our meeting to take place in Anchorage on July 7th and 8th (Monday/Tuesday) in Anchorage. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. That said, I'd prefer to err on the side of caution and get enough time on the calendar to ensure that we get through what we need to. In addition, to the two day stakeholder workshop, KHL will be holding a public meeting in Moose Pass sometime in early July as well to share details related to development and to discuss questions/concerns that the local public may have about the project. You all are obviously invited to attend this meeting as well. Details related to all of the meetings will follow after we confirm that folks are available to attend. So for now, if you all could please respond and confirm/deny your availability, I'd appreciate it.

Thanks and look forward to hearing from you soon,

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Monday, May 19, 2014 1:44 PM
To: nicole.lantz@alaska.gov
Cc: Emily Andersen
Subject: AHRs Corporate User Agreement Application
Attachments: Corporate_Agency User Agreement Application_McMillen_5_19_14.pdf

Hello Ms. Lantz,

My name is Cory Warnock and I am the consulting Project Manager for the proposed Grant Lake Hydroelectric Project on the Kenai Peninsula. I received your contact information from Mike Yarborough (our Cultural subconsultant on the project) at Cultural Resource Consultants. Per his recommendation, I've put together the attached application to provide key McMillen staff with appropriate credentials to access the AHRs database (if needed). Again, Mike Yarborough is leading our Cultural effort and will continue to be the primary Cultural point of contact but in an effort to cover our bases, getting this application to you seemed prudent. Please let me know if it meets your needs and/or if you have any questions or needs for additional documentation.

Thanks,

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

CORPORATE/ AGENCY -USER AGREEMENT

#

between

The Alaska Office of History and Archaeology/State Historic Preservation Office
Alaska Heritage Resource Survey (AHRS)
and

☒ New☐ RenewalCompany name McMillen, LLCCompany address 5771 Applegrove Ln. Ferndale, Wa. 98248

Corporate / Agency User Agreements are designed to be completed by a corporate officer or senior agency official, with or without cultural resource training, who is applying for access to the Alaska Heritage Resources Survey (AHRS) database on behalf of the group as a whole. A list of approved users will be provided with this signed agreement. Each individual user within the group must complete an Individual AHRS User Agreement. The Corporate/ Agency User Agreement provides for a higher level of access, to include (upon approval) data exports, for which a higher level of accountability is required. By signing a Corporate / Agency User Agreement, the senior official acknowledges the sensitivity of data such as coordinates and shapefiles, and is thus able to direct employees to handle the data in a manner consistent with OHA policy which is explained in detail in our "Data Access Policy and Guidelines" document.

In order to complete this agreement please submit the following information:

- a written description of how your company/agency uses the AHRS data.
- your company/agency's written policy for keeping AHRS records confidential within the organization
- your company/ agency written statement of confidentiality that will accompany client reports or shared data sets.
- a list of of all staff that will have access to the AHRS along with their individual user agreement forms.
- describe how you will ensure that AHRS data is interpreted by a Cultural Resource Professional

This User Agreement is submitted for access to the Alaska Heritage Resource Survey (AHRS) database and/or other records and files housed in the Office of History and Archaeology (OHA) AHRS section by authorized employees of our company or agency.

The applicant, by signing this agreement, agrees to insure that individual users under this agreement:

- ☒ have read and will adhere to OHA's "Data Access Policies and Guidelines";
- ☒ will abide by any additional restrictions that OHA may place on access
- ☒ have signed and will adhere to the OHA litigation disclosure form
- ☒ understand that site data (e.g. archaeological site locations) obtained from OHA must be stored in a secure place with restricted access
- ☒ understand that failure to comply with OHA policies governing the AHRS database use may result in the revocation of individual and/or corporate access.

Applicant Signature: Date Apr 29, 2014Name: Cory WarnockJob Title: Senior Licensing and Regulatory Consultantemail cory.warnock@mcmillen-llc.comphone 360-384-2662

OHA Use Only

☐ Approved☐ Disapproved

Approved By: _____

Date: _____

Access Expiration Date: _____

McMillen, LLC is utilizing IBS/AHRS data in conjunction with the Grant Lake Project, a federal undertaking under Section 106 of the National Historic Preservation Act (NHPA). The Cultural Resources study for this project presents information that will be used to analyze project impacts and propose protection, mitigation, and enhancement measures in the draft and final FERC license applications.

McMillen, LLC will limit access to IBS/AHRS data to those within the company who have a current IBS user agreement with the Alaska Office of History and Archaeology. These authorized users will keep site content and location information confidential by not disclosing it to unauthorized individuals or including it in publically distributed documents.

McMillen, LLC's Statement of Confidentiality to accompany reports or data sets containing sensitive/restricted information:

To protect fragile, vulnerable, or threatened cultural sites from disturbance, access to site specific information from the Alaska Heritage Resources Survey is restricted or confidential. Distribution of those portions of this report that identify the location of cultural sites is to be limited to those with a legitimate need to know, such as appropriate personnel from McMillen, LLC; SHPO; [agencies]; [subcontractors]; and authorized researchers. Restricted or confidential information is withheld from public records disclosure under state law (AS 40.25.110) and under the federal Freedom of Information Act (PL 89-554). Information about site inventory may be restricted pursuant to AS 40.25.120(a)(4), Alaska State Parks Policy and Procedure No. 50200, the National Historic Preservation Act (PL 89-665, 16 U.S.C. 470), and the Archaeological Resources Protection Act (PL 96-95).

Grant Lake Hydroelectric Project (FERC No. 13212) Licensing

Consultation Record

Phone/E-mail /One on One Meeting Log

Contact Name: Robert Stovall

Agency/Organization: United States Forest Service

Phone No./E-mail Address: 907-743-9474/rstovall@fs.fed.us

Date: 5/19/14

Time: 9:00am

Grant Lake Licensing Team Contact: Cory Warnock

Summary of Conversation and/or E-mail Exchange: After receiving multiple messages from Mr. Stovall stating that they were going to be late with their informal comments on the Grant Lake Study reports which were due on 4/25/14, Mr. Warnock left a message with Mr. Stovall stating that KHL was in the final portion of the process for revising reports and developing a comment response table related to the March 2014 Study Report Meeting. Mr. Warnock stated that the intent was to file the entire package (revised reports, comment response table, meeting minutes, presentations and agenda) with FERC soon and given the informal nature of the comments relative to the TLP process, KHL was going to be filing very soon. Additionally, Mr. Warnock stated that KHL was interested in the USFS comments and wanted to make sure they were appropriately evaluated and discussed. He provided the reminder that they would have the formal opportunity to file their comments during the review of the Draft License Application.

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Tuesday, May 20, 2014 1:02 PM
To: nicole.lantz@alaska.gov
Cc: Emily Andersen
Subject: AHRs Database Individual App and Waiver (Warnock(
Attachments: AHRs Database App_warnock.pdf; Waiver Request_warnock.pdf

Hi Nicole,

Here is the additional documentation your requested. Let me know if you need anything else. Emily's app to follow

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Tuesday, May 20, 2014 1:04 PM
To: nicole.lantz@alaska.gov
Cc: Emily Andersen
Subject: AHRs Database Individual App and Waiver (Andersen)
Attachments: AHRs Database App_andersen.pdf; Waiver Request_andersen.pdf

Categories: Green Category

Here is Emily's.

Thanks!

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

The Alaska Office of History and Archaeology/
Alaska Heritage Resource Survey (AHRS) Database and Site Records
INDIVIDUAL USER AGREEMENT

Corp Agree # _____

☒ New

☐ Renewal

☐ Changed Affiliation

This User Agreement is submitted for access to the Alaska Heritage Resource Survey (AHRS) database and/or other records and files housed in the Office of History and Archaeology (OHA) AHRS section by the signatory of this document.

The signatory request access to the AHRS (select any that will apply to you)

☐ In person at the OHA office located at 550 W. 7th Ave, Suite 1310, Anchorage, AK during posted business hours.

and/or

☒ via the AHRS internet portal.

☐ Other (specify) _____

AGREEMENT:

By signing this User Agreement I state that :

☐ I am a Cultural Resource Professional that meets state qualifications or ☐ I am a student/ researcher

and

☐ I have provided proof of these qualifications (e.g. transcript or copy of diploma). For non agency only per item 6.2 of Data Access Policy and Guidelines

or

☐ I am an employee of local, state, federal or tribal government who is authorized by my employer to access the AHRS.

☒ I am requesting a waiver (Please attach a justification statement)

And I agree to the following statements:

- ☒ I have read and will adhere to OHA's "Data Access Policies and Guidelines";
- ☒ I will abide by any additional restrictions that OHA may place on access;
- ☒ I have signed and will adhere to the OHA litigation disclosure form;
- ☒ I will store sensitive site data (e.g. archaeological site locations) obtained from OHA in a secure place with restricted access;
- ☒ I will not share my AHRS user account password; and
- ☒ I understand that failure to comply with OHA policies governing the AHRS database use may result in the revocation of individual and/or corporate access.

Applicant Signature: _____

Date May 20, 2014

Name: Cory Warnock

Job Title: Senior Licensing and Regulatory Specialist

Affiliation: McMillen, LLC (Grant Lake Hydroelectric Project)

Address: 5771 Applegrove Ln

City: Ferndale State Wa Zip 98248

Phone: 360-384-2662 email cory.warnock@mcmillen-llc.com

Supervisor Name: Steve Padula

Supervisor Phone: 360-576-3579

Supervisor email: steve.padula@mcmillen-llc.com

If you are a new user to the AHRS you must also create an account user name and password for access to the database. Please visit the New User link on our web portal at <https://dnr.alaska.gov/ohasecurity/portal>

OHA Use Only

☐ Approved

☐ Disapproved

Approved By: _____

Date: _____

Access Expiration Date: _____

The Alaska Office of History and Archaeology/
Alaska Heritage Resource Survey (AHRs) Database and Site Records
INDIVIDUAL USER AGREEMENT

Corp Agree # _____

☒ New

☐ Renewal

☐ Changed Affiliation

This User Agreement is submitted for access to the Alaska Heritage Resource Survey (AHRs) database and/or other records and files housed in the Office of History and Archaeology (OHA) AHRs section by the signatory of this document.

The signatory request access to the AHRs (*select any that will apply to you*)

☐ In person at the OHA office located at 550 W. 7th Ave, Suite 1310, Anchorage, AK during posted business hours.

and/or

☒ via the AHRs internet portal.

☐ Other (specify) _____

AGREEMENT:

By signing this User Agreement I state that :

☐ I am a Cultural Resource Professional that meets state qualifications or ☐ I am a student/ researcher

and

☐ I have provided proof of these qualifications (e.g. transcript or copy of diploma). For non agency only per item 6.2 of Data Access Policy and Guidelines

or

☐ I am an employee of local, state, federal or tribal government who is authorized by my employer to access the AHRs.

☒ I am requesting a waiver (Please attach a justification statement)

And I agree to the following statements:

- I have read and will adhere to OHA's "Data Access Policies and Guidelines";
- I will abide by any additional restrictions that OHA may place on access;
- I have signed and will adhere to the OHA litigation disclosure form;
- I will store sensitive site data (e.g. archaeological site locations) obtained from OHA in a secure place with restricted access;
- I will not share my AHRs user account password; and
- I understand that failure to comply with OHA policies governing the AHRs database use may result in the revocation of individual and/or corporate access.

Applicant Signature: **Emily Andersen**

Digitally signed by Emily Andersen
DN: cn=Emily Andersen, o=McMillen, ou,
email=emily.andersen@mcmillen-llc.net, c=US
Date: 2014.05.20 11:43:17 -0700

Date 5/20/2014

Name: Emily Andersen

Job Title: Natural Resources Consultant

Affiliation: McMillen LLC

Address: 2525 NW Raleigh St

City: Portland State Oregon Zip 97210

Phone: 5038278089 email emily.andersen@mcmillen-llc.net

Supervisor Name: Steve Padula

Supervisor Phone: 360-576-3579

Supervisor email: steve.padula@mcmillen-llc.net

If you are a new user to the AHRs you must also create an account user name and password for access to the database. Please visit the New User link on our web portal at

<https://dnr.alaska.gov/ohasecurity/portal>

OHA Use Only----- ☐ Approved

☐ Disapproved

Approved By: _____

Date: _____

Access Expiration Date: _____

REQUEST FOR WAIVER

☒ New

☐ Renewal

☐ Changed Affiliation

Because the interpretation of the AHRS data requires familiarization with the resource and data limitations, OHA restricts non-agency AHRS access to cultural resource professionals who meet qualification standards outlined in "Data Access Policies and Guidelines" (item 6.2)

The Chief of OHA/SHPO may grant a WAIVER for AHRS access to individuals who do not meet these standards if (1) access is believed to be in the best interest of protecting or managing the resource; and/or (2) the land or resource manager supports AHRS access and/or (3) the requesting individual has an established history of research an/or cultural resource management.

Please state your justification for why you need a waiver below. If you need additional space please attach your justification statement on a separate page

I am the consulting project manager (licensing, natural resources and engineering) representing Homer Electric Association on the proposed Grant Lake Hydroelectric Project on the Kenai Peninsula. I am working directly with our Cultural subconsultant, Mike Yarborough (CRC). Mike is the primary Cultural contact for the project and responsible for all data collection, reporting and primary consultation with appropriate stakeholders. Via the Federal Energy Regulatory Commission (FERC) process, my role in these proceedings is to facilitate collaboration and process at meetings, review data collected, edit and revise reports and synthesize cultural descriptions, data and stakeholder agreements into a license application suitable for submittal to FERC for their acceptance, review and approval. As such, having access to and/or information available on the AHRS database (via Mike Yarborough) may prove helpful during development of licensing documents and discussions with stakeholders. Again, Mike Yarborough would be used as the conduit to review this information. I am fully aware of the sensitivity and confidential nature associated with this database and will respect this at all times. Thank you for your consideration.

Applicant Signature: _____ Date: _____

Name: _____

Job Title: _____

Affiliation: _____

email: _____

Phone Number: _____

OHA Use Only----- ☐ Approved ☐ Disapproved

Approved By: _____

Date: _____ Access Expiration Date: _____

REQUEST FOR WAIVER

☒ New

☐ Renewal

☐ Changed Affiliation

Because the interpretation of the AHRS data requires familiarization with the resource and data limitations, OHA restricts non-agency AHRS access to cultural resource professionals who meet qualification standards outlined in "Data Access Policies and Guidelines" (item 6.2)

The Chief of OHA/SHPO may grant a WAIVER for AHRS access to individuals who do not meet these standards if (1) access is believed to be in the best interest of protecting or managing the resource; and/or (2) the land or resource manager supports AHRS access and/or (3) the requesting individual has an established history of research an/or cultural resource management.

Please state your justification for why you need a waiver below. If you need additional space please attach your justification statement on a separate page

I am the consulting assistant project manager (licensing, natural resources and engineering) representing Homer Electric Association on the proposed Grant Lake Hydroelectric Project on the Kenai Peninsula. I am working directly with our Cultural subconsultant, Mike Yarborough (CRC). Mike is the primary Cultural contact for the project and responsible for all data collection, reporting and primary consultation with appropriate stakeholders. Via the Federal Energy Regulatory Commission (FERC) process, my role in these proceedings is to facilitate collaboration and process at meetings, review data collected, edit and revise reports and synthesize cultural descriptions, data and stakeholder agreements into a license application suitable for submittal to FERC for their acceptance, review and approval. As such, having access to and/or information available on the AHRS database (via Mike Yarborough) may prove helpful during development of licensing documents and discussions with stakeholders. Again, Mike Yarborough would be used as the conduit to review this information. I am fully aware of the sensitivity and confidential nature associated with this database and will respect this at all times. Thank you for your consideration.

Applicant Signature: **Emily Andersen**

Digitally signed by Emily Andersen
DN: cn=Emily Andersen, o=McMillen, ou,
email=emily.andersen@mcmillen-llc.net, c=US
Date: 2014.05.20 11:46:04 -07'00'

Date 5/20/2014

Name: Emily Andersen

Job Title: Natural Resources Consultant

Affiliation: McMillen LLC

email: emily.andersen@mcmillen-llc.net

Phone Number: +1 (503) 827-8089

OHA Use Only----- ☐ Approved

☐ Disapproved

Approved By: _____

Date: _____

Access Expiration Date: _____

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Wednesday, May 21, 2014 8:17 AM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: RE: Next Meeting

Good Morning:

Here is the proposed agenda for tomorrow morning's meeting. We will be sending out a go to meeting invitation today for the call, which will be held at 9/10/11 am for AK/WA/ID, respectively.

Thanks very much – looking forward to talking with you tomorrow.

John

John Blum
Sr. Fisheries Scientist

1. Review of sockeye emergence timing
2. Address concerns from ADFG re: data products
3. Discuss Work Group's analysis of transects to use for rearing and spawning
4. Discuss information work group wants presented (i.e., wetted perimeter, substrate analysis, connectivity, etc.)

From: Cory Warnock
Sent: Wednesday, May 21, 2014 4:46 PM
To: Lantz, Nicole (DNR)
Cc: Cory Warnock; Michael Yarborough (salvagerecovery@gmail.com); Emily Andersen
Subject: Re: AHRs Corporate Agreement

Thanks Nicole.

Cory

> On May 21, 2014, at 4:32 PM, "Lantz, Nicole (DNR)" <nicole.lantz@alaska.gov> wrote:

>

> Hi Cory,

>

> We have approved your corporate agreement for access to the AHRs data. This agreement will be subject to renewal by May 31, 2015. I have attached the signed agreement for your records.

>

>

> K. Nicole Lantz

> Archaeologist II

> Alaska Heritage Resource Survey (AHRs) Coordinator Office of History

> and Archaeology/ State Historic Preservation Office

> 550 W. 7th Ave., Ste. 1310

> Anchorage, AK 99501-3365

>

> 907-269-8718

> nicole.lantz@alaska.gov<<mailto:nicole.lantz@alaska.gov>>

>

>

>

>

>

> From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.com>]

> Sent: Tuesday, May 20, 2014 12:04 PM

> To: Lantz, Nicole (DNR)

> Cc: Emily Andersen

> Subject: AHRs Database Individual App and Waiver (Andersen)

>

> Here is Emily's.

>

> Thanks!

>

> Cory Warnock

> Senior Licensing and Regulatory Consultant

>

> McMillen, LLC

> www.mcmillen-llc.com<<http://www.mcmillen-llc.com>>

> 5771 Applegrove Ln.

> Ferndale, Wa. 98248

> O – 360-384-2662

From: Cory Warnock
Sent: Thursday, May 22, 2014 10:23 AM
To: Emily Andersen
Subject: FW: Instream Flow Subcommittee Meeting

FYI

From: Cory Warnock
Sent: Thursday, May 22, 2014 10:22 AM
To: 'Dara Glass'
Subject: RE: Instream Flow Subcommittee Meeting

Understood in both regards. Have been following the fires a bit and certainly hope that things get under control up there soon. Good luck and we'll keep you posted/invited to proceedings so that you can join when you're available.

From: Dara Glass [<mailto:dglass@ciri.com>]
Sent: Thursday, May 22, 2014 10:03 AM
To: Cory Warnock
Subject: RE: Instream Flow Subcommittee Meeting

Hi Cory,

I apologize, but I am not going to be able join you. Too many "fires", both real and configuratively.

Thanks!

Dara

Dara Glass
CIRI Land Manager
Direct: 907.263.5140
Cell: 907.229.7052

-----Original Appointment-----

From: Cory Warnock [<mailto:cory.warnock@mcmillen-llc.net>]
Sent: Thursday, May 22, 2014 8:48 AM
To: Monte Miller; Jason Mouw; Joe Klein; Jeffry Anderson (Jeffry_Anderson@fws.gov); Dara Glass; Susan Walker; John Stevenson; John Blum; Mike Salzetti; Emily Andersen; 'Mark Miller (mark.miller@bioanalysts.net)'
Subject: Canceled: Instream Flow Subcommittee Meeting
When: Thursday, May 22, 2014 10:00 AM-12:00 PM (UTC-08:00) Pacific Time (US & Canada).
Where:
Importance: High

All, it appears that I sent two meeting invites with separate numbers. Please disregard this invite and use the other that should still be on your calendar if you accepted it.

Thanks!

1. Please join my meeting.

<https://global.gotomeeting.com/join/865955797>

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

Dial +1 (773) 897-3015

Access Code: 865-955-797

Audio PIN: Shown after joining the meeting

Meeting ID: 865-955-797

GoToMeeting®

Online Meetings Made Easy®

Not at your computer? Click the link to join this meeting from your iPhone®, iPad®, Android® or Windows Phone® device via the GoToMeeting app.

The information contained in this CIRI email message may be privileged, confidential and protected from disclosure. If you are not an intended recipient, please notify the sender by reply email and delete the message and any attachments immediately. The use, disclosure, dissemination, distribution or reproduction of this CIRI message or the information in it or attached to it by any unintended recipient is unauthorized, strictly prohibited by the sender, and may be unlawful. Thank you.

Draft
Conference call with the Grant Creek Instream Flow Work Group
May 22, 2014

Those attending via conference call:

- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 10:00 am PDT. John Blum sent out a draft agenda to the Work Group on May 21 via email. Agenda items are briefly detailed below:

1. Review of sockeye emergence timing
2. Address concerns from ADFG re: data products
3. Discuss Work Group's analysis of transects to use for rearing and spawning
4. Discuss information work group wants presented (i.e., wetted perimeter, substrate analysis, connectivity, etc.)

REVIEW OF SOCKEYE SALMON EMERGENCE TIMING

Per request of the Work Group at the April 18th meeting, John Blum used the DTU's agreed upon at that meeting to calculate Sockeye salmon incubation and emergence timing. Since the latest download of water temperature data occurred on March 20, it was suggested that John Blum look at the water temperature data from 2013 and use a trend analysis to make an initial temperature run.

John Blum ran several different analyses to attempt to piece together the temperature data from both years; however, temperature regimes were markedly different from 2013 to 2014, resulting in a wide range of potential emergence timing. Some of these scenarios were unrealistic, so John Blum suggested that we wait until the next water temperature download is completed (i.e., in June) and then rerun the analysis then. The Work Group agreed, and this item was shelved until these data were obtained.

To Do:

- John Blum will update emergence timing after water temperature data are downloaded in June.

ADDRESS ADFG CONCERNS RE: DATA PRODUCTS

John Blum reviewed ADFG's concerns re: an interactive tool that was developed previously to examine location of spawning substrate along the transects and how these substrates were

affected by changes in flow. John explained that the information requested was not available to develop as an interactive tool; however, if the Work Group let John know what analyses they wanted, John would produce that for the group and send it out.

Jason said that what he would like to see is the lateral positions of where the spawning was located along each transect, and at what flows those locations went dry/were connected. This included the evaluation of depths and velocities at those locations at flows up to 350 cfs. It was discussed how a type of an effective spawning analysis, over the range of normal flows, may accomplish that, especially for Reaches 1 and 3.

John Stevenson said that he had looked at where most of the juvenile rearing occurring along transects. The transects with the highest CPUE were 100, 130, 160, 200, 220, 230, 300, 330 and 400.

John Stevenson said that he had looked at where most of the spawning occurred, and it was along Transects 130, 140, 300 and 310, with most rearing occurring along Transects 100, 130, 160, 200, 220, 230, 300, and 330.

Jason and Monte asked John Stevenson if he could quantify the number of spawners along the transects, so that ADFG could make assessments of which transects to analyze for effective spawning. John Stevenson said he could do that. ADFG said they would turn that around quickly for John Blum's analysis.

Jason asked if John Blum could run effective spawning up to about 350 – 400 cfs. John Blum suggested he run the analysis up to 400 – 450 cfs. John Blum said he would do that as soon as he heard back from the Work Group re: which transects to analyze.

John Blum also asked the Work Group on how they wanted the transects weighted: equally; by importance (spawning or rearing), or by habitat frequency. Jason asked if several analyses could be run. John Blum said yes, and that the analysis for equal weighting of transects was already completed and in the Draft Habitat Mapping and Instream Flow Report. The transects were initially weighted equally, since the Grant Creek Instream Flow Study was based upon known, important rearing and spawning areas.

To Do:

- John Stevenson to tabulate spawners by transect [*Note: John Stevenson did this and the spreadsheet was sent to the Work Group via John Blum email on May 23*].
- ADFG to review data and make suggestions for use of transects for rearing and spawning as well as transect weighting.
- John Blum to analyze these transects to indicate at what point spawning substrates were exposed due to decreased flow.

OTHER ISSUES

Monte asked if there was more information re: where the tailrace would be returning water into Reach 4. Cory said that KHL was running different scenarios right now and would be documenting them and collaboratively discussing options related to operations, natural resources, the associated impacts and potential mitigation measures during the July meetings in Anchorage.

Monte also asked if KHL was still considering raising the lake level. Cory said that KHL was currently running scenarios that would not involve their raising the lake levels and these options (along with others) would be discussed with Stakeholders in July. Monte then commented that the wildlife/botanical issues at the lake would be eliminated if there was no raising of lake elevation.

There was also discussion on how increasing flows into the distributary in Reach 1 (Transects 100 and 110) could also prove to be an effective enhancement tool. Monte said he would like to discuss that further in future meetings.

NEXT MEETING

The next meeting of the Work Group is tentatively scheduled for June 12, 1 pm (AK), 2 pm (WA), and 3 pm (ID) time.

[Note: this meeting time has been cancelled; a meeting date has not been confirmed at the time of this submittal].

Subject: Grant Lake Instream Flow Sub-committee Call

Start: Thu 6/12/2014 2:00 PM
End: Thu 6/12/2014 3:00 PM
Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Organizer: Cory Warnock
Required Attendees: Monte Miller; Jason Mouw; Joe Klein (mailto:joe.klein@alaska.gov); Jeffry Anderson (Jeffry_Anderson@fws.gov); dglass@ciri.com; Susan Walker; 'Mark Sanchez' (mark.sanchez@mcmillen-llc.com); John Stevenson; John Blum; Mike Salzetti; Emily Andersen; 'Mark Miller (mark.miller@bioanalysts.net)'

1. Please join my meeting.

<https://global.gotomeeting.com/join/563257349>

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

Dial +1 (571) 317-3112

Access Code: 563-257-349

Audio PIN: Shown after joining the meeting

Meeting ID: 563-257-349

GoToMeeting®

Online Meetings Made Easy®

Not at your computer? Click the link to join this meeting from your iPhone®, iPad®, Android® or Windows Phone® device via the GoToMeeting app.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, May 23, 2014 4:02 PM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: Spawning and rearing transect quantification
Attachments: Copy of Spawning and rearing locations Grant Creek - JRS Update - May 23 2014.xlsx

Good afternoon:

John Stevenson reviewed the spawning data along Grant Creek transects, as requested on the Instream Flow Sub-Committee meeting yesterday. The purpose was to look at each of the transects and determine relative use. This was to establish which transects would be most important to model and what weighting to assign.

Please review and let us know if you have any questions. Have a good Memorial Day weekend!

John

John Blum
Sr. Fisheries Scientist

Transects with Most Evidence of Spawning

Transect	Chinook	Coho	Sockeye	Pink	Σ
100					0
110					0
120	2	2	15		19
130		4	17	2	23
140			13		13
150	1	6	10		17
160			2		2
200		1	2		3
210		1	6		7
220		3	1		4
230					0
300		3	16		19
310		6	2		8
320		3	5		8
330		8	13		21
400	2		5		7
410		2	1		3
430		2	1		3
510		1	3		4
Σ	5	42	112	2	161

Transects with Most Evidence of Salmonid Rearing

Transect	Chinook	Coho	Dolly Varden	Rainbow
100	0.370	0.045	0.381	0.000
110	0.222	0.040	0.079	0.000
120	0.307	0.020	0.163	0.078
130	0.620	0.183	0.225	0.089
140				
150	0.073	0.015	0.147	0.029
160	0.163	0.078	0.329	0.026
200	0.363	0.284	0.126	0.056
210	0.110	0.000	0.033	0.044
220	0.318	0.188	0.120	0.057
230	0.277	0.000	0.415	0.069
300	0.473	0.167	0.117	0.121
310	0.216	0.007	0.022	0.036
320				
330	0.433	0.149	0.263	0.124
400	0.048	0.026	0.148	0.087
410	0.126	0.021	0.228	0.062
430	0.097	0.007	0.174	0.060
510	0.037	0.003	0.100	0.087
520	0.020	0.000	0.090	0.024

	Highest CPUE/species
	2nd Highest CPUE/species
	3rd Highest CPUE/species
	4th Highest CPUE/species
	5th Highest CPUE/species
	Balance of transects

Transect	Chinook Catch	Chinook CPUE	Transect Rank
T 100	33	0.370	15
T 110	28	0.222	10
T 120	47	0.307	12
T 130	132	0.620	18
T 140			
T 150	5	0.073	4
T 160	63	0.163	8
T 200	78	0.363	14
T 210	10	0.110	6
T 220	61	0.318	13
T 230	12	0.277	11
T 300	125	0.473	17
T 310	30	0.216	9
T 320			
T 330	84	0.433	16
T 400	11	0.048	3
T 410	83	0.126	7
T 430	57	0.097	5
T 510	11	0.037	2
T 520	5	0.020	1

Transect	Coho Catch	Coho CPUE	Transect Rank
T 100	4	0.045	10
T 110	5	0.040	9
T 120	3	0.020	6
T 130	39	0.183	14
T 140			
T 150	1	0.015	5
T 160	30	0.078	11
T 200	61	0.284	16
T 210	0	0.000	1
T 220	36	0.188	15
T 230	0	0.000	1
T 300	44	0.167	13
T 310	1	0.007	4
T 320			
T 330	29	0.149	12
T 400	6	0.026	8
T 410	14	0.021	7
T 430	4	0.007	3
T 510	1	0.003	2
T 520	0	0.000	1

Transect	Dolly Varden Catch	Dolly Varden CPUE	Transect Rank
T 100	34	0.381	17
T 110	10	0.079	3
T 120	25	0.163	11
T 130	48	0.225	13
T 140			
T 150	10	0.147	9
T 160	127	0.329	16
T 200	27	0.126	8
T 210	3	0.033	2
T 220	23	0.120	7
T 230	18	0.415	18
T 300	31	0.117	6
T 310	3	0.022	1
T 320			
T 330	51	0.263	15
T 400	34	0.148	10
T 410	150	0.228	14
T 430	102	0.174	12
T 510	30	0.100	5
T 520	23	0.090	4

Transect	Rainbow Trout Catch	Rainbow Trout CPUE	Transect Rank
T 100	0	0.000	1
T 110	0	0.000	1
T 120	12	0.078	12
T 130	19	0.089	15
T 140			
T 150	2	0.029	4
T 160	10	0.026	3
T 200	12	0.056	7
T 210	4	0.044	6
T 220	11	0.057	8
T 230	3	0.069	11
T 300	32	0.121	16
T 310	5	0.036	5
T 320			
T 330	24	0.124	17
T 400	20	0.087	14
T 410	41	0.062	10
T 430	35	0.060	9
T 510	26	0.087	13
T 520	6	0.024	2

From: Dwayne Adams [mailto:wdadams@earthscape.alaska.com]

Sent: Tuesday, May 27, 2014 2:58 PM

To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; kvanmassenhove@fs.fed.us; lesli.schick@alaska.gov; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS'; 'Kime, Sherry D -FS'; 'Mike Salzetti'; mmueller@borough.kenai.ak.us; judy.bittner@alaska.gov; Cory Warnock; 'Kim Graham'

Cc: 'Griffin, David W (DNR)'

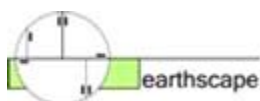
Subject: RE: INHT Meeting

This is to confirm that the date of July 15 seemed to be the best fit for the majority of people, based on a number of back and forth emails. I'll follow up with particulars about meeting location and ferrying across the lake.

I wanted to follow up just in case there remained any confusion as to the date.

Thanks folks

Dwayne Adams
Landscape Architect



705 W. 13th Ave.
Anchorage, AK 99501

P 907.279.2688

-----Original Appointment-----

From: Dwayne Adams [mailto:wdadams@earthscape.alaska.com]

Sent: Wednesday, May 14, 2014 4:02 PM

To: Dwayne Adams; Duvall, Shina A (DNR); 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'

Cc: Griffin, David W (DNR)

Subject: INHT Meeting

When: Tuesday, July 15, 2014 9:00 AM-4:00 PM (GMT-09:00) Alaska.

Where: Grant Lake

From the looks of it, this works for almost everyone. Bring spray for critters large and small.

Dwayne

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Wednesday, May 28, 2014 8:07 PM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: minutes from May 22 conference call
Attachments: Draft minutes for IFWG meeting 05-28-2014.docx

Good evening:

Here are the draft meeting minutes from our conference call last Thursday, May 22. Please get any revisions to me by the beginning of next week.

Last Friday, I emailed to everyone a table put together by John Stevenson which summarized the number of spawning salmon in the vicinity of the transects. This spreadsheet is referenced in the meeting minutes.

Thanks very much – please get back to me as soon as you can re: the minutes and deliverables discussed at the meeting.

John

John Blum
Sr. Fisheries Scientist

Draft
Conference call with the Grant Creek Instream Flow Work Group
May 22, 2014

Those attending via conference call:

- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 10:00 am PDT. John Blum sent out a draft agenda to the Work Group on May 21 via email. Agenda items are briefly detailed below:

1. Review of sockeye emergence timing
2. Address concerns from ADFG re: data products
3. Discuss Work Group's analysis of transects to use for rearing and spawning
4. Discuss information work group wants presented (i.e., wetted perimeter, substrate analysis, connectivity, etc.)

REVIEW OF SOCKEYE SALMON EMERGENCE TIMING

Per request of the Work Group at the April 18th meeting, John Blum used the DTU's agreed upon at that meeting to calculate Sockeye salmon incubation and emergence timing. Since the latest download of water temperature data occurred on March 20, it was suggested that John Blum look at the water temperature data from 2013 and use a trend analysis to make an initial temperature run.

John Blum ran several different analyses to attempt to piece together the temperature data from both years; however, temperature regimes were markedly different from 2013 to 2014, resulting in a wide range of potential emergence timing. Some of these scenarios were unrealistic, so John Blum suggested that we wait until the next water temperature download is completed (i.e., in June) and then rerun the analysis then. The Work Group agreed, and this item was shelved until these data were obtained.

To Do:

- John Blum will update emergence timing after water temperature data are downloaded in June.

ADDRESS ADFG CONCERNS RE: DATA PRODUCTS

John Blum reviewed ADFG's concerns re: an interactive tool that was developed previously to examine location of spawning substrate along the transects and how these substrates were

affected by changes in flow. John explained that the information requested was not available to develop as an interactive tool; however, if the Work Group let John know what analyses they wanted, John would produce that for the group and send it out.

Jason said that what he would like to see is the lateral positions of where the substrate was located along each transect, and at what flows that substrate went dry. What he was looking for was an effective spawning analysis over the range of suitable flows, especially for Reaches 1 and 3.

John Stevenson said that he had looked at where most of the spawning occurred, and it was along Transects 130, 140, 300 and 310, with most rearing occurring along Transects 100, 130, 160, 200, 220, 230, 300, and 330.

Jason and Monte asked John Stevenson if he could quantify the number of spawners along the transects, so that ADFG could make assessments of which transects to analyze for effective spawning. John Stevenson said he could do that. ADFG said they would turn that around quickly for John Blum's analysis.

Jason asked if John Blum could run effective spawning from about 400 – 450 cfs. John Blum said he would do that as soon as he heard back from the Work Group re: which transects to analyze.

John Blum also asked the Work Group on how they wanted the transects weighted: equally; by importance (spawning or rearing), or by habitat frequency. Jason asked if several analysis could be run. John Blum said yes, and that the analysis for equal weighting of transects was already completed and in the Draft Habitat Mapping and Instream Flow Report. The transects were initially weighted equally, since the Grant Creek Instream Flow Study was based upon known, important rearing and spawning areas.

To Do:

- John Stevenson to tabulate spawners by transect [*Note: John Stevenson did this and the spreadsheet was sent to the Work Group via John Blum email on May 23*].
- ADFG to review data and make suggestions for use of transects for rearing and spawning as well as transect weighting.
- John Blum to analyze these transects to indicate at what point spawning substrates were exposed due to decreased flow.

OTHER ISSUES

Monte asked if there was more information re: where the tailrace would be returning water into Reach 4. Cory said that KHL was running different scenarios right now and would be documenting them and collaboratively discussing options related to operations, natural resources, the associated impacts and potential mitigation measures during the July meetings in Anchorage.

Monte also asked if KHL was still considering raising the lake level. Cory said that KHL was currently running scenarios that would not involve their raising the lake levels and these options (along with others) would be discussed with Stakeholders in July. Monte then commented that the wildlife/botanical issues at the lake would be eliminated if there was no raising of lake elevation.

There was also discussion on how increasing flows into the distributary in Reach 1 (Transects 100 and 110) could also prove to be an effective enhancement tool. Monte said he would like to discuss that further in future meetings.

NEXT MEETING

The next meeting of the Work Group is tentatively scheduled for June 12, 1 pm (AK), 2 pm (WA), and 3 pm (ID) time.

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Thursday, May 29, 2014 1:49 PM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkhahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; 'Schade, David W (DNR)'; mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough
Subject: Grant Lake Project Stakeholder Workshop

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

Per the message below, we are looking forward to the upcoming workshop on July 7th and 8th in Anchorage. From a logistical perspective I wanted to let you all know that we will be meeting at the same location as our March Study Report Meetings:

*Aspen Suites
100 E. Tudor Rd
Anchorage, AK 99503
907-770-3400*

The workshop is currently scheduled to be all day on July 7th (8am – 5pm) and till noon (8-12) on the 8th. In the coming weeks, HEA will be distributing an agenda for the workshop along with webinar information for those who can't attend in person. In addition, HEA will be distributing a tech memo in advance of the workshop for your review. This document will be one of the fundamental talking points at the workshop so a review in advance would be appreciated. Once the Tuesday portion of the workshop is over, HEA's natural resource specialists and engineers will be making their way to Moose Pass for a public meeting that evening. Those details are still being worked out but we will notify you all as things become finalized and you are obviously invited to attend if your schedule allows. More details to follow and thanks.

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

From: Cory Warnock [mailto:cory.warnock@mcmillen-llc.com]

Sent: Monday, May 19, 2014 10:14 AM

To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves (klaves@fs.fed.us)'; 'Katherine McCafferty (katherine.a.mccafferty2@usace.army.mil)'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick (lesli.schick@alaska.gov)'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkhahn (patricia.berkhahn@alaska.gov)'; 'carl.reese@alaska.gov'; 'Kim Sager'; 'hshepherd@uci.net'; 'dglass@ciri.com'; 'David Griffin (david.griffin@alaska.gov)'; 'pamela.russell@alaska.gov'; 'Schade, David W (DNR)'; 'mcooney@arctic.net'; 'Audrey Alstrom (aalstrom@aidea.org)'; kenailake@arctic.net; Ken Hogan

Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; Charles Sauvageau; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough

Subject: RE: Grant Lake Meeting Minutes (3/18-3/20)/July Stakeholder Workshop (P-13212)

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

Based upon the responses that I've received, we are moving forward with a stakeholder workshop for the Grant Lake Project to be held in Anchorage on July 7th and 8th. This will be followed by a public meeting (likely in Moose Pass) on the night of July 8th. While logistical details are currently being worked out for both the workshop and public meeting, I wanted to get this note out so everyone could get the finalized dates on their calendars. As I stated below, this meeting will be more of a workshop than a meeting and primarily devoted to an in-depth discussion of the integration of engineering and natural resources. We will spend a majority of the meeting collaborating on potential, internally developed operational scenarios. Focus will be placed on these scenarios, their likely natural resource impacts (positive and negative), potential instream flow options in the bypass reach, potential mitigation and enhancement measures and specifics on infrastructure and design. Given the primary topics and their devotion to engineering and aquatic based issues, I'll let folks determine their desire/need to attend. Obviously, any and all are welcome. I appreciate that we are all busy and I'm just trying to avoid a situation where folks attending feel they could have spent their time more efficiently doing other things. My thought is that a full day on Monday would facilitate the need for only a half day on Tuesday and the potential exists for it to be a one day meeting depending on how much we are able to get through. In advance of our meeting, we'll be distributing some materials for you all to review related to infrastructural/operational refinements, environmental conditions and KHL's preferred approaches in hopes that everyone will come ready to collaborate and hopefully reach some agreements on some high level topics that will ultimately facilitate a more seamless formal review of a Draft License Application in the near future. In short, KHL heard and agrees with your hopes for continued transparency and collaboration related to project development and we think this workshop will facilitate that nicely.

For now, please get the dates on the calendar if you'd like to attend. As always, we'll provide call-in information and webinar services for those who can't be there in-person. Again, more details (times/locations, etc.) to follow and please let me know if you have any questions or concerns.

Thanks,

Cory

Cory Warnock

Senior Licensing and Regulatory Consultant

From: McCafferty, Katherine A POA [<mailto:Katherine.A.McCafferty2@usace.army.mil>]
Sent: Thursday, May 29, 2014 11:35 AM
To: Levia Shoutis
Subject: RE: Grant Lk short vs long term impacts, POA-2008-1492 (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Levia,
Sorry about the delayed response, I was at training last week. My most recent response, on May 8th, is the correct one. If we decide that the project can be authorized under a NWP, we would consider those impacts that I listed in my March 27th email, both the indirect and direct impacts, as loss of waters.

Hope this clears things up.

Katie McCafferty
Project Manager
Regulatory Division, Kenai Field Office
U.S. Army Corps of Engineers

phone: 907-283-3562

fax: 907-283-3981

Check out our website for more info: <http://www.poa.usace.army.mil/Missions/Regulatory.aspx>

From: Levia Shoutis [<mailto:Levia.Shoutis@erm.com>]

Sent: Thursday, May 22, 2014 8:07 AM

To: McCafferty, Katherine A POA

Subject: [EXTERNAL] FW: Grant Lk short vs long term impacts (UNCLASSIFIED)

Hi Katie,

Sorry to bother you- any thoughts on my question below? I'm sure it's getting nice up there and field season is likely getting into full swing, spring is so hectic...

Levia

Levia Shoutis

Environmental Resources Management (ERM), Inc.

P.O. Box 582

1 Ninth St. Island Dr.

Livingston, MT 59047

406-222-7600 x229

406-570-6194 Cell

406-222-7677 Fax

levia.shoutis@erm.com

www.erm.com

From: Levia Shoutis

Sent: Thursday, May 15, 2014 2:15 PM

To: 'McCafferty, Katherine A POA'

Subject: RE: Grant Lk short vs long term impacts (UNCLASSIFIED)

Hi Katy,

I was re-reading your email below, as well as the comments that you sent to Cory on 3/27/14. Could you clarify whether inundation or dewatering of wetlands associated w/Grant Lk, due to potential lake level fluctuations (beyond normal variation), would be considered direct or indirect impact?

See the highlighted in the paragraph below from 3/27, and in the email below.

3/37 Email Katie to Levia

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.

I had initially called dewatering of Grant Cr, and inundation or dewatering along Grant Lk, indirect impacts.

Thanks for the clarification!

Levia

Levia Shoutis

Environmental Resources Management (ERM), Inc.

P.O. Box 582

1 Ninth St. Island Dr.

Livingston, MT 59047

406-222-7600 x229

406-570-6194 Cell

406-222-7677 Fax

levia.shoutis@erm.com

www.erm.com

From: McCafferty, Katherine A POA [<mailto:Katherine.A.McCafferty2@usace.army.mil>]

Sent: Thursday, May 08, 2014 4:51 PM

To: Levia Shoutis

Subject: RE: Grant Lk short vs long term impacts (UNCLASSIFIED)

Classification: UNCLASSIFIED

Caveats: NONE

Hi Levia,

Maybe I received an older version of the table? Placement of fill due to structures is still listed as an operational rather than a construction impact and there is no placement of fill listed as a direct impact during construction.

My comments here are made with the assumption that the table is only for my benefit in evaluating impacts under our program and does not satisfy some NEPA/FERC requirement.

I want to clarify that we evaluate indirect vs. direct differently than we evaluate short term versus long term impacts because they seem to be used interchangeably in the discussion of what the table is meant to tell us.

- The separation of impacts that occur during the construction versus the operation phase is not useful for me, because regardless of when it happens, I have to evaluate all proposed discharges of fill.
- We are required to evaluate the direct, indirect, and cumulative impacts of the proposed project.
 - o We consider direct impacts as those that result from the activity needing the Corps permit, i/e placement of fill for dam construction.
 - o Secondary/indirect effects are those that occur later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Indirect effects are those caused by the activity needing the Corps permit authorization, but which take place later in time or farther

removed in distance (e.g., the indirect effects of dam construction include the inundation of the area behind the dam, and habitat and/or fisheries impacts downstream of the dam associated with hydroperiod changes). Some examples of secondary effects on an aquatic ecosystem are fluctuating water levels in an impoundment and downstream associated with the operation of a dam, septic tank leaching and surface runoff from residential or commercial developments on fill, and leachate and runoff from a sanitary landfill located in waters of the U.S. The USACE evaluates indirect impacts under both NEPA (40 CFR 1508.8(b)) and the 404(b)(1) guidelines (40 CFR 230.11(h)(2)).

O Separately from the discussion of direct and indirect impacts, we must determine whether the proposed project complies with the 404(b)(1) guidelines. To do that, we must determine the potential short-term and long-term effects of the proposed discharge (placement of fill) on the physical, chemical, and biological components of the aquatic environment. In making these determinations, we evaluate the following:

- nature and degree of effect of discharge individually and cumulatively, on substrate at the discharge site,
- nature and degree of effect that the discharge will, individually and cumulatively, have on Water (nutrients, chemical content, dissolved gas, pH, temperature), water circulation, fluctuation, and on kinds and concentrates of suspended particulates/turbidity,
- degree to which the material proposed for discharge will introduce, relocate, or introduce contaminants,
- nature and degree of effect that the discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms,
- potential impacts on biological characteristics of the Aquatic Ecosystem resulting from impacts to fish, crustaceans, mollusks, and other aquatic organisms in the food web, and other wildlife,
- potential Impacts on Special Aquatic Sites (Sanctuaries and refuges, Wetlands, Mudflats, Vegetated shallows, and Riffle and pool complexes),
- potential Effects on human use and characteristics from the possible loss of values to municipal and private water supplies, recreational and commercial fisheries, water-related recreation, aesthetics, parks, national and historic monuments, wilderness areas, research sites, and similar preserves.

- Also, the table deals solely with wetlands impacts, don't forget to do the same with both Grant Lake and Grant Creek and the other unnamed tributaries. The table only mentions the Lake and Creek in relation to how changes to their hydrologic regime might impact wetlands.

Thanks,

Katie McCafferty
Project Manager
Regulatory Division, Kenai Field Office
U.S. Army Corps of Engineers
phone: 907-283-3562
fax: 907-283-3981

Check out our website for more info: <http://www.poa.usace.army.mil/Missions/Regulatory.aspx>

From: Levia Shoutis [<mailto:Levia.Shoutis@erm.com>]
Sent: Wednesday, May 07, 2014 8:42 AM
To: McCafferty, Katherine A POA
Subject: [EXTERNAL] FW: Grant Lk short vs long term impacts

Hi Katie,
I'm so sorry to bug you about this. We're wrapping up the terrestrial report and I wanted to check in to see if you had any thoughts on the email below? Note that I've since moved all references to "fill" or "wetland excavation" to the Construction, Direct impacts column, and it's no longer in the Operations column. Is that sufficient?
Thanks and hope you're well,
Levia

Levia Shoutis
Environmental Resources Management (ERM), Inc.
P.O. Box 582
1 Ninth St. Island Dr.
Livingston, MT 59047
406-222-7600 x229
406-570-6194 Cell
406-222-7677 Fax
levia.shoutis@erm.com
www.erm.com

From: Levia Shoutis
Sent: Friday, April 04, 2014 1:27 PM
To: McCafferty, Katherine
Subject: Grant Lk short vs long term impacts

Hi Katie- During the March agency meeting you mentioned that "fill" needed to be added to the construction impacts, and changed to a long-term impact, per the USACE's definition of short vs long term impacts. Were there any other short term impacts that should be changed to long term? Or other activities that should occur under construction in addition to operations? See the table below from the report for reference.
Thanks- Levia Shoutis

Project Component	Potential Qualitative Construction Impacts ^{1,2}		Potential Qualitative Operational Impacts ^{1,2}	
	Direct	Indirect	Direct	Indirect

Project Component	Potential Qualitative Construction Impacts ^{1,2}		Potential Qualitative Operational Impacts ^{1,2}	
	Direct	Indirect	Direct	Indirect
GRANT CREEK DIVERSION				
Natural Outlet Option	Vegetation clearing/grubbing; soil disturbance; shoreline/bank disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat); temporary surface water turbidity	Weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Fills due to structures; altered bank, shoreline and lakebed; permanently reduced capacity to perform certain wetland functions (i.e., water quality, wildlife habitat, stormwater attenuation)	Effects of new max lake level elevation on wetland vegetation (i.e. inundation); change in lakeshore erosion/deposition; effect of new Grant Creek in-stream flow regime on hydrologically connected riparian wetlands; change in capacity to perform certain wetland functions (i.e. shoreline stabilization, wildlife habitat)
Concrete Dam Option	Vegetation clearing/grubbing; soil disturbance; shoreline/bank disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat); temporary surface water turbidity	Weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Fills due to structures; altered bank, shoreline and lakebed; permanently reduced capacity to perform certain wetland functions (i.e., water quality, wildlife habitat, stormwater attenuation)	Effects of new max lake level elevation on wetland vegetation (i.e. inundation); change in lakeshore erosion/deposition; effect of new Grant Creek in-stream flow regime on hydrologically connected riparian wetlands; change in capacity to perform certain wetland functions (i.e. shoreline stabilization, wildlife habitat)
WATER CONVEYANCE				

Project Component	Potential Qualitative Construction Impacts ^{1,2}		Potential Qualitative Operational Impacts ^{1,2}	
	Direct	Indirect	Direct	Indirect
Intake Structure	Vegetation clearing/grubbing; soil disturbance; shoreline/bank disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat); temporary surface water turbidity	Weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Fills due to structures; altered bank, shoreline and lakebed; permanently reduced capacity to perform certain wetland functions (i.e., water quality, wildlife habitat, stormwater attenuation)	Effects of new max lake level drop on wetland vegetation (i.e. wetland to upland conversion); downcutting in creeks may drain wetlands and add suspended sediments to water column; change in lakeshore erosion/deposition; effect of new in-stream flow regime on hydrologically connected riparian wetlands; change in capacity to perform certain wetland functions (i.e. shoreline stabilization, wildlife habitat)
Tunnel	At surficial entrance and exit of tunnel: vegetation clearing/grubbing; soil disturbance; shoreline/bank disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat); temporary surface water turbidity	At surficial entrance and exit of tunnel: weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Fills due to structures; permanently reduced capacity to perform certain wetland functions (i.e., water quality, wildlife habitat, stormwater attenuation)	At surficial entrance and exit of tunnel: weed infestation; soil erosion, sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)
Penstock	Vegetation clearing/grubbing; soil disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Weed infestation; soil erosion; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Fills due to structures; permanently reduced capacity to perform certain wetland functions (i.e., water quality, wildlife habitat, stormwater attenuation)	Weed infestation; soil erosion; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)

Project Component	Potential Qualitative Construction Impacts ^{1,2}		Potential Qualitative Operational Impacts ^{1,2}	
	Direct	Indirect	Direct	Indirect
Tailrace	Vegetation clearing/grubbing; soil disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat); temporary surface water turbidity	Weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Wetland excavation and fills; permanently reduced capacity to perform certain wetland functions (i.e., water quality, wildlife habitat, stormwater attenuation)	Drainage of adjacent wetlands; weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)
Tailrace Detention Pond	Vegetation clearing/grubbing; soil disturbance; bank disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat); temporary surface water turbidity	Weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Fills due to structures associated with detention pond and conveyance pipeline; inundation of wetland areas; sedimentation; loss of certain wetland functions and gain of others (i.e. loss of wildlife habitat functions tied to existing vegetation, and gain of open water habitat resulting from inundation)	Possible expansion of wetland fringe around water edge; weed infestation; soil erosion; sedimentation/burial of existing wetland vegetation; sediment input to water column (if pipeline conveys sediment laden water); poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)
POWERHOUSE				

Project Component	Potential Qualitative Construction Impacts ^{1,2}		Potential Qualitative Operational Impacts ^{1,2}	
	Direct	Indirect	Direct	Indirect
Powerhouse Structure	Vegetation clearing/grubbing; soil disturbance; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Weed infestation; soil erosion; sediment input to water column; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)	Fills due to structure; permanently reduced capacity to perform certain wetland functions (i.e., water quality, wildlife habitat, stormwater attenuation)	Weed infestation; soil erosion; poor native vegetation re-establishment; short-term reduced capacity to perform certain wetland functions (i.e. water quality, wildlife habitat)

Levia Shoutis

Environmental Resources Management (ERM), Inc.

P.O. Box 582

1 Ninth St. Island Dr.

Livingston, MT 59047

406-222-7600 x229

406-570-6194 Cell

406-222-7677 Fax

levia.shoutis@erm.com

www.erm.com

This message contains information which may be confidential, proprietary, privileged, or otherwise protected by law from disclosure or use by a third party. If you have received this message in error, please contact us immediately at (925) 946-0455 and take the steps necessary to delete the message completely from your computer system. Thank you.

Please visit ERM's web site: <http://www.erm.com>

This message contains information which may be confidential, proprietary, privileged, or otherwise protected by law from disclosure or use by a third party. If you have received this message in error, please contact us immediately at (303) 741-5050 and take the steps necessary to delete the message completely from your computer system. Thank you.

Please visit ERM's web site: <http://www.erm.com>

Classification: UNCLASSIFIED

Caveats: NONE

This message contains information which may be confidential, proprietary, privileged, or otherwise protected by law from disclosure or use by a third party. If you have received this message in error, please contact us immediately at (925) 946-0455 and take the steps necessary to delete the message completely from your computer system. Thank you.

From: Mouw, Jason E B (DFG) <jason.mouw@alaska.gov>
Sent: Monday, June 02, 2014 11:10 AM
To: John Blum; Miller, Monte D (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock; Klein, Joseph P (DFG)
Cc: 'Mike Salzetti'; Emily Andersen
Subject: RE: minutes from May 22 conference call
Attachments: Draft minutes for IFWG meeting 05-28-2014_corrections.docx

John,

I made just a few corrections using track changes. In part, we discussed HDR's interactive display of flow, substrate, and lateral spawning location. In that discussion, it was my understanding that you had found that this was proprietary and that something else would need to be done. We discussed how the mechanics of an effective spawning analysis may fit, and that in conjunction with the HSC that were developed, could be used to assess lateral habitats at a range of flows.

Jason

From: John Blum [mailto:john.blum@mcmillen-llc.com]
Sent: Wednesday, May 28, 2014 7:07 PM
To: Miller, Monte D (DFG); Mouw, Jason E B (DFG); Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'
Cc: 'Mike Salzetti'; 'Emily Andersen'
Subject: minutes from May 22 conference call

Good evening:

Here are the draft meeting minutes from our conference call last Thursday, May 22. Please get any revisions to me by the beginning of next week.

Last Friday, I emailed to everyone a table put together by John Stevenson which summarized the number of spawning salmon in the vicinity of the transects. This spreadsheet is referenced in the meeting minutes.

Thanks very much – please get back to me as soon as you can re: the minutes and deliverables discussed at the meeting.

John

John Blum
Sr. Fisheries Scientist

Draft
Conference call with the Grant Creek Instream Flow Work Group
May 22, 2014

Those attending via conference call:

- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 10:00 am PDT. John Blum sent out a draft agenda to the Work Group on May 21 via email. Agenda items are briefly detailed below:

1. Review of sockeye emergence timing
2. Address concerns from ADFG re: data products
3. Discuss Work Group's analysis of transects to use for rearing and spawning
4. Discuss information work group wants presented (i.e., wetted perimeter, substrate analysis, connectivity, etc.)

REVIEW OF SOCKEYE SALMON EMERGENCE TIMING

Per request of the Work Group at the April 18th meeting, John Blum used the DTU's agreed upon at that meeting to calculate Sockeye salmon incubation and emergence timing. Since the latest download of water temperature data occurred on March 20, it was suggested that John Blum look at the water temperature data from 2013 and use a trend analysis to make an initial temperature run.

John Blum ran several different analyses to attempt to piece together the temperature data from both years; however, temperature regimes were markedly different from 2013 to 2014, resulting in a wide range of potential emergence timing. Some of these scenarios were unrealistic, so John Blum suggested that we wait until the next water temperature download is completed (i.e., in June) and then rerun the analysis then. The Work Group agreed, and this item was shelved until these data were obtained.

To Do:

- John Blum will update emergence timing after water temperature data are downloaded in June.

ADDRESS ADFG CONCERNS RE: DATA PRODUCTS

John Blum reviewed ADFG's concerns re: an interactive tool that was developed previously to examine location of spawning substrate along the transects and how these substrates were

affected by changes in flow. John explained that the information requested was not available to develop as an interactive tool; however, if the Work Group let John know what analyses they wanted, John would produce that for the group and send it out.

Jason said that what he would like to see is the lateral positions of where the substrate spawning was located along each transect, and at what flows ~~that those substrate locations~~ went dry /were connected. This included the evaluation of depths and velocities at those locations at flows up to 350 cfs. It was discussed how a type of ~~What he was looking for was~~ an effective spawning analysis over the range of ~~suitable-normal~~ flows, may accomplish that, especially for Reaches 1 and 3.

John Stevenson said that he had looked at where most of the spawning occurred, and it was along Transects 130, 140, 300 and 310, with most rearing occurring along Transects 100, 130, 160, 200, 220, 230, 300, and 330.

Jason and Monte asked John Stevenson if he could quantify the number of spawners along the transects, so that ADFG could make assessments of which transects to analyze for effective spawning. John Stevenson said he could do that. ADFG said they would turn that around quickly for John Blum's analysis.

Jason asked if John Blum could run effective spawning ~~from up to~~ about 350 – 400 cfs. John Blum suggested he run the analysis up to 400 – 450 cfs. John Blum said he would do that as soon as he heard back from the Work Group re: which transects to analyze.

John Blum also asked the Work Group on how they wanted the transects weighted: equally; by importance (spawning or rearing), or by habitat frequency. Jason asked if several analysis could be run. John Blum said yes, and that the analysis for equal weighting of transects was already completed and in the Draft Habitat Mapping and Instream Flow Report. The transects were initially weighted equally, since the Grant Creek Instream Flow Study was based upon known, important rearing and spawning areas.

To Do:

- John Stevenson to tabulate spawners by transect [Note: John Stevenson did this and the spreadsheet was sent to the Work Group via John Blum email on May 23].
- ADFG to review data and make suggestions for use of transects for rearing and spawning as well as transect weighting.
- John Blum to analyze these transects to indicate at what point spawning substrates were exposed due to decreased flow.

OTHER ISSUES

Monte asked if there was more information re: where the tailrace would be returning water into Reach 4. Cory said that KHL was running different scenarios right now and would be documenting them and collaboratively discussing options related to operations, natural

resources, the associated impacts and potential mitigation measures during the July meetings in Anchorage.

Monte also asked if KHL was still considering raising the lake level. Cory said that KHL was currently running scenarios that would not involve their raising the lake levels and these options (along with others) would be discussed with Stakeholders in July. Monte then commented that the wildlife/botanical issues at the lake would be eliminated if there was no raising of lake elevation.

There was also discussion on how increasing flows into the distributary in Reach 1 (Transects 100 and 110) could also prove to be an effective enhancement tool. Monte said he would like to discuss that further in future meetings.

NEXT MEETING

The next meeting of the Work Group is tentatively scheduled for June 12, 1 pm (AK), 2 pm (WA), and 3 pm (ID) time.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Tuesday, June 10, 2014 8:16 PM
To: 'Miller, Monte D (DFG)'; Jason Mouw
Cc: Cory Warnock; Emily Andersen
Subject: RE: Transect selection and weighting

Thanks, Monte. I haven't seen anything yet re: transect weighting. You are an integral part of these discussions, and since you can't make the call on Thursday, I'm going to cancel it and reschedule for next Friday, the 20th.

I'm good with modeling all the transects. I'll look for something from you and Jason re: transect weighing.

Thanks, Monte,

Johh

John Blum
Sr. Fisheries Scientist

From: Miller, Monte D (DFG) [mailto:monte.miller@alaska.gov]
Sent: Friday, June 06, 2014 5:34 PM
To: John Blum
Subject: RE: Transect selection and weighting

John,

We are still reviewing the information provided to develop our recommendation. We have staff out both this week and next week but will try to get something more back to you on Monday. I will be on travel status Tue.-Thur. of next week as well. Internal discussion up to this point seems to agree on modeling for reaches 1-4, which is what was studied and is of similar gradient. Modeling of all transects would capture a more habitat relative result which would probably provide greater accuracy and consistency modeling. Modeling selected transects may introduce unintended selectivity. The questions arise on weighing transects, since the transects are independent and unconnected. Hopefully on Monday we can reach a decision on this matter. Thanks for your patience

Monte D. Miller
Statewide FERC Hydropower Coordinator
Alaska Department of Fish and Game
Division of Sport Fish / RTS
333 Raspberry Road
Anchorage, Alaska, 99518-1565

907 267-2312

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]

Sent: Monday, June 02, 2014 7:40 AM

To: Mouw, Jason E B (DFG); Miller, Monte D (DFG)

Cc: 'Cory Warnock'

Subject: Transect selection and weighting

Importance: High

Good morning:

I am out of the office this week, but will be back by the weekend. Would you look at the data I forwarded to you from John Stevenson and make some assessments re: spawning transects and transect weighting?

If I can have that by Friday, I will have the time to do the effective spawning analysis that we discussed during our last conference call.

Thanks, and have a good week!

John

John Blum

Sr. Fisheries Scientist

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4570 / Virus Database: 3955/7649 - Release Date: 06/09/14

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Tuesday, June 10, 2014 10:56 AM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkhahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; 'Schade, David W (DNR)'; mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough
Subject: Grant Lake Project Hydrological Tech Memo
Attachments: TM001-Grant Creek Hydrologic Analysis-Final.pdf

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

In advance of our upcoming get-together in Anchorage, you'll be receiving a series of engineering/operational tech memos for your review prior to the meetings. The first of these (Grant Creek Hydrological Analysis) is attached here. Please don't hesitate to let me know if you have any questions and again, more will be coming your way in the next couple weeks.

Thanks

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

McMILLEN, LLC

To:	Morton D. McMillen, P.E.	Project:	Grant Lake Hydroelectric Project
From:	Andre Ball	Cc:	Cory Warnock File
Date:	May 30, 2014	Job No:	13-102
Subject:	Grant Creek Hydrologic Analysis		

1.0 INTRODUCTION

McMillen, LLC (McMillen) has been retained by Homer Electric Association, Inc. (HEA) to provide engineering support for the proposed Grant Lake Hydroelectric Project (Project) FERC application. The project would be located near the community of Moose Pass, Alaska, approximately 25 miles north of Seward, Alaska.

1.1 Purpose and Scope

The purpose of this Technical Memorandum (TM) is to present the analyses and results of a hydrologic analysis of the Grant Lake and Grant Creek basin. The analyses presented within this TM utilized the available gage data, information from previous studies, as well as standard hydrologic estimation techniques. The primary objectives of this TM are:

- Complete an independent review and analysis of previous hydrologic analyses completed for the Grant Lake Basin;
- Assemble the available gage data for Grant Creek to support the analyses;
- Determine the peak streamflow magnitude and frequency discharges for Grant Creek that can be used in the design of the Project;
- Complete a record extension for the Grant Creek streamflow gage record based on the USGS Kenai River at Cooper Landing streamflow gage;
- Complete flow duration and mean daily flow analyses to be used in determining the estimated Project energy production.

1.2 Project Description

As outlined in the application for a preliminary permit (HEA, 2011) the proposed Project consists of constructing a new 5-Megawatt (approximate) hydroelectric facility on Grant Lake and Grant Creek near Moose Pass, Alaska. The new Project would divert water from Grant Lake and deliver the flow to a powerhouse located near the outlet of the existing Grant Creek natural, incised rock canyon. The Project would include the following major components:

- Diversion structure at the natural outlet of Grant Lake. (under consideration)
- An intake structure in Grant Lake.
- A tunnel extending from the lake intake to just east of the powerhouse.
- A powerhouse with two Francis turbines providing an anticipated combined 5-Megawatt output. The maximum design flow will be approximately 385 cfs.
- Tailrace detention pond.
- 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.

1.3 Project Background

Grant Lake has been studied on multiple occasions since the 1950's as a potential hydropower site. The previous work efforts included:

- 1954 – R.W. Beck and Associates preliminary investigation
- 1955 – U.S. Geological Survey (USGS) geological investigations of proposed power sites at Cooper, Grant, Ptarmagin, and Crescent Lake
- 1980 – CH2M Hill prefeasibility study
- 1981 – U.S. Army Corps of Engineers (USACE) National Hydroelectric Power Resources Study
- 1984 – Ebasco Services Project Feasibility Analysis (Ebasco, 1984)
- 2010 – HDR Grant Lake/Falls Creek Hydroelectric Project – Environmental Baseline Studies (HDR, 2010)

On August 6, 2009, Kenai Hydro LLC filed a Pre-Application Document (PAD), along with a Notice of Intent to file an application for an original license for the Grant Lake/Falls Creek project. FERC subsequently approved the use of the Traditional License Process for development of the license application and supporting documents. In 2009-2010, HDR completed a series of environmental baseline studies which were summarized in their report dated January 2010. A second preliminary permit was issued by FERC in 2012.

As part of these previous studies, the hydrologic conditions within the Grant Creek basin were evaluated and flows available to support a hydroelectric facility were evaluated. The most expansive analysis was completed as part of the Ebasco feasibility study. These previous studies and available gage data were used as the basis for the current hydrologic analysis. The subsequent gage data collected in 2009 (HDR, 2010) and 2013 by McMillen, along with the original USGS stream gage data (USGS Station 15246000) served as the basis for the flow estimation.

1.4 Grant Creek Basin Description

Grant Lake and Grant Creek are located near Moose Pass, Alaska on the Kenai Peninsula (Figure 1). Grant Lake is an 'L'-shaped, natural impoundment with a drainage area of 44.2 square miles (Basin area shaded in Figure 1). The natural lake elevation is elevation 703 feet (NAVD88). The lake has a surface area of 1,790 acres (2.8 square miles) and an active storage volume of 15,900 acre-feet between the lake elevations 703 feet and 692 feet. The mountains surrounding the basin reach elevations of up to 5,900 feet, some of which have small glaciers on them. Inlet Creek is the primary tributary and flows into the east end of Grant Lake. Several other small streams flow into the lake from the steep valleys formed between the surrounding mountains.

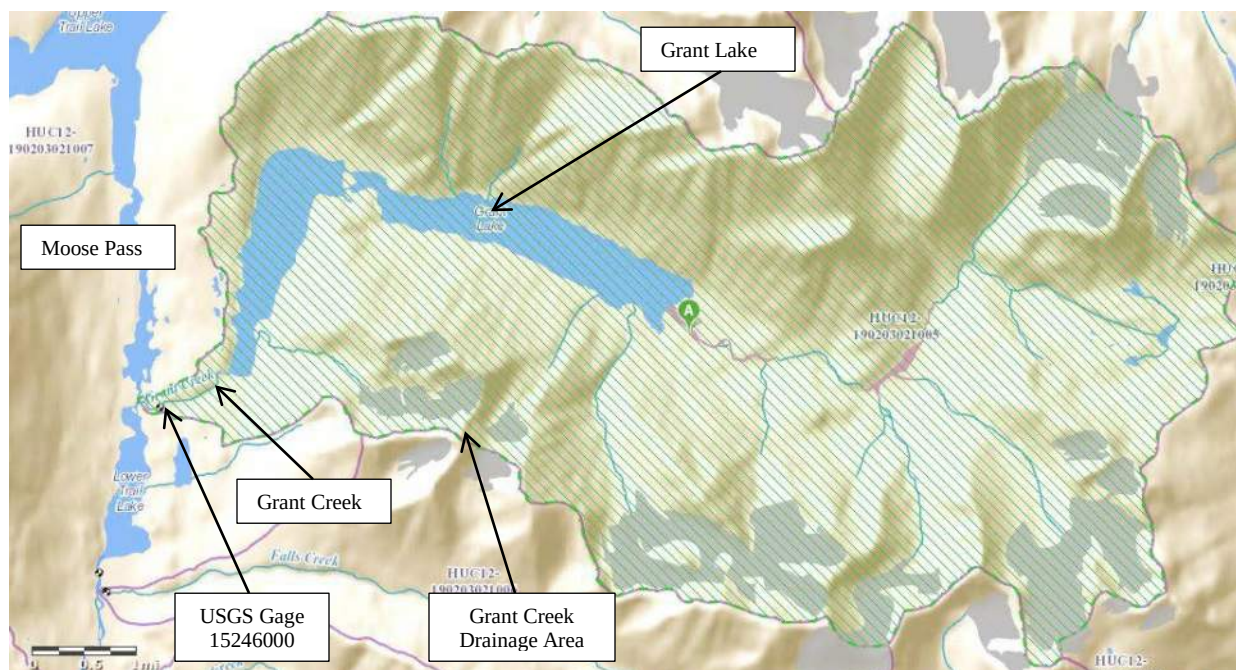


Figure 1. Grant Lake Hydroelectric Project Location Map

Grant Creek is the only natural outlet from Grant Lake and is located at the south end of the lake. Grant Creek is approximately 1 mile long and flows west from Grant Lake and discharges into the Trail Lake Narrows that connects the Upper Trail Lake to Lower Trail Lake. The total drop in elevation from Grant Lake to the Trail Lake Narrows is approximately 230 feet. The U.S. Geological Survey (USGS) had previously operated a stream flow gage (Station 15246000) on Grant Creek, but this gage is no longer operated. Additional basin statistics for Grant Creek are provided in Table 1.

Table 1. Grant Creek Basin Characteristics¹

USGS Station No.	Station Name	Drainage Area (mi ²)	Mean Basin Elevation (ft)	Areas of Lakes and Ponds (storage) (percent)	Area of Forest (percent)	Mean Annual Precipitation (inches)	Mean Min. January Temperature (°F)
15246000	Grant Creek near Moose Pass, AK	44.2	2,900	10	20	90	10

¹ Curran, Meyer, and Tasker, 2003

2.0 HYDROLOGIC DATA SUMMARY

The USGS operated streamflow gage 1524600 on Grant Creek between 1947 and 1958. Daily and annual peak flows were recorded for this period. This 11-year record is the most complete hydrologic data that exists for Grant Creek. The most recent statewide analysis of Alaska peak streamflow frequency was completed in 2003 (Curran, Meyer, and Tasker, 2003). The basin characteristics for Grant Creek in Table 1 are cited from this source.

2.1 Previous Hydrologic Studies

As discussed previously, Grant Lake has been studied several times since the 1950's as a potential hydroelectric project location. The most recent studies, which included hydrologic data, are briefly described below. In 1981, the Alaska Power Authority (APA) authorized Ebasco Services Inc. (Ebasco) to conduct a detailed feasibility analysis for Grant Lake and some additional nearby basins. Intermittent streamflow data for Grant Creek was collected between 1981 and 1983; and was conducted by R&M Consultants (Ebasco, 1984). A HEC-4 Monthly Streamflow Model was developed to extend the Grant Creek streamflow record and was used to estimate power generation potential. The Ebasco study included a peak streamflow statistical analysis and a Probable Maximum Flood (PMF) estimate (Table 2). In 2009, as part of the Grant Creek Baseline Environmental Studies, HDR collected streamflow data between June and October 2009 (HDR, 2010).

Table 2. Approximate Grant Creek Peak Streamflow Statistics from Ebasco Study¹

Peak streamflow, in cubic feet per second (cfs), for a given recurrence interval in years							
Q ₂	Q ₅	Q ₁₀	Q ₂₅	Q ₅₀	Q ₁₀₀		PMF
1,000	1,300	1,500	2,000	2,200	2,600	--	27,700

¹ Ebasco, 1984

2.2 Current Hydrologic Study

In 2013, under contract with HEA, McMillen reestablished streamflow measurements at the former USGS gage location as part of an instream flow study. The streamflow measurement location is referred to as GC200, consistent with the 2009 HDR report. McMillen established continuous stage monitoring for Grant Creek at the beginning of April 2013 and stage

monitoring is presently ongoing. The most recent streamflow data which has been retrieved and gone through the QA/QC process is through December 2013. During spring and summer 2013, five discharge measurements were taken for flows ranging between 17 and 706 cfs. These measurements were used to develop a stage-discharge rating for the GC200 location.

3.0 HYDROLOGIC ANALYSIS

The ongoing hydrologic analysis of Grant Creek will be used as a foundation for determining the anticipated power output from the powerhouse, determining the appropriate tailrace channel elevation, and developing a tailwater rating curve for Grant Creek at the tailrace channel exit. Flood protection requirements at the powerhouse site will be developed utilizing the peak streamflow information. Detailed discussion of the analysis is presented in the following paragraphs.

3.1 Peak Streamflow Magnitude and Frequency

3.1.1 Estimating Peak Streamflow Statistics Using Station Data

As stated previously, the 11-year USGS gage record for station 15246000 is the most complete gage record for Grant Creek. This station data is the most suitable for a peak streamflow magnitude and frequency analysis. The standard procedure for evaluating peak streamflow is to utilize the log-Pearson Type III frequency distribution. This procedure is described in Bulletin 17B issued by the Interagency Advisory Committee on Water Data (IACWD, 1982). The recommended minimum gage record length for such an analysis is 10 years. Additional miscellaneous streamflow data was collected in the 1980's, 2009, and 2013 by various consulting firms. The 2013 and 1980's data was excluded from the peak flow analysis since only the partial year data were available at the time of this analysis. The 2009 data was excluded since the stage-discharge information could not be verified. The peak streamflow estimates for Grant Creek using station data are provided in Table 3.

3.1.2 Estimating Peak Streamflow Statistics Using Regional Regression Equations

Regional regression equations are often developed to estimate flow statistics for streams with no gage record. Regional regression equations use basin characteristics (see Table 1 for basin data) to estimate peak flow statistics. The most recent regional regression equations for basins in Alaska were developed by the USGS in 2003 (Curran, Meyer, and Tasker, 2003). In the 2003 USGS study, Alaska was divided into 7 regions. Grant Creek is located in Region 4, which includes the northern part of the Kenai and Alaska Peninsulas. Geographically, Grant Creek is near the border of Region 3, which includes land along the Pacific Coast north of Juneau, along the south side of the Kenai Peninsula, and the south side of the Aleutian Range. The peak streamflow estimates for Grant Creek using the regional regression equation are provided in Table 3.

3.1.3 Grant Creek Peak Streamflow Magnitude and Frequency

Station and regression peak flow estimates may be combined to form a weighted value. This type of estimate is especially useful for stations with a short record length, such as Grant Creek (Curran, Meyer, and Tasker, 2003). Since Grant Creek had a suitable station record, it was included in a table of station information and peak flow estimates in the 2003 USGS report. The station, regression, and weighted peak flow estimates for Grant Creek from the 2003 report are provided in Table 3. Flow magnitudes are provided for the 2-year through the 500-year recurrence interval.

Table 3. Grant Creek Peak Streamflow Statistics at the USGS 15246000 Gage Location

Analysis Type	Peak streamflow, in cubic feet per second (cfs), for a given recurrence interval in years							
	Q ₂	Q ₅	Q ₁₀	Q ₂₅	Q ₅₀	Q ₁₀₀	Q ₂₀₀	Q ₅₀₀
Station	936	1,330	1,660	2,170	2,620	3,140	3,760	4,730
Regression	1,260	1,810	2,220	2,760	3,170	3,590	4,020	4,620
Weighted	961	1,410	1,790	2,350	2,810	3,310	3,860	4,690

A weighted average adds in temporal variability from the longer gage records used to form the regional regression. Most of the weighting goes to the local gage due to the uncertainty introduced by the regional regression equations based on basin characteristics. The weighted peak streamflow estimates for Grant Creek are considered to be the most appropriate and suitable for use in the evaluation and design of the Grant Lake Hydroelectric Project moving forward.

3.2 Grant Creek Daily Streamflow Record Extension

In order to give a better long-term representation of the Grant Creek streamflows, a record extension was conducted. A correlation between the Grant Creek USGS gage (station 15246000) and the Kenai River at Cooper Landing USGS gage (station 15258000) provided a means to extend the streamflow record at the Grant Creek gage location.

3.2.1 Record Extension Procedure

The procedure applied to Grant Creek was the “maintenance of variance extension” (MOVE), specifically the MOVE1 procedure (Hirsch, 1982; Robison, 1991). The MOVE1 procedure involves correlating short-term or incomplete gage data with one or more nearby gages that have more complete records (long-term gage). These long-term values and the relationship between the two gages are used to generate data to extend or fill in data at the short-term gage. Several studies have compared the different procedures with varying results. Alley and Burns (1983) illustrated several deficiencies of using simple linear regression including the loss of variance. Hirsch (1982) and Robison (1991) both showed that MOVE1 was superior to regression or regression plus noise when extending daily values.

The MOVE1 record extension, as mentioned earlier, involves using a correlation relationship between a “short-term” (incomplete or limited gage record) to a “long-term” (reference or source gage). As record extension is done, the long-term and short-term gage data should come from situations as similar as possible. Characteristics such as basin size, elevation, location, and other basin characteristics should be as similar as possible. Ideally, both gages should be unregulated or adjusted to unregulated conditions. In this study, extension occurs between mostly unregulated gages. When extension occurs there is a concurrent record where the short-term gage record and long-term record overlap. This concurrent record is used to create the relationship to fill in missing data on the short-term gage to the period of record of the long-term gage. The length of suitable concurrent record may be as small as 15–30 data points when the points are independent and represent variable conditions. Generally, the longer the concurrent record, the more confidence there is in the relationship.

By choosing gages with similar basin characteristics, there is a greater chance for a strong linear predictive relationship between the short- and long-term gages. MOVE1 assumes a linear relationship between the short- and long-term gages after they have been transformed into logarithms (LOGS) of the flow values.

Synthetic discharge values for missing values from the short-term site are calculated by entering known LOGs of the discharge at the long-term site into the equation (below) and then taking the inverse (exponential) of the LOGS to get the short-term gage flows back into original units. The equation for converting short-term gage flows in MOVE1 is show in Equation 1.

Equation 1
$$Y_i = Y_{ave} + Y_{StdDev} / X_{StdDev} (X_i - X_{ave})$$

Where:

Y_i	= Short-term gage extended flow, at the i^{th} step
Y_{ave}	= Average (mean) of concurrent short-term gage data
Y_{StdDev}	= Standard Deviation of concurrent short-term gage data
X_i	= Long-term flow data at concurrent short-term data point, i^{th} step
X_{StdDev}	= Standard Deviation of concurrent long-term gage data
X_{ave}	= Average of concurrent long-term gage data

3.2.2 Record Extension Application

The long-term gage selected for the Grant Creek record extension was the Kenai River at Cooper Landing USGS gage (station 15258000). The Kenai River gage is located approximately 16 miles due west of the Grant Creek location and has a drainage area of 634 square miles. Grant Creek is a tributary to the Kenai River. The period of record at the Kenai gage extends from 1947 to present and is concurrent with the entire 11-year period of record for the USGS Grant Creek gage (1947-1958).

Figure 2 provides a graph of the log transformations of the concurrent streamflow data for Grant Creek and Kenai River. The coefficient of determination (r^2) of 0.92 represents an excellent correlation between the two gages.

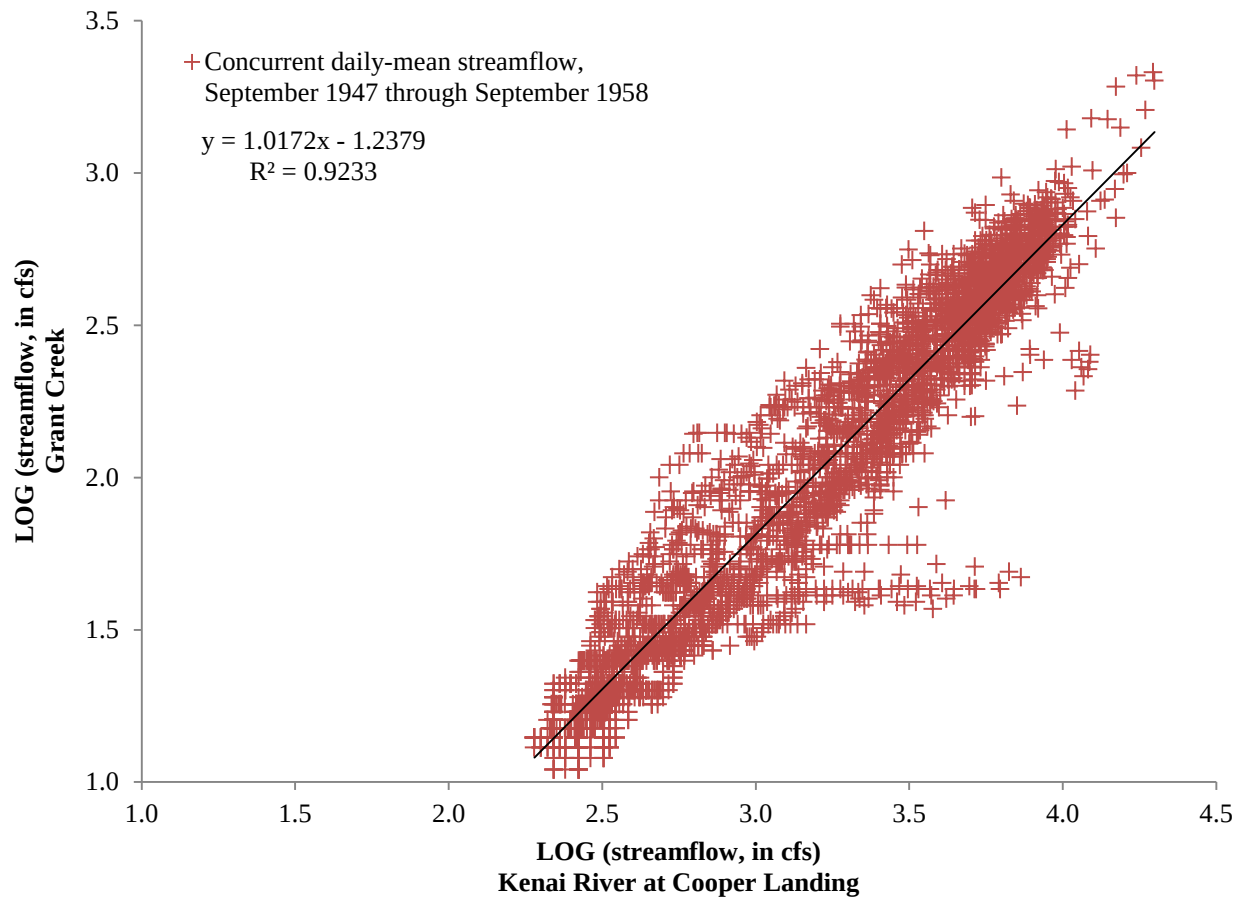


Figure 2. Correlation of daily mean streamflow between Grant Creek and Kenai River

The concurrent period of record for the Grant Creek and Kenai River gages was used to develop the MOVE1 equation. The MOVE1 equation was used to compute estimated Grant Creek streamflow records, based on the Kenai River record, for the period May 1947 through December 2013. The MOVE1 estimated streamflow record was combined with the observed Grant Creek streamflows (from USGS, EBASCO, and McMillen records) to create a composite record. The composite record (Composite) resulted in 66 complete years (Calendar Years 1948 through 2013) of streamflow for Grant Creek.

3.2.3 Cooper Lake Power Plant

The Kenai River flow at gage 15258000 is unregulated with the exception of the Cooper Lake hydroelectric power plant. Chugach Electric Associations commissioned the Cooper Lake power plant in 1960, which diverts flow from Cooper Lake into Kenai Lake, upstream of the 15258000 gage. Operations data from 1966-70 indicate that the average discharge from the Cooper Lake power plant was 89 cfs (USGS 1976). During the same period, the average flow at the Kenai gage was 2981 cfs, thus the additional inflow from Cooper Lake only represented about 3% of the total flow. Absent of detailed operations records for the Cooper Lake power plant, no adjustments to the Kenai gage record were made to account for this additional inflow. Thus, the extended record streamflows for Grant Creek, after 1960, may be approximately 3% high.

3.3 Streamflow Statistics

Streamflow statistics have been computed for Grant Creek to help characterize the daily streamflow. A flow duration analysis and mean daily flow analysis was performed for both the 11-year USGS gage record, and the 66-year composite streamflow record for Grant Creek.

3.3.1 Flow Duration Analysis

A flow duration analysis evaluates the percentage of time that a given magnitude of flow is exceeded. Flow duration curves were developed for the Grant Creek USGS record and Composite record. Table 4 and Figure 3 display the daily flow duration results for Grant Creek. With the exception of very high flows (<5% Days Exceeded), the USGS record was lower than the composite record. For the median flow and below, the flow values for the USGS record were between 29% and 41% lower than the longer Composite record. This indicates that the USGS record represents a drier period of record.

Table 4. Grant Creek Daily Flow Duration Analysis

Percent of Days Exceeded	Grant Creek Discharge (cfs) [USGS Record, WY 1948-1958]	Grant Creek Discharge (cfs) [Composite Record, CY 1948-2013]	11-year USGS Record relative to 66-year Composite Record
5%	580	575	1%
10%	496	499	-1%
20%	390	402	-3%
30%	279	302	-8%
40%	170	186	-9%
50%	91	110	-17%
60%	47	71	-34%
70%	33	49	-33%
80%	22	37	-41%
90%	18	27	-33%
95%	15	21	-29%

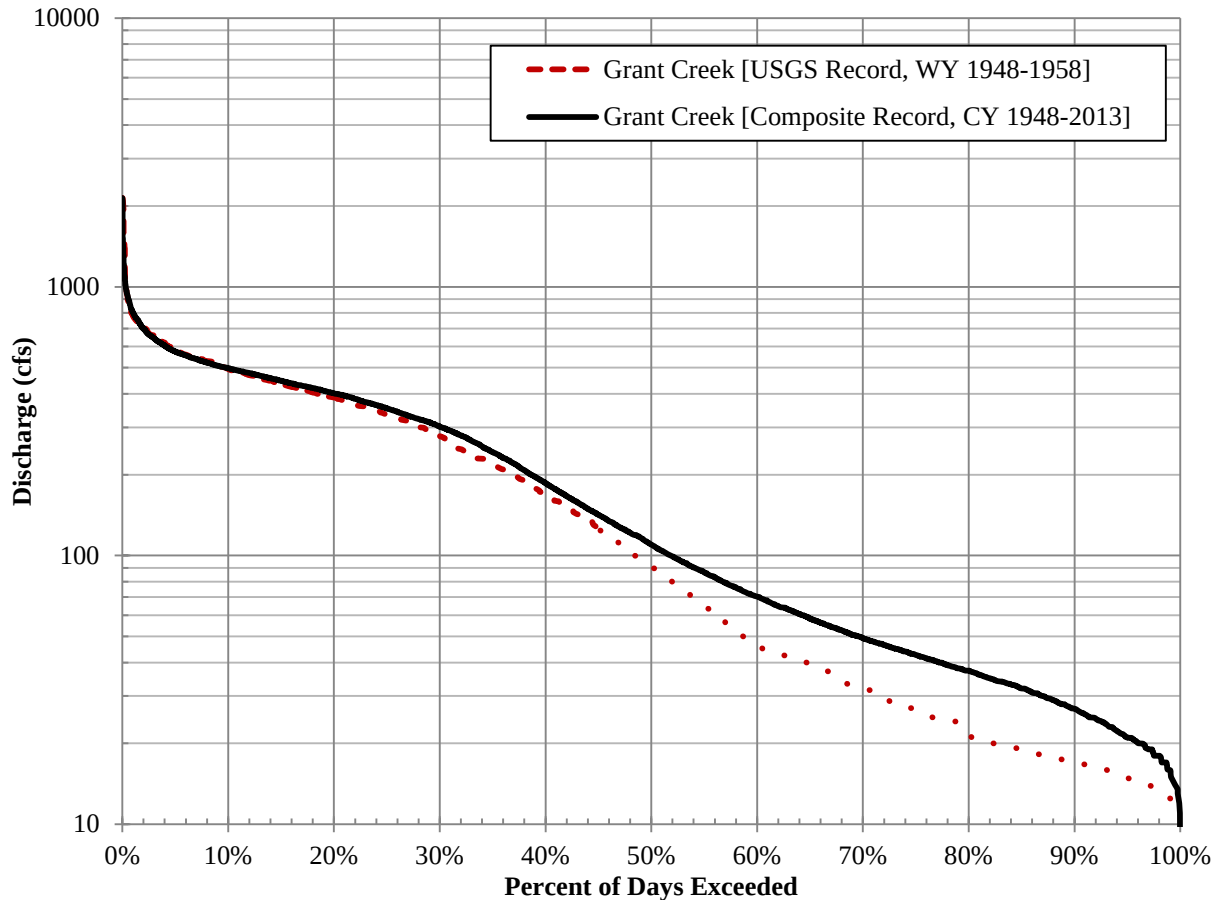


Figure 3. Grant Creek Daily Flow Duration Analysis

3.3.2 Mean Daily Flow Analysis

A mean daily flow analysis evaluates the mean flow on a given day over multiple years of recorded data. Averaging the daily flow values results in a composite, average annual hydrograph where specific events are smoothed out but seasonal trends can be identified. Figure 4 compares the mean daily flow for the Grant Creek USGS Record and the Grant Creek Composite record. The most recent annual hydrograph, from 2013, is also provided in Figure 4 for comparison. The figure presents the annual hydrograph with respect to the calendar year, as opposed to a water year, due to the shape of the annual hydrograph.

The shape of the Grant Creek average annual hydrographs (USGS - dashed red line and Composite - solid line) illustrate that annual runoff begins to increase in mid-April and peaks in late June. The runoff declines from July through mid-November as the snowpack is diminished. There is a slight bump between Mid-November and early December which is likely indicative of late Fall rain-runoff events before the basin precipitation transitions to snow. There is also a pronounced rise in the average annual hydrograph for the Composite record in the latter part of September. This spike is a relic of the Kenai River gage data that was used to extend the Grant Creek record. Almost a quarter of all Kenai River annual peak flows occurred in September and a third of the September annual peaks were the result of glacial-outburst floods. Glacial-outburst

floods are events unique to a specific basin, in this case the Kenai basin, and thus, corresponding glacial outbursts in the Grant Creek basin would not be expected. The MOVE1 record extension method, described previously, is used to correlate the same types of runoff events between basins, in this case, typically rainfall-runoff and snowmelt events.

The 2013 data (dashed blue line) shows that there were two peak runoff events, one in Mid-June and one in Mid-September. The Mid-June event was a spring freshet with warming temperatures resulting in increased snowmelt. The Mid-September event was a rainfall-runoff event resulting from heavy precipitation. These two peaks do not imply that the most recent year contained more intense run-off events. The average annual hydrographs are smoother due to averaging. The shape and timing of the 2013 hydrograph is consistent average Grant Creek hydrographs.

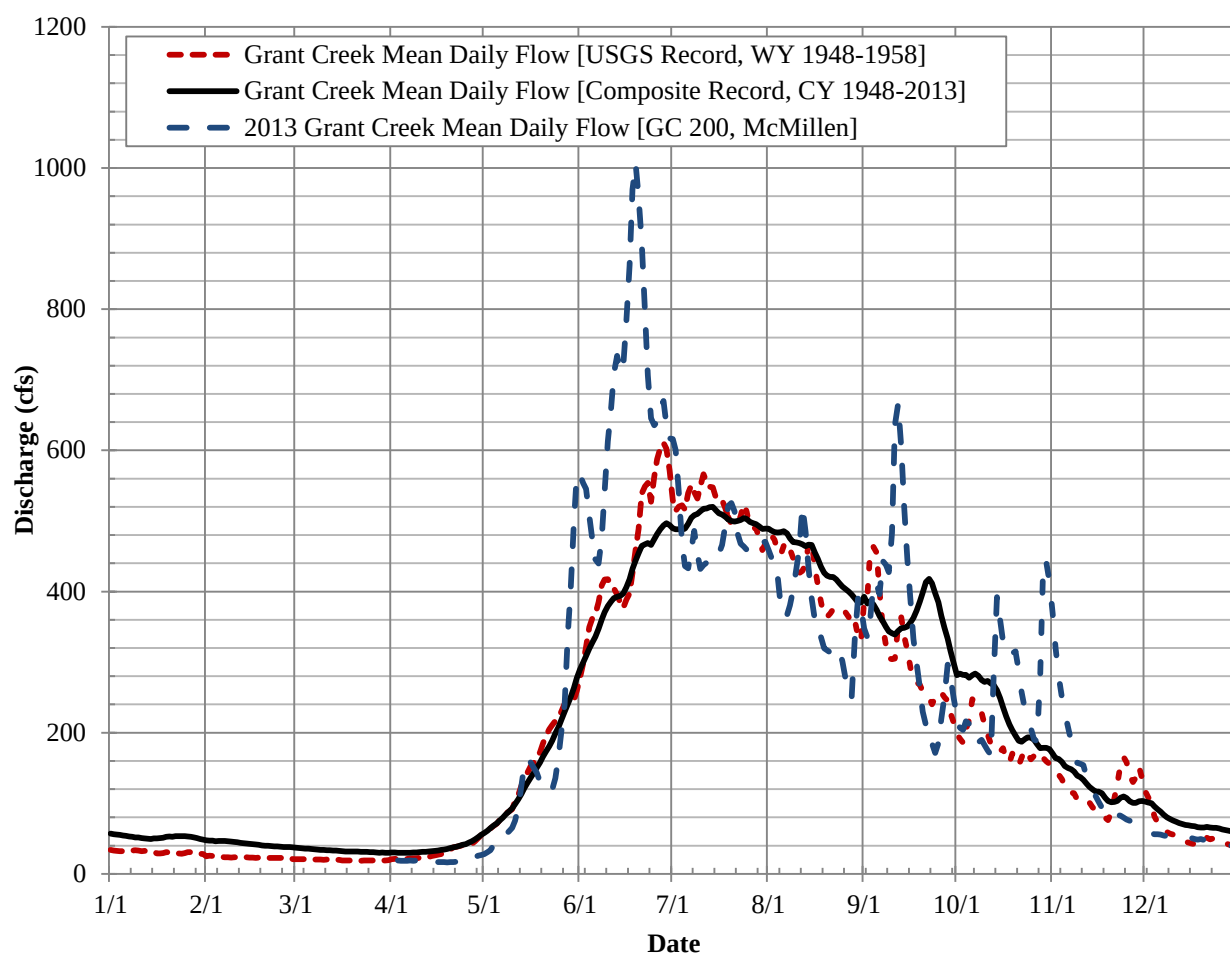


Figure 4. Grant Creek Annual Hydrographs

4.0 CONCLUSIONS AND RECOMENDATIONS

4.1 Conclusions

The Grant Lake site has been studied on numerous occasions since 1954 when R.W. Beck completed their original study. Within these studies, analyses of the hydrologic conditions within

the basin were completed to develop an understanding of the potential water availability and associated power production. The most comprehensive study was completed by Ebasco (Ebasco, 1984) which primarily utilized the 11-year gage record for USGS station 15246000 for their analyses. The current study reviewed the more recent data collected in 2009 by HDR and 2013 data by McMillen. The USGS gage record for Grant Creek still represents the longest term and most reliable streamflow data for Grant Creek.

Regional regression equations were used to improve the peak flow estimates. The estimated 100-year discharge for Grant Creek was 3,310 cfs; the 25-year event was 2,350 cfs; and the 10-year event was 1,790 cfs. In comparing these current flood magnitude estimates to the Ebasco estimates, the smaller magnitude events are similar for both. The Ebasco 100-year estimate was 2,600 cfs, 700 cfs smaller than the present weighted estimate that included the regional regression equations.

A daily streamflow record extension for Grant Creek was performed based on the Kenai River at Cooper Landing USGS streamflow record. This record extension was used to create a Composite, 66-year streamflow record for Grant Creek to be used for the Project. A flow durational analysis of the Composite record indicated that the 95% exceedance flow was 21 cfs and the 5% exceedance was 575 cfs. The 20% exceedance flow, which is often selected to size powerhouse turbines, was estimated at 402 cfs. Additional streamflow data tables are provided in Appendix A.

4.2 Recommendations

Based on the analysis presented in this TM, the estimated 100-year flood flow of 3,310 cfs is recommended to be used to determine the flood protection requirements at the proposed powerhouse. The Composite streamflow record for Grant Creek is recommended to be used as the basis for developing energy production estimates from the generation model.

5.0 REFERENCES

- Alley, W.M. and A.W. Burns. 1983. Mixed-station extension of monthly streamflow records. *J. Hydraulic Eng.* Vol. 109 (10). p. 1272- 1284.
- Curran, J.H., Meyer, D.F., and Tasker, G.D., 2003. Estimating the magnitude and frequency of peak streamflows for ungaged sites on streams in Alaska and conterminous basins in Canada: U.S. Geological Survey Water-Resources Investigations Report 03-4188. [101 p.] <http://pubs.usgs.gov/wri/wri034188/>
- Ebasco, 1984. Grant Lake Hydroelectric Project Feasibility Analysis (Volumes 1 and 3). Prepared for Alaska Power Authority.
- HDR, 2010. Grant Lake/Falls Creek Hydroelectric Project – Environmental Baseline Studies, 2009 – Final Report. Prepared for Kenai Hydro, LLC.
- Hirsch, R.M., 1982. A comparison of four streamflow record extension techniques. *Water Resources Research*, v. 18, no. 4, p. 1081–1088.
- Robison, E.G. 1991. *Water availability for Oregon's rivers and streams*. Volume 2; Technical Guide and Appendixes. Water Resources Department, Salem Oregon. May 1991.
- U.S. Interagency Advisory Committee on Water Data (IAWCD). 1982. Guidelines for determining flood flow frequency, Bulletin 17B of the Hydrology Subcommittee: Reston, Virginia, U.S. Geological Survey, Office of Water Data Coordination [183 p.] http://water.usgs.gov/osw/bulletin17b/bulletin_17B.html.
- U.S. Geological Survey (USGS). 1976. *Surface water supply of the United States, 1966-70, Part 15, Alaska*. USGS Water Supply Paper: 2136

Appendix A: Gage Data

Grant Creek - USGS Station 15246000

Average of Daily Mean Discharges (cfs)
Data from Water Years 1948-1958

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	34	25	21	21	59	278	529	480	386	198	153	117
2	33	26	21	21	62	298	515	480	393	192	145	108
3	33	25	21	21	64	322	520	473	459	186	141	98
4	32	25	21	21	68	349	522	456	463	205	134	81
5	32	24	21	21	71	363	516	452	455	218	124	73
6	33	24	20	21	76	368	540	465	401	248	117	69
7	32	24	20	22	81	385	551	471	351	242	115	63
8	33	23	20	22	86	409	541	460	324	235	114	59
9	33	23	20	22	88	417	532	447	305	228	105	57
10	33	23	20	23	92	417	549	436	304	212	106	56
11	32	23	20	23	103	410	566	426	305	198	107	51
12	32	24	20	24	111	405	554	429	351	184	104	49
13	32	23	20	24	125	396	548	439	363	177	101	47
14	32	23	20	25	135	384	548	466	337	174	94	46
15	31	23	20	26	144	377	533	470	317	173	90	44
16	29	23	19	27	153	389	530	434	292	178	85	43
17	29	23	19	28	157	397	530	410	278	160	83	42
18	29	23	19	29	165	426	518	385	271	158	80	42
19	31	23	19	32	172	460	506	364	268	170	76	42
20	30	23	19	35	185	488	496	364	259	165	86	44
21	30	23	19	38	196	539	492	369	254	154	107	51
22	29	23	19	38	205	549	497	375	250	165	127	49
23	29	23	19	39	211	554	507	378	240	176	154	50
24	29	23	19	41	217	527	526	378	250	170	165	51
25	30	23	19	40	222	562	513	376	258	162	158	48
26	31	23	19	41	230	587	490	370	257	167	140	46
27	31	22	19	42	241	604	490	363	250	164	130	44
28	30	22	19	46	245	611	490	370	245	157	136	42
29	29	21	19	51	244	602	475	358	228	164	152	40
30	28	---	19	55	246	571	459	336	214	160	134	39
31	28	---	19	---	259	---	468	329	---	156	---	37
Mean	31	23	20	31	152	448	518	413	311	184	119	56
Min	28	21	19	21	59	278	459	329	214	154	76	37
Max	34	26	21	55	259	611	566	480	463	248	165	117

**Grant Creek - Composite Record
(USGS Station 15246000 Location)**

Average of Daily Mean Discharges (cfs)
Data from Calendar Years 1948-2013

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	57	47	37	30	58	290	489	489	392	281	170	102
2	56	47	37	30	61	300	488	487	383	284	164	101
3	56	47	36	30	65	309	488	484	386	282	163	100
4	55	46	36	30	68	319	488	484	382	282	158	96
5	54	47	36	30	72	328	489	484	374	278	153	92
6	54	47	35	30	76	336	496	485	365	282	150	88
7	53	47	35	30	80	347	505	482	358	284	148	84
8	53	46	34	30	84	360	508	476	350	281	145	80
9	52	46	34	30	88	371	510	470	344	275	139	78
10	52	45	34	31	93	379	514	469	341	272	137	76
11	51	45	34	31	99	386	517	469	339	273	133	74
12	50	44	33	31	105	391	518	467	344	270	128	72
13	50	44	33	32	113	393	519	464	348	267	123	71
14	50	43	33	32	121	394	520	466	349	260	120	69
15	50	42	33	33	129	397	515	466	350	249	117	69
16	50	42	32	33	137	406	511	455	356	236	117	68
17	51	41	32	34	143	417	509	447	362	223	114	67
18	51	41	32	34	150	432	506	435	373	212	108	66
19	53	40	32	35	158	444	502	427	386	204	103	65
20	53	40	32	36	166	454	500	423	399	196	101	65
21	53	40	32	38	173	464	499	420	413	188	102	66
22	53	39	31	39	181	467	500	420	418	187	103	66
23	53	39	31	40	189	469	501	417	412	191	108	65
24	53	39	31	41	199	466	504	412	398	194	110	65
25	53	39	31	42	208	474	503	407	385	193	107	64
26	53	38	31	44	218	481	498	403	366	190	103	63
27	53	38	30	46	230	488	497	400	348	184	100	62
28	52	38	30	49	241	494	495	396	333	178	101	61
29	51	37	30	52	251	497	492	390	315	179	103	60
30	49	---	30	55	263	494	489	384	298	178	103	59
31	49	---	30	---	277	---	489	385	---	177	---	58
Mean	52	43	33	36	145	408	502	444	366	233	124	73
Min	49	37	30	30	58	290	488	384	298	177	100	58
Max	57	47	37	55	277	497	520	489	418	284	170	102

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1947

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	---	---	---	---	---	418	152	500
2	---	---	---	---	---	---	---	---	---	467	131	480
3	---	---	---	---	---	---	---	---	---	404	117	400
4	---	---	---	---	---	---	---	---	---	362	104	250
5	---	---	---	---	---	---	---	---	---	327	91	180
6	---	---	---	---	---	---	---	---	---	313	78	160
7	---	---	---	---	---	---	---	---	---	306	86	130
8	---	---	---	---	---	---	---	---	---	278	86	110
9	---	---	---	---	---	---	---	---	---	250	84	100
10	---	---	---	---	---	---	---	---	---	222	82	94
11	---	---	---	---	---	---	---	---	---	243	78	86
12	---	---	---	---	---	---	---	---	---	236	72	76
13	---	---	---	---	---	---	---	---	---	229	68	71
14	---	---	---	---	---	---	---	---	---	236	66	65
15	---	---	---	---	---	---	---	---	---	236	64	65
16	---	---	---	---	---	---	---	---	---	222	64	58
17	---	---	---	---	---	---	---	---	---	208	62	52
18	---	---	---	---	---	---	---	---	---	180	62	47
19	---	---	---	---	---	---	---	---	---	159	64	47
20	---	---	---	---	---	---	---	---	---	145	70	71
21	---	---	---	---	---	---	---	---	---	138	80	65
22	---	---	---	---	---	---	---	---	---	215	230	58
23	---	---	---	---	---	---	---	---	---	320	420	71
24	---	---	---	---	---	---	---	---	---	313	500	71
25	---	---	---	---	---	---	---	---	---	278	540	52
26	---	---	---	---	---	---	---	---	---	280	430	52
27	---	---	---	---	---	---	---	---	---	278	350	42
28	---	---	---	---	---	---	---	---	---	243	460	42
29	---	---	---	---	---	---	---	---	---	243	700	38
30	---	---	---	---	---	---	---	---	---	201	600	35
31	---	---	---	---	---	---	---	---	---	187	---	35
Mean	---	---	---	---	---	---	---	---	---	262	200	116
Min	---	---	---	---	---	---	---	---	---	138	62	35
Max	---	---	---	---	---	---	---	---	---	467	700	500

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1948

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	33	30	18	16	32	383	529	467	173	138	128	39
2	30	42	19	15	38	376	561	453	160	138	128	36
3	30	38	18	15	42	348	569	432	152	173	120	33
4	26	32	18	14	52	362	585	418	152	173	120	31
5	25	28	18	14	58	369	585	418	160	152	107	29
6	27	27	17	14	78	362	765	432	166	138	100	28
7	26	26	17	14	84	369	780	418	180	117	128	27
8	24	25	17	15	104	369	705	383	208	320	120	27
9	23	24	17	16	104	383	665	355	222	517	81	28
10	22	25	16	16	104	390	665	334	236	537	100	29
11	23	26	16	19	173	411	625	316	222	478	148	28
12	28	26	16	21	187	425	585	320	210	436	148	28
13	30	24	16	23	208	482	521	348	201	358	142	29
14	30	23	16	28	229	553	529	453	180	324	128	28
15	28	22	16	35	264	585	521	505	194	316	114	27
16	28	22	16	42	313	625	561	545	210	400	107	26
17	30	21	16	42	320	609	545	545	220	372	94	27
18	32	21	16	42	383	665	561	505	208	352	87	27
19	32	20	16	47	369	705	545	467	201	324	74	26
20	30	20	16	42	348	665	529	425	180	324	62	27
21	32	20	15	38	341	600	497	397	145	260	55	24
22	30	20	15	35	313	561	490	418	138	226	50	23
23	28	19	15	35	306	537	497	453	117	212	48	22
24	30	19	15	35	292	505	529	418	104	198	45	21
25	42	20	16	32	320	505	521	348	104	176	43	21
26	58	21	17	30	390	529	505	299	91	162	46	20
27	58	20	18	30	446	545	497	257	78	148	45	19
28	52	19	17	28	460	529	475	230	65	156	43	18
29	44	19	16	30	425	505	446	210	71	148	42	18
30	38	---	15	30	404	529	418	194	117	142	40	18
31	35	---	16	---	390	---	432	180	---	128	---	18
Mean	32	24	16	27	244	493	556	385	162	259	90	26
Min	22	19	15	14	32	348	418	180	65	117	40	18
Max	58	42	19	47	460	705	780	545	236	537	148	39

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1949

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	18	13	14	16	25	450	380	390	660	420	215	150
2	19	12	13	16	22	467	380	400	710	370	208	146
3	20	11	14	14	20	467	376	370	770	330	220	140
4	20	12	15	13	20	450	411	370	800	300	180	130
5	19	13	16	14	20	430	470	380	800	270	160	120
6	17	13	15	14	20	380	540	390	740	250	170	115
7	16	12	16	14	19	350	580	411	610	250	145	100
8	16	11	14	13	19	330	590	430	550	210	138	91
9	17	11	14	13	18	320	570	440	470	190	120	82
10	18	11	13	14	19	310	545	430	410	170	110	76
11	17	12	14	14	20	310	530	410	370	150	100	68
12	16	13	16	14	20	320	540	360	320	140	92	60
13	15	14	16	14	21	340	577	320	300	150	95	58
14	15	14	15	14	23	334	560	274	290	140	91	55
15	14	13	14	14	25	320	540	260	320	130	84	53
16	14	12	13	15	27	310	510	230	310	110	77	55
17	13	11	12	16	30	310	490	210	300	98	74	54
18	12	11	12	17	38	330	480	200	285	90	74	54
19	13	11	13	18	58	369	480	200	260	95	81	55
20	13	11	13	20	91	400	460	208	250	110	180	54
21	13	11	14	20	110	450	430	218	230	100	397	53
22	13	12	15	18	222	600	400	280	220	90	500	50
23	13	13	17	16	278	785	400	260	210	80	545	48
24	14	13	17	18	313	600	432	240	250	84	467	46
25	13	14	17	19	320	500	440	230	330	159	334	45
26	12	14	17	19	341	430	460	230	430	264	250	44
27	13	14	16	23	418	397	460	240	520	299	230	43
28	13	14	15	27	430	390	460	300	630	260	215	42
29	12	---	16	30	432	430	430	360	550	243	190	41
30	13	---	16	27	410	390	400	480	470	243	159	41
31	13	---	16	---	430	---	376	560	---	222	---	41
Mean	15	12	15	17	137	409	474	325	446	194	197	71
Min	12	11	12	13	18	310	376	200	210	80	74	41
Max	20	14	17	30	432	785	590	560	800	420	545	150

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1950

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	43	27	20	17	39	200	545	397	327	166	54	21
2	43	27	20	17	39	210	529	390	320	160	50	21
3	43	27	20	17	39	210	545	390	300	170	47	21
4	43	27	20	17	39	220	505	432	290	173	43	21
5	43	27	20	16	42	230	497	460	264	166	42	21
6	40	22	19	16	47	280	490	482	260	150	41	21
7	40	22	19	16	44	292	510	480	250	139	39	21
8	40	22	19	16	55	300	510	467	257	133	36	21
9	40	22	19	16	61	290	545	450	280	120	35	21
10	40	22	19	17	77	250	565	440	370	110	34	21
11	37	20	18	18	100	383	600	450	450	110	33	21
12	37	20	18	19	110	320	585	467	486	110	33	21
13	37	20	18	20	120	240	570	482	440	105	35	21
14	37	20	18	22	139	240	545	480	370	100	28	21
15	37	20	18	23	140	250	505	520	360	95	28	21
16	38	19	18	23	140	310	486	505	350	89	28	21
17	38	19	18	25	140	420	470	490	348	81	28	21
18	38	19	18	29	140	540	440	460	360	77	28	21
19	38	19	18	32	140	650	400	453	390	74	28	21
20	38	19	18	35	139	750	400	467	430	70	28	21
21	33	19	18	37	139	865	450	480	505	67	28	21
22	33	19	18	39	140	820	525	505	470	64	28	21
23	33	19	18	42	152	800	665	540	420	67	28	21
24	33	19	18	39	160	665	849	569	369	77	28	21
25	33	19	18	35	170	665	700	640	320	76	28	21
26	33	19	17	34	170	580	505	650	280	74	28	21
27	33	19	17	34	173	570	480	600	250	70	28	21
28	33	19	17	35	173	570	460	529	220	67	28	21
29	33	---	17	37	180	610	440	490	200	64	28	21
30	33	---	17	39	194	665	420	400	190	62	28	21
31	33	---	17	---	200	---	400	340	---	58	---	21
Mean	37	21	18	26	117	447	521	481	338	101	33	21
Min	33	19	17	16	39	200	400	340	190	58	28	21
Max	43	27	20	42	200	865	849	650	505	173	54	21

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1951

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	21	16	13	17	45	190	467	340	530	120	60	33
2	21	16	13	21	45	220	500	340	530	120	60	33
3	21	16	13	21	45	257	545	340	530	120	60	33
4	21	16	13	21	45	360	545	340	530	120	60	33
5	21	16	13	21	45	360	486	362	530	120	60	33
6	21	16	13	21	48	360	540	390	530	120	60	33
7	21	16	13	21	84	360	620	390	530	120	60	33
8	21	16	13	21	84	360	665	390	530	120	60	33
9	21	16	13	21	84	360	660	390	530	120	60	33
10	21	16	13	21	84	450	660	390	530	120	60	33
11	21	16	13	21	84	330	660	390	530	120	60	33
12	21	16	13	21	84	330	660	414	530	120	60	33
13	21	16	13	21	135	330	660	470	530	120	60	33
14	21	16	13	21	170	330	660	560	530	120	60	33
15	21	16	13	23	170	330	585	545	530	120	60	31
16	17	15	14	25	170	330	540	420	480	120	43	28
17	17	15	14	25	170	257	540	420	480	60	43	28
18	17	15	14	25	170	230	540	420	480	53	43	28
19	17	15	14	25	170	230	540	344	480	53	43	28
20	17	15	14	25	170	230	540	310	480	53	43	28
21	17	15	14	25	170	230	540	310	480	53	43	28
22	17	15	14	25	170	230	467	310	480	53	43	28
23	17	15	14	31	170	230	400	310	480	53	43	28
24	17	15	14	43	170	348	400	310	480	53	43	28
25	17	15	14	43	170	420	400	292	480	53	43	28
26	17	15	14	43	170	420	400	360	480	53	43	28
27	17	15	14	43	140	420	400	360	480	53	43	28
28	17	15	14	43	140	420	400	360	480	53	43	28
29	17	---	14	43	140	420	362	360	480	53	43	28
30	19	---	16	43	152	420	350	360	480	53	43	28
31	19	---	16	---	160	---	340	360	---	53	---	28
Mean	19	16	14	27	124	325	518	376	505	88	52	30
Min	17	15	13	17	45	190	340	292	480	53	43	28
Max	21	16	16	43	170	450	665	560	530	120	60	33

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1952

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	20	16	17	14	17	200	510	555	306	279	300	168
2	20	16	17	14	18	212	452	508	306	251	283	110
3	20	16	17	14	19	212	466	476	292	276	270	110
4	20	16	17	14	20	210	423	472	276	560	254	110
5	20	16	17	14	22	212	435	476	254	702	244	110
6	20	16	17	14	23	200	510	494	222	708	225	110
7	20	16	17	14	25	184	585	570	202	605	247	110
8	20	16	17	14	27	176	533	600	188	512	300	110
9	20	16	17	14	30	176	479	580	175	440	300	110
10	20	16	17	14	33	200	456	555	163	408	328	110
11	20	16	17	14	38	218	470	526	156	376	338	90
12	20	16	15	14	42	282	533	565	152	338	328	90
13	20	16	15	14	44	344	651	570	163	317	303	90
14	20	16	15	14	45	358	675	540	213	324	273	90
15	20	16	15	14	45	358	603	521	244	331	263	90
16	17	17	15	15	47	390	528	472	241	331	241	90
17	17	17	15	15	51	414	479	420	225	300	213	90
18	17	17	15	15	56	450	452	380	208	279	193	90
19	17	17	15	15	60	464	443	338	193	260	175	90
20	17	17	15	15	74	471	484	346	188	244	178	90
21	17	17	15	15	90	521	538	349	222	228	178	186
22	17	17	15	15	90	541	669	349	314	219	165	178
23	17	17	15	15	90	565	733	346	349	208	235	186
24	17	17	15	15	92	537	792	328	400	193	372	202
25	17	17	15	15	95	509	785	328	462	183	372	196
26	17	17	15	15	100	494	720	324	458	202	335	180
27	17	17	15	15	111	545	702	314	420	228	286	161
28	17	17	15	15	130	621	696	292	384	247	260	147
29	17	17	15	15	156	601	702	286	349	306	228	135
30	17	---	15	15	170	581	636	283	306	300	196	122
31	17	---	15	---	190	---	595	289	---	289	---	106
Mean	18	16	16	15	66	375	572	434	268	337	263	124
Min	17	16	15	14	17	176	423	283	152	183	165	90
Max	20	17	17	15	190	621	792	600	462	708	372	202

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1953

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	90	42	33	24	170	524	1210	657	352	115	80	45
2	83	42	33	24	177	575	989	831	320	108	80	44
3	76	42	33	24	182	657	885	933	295	103	80	44
4	72	42	33	24	193	726	810	831	391	126	80	42
5	70	42	33	24	201	768	747	675	549	237	80	41
6	70	42	33	24	204	726	705	585	538	645	80	40
7	64	42	33	24	207	699	693	569	488	740	80	38
8	64	42	33	24	207	705	699	538	443	657	80	39
9	64	42	33	24	201	733	651	538	387	528	80	41
10	64	42	33	24	190	761	609	549	345	423	80	41
11	64	42	33	24	177	719	597	520	305	367	74	41
12	64	42	33	24	198	699	627	484	302	323	74	39
13	64	42	33	24	212	663	657	524	327	363	74	38
14	64	42	33	24	243	597	719	585	338	356	74	38
15	64	42	33	24	262	554	754	549	331	313	74	37
16	47	48	28	26	278	543	761	488	309	281	74	40
17	47	48	28	30	302	543	719	427	288	243	74	41
18	47	48	28	35	323	564	675	391	269	218	74	41
19	47	48	28	66	359	621	663	367	246	204	74	39
20	47	48	28	90	399	663	621	349	230	185	74	39
21	47	48	28	110	411	733	575	341	210	167	59	41
22	47	48	28	120	387	824	559	349	193	165	56	40
23	47	48	28	120	359	925	575	407	195	160	58	40
24	47	48	28	120	345	1050	580	439	201	150	56	42
25	47	48	28	115	338	1510	705	448	193	140	54	41
26	47	46	28	110	331	1920	754	419	177	130	53	39
27	47	45	28	109	338	2090	754	387	165	120	51	39
28	47	44	28	126	356	2140	747	439	154	110	50	37
29	47	---	28	145	356	2010	705	474	139	100	48	36
30	47	---	28	160	367	1610	663	427	126	99	47	35
31	47	---	28	---	439	---	645	387	---	97	---	34
Mean	58	44	30	61	281	928	711	513	294	257	69	40
Min	47	42	28	24	170	524	559	341	126	97	47	34
Max	90	48	33	160	439	2140	1210	933	549	740	80	45

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1954

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	34	32	32	25	55	233	452	627	237	160	338	93
2	33	32	32	25	56	269	452	569	227	158	327	86
3	32	32	32	25	58	313	427	543	233	147	309	79
4	30	32	32	25	63	327	411	520	240	135	285	71
5	30	32	32	25	68	352	395	484	237	124	253	65
6	30	32	32	25	80	387	379	466	224	115	224	60
7	30	32	32	25	89	431	367	456	215	110	198	57
8	33	32	32	25	94	492	379	439	201	98	177	57
9	40	32	32	25	106	510	399	439	193	96	154	58
10	40	32	32	25	117	502	448	427	221	94	137	56
11	38	34	32	25	131	479	502	431	230	91	122	52
12	38	34	32	25	156	484	492	448	221	89	112	51
13	37	34	32	25	180	448	456	403	198	86	106	50
14	36	34	32	25	182	383	423	352	177	96	97	48
15	35	34	32	25	180	367	419	323	167	154	91	45
16	35	34	25	25	185	363	452	305	172	180	89	44
17	34	34	25	25	190	375	474	281	224	170	84	43
18	34	34	25	25	190	403	452	295	249	154	82	44
19	32	34	25	25	201	427	448	320	249	147	78	50
20	32	34	25	25	221	431	443	338	230	143	78	50
21	31	34	25	29	230	452	423	323	207	126	76	46
22	31	34	25	30	224	435	391	298	182	119	76	45
23	30	34	25	31	233	403	363	320	163	239	86	42
24	29	34	25	33	262	387	345	356	185	302	96	39
25	29	34	25	36	275	403	327	363	185	281	124	38
26	28	34	25	39	272	435	331	352	170	295	126	38
27	28	34	25	44	275	452	352	331	154	272	122	37
28	27	34	25	47	265	452	387	298	139	246	115	37
29	27	---	25	50	256	448	411	278	145	237	104	37
30	26	---	25	53	237	439	456	262	151	243	97	37
31	26	---	25	---	224	---	549	249	---	309	---	37
Mean	32	33	28	30	173	409	420	384	201	168	145	51
Min	26	32	25	25	55	233	327	249	139	86	76	37
Max	40	34	32	53	275	510	549	627	249	309	338	93

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1955

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	38	27	18	18	20	112	403	627	768	95	59	25
2	38	27	18	18	21	112	461	621	810	91	56	25
3	38	27	18	18	22	114	559	597	621	89	53	25
4	38	27	18	18	23	117	693	559	488	88	51	25
5	38	27	18	18	24	122	693	675	391	93	48	25
6	38	27	18	18	26	127	651	789	331	96	47	25
7	38	27	18	18	26	135	627	726	285	93	47	25
8	38	27	18	18	28	156	609	633	249	89	45	25
9	38	27	18	18	29	210	657	543	237	85	44	25
10	38	27	18	18	32	240	877	497	265	81	44	25
11	38	27	18	18	38	278	1030	456	302	77	44	25
12	38	27	18	18	44	275	893	411	379	75	43	25
13	38	27	18	18	53	259	733	371	375	71	42	25
14	38	27	18	18	56	240	633	345	334	74	42	25
15	38	27	18	18	61	230	575	313	288	71	43	25
16	45	20	18	18	76	240	559	275	249	71	42	25
17	45	20	18	18	90	262	528	253	210	74	42	25
18	45	20	18	18	98	316	510	237	180	76	41	25
19	45	20	18	18	100	383	520	230	163	74	41	25
20	45	20	18	18	102	415	575	227	143	69	40	25
21	45	20	18	18	103	423	657	227	131	68	39	25
22	45	20	18	18	103	431	712	233	126	85	38	25
23	45	20	18	18	106	443	740	246	117	99	37	25
24	45	20	18	18	119	456	726	295	117	99	36	25
25	45	20	18	18	126	488	687	352	115	94	35	25
26	45	20	18	18	124	488	663	349	112	88	34	25
27	45	20	18	18	119	448	633	338	108	84	33	25
28	45	20	18	18	117	423	591	334	104	78	32	25
29	45	---	18	18	117	395	569	298	98	72	31	25
30	45	---	18	18	117	383	564	259	94	65	30	25
31	45	---	18	---	112	---	609	308	---	63	---	25
Mean	42	24	18	18	72	291	643	407	273	82	42	25
Min	38	20	18	18	20	112	403	227	94	63	30	25
Max	45	27	18	18	126	488	1030	789	810	99	59	25

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1956

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	20	17	15	18	74	141	456	534	312	94	44	119
2	20	17	15	18	78	139	460	477	290	91	45	108
3	20	17	15	18	79	145	460	431	263	88	44	98
4	20	17	15	18	78	154	460	390	245	87	44	89
5	20	17	15	18	81	156	452	358	231	84	43	83
6	20	17	15	18	87	166	447	397	220	79	42	76
7	20	17	15	18	89	178	460	447	212	75	41	71
8	20	17	15	18	91	199	469	443	202	71	41	65
9	20	17	15	18	95	215	439	416	193	69	42	60
10	20	17	15	18	95	228	408	408	193	69	41	58
11	20	17	15	18	94	237	393	424	215	70	41	54
12	20	17	15	18	93	251	397	460	245	69	41	51
13	20	17	15	18	90	263	443	469	284	67	41	49
14	20	17	15	18	89	278	505	456	296	66	41	46
15	20	17	15	18	87	293	576	486	272	64	40	44
16	20	17	15	18	87	318	622	560	248	65	39	41
17	20	17	15	18	88	355	633	560	223	63	38	39
18	20	17	15	18	89	372	610	545	248	62	38	37
19	20	17	15	18	90	368	571	555	281	60	38	36
20	20	17	15	18	105	355	539	645	272	59	38	35
21	20	17	15	21	147	332	500	599	239	57	41	34
22	20	17	15	20	183	305	473	510	210	54	44	34
23	20	17	15	20	196	290	447	452	183	51	43	33
24	20	17	15	21	193	290	435	397	160	49	42	32
25	20	17	15	22	191	287	416	386	141	49	47	32
26	20	17	15	26	199	299	400	375	129	48	70	31
27	20	17	15	29	196	322	404	368	119	52	130	31
28	20	17	15	35	191	332	404	412	112	51	145	30
29	20	17	15	46	183	372	404	397	105	49	151	30
30	20	---	15	58	160	427	424	355	99	47	134	30
31	20	---	15	---	147	---	500	335	---	45	---	29
Mean	20	17	15	22	121	269	471	453	215	65	56	52
Min	20	17	15	18	74	139	393	335	99	45	38	29
Max	20	17	15	58	199	427	633	645	312	94	151	119

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1957

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	26	19	20	19	46	288	423	327	363	175	253	98
2	26	19	20	19	46	327	431	327	435	156	230	104
3	26	19	20	19	49	407	427	327	1390	143	227	100
4	26	19	20	20	52	492	423	327	1500	129	253	94
5	26	19	20	20	55	543	399	305	1410	119	240	94
6	26	19	20	20	60	569	363	288	1000	110	215	89
7	26	19	20	20	66	627	341	291	712	104	193	82
8	26	19	20	20	80	687	334	320	564	100	172	76
9	26	19	20	20	100	687	352	352	502	96	158	70
10	26	19	20	20	115	651	383	371	452	93	147	68
11	26	19	21	20	135	585	403	375	419	91	141	61
12	26	19	21	20	149	549	403	363	853	86	143	60
13	26	19	21	21	172	488	399	331	1020	82	143	55
14	26	19	21	23	167	479	407	320	817	79	135	52
15	26	19	21	25	204	466	423	338	621	76	124	49
16	19	19	21	25	210	448	423	356	488	90	127	47
17	19	19	21	26	195	423	419	367	399	96	163	45
18	19	19	21	27	190	415	403	349	359	196	156	44
19	19	19	21	28	204	403	383	323	345	423	143	42
20	19	19	21	30	237	391	341	305	309	411	160	40
21	19	19	18	36	259	359	316	423	295	427	185	39
22	19	19	18	38	253	352	305	466	298	520	172	37
23	19	19	18	40	240	345	285	427	275	448	154	36
24	19	19	18	43	227	341	272	387	334	356	135	35
25	19	19	18	44	218	345	275	356	371	295	120	34
26	19	19	18	45	212	345	291	349	363	243	120	33
27	19	19	18	45	218	345	295	474	323	201	112	33
28	19	19	18	45	221	349	285	575	281	218	108	32
29	19	---	18	45	230	367	291	520	243	288	104	32
30	19	---	18	45	253	399	305	435	207	302	102	32
31	19	---	18	---	269	---	316	383	---	262	---	32
Mean	22	19	20	29	166	449	359	370	565	207	161	56
Min	19	19	18	19	46	288	272	288	207	76	102	32
Max	26	19	21	45	269	687	431	575	1500	520	253	104

Grant Creek - USGS Station 15246000

Daily Mean Discharge (cfs)
Calendar Year
1958

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	32	32	27	44	125	335	447	361	220	---	---	---
2	32	32	27	48	139	372	447	361	212	---	---	---
3	33	32	27	49	154	408	464	368	199	---	---	---
4	35	31	26	50	162	424	477	361	186	---	---	---
5	40	30	26	50	164	447	520	379	178	---	---	---
6	49	30	25	52	162	491	545	404	176	---	---	---
7	56	30	25	55	158	610	496	424	178	---	---	---
8	62	30	26	59	154	726	456	420	174	---	---	---
9	58	29	25	60	145	705	431	416	169	---	---	---
10	54	29	25	62	141	610	424	393	160	---	---	---
11	51	29	25	65	139	555	416	390	158	---	---	---
12	48	29	24	66	141	515	382	431	160	---	---	---
13	45	28	24	67	143	496	365	539	160	---	---	---
14	43	29	25	69	143	431	368	761	158	---	---	---
15	41	28	25	68	143	390	358	810	156	---	---	---
16	38	28	25	68	145	397	393	616	151	---	---	---
17	36	28	25	67	147	404	529	539	145	---	---	---
18	42	30	25	67	143	404	576	456	139	---	---	---
19	58	30	25	65	141	443	571	408	138	---	---	---
20	56	29	25	66	145	599	520	382	132	---	---	---
21	53	28	25	65	156	965	486	390	125	---	---	---
22	51	28	25	65	169	941	473	404	120	---	---	---
23	49	28	25	64	186	768	469	393	134	---	---	---
24	44	28	25	64	210	622	424	416	147	---	---	---
25	43	27	26	65	215	555	382	397	141	---	---	---
26	40	27	25	69	223	520	361	365	138	---	---	---
27	39	27	25	77	218	505	408	328	134	---	---	---
28	38	28	26	87	212	491	486	296	129	---	---	---
29	35	---	26	101	212	469	469	269	123	---	---	---
30	34	---	27	114	242	443	408	245	115	---	---	---
31	33	---	29	---	290	---	382	231	---	---	---	---
Mean	44	29	26	66	170	535	449	418	155	---	---	---
Min	32	27	24	44	125	335	358	231	115	---	---	---
Max	62	32	29	114	290	965	576	810	220	---	---	---

Grant Creek - EBASCO Gage

Daily Mean Discharge (cfs)
Calendar Year
1981

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---
8	---	---	---	---	---	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---	---	---	---	---	---
11	---	---	---	---	---	---	---	---	---	---	---	---
12	---	---	---	---	---	---	---	---	---	---	---	---
13	---	---	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---	---
20	---	---	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	121	---	---
22	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---
30	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---
Mean	---	---	---	---	---	---	---	---	---	---	---	---
Min	---	---	---	---	---	---	---	---	---	121	---	---
Max	---	---	---	---	---	---	---	---	---	121	---	---

Grant Creek - EBASCO Gage

Daily Mean Discharge (cfs)
Calendar Year
1982

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	26	---	196	468	490	284	260	103	94
2	---	---	---	---	---	210	446	472	262	---	104	92
3	---	---	---	---	---	223	400	460	232	---	101	94
4	---	---	30	---	---	234	365	449	261	---	105	97
5	---	---	---	---	---	238	365	434	219	---	105	108
6	---	---	---	---	---	244	354	427	412	---	103	120
7	---	---	---	---	---	262	361	427	454	---	101	118
8	---	---	---	---	---	274	408	438	451	---	101	111
9	43	---	---	---	---	298	442	442	446	---	99	108
10	---	---	---	---	---	342	488	434	424	---	97	108
11	---	---	---	---	---	394	486	419	407	---	94	104
12	---	---	---	---	---	375	472	405	385	---	92	101
13	---	---	---	---	---	348	466	393	394	---	92	96
14	---	---	---	---	---	314	472	400	433	---	91	92
15	---	---	---	---	---	290	474	400	457	---	90	90
16	---	---	---	---	---	274	474	398	602	---	89	89
17	---	---	---	---	---	304	472	374	590	---	87	96
18	---	---	---	---	---	304	466	358	552	---	86	104
19	---	---	---	---	---	274	460	338	545	---	84	110
20	---	---	---	---	---	282	464	316	532	---	84	108
21	---	---	---	---	97	282	472	305	514	---	77	106
22	---	---	---	---	---	278	476	289	504	---	77	104
23	---	---	---	---	---	276	474	296	482	---	76	103
24	---	---	---	---	150	288	486	307	454	---	76	101
25	---	---	---	---	155	306	486	316	433	---	80	97
26	---	---	---	---	166	338	474	303	407	---	89	96
27	---	---	---	---	170	388	472	294	383	---	101	95
28	---	---	---	---	166	460	474	274	347	105	101	94
29	---	---	---	---	166	482	490	280	290	104	99	93
30	22	---	---	---	170	468	514	298	260	103	96	92
31	---	---	---	---	180	---	505	292	---	101	---	91
Mean	---	---	---	---	---	308	456	372	414	---	93	100
Min	22	---	30	26	97	196	354	274	219	101	76	89
Max	43	---	30	26	180	482	514	490	602	260	105	120

Grant Creek - EBASCO Gage

Daily Mean Discharge (cfs)
Calendar Year
1983

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	96	512	535	422	303	136	110	138
2	---	---	---	---	107	517	533	424	297	135	113	141
3	---	---	---	---	114	496	517	429	282	133	117	140
4	---	---	---	---	119	466	507	449	261	130	114	133
5	---	---	---	---	119	432	509	456	229	127	113	128
6	---	---	---	---	120	412	504	476	203	122	111	122
7	---	---	---	---	117	412	499	476	182	117	111	116
8	---	---	---	---	119	419	494	489	174	114	113	---
9	---	---	---	---	123	422	522	494	167	113	113	---
10	---	---	---	---	128	439	530	481	160	117	124	---
11	---	---	---	---	130	439	517	461	156	131	128	---
12	---	---	---	---	133	429	501	444	149	139	128	---
13	---	---	---	---	138	424	491	427	146	139	124	---
14	---	---	---	---	146	429	489	405	165	136	119	---
15	---	---	---	---	156	436	486	382	148	133	117	---
16	---	---	---	---	166	432	484	368	143	130	113	---
17	---	---	---	---	175	432	486	354	138	127	111	---
18	---	---	---	---	184	434	486	345	133	128	105	---
19	---	---	---	---	184	449	479	336	136	128	102	---
20	---	---	---	---	182	459	469	327	144	123	98	---
21	46	---	---	---	184	456	459	323	154	127	95	---
22	---	---	---	---	193	459	449	327	161	133	94	---
23	---	---	18	---	199	466	434	325	158	135	92	---
24	---	---	---	---	197	476	424	323	153	133	89	---
25	---	---	---	---	195	489	417	318	146	128	88	---
26	---	---	---	65	195	507	407	320	143	123	87	---
27	---	---	---	70	195	519	410	323	138	120	84	---
28	---	---	---	80	195	525	419	323	135	122	88	---
29	---	---	---	87	208	525	432	320	136	119	96	---
30	---	---	---	92	288	530	434	318	138	116	128	---
31	---	---	---	96	424	---	429	310	---	113	---	---
Mean	---	---	---	---	169	461	476	386	173	127	108	---
Min	46	---	18	65	96	412	407	310	133	113	84	116
Max	46	---	18	96	424	530	535	494	303	139	128	141

Grant Creek - McMillen GC200 Gage

Daily Mean Discharge (cfs)
Calendar Year
2013

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	---	---	---	---	28	565	616	459	348	224	370	60
2	---	---	---	---	31	554	600	448	335	207	321	59
3	---	---	---	19	33	545	539	436	362	204	280	57
4	---	---	---	19	41	507	468	420	411	216	250	56
5	---	---	---	19	46	472	436	381	411	212	229	56
6	---	---	---	19	49	446	433	368	396	200	208	56
7	---	---	---	19	52	440	460	367	443	190	188	54
8	---	---	---	19	56	477	486	381	438	186	174	54
9	---	---	---	19	60	542	453	402	427	190	157	53
10	---	---	---	19	65	613	432	432	483	183	156	52
11	---	---	---	19	75	659	438	459	636	175	154	50
12	---	---	---	18	94	710	441	521	665	169	137	49
13	---	---	---	18	125	734	444	484	604	284	125	49
14	---	---	---	18	154	712	452	434	520	392	118	52
15	---	---	---	17	162	718	451	390	445	359	110	53
16	---	---	---	17	158	784	454	359	386	329	102	51
17	---	---	---	16	151	862	466	348	333	317	94	49
18	---	---	---	17	143	970	493	336	298	311	87	49
19	---	---	---	16	130	1005	521	319	264	313	82	49
20	---	---	---	17	130	960	526	317	230	315	77	48
21	---	---	---	17	123	894	514	313	211	288	76	47
22	---	---	---	17	119	797	483	320	200	258	84	47
23	---	---	---	19	119	706	468	319	185	234	82	45
24	---	---	---	21	135	646	464	317	171	216	80	44
25	---	---	---	22	167	636	459	301	185	206	77	43
26	---	---	---	23	203	641	463	276	219	190	75	42
27	---	---	---	24	240	660	459	253	251	188	75	41
28	---	---	---	24	340	670	461	251	296	278	68	41
29	---	---	---	26	404	636	467	335	279	446	65	40
30	---	---	---	27	499	617	470	391	248	442	62	39
31	---	---	---	---	566	---	470	378	---	414	---	40
Mean	---	---	---	19	152	673	477	371	356	263	139	49
Min	---	---	---	16	28	440	432	251	171	169	62	39
Max	---	---	---	27	566	1005	616	521	665	446	370	60

```
#
# U.S. Geological Survey
# National Water Information System
# Retrieved: 2013-11-01 18:39:32 EDT
#
# -----WARNING-----
# The data you have obtained from this automated
# U.S. Geological Survey database have not received
# Director's approval and as such are provisional
# and subject to revision. The data are released
# on the condition that neither the USGS nor the
# United States Government may be held liable for
# any damages resulting from its use.
#
# More data may be available offline.
# For more information on these data, contact Alaska Water Data Inquiries.
# This file contains the annual peak streamflow data.
#
# This information includes the following fields:
#
# agency_cd    Agency Code
# site_no      USGS station number
# peak_dt      Date of peak streamflow (format YYYY-MM-DD)
# peak_tm      Time of peak streamflow (24 hour format, 00:00 - 23:59)
# peak_va      Annual peak streamflow value in cfs
# peak_cd      Peak Discharge-Qualification codes (see explanation below)
# gage_ht      Gage height for the associated peak streamflow in feet
# gage_ht_cd   Gage height qualification codes
# year_last_pk Peak streamflow reported is the highest since this year
# ag_dt        Date of maximum gage-height for water year (if not concurrent with peak)
# ag_tm        Time of maximum gage-height for water year (if not concurrent with peak)
# ag_gage_ht    maximum Gage height for water year in feet (if not concurrent with peak)
# ag_gage_ht_cd maximum Gage height code
#
# Sites in this file include:
# USGS 15246000 GRANT C NR MOOSE PASS AK
#
# Peak Streamflow-Qualification Codes(peak_cd):
# 1 ... Discharge is a Maximum Daily Average
# 2 ... Discharge is an Estimate
# 3 ... Discharge affected by Dam Failure
# 4 ... Discharge less than indicated value,
#       which is Minimum Recordable Discharge at this site
# 5 ... Discharge affected to unknown degree by
#       Regulation or Diversion
# 6 ... Discharge affected by Regulation or Diversion
# 7 ... Discharge is an Historic Peak
# 8 ... Discharge actually greater than indicated value
# 9 ... Discharge due to Snowmelt, Hurricane,
#       Ice-Jam or Debris Dam breakup
# A ... Year of occurrence is unknown or not exact
# B ... Month or Day of occurrence is unknown or not exact
# C ... All or part of the record affected by Urbanization,
```

Mining, Agricultural changes, Channelization, or other
 # D ... Base Discharge changed during this year
 # E ... Only Annual Maximum Peak available for this year
 #
 # Gage height qualification codes(gage_ht_cd,ag_gage_ht_cd):
 # 1 ... Gage height affected by backwater
 # 2 ... Gage height not the maximum for the year
 # 3 ... Gage height at different site and(or) datum
 # 4 ... Gage height below minimum recordable elevation
 # 5 ... Gage height is an estimate
 # 6 ... Gage datum changed during this year
 #
 #

agency_cd	site_no	peak_dt	peak_tm	peak_va	peak_cd	gage_ht	gage_ht_cd	year_last_pk	ag_dt	ag_tm				
ag_gage_ht	ag_gage_ht_cd													
5s	15s	10d	6s	8s	27s	8s	13s	4s	10d	6s	8s	11s		
USGS	15246000			1948-07-07			780	1						
USGS	15246000			1949-09-04			800	1						
USGS	15246000			1950-06-21			865		4.00					
USGS	15246000			1951-07-08			665	1						
USGS	15246000			1952-07-24			820		3.00	2		1952-06-28	3.36	
USGS	15246000			1953-06-28			2230		4.46					
USGS	15246000			1953-10-07			782		3.11					
USGS	15246000			1955-07-11			1050		3.45					
USGS	15246000			1956-08-20			663		2.93	2		1956-01-10	3.30	1
USGS	15246000			1957-09-03			1700		4.06					
USGS	15246000			1958-06-21			1020		3.42					

Appendix B: Supplemental Information

Table 3. Regression equations for estimating 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year peak streamflows for unregulated streams in Regions 1-7, Alaska and conterminous basins in Canada

[Q_T , T -year peak streamflow, in cubic feet per second; A , drainage area, in square miles; ST , area of lakes and ponds (storage), in percent; P , mean annual precipitation, in inches; J , mean minimum January temperature, in degrees Fahrenheit; E , elevation, in feet; F , area of forest, in percent]

Regression equation for specified recurrence interval Q_T	Average standard error of prediction (log units)	Average standard error of prediction (percent)	Average equivalent years of record
Region 1, Region 3 (93 gaging stations)			
Applicable range of variables:			
A: 0.720–571; ST: 0–26; P: 70–300; J: 0–32			
$Q_2 = 0.004119 A^{0.8361} (ST+1)^{-0.3590} P^{0.9110} (J+32)^{1.635}$	0.158	38	0.88
$Q_5 = 0.009024 A^{0.8322} (ST+1)^{-0.3670} P^{0.8128} (J+32)^{1.640}$	.156	37	1.3
$Q_{10} = 0.01450 A^{0.8306} (ST+1)^{-0.3691} P^{0.7655} (J+32)^{1.622}$	.157	37	1.8
$Q_{25} = 0.02522 A^{0.8292} (ST+1)^{-0.3697} P^{0.7165} (J+32)^{1.588}$	.161	38	2.4
$Q_{50} = 0.03711 A^{0.8286} (ST+1)^{-0.3693} P^{0.6847} (J+32)^{1.559}$	.166	40	2.8
$Q_{100} = 0.05364 A^{0.8281} (ST+1)^{-0.3683} P^{0.6556} (J+32)^{1.527}$	.171	41	3.1
$Q_{200} = 0.07658 A^{0.8276} (ST+1)^{-0.3669} P^{0.6284} (J+32)^{1.495}$	.178	43	3.4
$Q_{500} = 0.1209 A^{0.8272} (ST+1)^{-0.3646} P^{0.5948} (J+32)^{1.449}$	.188	45	3.6
Region 2 (25 gaging stations)			
Applicable range of variables:			
A: 92.7–19,900; ST: 0–9; P: 12–100			
$Q_2 = 0.7479 A^{0.9580} (ST+1)^{-0.03292} P^{0.9284}$	.121	28	.82
$Q_5 = 1.021 A^{0.9449} (ST+1)^{-0.03603} P^{0.9359}$	.116	27	1.5
$Q_{10} = 1.184 A^{0.9368} (ST+1)^{-0.03813} P^{0.9500}$	.119	28	2.0
$Q_{25} = 1.374 A^{0.9274} (ST+1)^{-0.04074} P^{0.9713}$	.129	30	2.5
$Q_{50} = 1.506 A^{0.9209} (ST+1)^{-0.04263} P^{0.9887}$	.141	33	2.7
$Q_{100} = 1.628 A^{0.9147} (ST+1)^{-0.04448} P^{1.007}$	.154	37	2.7
$Q_{200} = 1.742 A^{0.9086} (ST+1)^{-0.04629} P^{1.027}$	.168	40	2.7
$Q_{500} = 1.880 A^{0.9008} (ST+1)^{-0.04864} P^{1.056}$	.189	46	2.6
Region 4 (71 gaging stations)			
Applicable range of variables:			
A: 1.07–19,400; ST: 0–28; P: 20–158			
$Q_2 = 0.2535 A^{0.9462} (ST+1)^{-0.1981} P^{1.201}$	.177	42	.98
$Q_5 = 0.5171 A^{0.9084} (ST+1)^{-0.2128} P^{1.162}$	.162	39	2.2
$Q_{10} = 0.7445 A^{0.8887} (ST+1)^{-0.2204} P^{1.147}$	.159	38	3.5
$Q_{25} = 1.091 A^{0.8686} (ST+1)^{-0.2273} P^{1.131}$	.164	39	5.0
$Q_{50} = 1.395 A^{0.8563} (ST+1)^{-0.2313} P^{1.120}$	.172	41	5.9
$Q_{100} = 1.738 A^{0.8457} (ST+1)^{-0.2347} P^{1.109}$	.183	44	6.6
$Q_{200} = 2.124 A^{0.8363} (ST+1)^{-0.2377} P^{1.099}$	.194	47	7.1
$Q_{500} = 2.704 A^{0.8253} (ST+1)^{-0.2413} P^{1.088}$	.212	52	7.4

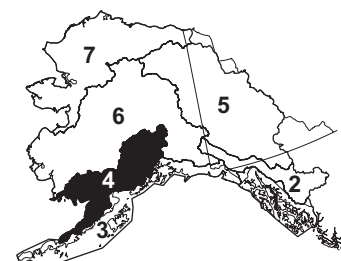
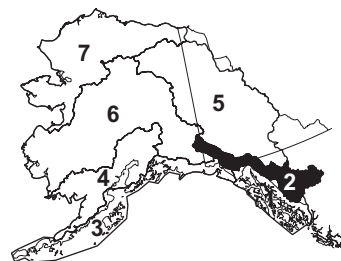


Table 4. Station information and peak-streamflow statistics for streamflow-gaging and partial-record stations in Alaska and conterminous basins in Canada—*Continued*

[Rounding differences may cause values in this table to vary by less than 1 percent from those computed using equations in table 3 or by the computer program available at <http://pubs.water.usgs.gov/wri034188>. **Station No.:** R, presently regulated. **Station name:** AK, Alaska; BC, British Columbia; YT, Yukon. **Region:** See [figure 1](#) for location of regions. **Latitude and Longitude** are given in degrees, minutes, and seconds. **Mean basin elevation:** Elevations are given in feet above NGVD of 1929. **Skew coefficient used for analysis:** weighted skew except where noted in footnote. **Peak streamflow analysis type:** Sta, value of Q_T from analysis of observed station data using weighted skew coefficient; Reg, value of Q_T estimated from regression equation ([table 3](#)); Wtd, value of Q_T estimated by weighting Sta and Reg based on the years of record for station data and equivalent years of record for the equation. **Peak streamflow:** Q_T , peak streamflow having a recurrence interval of T years. —, not available; ft, foot; mi², square mile; in., inch; °F, degree Fahrenheit]

Station No.	Station name	Region	Latitude	Longitude	Drainage area (mi ²)	Mean basin elevation (ft)	Area of lakes and ponds (storage) (percent)	Area of forest (percent)	Mean annual precipitation (in.)	Mean minimum January temperature (°F)
15242000	Kasilof River near Kasilof, AK	4	60 19 05	151 15 35	738	1,810	15	39	50	10
15243950	Porcupine Creek near Primrose, AK	4	60 20 24	149 22 30	16.8	2,300	0	34	80	10
15244000	Ptarmigan Creek at Lawing, AK	4	60 24 20	149 21 45	32.6	2,800	6	46	90	10
15246000	Grant Creek near Moose Pass, AK	4	60 27 25	149 21 15	44.2	2,900	10	20	90	10
15248000	Trail River near Lawing, AK	4	60 26 01	149 22 19	181	2,470	2	9	90	10
15250000	Falls Creek near Lawing, AK	4	60 25 50	149 22 10	11.8	3,480	0	19	80	10
15251800	Quartz Creek at Gilpatricks, AK	4	60 35 45	49 32 35	9.41	3,260	0	11	60	10
15254000	Crescent Creek near Cooper Landing, AK	4	60 29 49	149 40 38	31.7	2,700	13	38	50	8
15258000 ^{1,R}	Kenai River at Cooper Landing, AK	4	60 29 34	149 48 28	634	2,650	5	13	70	10
15258000 ^{1,2,R}	Kenai River at Cooper Landing, AK, regulated years	4	61 29 34	150 48 28	634	2,650	5	13	70	10
15260000	Cooper Creek near Cooper Landing, AK	4	60 26 00	149 49 15	31.8	2,400	16	44	60	8
15266300	Kenai River at Soldotna, AK	4	60 28 39	151 04 46	1,950	1,750	5	29	50	8
15266500	Beaver Creek near Kenai, AK	4	60 33 50	151 07 03	51.0	140	15	67	20	6

¹ Record includes glacial outbursts. Station not included in regression analysis. Station skew coefficient used to calculate Q_T .

² Record includes regulated years. Station not included in regression analysis. Station skew coefficient used to calculate Q_T .

³ Drainage area is indeterminate. Station not included in regression analysis. Station skew coefficient used to calculate Q_T .

Table 4. Station information and peak-streamflow statistics for streamflow-gaging and partial-record stations in Alaska and conterminous basins in Canada—*Continued*

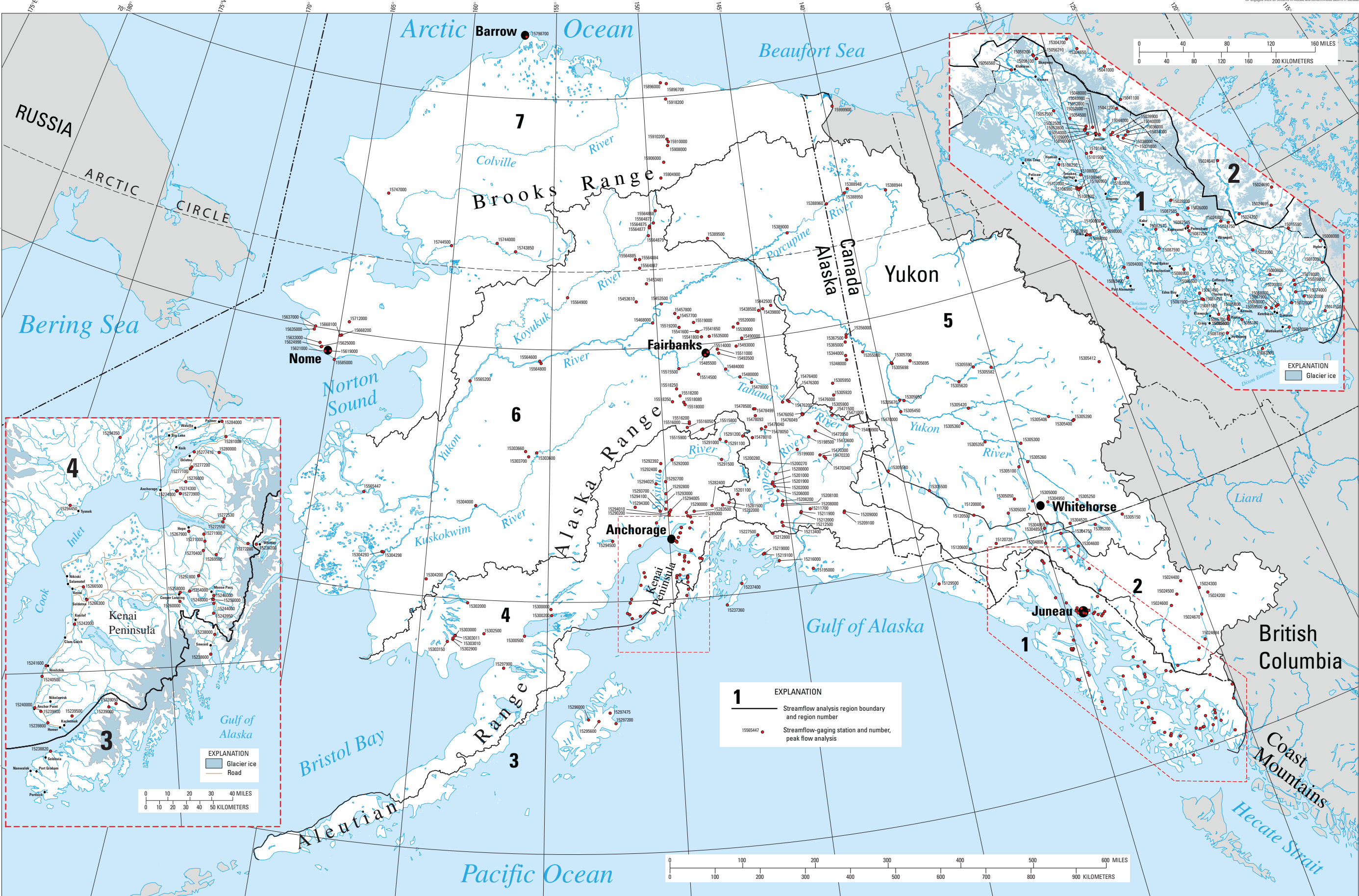
[Rounding differences may cause values in this table to vary by less than 1 percent from those computed using equations in table 3 or by the computer program available at <http://pubs.water.usgs.gov/wri034188>. **Station No.:** R, presently regulated. **Station name:** AK, Alaska; BC, British Columbia; YT, Yukon.

Region: See [figure 1](#) for location of regions. **Latitude and Longitude** are given in degrees, minutes, and seconds. **Mean basin elevation:** Elevations are given in feet above NGVD of 1929. **Skew coefficient used for analysis:** weighted skew except where noted in footnote. **Peak streamflow analysis type:** Sta, value of Q_T from analysis of observed station data using weighted skew coefficient; Reg, value of Q_T estimated from regression equation ([table 3](#)); Wtd, value of Q_T estimated by weighting Sta and Reg based on the years of record for station data and equivalent years of record for the equation. **Peak streamflow:** Q_T , peak streamflow having a recurrence interval of T years. —, not available; ft, foot; mi², square mile; in., inch; °F, degree Fahrenheit]

Station No.	Number of systematic peaks	Skew coefficient used for analysis	Peak streamflow analysis type	Peak streamflow, in cubic feet per second, for given recurrence interval, in years							
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{200}	Q_{500}
15242000	25	0.158	Sta	8,080	9,890	11,000	12,400	13,400	14,400	15,400	16,700
			Reg	8,300	10,900	12,700	15,000	16,800	18,500	20,300	22,700
			Wtd	8,080	9,930	11,100	12,700	13,800	14,900	16,000	17,500
15243950	27	.939	Sta	772	1,290	1,790	2,640	3,490	4,550	5,900	8,250
			Reg	706	1,090	1,390	1,800	2,110	2,440	2,780	3,270
			Wtd	769	1,270	1,730	2,460	3,140	3,960	4,940	6,580
15244000	10	.380	Sta	523	703	832	1,000	1,140	1,280	1,430	1,650
			Reg	1,040	1,510	1,870	2,350	2,710	3,080	3,470	4,010
			Wtd	558	815	1,040	1,350	1,590	1,830	2,080	2,430
15246000	10	.962	Sta	936	1,330	1,660	2,170	2,620	3,140	3,760	4,730
			Reg	1,260	1,810	2,220	2,760	3,170	3,590	4,020	4,620
			Wtd	961	1,410	1,790	2,350	2,810	3,310	3,860	4,690
15248000	29	.609	Sta	3,670	4,840	5,700	6,890	7,860	8,890	10,000	11,600
			Reg	6,200	8,600	10,400	12,600	14,300	16,000	17,800	20,300
			Wtd	3,720	4,990	5,980	7,370	8,490	9,660	10,900	12,700
15250000	8	.349	Sta	242	452	642	951	1,240	1,580	1,990	2,650
			Reg	505	793	1,020	1,320	1,560	1,810	2,070	2,440
			Wtd	266	519	749	1,090	1,380	1,690	2,030	2,540
15251800	8	.867	Sta	166	319	478	773	1,090	1,510	2,060	3,100
			Reg	289	462	599	785	932	1,090	1,250	1,480
			Wtd	176	343	508	777	1,020	1,310	1,660	2,240
15254000	34	.750	Sta	331	519	682	939	1,180	1,460	1,790	2,330
			Reg	434	643	799	1,010	1,170	1,330	1,510	1,750
			Wtd	334	526	692	948	1,170	1,430	1,730	2,210
15258000 ^{1,R}	13	1.42	Sta	9,960	12,900	15,400	19,200	22,600	26,500	31,000	38,000
15258000 ^{1,2,R}	39	.372	Sta	11,100	14,800	17,400	20,800	23,500	26,400	29,300	33,500
15260000	10	.952	Sta	294	413	512	662	796	950	1,130	1,410
			Reg	521	764	947	1,190	1,370	1,560	1,760	2,040
			Wtd	310	465	605	812	982	1,170	1,360	1,660
15266300	35	.788	Sta	18,900	24,000	27,700	32,800	37,000	41,400	46,300	53,200
			Reg	25,300	32,500	37,500	43,700	48,400	53,000	57,800	64,300
			Wtd	19,000	24,200	28,100	33,400	37,700	42,300	47,200	54,200
15266500	25	.0559	Sta	188	357	501	721	914	1,130	1,380	1,750
			Reg	221	332	414	524	610	699	793	925
			Wtd	189	355	490	685	849	1,030	1,230	1,530

Appendix A. Years of record for annual peak streamflows used in this report—*Continued*[Refer to [table 4](#) for number of systematic peaks used; AK, Alaska; BC, British Columbia; YT, Yukon]

Station No.	Station name	Water years for peak streamflows (systematic and historic) used in this report	Water years for historic peaks used in this report	Length of historic period (years)
15216000	Power Creek near Cordova, AK	1948-95	—	—
15219000	West Fork Olsen Bay Creek near Cordova, AK	1965-80	—	—
15219100	Control Creek near Cordova, AK	1964-74	—	—
15227500	Mineral Creek near Valdez, AK	1976-81, 1990-99	—	—
15236200	Shakespeare Creek at Whittier, AK	1970-80, 1984-99	—	—
15237360	San Juan River near Seward, AK	1987-96	—	—
15237400	Chalmers River near Cordova, AK	1967-73, 1975-80	—	—
15238000	Lost Creek near Seward, AK	1949, 1963-72, 1976, 1987	1976, 1987	51
15238600	Spruce Creek near Seward, AK	1966-86, 1988-99	—	—
15238820	Barabara Creek near Seldovia, AK	1973-92	—	—
15239000	Bradley River near Homer, AK	1958-88	—	—
15239050	Middle Fork Bradley River tributary near Homer, AK	1980-99	—	—
15239500	Fritz Creek near Homer, AK	1963-99	—	—
15239800	Diamond Creek near Homer, AK	1963-81	—	—
15239900	Anchor River near Anchor Point, AK	1966-74, 1979-87, 1992	—	48
15240000	Anchor River at Anchor Point, AK	1954-66, 1984-92	—	48
15240500	Cook Inlet tributary near Ninilchik, AK	1966-81	—	—
15241600	Ninilchik River at Ninilchik, AK	1963-85, 1999	—	—
15242000	Kasilof River near Kasilof, AK	1950-74, 1977	1977	28
15243950	Porcupine Creek near Primrose, AK	1963-89	—	—
15244000	Ptarmigan Creek at Lawing, AK	1948-50, 1952-58	—	—
15246000	Grant Creek near Moose Pass, AK	1948-50, 1952-58	—	—
15248000	Trail River near Lawing, AK	1948-50, 1952-77	—	—
15250000	Falls Creek near Lawing, AK	1963-70	—	—
15251800	Quartz Creek at Gilpatricks, AK	1963-70, 1987	1987	25
15254000	Crescent Creek near Cooper Landing, AK	1950-83	—	—
15258000	Kenai River at Cooper Landing, AK	1948-60	—	—
15258000	Kenai River at Cooper Landing, AK, regulated years	1961-99	—	—
15260000	Cooper Creek near Cooper Landing, AK	1950-59	—	—
15266300	Kenai River at Soldotna, AK	1965-99	—	47
15266500	Beaver Creek near Kenai, AK	1968-78, 1980-83, 1985-94	—	—
15267900	Resurrection Creek near Hope, AK	1968-85	—	—
15269500	Granite Creek near Portage, AK	1967-80	—	—
15270400	Donaldson Creek near Wibel, AK	1963-72	—	—
15271000	Sixmile Creek near Hope, AK	1980-90, 1998-99	—	—
15271900	Cub Creek near Hope, AK	1965-79	—	—
15272280	Portage Creek at Portage Lake outlet near Whittier, AK	1989-99	—	—
15272530	California Creek at Girdwood, AK	1967-84, 1986-93, 1995	1995	28
15272550	Glacier Creek at Girdwood, AK	1966-78	—	—
15273900	South Fork Campbell Creek at canyon mouth near Anchorage, AK	1967-79, 1981	—	—
15274000	South Fork Campbell Creek near Anchorage, AK	1948-72, 1999	—	—
15274300	North Fork Campbell Creek near Anchorage, AK	1967-84	—	—



MAP SHOWING STREAMFLOW ANALYSIS REGIONS AND LOCATIONS OF STREAMFLOW-GAGING AND PARTIAL-RECORD STATIONS FOR WHICH PEAK-STREAMFLOW STATISTICS WERE COMPUTED, ALASKA AND CONTERMINOUS BASINS IN CANADA

By
Janet H. Curran, David F. Meyer, and Gary D. Tasker
2003

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Tuesday, June 10, 2014 8:31 PM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock; dglass@ciri.com
Cc: 'Mike Salzetti'; Emily Andersen
Subject: Final minutes from May 22 conference call: cancelling next call and reschedule
Attachments: Final minutes for IFWG meeting 05-22-2014.docx

Good evening:

Please find attached the final meeting minutes from the May 22nd call; comments received were incorporated into the final minutes.

I would like to reschedule our next call from this Thursday (June 12) until a week from Friday (June 20th). Please let me know your availability for a call that day.

Thank you,

John

John Blum
Sr. Fisheries Scientist

Draft
Conference call with the Grant Creek Instream Flow Work Group
May 22, 2014

Those attending via conference call:

- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 10:00 am PDT. John Blum sent out a draft agenda to the Work Group on May 21 via email. Agenda items are briefly detailed below:

1. Review of sockeye emergence timing
2. Address concerns from ADFG re: data products
3. Discuss Work Group's analysis of transects to use for rearing and spawning
4. Discuss information work group wants presented (i.e., wetted perimeter, substrate analysis, connectivity, etc.)

REVIEW OF SOCKEYE SALMON EMERGENCE TIMING

Per request of the Work Group at the April 18th meeting, John Blum used the DTU's agreed upon at that meeting to calculate Sockeye salmon incubation and emergence timing. Since the latest download of water temperature data occurred on March 20, it was suggested that John Blum look at the water temperature data from 2013 and use a trend analysis to make an initial temperature run.

John Blum ran several different analyses to attempt to piece together the temperature data from both years; however, temperature regimes were markedly different from 2013 to 2014, resulting in a wide range of potential emergence timing. Some of these scenarios were unrealistic, so John Blum suggested that we wait until the next water temperature download is completed (i.e., in June) and then rerun the analysis then. The Work Group agreed, and this item was shelved until these data were obtained.

To Do:

- John Blum will update emergence timing after water temperature data are downloaded in June.

ADDRESS ADFG CONCERNS RE: DATA PRODUCTS

John Blum reviewed ADFG's concerns re: an interactive tool that was developed previously to examine location of spawning substrate along the transects and how these substrates were

affected by changes in flow. John explained that the information requested was not available to develop as an interactive tool; however, if the Work Group let John know what analyses they wanted, John would produce that for the group and send it out.

Jason said that what he would like to see is the lateral positions of where the substrate was located along each transect, and at what flows that substrate went dry. What he was looking for was an effective spawning analysis over the range of suitable flows, especially for Reaches 1 and 3.

John Stevenson said that he had looked at where most of the spawning occurred, and it was along Transects 130, 140, 300 and 310, with most rearing occurring along Transects 100, 130, 160, 200, 220, 230, 300, and 330.

Jason and Monte asked John Stevenson if he could quantify the number of redds along the transects, so that ADFG could make assessments of which transects to analyze for effective spawning. John Stevenson said he could do that. ADFG said they would turn that around quickly for John Blum's analysis.

Jason asked if John Blum could run effective spawning from about 400 – 450 cfs. John Blum said he would do that as soon as he heard back from the Work Group re: which transects to analyze.

John Blum also asked the Work Group on how they wanted the transects weighted: equally; by importance (spawning or rearing), or by habitat frequency. Jason asked if several analysis could be run. John Blum said yes, and that the analysis for equal weighting of transects was already completed and in the Draft Habitat Mapping and Instream Flow Report. The transects were initially weighted equally, since the Grant Creek Instream Flow Study was based upon known, important rearing and spawning areas.

To Do:

- John Stevenson to tabulate redds by transect [*Note: John Stevenson did this and the spreadsheet was sent to the Work Group via John Blum email on May 23, 2014*].
- ADFG to review data and make suggestions for use of transects for rearing and spawning as well as transect weighting.
- John Blum to analyze these transects to indicate at what point spawning substrates were exposed due to decreased flow.

OTHER ISSUES

Monte asked if there was more information re: where the tailrace would be returning water into Reach 4. Cory said that KHL was running different scenarios right now and would be documenting them and collaboratively discussing options related to operations, natural resources, the associated impacts and potential mitigation measures during the July meetings in Anchorage.

Monte also asked if KHL was still considering raising the lake level. Cory said that KHL was currently running scenarios that would not involve their raising the lake levels and these options (along with others) would be discussed with Stakeholders in July. Monte then commented that the wildlife/botanical issues at the lake would be eliminated if there was no raising of lake elevation.

There was also discussion on how increasing flows into the distributary in Reach 1 (Transects 100 and 110) could also prove to be an effective enhancement tool. Monte said he would like to discuss that further in future meetings.

NEXT MEETING

The next meeting of the Work Group is tentatively scheduled for June 12, 1 pm (AK), 2 pm (WA), and 3 pm (ID) time.

From: Cory Warnock
Sent: Wednesday, June 11, 2014 1:57 PM
To: hshepherd@uci.net
Cc: Emily Andersen
Subject: RE: Grant Lake Project Hydrological Tech Memo

Hi Hal,

Working on the details this week. Should know more early next.

Cory

From: hshepherd@uci.net [mailto:hshepherd@uci.net]
Sent: Wednesday, June 11, 2014 12:32 PM
To: Cory Warnock
Cc: hshepherd@uci.net
Subject: Re: Grant Lake Project Hydrological Tech Memo

Cory:

Thanks for keeping me posted. Do you know when you'll have the details(e.g. date, time, format, etc. on the public meeting in Grant Lake? Thanks.

Hal Shepherd, Director
Center for Water Advocacy
P.O. Box 15332
Fritz Creek, AK 99603
(907)491-1355

On Tue 10/06/14 10:56 AM , "Cory Warnock" cory.warnock@mcmillen-llc.com sent:

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

In advance of our upcoming get-together in Anchorage, you'll be receiving a series of engineering/operational tech memos for your review prior to the meetings. The first of these (Grant Creek Hydrological Analysis) is attached here. Please don't hesitate to let me know if you have any questions and again, more will be coming your way in the next couple weeks.

Thanks

Cory Warnock
Senior Licensing and Regulatory Consultant

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, June 13, 2014 12:33 PM
To: Cory Warnock; Emily Andersen
Subject: FW: Final minutes from May 22 conference call: cancelling next call and reschedule

FYI

John Blum
Sr. Fisheries Scientist

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Friday, June 13, 2014 12:33 PM
To: 'Miller, Monte D (DFG)'
Subject: RE: Final minutes from May 22 conference call: cancelling next call and reschedule

Thanks, Monte!

John

John Blum
Sr. Fisheries Scientist

From: Miller, Monte D (DFG) [<mailto:monte.miller@alaska.gov>]
Sent: Friday, June 13, 2014 12:25 PM
To: John Blum
Subject: RE: Final minutes from May 22 conference call: cancelling next call and reschedule

I am just back from travel and Jason and I will meet this afternoon so that I can evaluate where we are and what progress he has made this week. My supervisor also wants to check recommendations. We will try to get something more to you ASAP.
Monte Miller

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Friday, June 13, 2014 10:18 AM
To: Miller, Monte D (DFG)
Subject: RE: Final minutes from May 22 conference call: cancelling next call and reschedule

Thanks, Monte. Have you and Jason had a chance to look at the transect weighting? Once I have that, I can move forward with the different analyses.

Hopefully your trip is for vacation!

Have a good weekend.

John

John Blum
Sr. Fisheries Scientist

From: Miller, Monte D (DFG) [<mailto:monte.miller@alaska.gov>]
Sent: Friday, June 13, 2014 11:12 AM
To: John Blum; Mouw, Jason E B (DFG); Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'; dglass@ciri.com
Cc: 'Mike Salzetti'; 'Emily Andersen'
Subject: RE: Final minutes from May 22 conference call: cancelling next call and reschedule

John,
Unfortunately, I will also not be available June 18-20 as I will be out of state.
Monte Miller

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Tuesday, June 10, 2014 7:31 PM
To: Miller, Monte D (DFG); Mouw, Jason E B (DFG); Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'; dglass@ciri.com
Cc: 'Mike Salzetti'; 'Emily Andersen'
Subject: Final minutes from May 22 conference call: cancelling next call and reschedule

Good evening:

Please find attached the final meeting minutes from the May 22nd call; comments received were incorporated into the final minutes.

I would like to reschedule our next call from this Thursday (June 12) until a week from Friday (June 20th). Please let me know your availability for a call that day.

Thank you,

John

John Blum
Sr. Fisheries Scientist

No virus found in this message.
Checked by AVG - www.avg.com
Version: 2014.0.4570 / Virus Database: 3964/7673 - Release Date: 06/13/14

No virus found in this message.
Checked by AVG - www.avg.com
Version: 2014.0.4570 / Virus Database: 3964/7673 - Release Date: 06/13/14

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Friday, June 13, 2014 10:09 AM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; 'Schade, David W (DNR)'; mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough; 'Andre Ball'
Subject: Grant Lake Project Hydraulic Tech Memo
Attachments: TM002-Grant Creek Hydraulic Analysis-Final.pdf

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

Attached is the Grant Creek Hydraulic Analysis Tech Memo for your review in advance of our meeting on July 7/8. Please don't hesitate to let me know if you have any questions and again, more will be coming your way in the next couple weeks.

Thanks

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

McMILLEN, LLC

To:	Mike Salzetti, HEA	Project:	Grant Lake Hydroelectric Project
From:	Morton D. McMillen, P.E. Andre Ball, P.E. (WA)	Cc:	Cory Warnock File
Date:	June 6, 2014	Job No:	13-102
Subject:	Grant Creek Hydraulic Analysis		

1.0 INTRODUCTION

McMillen, LLC (McMillen) has been retained by Homer Electric Association, Inc. (HEA) to provide engineering support for the proposed Grant Lake Hydroelectric Project (Project) FERC application. The project would be located near the community of Moose Pass, Alaska, approximately 25 miles north of Seward, Alaska.

1.1 Purpose and Scope

The purpose of this Technical Memorandum (TM) is to present the analyses and results of a hydraulic analysis of Grant Creek. The analysis presented within this TM utilized the available data from previous studies, ongoing studies being conducted by McMillen, and the results of TM 001, Grant Creek Hydrologic Analysis. The primary objectives of this TM are:

- Utilize the cross-sections surveyed for the IFIM study to develop a HEC-RAS model of the Grant Creek channel from near the powerhouse location to near the gage location.
- Determine the water surface profiles along Grant Creek for various flows and develop a tailwater rating curve for the powerhouse tailrace channel and Grant Creek confluence.
- Determine the 100-year flood event water surface elevation at the proposed powerhouse location.

1.2 Project Description

As outlined in the application for a preliminary permit (HEA, 2011) the proposed Project consists of constructing a new 5-Megawatt (approximate) hydroelectric facility on Grant Lake and Grant Creek near Moose Pass, Alaska. The new Project would divert water from Grant Lake and deliver the flow to a powerhouse located near the outlet of the existing Grant Creek natural, incised rock canyon. The Project would include the following major components:

- Diversion structure at the natural outlet of Grant Lake. (under consideration)
- An intake structure in Grant Lake.
- A tunnel extending from the lake intake to just east of the powerhouse.

- A powerhouse with two Francis turbines providing an anticipated combined 5-Megawatt output. The maximum design flow will be approximately 385 cfs.
- Tailrace detention pond.
- 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.

1.3 Project Background

Grant Lake has been studied on multiple occasions since the 1950's as a potential hydropower site. The previous work efforts included:

- 1954 – R.W. Beck and Associates preliminary investigation
- 1955 – U.S. Geological Survey (USGS) geological investigations of proposed power sites at Cooper, Grant, Ptarmigan, and Crescent Lake
- 1980 – CH2M Hill prefeasibility study
- 1981 – U.S. Army Corps of Engineers (USACE) National Hydroelectric Power Resources Study
- 1984 – Ebasco Services Project Feasibility Analysis (Ebasco, 1984)
- 2010 – HDR Grant Lake/Falls Creek Hydroelectric Project – Environmental Baseline Studies (HDR, 2010)

On August 6, 2009, Kenai Hydro LLC filed a Pre-Application Document (PAD), along with a Notice of Intent to file an application for an original license for the Grant Lake/Falls Creek project. FERC subsequently approved the use of the Traditional License Process for development of the license application and supporting documents. In 2009-2010, HDR completed a series of environmental baseline studies which were summarized in their report dated January 2010. A second preliminary permit was issued by FERC in 2012.

As part of these previous studies, the hydrologic conditions within the Grant Creek basin were evaluated and flows available to support a hydroelectric facility were evaluated. The most expansive analysis was completed as part of the Ebasco feasibility study. These previous studies and available gage data were used as the basis for the current hydrologic analysis. The subsequent gage data collected in 2009 (HDR, 2010) and 2013 by McMillen, along with the original USGS stream gage data (USGS Station 15246000) served as the basis for the flow estimation.

1.4 Grant Creek Description

Grant Creek is the only natural outlet from Grant Lake and is located at the south end of the lake (Figure 1). Grant Creek is approximately 1 mile long and flows west from Grant Lake and discharges into the narrows that connect the Upper Trail Lake to Lower Trail Lake. The average gradient of Grant Creek is 207 feet per mile. The U.S. Geological Survey (USGS) had previously operated a stream flow gage (Station 15246000) on Grant Creek, but this gage is no longer

operated. Intermittent stream gaging has been conducted on Grant Creek by Ebasco in the early 1980's and HDR in 2009 (Ebasco, 1984) (HDR, 2010). In 2013, McMillen reestablished streamflow measurements at the historic USGS gage location (GC200). McMillen evaluated streamflow statistics for Grant Creek as documented in TM 001 (McMillen, 2014). The mean annual discharge in Grant Creek is 193 cubic feet per second (cfs) and the average channel width is 25 feet. The upper portion of Grant Creek flows through a steep walled, canyon section with multiple waterfalls, abundant bedrock, and large boulders in the channel. The lower portion of the creek is less turbulent, less channelized, and has more gravel shoals (Ebasco 1984). The channel bifurcates near the mouth and has a network of distributaries.

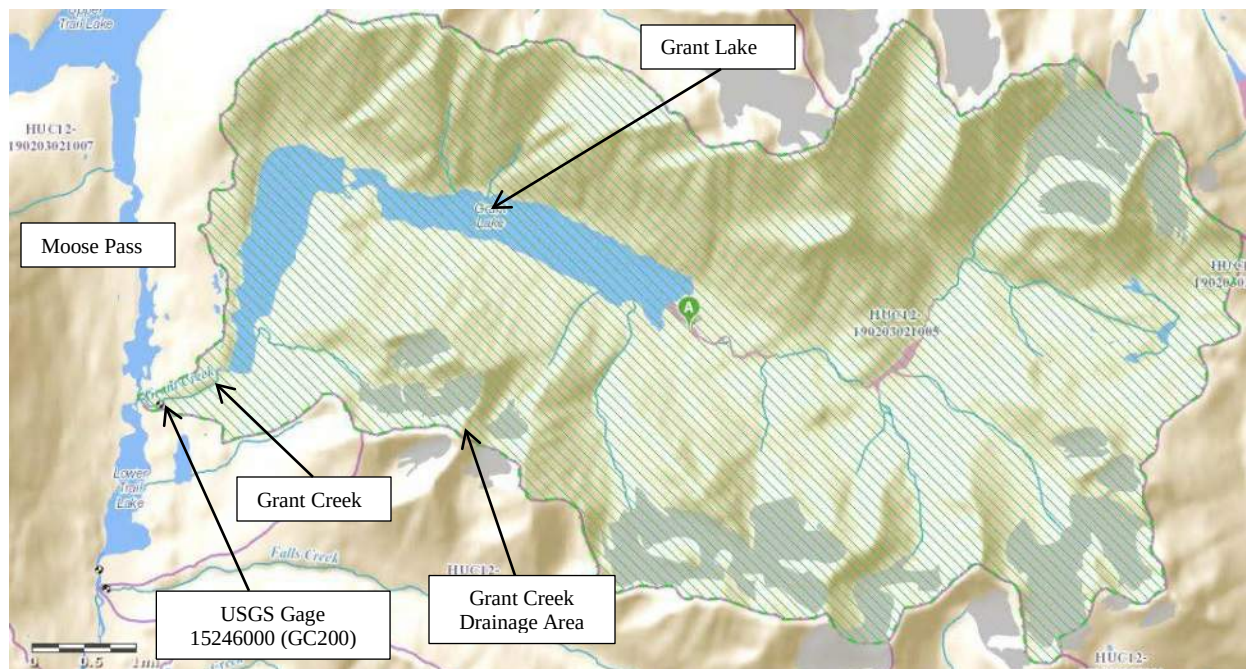


Figure 1. Grant Lake Hydroelectric Project Location Map

2.0 HYDRAULIC DATA SUMMARY

The data sources used to conduct the hydraulic analysis included field surveys and observations, as well as previous reports. During the 2013 fieldwork season, McMillen personnel collected channel cross section information and measured water levels as part of the Water Resources and Instream Flow Incremental Methodology (IFIM) studies. Additional background information about Grant Creek was available in the previous studies completed by Ebasco and HDR. The flood hydrology used for the hydraulic simulation is documented in a separate McMillen technical memorandum, TM 001 Grant Creek Hydrologic Analysis (McMillen, 2014). Table 1. summarizes the peak streamflow statistics for Grant Creek.

Table 1. Grant Creek Peak Streamflow Statistics at the USGS 15246000 Gage Location (GC200)

Analysis Type	Peak streamflow, in cubic feet per second (cfs), for a given recurrence interval in years							
	Q ₂	Q ₅	Q ₁₀	Q ₂₅	Q ₅₀	Q ₁₀₀	Q ₂₀₀	Q ₅₀₀
Weighted	961	1,410	1,790	2,350	2,810	3,310	3,860	4,690

3.0 HYDRAULIC ANALYSIS

The Grant Creek hydraulic gradeline was evaluated using HEC-RAS (Version 4.1.0); a one-dimensional hydraulic numerical model developed by the U.S. Army Corps of Engineers (USACE). The HEC-RAS program contains one-dimensional river analysis components for steady flow water surface computations, unsteady flow simulation, movable boundary sediment transport computations, and water quality analysis. The model utilizes common geometric data representation and geometric and hydraulic computation routines. A description of the model development, calibration, and results for Grant Creek are presented in the following paragraphs.

3.1 Model Geometry

The model geometry for the Grant Creek HEC-RAS model was based on the surveyed channel cross sections collected in spring 2013 for an Instream Flow Incremental Methodology (IFIM) study (documented in the Aquatic Resource Study report). An additional survey was performed in fall 2013 to establish a common vertical datum and define the channel slope. In total, eight surveyed cross sections were used, representing a 2,060 foot long portion of Grant Creek.

Table 2 summarizes the cross sections and their associated downstream reach lengths. Figure 2. (attached), shows the IFIM study section locations and can be cross referenced to the cross sections used in the HEC-RAS model by utilizing Table 2. Interpolated cross sections were added to the HEC-RAS model to reduce the distance between cross-sections, which provides a more stable hydraulic model. After interpolating cross-sections, the maximum modeled distance between cross sections was no more than 50 feet. A schematic of the HEC-RAS model geometry for Grant Creek is shown in Appendix A.

Table 2. Grant Creek Surveyed Cross Sections and Reach Lengths

Cross Section Name (IFIM Study)	HEC-RAS Station (ft)	Downstream Reach Length (ft)
T220	50	0
T230	82	32
T300	932	850
T310	1061	129
T400	1381	320
T410	1435	54
T430	1865	430
T510	2110	245

For this analysis, the hydraulic model was set up to represent Grant Creek as a single channel. In one location, there is a side channel that flows to the left of the main channel. The side channel begins downstream of T400 and rejoins the main channel between T300 and T230. At the time of this analysis, the hydraulic information available for the side channel was limited, and thus, the side channel was omitted from this initial hydraulic model. Based on a review of the overall creek hydraulics and controls, the side channel was considered to have minimal impact on the hydraulic gradeline at the area of interest near the proposed powerhouse tailrace location.

3.2 Model Calibration

Observed water surface elevations at the surveyed cross sections were used to calibrate the HEC-RAS model. Five different discharges were simulated, ranging from 17 cfs to 706 cfs. Due to the steep grade of the creek, the model was run in the mixed flow regime with critical depth boundary conditions at the upstream and downstream ends. The mixed flow regime allows the model to determine if the section is supercritical or subcritical. The model computed a subcritical flow regime for most of the reach. The Froude numbers ranged between 0.4 and 0.7 for the upper half of the model.

The model was calibrated by modifying the channel roughness, Manning's 'n', as this was the most uncertain variable that could be adjusted. Any roughness adjustments were done within the range of roughness that is acceptable for the channel conditions (Barnes, 1967 and Brunner, 2010). In addition to modifying the roughness, ineffective flow areas were added to some cross sections, outside of the main channel, to refine the model. The calibration and refinement efforts focused on calibrating the model to best represent the creek in the reach between T410 and T430 since this is where the powerhouse tailrace will join the main channel. The resulting n-values used in the calibrated version of the Grant Creek are shown in Table 3.

Table 3. Grant Creek Modeled Roughness Values

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

The Ebasco report mentions a HEC-2 (HEC-RAS predecessor) model of Grant Lake outlet channel. The roughness values used in that model were $n = 0.06$ for the main channel and $n = 0.10$ for the overbank areas. It is unclear if these roughness values were computed based on field data or if they were selected based on reference literature. The new HEC-RAS model described in this memorandum required roughness values (Table 3) that were at the upper end of

acceptable values to bring the modeled water surface elevations closer to the observed water surface elevations. Manning's n-values are known to be higher for mountain streams such as Grant Creek (Barnes, 1967). Furthermore, these calibration measurements were taken at lower flows and it is also known that Manning's n-values for boulder mountain streams are higher for low flows because the roughness creates greater drag relative to streamflow when streamflow depths are lower (Bathurst, 1985 and Whol, 2000). The highest discharge available for the calibration was 706 cfs, whereas the lowest modeled flood flow, the 2-year event, was 961 cfs. The observed and modeled water surface elevations for cross sections T410 and T430 are shown in Figure 3 and Figure 4 respectively. All modeled water surface elevations are within 0.2 feet of the observed water surface elevations.

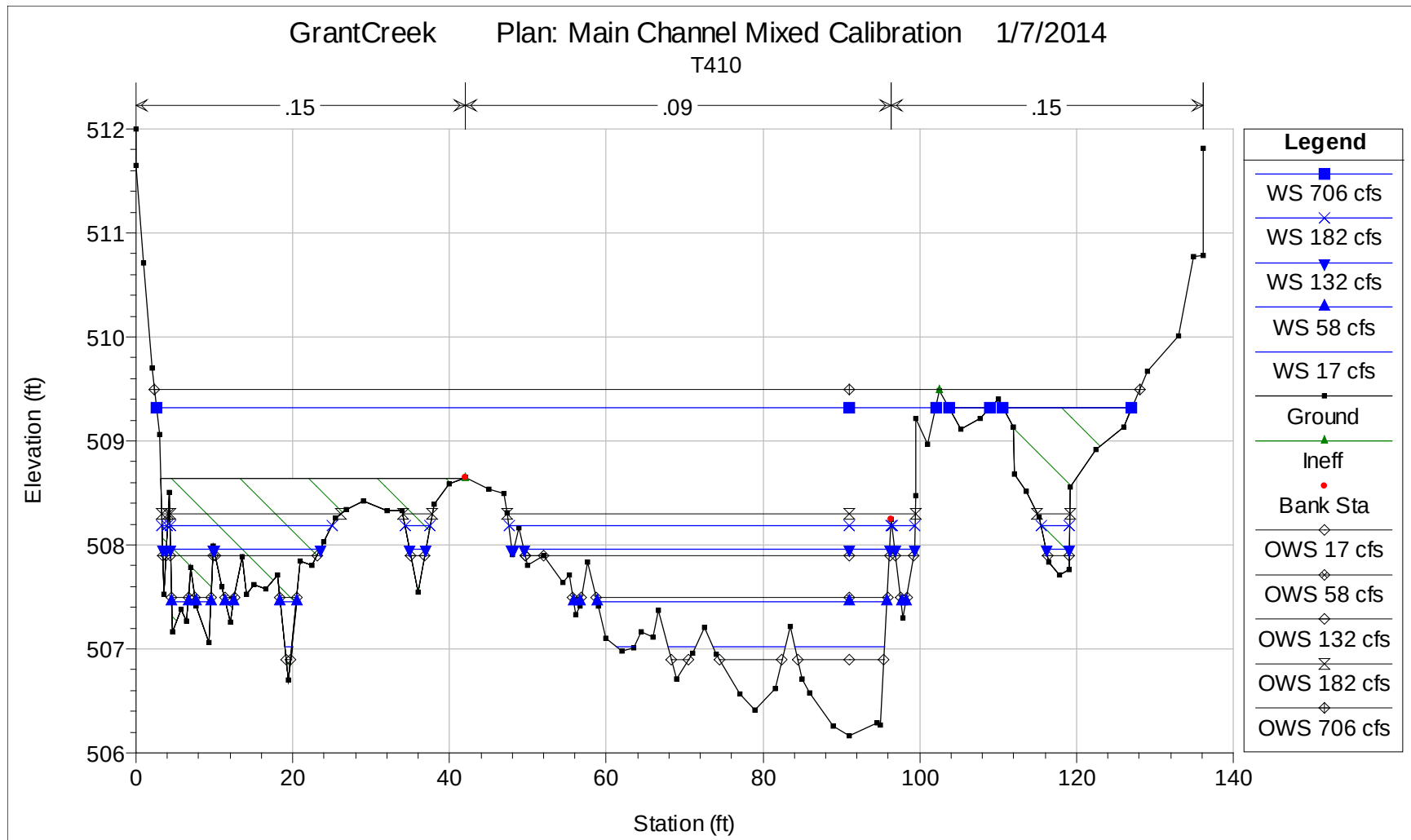


Figure 3. Modeled (WS) vs. Observed Water Surface (OWS) Elevations – Cross Section T410

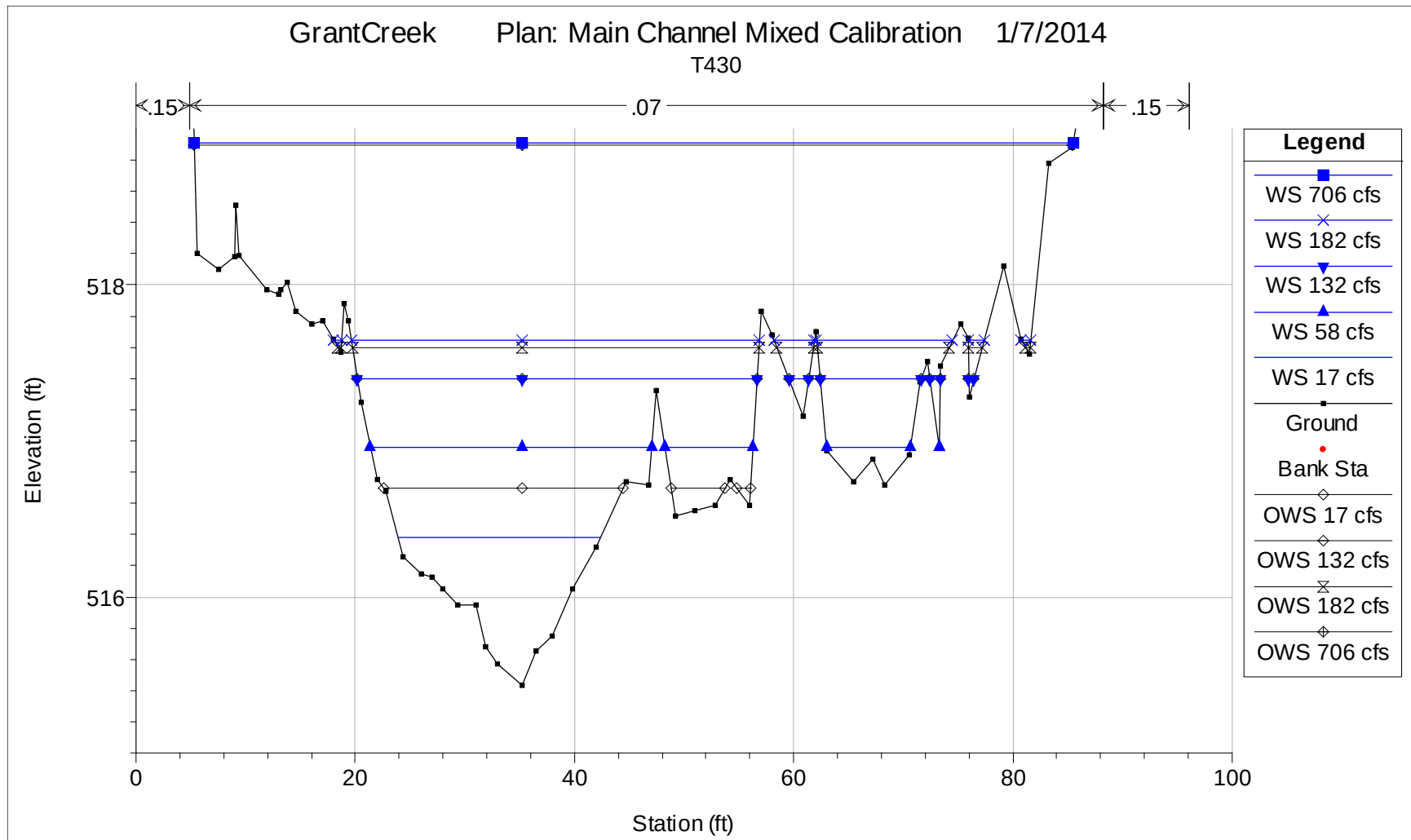


Figure 4. Modeled (WS) vs. Observed Water Surface (OWS) Elevations – Cross Section T430

3.3 Channel Roughness Sensitivity Analysis

As discussed in the Model Calibration section, the roughness values required to calibrate to the known water surface elevations were relatively high. A sensitivity analysis was conducted to evaluate how much influence the channel roughness had on the modeled water surface elevation. A revised model geometry was created that had lower roughness values that coincided more with the roughness values documented for boulder filled mountain streams (Barnes, 1967). For the sensitivity run, all cross sections were assigned roughness values of $n = 0.055$ for the main channel and $n = 0.080$ for the overbanks. The sensitivity n -values are lower than the calibrated n -values which will result in lower water surface elevations and higher flow velocities for a given discharge. Table 4 compares the water surface elevations resulting from the ‘calibrated’ n -values and the ‘sensitivity’ n -values for cross sections T410 and T430. At lower flows, in the flow range used for calibration, the water surface elevations only vary by a few tenths of a foot. At the 100-year flood discharge, the calibrated n -values result in water surface elevations that are 0.9 and 0.6 feet higher, relative to the sensitivity n -value water surface elevations, for cross sections T410 and T430 respectively. The calibrated n -values are conservative since it is likely that the effective n -values will be lower at flood flow conditions, thus there is confidence that an observed 100-year flood elevation will not exceed the modeled 100-year flood elevation.

Table 4. Water Surface Elevations for Cross Sections T410 and T430 – Channel Roughness Sensitivity Analysis

	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

3.4 Model Results

After the HEC-RAS model was calibrated, an additional series of flow scenarios was simulated to represent the 2-year through the 100-year flood discharges. The figures below provide a summary of the results. Figure 5 represent the hydraulic profiles for the different flood magnitudes for Grant Creek.

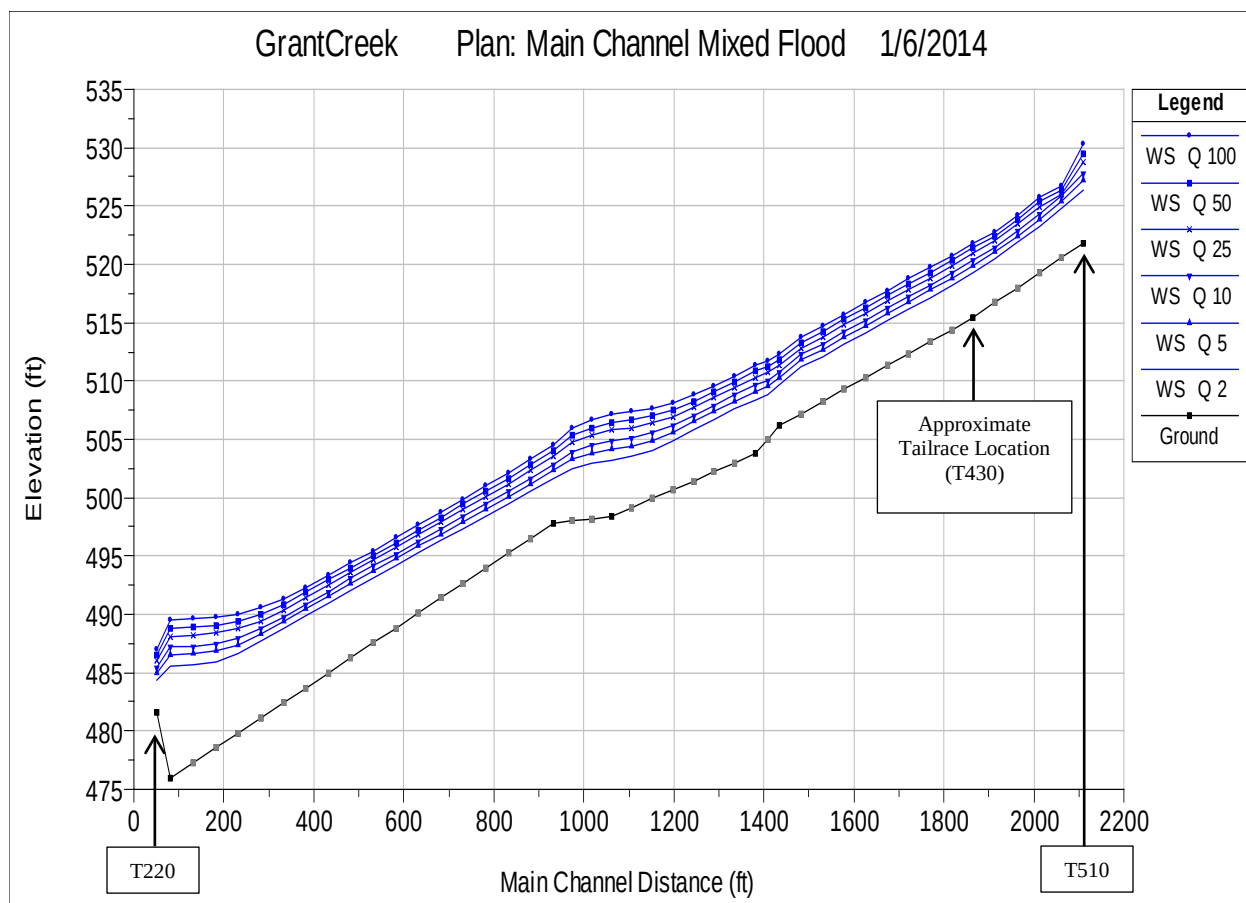


Figure 5. Grant Creek Hydraulic Profiles – 2-year through 100-year Floods

The powerhouse tailrace channel will return flow to Grant Creek near cross section T430 (HEC-RAS Station 1865). Table 5 and Figure 6 provide the flood water levels at the T430 cross section. The flood rating curve for cross section T430 is shown in Figure 7. More detailed water surface elevation information is included in Appendix A.

Table 5. Flood Water Surface Elevations at Cross Section T430

Discharge (cfs)	Flood Frequency	Water Surface Elevation (ft)
961	2-year	519.3
1410	5-year	519.9
1790	10-year	520.4
2350	25-year	521.1
2810	50-year	521.4
3310	100-year	521.8

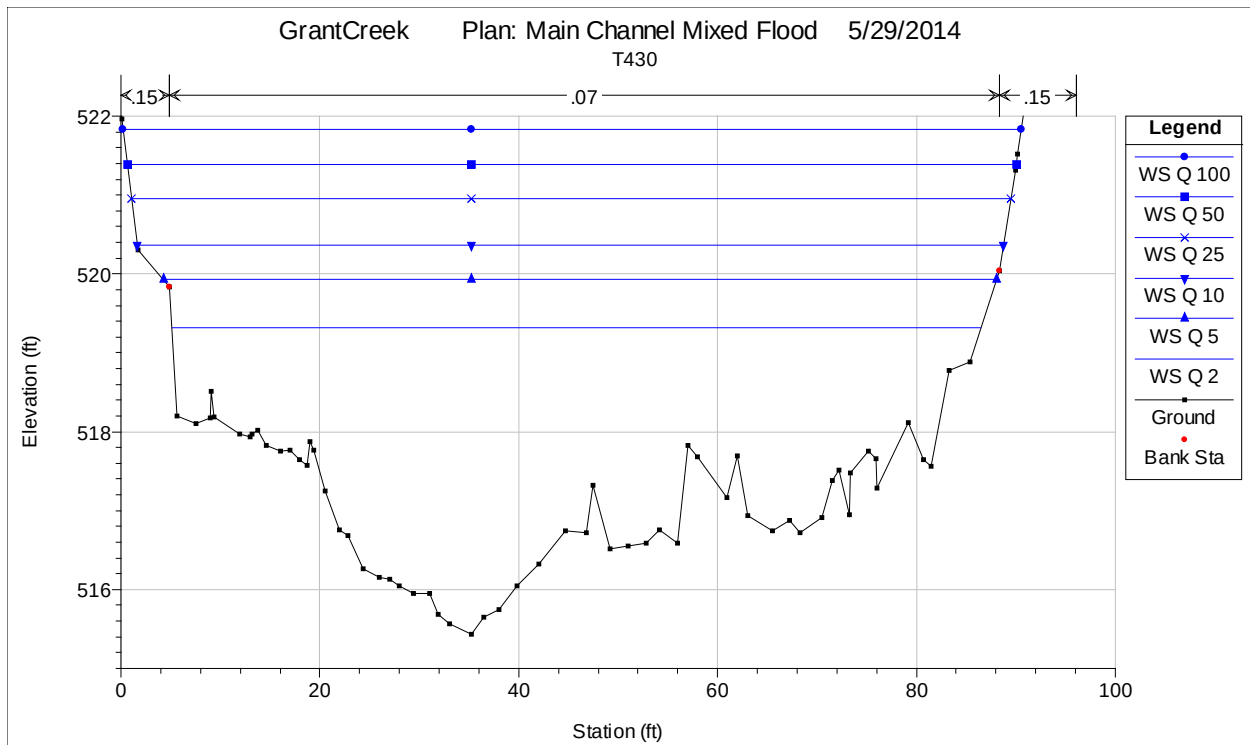


Figure 6. Modeled Flood Water Surface Elevations – Cross Section T430

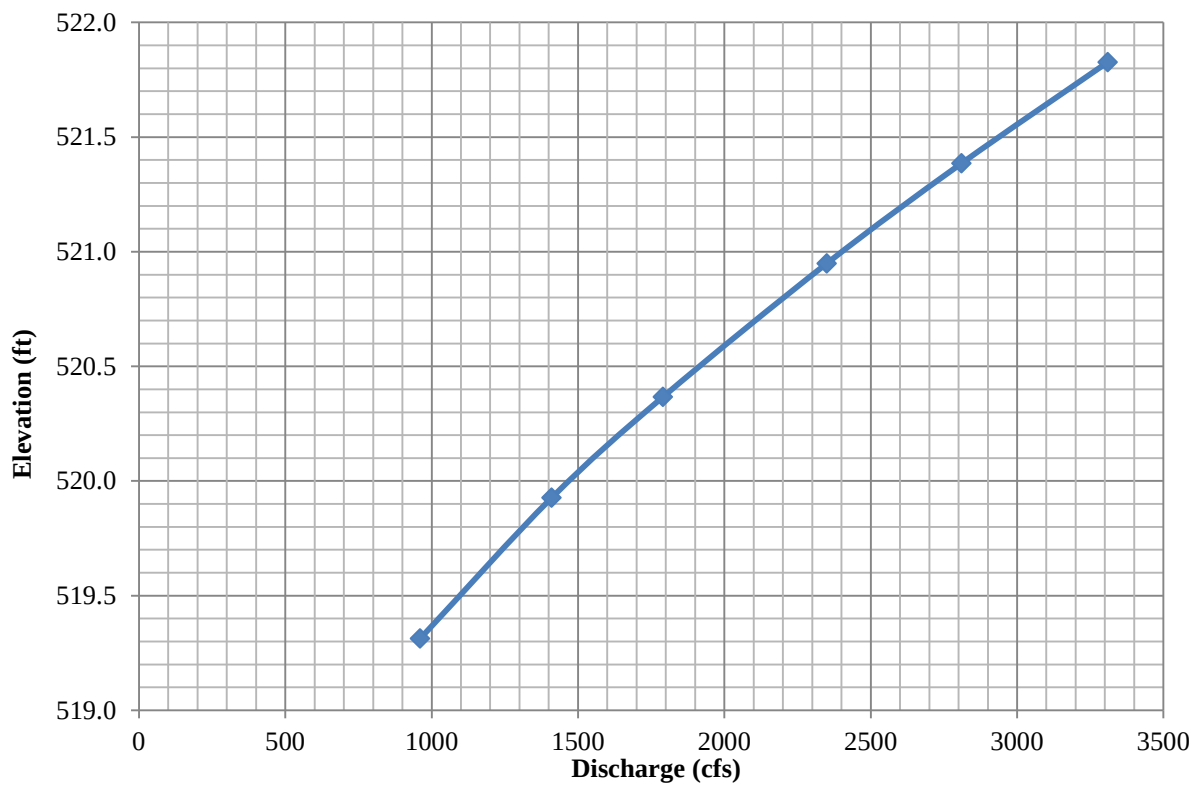


Figure 7. Grant Creek Flood Rating Curve – Cross Section T430

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

This technical memorandum describes the hydraulic model for Grant Creek that will be used for the powerhouse tailrace design. The cross sections and water surface calibration information used in the model were obtained from the 2013 IFIM study. Additional cross-sections were interpolated in the HEC-RAS model to provide shorter distances between modeled cross sections. During the model calibration, the model roughness was adjusted to a relatively high level, while still being considered reasonable, in order to match the observed water surface elevations.

Based on the modeling conducted for this task, the 100-year discharge (3,310 cfs) for Grant Creek is expected to have a water surface elevation of approximately 521.8 feet (depth of 6.4 feet) at the downstream end of the powerhouse tailrace. The water surface elevation associated with the 100-year discharge is located at the top of the extents of the surveyed cross section.

4.2 Recommendations

The hydraulic analysis presented within this TM estimated a water surface elevation of 521.8 feet at the downstream end of the proposed tailrace for the 100-year flood event of 3,310 cfs. This elevation represents a conservative estimate due to the higher n-values used for the model calibration. This elevation, along with the estimated tailwater rating curve, is recommended for use in developing the site grading plan and corresponding flood protection elevations.

5.0 REFERENCES

- Barnes, Harry. 1967. Roughness Characteristics of Natural Channels, U.S. Geological Survey Water Supply Paper 1849.
- Bathurst, J.C. 1985. Flow resistance estimation in Mountain Rivers. J. Hydraulic. Eng. 111(4) p. 625-643.
- Brunner, Gary W. 2010. HEC-RAS: River Analysis System Hydraulic Reference Manual. US Army Corps of Engineers – Hydraulic Engineering Center
- Ebasco, 1984. Grant Lake Hydroelectric Project Feasibility Analysis (Volumes 1, 2, & 3). Prepared for Alaska Power Authority.
- HDR, 2010. Grant Lake/Falls Creek Hydroelectric Project – Environmental Baseline Studies, 2009 – Final Report. Prepared for Kenai Hydro, LLC.
- McMillen, 2014. TM 001: Grant Creek Hydrologic Analysis. Prepared for Homer Electric Association.
- Whol, E. 2000. Mountain Rivers. (See page 85). American Geophysical Union, Water Resources Monograph:14. 320 p.

Appendix A: Supplemental HEC-RAS Model Information

HEC-RAS Model Plans

HEC-RAS 4.1.0

File Edit Run View Options GIS Tools Help

Project: GrantCreek C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.prj

Plan: Main Channel Mixed Calibration C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.p01

Geometry: Main Channel Only C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.g01

Steady Flow: Main Channel Calibration Flows C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.f01

Unsteady Flow:

Description: US Customary Units

HEC-RAS 4.1.0

File Edit Run View Options GIS Tools Help

Project: GrantCreek C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.prj

Plan: Main Channel Mixed Flood C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.p02

Geometry: Main Channel Only C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.g01

Steady Flow: Main Channel Flood Flows C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.f02

Unsteady Flow:

Description: US Customary Units

HEC-RAS 4.1.0

File Edit Run View Options GIS Tools Help

Project: GrantCreek C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.prj

Plan: Main Channel Mixed Calibration Low n C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.p04

Geometry: Main Channel Only-low n C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.g02

Steady Flow: Main Channel Calibration Flows C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.f01

Unsteady Flow:

Description: US Customary Units

HEC-RAS 4.1.0

File Edit Run View Options GIS Tools Help

Project: GrantCreek C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.prj

Plan: Main Channel Mixed Flood Low n C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.p03

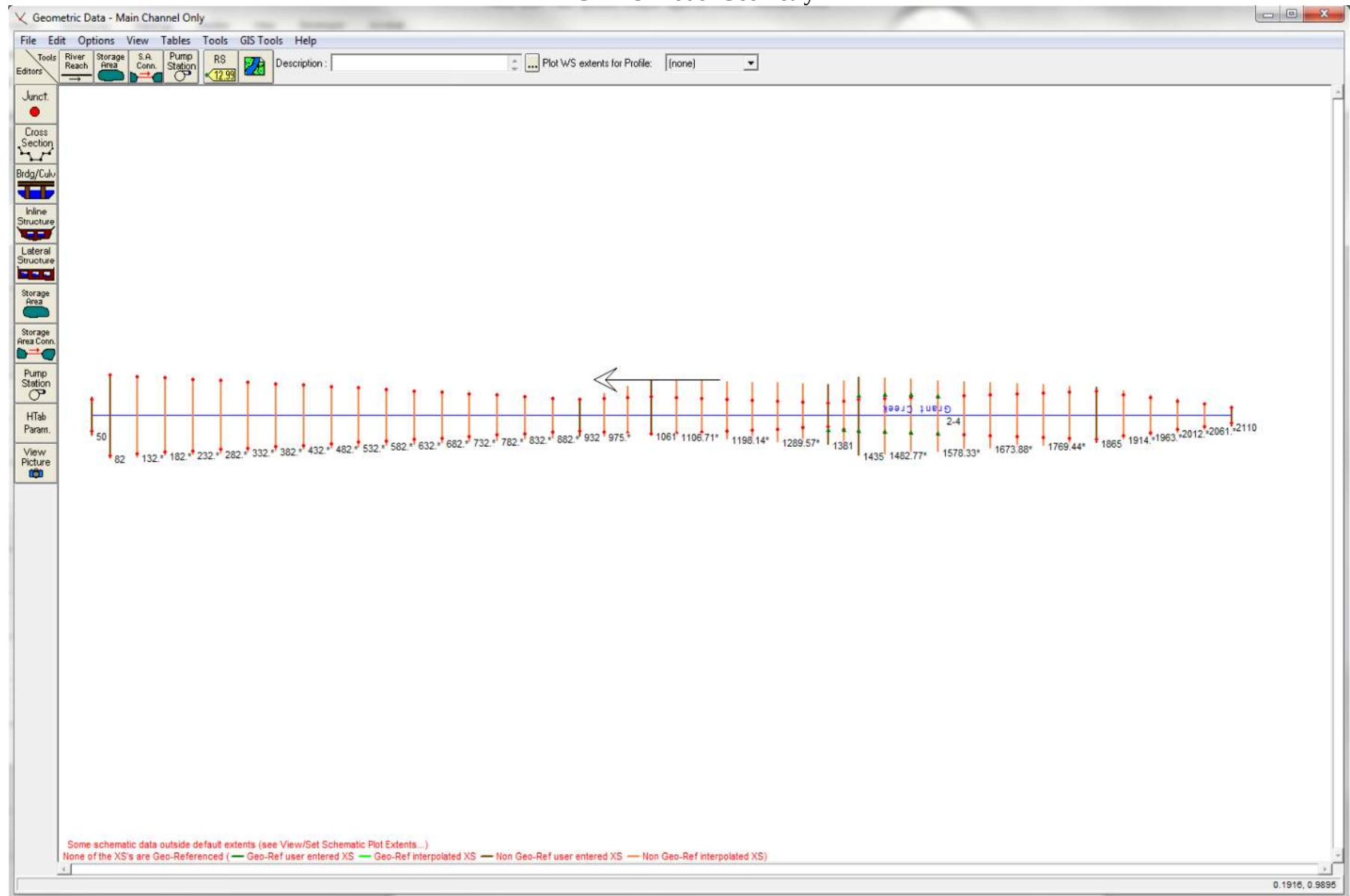
Geometry: Main Channel Only-low n C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.g02

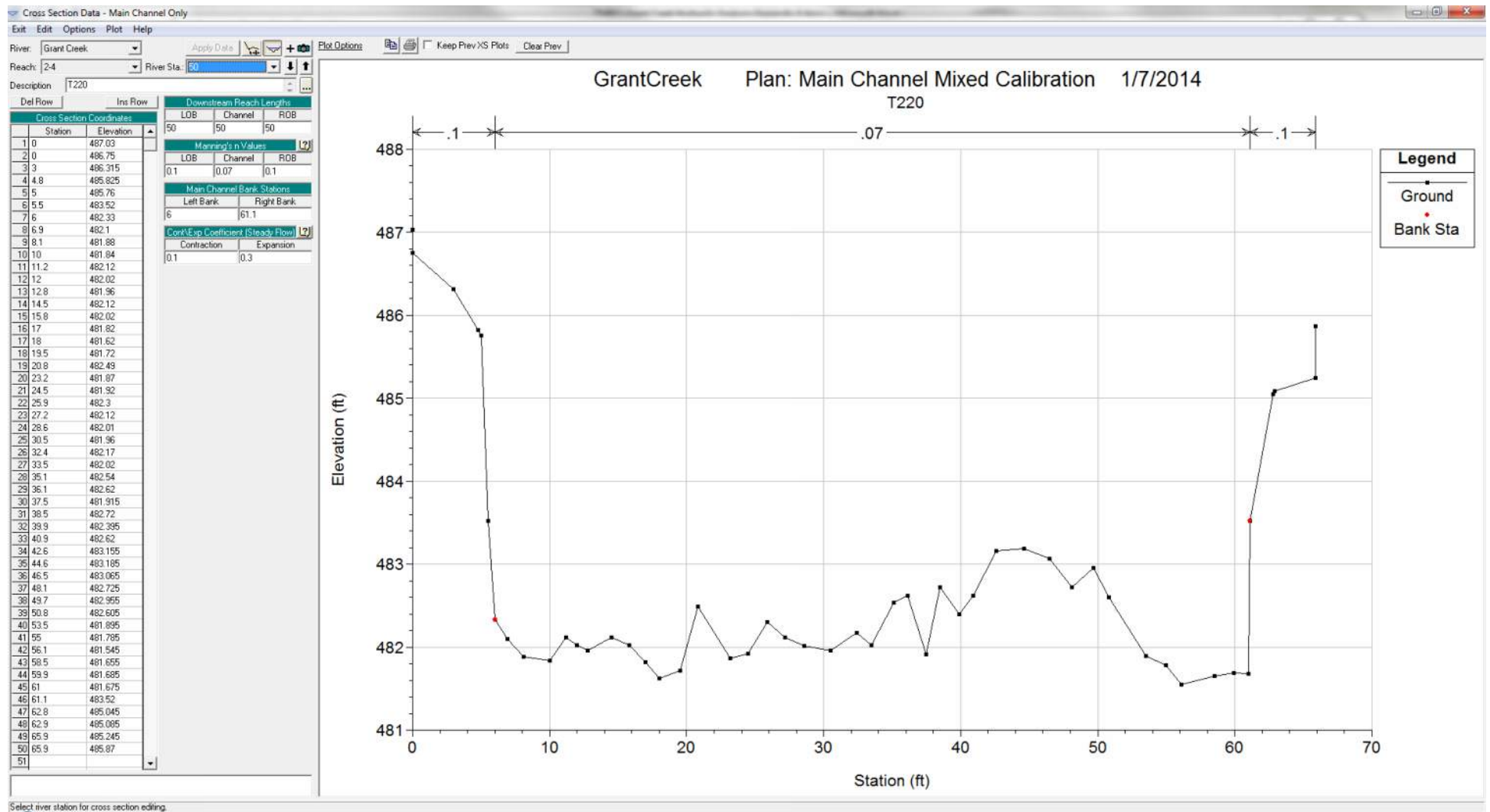
Steady Flow: Main Channel Flood Flows C:\...\Grant Lake\Task 5 Hydraulics\HECRAS\GrantCreek.f02

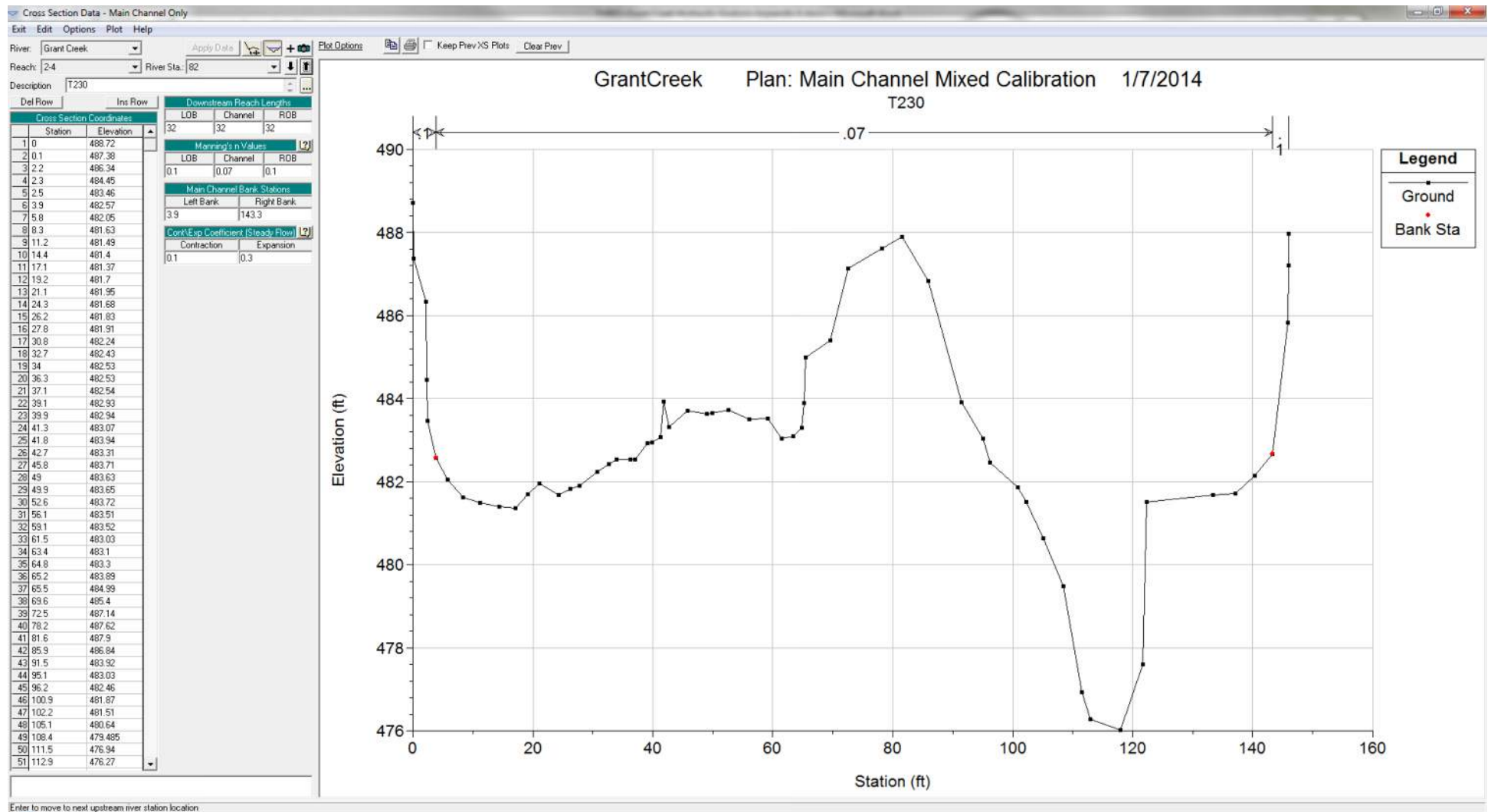
Unsteady Flow:

Description: US Customary Units

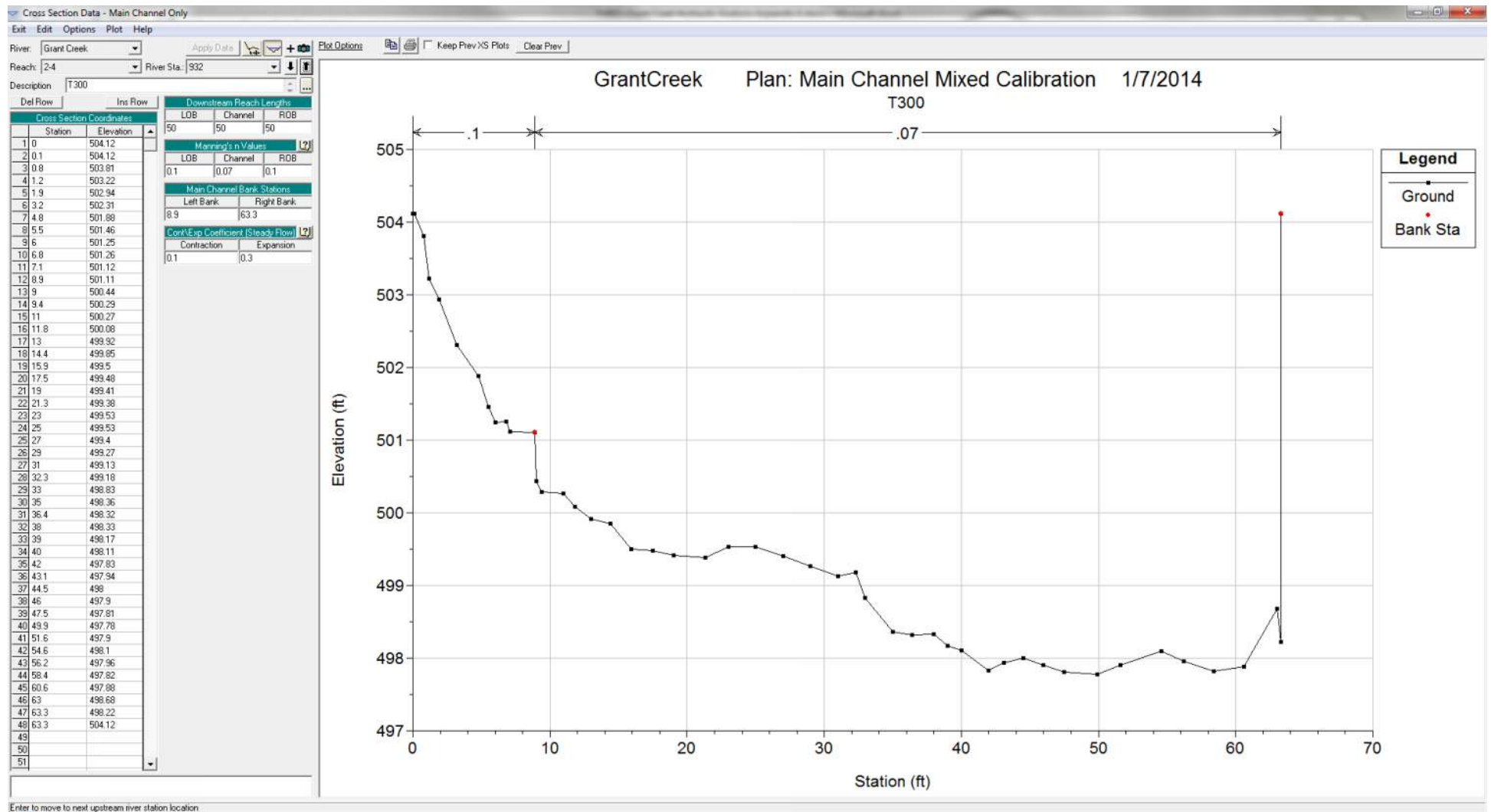
HEC-RAS Model Geometry

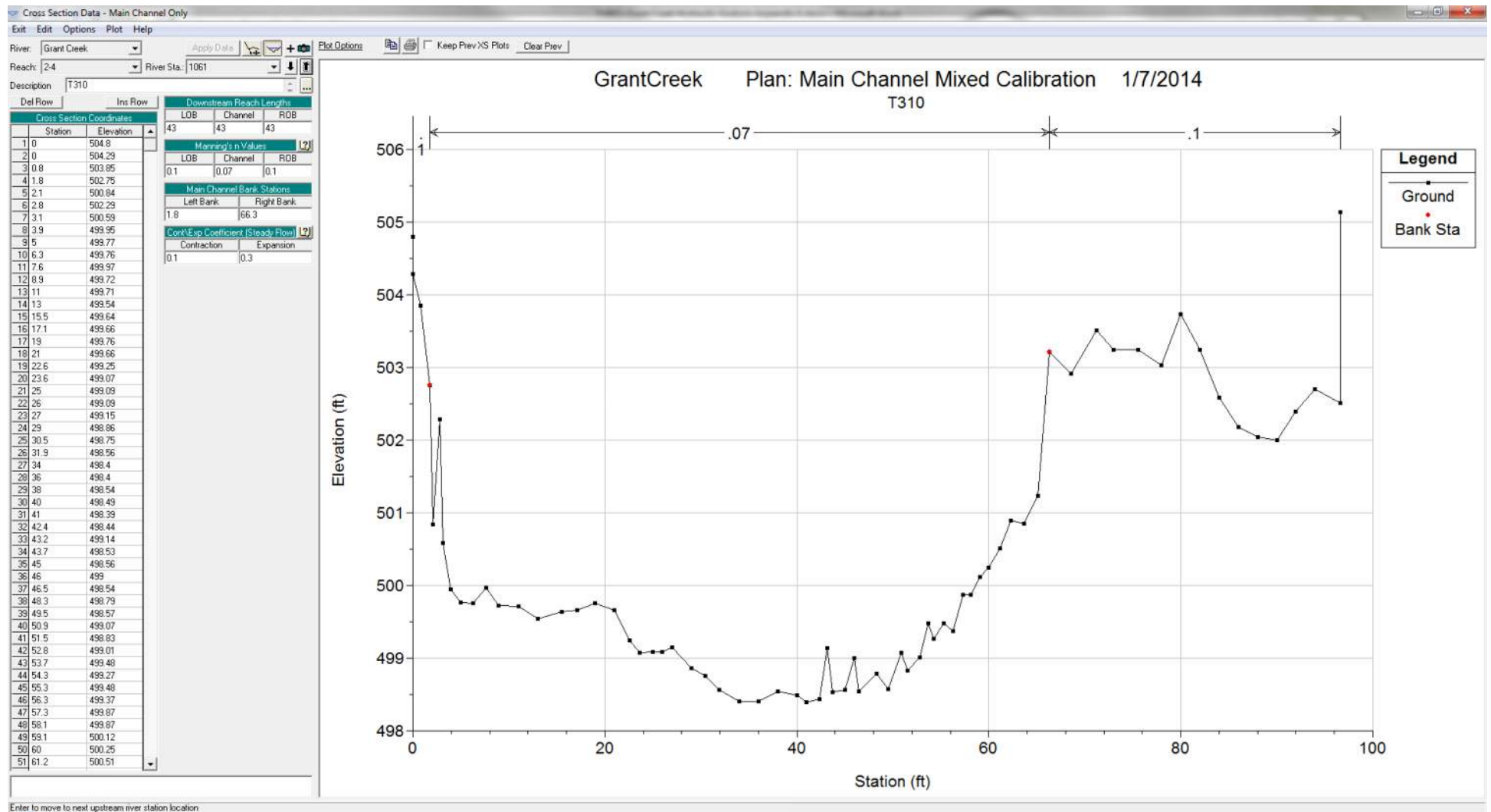


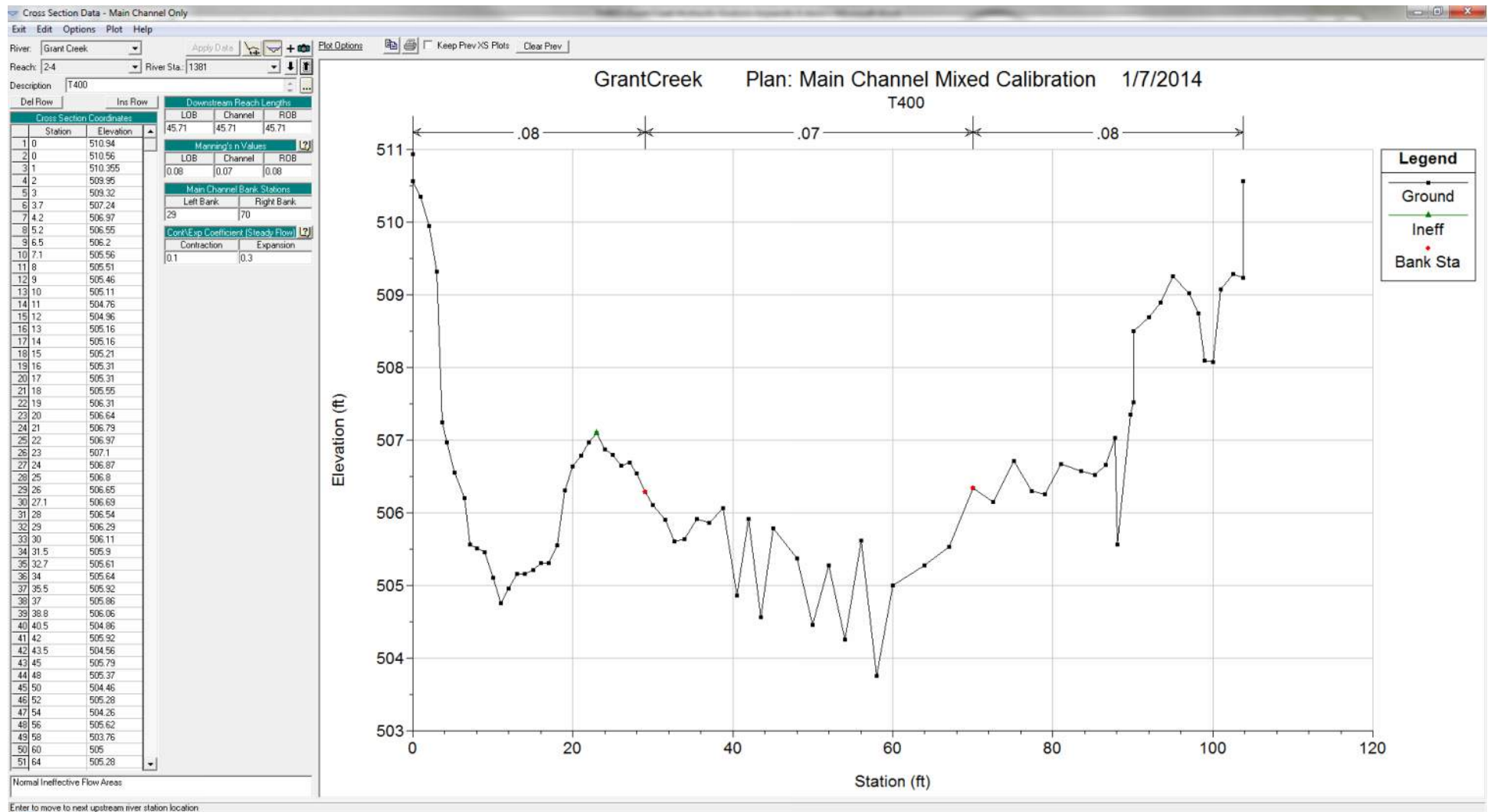


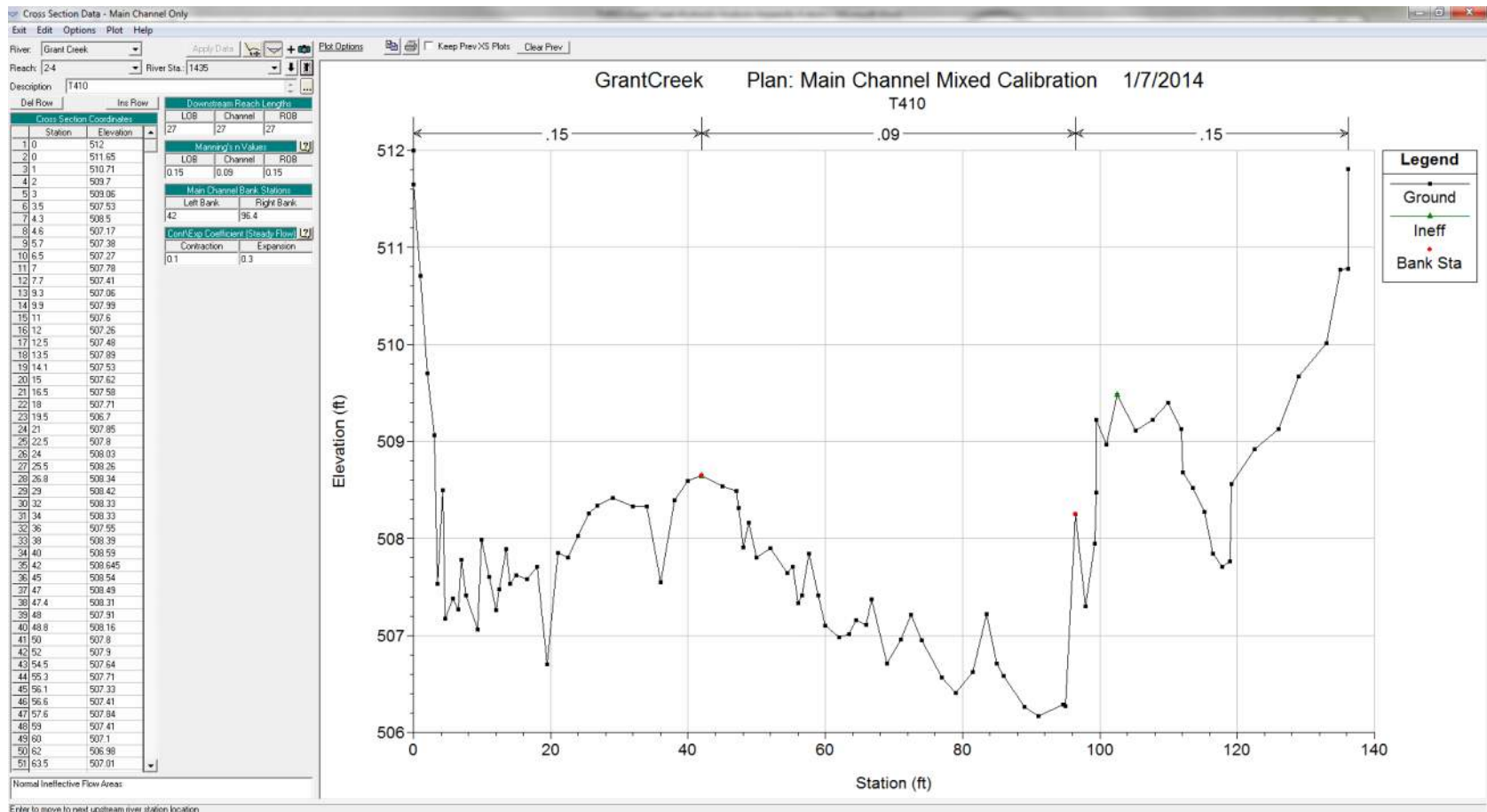


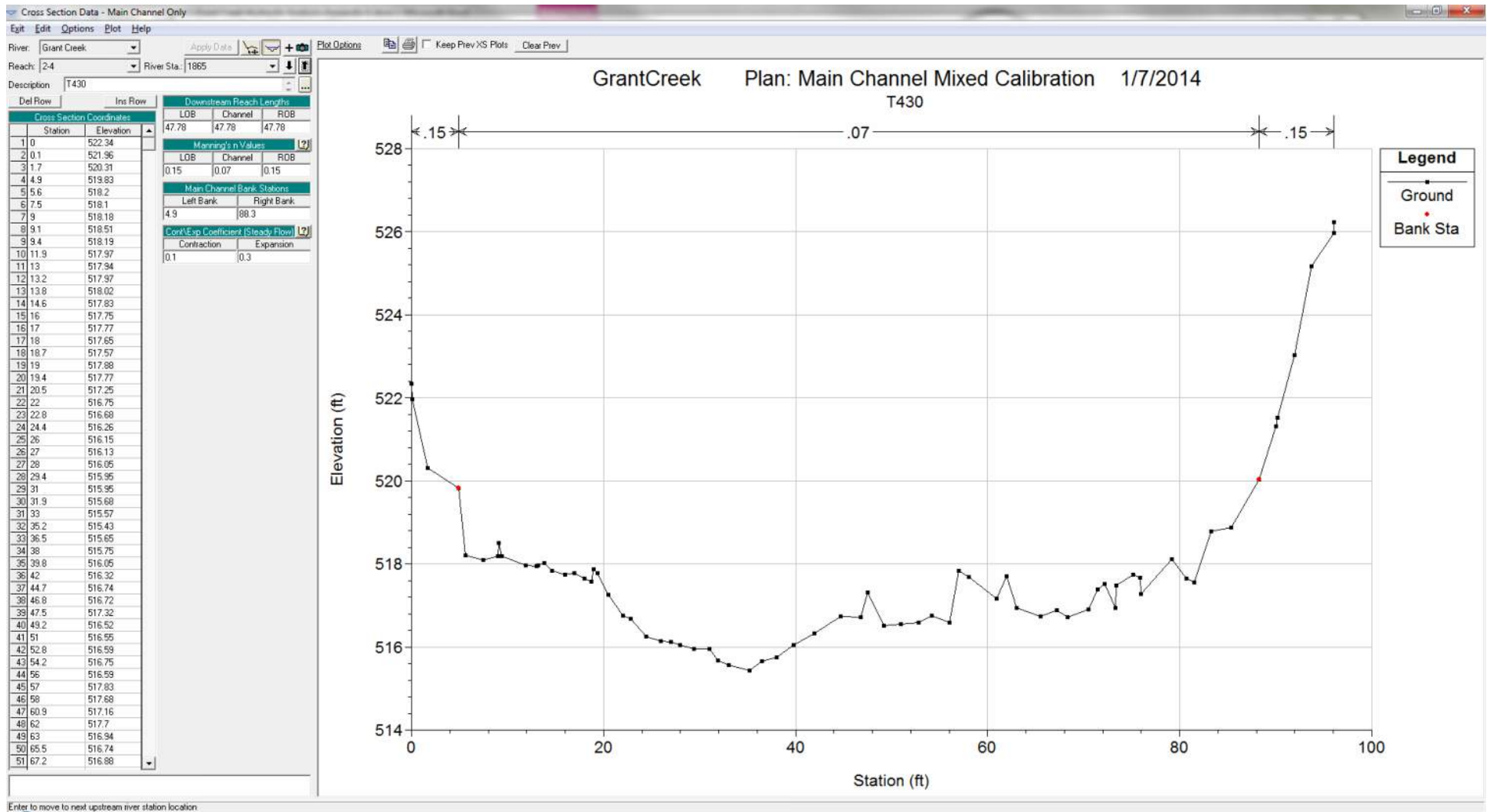
Enter to move to next upstream river station location











HEC-RAS Model Output Tables

HEC-RAS Plan: Calib River: Grant Creek Reach: 2-4

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	2110	17 cfs	17.00	521.86	523.13	522.89	523.19	0.024540	1.83	9.28	19.56	0.47
2-4	2110	58 cfs	58.00	521.86	523.60	523.33	523.72	0.029034	2.80	20.72	27.03	0.56
2-4	2110	132 cfs	132.00	521.86	524.07	523.72	524.31	0.030445	3.95	33.71	28.85	0.62
2-4	2110	182 cfs	182.00	521.86	524.31	523.95	524.63	0.031992	4.55	40.80	29.85	0.66
2-4	2110	706 cfs	706.00	521.86	525.89	525.60	526.96	0.041093	8.37	91.50	34.08	0.84
2-4	2061.*	17 cfs	17.00	520.57	521.88		521.92	0.026630	1.72	9.87	26.22	0.49
2-4	2061.*	58 cfs	58.00	520.57	522.30		522.39	0.025102	2.43	23.90	36.53	0.53
2-4	2061.*	132 cfs	132.00	520.57	522.69		522.87	0.027667	3.41	38.72	38.18	0.60
2-4	2061.*	182 cfs	182.00	520.57	522.90		523.14	0.028089	3.89	46.77	38.39	0.62
2-4	2061.*	706 cfs	706.00	520.57	524.28		525.05	0.033716	7.05	103.67	43.24	0.77
2-4	2012.*	17 cfs	17.00	519.28	520.56		520.61	0.027071	1.80	9.46	24.43	0.51
2-4	2012.*	58 cfs	58.00	519.28	521.00		521.08	0.028557	2.35	24.70	44.60	0.56
2-4	2012.*	132 cfs	132.00	519.28	521.37		521.53	0.027186	3.15	41.92	46.80	0.59
2-4	2012.*	182 cfs	182.00	519.28	521.56		521.76	0.027860	3.57	50.97	47.90	0.61
2-4	2012.*	706 cfs	706.00	519.28	522.84		523.43	0.030322	6.21	114.94	53.13	0.72
2-4	1963.*	17 cfs	17.00	518.00	519.24		519.29	0.027115	1.75	9.72	26.83	0.51
2-4	1963.*	58 cfs	58.00	518.00	519.67		519.76	0.025587	2.36	24.61	40.70	0.53
2-4	1963.*	132 cfs	132.00	518.00	520.11		520.24	0.025275	2.89	45.74	55.53	0.56
2-4	1963.*	182 cfs	182.00	518.00	520.29		520.45	0.025029	3.25	56.01	56.29	0.57
2-4	1963.*	706 cfs	706.00	518.00	521.47		521.96	0.028475	5.61	125.77	60.98	0.69
2-4	1914.*	17 cfs	17.00	516.71	517.71		517.80	0.034552	2.34	7.28	15.76	0.61
2-4	1914.*	58 cfs	58.00	516.71	518.26		518.36	0.032017	2.60	22.29	38.34	0.60
2-4	1914.*	132 cfs	132.00	516.71	518.68		518.85	0.031721	3.24	40.80	49.22	0.63
2-4	1914.*	182 cfs	182.00	516.71	518.91		519.09	0.030729	3.43	53.13	57.58	0.63
2-4	1914.*	706 cfs	706.00	516.71	520.10		520.54	0.028929	5.32	132.69	70.34	0.68
2-4	1865	17 cfs	17.00	515.43	516.38		516.44	0.022287	1.93	8.83	18.49	0.49
2-4	1865	58 cfs	58.00	515.43	516.96		517.04	0.022973	2.29	25.30	41.38	0.52
2-4	1865	132 cfs	132.00	515.43	517.40		517.53	0.022754	2.94	44.88	48.90	0.54
2-4	1865	182 cfs	182.00	515.43	517.64		517.80	0.022756	3.15	57.77	56.37	0.55
2-4	1865	706 cfs	706.00	515.43	518.91		519.25	0.022882	4.70	150.13	80.18	0.61
2-4	1817.22*	17 cfs	17.00	514.40	515.34		515.40	0.021698	1.89	9.01	19.08	0.48
2-4	1817.22*	58 cfs	58.00	514.40	515.86		515.94	0.023196	2.31	25.06	40.54	0.52
2-4	1817.22*	132 cfs	132.00	514.40	516.31		516.44	0.022894	2.92	45.15	49.76	0.54
2-4	1817.22*	182 cfs	182.00	514.40	516.55		516.70	0.023096	3.13	58.16	58.14	0.55
2-4	1817.22*	706 cfs	706.00	514.40	517.81		518.17	0.022801	4.77	148.04	77.56	0.61
2-4	1769.44*	17 cfs	17.00	513.37	514.33		514.37	0.021171	1.71	9.93	23.86	0.47
2-4	1769.44*	58 cfs	58.00	513.37	514.78		514.86	0.022345	2.29	25.34	40.27	0.51
2-4	1769.44*	132 cfs	132.00	513.37	515.23		515.36	0.022405	2.88	45.85	50.95	0.53
2-4	1769.44*	182 cfs	182.00	513.37	515.46		515.61	0.022695	3.12	58.34	58.09	0.55
2-4	1769.44*	706 cfs	706.00	513.37	516.75		517.10	0.021850	4.78	147.71	75.01	0.60
2-4	1721.66*	17 cfs	17.00	512.34	513.28		513.32	0.022968	1.60	10.61	28.64	0.46
2-4	1721.66*	58 cfs	58.00	512.34	513.71		513.79	0.022225	2.22	26.07	41.02	0.49
2-4	1721.66*	132 cfs	132.00	512.34	514.17		514.29	0.021945	2.80	47.11	51.68	0.52
2-4	1721.66*	182 cfs	182.00	512.34	514.39		514.53	0.022298	3.08	59.10	56.96	0.53
2-4	1721.66*	706 cfs	706.00	512.34	515.72		516.07	0.021201	4.73	149.42	72.60	0.58
2-4	1673.88*	17 cfs	17.00	511.31	512.23		512.27	0.021484	1.48	11.48	31.02	0.43
2-4	1673.88*	58 cfs	58.00	511.31	512.66		512.73	0.022296	2.14	27.10	42.53	0.47
2-4	1673.88*	132 cfs	132.00	511.31	513.11		513.23	0.022310	2.73	48.29	52.59	0.50
2-4	1673.88*	182 cfs	182.00	511.31	513.33		513.47	0.022042	3.04	59.95	55.25	0.51
2-4	1673.88*	706 cfs	706.00	511.31	514.71		515.05	0.021194	4.68	151.76	77.76	0.56
2-4	1626.11*	17 cfs	17.00	510.29	511.16		511.19	0.023363	1.49	11.43	30.56	0.43
2-4	1626.11*	58 cfs	58.00	510.29	511.58		511.65	0.022929	2.15	26.98	40.61	0.46
2-4	1626.11*	132 cfs	132.00	510.29	512.06		512.17	0.021955	2.71	48.71	50.20	0.48
2-4	1626.11*	182 cfs	182.00	510.29	512.31		512.44	0.021368	2.94	61.83	55.16	0.49
2-4	1626.11*	706 cfs	706.00	510.29	513.70		514.03	0.021430	4.66	158.07	91.77	0.55
2-4	1578.33*	17 cfs	17.00	509.26	510.12	509.88	510.15	0.020701	1.37	12.37	32.07	0.39
2-4	1578.33*	58 cfs	58.00	509.26	510.55	510.21	510.62	0.020314	2.07	27.98	38.51	0.43
2-4	1578.33*	132 cfs	132.00	509.26	511.03	510.54	511.14	0.021014	2.65	49.87	48.80	0.46
2-4	1578.33*	182 cfs	182.00	509.26	511.30	510.74	511.42	0.021134	2.87	63.45	55.56	0.47
2-4	1578.33*	706 cfs	706.00	509.26	512.68	511.89	513.00	0.021591	4.62	167.63	93.45	0.53
2-4	1530.55*	17 cfs	17.00	508.23	509.03	508.82	509.07	0.024712	1.49	11.43	28.54	0.41
2-4	1530.55*	58 cfs	58.00	508.23	509.53	509.15	509.59	0.023001	2.04	28.41	41.83	0.44
2-4	1530.55*	132 cfs	132.00	508.23	510.03	509.53	510.13	0.021229	2.60	50.75	49.63	0.45
2-4	1530.55*	182 cfs	182.00	508.23	510.28	509.69	510.41	0.021401	2.85	63.88	56.74	0.46
2-4	1530.55*	706 cfs	706.00	508.23	511.65	510.88	511.96	0.021789	4.56	178.64	99.75	0.52

HEC-RAS Plan: Calib River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	1482.77*	17 cfs	17.00	507.20	508.06	507.75	508.08	0.017429	1.34	12.72	27.28	0.34
2-4	1482.77*	58 cfs	58.00	507.20	508.57	508.11	508.63	0.017703	1.87	31.04	41.71	0.38
2-4	1482.77*	132 cfs	132.00	507.20	509.10	508.49	509.19	0.018480	2.41	54.91	64.78	0.41
2-4	1482.77*	182 cfs	182.00	507.20	509.34	508.67	509.46	0.018680	2.71	67.79	73.88	0.42
2-4	1482.77*	706 cfs	706.00	507.20	510.79	509.89	511.02	0.017002	4.11	216.07	117.66	0.45
2-4	1435	17 cfs	17.00	506.17	507.02		507.06	0.026805	1.51	11.27	27.28	0.41
2-4	1435	58 cfs	58.00	506.17	507.46		507.53	0.030693	2.22	26.22	45.73	0.47
2-4	1435	132 cfs	132.00	506.17	507.96		508.08	0.030186	2.80	47.71	73.75	0.49
2-4	1435	182 cfs	182.00	506.17	508.18		508.33	0.030328	3.13	59.06	79.75	0.51
2-4	1435	706 cfs	706.00	506.17	509.32		509.78	0.043137	5.59	149.59	121.23	0.67
2-4	1408.*	17 cfs	17.00	504.97	506.12	505.96	506.18	0.039624	1.91	8.92	24.33	0.54
2-4	1408.*	58 cfs	58.00	504.97	506.60	506.34	506.70	0.030728	2.51	23.08	43.14	0.53
2-4	1408.*	132 cfs	132.00	504.97	507.08	506.70	507.24	0.031329	3.15	42.41	62.81	0.56
2-4	1408.*	182 cfs	182.00	504.97	507.31	506.93	507.49	0.031368	3.49	53.17	69.93	0.58
2-4	1408.*	706 cfs	706.00	504.97	508.39	507.98	508.77	0.031163	5.38	165.63	101.30	0.64
2-4	1381	17 cfs	17.00	503.76	505.39	505.07	505.44	0.020526	1.72	9.88	28.42	0.43
2-4	1381	58 cfs	58.00	503.76	505.96	505.56	506.04	0.020245	2.24	25.93	48.69	0.47
2-4	1381	132 cfs	132.00	503.76	506.40	506.00	506.54	0.021555	3.03	44.43	62.34	0.52
2-4	1381	182 cfs	182.00	503.76	506.61	506.18	506.79	0.021822	3.44	55.27	71.60	0.54
2-4	1381	706 cfs	706.00	503.76	507.93	507.16	508.18	0.014253	4.48	182.89	86.63	0.49
2-4	1335.28*	17 cfs	17.00	502.99	504.50		504.55	0.018552	1.66	10.26	21.47	0.42
2-4	1335.28*	58 cfs	58.00	502.99	505.04		505.12	0.019839	2.20	26.88	43.50	0.47
2-4	1335.28*	132 cfs	132.00	502.99	505.48		505.61	0.019120	2.86	48.73	53.10	0.50
2-4	1335.28*	182 cfs	182.00	502.99	505.71		505.86	0.018757	3.18	60.99	55.44	0.51
2-4	1335.28*	706 cfs	706.00	502.99	507.13		507.47	0.016983	5.02	170.66	86.18	0.55
2-4	1289.57*	17 cfs	17.00	502.23	503.57		503.62	0.022182	1.78	9.55	21.05	0.47
2-4	1289.57*	58 cfs	58.00	502.23	504.14		504.21	0.019878	2.20	26.36	39.69	0.48
2-4	1289.57*	132 cfs	132.00	502.23	504.57		504.71	0.020023	2.91	45.35	45.67	0.51
2-4	1289.57*	182 cfs	182.00	502.23	504.79		504.96	0.020395	3.29	55.57	50.09	0.53
2-4	1289.57*	706 cfs	706.00	502.23	506.26		506.65	0.018417	5.23	155.89	85.55	0.57
2-4	1243.85*	17 cfs	17.00	501.46	502.71		502.75	0.016540	1.60	10.60	22.40	0.41
2-4	1243.85*	58 cfs	58.00	501.46	503.22		503.30	0.020225	2.21	26.20	40.12	0.48
2-4	1243.85*	132 cfs	132.00	501.46	503.66		503.78	0.019887	2.88	45.82	46.79	0.51
2-4	1243.85*	182 cfs	182.00	501.46	503.87		504.04	0.020064	3.24	56.23	48.47	0.53
2-4	1243.85*	706 cfs	706.00	501.46	505.33		505.77	0.020219	5.36	140.08	81.72	0.59
2-4	1198.14*	17 cfs	17.00	500.69	501.71		501.77	0.028259	1.94	8.78	21.08	0.53
2-4	1198.14*	58 cfs	58.00	500.69	502.26		502.35	0.020810	2.36	24.59	35.13	0.50
2-4	1198.14*	132 cfs	132.00	500.69	502.73		502.86	0.020498	2.86	46.09	48.94	0.52
2-4	1198.14*	182 cfs	182.00	500.69	502.95		503.11	0.020221	3.22	56.61	49.97	0.53
2-4	1198.14*	706 cfs	706.00	500.69	504.40		504.83	0.020556	5.28	134.02	60.52	0.59
2-4	1152.42*	17 cfs	17.00	499.92	500.95	500.64	500.98	0.011415	1.38	12.32	25.04	0.35
2-4	1152.42*	58 cfs	58.00	499.92	501.40		501.48	0.017552	2.18	26.63	37.92	0.46
2-4	1152.42*	132 cfs	132.00	499.92	501.85		501.97	0.018778	2.74	48.09	51.14	0.50
2-4	1152.42*	182 cfs	182.00	499.92	502.04		502.19	0.020019	3.15	57.69	52.18	0.53
2-4	1152.42*	706 cfs	706.00	499.92	503.54		503.93	0.018439	5.00	141.20	57.35	0.56
2-4	1106.71*	17 cfs	17.00	499.16	499.79		499.89	0.077610	2.65	6.41	20.59	0.84
2-4	1106.71*	58 cfs	58.00	499.16	500.35		500.46	0.028809	2.65	21.87	33.52	0.58
2-4	1106.71*	132 cfs	132.00	499.16	500.88		501.01	0.024071	2.93	45.09	52.47	0.56
2-4	1106.71*	182 cfs	182.00	499.16	501.13		501.28	0.019680	3.09	58.91	54.32	0.52
2-4	1106.71*	706 cfs	706.00	499.16	502.93		503.22	0.012177	4.30	164.00	60.61	0.46
2-4	1061	17 cfs	17.00	498.39	499.29		499.31	0.004738	0.97	17.49	31.10	0.23
2-4	1061	58 cfs	58.00	498.39	499.95		499.98	0.005085	1.30	44.53	54.28	0.25
2-4	1061	132 cfs	132.00	498.39	500.52		500.57	0.004696	1.72	76.81	58.05	0.26
2-4	1061	182 cfs	182.00	498.39	500.80		500.86	0.004827	1.96	93.09	58.98	0.27
2-4	1061	706 cfs	706.00	498.39	502.63		502.81	0.006029	3.38	211.86	75.46	0.33
2-4	1018.*	17 cfs	17.00	498.19	499.08		499.09	0.005322	1.02	16.64	30.34	0.24
2-4	1018.*	58 cfs	58.00	498.19	499.69		499.72	0.006944	1.48	39.12	50.11	0.30
2-4	1018.*	132 cfs	132.00	498.19	500.30		500.35	0.005551	1.81	72.82	58.29	0.29
2-4	1018.*	182 cfs	182.00	498.19	500.58		500.64	0.005503	2.04	89.08	58.99	0.29
2-4	1018.*	706 cfs	706.00	498.19	502.32		502.53	0.006924	3.63	194.68	61.52	0.36
2-4	975.*	17 cfs	17.00	497.98	498.83		498.85	0.005763	1.05	16.14	30.21	0.25
2-4	975.*	58 cfs	58.00	497.98	499.37		499.41	0.007314	1.71	33.90	36.61	0.31
2-4	975.*	132 cfs	132.00	497.98	500.01		500.07	0.007548	2.04	64.76	54.94	0.33
2-4	975.*	182 cfs	182.00	497.98	500.29		500.37	0.007198	2.26	80.48	56.08	0.33
2-4	975.*	706 cfs	706.00	497.98	501.93		502.18	0.009123	4.05	174.73	59.48	0.41

HEC-RAS Plan: Calib River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	932	17 cfs	17.00	497.78	498.39		498.43	0.019781	1.58	10.73	27.35	0.45
2-4	932	58 cfs	58.00	497.78	498.83		498.93	0.019303	2.44	23.72	30.31	0.49
2-4	932	132 cfs	132.00	497.78	499.40		499.55	0.020461	3.14	42.05	38.22	0.53
2-4	932	182 cfs	182.00	497.78	499.71		499.87	0.020262	3.24	56.10	48.30	0.53
2-4	932	706 cfs	706.00	497.78	501.13		501.58	0.022010	5.39	131.10	56.22	0.61
2-4	882.*	17 cfs	17.00	496.50	497.31		497.35	0.023428	1.78	9.56	23.35	0.49
2-4	882.*	58 cfs	58.00	496.50	497.82		497.91	0.021446	2.50	23.19	31.09	0.51
2-4	882.*	132 cfs	132.00	496.50	498.39		498.54	0.020078	3.13	42.15	37.96	0.52
2-4	882.*	182 cfs	182.00	496.50	498.73		498.88	0.019809	3.11	58.53	53.02	0.52
2-4	882.*	706 cfs	706.00	496.50	500.06		500.48	0.021662	5.19	135.99	61.14	0.60
2-4	832.*	17 cfs	17.00	495.22	496.28		496.32	0.018453	1.64	10.35	23.65	0.44
2-4	832.*	58 cfs	58.00	495.22	496.74		496.85	0.021364	2.61	22.26	27.89	0.51
2-4	832.*	132 cfs	132.00	495.22	497.32		497.49	0.022137	3.29	40.13	36.05	0.55
2-4	832.*	182 cfs	182.00	495.22	497.77		497.90	0.019057	2.93	62.07	59.70	0.51
2-4	832.*	706 cfs	706.00	495.22	499.01		499.40	0.021310	5.01	140.96	66.10	0.60
2-4	782.*	17 cfs	17.00	493.94	495.15		495.21	0.028051	1.91	8.90	22.00	0.53
2-4	782.*	58 cfs	58.00	493.94	495.68		495.78	0.021040	2.60	22.31	27.72	0.51
2-4	782.*	132 cfs	132.00	493.94	496.21		496.40	0.021546	3.47	37.99	30.53	0.55
2-4	782.*	182 cfs	182.00	493.94	496.74		496.88	0.022183	2.97	61.27	64.74	0.54
2-4	782.*	706 cfs	706.00	493.94	497.97		498.34	0.020950	4.84	145.93	71.10	0.59
2-4	732.*	17 cfs	17.00	492.66	493.74		493.85	0.025813	2.68	6.35	8.50	0.55
2-4	732.*	58 cfs	58.00	492.66	494.58		494.69	0.022787	2.67	21.70	27.47	0.53
2-4	732.*	132 cfs	132.00	492.66	495.14		495.32	0.021549	3.45	38.30	31.12	0.55
2-4	732.*	182 cfs	182.00	492.66	495.57		495.75	0.022947	3.37	54.07	48.10	0.56
2-4	732.*	706 cfs	706.00	492.66	496.94		497.28	0.020850	4.70	150.25	76.10	0.58
2-4	682.*	17 cfs	17.00	491.38	492.45		492.57	0.025497	2.74	6.20	7.89	0.55
2-4	682.*	58 cfs	58.00	491.38	493.54		493.64	0.019324	2.53	22.97	27.74	0.49
2-4	682.*	132 cfs	132.00	491.38	494.07		494.25	0.021502	3.41	38.72	31.90	0.55
2-4	682.*	182 cfs	182.00	491.38	494.41		494.62	0.022080	3.60	50.54	39.12	0.56
2-4	682.*	706 cfs	706.00	491.38	495.92		496.24	0.020577	4.57	154.89	81.13	0.58
2-4	632.*	17 cfs	17.00	490.10	491.17		491.28	0.025901	2.76	6.17	7.91	0.55
2-4	632.*	58 cfs	58.00	490.10	492.33		492.46	0.029820	2.98	19.48	25.11	0.60
2-4	632.*	132 cfs	132.00	490.10	492.99		493.16	0.021808	3.39	38.96	32.69	0.55
2-4	632.*	182 cfs	182.00	490.10	493.30		493.51	0.022121	3.67	49.60	37.22	0.56
2-4	632.*	706 cfs	706.00	490.10	494.87		495.19	0.021585	4.52	156.49	86.10	0.59
2-4	582.*	17 cfs	17.00	488.82	489.89		490.01	0.025249	2.72	6.24	8.02	0.54
2-4	582.*	58 cfs	58.00	488.82	490.84		491.07	0.025704	3.83	15.13	11.18	0.58
2-4	582.*	132 cfs	132.00	488.82	491.87		492.06	0.022632	3.45	38.24	32.04	0.56
2-4	582.*	182 cfs	182.00	488.82	492.19		492.41	0.021980	3.72	48.98	35.77	0.56
2-4	582.*	706 cfs	706.00	488.82	493.79		494.11	0.021428	4.56	155.13	83.35	0.58
2-4	532.*	17 cfs	17.00	487.54	488.60		488.72	0.026503	2.75	6.17	8.15	0.56
2-4	532.*	58 cfs	58.00	487.54	489.54		489.77	0.026229	3.93	14.76	10.60	0.59
2-4	532.*	132 cfs	132.00	487.54	490.82		490.99	0.020413	3.33	39.68	32.32	0.53
2-4	532.*	182 cfs	182.00	487.54	491.07		491.29	0.022459	3.78	48.20	34.79	0.57
2-4	532.*	706 cfs	706.00	487.54	492.71		493.03	0.021860	4.55	155.49	84.90	0.59
2-4	482.*	17 cfs	17.00	486.25	487.33		487.44	0.024845	2.68	6.34	8.34	0.54
2-4	482.*	58 cfs	58.00	486.25	488.22		488.47	0.026224	4.00	14.52	10.11	0.59
2-4	482.*	132 cfs	132.00	486.25	489.55		489.77	0.029490	3.82	34.52	29.66	0.62
2-4	482.*	182 cfs	182.00	486.25	490.00		490.21	0.020785	3.69	49.26	34.55	0.55
2-4	482.*	706 cfs	706.00	486.25	491.63		491.95	0.021325	4.50	157.02	85.18	0.58
2-4	432.*	17 cfs	17.00	484.97	486.02		486.14	0.027449	2.75	6.18	8.51	0.57
2-4	432.*	58 cfs	58.00	484.97	486.92		487.17	0.026015	4.00	14.49	10.04	0.59
2-4	432.*	132 cfs	132.00	484.97	488.02		488.38	0.025833	4.81	27.44	13.90	0.60
2-4	432.*	182 cfs	182.00	484.97	488.77		489.02	0.027142	4.02	45.22	33.83	0.61
2-4	432.*	706 cfs	706.00	484.97	490.56		490.87	0.021408	4.44	159.15	88.39	0.58
2-4	382.*	17 cfs	17.00	483.69	484.79		484.89	0.022602	2.56	6.65	8.82	0.52
2-4	382.*	58 cfs	58.00	483.69	485.63		485.87	0.025698	3.97	14.60	10.19	0.58
2-4	382.*	132 cfs	132.00	483.69	486.70		487.07	0.026137	4.90	26.92	13.28	0.61
2-4	382.*	182 cfs	182.00	483.69	487.25		487.68	0.025895	5.21	34.91	15.50	0.61
2-4	382.*	706 cfs	706.00	483.69	489.51		489.80	0.021263	4.37	161.84	91.70	0.58
2-4	332.*	17 cfs	17.00	482.41	483.41		483.54	0.032987	2.92	5.83	8.48	0.62
2-4	332.*	58 cfs	58.00	482.41	484.31		484.56	0.027016	4.03	14.40	10.31	0.60
2-4	332.*	132 cfs	132.00	482.41	485.38		485.76	0.026302	4.97	26.57	12.87	0.61
2-4	332.*	182 cfs	182.00	482.41	485.95		486.38	0.025872	5.28	34.46	14.91	0.61
2-4	332.*	706 cfs	706.00	482.41	488.42		488.71	0.022374	4.38	161.37	94.72	0.59

HEC-RAS Plan: Calib River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	282.*	17 cfs	17.00	481.13	482.31		482.39	0.016521	2.29	7.44	9.23	0.45
2-4	282.*	58 cfs	58.00	481.13	483.11		483.33	0.022168	3.75	15.49	10.64	0.55
2-4	282.*	132 cfs	132.00	481.13	484.17		484.52	0.022903	4.75	27.78	12.90	0.57
2-4	282.*	182 cfs	182.00	481.13	484.80		485.18	0.021798	4.99	36.48	14.99	0.56
2-4	282.*	706 cfs	706.00	481.13	487.27		487.59	0.022477	4.52	156.40	87.61	0.59
2-4	232.*	17 cfs	17.00	479.85	482.24		482.25	0.000881	0.84	20.30	11.45	0.11
2-4	232.*	58 cfs	58.00	479.85	482.76		482.83	0.004872	2.19	26.44	12.26	0.26
2-4	232.*	132 cfs	132.00	479.85	483.50		483.70	0.011252	3.63	36.40	14.64	0.41
2-4	232.*	182 cfs	182.00	479.85	484.11		484.36	0.011845	3.95	46.06	16.82	0.42
2-4	232.*	706 cfs	706.00	479.85	486.19		486.50	0.020879	4.48	157.83	84.61	0.58
2-4	182.*	17 cfs	17.00	478.57	482.23		482.23	0.000177	0.46	36.86	14.45	0.05
2-4	182.*	58 cfs	58.00	478.57	482.68		482.70	0.001337	1.33	43.65	15.85	0.14
2-4	182.*	132 cfs	132.00	478.57	483.25		483.35	0.004201	2.47	53.37	17.93	0.25
2-4	182.*	182 cfs	182.00	478.57	483.61		483.75	0.011297	2.98	61.09	35.83	0.40
2-4	182.*	706 cfs	706.00	478.57	485.40		485.62	0.014125	3.82	185.01	94.26	0.48
2-4	132.*	17 cfs	17.00	477.29	482.22		482.23	0.000055	0.29	58.04	18.49	0.03
2-4	132.*	58 cfs	58.00	477.29	482.63		482.64	0.000908	0.86	67.47	38.53	0.11
2-4	132.*	132 cfs	132.00	477.29	483.12		483.15	0.002941	1.41	93.37	63.68	0.21
2-4	132.*	182 cfs	182.00	477.29	483.38		483.42	0.003609	1.64	110.73	70.65	0.23
2-4	132.*	706 cfs	706.00	477.29	485.07		485.18	0.005248	2.66	267.28	112.37	0.30
2-4	82	17 cfs	17.00	476.01	482.22		482.22	0.000033	0.16	107.56	68.16	0.02
2-4	82	58 cfs	58.00	476.01	482.62		482.62	0.000215	0.42	136.89	80.80	0.06
2-4	82	132 cfs	132.00	476.01	483.08		483.09	0.000539	0.75	175.83	88.70	0.09
2-4	82	182 cfs	182.00	476.01	483.33		483.34	0.000736	0.92	198.29	93.67	0.11
2-4	82	706 cfs	706.00	476.01	484.97		485.03	0.001707	1.85	384.35	118.94	0.18
2-4	50	17 cfs	17.00	481.55	482.10	482.10	482.21	0.126642	2.68	6.34	29.08	1.01
2-4	50	58 cfs	58.00	481.55	482.36	482.36	482.58	0.106335	3.70	15.68	38.62	1.02
2-4	50	132 cfs	132.00	481.55	482.67	482.67	483.00	0.091667	4.60	28.73	45.42	1.02
2-4	50	182 cfs	182.00	481.55	482.84	482.84	483.23	0.085592	5.00	36.43	48.12	1.01
2-4	50	706 cfs	706.00	481.55	483.92	483.92	484.78	0.065505	7.48	94.82	56.13	1.01

HEC-RAS Plan: Flood River: Grant Creek Reach: 2-4

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	2110	Q 2	961.00	521.86	526.42	526.21	527.82	0.044334	9.66	109.41	34.12	0.90
2-4	2110	Q 5	1410.00	521.86	527.16	527.14	529.20	0.050323	11.67	134.85	34.35	0.99
2-4	2110	Q 10	1790.00	521.86	527.83	527.83	530.27	0.050053	12.79	157.64	34.35	1.01
2-4	2110	Q 25	2350.00	521.86	528.81	528.81	531.72	0.047164	13.99	191.34	34.35	1.01
2-4	2110	Q 50	2810.00	521.86	529.53	529.53	532.83	0.045914	14.90	216.28	34.35	1.01
2-4	2110	Q 100	3310.00	521.86	530.27	530.27	533.98	0.044969	15.81	241.56	34.35	1.02
2-4	2061.*	Q 2	961.00	520.57	524.75	524.36	525.76	0.035793	8.11	124.22	44.97	0.82
2-4	2061.*	Q 5	1410.00	520.57	525.44	525.15	526.86	0.038825	9.66	155.32	45.66	0.88
2-4	2061.*	Q 10	1790.00	520.57	525.92	525.74	527.70	0.041330	10.81	177.82	46.60	0.92
2-4	2061.*	Q 25	2350.00	520.57	525.98	526.53	528.96	0.068095	14.00	180.46	46.65	1.19
2-4	2061.*	Q 50	2810.00	520.57	526.32	527.11	529.96	0.075395	15.49	196.16	46.70	1.27
2-4	2061.*	Q 100	3310.00	520.57	526.66	527.72	531.01	0.081914	16.94	212.36	46.70	1.34
2-4	2012.*	Q 2	961.00	519.28	523.26		524.04	0.031675	7.11	137.98	54.33	0.76
2-4	2012.*	Q 5	1410.00	519.28	523.89		524.99	0.033865	8.44	172.62	56.05	0.81
2-4	2012.*	Q 10	1790.00	519.28	524.35	523.97	525.71	0.035357	9.39	198.56	56.75	0.85
2-4	2012.*	Q 25	2350.00	519.28	524.94	524.66	526.67	0.037529	10.65	232.04	57.36	0.89
2-4	2012.*	Q 50	2810.00	519.28	525.36	525.16	527.41	0.039253	11.58	256.59	57.87	0.93
2-4	2012.*	Q 100	3310.00	519.28	525.78	525.66	528.18	0.041079	12.53	281.04	58.63	0.96
2-4	1963.*	Q 2	961.00	518.00	521.87		522.51	0.029245	6.40	150.81	63.82	0.72
2-4	1963.*	Q 5	1410.00	518.00	522.46		523.35	0.030778	7.57	188.98	65.65	0.76
2-4	1963.*	Q 10	1790.00	518.00	522.88		523.98	0.032032	8.42	217.08	66.74	0.80
2-4	1963.*	Q 25	2350.00	518.00	523.43	523.01	524.83	0.033648	9.52	254.23	67.96	0.84
2-4	1963.*	Q 50	2810.00	518.00	523.84	523.44	525.48	0.034878	10.33	281.72	68.42	0.86
2-4	1963.*	Q 100	3310.00	518.00	524.24	523.90	526.14	0.036177	11.14	309.15	68.93	0.89
2-4	1914.*	Q 2	961.00	516.71	520.49		521.05	0.029510	6.01	159.99	71.52	0.71
2-4	1914.*	Q 5	1410.00	516.71	521.05		521.82	0.030100	7.02	201.45	75.06	0.74
2-4	1914.*	Q 10	1790.00	516.71	521.46		522.40	0.030685	7.76	232.49	76.54	0.77
2-4	1914.*	Q 25	2350.00	516.71	521.99		523.17	0.031519	8.72	273.59	77.79	0.80
2-4	1914.*	Q 50	2810.00	516.71	522.39		523.76	0.032114	9.41	304.50	78.70	0.82
2-4	1914.*	Q 100	3310.00	516.71	522.79	522.31	524.36	0.032694	10.10	335.89	79.39	0.84
2-4	1865	Q 2	961.00	515.43	519.31		519.74	0.022602	5.26	182.60	81.36	0.62
2-4	1865	Q 5	1410.00	515.43	519.93		520.50	0.022309	6.05	233.12	83.77	0.64
2-4	1865	Q 10	1790.00	515.43	520.37		521.05	0.022186	6.63	270.75	87.09	0.65
2-4	1865	Q 25	2350.00	515.43	520.95		521.79	0.021959	7.37	321.87	88.44	0.66
2-4	1865	Q 50	2810.00	515.43	521.39		522.35	0.021836	7.90	360.66	89.41	0.68
2-4	1865	Q 100	3310.00	515.43	521.83		522.92	0.021738	8.42	400.36	90.34	0.68
2-4	1817.22*	Q 2	961.00	514.40	518.23		518.67	0.022424	5.33	180.38	78.77	0.62
2-4	1817.22*	Q 5	1410.00	514.40	518.84		519.43	0.022211	6.14	230.23	85.76	0.64
2-4	1817.22*	Q 10	1790.00	514.40	519.29		519.99	0.022028	6.74	269.04	87.85	0.65
2-4	1817.22*	Q 25	2350.00	514.40	519.88		520.74	0.021853	7.48	321.50	90.38	0.67
2-4	1817.22*	Q 50	2810.00	514.40	520.32		521.31	0.021731	8.01	361.68	91.67	0.68
2-4	1817.22*	Q 100	3310.00	514.40	520.76		521.88	0.021640	8.54	402.84	92.97	0.69
2-4	1769.44*	Q 2	961.00	513.37	517.17		517.62	0.021544	5.34	179.91	76.28	0.61
2-4	1769.44*	Q 5	1410.00	513.37	517.79		518.39	0.021425	6.19	231.41	87.75	0.63
2-4	1769.44*	Q 10	1790.00	513.37	518.25		518.96	0.021265	6.78	271.83	90.27	0.65
2-4	1769.44*	Q 25	2350.00	513.37	518.85		519.72	0.021103	7.52	326.88	92.98	0.66
2-4	1769.44*	Q 50	2810.00	513.37	519.29		520.29	0.021010	8.06	368.87	94.67	0.67
2-4	1769.44*	Q 100	3310.00	513.37	519.74		520.86	0.021006	8.59	411.78	97.05	0.68
2-4	1721.66*	Q 2	961.00	512.34	516.15		516.59	0.021261	5.31	182.14	84.34	0.60
2-4	1721.66*	Q 5	1410.00	512.34	516.78		517.37	0.021106	6.16	237.80	91.05	0.62
2-4	1721.66*	Q 10	1790.00	512.34	517.25		517.94	0.021019	6.75	280.52	93.67	0.63
2-4	1721.66*	Q 25	2350.00	512.34	517.86		518.71	0.020952	7.49	338.37	96.38	0.65
2-4	1721.66*	Q 50	2810.00	512.34	518.30		519.28	0.021008	8.03	382.70	100.52	0.66
2-4	1721.66*	Q 100	3310.00	512.34	518.76		519.85	0.021035	8.55	428.38	101.54	0.67
2-4	1673.88*	Q 2	961.00	511.31	515.14		515.57	0.021293	5.28	188.69	90.40	0.58
2-4	1673.88*	Q 5	1410.00	511.31	515.78		516.35	0.021220	6.11	247.67	93.51	0.60
2-4	1673.88*	Q 10	1790.00	511.31	516.25		516.93	0.021269	6.70	292.40	97.10	0.62
2-4	1673.88*	Q 25	2350.00	511.31	516.86		517.69	0.021389	7.44	354.28	103.85	0.63
2-4	1673.88*	Q 50	2810.00	511.31	517.31		518.25	0.021443	7.97	401.44	104.85	0.64
2-4	1673.88*	Q 100	3310.00	511.31	517.77		518.82	0.021576	8.49	449.09	106.39	0.66
2-4	1626.11*	Q 2	961.00	510.29	514.13		514.55	0.021404	5.24	197.98	92.58	0.56
2-4	1626.11*	Q 5	1410.00	510.29	514.78		515.33	0.021562	6.07	259.28	99.37	0.59
2-4	1626.11*	Q 10	1790.00	510.29	515.24		515.90	0.021764	6.66	307.89	106.34	0.60
2-4	1626.11*	Q 25	2350.00	510.29	515.85		516.64	0.021912	7.38	373.41	108.63	0.62
2-4	1626.11*	Q 50	2810.00	510.29	516.30		517.20	0.022093	7.91	422.81	111.56	0.63
2-4	1626.11*	Q 100	3310.00	510.29	516.75		517.76	0.022353	8.43	473.03	114.06	0.65
2-4	1578.33*	Q 2	961.00	509.26	513.11	512.27	513.51	0.021702	5.19	208.83	97.68	0.55

HEC-RAS Plan: Flood River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	1578.33*	Q 5	1410.00	509.26	513.75	512.84	514.28	0.022010	6.01	275.92	109.24	0.58
2-4	1578.33*	Q 10	1790.00	509.26	514.22	513.26	514.84	0.022243	6.58	327.10	111.86	0.59
2-4	1578.33*	Q 25	2350.00	509.26	514.82	513.80	515.57	0.022537	7.30	396.29	116.55	0.61
2-4	1578.33*	Q 50	2810.00	509.26	515.27	514.18	516.11	0.022820	7.83	448.79	120.50	0.62
2-4	1578.33*	Q 100	3310.00	509.26	515.71	514.58	516.66	0.023020	8.33	502.50	121.66	0.63
2-4	1530.55*	Q 2	961.00	508.23	512.09	511.30	512.47	0.021762	5.11	225.65	109.18	0.54
2-4	1530.55*	Q 5	1410.00	508.23	512.73	511.79	513.21	0.021988	5.88	298.69	117.72	0.56
2-4	1530.55*	Q 10	1790.00	508.23	513.19	512.20	513.76	0.022258	6.43	353.49	120.61	0.57
2-4	1530.55*	Q 25	2350.00	508.23	513.79	512.70	514.47	0.022656	7.13	427.15	125.17	0.59
2-4	1530.55*	Q 50	2810.00	508.23	514.23	513.08	515.00	0.022928	7.63	482.59	127.29	0.60
2-4	1530.55*	Q 100	3310.00	508.23	514.68	513.43	515.53	0.023055	8.10	539.32	127.29	0.61
2-4	1482.77*	Q 2	961.00	507.20	511.24	510.21	511.52	0.017149	4.59	270.44	122.53	0.46
2-4	1482.77*	Q 5	1410.00	507.20	511.84	510.70	512.22	0.018624	5.40	345.87	128.03	0.50
2-4	1482.77*	Q 10	1790.00	507.20	512.28	511.09	512.73	0.019531	5.96	402.05	129.62	0.52
2-4	1482.77*	Q 25	2350.00	507.20	512.84	511.55	513.40	0.020612	6.68	476.32	131.74	0.55
2-4	1482.77*	Q 50	2810.00	507.20	513.27	511.93	513.90	0.021178	7.18	532.45	131.74	0.56
2-4	1482.77*	Q 100	3310.00	507.20	513.71	512.27	514.42	0.021596	7.66	589.97	131.74	0.58
2-4	1435	Q 2	961.00	506.17	509.69		510.25	0.044179	6.29	192.02	127.21	0.70
2-4	1435	Q 5	1410.00	506.17	510.29		510.93	0.040269	6.93	270.97	132.34	0.69
2-4	1435	Q 10	1790.00	506.17	510.76		511.44	0.037395	7.32	332.57	134.02	0.68
2-4	1435	Q 25	2350.00	506.17	511.38		512.13	0.034391	7.80	416.35	135.91	0.67
2-4	1435	Q 50	2810.00	506.17	511.85		512.65	0.032304	8.12	481.29	136.20	0.66
2-4	1435	Q 100	3310.00	506.17	512.34		513.19	0.030561	8.43	547.82	136.20	0.65
2-4	1408.*	Q 2	961.00	504.97	508.84	508.31	509.26	0.028331	5.81	211.24	104.49	0.63
2-4	1408.*	Q 5	1410.00	504.97	509.55	508.76	510.05	0.024789	6.38	290.10	114.62	0.62
2-4	1408.*	Q 10	1790.00	504.97	510.07	509.15	510.62	0.023093	6.78	350.32	118.47	0.61
2-4	1408.*	Q 25	2350.00	504.97	510.74	509.63	511.36	0.021537	7.29	430.11	119.44	0.60
2-4	1408.*	Q 50	2810.00	504.97	511.25	509.96	511.93	0.020627	7.66	490.79	120.00	0.60
2-4	1408.*	Q 100	3310.00	504.97	511.76	510.35	512.50	0.019933	8.03	551.98	120.00	0.60
2-4	1381	Q 2	961.00	503.76	508.40	507.47	508.71	0.014010	4.96	223.94	88.48	0.50
2-4	1381	Q 5	1410.00	503.76	509.13	507.93	509.54	0.013651	5.66	291.84	96.79	0.51
2-4	1381	Q 10	1790.00	503.76	509.64	508.29	510.12	0.013975	6.23	342.94	101.31	0.53
2-4	1381	Q 25	2350.00	503.76	510.32	508.76	510.89	0.013774	6.82	412.08	102.72	0.54
2-4	1381	Q 50	2810.00	503.76	510.83	509.18	511.47	0.013646	7.24	464.83	103.80	0.55
2-4	1381	Q 100	3310.00	503.76	511.34	509.65	512.05	0.013480	7.64	518.09	103.80	0.55
2-4	1335.28*	Q 2	961.00	502.99	507.59		508.00	0.016863	5.58	211.08	88.11	0.56
2-4	1335.28*	Q 5	1410.00	502.99	508.30		508.83	0.017084	6.44	276.79	99.05	0.58
2-4	1335.28*	Q 10	1790.00	502.99	508.79		509.40	0.017211	7.00	326.00	100.49	0.60
2-4	1335.28*	Q 25	2350.00	502.99	509.44		510.17	0.017218	7.70	392.22	101.81	0.61
2-4	1335.28*	Q 50	2810.00	502.99	509.93		510.75	0.017198	8.20	442.65	102.77	0.62
2-4	1335.28*	Q 100	3310.00	502.99	510.44		511.34	0.017063	8.66	494.29	102.77	0.63
2-4	1289.57*	Q 2	961.00	502.23	506.73		507.20	0.017938	5.76	196.94	87.60	0.58
2-4	1289.57*	Q 5	1410.00	502.23	507.42		508.02	0.018055	6.62	261.93	99.39	0.60
2-4	1289.57*	Q 10	1790.00	502.23	507.92		508.59	0.017967	7.16	310.82	99.64	0.61
2-4	1289.57*	Q 25	2350.00	502.23	508.57		509.36	0.017805	7.84	376.60	100.92	0.62
2-4	1289.57*	Q 50	2810.00	502.23	509.07		509.95	0.017589	8.31	427.29	101.74	0.63
2-4	1289.57*	Q 100	3310.00	502.23	509.59		510.55	0.017198	8.73	480.25	101.74	0.63
2-4	1243.85*	Q 2	961.00	501.46	505.83		506.34	0.019235	5.90	182.48	86.75	0.60
2-4	1243.85*	Q 5	1410.00	501.46	506.52		507.17	0.018929	6.71	248.10	98.71	0.61
2-4	1243.85*	Q 10	1790.00	501.46	507.03		507.75	0.018517	7.23	298.08	98.89	0.62
2-4	1243.85*	Q 25	2350.00	501.46	507.72		508.55	0.017748	7.83	366.91	100.07	0.62
2-4	1243.85*	Q 50	2810.00	501.46	508.26		509.15	0.017058	8.22	420.91	100.71	0.62
2-4	1243.85*	Q 100	3310.00	501.46	508.82		509.78	0.016267	8.57	477.78	100.71	0.61
2-4	1198.14*	Q 2	961.00	500.69	504.91		505.45	0.019917	5.89	171.14	84.43	0.60
2-4	1198.14*	Q 5	1410.00	500.69	505.66		506.31	0.018679	6.62	241.11	98.03	0.61
2-4	1198.14*	Q 10	1790.00	500.69	506.21		506.93	0.017592	7.05	295.50	98.24	0.60
2-4	1198.14*	Q 25	2350.00	500.69	506.97		507.76	0.016160	7.54	370.55	99.66	0.59
2-4	1198.14*	Q 50	2810.00	500.69	507.56		508.41	0.015102	7.85	429.47	99.69	0.58
2-4	1198.14*	Q 100	3310.00	500.69	508.18		509.07	0.014157	8.14	490.67	99.69	0.57
2-4	1152.42*	Q 2	961.00	499.92	504.10		504.58	0.017518	5.54	174.87	72.41	0.56
2-4	1152.42*	Q 5	1410.00	499.92	504.93		505.50	0.015662	6.16	251.29	97.23	0.55
2-4	1152.42*	Q 10	1790.00	499.92	505.56		506.18	0.014250	6.50	312.29	97.64	0.54
2-4	1152.42*	Q 25	2350.00	499.92	506.40		507.08	0.012773	6.91	394.87	98.66	0.53
2-4	1152.42*	Q 50	2810.00	499.92	507.04		507.76	0.011896	7.19	457.92	98.66	0.52
2-4	1152.42*	Q 100	3310.00	499.92	507.69		508.46	0.011190	7.48	522.36	98.66	0.51
2-4	1106.71*	Q 2	961.00	499.16	503.54		503.89	0.011589	4.76	205.52	76.64	0.46
2-4	1106.71*	Q 5	1410.00	499.16	504.46		504.88	0.010438	5.31	289.06	96.60	0.46

HEC-RAS Plan: Flood River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	1106.71*	Q 10	1790.00	499.16	505.13		505.60	0.009671	5.65	354.48	97.43	0.45
2-4	1106.71*	Q 25	2350.00	499.16	506.02		506.55	0.008950	6.07	441.00	97.63	0.45
2-4	1106.71*	Q 50	2810.00	499.16	506.68		507.26	0.008557	6.38	505.77	97.63	0.44
2-4	1106.71*	Q 100	3310.00	499.16	507.35		507.98	0.008248	6.70	571.42	97.63	0.44
2-4	1061	Q 2	961.00	498.39	503.25		503.48	0.006166	3.82	261.77	89.11	0.34
2-4	1061	Q 5	1410.00	498.39	504.20		504.48	0.006065	4.38	350.70	96.43	0.35
2-4	1061	Q 10	1790.00	498.39	504.88		505.22	0.005971	4.76	417.17	96.60	0.36
2-4	1061	Q 25	2350.00	498.39	505.78		506.18	0.005909	5.24	503.87	96.60	0.37
2-4	1061	Q 50	2810.00	498.39	506.45		506.90	0.005880	5.58	568.56	96.60	0.37
2-4	1061	Q 100	3310.00	498.39	507.13		507.63	0.005859	5.93	634.01	96.60	0.38
2-4	1018.*	Q 2	961.00	498.19	502.92		503.19	0.007327	4.16	232.29	67.03	0.38
2-4	1018.*	Q 5	1410.00	498.19	503.82		504.18	0.007703	4.88	299.94	84.57	0.40
2-4	1018.*	Q 10	1790.00	498.19	504.48		504.92	0.007740	5.35	356.72	85.50	0.41
2-4	1018.*	Q 25	2350.00	498.19	505.35		505.87	0.007774	5.93	430.93	85.50	0.42
2-4	1018.*	Q 50	2810.00	498.19	506.00		506.59	0.007792	6.34	486.33	85.50	0.43
2-4	1018.*	Q 100	3310.00	498.19	506.65		507.32	0.007813	6.75	542.31	85.50	0.43
2-4	975.*	Q 2	961.00	497.98	502.48		502.82	0.009709	4.64	208.28	60.82	0.43
2-4	975.*	Q 5	1410.00	497.98	503.32		503.79	0.010473	5.50	260.16	62.91	0.46
2-4	975.*	Q 10	1790.00	497.98	503.94		504.51	0.010929	6.10	301.69	73.44	0.48
2-4	975.*	Q 25	2350.00	497.98	504.75		505.46	0.011198	6.82	362.00	74.40	0.50
2-4	975.*	Q 50	2810.00	497.98	505.36		506.17	0.011317	7.33	407.31	74.40	0.51
2-4	975.*	Q 100	3310.00	497.98	505.97		506.89	0.011433	7.82	452.97	74.40	0.52
2-4	932	Q 2	961.00	497.78	501.60		502.18	0.022611	6.12	158.21	58.04	0.64
2-4	932	Q 5	1410.00	497.78	502.31		503.11	0.023505	7.17	200.07	60.11	0.67
2-4	932	Q 10	1790.00	497.78	502.84		503.80	0.024121	7.91	231.85	61.19	0.69
2-4	932	Q 25	2350.00	497.78	503.52		504.72	0.024915	8.84	274.33	62.31	0.71
2-4	932	Q 50	2810.00	497.78	504.03		505.41	0.025549	9.52	306.05	63.00	0.73
2-4	932	Q 100	3310.00	497.78	504.53		506.11	0.026269	10.19	337.86	63.30	0.75
2-4	882.*	Q 2	961.00	496.50	500.51		501.05	0.022107	5.89	164.19	62.81	0.63
2-4	882.*	Q 5	1410.00	496.50	501.19		501.93	0.022902	6.90	207.22	64.20	0.66
2-4	882.*	Q 10	1790.00	496.50	501.70		502.59	0.023445	7.61	239.90	65.55	0.68
2-4	882.*	Q 25	2350.00	496.50	502.36		503.47	0.024162	8.51	283.57	66.90	0.70
2-4	882.*	Q 50	2810.00	496.50	502.84		504.13	0.024714	9.16	316.22	67.25	0.72
2-4	882.*	Q 100	3310.00	496.50	503.32		504.79	0.025248	9.83	348.60	68.16	0.74
2-4	832.*	Q 2	961.00	495.22	499.44		499.94	0.021737	5.69	170.02	67.63	0.62
2-4	832.*	Q 5	1410.00	495.22	500.10		500.78	0.022435	6.66	214.34	68.36	0.65
2-4	832.*	Q 10	1790.00	495.22	500.58		501.41	0.022936	7.34	247.83	69.93	0.67
2-4	832.*	Q 25	2350.00	495.22	501.21		502.25	0.023584	8.21	292.63	71.30	0.69
2-4	832.*	Q 50	2810.00	495.22	501.68		502.88	0.024084	8.85	326.10	71.90	0.71
2-4	832.*	Q 100	3310.00	495.22	502.14		503.52	0.024568	9.49	359.41	72.86	0.73
2-4	782.*	Q 2	961.00	493.94	498.39		498.86	0.021412	5.50	175.74	72.50	0.61
2-4	782.*	Q 5	1410.00	493.94	499.01		499.66	0.022030	6.43	221.42	72.89	0.64
2-4	782.*	Q 10	1790.00	493.94	499.48		500.26	0.022498	7.10	255.68	74.26	0.66
2-4	782.*	Q 25	2350.00	493.94	500.09		501.07	0.023080	7.94	301.66	75.64	0.68
2-4	782.*	Q 50	2810.00	493.94	500.54		501.67	0.023535	8.56	335.85	76.62	0.70
2-4	782.*	Q 100	3310.00	493.94	500.99		502.28	0.023968	9.18	370.16	77.38	0.72
2-4	732.*	Q 2	961.00	492.66	497.34		497.78	0.021184	5.33	181.13	77.36	0.60
2-4	732.*	Q 5	1410.00	492.66	497.95		498.55	0.021731	6.24	228.16	77.70	0.63
2-4	732.*	Q 10	1790.00	492.66	498.40		499.13	0.022158	6.88	263.22	78.50	0.65
2-4	732.*	Q 25	2350.00	492.66	498.99		499.90	0.022706	7.70	310.24	80.05	0.67
2-4	732.*	Q 50	2810.00	492.66	499.42		500.48	0.023112	8.31	345.13	81.33	0.69
2-4	732.*	Q 100	3310.00	492.66	499.85		501.07	0.023488	8.90	380.51	82.01	0.71
2-4	682.*	Q 2	961.00	491.38	496.30		496.72	0.020959	5.18	186.46	82.24	0.60
2-4	682.*	Q 5	1410.00	491.38	496.89		497.46	0.021452	6.06	234.80	82.54	0.62
2-4	682.*	Q 10	1790.00	491.38	497.32		498.02	0.021834	6.68	270.77	82.84	0.64
2-4	682.*	Q 25	2350.00	491.38	497.90		498.76	0.022361	7.48	318.67	84.57	0.67
2-4	682.*	Q 50	2810.00	491.38	498.32		499.32	0.022718	8.07	354.39	85.79	0.68
2-4	682.*	Q 100	3310.00	491.38	498.74		499.89	0.023068	8.65	390.74	86.77	0.70
2-4	632.*	Q 2	961.00	490.10	495.27		495.67	0.020838	5.05	191.40	87.14	0.59
2-4	632.*	Q 5	1410.00	490.10	495.84		496.38	0.021234	5.90	241.14	87.40	0.62
2-4	632.*	Q 10	1790.00	490.10	496.26		496.92	0.021578	6.50	278.04	87.50	0.64
2-4	632.*	Q 25	2350.00	490.10	496.82		497.64	0.022073	7.29	326.72	89.20	0.66
2-4	632.*	Q 50	2810.00	490.10	497.22		498.18	0.022393	7.86	363.36	90.38	0.68
2-4	632.*	Q 100	3310.00	490.10	497.63		498.73	0.022722	8.42	400.60	91.53	0.69
2-4	582.*	Q 2	961.00	488.82	494.21		494.60	0.021941	5.01	192.79	92.00	0.60
2-4	582.*	Q 5	1410.00	488.82	494.80		495.31	0.021076	5.75	247.16	92.26	0.61
2-4	582.*	Q 10	1790.00	488.82	495.21		495.83	0.021393	6.34	284.96	92.34	0.63

HEC-RAS Plan: Flood River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	582.*	Q 25	2350.00	488.82	495.75		496.53	0.021825	7.11	334.57	93.68	0.65
2-4	582.*	Q 50	2810.00	488.82	496.14		497.05	0.022120	7.66	372.07	94.99	0.67
2-4	582.*	Q 100	3310.00	488.82	496.54		497.58	0.022428	8.21	410.16	96.19	0.68
2-4	532.*	Q 2	961.00	487.54	493.12		493.51	0.021593	5.05	191.28	88.71	0.60
2-4	532.*	Q 5	1410.00	487.54	493.75		494.24	0.021442	5.66	251.17	97.13	0.61
2-4	532.*	Q 10	1790.00	487.54	494.16		494.76	0.021271	6.20	291.37	97.31	0.63
2-4	532.*	Q 25	2350.00	487.54	494.68		495.43	0.021613	6.94	342.27	98.24	0.65
2-4	532.*	Q 50	2810.00	487.54	495.07		495.94	0.021883	7.48	380.62	99.64	0.66
2-4	532.*	Q 100	3310.00	487.54	495.46		496.45	0.022160	8.01	419.59	100.75	0.68
2-4	482.*	Q 2	961.00	486.25	492.03		492.42	0.021848	5.02	192.22	90.48	0.60
2-4	482.*	Q 5	1410.00	486.25	492.64		493.15	0.022462	5.70	249.06	98.28	0.63
2-4	482.*	Q 10	1790.00	486.25	493.09		493.67	0.021783	6.12	294.89	102.32	0.63
2-4	482.*	Q 25	2350.00	486.25	493.63		494.34	0.021462	6.79	349.56	102.90	0.64
2-4	482.*	Q 50	2810.00	486.25	494.01		494.83	0.021668	7.31	388.93	104.27	0.66
2-4	482.*	Q 100	3310.00	486.25	494.39		495.34	0.021898	7.83	428.89	105.41	0.67
2-4	432.*	Q 2	961.00	484.97	490.95		491.33	0.021740	4.98	193.77	91.81	0.60
2-4	432.*	Q 5	1410.00	484.97	491.54		492.04	0.021755	5.69	249.48	96.16	0.62
2-4	432.*	Q 10	1790.00	484.97	491.98		492.56	0.022530	6.17	292.39	102.71	0.64
2-4	432.*	Q 25	2350.00	484.97	492.56		493.25	0.021757	6.69	354.68	107.86	0.64
2-4	432.*	Q 50	2810.00	484.97	492.95		493.74	0.021502	7.16	397.03	108.85	0.65
2-4	432.*	Q 100	3310.00	484.97	493.33		494.23	0.021599	7.65	438.51	110.10	0.66
2-4	382.*	Q 2	961.00	483.69	489.87		490.25	0.021649	4.93	195.47	93.45	0.60
2-4	382.*	Q 5	1410.00	483.69	490.45		490.94	0.021875	5.64	251.62	98.89	0.62
2-4	382.*	Q 10	1790.00	483.69	490.87		491.45	0.021892	6.15	293.13	101.14	0.63
2-4	382.*	Q 25	2350.00	483.69	491.44		492.14	0.022757	6.73	352.75	110.04	0.66
2-4	382.*	Q 50	2810.00	483.69	491.89		492.66	0.021611	7.04	403.46	113.44	0.65
2-4	382.*	Q 100	3310.00	483.69	492.29		493.15	0.021086	7.46	449.47	114.84	0.66
2-4	332.*	Q 2	961.00	482.41	488.81		489.17	0.021430	4.85	198.77	96.71	0.59
2-4	332.*	Q 5	1410.00	482.41	489.36		489.85	0.021993	5.60	253.00	100.82	0.62
2-4	332.*	Q 10	1790.00	482.41	489.79		490.36	0.021691	6.07	297.00	103.99	0.63
2-4	332.*	Q 25	2350.00	482.41	490.34		491.03	0.021374	6.67	355.83	107.13	0.64
2-4	332.*	Q 50	2810.00	482.41	490.84		491.58	0.020976	6.91	410.98	115.93	0.64
2-4	332.*	Q 100	3310.00	482.41	491.33		492.12	0.019488	7.16	468.32	119.70	0.63
2-4	282.*	Q 2	961.00	481.13	487.74		488.10	0.021380	4.78	201.58	100.03	0.59
2-4	282.*	Q 5	1410.00	481.13	488.28		488.76	0.021331	5.53	256.40	101.96	0.61
2-4	282.*	Q 10	1790.00	481.13	488.75		489.29	0.020498	5.90	305.59	107.18	0.61
2-4	282.*	Q 25	2350.00	481.13	489.40		490.02	0.018439	6.30	376.42	110.42	0.60
2-4	282.*	Q 50	2810.00	481.13	489.98		490.62	0.016721	6.45	440.69	116.26	0.58
2-4	282.*	Q 100	3310.00	481.13	490.54		491.21	0.015567	6.58	509.93	124.96	0.57
2-4	232.*	Q 2	961.00	479.85	486.69		487.03	0.020927	4.69	205.46	103.57	0.58
2-4	232.*	Q 5	1410.00	479.85	487.36		487.77	0.017460	5.13	276.29	105.90	0.56
2-4	232.*	Q 10	1790.00	479.85	487.94		488.38	0.015315	5.33	338.89	111.55	0.53
2-4	232.*	Q 25	2350.00	479.85	488.76		489.22	0.012450	5.51	431.28	115.46	0.50
2-4	232.*	Q 50	2810.00	479.85	489.41		489.89	0.011216	5.60	508.57	123.63	0.48
2-4	232.*	Q 100	3310.00	479.85	490.04		490.54	0.010211	5.71	589.35	130.80	0.47
2-4	182.*	Q 2	961.00	478.57	485.96		486.20	0.012576	3.96	243.76	108.26	0.46
2-4	182.*	Q 5	1410.00	478.57	486.83		487.10	0.009615	4.19	339.19	112.85	0.42
2-4	182.*	Q 10	1790.00	478.57	487.49		487.79	0.008297	4.34	416.49	117.65	0.40
2-4	182.*	Q 25	2350.00	478.57	488.41		488.72	0.006974	4.53	525.75	122.59	0.38
2-4	182.*	Q 50	2810.00	478.57	489.09		489.42	0.006743	4.66	613.12	134.97	0.38
2-4	182.*	Q 100	3310.00	478.57	489.76		490.11	0.005985	4.79	704.51	136.19	0.37
2-4	132.*	Q 2	961.00	477.29	485.68		485.80	0.004707	2.89	335.45	114.31	0.29
2-4	132.*	Q 5	1410.00	477.29	486.59		486.75	0.004342	3.21	444.17	121.59	0.29
2-4	132.*	Q 10	1790.00	477.29	487.29		487.47	0.004039	3.42	529.89	124.57	0.29
2-4	132.*	Q 25	2350.00	477.29	488.23		488.43	0.003925	3.67	650.30	135.98	0.29
2-4	132.*	Q 50	2810.00	477.29	488.92		489.14	0.003731	3.83	747.03	141.08	0.29
2-4	132.*	Q 100	3310.00	477.29	489.61		489.85	0.003460	4.00	844.78	141.14	0.29
2-4	82	Q 2	961.00	476.01	485.58		485.65	0.001890	2.12	457.87	125.02	0.19
2-4	82	Q 5	1410.00	476.01	486.50		486.59	0.002001	2.49	574.86	128.94	0.21
2-4	82	Q 10	1790.00	476.01	487.20		487.31	0.002069	2.73	666.58	134.25	0.21
2-4	82	Q 25	2350.00	476.01	488.13		488.27	0.002191	3.00	798.84	145.96	0.22
2-4	82	Q 50	2810.00	476.01	488.83		488.98	0.002114	3.18	900.58	146.00	0.22
2-4	82	Q 100	3310.00	476.01	489.53		489.70	0.002060	3.37	1002.74	146.00	0.23
2-4	50	Q 2	961.00	481.55	484.31	484.31	485.37	0.060805	8.28	116.99	56.66	1.01
2-4	50	Q 5	1410.00	481.55	484.93	484.93	486.29	0.054971	9.35	152.53	57.49	1.00
2-4	50	Q 10	1790.00	481.55	485.41	485.41	486.98	0.051273	10.07	181.16	60.82	0.99
2-4	50	Q 25	2350.00	481.55	486.06	486.06	487.91	0.047641	10.97	220.43	61.95	0.98

HEC-RAS Plan: Flood River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	50	Q 50	2810.00	481.55	486.53	486.53	488.61	0.046128	11.65	249.94	64.36	0.99
2-4	50	Q 100	3310.00	481.55	487.05	487.05	489.32	0.043423	12.19	283.99	65.90	0.98

HEC-RAS Plan: Calib-Low n River: Grant Creek Reach: 2-4

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	2110	17 cfs	17.00	521.86	523.05	522.89	523.13	0.026340	2.21	7.69	18.53	0.61
2-4	2110	58 cfs	58.00	521.86	523.49	523.33	523.65	0.029926	3.27	17.75	26.95	0.71
2-4	2110	132 cfs	132.00	521.86	523.91	523.72	524.23	0.029951	4.54	29.17	27.26	0.77
2-4	2110	182 cfs	182.00	521.86	524.11	523.95	524.54	0.032008	5.27	34.90	29.29	0.82
2-4	2110	706 cfs	706.00	521.86	525.60	525.60	526.88	0.035322	9.23	81.42	33.65	0.98
2-4	2061.*	17 cfs	17.00	520.57	521.79		521.86	0.025299	2.17	7.85	20.15	0.61
2-4	2061.*	58 cfs	58.00	520.57	522.21		522.33	0.024069	2.79	20.81	35.98	0.65
2-4	2061.*	132 cfs	132.00	520.57	522.56		522.80	0.027156	3.93	33.57	37.79	0.74
2-4	2061.*	182 cfs	182.00	520.57	522.74		523.06	0.027644	4.48	40.64	38.23	0.76
2-4	2061.*	706 cfs	706.00	520.57	523.79	523.89	524.97	0.042443	8.74	82.32	42.61	1.06
2-4	2012.*	17 cfs	17.00	519.28	520.47		520.55	0.028634	2.28	7.45	20.10	0.66
2-4	2012.*	58 cfs	58.00	519.28	520.90		521.02	0.029957	2.84	20.45	41.43	0.71
2-4	2012.*	132 cfs	132.00	519.28	521.24	521.09	521.45	0.027644	3.69	35.79	45.87	0.74
2-4	2012.*	182 cfs	182.00	519.28	521.41		521.68	0.028338	4.18	43.52	46.98	0.77
2-4	2012.*	706 cfs	706.00	519.28	522.52	522.38	523.32	0.030727	7.20	98.34	51.90	0.90
2-4	1963.*	17 cfs	17.00	518.00	519.15		519.23	0.025279	2.20	7.72	20.51	0.63
2-4	1963.*	58 cfs	58.00	518.00	519.58		519.70	0.024375	2.78	20.84	37.32	0.66
2-4	1963.*	132 cfs	132.00	518.00	519.99		520.17	0.024824	3.36	39.32	53.98	0.69
2-4	1963.*	182 cfs	182.00	518.00	520.16		520.38	0.024324	3.74	48.72	55.96	0.71
2-4	1963.*	706 cfs	706.00	518.00	521.20		521.85	0.027692	6.45	109.43	60.37	0.84
2-4	1914.*	17 cfs	17.00	516.71	517.63		517.76	0.036069	2.80	6.07	14.84	0.77
2-4	1914.*	58 cfs	58.00	516.71	518.16		518.31	0.033213	3.12	18.59	36.16	0.77
2-4	1914.*	132 cfs	132.00	516.71	518.53		518.77	0.032451	3.92	33.70	44.70	0.80
2-4	1914.*	182 cfs	182.00	516.71	518.74		519.01	0.031833	4.16	43.78	52.23	0.80
2-4	1914.*	706 cfs	706.00	516.71	519.82	519.64	520.42	0.030087	6.26	112.78	69.46	0.87
2-4	1865	17 cfs	17.00	515.43	516.32		516.39	0.021555	2.24	7.59	17.78	0.60
2-4	1865	58 cfs	58.00	515.43	516.86		516.98	0.022647	2.71	21.37	38.64	0.64
2-4	1865	132 cfs	132.00	515.43	517.24		517.43	0.022805	3.51	37.62	45.63	0.68
2-4	1865	182 cfs	182.00	515.43	517.45		517.68	0.023172	3.85	47.32	50.05	0.70
2-4	1865	706 cfs	706.00	515.43	518.63		519.10	0.022895	5.51	128.18	77.67	0.76
2-4	1817.22*	17 cfs	17.00	514.40	515.27		515.34	0.022561	2.24	7.57	18.28	0.61
2-4	1817.22*	58 cfs	58.00	514.40	515.77		515.88	0.023008	2.71	21.44	39.38	0.65
2-4	1817.22*	132 cfs	132.00	514.40	516.15		516.34	0.022917	3.50	37.74	45.95	0.68
2-4	1817.22*	182 cfs	182.00	514.40	516.36		516.59	0.022707	3.79	48.03	51.11	0.69
2-4	1817.22*	706 cfs	706.00	514.40	517.54		518.02	0.022506	5.56	127.01	75.27	0.75
2-4	1769.44*	17 cfs	17.00	513.37	514.24		514.31	0.020876	2.15	7.90	19.16	0.59
2-4	1769.44*	58 cfs	58.00	513.37	514.68		514.79	0.022632	2.71	21.44	38.68	0.64
2-4	1769.44*	132 cfs	132.00	513.37	515.08		515.26	0.023233	3.43	38.49	47.19	0.67
2-4	1769.44*	182 cfs	182.00	513.37	515.28		515.50	0.022470	3.74	48.71	52.71	0.68
2-4	1769.44*	706 cfs	706.00	513.37	516.46		516.94	0.022388	5.60	126.18	74.15	0.76
2-4	1721.66*	17 cfs	17.00	512.34	513.20		513.26	0.022563	2.02	8.41	23.71	0.60
2-4	1721.66*	58 cfs	58.00	512.34	513.59		513.71	0.022837	2.71	21.42	38.63	0.64
2-4	1721.66*	132 cfs	132.00	512.34	513.98		514.17	0.023506	3.48	37.96	47.43	0.68
2-4	1721.66*	182 cfs	182.00	512.34	514.20		514.42	0.022567	3.73	48.84	53.47	0.69
2-4	1721.66*	706 cfs	706.00	512.34	515.38		515.88	0.022245	5.67	124.45	71.54	0.76
2-4	1673.88*	17 cfs	17.00	511.31	512.16		512.22	0.021293	1.83	9.31	29.21	0.57
2-4	1673.88*	58 cfs	58.00	511.31	512.53		512.64	0.022113	2.65	21.92	39.73	0.63
2-4	1673.88*	132 cfs	132.00	511.31	512.90		513.09	0.021770	3.48	37.90	44.76	0.67
2-4	1673.88*	182 cfs	182.00	511.31	513.12		513.34	0.022468	3.75	48.54	52.65	0.69
2-4	1673.88*	706 cfs	706.00	511.31	514.32		514.83	0.021585	5.71	123.62	69.34	0.75
2-4	1626.11*	17 cfs	17.00	510.29	511.07		511.13	0.024461	1.92	8.83	28.25	0.61
2-4	1626.11*	58 cfs	58.00	510.29	511.44		511.56	0.023306	2.69	21.60	39.83	0.64
2-4	1626.11*	132 cfs	132.00	510.29	511.84		512.03	0.022734	3.46	38.17	47.35	0.68
2-4	1626.11*	182 cfs	182.00	510.29	512.03		512.26	0.022535	3.83	47.46	50.06	0.69
2-4	1626.11*	706 cfs	706.00	510.29	513.25		513.78	0.022107	5.85	121.32	71.98	0.76
2-4	1578.33*	17 cfs	17.00	509.26	510.02	509.88	510.07	0.020364	1.82	9.35	28.13	0.56
2-4	1578.33*	58 cfs	58.00	509.26	510.39	510.21	510.50	0.020746	2.67	21.73	37.20	0.62
2-4	1578.33*	132 cfs	132.00	509.26	510.80	510.54	510.98	0.021194	3.42	38.59	46.32	0.66
2-4	1578.33*	182 cfs	182.00	509.26	510.98	510.74	511.21	0.021353	3.83	47.46	48.20	0.68
2-4	1578.33*	706 cfs	706.00	509.26	512.31	511.89	512.81	0.018512	5.63	126.16	90.91	0.71
2-4	1530.55*	17 cfs	17.00	508.23	508.92	508.82	508.98	0.025396	2.03	8.37	25.26	0.62
2-4	1530.55*	58 cfs	58.00	508.23	509.31	509.15	509.44	0.023553	2.87	20.23	34.33	0.66
2-4	1530.55*	132 cfs	132.00	508.23	509.72	509.53	509.92	0.023264	3.61	36.59	43.60	0.69
2-4	1530.55*	182 cfs	182.00	508.23	509.93	509.69	510.17	0.022177	3.95	46.04	46.64	0.70
2-4	1530.55*	706 cfs	706.00	508.23	511.04	510.88	511.70	0.028685	6.56	108.56	91.46	0.87

HEC-RAS Plan: Calib-Low n River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/s)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	1482.77*	17 cfs	17.00	507.20	507.90	507.75	507.96	0.018546	1.92	8.87	23.13	0.55
2-4	1482.77*	58 cfs	58.00	507.20	508.38	508.11	508.47	0.017266	2.50	23.23	39.04	0.57
2-4	1482.77*	132 cfs	132.00	507.20	508.76	508.49	508.94	0.018195	3.38	39.04	45.19	0.62
2-4	1482.77*	182 cfs	182.00	507.20	509.01	508.67	509.22	0.017821	3.61	50.55	59.97	0.63
2-4	1482.77*	706 cfs	706.00	507.20	510.30	509.89	510.68	0.014331	5.19	159.53	102.53	0.63
2-4	1435	17 cfs	17.00	506.17	506.87		506.94	0.024362	2.19	7.77	20.81	0.62
2-4	1435	58 cfs	58.00	506.17	507.27		507.41	0.029206	3.01	19.27	38.96	0.72
2-4	1435	132 cfs	132.00	506.17	507.66		507.89	0.026873	3.88	34.19	55.16	0.74
2-4	1435	182 cfs	182.00	506.17	507.86		508.14	0.028470	4.27	42.99	69.54	0.78
2-4	1435	706 cfs	706.00	506.17	508.97	508.97	509.67	0.030788	6.87	115.03	107.79	0.90
2-4	1408.*	17 cfs	17.00	504.97	506.03	505.96	506.13	0.038387	2.45	6.93	21.83	0.76
2-4	1408.*	58 cfs	58.00	504.97	506.46	506.34	506.61	0.030209	3.17	18.32	38.64	0.74
2-4	1408.*	132 cfs	132.00	504.97	506.90	506.70	507.13	0.028922	3.88	34.10	58.91	0.76
2-4	1408.*	182 cfs	182.00	504.97	507.08	506.94	507.37	0.028278	4.34	42.35	62.78	0.78
2-4	1408.*	706 cfs	706.00	504.97	508.07	507.97	508.64	0.027368	6.58	132.70	100.85	0.85
2-4	1381	17 cfs	17.00	503.76	505.30	505.07	505.36	0.021500	2.11	8.07	24.52	0.56
2-4	1381	58 cfs	58.00	503.76	505.82	505.56	505.94	0.020277	2.73	21.31	43.69	0.59
2-4	1381	132 cfs	132.00	503.76	506.26	506.00	506.45	0.021213	3.51	37.91	55.89	0.64
2-4	1381	182 cfs	182.00	503.76	506.44	506.19	506.69	0.022135	4.02	46.55	63.50	0.68
2-4	1381	706 cfs	706.00	503.76	507.66	507.20	508.04	0.015313	5.50	160.05	86.54	0.64
2-4	1335.28*	17 cfs	17.00	502.99	504.43		504.49	0.017409	1.95	8.70	19.41	0.51
2-4	1335.28*	58 cfs	58.00	502.99	504.92		505.03	0.019664	2.69	21.81	35.50	0.59
2-4	1335.28*	132 cfs	132.00	502.99	505.34		505.51	0.019235	3.35	41.32	51.94	0.62
2-4	1335.28*	182 cfs	182.00	502.99	505.54		505.75	0.018925	3.73	51.73	53.74	0.63
2-4	1335.28*	706 cfs	706.00	502.99	506.84		507.31	0.016467	5.83	146.10	86.08	0.67
2-4	1289.57*	17 cfs	17.00	502.23	503.48		503.56	0.023672	2.16	7.85	19.51	0.60
2-4	1289.57*	58 cfs	58.00	502.23	503.98		504.10	0.020806	2.78	20.86	32.65	0.61
2-4	1289.57*	132 cfs	132.00	502.23	504.42		504.60	0.020608	3.44	38.42	43.84	0.65
2-4	1289.57*	182 cfs	182.00	502.23	504.62		504.85	0.020387	3.84	47.44	46.24	0.66
2-4	1289.57*	706 cfs	706.00	502.23	505.94	505.56	506.50	0.018740	6.15	128.52	83.87	0.72
2-4	1243.85*	17 cfs	17.00	501.46	502.64	502.43	502.70	0.015107	1.85	9.21	21.10	0.49
2-4	1243.85*	58 cfs	58.00	501.46	503.09		503.20	0.018694	2.71	21.42	32.64	0.59
2-4	1243.85*	132 cfs	132.00	501.46	503.53		503.70	0.018944	3.30	39.99	46.12	0.62
2-4	1243.85*	182 cfs	182.00	501.46	503.71		503.93	0.019874	3.78	48.20	47.06	0.66
2-4	1243.85*	706 cfs	706.00	501.46	504.99		505.59	0.020703	6.27	115.17	64.50	0.75
2-4	1198.14*	17 cfs	17.00	500.69	501.63		501.72	0.032032	2.38	7.13	19.73	0.70
2-4	1198.14*	58 cfs	58.00	500.69	502.13		502.26	0.022642	2.88	20.14	32.60	0.65
2-4	1198.14*	132 cfs	132.00	500.69	502.58		502.76	0.022089	3.41	38.69	48.03	0.67
2-4	1198.14*	182 cfs	182.00	500.69	502.78		503.00	0.021024	3.79	48.07	49.13	0.67
2-4	1198.14*	706 cfs	706.00	500.69	504.05		504.64	0.020948	6.17	114.44	53.99	0.75
2-4	1152.42*	17 cfs	17.00	499.92	500.88	500.64	500.92	0.010613	1.62	10.49	22.72	0.42
2-4	1152.42*	58 cfs	58.00	499.92	501.30	501.02	501.40	0.015604	2.52	22.97	34.40	0.54
2-4	1152.42*	132 cfs	132.00	499.92	501.77	501.44	501.91	0.015623	3.01	43.79	50.63	0.57
2-4	1152.42*	182 cfs	182.00	499.92	501.92	501.62	502.11	0.017762	3.54	51.47	51.53	0.62
2-4	1152.42*	706 cfs	706.00	499.92	503.13		503.69	0.020231	6.00	117.65	56.75	0.73
2-4	1106.71*	17 cfs	17.00	499.16	499.74	499.74	499.89	0.072788	3.08	5.52	19.51	1.02
2-4	1106.71*	58 cfs	58.00	499.16	500.22		500.39	0.033216	3.31	17.51	30.73	0.77
2-4	1106.71*	132 cfs	132.00	499.16	500.67		500.90	0.032752	3.81	34.68	49.25	0.80
2-4	1106.71*	182 cfs	182.00	499.16	500.90		501.14	0.025406	3.90	46.62	52.68	0.73
2-4	1106.71*	706 cfs	706.00	499.16	502.52		502.92	0.012644	5.08	138.93	60.03	0.59
2-4	1061	17 cfs	17.00	498.39	499.21	498.84	499.23	0.004676	1.13	15.06	30.39	0.28
2-4	1061	58 cfs	58.00	498.39	499.79		499.83	0.005650	1.60	36.20	50.21	0.33
2-4	1061	132 cfs	132.00	498.39	500.34		500.41	0.004568	1.98	66.52	57.03	0.32
2-4	1061	182 cfs	182.00	498.39	500.61		500.69	0.004510	2.23	81.79	58.39	0.33
2-4	1061	706 cfs	706.00	498.39	502.28		502.50	0.005394	3.80	186.58	69.78	0.39
2-4	1018.*	17 cfs	17.00	498.19	499.00		499.02	0.005334	1.19	14.25	29.59	0.30
2-4	1018.*	58 cfs	58.00	498.19	499.53		499.58	0.005868	1.80	32.15	38.68	0.35
2-4	1018.*	132 cfs	132.00	498.19	500.12		500.19	0.005537	2.11	62.61	57.32	0.36
2-4	1018.*	182 cfs	182.00	498.19	500.40		500.48	0.005112	2.32	78.54	58.66	0.35
2-4	1018.*	706 cfs	706.00	498.19	502.00		502.26	0.006015	4.03	175.15	61.10	0.42
2-4	975.*	17 cfs	17.00	497.98	498.76		498.78	0.005520	1.21	14.01	29.54	0.31
2-4	975.*	58 cfs	58.00	497.98	499.25		499.31	0.006682	1.95	29.71	35.33	0.38
2-4	975.*	132 cfs	132.00	497.98	499.83		499.92	0.007332	2.40	55.08	51.60	0.41
2-4	975.*	182 cfs	182.00	497.98	500.13		500.23	0.006418	2.54	71.70	55.52	0.39
2-4	975.*	706 cfs	706.00	497.98	501.65		501.96	0.007725	4.46	158.40	57.77	0.47

HEC-RAS Plan: Calib-Low n River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	932	17 cfs	17.00	497.78	498.30		498.36	0.022112	2.01	8.47	23.73	0.59
2-4	932	58 cfs	58.00	497.78	498.72		498.85	0.019666	2.86	20.25	29.83	0.61
2-4	932	132 cfs	132.00	497.78	499.17		499.41	0.020589	3.87	34.15	32.75	0.67
2-4	932	182 cfs	182.00	497.78	499.54		499.76	0.020766	3.81	47.83	47.56	0.67
2-4	932	706 cfs	706.00	497.78	500.80		501.41	0.021798	6.23	113.25	54.35	0.76
2-4	882.*	17 cfs	17.00	496.50	497.27		497.33	0.019599	1.96	8.67	23.03	0.56
2-4	882.*	58 cfs	58.00	496.50	497.68		497.82	0.021418	3.04	19.08	27.41	0.64
2-4	882.*	132 cfs	132.00	496.50	498.18		498.40	0.019393	3.79	34.85	33.05	0.65
2-4	882.*	182 cfs	182.00	496.50	498.55		498.76	0.019134	3.69	49.35	48.42	0.64
2-4	882.*	706 cfs	706.00	496.50	499.75		500.31	0.021392	6.00	117.65	59.35	0.75
2-4	832.*	17 cfs	17.00	495.22	496.19		496.26	0.023704	2.08	8.18	22.76	0.61
2-4	832.*	58 cfs	58.00	495.22	496.63		496.77	0.020738	3.04	19.08	26.78	0.63
2-4	832.*	132 cfs	132.00	495.22	497.13		497.37	0.021916	3.92	33.66	33.18	0.69
2-4	832.*	182 cfs	182.00	495.22	497.47		497.71	0.022840	3.93	46.26	46.95	0.70
2-4	832.*	706 cfs	706.00	495.22	498.71		499.24	0.021125	5.79	121.86	64.36	0.74
2-4	782.*	17 cfs	17.00	493.94	494.90		495.04	0.024779	3.05	5.58	8.71	0.67
2-4	782.*	58 cfs	58.00	493.94	495.54		495.69	0.022535	3.13	18.54	26.57	0.66
2-4	782.*	132 cfs	132.00	493.94	496.03		496.29	0.021422	4.05	32.59	29.91	0.68
2-4	782.*	182 cfs	182.00	493.94	496.28		496.60	0.021423	4.54	40.11	30.81	0.70
2-4	782.*	706 cfs	706.00	493.94	497.69		498.18	0.020825	5.60	126.08	69.37	0.73
2-4	732.*	17 cfs	17.00	492.66	493.61		493.77	0.026168	3.23	5.26	7.76	0.69
2-4	732.*	58 cfs	58.00	492.66	494.50		494.64	0.019414	2.98	19.48	26.72	0.61
2-4	732.*	132 cfs	132.00	492.66	494.96		495.21	0.021545	4.02	32.80	30.47	0.68
2-4	732.*	182 cfs	182.00	492.66	495.20		495.52	0.021724	4.52	40.23	31.35	0.70
2-4	732.*	706 cfs	706.00	492.66	496.66		497.13	0.020839	5.45	129.62	74.38	0.73
2-4	682.*	17 cfs	17.00	491.38	492.34		492.50	0.024922	3.21	5.30	7.60	0.68
2-4	682.*	58 cfs	58.00	491.38	493.35		493.52	0.026413	3.27	17.72	26.30	0.70
2-4	682.*	132 cfs	132.00	491.38	493.89		494.14	0.021522	3.99	33.09	31.10	0.68
2-4	682.*	182 cfs	182.00	491.38	494.13		494.44	0.021324	4.45	40.87	32.10	0.70
2-4	682.*	706 cfs	706.00	491.38	495.66		496.09	0.020254	5.26	134.27	79.42	0.71
2-4	632.*	17 cfs	17.00	490.10	491.04		491.21	0.026751	3.28	5.18	7.62	0.70
2-4	632.*	58 cfs	58.00	490.10	491.90		492.22	0.025096	4.49	12.93	10.79	0.72
2-4	632.*	132 cfs	132.00	490.10	492.78		493.04	0.022654	4.08	32.35	30.52	0.70
2-4	632.*	182 cfs	182.00	490.10	493.05		493.36	0.021659	4.42	41.16	33.04	0.70
2-4	632.*	706 cfs	706.00	490.10	494.61		495.04	0.021745	5.28	133.83	83.26	0.73
2-4	582.*	17 cfs	17.00	488.82	489.79		489.94	0.023879	3.14	5.41	7.81	0.67
2-4	582.*	58 cfs	58.00	488.82	490.60		490.93	0.025934	4.64	12.51	10.11	0.73
2-4	582.*	132 cfs	132.00	488.82	491.73		491.97	0.020020	3.91	33.77	30.76	0.66
2-4	582.*	182 cfs	182.00	488.82	491.94		492.26	0.022563	4.49	40.56	32.79	0.71
2-4	582.*	706 cfs	706.00	488.82	493.50		493.95	0.021787	5.36	131.62	79.49	0.73
2-4	532.*	17 cfs	17.00	487.54	488.47		488.64	0.028656	3.32	5.12	7.90	0.73
2-4	532.*	58 cfs	58.00	487.54	489.29		489.64	0.025936	4.72	12.29	9.62	0.74
2-4	532.*	132 cfs	132.00	487.54	490.51		490.81	0.027113	4.37	30.19	28.85	0.75
2-4	532.*	182 cfs	182.00	487.54	490.87		491.17	0.020827	4.38	41.57	32.71	0.68
2-4	532.*	706 cfs	706.00	487.54	492.43		492.87	0.021396	5.32	132.73	80.02	0.73
2-4	482.*	17 cfs	17.00	486.25	487.24		487.38	0.021881	3.02	5.64	8.19	0.64
2-4	482.*	58 cfs	58.00	486.25	487.98		488.33	0.026081	4.75	12.21	9.52	0.74
2-4	482.*	132 cfs	132.00	486.25	488.96		489.47	0.025635	5.72	23.07	13.00	0.76
2-4	482.*	182 cfs	182.00	486.25	489.71	489.01	490.04	0.024860	4.61	39.46	32.53	0.74
2-4	482.*	706 cfs	706.00	486.25	491.37		491.80	0.021283	5.23	135.01	83.43	0.72
2-4	432.*	17 cfs	17.00	484.97	485.87		486.06	0.032538	3.44	4.94	8.01	0.77
2-4	432.*	58 cfs	58.00	484.97	486.69		487.04	0.026116	4.74	12.24	9.65	0.74
2-4	432.*	132 cfs	132.00	484.97	487.65		488.18	0.025979	5.84	22.61	12.42	0.76
2-4	432.*	182 cfs	182.00	484.97	488.15		488.75	0.025618	6.20	29.34	14.46	0.77
2-4	432.*	706 cfs	706.00	484.97	490.30		490.72	0.021850	5.20	135.88	86.63	0.73
2-4	382.*	17 cfs	17.00	483.69	484.72		484.85	0.018259	2.81	6.05	8.58	0.59
2-4	382.*	58 cfs	58.00	483.69	485.41		485.75	0.025376	4.67	12.41	9.83	0.73
2-4	382.*	132 cfs	132.00	483.69	486.34		486.88	0.025914	5.90	22.37	12.02	0.76
2-4	382.*	182 cfs	182.00	483.69	486.84		487.46	0.025831	6.31	28.83	13.82	0.77
2-4	382.*	706 cfs	706.00	483.69	489.17		489.61	0.022250	5.36	131.71	80.97	0.74
2-4	332.*	17 cfs	17.00	482.41	483.23	483.19	483.46	0.045371	3.85	4.41	7.75	0.90
2-4	332.*	58 cfs	58.00	482.41	484.09		484.44	0.027088	4.76	12.19	9.96	0.76
2-4	332.*	132 cfs	132.00	482.41	484.99		485.56	0.026854	6.06	21.80	11.55	0.78
2-4	332.*	182 cfs	182.00	482.41	485.51		486.15	0.026376	6.44	28.26	13.31	0.78
2-4	332.*	706 cfs	706.00	482.41	488.06		488.51	0.021727	5.40	130.72	77.93	0.73

HEC-RAS Plan: Calib-Low n River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	282.*	17 cfs	17.00	481.13	482.25		482.34	0.012645	2.47	6.90	8.99	0.50
2-4	282.*	58 cfs	58.00	481.13	482.87		483.18	0.023155	4.48	12.93	10.27	0.70
2-4	282.*	132 cfs	132.00	481.13	483.76		484.28	0.023711	5.81	22.71	11.62	0.73
2-4	282.*	182 cfs	182.00	481.13	484.24		484.87	0.024719	6.34	28.72	13.13	0.76
2-4	282.*	706 cfs	706.00	481.13	486.95		487.41	0.022173	5.42	130.23	78.39	0.74
2-4	232.*	17 cfs	17.00	479.85	482.23		482.24	0.000554	0.84	20.18	11.43	0.11
2-4	232.*	58 cfs	58.00	479.85	482.68		482.76	0.003337	2.28	25.45	12.09	0.28
2-4	232.*	132 cfs	132.00	479.85	483.28		483.52	0.008744	3.97	33.24	13.92	0.45
2-4	232.*	182 cfs	182.00	479.85	483.60		483.96	0.011871	4.80	37.95	14.98	0.53
2-4	232.*	706 cfs	706.00	479.85	485.82		486.29	0.022564	5.53	127.66	75.28	0.75
2-4	182.*	17 cfs	17.00	478.57	482.22		482.23	0.000110	0.46	36.80	14.44	0.05
2-4	182.*	58 cfs	58.00	478.57	482.64		482.67	0.000856	1.35	43.04	15.73	0.14
2-4	182.*	132 cfs	132.00	478.57	483.15		483.25	0.002832	2.56	51.52	17.56	0.26
2-4	182.*	182 cfs	182.00	478.57	483.40		483.56	0.004352	3.24	56.10	18.49	0.33
2-4	182.*	706 cfs	706.00	478.57	485.15		485.44	0.011793	4.33	163.31	86.21	0.55
2-4	132.*	17 cfs	17.00	477.29	482.22		482.22	0.000034	0.29	57.99	18.48	0.03
2-4	132.*	58 cfs	58.00	477.29	482.62		482.63	0.000544	0.87	66.82	36.59	0.11
2-4	132.*	132 cfs	132.00	477.29	483.08		483.11	0.001951	1.46	90.69	62.40	0.21
2-4	132.*	182 cfs	182.00	477.29	483.32		483.37	0.002446	1.70	106.86	69.25	0.24
2-4	132.*	706 cfs	706.00	477.29	484.96		485.08	0.003769	2.78	254.97	112.01	0.32
2-4	82	17 cfs	17.00	476.01	482.22		482.22	0.000021	0.16	107.45	68.11	0.02
2-4	82	58 cfs	58.00	476.01	482.61		482.61	0.000135	0.43	136.12	80.66	0.06
2-4	82	132 cfs	132.00	476.01	483.06		483.07	0.000341	0.76	173.85	87.74	0.09
2-4	82	182 cfs	182.00	476.01	483.30		483.31	0.000472	0.93	195.57	93.12	0.11
2-4	82	706 cfs	706.00	476.01	484.92		484.97	0.001118	1.89	377.34	118.76	0.19
2-4	50	17 cfs	17.00	481.55	482.10	482.10	482.21	0.078182	2.68	6.34	29.08	1.01
2-4	50	58 cfs	58.00	481.55	482.36	482.36	482.58	0.065646	3.70	15.68	38.62	1.02
2-4	50	132 cfs	132.00	481.55	482.67	482.67	483.00	0.056591	4.60	28.73	45.42	1.02
2-4	50	182 cfs	182.00	481.55	482.84	482.84	483.23	0.052847	5.00	36.43	48.12	1.01
2-4	50	706 cfs	706.00	481.55	483.92	483.92	484.78	0.040441	7.48	94.82	56.13	1.01

HEC-RAS Plan: Flood-Flow n River: Grant Creek Reach: 2-4

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	2110	Q 2	961.00	521.86	526.20	526.20	527.75	0.033148	10.19	101.80	34.10	0.98
2-4	2110	Q 5	1410.00	521.86	527.10	527.10	529.10	0.031447	11.63	132.78	34.35	0.99
2-4	2110	Q 10	1790.00	521.86	527.78	527.78	530.14	0.030715	12.67	155.97	34.35	1.00
2-4	2110	Q 25	2350.00	521.86	528.70	528.70	531.56	0.029611	13.95	187.77	34.35	1.01
2-4	2110	Q 50	2810.00	521.86	529.42	529.42	532.64	0.028776	14.84	212.29	34.35	1.02
2-4	2110	Q 100	3310.00	521.86	530.13	530.13	533.76	0.028268	15.76	236.85	34.35	1.03
2-4	2061.*	Q 2	961.00	520.57	524.07	524.38	525.75	0.050999	10.43	94.58	42.98	1.19
2-4	2061.*	Q 5	1410.00	520.57	524.56	525.15	527.01	0.058564	12.65	115.68	44.15	1.31
2-4	2061.*	Q 10	1790.00	520.57	524.92	525.73	527.99	0.062955	14.19	131.92	45.16	1.39
2-4	2061.*	Q 25	2350.00	520.57	525.40	526.51	529.34	0.067704	16.13	153.62	45.61	1.47
2-4	2061.*	Q 50	2810.00	520.57	525.76	527.08	530.40	0.070735	17.53	169.99	46.08	1.53
2-4	2061.*	Q 100	3310.00	520.57	526.12	527.66	531.48	0.073008	18.86	187.13	46.70	1.58
2-4	2012.*	Q 2	961.00	519.28	522.89	522.82	523.94	0.032220	8.26	117.62	53.77	0.95
2-4	2012.*	Q 5	1410.00	519.28	523.48	523.48	524.91	0.032199	9.61	150.04	54.77	0.99
2-4	2012.*	Q 10	1790.00	519.28	523.98	523.98	525.64	0.030580	10.39	177.65	56.33	0.99
2-4	2012.*	Q 25	2350.00	519.28	524.55	524.65	526.62	0.031164	11.62	210.17	56.93	1.02
2-4	2012.*	Q 50	2810.00	519.28	524.83	525.15	527.39	0.035422	12.96	226.13	57.19	1.10
2-4	2012.*	Q 100	3310.00	519.28	525.11	525.64	528.23	0.039860	14.32	241.78	57.59	1.18
2-4	1963.*	Q 2	961.00	518.00	521.55	521.38	522.39	0.028609	7.35	130.78	61.22	0.88
2-4	1963.*	Q 5	1410.00	518.00	522.08	521.95	523.24	0.029781	8.67	163.92	64.98	0.93
2-4	1963.*	Q 10	1790.00	518.00	522.20	522.41	523.91	0.040962	10.49	172.31	65.21	1.10
2-4	1963.*	Q 25	2350.00	518.00	522.64	523.01	524.82	0.043366	11.88	200.89	66.11	1.16
2-4	1963.*	Q 50	2810.00	518.00	523.05	523.47	525.49	0.041240	12.56	228.55	67.19	1.16
2-4	1963.*	Q 100	3310.00	518.00	523.49	523.90	526.16	0.038908	13.16	258.34	68.04	1.15
2-4	1914.*	Q 2	961.00	516.71	520.14	519.99	520.92	0.030711	7.08	135.83	70.48	0.90
2-4	1914.*	Q 5	1410.00	516.71	520.63	520.53	521.69	0.032238	8.29	170.08	71.97	0.95
2-4	1914.*	Q 10	1790.00	516.71	520.97	520.95	522.28	0.033273	9.20	194.98	74.55	0.99
2-4	1914.*	Q 25	2350.00	516.71	521.48	521.48	523.07	0.031836	10.11	234.24	76.59	0.99
2-4	1914.*	Q 50	2810.00	516.71	521.80	521.90	523.67	0.033246	11.00	258.47	77.36	1.03
2-4	1914.*	Q 100	3310.00	516.71	522.25	522.30	524.28	0.030848	11.47	293.30	78.37	1.01
2-4	1865	Q 2	961.00	515.43	519.00		519.58	0.022654	6.12	157.02	80.44	0.77
2-4	1865	Q 5	1410.00	515.43	519.53		520.30	0.022351	7.04	200.29	82.00	0.79
2-4	1865	Q 10	1790.00	515.43	519.93		520.84	0.022092	7.67	233.46	83.80	0.81
2-4	1865	Q 25	2350.00	515.43	520.44	520.04	521.56	0.021925	8.52	277.01	87.26	0.83
2-4	1865	Q 50	2810.00	515.43	520.82	520.42	522.11	0.021797	9.13	310.15	88.13	0.84
2-4	1865	Q 100	3310.00	515.43	521.20	520.78	522.66	0.021679	9.72	344.10	89.01	0.85
2-4	1817.22*	Q 2	961.00	514.40	517.90		518.50	0.022449	6.20	155.11	77.83	0.77
2-4	1817.22*	Q 5	1410.00	514.40	518.45		519.24	0.022072	7.12	198.17	79.43	0.79
2-4	1817.22*	Q 10	1790.00	514.40	518.85		519.79	0.022027	7.79	230.45	85.77	0.81
2-4	1817.22*	Q 25	2350.00	514.40	519.36	518.99	520.52	0.021837	8.65	275.04	88.12	0.83
2-4	1817.22*	Q 50	2810.00	514.40	519.74	519.36	521.06	0.021773	9.27	308.73	89.75	0.84
2-4	1817.22*	Q 100	3310.00	514.40	520.11		521.62	0.021837	9.90	342.74	91.18	0.86
2-4	1769.44*	Q 2	961.00	513.37	516.82		517.43	0.022093	6.26	153.50	75.24	0.77
2-4	1769.44*	Q 5	1410.00	513.37	517.38		518.19	0.021859	7.20	196.01	80.01	0.80
2-4	1769.44*	Q 10	1790.00	513.37	517.77	517.39	518.74	0.021841	7.91	229.42	87.70	0.81
2-4	1769.44*	Q 25	2350.00	513.37	518.28	517.92	519.47	0.021873	8.80	274.40	90.42	0.84
2-4	1769.44*	Q 50	2810.00	513.37	518.64	518.33	520.01	0.022011	9.45	308.16	92.40	0.85
2-4	1769.44*	Q 100	3310.00	513.37	519.02	518.74	520.57	0.022108	10.08	342.91	93.63	0.87
2-4	1721.66*	Q 2	961.00	512.34	515.75		516.38	0.022009	6.35	151.33	72.77	0.78
2-4	1721.66*	Q 5	1410.00	512.34	516.30		517.13	0.022016	7.35	194.61	87.70	0.80
2-4	1721.66*	Q 10	1790.00	512.34	516.68	516.38	517.68	0.022108	8.07	228.69	89.82	0.82
2-4	1721.66*	Q 25	2350.00	512.34	517.18	516.91	518.41	0.022193	8.97	274.70	93.05	0.85
2-4	1721.66*	Q 50	2810.00	512.34	517.56	517.31	518.96	0.022186	9.60	310.10	94.99	0.86
2-4	1721.66*	Q 100	3310.00	512.34	517.93	517.70	519.51	0.022272	10.23	345.86	97.13	0.88
2-4	1673.88*	Q 2	961.00	511.31	514.71		515.34	0.021395	6.39	151.07	77.40	0.77
2-4	1673.88*	Q 5	1410.00	511.31	515.23		516.08	0.021903	7.46	196.46	91.24	0.81
2-4	1673.88*	Q 10	1790.00	511.31	515.61	515.34	516.63	0.022001	8.18	231.62	92.86	0.83
2-4	1673.88*	Q 25	2350.00	511.31	516.11	515.87	517.35	0.022113	9.08	278.94	96.24	0.85
2-4	1673.88*	Q 50	2810.00	511.31	516.47	516.27	517.89	0.022504	9.76	313.59	101.01	0.87
2-4	1673.88*	Q 100	3310.00	511.31	516.82	516.67	518.43	0.022874	10.43	350.08	103.79	0.89
2-4	1626.11*	Q 2	961.00	510.29	513.61	513.30	514.28	0.022656	6.61	149.90	90.53	0.79
2-4	1626.11*	Q 5	1410.00	510.29	514.12	513.92	515.01	0.022871	7.66	197.16	92.56	0.83
2-4	1626.11*	Q 10	1790.00	510.29	514.50	514.27	515.55	0.022995	8.39	232.52	94.66	0.85
2-4	1626.11*	Q 25	2350.00	510.29	514.98	514.83	516.26	0.023368	9.32	280.28	104.20	0.88
2-4	1626.11*	Q 50	2810.00	510.29	515.34	515.24	516.78	0.023431	9.96	318.42	106.46	0.89
2-4	1626.11*	Q 100	3310.00	510.29	515.69	515.61	517.31	0.023634	10.60	356.18	107.87	0.91
2-4	1578.33*	Q 2	961.00	509.26	512.58	512.27	513.23	0.021093	6.54	158.88	93.31	0.77

HEC-RAS Plan: Flood-Flow n River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	1578.33*	Q 5	1410.00	509.26	513.11	512.84	513.95	0.021002	7.52	208.84	97.68	0.80
2-4	1578.33*	Q 10	1790.00	509.26	513.48	513.26	514.47	0.021524	8.27	246.12	105.87	0.83
2-4	1578.33*	Q 25	2350.00	509.26	513.93	513.78	515.15	0.022439	9.25	295.29	110.24	0.86
2-4	1578.33*	Q 50	2810.00	509.26	514.22	514.15	515.65	0.023894	10.06	327.92	111.90	0.90
2-4	1578.33*	Q 100	3310.00	509.26	514.56	514.51	516.16	0.024348	10.73	365.89	114.98	0.92
2-4	1530.55*	Q 2	961.00	508.23	511.40	511.30	512.12	0.025570	6.99	154.28	97.11	0.85
2-4	1530.55*	Q 5	1410.00	508.23	511.87	511.80	512.81	0.026437	8.13	199.20	103.52	0.89
2-4	1530.55*	Q 10	1790.00	508.23	512.22	512.19	513.32	0.026587	8.86	239.07	112.33	0.91
2-4	1530.55*	Q 25	2350.00	508.23	512.68	512.68	513.98	0.026432	9.74	291.86	116.97	0.93
2-4	1530.55*	Q 50	2810.00	508.23	513.04	513.04	514.46	0.025636	10.27	335.21	119.64	0.93
2-4	1530.55*	Q 100	3310.00	508.23	513.38	513.38	514.96	0.025815	10.90	375.55	122.66	0.95
2-4	1482.77*	Q 2	961.00	507.20	510.67	510.20	511.13	0.014648	5.84	195.25	112.82	0.66
2-4	1482.77*	Q 5	1410.00	507.20	511.15	510.68	511.76	0.015516	6.78	260.00	121.98	0.70
2-4	1482.77*	Q 10	1790.00	507.20	511.51	511.08	512.23	0.016072	7.45	304.11	124.74	0.72
2-4	1482.77*	Q 25	2350.00	507.20	512.01	511.50	512.86	0.016140	8.20	367.55	128.64	0.74
2-4	1482.77*	Q 50	2810.00	507.20	512.33	511.87	513.31	0.016890	8.85	409.07	129.82	0.77
2-4	1482.77*	Q 100	3310.00	507.20	512.60	512.20	513.75	0.018414	9.64	444.39	131.50	0.81
2-4	1435	Q 2	961.00	506.17	509.33	509.33	510.14	0.028951	7.51	150.20	121.46	0.90
2-4	1435	Q 5	1410.00	506.17	509.90	509.90	510.81	0.024758	8.14	219.69	129.96	0.87
2-4	1435	Q 10	1790.00	506.17	510.25	510.25	511.26	0.024553	8.77	265.00	132.17	0.88
2-4	1435	Q 25	2350.00	506.17	510.64	510.64	511.86	0.026078	9.78	316.57	133.58	0.92
2-4	1435	Q 50	2810.00	506.17	510.99	510.99	512.30	0.025138	10.24	364.60	135.50	0.92
2-4	1435	Q 100	3310.00	506.17	511.42	511.29	512.76	0.022902	10.48	421.85	135.95	0.90
2-4	1408.*	Q 2	961.00	504.97	508.47	508.30	509.09	0.023445	6.95	173.64	101.32	0.82
2-4	1408.*	Q 5	1410.00	504.97	509.11	508.75	509.81	0.019605	7.51	240.49	109.01	0.78
2-4	1408.*	Q 10	1790.00	504.97	509.61	509.13	510.36	0.017439	7.87	296.33	114.92	0.75
2-4	1408.*	Q 25	2350.00	504.97	510.26	509.62	511.08	0.015369	8.31	372.51	118.71	0.73
2-4	1408.*	Q 50	2810.00	504.97	510.75	509.96	511.62	0.014170	8.61	430.99	119.45	0.71
2-4	1408.*	Q 100	3310.00	504.97	511.25	510.33	512.17	0.013198	8.92	491.28	120.00	0.70
2-4	1381	Q 2	961.00	503.76	508.08	507.53	508.54	0.015275	6.13	195.84	86.88	0.65
2-4	1381	Q 5	1410.00	503.76	508.72	508.01	509.32	0.015239	7.04	252.61	91.40	0.68
2-4	1381	Q 10	1790.00	503.76	509.21	508.39	509.91	0.014942	7.64	299.26	98.27	0.68
2-4	1381	Q 25	2350.00	503.76	509.78	508.91	510.65	0.015690	8.58	356.91	101.53	0.72
2-4	1381	Q 50	2810.00	503.76	510.22	509.41	511.20	0.015702	9.15	402.16	102.48	0.73
2-4	1381	Q 100	3310.00	503.76	510.67	509.78	511.77	0.015731	9.71	448.71	103.80	0.74
2-4	1335.28*	Q 2	961.00	502.99	507.25		507.81	0.016299	6.46	181.59	86.22	0.69
2-4	1335.28*	Q 5	1410.00	502.99	507.89		508.59	0.016150	7.38	237.58	92.28	0.71
2-4	1335.28*	Q 10	1790.00	502.99	508.34		509.18	0.016445	8.10	281.28	100.09	0.73
2-4	1335.28*	Q 25	2350.00	502.99	508.92		509.91	0.016455	8.89	339.20	100.70	0.74
2-4	1335.28*	Q 50	2810.00	502.99	509.35		510.46	0.016436	9.46	383.24	101.59	0.76
2-4	1335.28*	Q 100	3310.00	502.99	509.80		511.02	0.016431	10.03	428.42	102.77	0.77
2-4	1289.57*	Q 2	961.00	502.23	506.39		507.03	0.017394	6.69	167.50	85.75	0.71
2-4	1289.57*	Q 5	1410.00	502.23	507.01		507.82	0.017343	7.64	221.99	92.95	0.73
2-4	1289.57*	Q 10	1790.00	502.23	507.46		508.40	0.017397	8.32	265.51	99.41	0.75
2-4	1289.57*	Q 25	2350.00	502.23	508.04		509.13	0.017156	9.08	323.59	99.85	0.76
2-4	1289.57*	Q 50	2810.00	502.23	508.46		509.68	0.017239	9.68	365.73	100.65	0.78
2-4	1289.57*	Q 100	3310.00	502.23	508.88		510.23	0.017386	10.27	408.30	101.74	0.79
2-4	1243.85*	Q 2	961.00	501.46	505.43		506.17	0.020037	6.98	148.72	84.23	0.76
2-4	1243.85*	Q 5	1410.00	501.46	506.11	505.79	507.00	0.018357	7.78	208.07	94.59	0.75
2-4	1243.85*	Q 10	1790.00	501.46	506.55	506.24	507.57	0.018416	8.46	250.52	98.72	0.77
2-4	1243.85*	Q 25	2350.00	501.46	507.09	506.82	508.30	0.018671	9.33	304.39	98.91	0.79
2-4	1243.85*	Q 50	2810.00	501.46	507.54	507.20	508.86	0.018211	9.84	348.69	99.61	0.80
2-4	1243.85*	Q 100	3310.00	501.46	508.01		509.43	0.017551	10.29	396.19	100.71	0.79
2-4	1198.14*	Q 2	961.00	500.69	504.48		505.23	0.021112	6.96	139.07	62.85	0.77
2-4	1198.14*	Q 5	1410.00	500.69	505.14	504.78	506.11	0.020306	7.95	191.43	94.03	0.78
2-4	1198.14*	Q 10	1790.00	500.69	505.61	505.34	506.70	0.019540	8.55	236.55	98.02	0.79
2-4	1198.14*	Q 25	2350.00	500.69	506.26	505.95	507.46	0.017976	9.14	300.26	98.25	0.78
2-4	1198.14*	Q 50	2810.00	500.69	506.79		508.04	0.016524	9.46	352.15	99.03	0.76
2-4	1198.14*	Q 100	3310.00	500.69	507.35		508.65	0.015041	9.72	408.45	99.69	0.74
2-4	1152.42*	Q 2	961.00	499.92	503.62		504.29	0.019118	6.60	145.58	57.42	0.73
2-4	1152.42*	Q 5	1410.00	499.92	504.35	503.72	505.21	0.017659	7.46	195.74	89.59	0.73
2-4	1152.42*	Q 10	1790.00	499.92	504.92		505.85	0.015854	7.87	249.69	97.19	0.71
2-4	1152.42*	Q 25	2350.00	499.92	505.71		506.69	0.013436	8.21	326.70	97.76	0.67
2-4	1152.42*	Q 50	2810.00	499.92	506.32		507.33	0.011986	8.43	386.95	98.66	0.65
2-4	1152.42*	Q 100	3310.00	499.92	506.95		508.00	0.010815	8.64	449.35	98.66	0.63
2-4	1106.71*	Q 2	961.00	499.16	503.08		503.56	0.011769	5.56	172.95	64.32	0.58
2-4	1106.71*	Q 5	1410.00	499.16	503.92		504.52	0.010547	6.21	238.21	92.41	0.57

HEC-RAS Plan: Flood-Flow n River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	1106.71*	Q 10	1790.00	499.16	504.57		505.21	0.009434	6.54	299.89	96.84	0.55
2-4	1106.71*	Q 25	2350.00	499.16	505.43		506.12	0.008280	6.92	383.38	97.63	0.54
2-4	1106.71*	Q 50	2810.00	499.16	506.07		506.82	0.007642	7.19	446.57	97.63	0.53
2-4	1106.71*	Q 100	3310.00	499.16	506.73		507.52	0.007151	7.47	510.66	97.63	0.52
2-4	1061	Q 2	961.00	498.39	502.86		503.14	0.005493	4.29	229.62	77.82	0.41
2-4	1061	Q 5	1410.00	498.39	503.75		504.11	0.005374	4.92	307.51	95.71	0.42
2-4	1061	Q 10	1790.00	498.39	504.41		504.83	0.005128	5.29	371.89	96.60	0.42
2-4	1061	Q 25	2350.00	498.39	505.29		505.77	0.004901	5.75	456.43	96.60	0.42
2-4	1061	Q 50	2810.00	498.39	505.95		506.48	0.004769	6.09	519.74	96.60	0.42
2-4	1061	Q 100	3310.00	498.39	506.61		507.20	0.004666	6.43	583.79	96.60	0.42
2-4	1018.*	Q 2	961.00	498.19	502.56		502.89	0.006264	4.59	209.33	62.12	0.44
2-4	1018.*	Q 5	1410.00	498.19	503.40		503.85	0.006533	5.39	266.62	74.42	0.46
2-4	1018.*	Q 10	1790.00	498.19	504.04		504.57	0.006505	5.89	318.99	85.10	0.47
2-4	1018.*	Q 25	2350.00	498.19	504.89		505.52	0.006334	6.47	391.57	85.50	0.48
2-4	1018.*	Q 50	2810.00	498.19	505.53		506.23	0.006216	6.87	446.03	85.50	0.48
2-4	1018.*	Q 100	3310.00	498.19	506.17		506.95	0.006124	7.27	500.98	85.50	0.48
2-4	975.*	Q 2	961.00	497.98	502.17		502.58	0.008077	5.09	189.47	60.31	0.50
2-4	975.*	Q 5	1410.00	497.98	502.97		503.52	0.008523	5.99	237.91	62.19	0.52
2-4	975.*	Q 10	1790.00	497.98	503.56		504.23	0.008770	6.62	275.42	65.97	0.54
2-4	975.*	Q 25	2350.00	497.98	504.35		505.18	0.008868	7.37	332.16	74.40	0.56
2-4	975.*	Q 50	2810.00	497.98	504.95		505.89	0.008801	7.87	376.76	74.40	0.56
2-4	975.*	Q 100	3310.00	497.98	505.56		506.61	0.008721	8.35	422.22	74.40	0.57
2-4	932	Q 2	961.00	497.78	501.22		501.99	0.022415	7.08	135.99	56.41	0.79
2-4	932	Q 5	1410.00	497.78	501.83		502.90	0.023344	8.31	171.54	58.42	0.83
2-4	932	Q 10	1790.00	497.78	502.29	501.95	503.59	0.024014	9.18	198.36	60.01	0.86
2-4	932	Q 25	2350.00	497.78	502.88	502.61	504.50	0.024835	10.27	234.39	61.28	0.89
2-4	932	Q 50	2810.00	497.78	503.32	503.09	505.20	0.025447	11.07	261.55	62.17	0.91
2-4	932	Q 100	3310.00	497.78	503.76	503.60	505.90	0.026063	11.85	288.96	62.47	0.93
2-4	882.*	Q 2	961.00	496.50	500.15		500.87	0.021921	6.81	141.30	61.32	0.78
2-4	882.*	Q 5	1410.00	496.50	500.74		501.72	0.022728	7.99	178.13	63.06	0.82
2-4	882.*	Q 10	1790.00	496.50	501.17		502.37	0.023344	8.83	205.63	64.11	0.84
2-4	882.*	Q 25	2350.00	496.50	501.74	501.44	503.24	0.024075	9.88	242.71	65.64	0.87
2-4	882.*	Q 50	2810.00	496.50	502.16	501.88	503.90	0.024623	10.64	270.63	66.56	0.90
2-4	882.*	Q 100	3310.00	496.50	502.59	502.38	504.58	0.025151	11.39	299.04	67.06	0.91
2-4	832.*	Q 2	961.00	495.22	499.09		499.76	0.021572	6.57	146.43	66.28	0.77
2-4	832.*	Q 5	1410.00	495.22	499.66		500.58	0.022314	7.71	184.44	67.85	0.81
2-4	832.*	Q 10	1790.00	495.22	500.07		501.19	0.022835	8.51	212.81	68.28	0.83
2-4	832.*	Q 25	2350.00	495.22	500.62	500.29	502.02	0.023498	9.53	250.87	70.02	0.86
2-4	832.*	Q 50	2810.00	495.22	501.03	500.71	502.65	0.023992	10.27	279.55	70.86	0.88
2-4	832.*	Q 100	3310.00	495.22	501.44	501.18	503.29	0.024470	10.99	308.81	71.67	0.90
2-4	782.*	Q 2	961.00	493.94	498.05		498.68	0.021238	6.35	151.50	71.25	0.76
2-4	782.*	Q 5	1410.00	493.94	498.59		499.45	0.021918	7.45	190.71	72.70	0.80
2-4	782.*	Q 10	1790.00	493.94	499.00		500.04	0.022378	8.22	220.00	72.88	0.82
2-4	782.*	Q 25	2350.00	493.94	499.53		500.83	0.022992	9.21	259.00	74.42	0.85
2-4	782.*	Q 50	2810.00	493.94	499.92	499.56	501.44	0.023419	9.92	288.55	75.28	0.87
2-4	782.*	Q 100	3310.00	493.94	500.31	500.01	502.05	0.023913	10.62	318.34	76.16	0.89
2-4	732.*	Q 2	961.00	492.66	497.02		497.61	0.021053	6.17	156.16	76.50	0.75
2-4	732.*	Q 5	1410.00	492.66	497.54		498.35	0.021640	7.22	196.61	77.54	0.79
2-4	732.*	Q 10	1790.00	492.66	497.93		498.91	0.022051	7.97	226.78	77.69	0.81
2-4	732.*	Q 25	2350.00	492.66	498.44		499.67	0.022610	8.92	266.73	78.65	0.84
2-4	732.*	Q 50	2810.00	492.66	498.82		500.25	0.022995	9.61	297.04	79.70	0.86
2-4	732.*	Q 100	3310.00	492.66	499.20	498.87	500.84	0.023428	10.30	327.44	80.61	0.88
2-4	682.*	Q 2	961.00	491.38	495.99		496.55	0.020705	5.98	161.16	81.83	0.74
2-4	682.*	Q 5	1410.00	491.38	496.50		497.26	0.021364	7.01	202.45	82.40	0.78
2-4	682.*	Q 10	1790.00	491.38	496.87		497.80	0.021737	7.73	233.48	82.54	0.80
2-4	682.*	Q 25	2350.00	491.38	497.37		498.53	0.022244	8.66	274.49	82.98	0.83
2-4	682.*	Q 50	2810.00	491.38	497.74		499.08	0.022628	9.33	305.41	84.18	0.85
2-4	682.*	Q 100	3310.00	491.38	498.11	497.75	499.65	0.022994	10.00	336.47	85.17	0.87
2-4	632.*	Q 2	961.00	490.10	494.96		495.49	0.021261	5.88	163.87	86.76	0.74
2-4	632.*	Q 5	1410.00	490.10	495.46		496.18	0.021160	6.82	208.00	87.27	0.77
2-4	632.*	Q 10	1790.00	490.10	495.83		496.70	0.021491	7.52	238.88	87.40	0.79
2-4	632.*	Q 25	2350.00	490.10	496.31		497.40	0.021940	8.42	281.99	87.51	0.82
2-4	632.*	Q 50	2810.00	490.10	496.67		497.94	0.022321	9.08	313.33	88.60	0.84
2-4	632.*	Q 100	3310.00	490.10	497.02		498.48	0.022643	9.73	345.16	89.79	0.86
2-4	582.*	Q 2	961.00	488.82	493.87		494.42	0.021616	5.95	161.83	84.60	0.75
2-4	582.*	Q 5	1410.00	488.82	494.44		495.12	0.020912	6.64	213.58	92.14	0.76
2-4	582.*	Q 10	1790.00	488.82	494.79		495.62	0.021269	7.33	246.09	92.26	0.78

HEC-RAS Plan: Flood-Flow n River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	582.*	Q 25	2350.00	488.82	495.26		496.30	0.021720	8.21	289.12	92.35	0.81
2-4	582.*	Q 50	2810.00	488.82	495.60		496.81	0.022048	8.85	321.00	93.11	0.83
2-4	582.*	Q 100	3310.00	488.82	495.95		497.34	0.022352	9.49	353.57	94.42	0.85
2-4	532.*	Q 2	961.00	487.54	492.79		493.33	0.021732	5.92	162.72	85.76	0.75
2-4	532.*	Q 5	1410.00	487.54	493.35		494.04	0.022357	6.68	212.44	95.37	0.78
2-4	532.*	Q 10	1790.00	487.54	493.75		494.55	0.021304	7.18	251.29	97.13	0.78
2-4	532.*	Q 25	2350.00	487.54	494.21		495.20	0.021507	8.01	295.95	97.36	0.80
2-4	532.*	Q 50	2810.00	487.54	494.54		495.70	0.021801	8.64	328.59	97.76	0.82
2-4	532.*	Q 100	3310.00	487.54	494.88	494.45	496.21	0.022098	9.26	361.82	99.00	0.84
2-4	482.*	Q 2	961.00	486.25	491.71		492.25	0.021631	5.88	163.67	86.41	0.75
2-4	482.*	Q 5	1410.00	486.25	492.24		492.94	0.021710	6.71	211.27	91.70	0.77
2-4	482.*	Q 10	1790.00	486.25	492.64		493.45	0.022469	7.25	248.54	98.17	0.80
2-4	482.*	Q 25	2350.00	486.25	493.16		494.12	0.021501	7.86	301.71	102.38	0.80
2-4	482.*	Q 50	2810.00	486.25	493.50		494.60	0.021567	8.44	336.04	102.71	0.82
2-4	482.*	Q 100	3310.00	486.25	493.82		495.09	0.021859	9.05	369.88	103.58	0.83
2-4	432.*	Q 2	961.00	484.97	490.64		491.16	0.021433	5.80	165.98	88.80	0.74
2-4	432.*	Q 5	1410.00	484.97	491.16		491.84	0.021892	6.65	213.07	94.16	0.77
2-4	432.*	Q 10	1790.00	484.97	491.53		492.34	0.021836	7.24	248.80	96.12	0.79
2-4	432.*	Q 25	2350.00	484.97	492.04		493.01	0.022577	7.91	299.35	104.16	0.82
2-4	432.*	Q 50	2810.00	484.97	492.43		493.50	0.021932	8.33	340.66	107.73	0.82
2-4	432.*	Q 100	3310.00	484.97	492.78		493.99	0.021608	8.85	378.10	108.22	0.83
2-4	382.*	Q 2	961.00	483.69	489.58		490.08	0.021419	5.72	168.42	92.06	0.74
2-4	382.*	Q 5	1410.00	483.69	490.07		490.75	0.021824	6.61	214.15	94.96	0.77
2-4	382.*	Q 10	1790.00	483.69	490.45		491.24	0.021936	7.17	251.00	98.85	0.79
2-4	382.*	Q 25	2350.00	483.69	490.92		491.89	0.022075	7.94	298.35	101.51	0.81
2-4	382.*	Q 50	2810.00	483.69	491.28		492.39	0.022589	8.45	335.74	106.10	0.83
2-4	382.*	Q 100	3310.00	483.69	491.69		492.88	0.022290	8.77	381.27	113.05	0.83
2-4	332.*	Q 2	961.00	482.41	488.51		489.01	0.021443	5.64	170.76	95.41	0.74
2-4	332.*	Q 5	1410.00	482.41	488.99		489.65	0.021576	6.53	216.96	97.25	0.76
2-4	332.*	Q 10	1790.00	482.41	489.35		490.14	0.022094	7.14	252.16	100.70	0.79
2-4	332.*	Q 25	2350.00	482.41	489.83		490.78	0.022006	7.85	301.58	104.22	0.81
2-4	332.*	Q 50	2810.00	482.41	490.20		491.27	0.021529	8.32	340.66	106.12	0.81
2-4	332.*	Q 100	3310.00	482.41	490.68		491.80	0.020251	8.54	391.92	112.54	0.80
2-4	282.*	Q 2	961.00	481.13	487.40		487.91	0.022551	5.75	167.37	94.20	0.76
2-4	282.*	Q 5	1410.00	481.13	487.91		488.56	0.022036	6.49	218.22	100.62	0.77
2-4	282.*	Q 10	1790.00	481.13	488.27		489.04	0.021516	7.05	255.31	101.92	0.78
2-4	282.*	Q 25	2350.00	481.13	488.89		489.73	0.018921	7.41	319.80	107.85	0.75
2-4	282.*	Q 50	2810.00	481.13	489.41		490.29	0.016165	7.52	377.27	110.46	0.71
2-4	282.*	Q 100	3310.00	481.13	490.02		490.89	0.013983	7.52	445.38	117.32	0.67
2-4	232.*	Q 2	961.00	479.85	486.32		486.82	0.020727	5.70	168.93	90.29	0.73
2-4	232.*	Q 5	1410.00	479.85	486.98		487.54	0.017933	6.01	235.57	104.56	0.70
2-4	232.*	Q 10	1790.00	479.85	487.55		488.12	0.014054	6.09	295.99	107.16	0.64
2-4	232.*	Q 25	2350.00	479.85	488.38		488.96	0.010665	6.12	388.17	113.66	0.58
2-4	232.*	Q 50	2810.00	479.85	489.03		489.62	0.008817	6.13	463.71	117.19	0.54
2-4	232.*	Q 100	3310.00	479.85	489.70		490.28	0.008085	6.17	544.81	129.30	0.52
2-4	182.*	Q 2	961.00	478.57	485.72		486.02	0.011052	4.42	218.25	107.36	0.54
2-4	182.*	Q 5	1410.00	478.57	486.59		486.91	0.007500	4.53	313.31	110.37	0.47
2-4	182.*	Q 10	1790.00	478.57	487.27		487.60	0.006287	4.63	390.06	116.59	0.44
2-4	182.*	Q 25	2350.00	478.57	488.18		488.53	0.005050	4.78	498.54	120.78	0.41
2-4	182.*	Q 50	2810.00	478.57	488.87		489.24	0.004698	4.88	584.39	130.87	0.40
2-4	182.*	Q 100	3310.00	478.57	489.55		489.94	0.004213	4.98	676.85	136.17	0.39
2-4	132.*	Q 2	961.00	477.29	485.56		485.70	0.003307	3.01	322.12	113.95	0.31
2-4	132.*	Q 5	1410.00	477.29	486.47		486.64	0.002978	3.32	429.49	121.04	0.31
2-4	132.*	Q 10	1790.00	477.29	487.17		487.36	0.002733	3.52	514.53	124.01	0.30
2-4	132.*	Q 25	2350.00	477.29	488.10		488.32	0.002591	3.77	633.21	133.67	0.30
2-4	132.*	Q 50	2810.00	477.29	488.79		489.03	0.002487	3.92	729.82	141.07	0.30
2-4	132.*	Q 100	3310.00	477.29	489.49		489.75	0.002281	4.08	828.12	141.13	0.29
2-4	82	Q 2	961.00	476.01	485.51		485.58	0.001234	2.16	449.80	124.73	0.20
2-4	82	Q 5	1410.00	476.01	486.43		486.53	0.001295	2.53	566.16	128.55	0.21
2-4	82	Q 10	1790.00	476.01	487.13		487.24	0.001325	2.77	657.24	133.12	0.22
2-4	82	Q 25	2350.00	476.01	488.06		488.20	0.001413	3.04	788.41	145.95	0.23
2-4	82	Q 50	2810.00	476.01	488.76		488.92	0.001355	3.22	890.49	146.00	0.23
2-4	82	Q 100	3310.00	476.01	489.46		489.64	0.001314	3.41	992.92	146.00	0.23
2-4	50	Q 2	961.00	481.55	484.31	484.31	485.37	0.037526	8.28	117.00	56.66	1.01
2-4	50	Q 5	1410.00	481.55	484.93	484.93	486.29	0.033933	9.35	152.54	57.49	1.00
2-4	50	Q 10	1790.00	481.55	485.41	485.41	486.98	0.031668	10.07	181.14	60.82	0.99
2-4	50	Q 25	2350.00	481.55	486.06	486.06	487.91	0.029428	10.97	220.42	61.95	0.98

HEC-RAS Plan: Flood-Lo n River: Grant Creek Reach: 2-4 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
2-4	50	Q 50	2810.00	481.55	486.53	486.53	488.61	0.028490	11.65	249.95	64.36	0.99
2-4	50	Q 100	3310.00	481.55	487.05	487.05	489.32	0.026735	12.18	284.30	65.90	0.98

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, June 13, 2014 3:06 PM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen; 'John Blum'
Subject: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call
Attachments: Rev Final minutes for IFWG meeting 05-22-2014.docx

Good afternoon:

Please find attached revised meeting minutes from the May 22nd meeting. I had not seen revisions that were forwarded to me; this have been incorporated into this draft.

I have heard that some could not make the next scheduled meeting of Friday, June 20th. I'd like to suggest a call on Monday morning (June 23rd), at 11/10/9 am ID/WA/AK time. Could you let me know if those times work for you, please? If not, let me know times on Wednesday – Friday, June 25 – 27.

Thanks, and have a good weekend!

John

John Blum
Sr. Fisheries Scientist

Draft
Conference call with the Grant Creek Instream Flow Work Group
May 22, 2014

Those attending via conference call:

- Monte Miller (ADFG)
- Jason Mouw (ADFG)
- John Stevenson (BioAnalysts)
- Cory Warnock (McMillen, LLC)
- John Blum (McMillen, LLC)

The conference call with the Instream Flow Work Group (Work Group) began at 10:00 am PDT. John Blum sent out a draft agenda to the Work Group on May 21 via email. Agenda items are briefly detailed below:

1. Review of sockeye emergence timing
2. Address concerns from ADFG re: data products
3. Discuss Work Group's analysis of transects to use for rearing and spawning
4. Discuss information work group wants presented (i.e., wetted perimeter, substrate analysis, connectivity, etc.)

REVIEW OF SOCKEYE SALMON EMERGENCE TIMING

Per request of the Work Group at the April 18th meeting, John Blum used the DTU's agreed upon at that meeting to calculate Sockeye salmon incubation and emergence timing. Since the latest download of water temperature data occurred on March 20, it was suggested that John Blum look at the water temperature data from 2013 and use a trend analysis to make an initial temperature run.

John Blum ran several different analyses to attempt to piece together the temperature data from both years; however, temperature regimes were markedly different from 2013 to 2014, resulting in a wide range of potential emergence timing. Some of these scenarios were unrealistic, so John Blum suggested that we wait until the next water temperature download is completed (i.e., in June) and then rerun the analysis then. The Work Group agreed, and this item was shelved until these data were obtained.

To Do:

- John Blum will update emergence timing after water temperature data are downloaded in June.

ADDRESS ADFG CONCERNS RE: DATA PRODUCTS

John Blum reviewed ADFG's concerns re: an interactive tool that was developed previously to examine location of spawning substrate along the transects and how these substrates were

affected by changes in flow. John explained that the information requested was not available to develop as an interactive tool; however, if the Work Group let John know what analyses they wanted, John would produce that for the group and send it out.

Jason said that what he would like to see is the lateral positions of where the spawning was located along each transect, and at what flows those locations went dry/were connected. This included the evaluation of depths and velocities at those locations at flows up to 350 cfs. It was discussed how a type of an effective spawning analysis, over the range of normal flows, may accomplish that, especially for Reaches 1 and 3.

John Stevenson said that he had looked at where most of the juvenile rearing occurring along transects. The transects with the highest CPUE were 100, 130, 160, 200, 220, 230, 300, 330 and 400.

John Stevenson said that he had looked at where most of the spawning occurred, and it was along Transects 130, 140, 300 and 310, with most rearing occurring along Transects 100, 130, 160, 200, 220, 230, 300, and 330.

Jason and Monte asked John Stevenson if he could quantify the number of spawners along the transects, so that ADFG could make assessments of which transects to analyze for effective spawning. John Stevenson said he could do that. ADFG said they would turn that around quickly for John Blum's analysis.

Jason asked if John Blum could run effective spawning up to about 350 – 400 cfs. John Blum suggested he run the analysis up to 400 – 450 cfs. John Blum said he would do that as soon as he heard back from the Work Group re: which transects to analyze.

John Blum also asked the Work Group on how they wanted the transects weighted: equally; by importance (spawning or rearing), or by habitat frequency. Jason asked if several analyses could be run. John Blum said yes, and that the analysis for equal weighting of transects was already completed and in the Draft Habitat Mapping and Instream Flow Report. The transects were initially weighted equally, since the Grant Creek Instream Flow Study was based upon known, important rearing and spawning areas.

To Do:

- John Stevenson to tabulate spawners by transect [*Note: John Stevenson did this and the spreadsheet was sent to the Work Group via John Blum email on May 23*].
- ADFG to review data and make suggestions for use of transects for rearing and spawning as well as transect weighting.
- John Blum to analyze these transects to indicate at what point spawning substrates were exposed due to decreased flow.

OTHER ISSUES

Monte asked if there was more information re: where the tailrace would be returning water into Reach 4. Cory said that KHL was running different scenarios right now and would be documenting them and collaboratively discussing options related to operations, natural resources, the associated impacts and potential mitigation measures during the July meetings in Anchorage.

Monte also asked if KHL was still considering raising the lake level. Cory said that KHL was currently running scenarios that would not involve their raising the lake levels and these options (along with others) would be discussed with Stakeholders in July. Monte then commented that the wildlife/botanical issues at the lake would be eliminated if there was no raising of lake elevation.

There was also discussion on how increasing flows into the distributary in Reach 1 (Transects 100 and 110) could also prove to be an effective enhancement tool. Monte said he would like to discuss that further in future meetings.

NEXT MEETING

The next meeting of the Work Group is tentatively scheduled for June 12, 1 pm (AK), 2 pm (WA), and 3 pm (ID) time.

[Note: this meeting time has been cancelled; a meeting date has not been confirmed at the time of this submittal].

From: Anderson, Jeffry <jeffry_anderson@fws.gov>
Sent: Monday, June 16, 2014 12:17 PM
To: Dara Glass
Cc: Mouw, Jason E B (DFG); John Blum; Miller, Monte D (DFG); susan.walker@noaa.gov; Mark Miller; John Stevenson; Cory Warnock; Mike Salzetti; Emily Andersen
Subject: Re: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call

Sorry, but I won't be able to join you on the 23rd. I'm hoping to attend the July 7/8 meeting in person.

-- Jeff

Jeffry Anderson
Field Supervisor
USFWS, Kenai Fish & Wildlife Field Office
43655 Kalifornsky Beach Road, Soldotna, AK 99669
Office: 907-260-0132
Cell: 907-252-4896

On Mon, Jun 16, 2014 at 10:56 AM, Dara Glass <dglass@ciri.com> wrote:

The 23rd works for me as well.

Thanks.

Dara Glass

CIRI Land Manager

Direct: 907.263.5140

Cell: 907.229.7052

From: Mouw, Jason E B (DFG) [mailto:jason.mouw@alaska.gov]
Sent: Monday, June 16, 2014 10:46 AM
To: John Blum; Miller, Monte D (DFG); jeffry_anderson@fws.gov; Dara Glass; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'

Cc: 'Mike Salzetti'; 'Emily Andersen'

Subject: RE: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call

Hi John,

The 23rd will work for both Monte and me.

Thanks,

Jason

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]

Sent: Friday, June 13, 2014 2:06 PM

To: Miller, Monte D (DFG); Mouw, Jason E B (DFG); Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'

Cc: 'Mike Salzetti'; 'Emily Andersen'; 'John Blum'

Subject: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call

Good afternoon:

Please find attached revised meeting minutes from the May 22nd meeting. I had not seen revisions that were forwarded to me; this have been incorporated into this draft.

I have heard that some could not make the next scheduled meeting of Friday, June 20th. I'd like to suggest a call on Monday morning (June 23rd), at 11/10/9 am ID/WA/AK time. Could you let me know if those times work for you, please? If not, let me know times on Wednesday – Friday, June 25 – 27.

Thanks, and have a good weekend!

John

John Blum
Sr. Fisheries Scientist

The information contained in this CIRI email message may be privileged, confidential and protected from disclosure. If you are not an intended recipient, please notify the sender by reply email and delete the message and any attachments immediately. The use, disclosure, dissemination, distribution or reproduction of this CIRI message or the information in it or attached to it by any unintended recipient is unauthorized, strictly prohibited by the sender, and may be unlawful. Thank you.

Subject: GoToMeeting Invitation - Grant Lake Instream Flow Call

Start: Mon 6/23/2014 10:00 AM
End: Mon 6/23/2014 11:00 AM
Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Organizer: Cory Warnock
Required Attendees: Monte Miller; Jason Mouw; Jeffry Anderson (Jeffry_Anderson@fws.gov);
dglass@ciri.com; John Blum; Susan Walker; Emily Andersen; Cory Warnock; Mike
Salzetti; John Stevenson

1. Please join my meeting.

<https://global.gotomeeting.com/join/972991981>

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

Dial +1 (786) 358-5420

Access Code: 972-991-981

Audio PIN: Shown after joining the meeting

Meeting ID: 972-991-981

GoToMeeting®

Online Meetings Made Easy®

Not at your computer? Click the link to join this meeting from your iPhone®, iPad®, Android® or Windows Phone® device via the GoToMeeting app.

From: Stovall, Robert -FS [mailto:rstovall@fs.fed.us]
Sent: Monday, June 16, 2014 1:01 PM
To: Cory Warnock
Cc: Mike Salzetti
Subject: FW: Message from KMBT_751

Cory:

Attached is the signed letter for the FS Response and Review of the Grant Lake Hydro Investigative Studies. I apologize for getting this late to you folks. I hope it is still useful to you.

I am working on getting FS folks to attend or Webinar into the July 7 and 8th meetings. Many will plan to attend the Public meeting in Moose Pass.

Please let me know if you need any additional info from the Forest Service.

Robert

Deputy District Ranger
Chugach NF, Seward RD
Po Box 390, 334 Fourth Ave.
Seward, AK 99664
Seward office # 907 743-9474; KLWC # 288-7707
Gov. Cell # 907 399-3966

From: Lesslie, Rachael M -FS
Sent: Friday, June 13, 2014 4:43 PM
To: Stovall, Robert -FS
Subject: FW: Message from KMBT_751



Rachael Lesslie
Executive Assistant
Forest Service
Chugach National Forest
p: (907) 743-9523

f: (907) 743-9488

rmlesslie@fs.fed.us

161 E 1st Avenue Door 8

Anchorage, AK 99501

www.fs.fed.us



Caring for the land and serving people

"I don't want to get to the end of my life and find that I have just lived the length of it. I want to have lived the width of it as well." Diane Ackerman

From: pr4610@fs.fed.us [<mailto:pr4610@fs.fed.us>]

Sent: Friday, June 13, 2014 5:34 PM

To: Lesslie, Rachael M -FS

Subject: Message from KMBT_751

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.



File Code: 2720

Date: June 10, 2014

Cory Warnock
Senior Licensing and Regulatory Consultant
McMillen LLC
5771 Applegate Lane
Ferndale, WA 98248

Dear Mr. Warnock:

Forest Service specialists recently completed their review of Investigative Study Reports for support of the Grant Lake Hydroelectric Project (FERC #13212), and participated in Resource Work Group meetings on March 18-20, 2014. Final study reports were completed in 2013 with a few ongoing studies continuing through 2014.

Our Resource Specialists have reviewed the following Investigative Study Reports and had no comments:

Engineering Feasibility

Aquatic Resources: Fisheries Assessment; Macro Invertebrates/Periphyton Resources;

Aquatic Habitat Mapping and Instream Flows

Water Resources: Water Quality/Hydrology; Geomorphology

Terrestrial Resources: Botanical; Wildlife

The following reports had specific comments:

Recreation and Visual Resources:

Section 4 Methods:

It is unclear from the description that the initial winter survey actually included the National Forest System Lands around Grant Lake. Normal winter routes to Grant Lake do not utilize the Vagt Lake Trail. Rather, access is gained from one of two winter trails at the northern end of the Trail Lake narrows. Table 4.1-1 indicates only one winter and one summer visit.

Section 6.2.1 Existing Observed Winter Use:

The second paragraph of this section is not accurate. Winter access to the Grant Lake area is most commonly via crossing Upper Trail Lake and one of two winter trails which leave the shoreline just south of the mouth of the lake. The most used trail is a portage trail which is easily negotiated via snowshoe, ski or snow machine. This trail is located in the southern portion of Section 31. It would be difficult to identify the winter use of the Grant Lake area without observing these routes. Another known winter use of the Grant Lake area would be trapping of fur bearing animals.

Section 6.2.2 Existing Observed Summer Use:

Other known uses include hiking to Grant Lake on one of the trails mentioned above and boating in paddle craft portaged from Upper Trail Lake. Though mentioned later in the document, it would seem appropriate to include here that summer use of the Grant Lake area can be expected to increase with the completion of planned developments associated with the Iditarod National Historic Trail (INHT).



Section 6.3 INHT:

This paragraph describes the existing use of the Vagt Lake Trail as "light". If a conclusion is drawn on the amount of use, then the term, light, should be defined. The report is correct in that discussions of a reroute of the INHT easement are ongoing with state and federal agencies, and other stakeholders. Until the analysis and review of alternative routes are completed, it seems inappropriate to describe the benefits or deficiencies of the alternative routes.

Section 6.4 Sight-Seeing Flights:

The description of typical routes seems to indicate the Harding Ice field is in the vicinity of Prince William Sound. This is inaccurate; perhaps the writer is referring to the Sargent Ice field or that flights also continue south and west to view the Harding Ice field.

Section 6.6.6 Noise:

There has not been sufficient study of non-motorized recreational use of the Grant Lake area to describe it as "small to absent".

In conclusion, it seems somewhat presumptuous to assume that conclusions on recreational use of the National Forest System lands in the vicinity of Grant Lake could be reached based on two visits. The inaccuracies and omissions mentioned should be corrected and further study should be undertaken to more accurately characterize the recreational use of the National Forest System lands in the vicinity of Grant Lake. Further analysis and discussion will be required to assess the effects to the Iditarod National Historic Trail and the public use and development scale of the proposed road to Grant Lake. We are also concerned about how the proposed buildings, fluctuating lake level, and power distribution lines will affect the visual integrity of the National Forest in this area.

Cultural Resources: Archaeological and Historic Study:

We anticipate further discussion regarding the determinations of eligibility and findings of effect during our formal review of the determinations for historic properties in the coming months.

As for the proposed INHT re-route, our main concern is adding the re-route to the APE and surveying for cultural resources once that route has been established.

We look forward to the opportunity to review any final reports, and the formal review of the Draft License Application.

If you have any questions or concerns regarding this information please contact Robert Stovall at (907) 743-9474 or rstovall@fs.fed.us.

Sincerely,



For TERRI MARCERON
Forest Supervisor

From: Cory Warnock
Sent: Monday, June 16, 2014 1:13 PM
To: Stovall, Robert -FS; Cory Warnock
Cc: Mike Salzetti; Emily Andersen
Subject: RE: Message from KMBT_751
Attachments: image001.jpg; image002.png; image003.png

Robert,

Thank you for the comments, I'll be reviewing them later this week. Per the voicemail I left with you a few weeks ago, we have finalized our responses to the comments received from other agencies and will be filing the package (reports, comment responses, meeting minutes, etc.) from our March meetings with FERC very soon. Given the informal nature of the request for comments at this phase of the Traditional Licensing Process (TLP) and the fact that we were seeking comments from the reports/meeting by April 25th, we will not be incorporating the FS comments into that package. Please don't take this to mean that HEA views your comments as irrelevant in any way as that is certainly not the case. Rather, we have simply gone too far down the path of developing our filing to incorporate at this point. HEA will very seriously review your comments and they will be considered with equal weight to any and all Stakeholder comments while developing the Draft License Application (DLA).

Thanks Robert. We look forward to continued FS involvement and as always, I'll keep you posted as developments occur.

Cory

From: Stovall, Robert -FS [mailto:rstovall@fs.fed.us]
Sent: Monday, June 16, 2014 1:01 PM
To: Cory Warnock
Cc: Mike Salzetti
Subject: FW: Message from KMBT_751

Cory:

Attached is the signed letter for the FS Response and Review of the Grant Lake Hydro Investigative Studies. I apologize for getting this late to you folks. I hope it is still useful to you.

I am working on getting FS folks to attend or Webinar into the July 7 and 8th meetings. Many will plan to attend the Public meeting in Moose Pass.

Please let me know if you need any additional info from the Forest Service.

Robert

Deputy District Ranger
Chugach NF, Seward RD
Po Box 390, 334 Fourth Ave.
Seward, AK 99664
Seward office # 907 743-9474; KLWC # 288-7707
Gov. Cell # 907 399-3966

From: Lesslie, Rachael M -FS
Sent: Friday, June 13, 2014 4:43 PM
To: Stovall, Robert -FS
Subject: FW: Message from KMBT_751



Rachael Lesslie
Executive Assistant
Forest Service
Chugach National Forest

p: (907) 743-9523

f: (907) 743-9488

rmlesslie@fs.fed.us

161 E 1st Avenue Door 8

Anchorage, AK 99501

www.fs.fed.us



Caring for the land and serving people

"I don't want to get to the end of my life and find that I have just lived the length of it. I want to have lived the width of it as well." Diane Ackerman

From: pr4610@fs.fed.us [<mailto:pr4610@fs.fed.us>]
Sent: Friday, June 13, 2014 5:34 PM
To: Lesslie, Rachael M -FS
Subject: Message from KMBT_751

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

From: Mouw, Jason E B (DFG) [<mailto:jason.mouw@alaska.gov>]
Sent: Tuesday, June 17, 2014 10:39 AM
To: John Blum
Subject: RE: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call

John,

We have reviewed this and I'm waiting to hear back from Monte and Joe and will get back with you as soon as possible.

Thanks again for your patience,

Jason

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Monday, June 16, 2014 11:05 AM
To: Mouw, Jason E B (DFG); Miller, Monte D (DFG)
Cc: 'Cory Warnock'; 'Emily Andersen'
Subject: RE: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call

Thanks, Jason:

Have you and Monte had the chance to review the transect weighting? That's the last piece I need in order to do the analysis for the next call and our meeting in early July. I appreciate your efforts on this.

Thanks,

John

John Blum
Sr. Fisheries Scientist

From: Mouw, Jason E B (DFG) [<mailto:jason.mouw@alaska.gov>]
Sent: Monday, June 16, 2014 11:46 AM
To: John Blum; Miller, Monte D (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'
Cc: 'Mike Salzetti'; 'Emily Andersen'
Subject: RE: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call

Hi John,

The 23rd will work for both Monte and me.

Thanks,

Jason

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]

Sent: Friday, June 13, 2014 2:06 PM

To: Miller, Monte D (DFG); Mouw, Jason E B (DFG); Klein, Joseph P (DFG); jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; 'Cory Warnock'

Cc: 'Mike Salzetti'; 'Emily Andersen'; 'John Blum'

Subject: Revised Final Meeting Minutes for May 22nd meeting; reschedule of next conference call

Good afternoon:

Please find attached revised meeting minutes from the May 22nd meeting. I had not seen revisions that were forwarded to me; this have been incorporated into this draft.

I have heard that some could not make the next scheduled meeting of Friday, June 20th. I'd like to suggest a call on Monday morning (June 23rd), at 11/10/9 am ID/WA/AK time. Could you let me know if those times work for you, please? If not, let me know times on Wednesday – Friday, June 25 – 27.

Thanks, and have a good weekend!

John

John Blum

Sr. Fisheries Scientist

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4570 / Virus Database: 3964/7687 - Release Date: 06/16/14

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4570 / Virus Database: 3972/7693 - Release Date: 06/17/14

From: Cory Warnock
Sent: Friday, June 20, 2014 8:43 PM
To: Dara Glass
Cc: Emily Andersen
Subject: RE: Grant Lake Project Meeting w/CIRI

Sounds good and keep me posted as to your availability.

Thanks!

-----Original Message-----

From: Dara Glass [mailto:dglass@ciri.com]
Sent: Thursday, June 19, 2014 9:36 PM
To: Cory Warnock
Cc: Emily Andersen
Subject: RE: Grant Lake Project Meeting w/CIRI

Hi Cory,

Summer is proving to be rather crazy for us. I am planning on attending the stakeholder meetings and will just be getting back to town from 10 days in the Pacific Northwest. I don't know Ethan's schedule and won't be able to find out until Monday as I am currently working on the Kenai and he is working out of the office as well.

We have discussed meeting with you and do look forward to it. Thank you for reaching out to us.

Dara

From: Cory Warnock
Sent: Thursday, June 19, 2014 7:52:01 PM
To: Dara Glass
Cc: Emily Andersen
Subject: Grant Lake Project Meeting w/CIRI

Hi Dara,

I'm writing to discuss the potential of Mike and I meeting with you and Ethan sometime over the summer to discuss the Grant Lake Project. As a first alternative, I wanted to explore the potential of meeting early in the afternoon on July 7th (perhaps over lunch) in Anchorage. It would coincide with our Stakeholder workshop which hopefully you're planning on attending. If that date doesn't work, we'd be open to other suggestions later in the summer as schedules allow. HEA (and I) have a distinct interest in meeting with both you and Ethan to discuss any questions/concerns you may have and per your direction in March, I'm starting with you to try and coordinate that.

Let me know your thoughts and hope all is well,

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, June 20, 2014 10:22 AM
To: Miller, Monte D (DFG); Jason Mouw; Klein, Joseph P (DFG); Jeffry Anderson; dglass@ciri.com; Mark Miller; John Stevenson; Cory Warnock
Cc: Salzetti, Mikel; Emily Andersen
Subject: Reschedule of June 23 call.

Importance: High

Good Morning:

I would like to reschedule the June 23 conference call until either Thursday, June 26 ,or Friday, June 27. We will have some additional analysis for the group at that time.

Would a 11/10/9 am call for ID/WA/AK work for everyone?

Thanks for your patience, and have a good weekend.

John

John Blum
Sr. Fisheries Scientist

John Blum
Sr. Fisheries Scientist

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Monday, June 23, 2014 9:12 AM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; 'Schade, David W (DNR)'; mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough; Emily Andersen
Subject: Grant Lake Public Meeting Delay

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

I wanted to touch base with you and let you know that due to a variety of scheduling conflicts, KHL will be delaying the Public Meeting in Moose Pass until later this year when all parties and facilities are available. KHL has a desire for this meeting to be as comprehensive and inclusive as possible and this delay will assist in facilitating that. Our Stakeholder workshop in Anchorage will go on as planned at the Aspen Suites on July 7th (full day) and July 8th (half day). You have already received two technical memos for review. A third, which will serve as the fundamental discussion document for our meeting and an agenda will follow shortly, (late this week or very early next).

Thanks and let me know if you have any questions/concerns leading up to our workshop.

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

From: Cory Warnock
Sent: Monday, June 23, 2014 1:06 PM
To: 'Brendan Culverwell'
Subject: RE: Grant Lake Hydroelectric Project

That's correct, construction has not begun. We are currently in the 2nd stage of the TLP licensing process and working very collaboratively to develop a DLA. To estimate an online date would be a bit premature and presumptuous at this point.

From: Brendan Culverwell [<mailto:bculverwell@snl.com>]
Sent: Monday, June 23, 2014 11:29 AM
To: Cory Warnock
Subject: Re: Grant Lake Hydroelectric Project

Hi Cory,

I work as an Industry Specialist for SNL Financial, energy department. We maintain a database on all energy projects in the US & Canada that are greater than 1 MW in capacity and actively work to ensure that our data accurately portrays the most recent and accurate project information. For this reason, we've been tracking your Grant Lake Hydroelectric Project.

So I can understand that construction has not yet begun? Is there an estimated commercial online date?

Thanks,

Brendan

On Mon, Jun 23, 2014 at 12:22 PM, Cory Warnock <cory.warnock@mcmillen-llc.net> wrote:

Hi Brendan,

I'm the consulting Project Manager for the licensing and development of the Grant Lake Hydroelectric Project and am fielding all calls for Mike Salzetti at Homer Electric while he is on vacation. We are currently in the process of working collaboratively with our local, state and federal stakeholder group on the development of the Draft FERC License Application for the project. Further information related to current status, process, and project description can be found at: <http://www.kenaihydro.com/>.

I'd be curious to hear a bit more about your (and SNL's as a whole) specific reason for being interested in the project.

Thanks,

Cory Warnock

Senior Licensing and Regulatory Consultant

McMillen, LLC

www.mcmillen-llc.com

5771 Applegrove Ln.

Ferndale, Wa. 98248

O – [360-384-2662](tel:360-384-2662)

C – [360-739-0187](tel:360-739-0187)

F – [360-542-2264](tel:360-542-2264)

From: Brendan Culverwell [mailto:bculverwell@snl.com]

Sent: Monday, June 23, 2014 11:11 AM

To: Cory Warnock

Subject: Grant Lake Hydroelectric Project

Hi Cory,

Could you please verify the development status and estimated commercial online date of the Grant Lake Hydroelectric Project?

Thanks and Best,

--

Brendan Culverwell

Industry Specialist

SNL Energy

[303.501.1681](tel:303.501.1681)

SNL.com

--

Brendan Culverwell

Industry Specialist

SNL Energy

303.501.1681

SNL.com

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Friday, June 27, 2014 9:55 PM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkhahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; 'Schade, David W (DNR)'; mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough; 'Andre Ball'; 'Adrian Strain'
Subject: Grant Lake Project Operations and Fish Habitat Technical Memo
Attachments: TM003-Grant Lake Hydroelectric Project Operations and Fisheries Habitat - Final.pdf

Hi all,

I am attaching the Grant Lake Project Operations and Fish Habitat Technical Memo for your review. It is our hope that this document and the associated presentations that lead off our workshop will be the primary deliverables responsible for much of the discussion, questions, concerns, etc. on July 7th and 8th in Anchorage. As such, I would appreciate it if you all could review the tech memo sometime in the next week in advance of our get together. Your proactive review will assist in facilitating the collaborative discussion and progress that HEA hopes have/make during our workshop. I will be following up with an agenda next week but given that much of the workshop is truly intended to be a discussion with a lot of back and forth based upon this document and the associated presentations, the agenda will be somewhat limited in its description. As always, if there are any questions or concerns in advance of the workshop, please don't hesitate to let me know.

Thanks.

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

McMILLEN, LLC

To:	Mike Salzetti, HEA	Project:	Grant Lake Hydroelectric Project
From:	Cory Warnock	Cc:	Mort McMillen, Andre Ball, John Blum
Date:	June 27, 2014	Job No:	13-102
Subject:	Grant Lake Hydroelectric Project Operations and Fisheries Habitat		

1.0 INTRODUCTION

McMillen, LLC (McMillen) has been retained by Homer Electric Association (HEA) to provide licensing, natural resource and engineering support for the proposed Grant Lake Hydroelectric Project (Project) FERC License Application. The project would be located near the city of Moose Pass, Alaska, approximately 25 miles north of Seward, Alaska.

A suite of natural resource studies (fisheries, water resources, terrestrial, cultural and recreation/visual) were developed in collaboration with Stakeholders in 2012 and implemented in 2013 and 2014. While comprehensive and quantitative in their own right, these studies were further supplemented by data collected by HEA data in 2009/2010, as well as historical natural resource data collected on Grant Creek. Simultaneous with the natural resources work, HEA has been refining the Project infrastructural description and carrying out the engineering analyses required to accurately define the operational aspects of the project in preparation for License Application submittal.

1.1 Purpose and Scope

The purpose of this technical memorandum (TM) is to present HEA's proposed Grant Lake Hydroelectric Project operations, instream flow regime in Reach 5, and to discuss the potential impacts to fisheries and instream flows on Grant Creek. The operations analysis presented within this TM build upon previous studies. The scope of information presented in this TM is as follows:

- Summary of Grant Lake fisheries and water resources
- Proposed project infrastructure
- Proposed project operations and energy generation analysis
- Project impacts to fisheries habitat and instream flows

2.0 GRANT CREEK FISHERIES AND WATER RESOURCES

Grant Creek is the only natural outlet from Grant Lake and is located at the south end of the lake (Figure 1, Appendix A). Grant Creek flows west from Grant Lake for about a mile before flowing into the Trail Lake Narrows. During the 2013/2014 natural resource studies, Grant Creek was divided into six different reaches (Reaches 1-6, Figure 1). All anadromous species are precluded from upstream movement into Grant Lake by an impassible falls located at the Reach 5 – Reach 6 transition. The only resident fish species that reside in Grant Lake are sculpin and stickleback. An extensive set of fisheries investigations were conducted in 2013, which documented four anadromous species of salmon (Chinook, Sockeye, Coho and Pink salmon) along with Rainbow trout and Dolly Varden char in Grant Creek. Species of sculpin and stickleback were also documented in Grant Creek.

Grant Creek experiences large variations in flow on a seasonal basis due to snowmelt in the early summer (June/July) and rainfall events later in the summer/fall. Minimum flows in late winter typically range between 15-20 cubic feet per second (cfs), while peak flows in the summer or fall exceed 1000 cfs frequently. The primary sediment input for Grant Creek is associated with the shearing of extremely angular material during episodic high flow events through the steep-walled canyon in Reach 5. Given the relatively low quality of the overall substrate composition in Reaches 1-4, spawning tends to be opportunistic and focused on areas where pockets of higher quality spawning substrates exists. Rearing tends to be associated with stream margins and a few primary side channels that exist.

Table 1 (Appendix A) documents the periodicity for the various life stages of the fish species discussed above, along with relevant Grant Creek streamflow statistics.

2.1 Fisheries and Habitat

Grant Creek is a high gradient stream with high streamflow velocities. High flows and velocities limit the amount of large woody debris (LWD) retained in the system, since there are only a few places where LWD will collect in the main channel. Most wood is found in the distributary and the Reach 2/3 side channels, where flows are greatly reduced and are protected from the main discharges in Grant Creek. The system is dominated by riffles in the lower four reaches and cascades in Reach 5. Pools are also generally lacking in the mainstem. As with LWD, the exception is in the side channels and distributary. The other major habitat found with some abundance is undercut banks, primarily in Reaches 1 and 4 (see Tables 2 and 3).

Low winter flows may affect incubation and winter rearing of juveniles and fry. Side channels, which provide excellent rearing habitat for juvenile fish, are either dry at lower flows (in the case of the distributary in Reach 1), or have extremely low flows during winter time (in the Reach 2/3 side channels) and may freeze. Spawning substrate throughout lower Grant Creek (Reaches 1 – 4) is limited, and salmonid spawning may be more a function of suitable substrates than preferred depths and velocities. Since much of the preferred substrates are found along the stream margins where they are dropped during high flows, eggs deposited along the banks at high flows may be subject to desiccation when those high flow recede. This may be a factor

especially early during the spawning period for Chinook and Sockeye salmon when they spawn on the receding hydrograph (see periodicity and hydrology data in Table 1 of Appendix A).

Table 2. 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

Table 3. 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

2.2 Hydrology

The streamflow record utilized for the Grant Creek habitat assessment and energy analysis is a combination of recorded streamflow and record extension. Grant Creek has an 11-year USGS streamflow gage record for water years 1948-1958 at USGS gage 15246000. Intermittent streamflow monitoring was conducted in 1981-83, 2009 and from 2013 to present. A record extension was performed based on the USGS gage 15258000, Kenai River at Cooper Landing, record. A composite streamflow record was created for Grant Creek that represents of 66 years of daily streamflow data for calendar years 1948 through 2013. The Grant Creek hydrology and streamflow records are discussed in greater detail in a separate technical memorandum, TM001 Grant Creek Hydrologic Analysis (McMillen, 2014).

Monthly streamflow statistics for the Grant Creek composite record are provided in Table 1 of Appendix A. Based on the average annual hydrograph, flows are lowest, around 34 cfs, in Grant Creek during March and April. Flows begin to rise in May and June due to snow melt and tend to peak in July (503 cfs). Flow values then taper off by an order of magnitude from August through February (444 cfs to 43 cfs).

3.0 PROPOSED PROJECT INFRASTRUCTURE

As outlined in HEA's 2011 application for a preliminary permit, the proposed Project consists of constructing a new 5-Megawatt (approximate) hydroelectric facility on Grant Lake and Grant Creek near Moose Pass, Alaska. The new Project would divert water from Grant Lake and deliver the flow to a powerhouse located near the outlet of the existing Grant Creek natural, incised rock canyon downstream from Reach 5. The Project would include the following major components:

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

The layout has been revised to minimize the Project footprint. The current design omits the construction of a diversion structure (dam) at the outlet of Grant Lake. All 13-feet of storage that will be utilized for power generation will be drawn from below the natural lake outlet. The tailrace channel, which returns flow from the powerhouse to Grant Creek, will be located at the upstream of Reach 4. This tailrace location ensures that the reaches with the best natural habitat for fish will

not be dewatered. The detention pond will be utilized to allow the powerhouse to meet the spinning reserve without resulting in drastic changes to in-channel flows.

4.0 PROPOSED PROJECT OPERATIONS

The proposed Project operations will utilize Grant Lake as a natural storage reservoir. This will allow the Project to regulate the lake outflow, which will result in year round power generation and consistent instream flows. On a typical year, Grant Lake will be operated following a rule curve. The rule curve will maintain the lake at the full level from mid-August through October. Beginning in November, when natural runoff begins to taper off, the lake level will be drafted to provide additional power generation. The lake will be lowered by a maximum of 13 feet during winter. In late spring and through mid-summer, the lake will be refilled with snowmelt runoff.

The regulated outflow from Grant Lake will be run through the powerhouse. With two, asymmetrically-sized turbines, the Project will be able to efficiently generate power over a range of discharges. After passing through the powerhouse, the flow will be returned to Grant Creek at the upstream end of Reach 4. In order to maintain a wetted channel throughout Grant Creek, instream flow releases are proposed for the Reach 5 and 6 section between Grant Lake and the powerhouse. The proposed instream flow releases would provide 10 cfs in Reach 5 during the Chinook spawning period and continue to provide 7 cfs through the Coho spawning period. During the remainder of the year, 5 cfs would be passed through Reach 5.

An energy generation model was developed to simulate the Project under these proposed operations. Utilizing the average daily inflows from the composite record, the anticipated annual energy production would be 19,500,000 kilowatt-hours. Table 4 (Appendix A) summarizes the average weekly flows in Grant Creek, with and without the Project.

5.0 PROJECT IMPACTS TO FISHERIES HABITAT AND INSTREAM FLOWS

The flow regime, as proposed, would increase winter flows while decreasing the peak flows found during snow melt and episodic rain events throughout the year. The Project, as proposed to be operated, would provide more stable flows throughout the year. Winter flows (November – February) would be increased over natural flows. The Project would closely mimic natural flows during March, April, September, and October. The Project would reduce mean flows during June, July and August period (Table 4).

Based on the proposed operational regime, the implications to the instream flows for Reach 5 and Reaches 1-4 are described below.

5.1 Reach 5 Instream Flows

HEA proposes to provide an instream flow through Reaches 5 and 6 accordingly (see Table 4 in Appendix A):

- 5 cfs (January 1 – July 31; November 1 – December 31. Rainbow trout spawning from May 16 – June 30)
- 10 cfs (August 1 – September 7; Chinook and Sockeye salmon and Dolly Varden char spawning)
- 7 cfs (September 8 – October 31; Sockeye and Coho salmon and Dolly Varden char spawning)

Flows are proposed to provide sufficient passage for adult salmonids which may utilize Reach 5. Surveys in 2013, however, indicated limited use of the canyon. Of the 388 adult salmon noted during the 2013 surveys, only 3 Sockeye and 2 Coho salmon were observed in Reach 5. These fish constitute 1.3% of the total observed population.

Connectivity for Sockeye and Coho salmon, based on the 2013 study, indicated that connectivity was provided at a flow of 10 cfs, with trout connectivity provided at a flow of 5 cfs [*Note: data for trout were re-analyzed after the submission to the Instream Flow study report*]. Chinook connectivity is achieved at flows ranging from 25 – 30 cfs; however, no Chinook have been observed in Reach 5.

HEA proposes additional flows in the Reach 2/3 side channels during the November – February period, which increases habitat for rearing salmonids in Grant Creek. This metric is discussed in the following section.

5.2 Reach 1-4 Flows

In general, maximum habitat (as measured by Weighted Usable Area, WUA) in Grant Creek occurs at flows ranging from approximately 300 cfs to 400 cfs, as measured at the Grant Creek stream gauge. There are specific instances when higher flows maximize WUA. In Reach1 (main channel), rearing habitat increases with flow throughout the modeled range. In Reach 3 (mainstem), habitat for spawning and fry, juvenile and adult rearing, is maximized at flows of approximately 100 cfs and then generally decreases as flow increases above 100 cfs..

A preliminary look at WUA for Chinook and Sockeye salmon indicates no net loss in spawning habitat, with a slight overall increase (approximately 1%). Coho salmon spawning habitat remains the same since flows during the spawning period are the same, pre- and post-project. Overall decreases in Dolly Varden and Rainbow trout adult rearing WUA is approximately 10% for the June – August period.

Due to reduced flows in the Reach 2/3 side channels during the summer months, there is a slight decrease in habitat during this period. However, there are marked increases in overwintering habitat for Chinook salmon, Dolly Varden char, and Rainbow trout. Overall, Chinook juvenile habitat increased by over 56%, Rainbow trout rearing increase by over 10%, and Dolly Varden

juvenile habitat increased by over 6%. The overall increase in habitat over this period was 17.2%. Coho salmon juvenile habitat decreased overall by 1%, ranging from a decrease of over 5% in WUA during January, to an increase of over 8% in November (Table 5).

In the Reach 2/3 side channels, flows are decreased during the June – August period. There are losses in fry, juvenile, and adult rearing WUA of 3%, 9% and 16% respectively in these side channels for this period.

Table 5. Changes in WUA for rearing salmonids in the Reach 2/3 side channels, comparing pre-Project to proposed Project flows.

Species/Life Stage	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%
Rainbow Fry	119.7%	127.2%	95.7%	108.7%	112.8%
Mean	120.3%	128.3%	107.9%	112.5%	117.2%

6.0 SUMMARY AND CONCLUSIONS

This technical memorandum was intended to provide specific details related to HEA’s proposed operational regime for the Grant Lake Project. Also outlined, were HEA’s proposed instream flow releases for Reaches 5 and 6 (bypass reach) that are intended to permit the small number of fish currently utilizing the area to continue to do so. Under natural conditions, Reach 5 has the least area of habitat suitable for spawning and rearing. The operational scenario outlined and the resulting instream flows in Reaches 1-4 should provide a more stable condition that amplifies and maintains habitat in the mainstem and side channels. The side channels are highly valued for their habitat that provides some of the best spawning and rearing potential in Grant Creek. Based on the analysis of the proposed Project operations that has been conducted, this increase in habitat in the Reach 2/3 side channel complex will far exceed any loss of habitat that may occur in Reach 5 area.

HEA has proactively developed this operational scenario and associated instream flow regime based both upon the data that was collected during the 2013 study program and the quality amount of consultation that has taken place with all of the Stakeholders. We want to emphasize that the scenario described in this memo represents a realistic and somewhat unique opportunity for HEA to responsibly develop the Grant Lake Project while at the same time, positively impact the aquatic environment by generating more abundant, stable and consistent habitat than is currently present under natural conditions. HEA looks forward to discussing this memo with the Stakeholders, answering questions and collaborating on the details related to this proposal. The ultimate goal for HEA as it relates to Stakeholder consultation is to develop the most collaborative FERC License Application possible. We sincerely hope that this memo and the associated discussions during our July 2014 meeting will greatly assist in that development.

7.0 REFERENCES

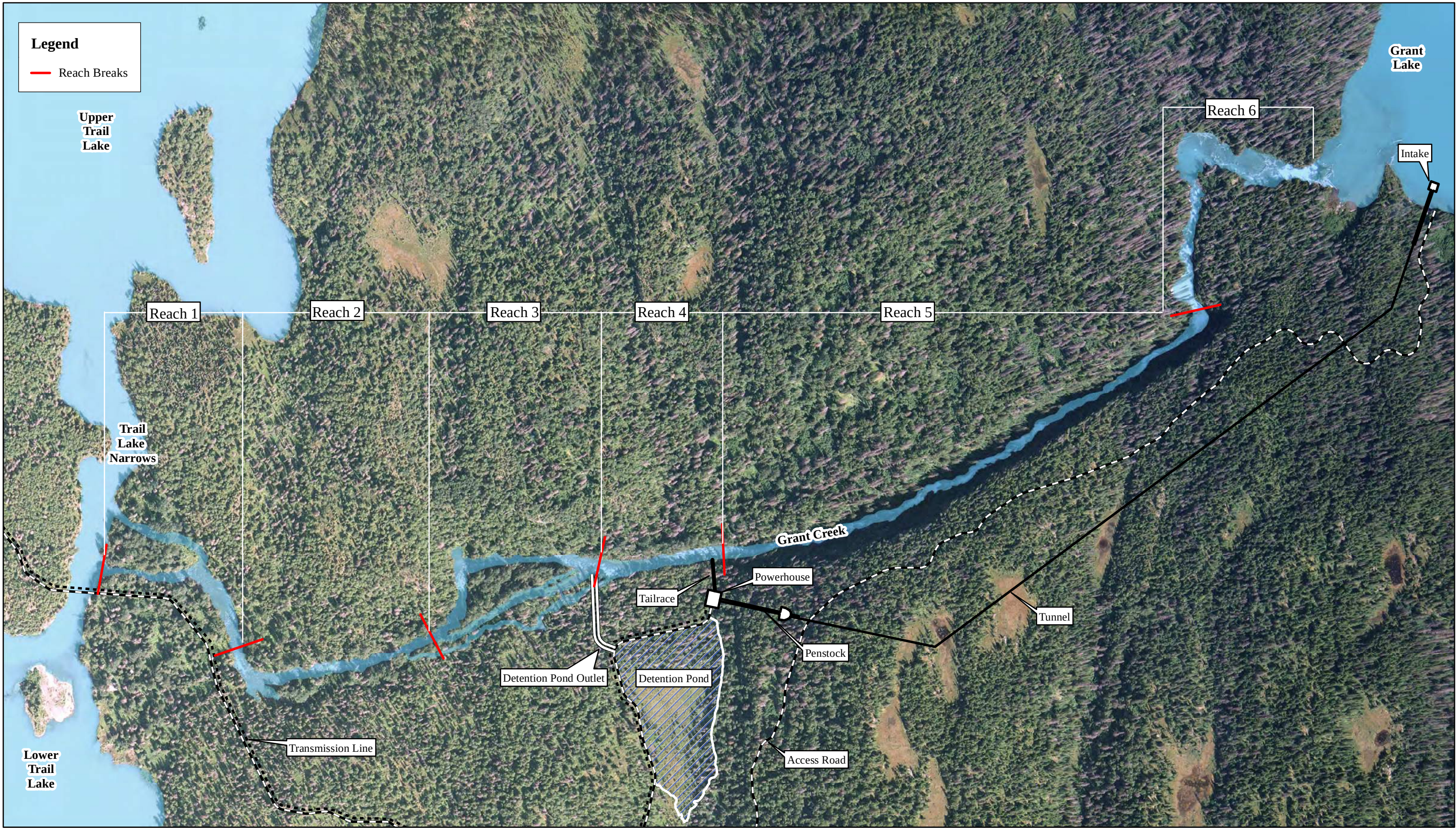
McMillen, 2014. TM 001: Grant Creek Hydrologic Analysis. Prepared for Homer Electric Association.

8.0 APPENDIX A

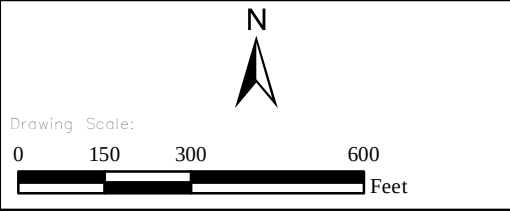
Figure 1. Grant Creek Reaches and Project Infrastructure

Table 1. Grant Creek Biology, Hydrology, and Operations Summary

Table 4. Grant Creek Instream Flows under Natural Conditions and with Project Operations



REV	DATE	BY	DESCRIPTION	



McMILLEN, LLC

1401 Shoreline Drive
Suite 100
Boise, ID 83702OFFICE: 208.342.4214
FAX: 208.342.4216

Developed For:

**Homer Electric Association, Inc.**
A Touchstone Energy® Cooperative

GRANT LAKE HYDROELECTRIC PROJECT - FERC PROJECT #P-13212

TM003: Grant Lake Hydroelectric Project Operations and Fisheries Habitat

Figure 1.
Grant Creek Reaches and Project Infrastructure

DESIGNED	A. Ball	DRAWING
DRAWN	A. Ball	
CHECKED	C. Warnock	
ISSUED DATE	6/18/2014	
		SCALE: 1:4,000

Table 1. Grant Creek Biology, Hydrology, and Operations Summary Table

[illegible]

Table 2. Grant Creek Instream Flows under Natural Conditions and with Project Operations

[illegible]

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Wednesday, July 02, 2014 10:01 AM
To: jeavis@fs.fed.us; Joe Klein; 'Kevin Laves'; 'Katherine McCafferty'; Monte Miller; Jason Mouw; Susan Walker; 'Lesli Schick'; rstovall@fs.fed.us; Cassie Thomas; 'Jeffry Anderson'; 'Patricia Berkahn'; carl.reese@alaska.gov; 'Kim Sager'; hshepherd@uci.net; dglass@ciri.com; 'David Griffin'; pamela.russell@alaska.gov; 'Schade, David W (DNR)'; mcooney@arctic.net; 'Audrey Alstrom'; kenailake@arctic.net; Ken Hogan
Cc: Mike Salzetti; Emily Andersen; 'Morton Mcmillen'; John Blum; John Stevenson; Dwayne Adams; Michael Yarborough; 'Andre Ball'; Charles Sauvageau
Subject: Grant Lake Project Operations Workshop Agenda
Attachments: Grant Lake Hydroelectric Project Workshop Agenda.pdf

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

I've attached the agenda for our Grant Lake Project Operations Workshop next week. Please note that the start time has changed on Monday (7th) from 8am to 9am. Additionally, page 3 of the attached agenda contains the webinar/dial-in information for those that will be participating remotely. Hopefully all of you have/will have the chance to review the Project Operations and Fisheries Habitat Tech Memo (sent last Friday) in advance of our workshop. Looking forward to a collaborative and productive discussion.

Thanks and let me know if there are any questions/concerns in advance of next Monday. Hope everyone has a good holiday weekend.

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

Grant Lake Hydroelectric Project (FERC No. 13212)
Grant Lake Project Operations Workshop
July 7th and 8th, 2014
Aspen Suites Hotel, 100 E. Tudor Rd., Anchorage AK
9:00 am to 5:00 pm (July 7th) and 8:00 am to 12:00 pm (July 8th)

Day 1 (July 7th)

9:00am – 9:30am

- **Introductions and Agenda (C. Warnock/ M. Salzetti)**
 - Introductions
 - Progress summary
 - Meeting intent
 - Agenda

9:30am – 10:30am

- **Grant Lake Project Aquatic and Operations Analysis (J. Blum)**
 - History and progress since last meeting
 - Outstanding information
 - Proposed instream flow regime
 - Proposed enhancement measures
 - Next steps

10:30am – 10:45am

- **Break**

10:45am – 12:00pm

- **Grant Lake Operations and Infrastructure Presentation (M. McMillen/A. Ball)**
 - Infrastructure/layout
 - Hydrologic/hydraulic analysis
 - Operations
 - Next steps
 - Questions

12:00pm – 1:00pm

- **Lunch (on your own)**

*Snacks to be provided during the day

1:00pm – 3:00pm

- **General Operational/Aquatics Discussion**
 - Stakeholder impression of:
 - Operational regime
 - Infrastructure
 - Instream flow proposal
 - Impacts
 - PM&E's

3:00pm – 3:15pm

- Break

3:15pm – 4:30pm

- **Path Forward**
 - o Where are we in the process?
 - o Follow-up discussions?
 - o Continued infrastructural refinement
 - o Anticipated schedule
 - o DLA development

4:30pm

- Adjourn

Day 2 (July 8th)

8:00am – 8:15am

- **Introductions and Agenda (C. Warnock/ M. Salzetti)**
 - o Introductions
 - o Progress summary
 - o Meeting intent
 - o Agenda

8:15am – 11:30am

- **Collaborative discussion based upon previous day's requests and subsequent analysis**

11:30am – 12:00pm

- **Path Forward**
 - o Where are we in the process?
 - o Follow-up discussions?
 - o Continued infrastructural refinement
 - o Anticipated schedule
 - o DLA development

12:00pm

- Adjourn

*For those participating via webinar, the information below will allow you to see and hear the proceedings.

Monday (7th)

1. Please join my meeting.

<https://global.gotomeeting.com/join/640955829>

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

Dial +1 (773) 897-3015

Access Code: 640-955-829

Audio PIN: Shown after joining the meeting

Meeting ID: 640-955-829

Tuesday (8th)

1. Please join my meeting.

<https://global.gotomeeting.com/join/602876037>

2. Use your microphone and speakers (VoIP) - a headset is recommended. Or, call in using your telephone.

Dial +1 (213) 289-0016

Access Code: 602-876-037

Audio PIN: Shown after joining the meeting

Meeting ID: 602-876-037

From: Cory Warnock
Sent: Thursday, July 03, 2014 5:10 PM
To: Anderson, Jeffry
Cc: Emily Andersen
Subject: Re: Grant Lake Project Operations Workshop Agenda

Categories: Green Category

Hi Jeff,

Unfortunately, I'm on a remote vacation for the 4th and will not be returning to my office prior to heading to AK. As such, printing off the reports isn't likely. I will however have copies of the primary memo for this meeting and the presentations. We can chat offline at the meeting and perhaps I can have some printed for you there. Again, apologies.

Cory

On Jul 3, 2014, at 12:28 PM, "Anderson, Jeffry" <jeffry_anderson@fws.gov> wrote:

Hi Cory. I have a request for Monday's meeting. Can you have hard-copies of the tech memos on hand? I can't get any of the large map/table pages to print properly. Also, can you provide hard-copies for the final 2013 resource investigation reports (i.e., fisheries assessment, geomorphology, etc...)?

Thanks. Sorry for the late request, and have a good weekend.

-- Jeff

Jeffry Anderson
Field Supervisor
USFWS, Kenai Fish & Wildlife Field Office
43655 Kalifornsky Beach Road, Soldotna, AK 99669
Office: 907-260-0132
Cell: 907-252-4896

On Wed, Jul 2, 2014 at 9:01 AM, Cory Warnock <cory.warnock@mcmillen-llc.com> wrote:

Grant Lake Hydroelectric Project (FERC No. 13212) Natural Resources Study Stakeholder Group (Natural Resource Work Group , Aquatics Resource Work Group Members):

Hi all,

I've attached the agenda for our Grant Lake Project Operations Workshop next week. Please note that the start time has changed on Monday (7th) from 8am to 9am. Additionally, page 3 of the attached agenda contains the webinar/dial-in information for those that will be participating remotely. Hopefully all of you have/will have the chance to review the Project Operations and Fisheries Habitat Tech Memo (sent last Friday) in advance of our workshop. Looking forward to a collaborative and productive discussion.

Thanks and let me know if there are any questions/concerns in advance of next Monday. Hope everyone has a good holiday weekend.

Cory

Cory Warnock

Senior Licensing and Regulatory Consultant

McMillen, LLC

www.mcmillen-llc.com

5771 Applegrove Ln.

Ferndale, Wa. 98248

O – 360-384-2662

C – 360-739-0187

F – 360-542-2264

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 Berkahn, (USFWS) *[via phone]*
Mark Miller, BioAnalysts *[via phone]*

Cassie Thomas, National Park Service
Jason Mouw, Alaska Department of Fish and Wildlife (ADF&G)
Betsy McCracken, 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 McCracken (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 McMullen 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 McCracken 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

From: Cory Warnock <cory.warnock@mcmillen-llc.com>
Sent: Tuesday, July 08, 2014 11:47 AM
To: dglass@ciri.com; Mike Salzetti
Cc: Emily Andersen
Subject: Meeting in late August

Hi Dara,

Thanks for the call. Based on our discussion, we'll work toward refining a date in late August to meet up with you and Ethan. Once you have a better feel for Ethan's schedule during that time frame, shoot me a message and we'll get a date on the calendar.

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

From: [Griffin, David W \(DNR\)](#)
To: [Dwayne Adams](#)
Subject: RE: INHT Meeting
Date: Wednesday, July 09, 2014 2:28:20 PM

Hi Dwayne,

I'm not going to be able to make this trip. Just wanted to let you know.

Thanks,

David Griffin
(907) 269-8696
david.griffin@alaska.gov

Special Assistant to the Director

*Director's Office
Division of Parks and Outdoor Recreation
Department of Natural Resources
550 West 7th Ave., Suite 1380
Anchorage, AK 99501*

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, July 09, 2014 11:47 AM
To: 'Dwayne Adams'; Duvall, Shina A (DNR); 'Stovall, Robert -FS'; Russell, Pamela J (DNR); kvanmassenhove@fs.fed.us; Schick, Lesli J (DNR); 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS'; 'Kime, Sherry D -FS'; 'Mike Salzetti'; mmueller@borough.kenai.ak.us; Bittner, Judith E (DNR); 'Cory Warnock'; 'Matt McMillan'
Cc: Griffin, David W (DNR)
Subject: RE: INHT Meeting

This is a friendly reminder that we're slated to do a hike of an alternative proposed for the INHT trail in the vicinity of Grant Creek next Tuesday, the 15th. Following is the proposed itinerary. Things are a little complicated as the creek level is pretty high and the weir we used last year to cross the creek has been removed. Thus we will probably need a couple different stages, one for south of Grant Creek, one for north of Grant Creek.

- 8:30 Meet at Vagt Lake trail head which is at the southern end of Lower Trail Lake. Hike the 1.75 miles +/- to Vagt Lake.
- Hike the proposed re-route to the southern bank of Grant Creek.
- Return to the Vagt Lake Trail Head.
- 12:00 eat lunch—We will provide sandwiches/lunch. Let me know if you have specific

dietary requirements.

- After lunch, carpool to MP26.9. We will have a canoe and will ferry people across Upper Trail Lake, to the north side of Grant Creek.
- We will review the possible alternate trail for the north side of the creek.
- Return around 4:30 or so to ferry back across the lake.

I know it's a full day and it does provide an opportunity to visit only one half of the trail if that is all the time you have. However, we certainly encourage you to view the proposed alternative in whole.

Please let me know if you will be attending so we know how many lunches and snacks to provide. Also, let me know your dietary needs if appropriate.

Thanks much folks.

Dwayne Adams
Landscape Architect



705 W. 13th Ave.
Anchorage, AK 99501

P 907.279.2688

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]

Sent: Tuesday, May 27, 2014 1:58 PM

To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'

Cc: 'Griffin, David W (DNR)'

Subject: RE: INHT Meeting

This is to confirm that the date of July 15 seemed to be the best fit for the majority of people, based on a number of back and forth emails. I'll follow up with particulars about meeting location and ferrying across the lake.

I wanted to follow up just in case there remained any confusion as to the date.

Thanks folks

Dwayne Adams
Landscape Architect



705 W. 13th Ave.
Anchorage, AK 99501

P 907.279.2688

-----Original Appointment-----

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]

Sent: Wednesday, May 14, 2014 4:02 PM

To: Dwayne Adams; Duvall, Shina A (DNR); 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'

Cc: Griffin, David W (DNR)

Subject: INHT Meeting

When: Tuesday, July 15, 2014 9:00 AM-4:00 PM (GMT-09:00) Alaska.

Where: Grant Lake

From the looks of it, this works for almost everyone. Bring spray for critters large and small.

Dwayne

From: Dwayne Adams [mailto:wdadams@earthscape.alaska.com]

Sent: Wednesday, July 09, 2014 12:47 PM

To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; kvanmassenhove@fs.fed.us; lesli.schick@alaska.gov; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS'; 'Kime, Sherry D -FS'; 'Mike Salzetti'; mmueller@borough.kenai.ak.us; judy.bittner@alaska.gov; Cory Warnock; 'Matt McMillan'

Cc: 'Griffin, David W (DNR)'

Subject: RE: INHT Meeting

This is a friendly reminder that we're slated to do a hike of an alternative proposed for the INHT trail in the vicinity of Grant Creek next Tuesday, the 15th. Following is the proposed itinerary. Things are a little complicated as the creek level is pretty high and the weir we used last year to cross the creek has been removed. Thus we will probably need a couple different stages, one for south of Grant Creek, one for north of Grant Creek.

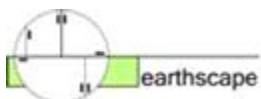
- 8:30 Meet at Vagt Lake trail head which is at the southern end of Lower Trail Lake. Hike the 1.75 miles +/- to Vagt Lake.
- Hike the proposed re-route to the southern bank of Grant Creek.
- Return to the Vagt Lake Trail Head.
- 12:00 eat lunch—We will provide sandwiches/lunch. Let me know if you have specific dietary requirements.
- After lunch, carpool to MP26.9. We will have a canoe and will ferry people across Upper Trail Lake, to the north side of Grant Creek.
- We will review the possible alternate trail for the north side of the creek.
- Return around 4:30 or so to ferry back across the lake.

I know it's a full day and it does provide an opportunity to visit only one half of the trail if that is all the time you have. However, we certainly encourage you to view the proposed alternative in whole.

Please let me know if you will be attending so we know how many lunches and snacks to provide. Also, let me know your dietary needs if appropriate.

Thanks much folks.

Dwayne Adams
Landscape Architect



705 W. 13th Ave.
Anchorage, AK 99501

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Tuesday, May 27, 2014 1:58 PM
To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'
Cc: 'Griffin, David W (DNR)'
Subject: RE: INHT Meeting

This is to confirm that the date of July 15 seemed to be the best fit for the majority of people, based on a number of back and forth emails. I'll follow up with particulars about meeting location and ferrying across the lake.

I wanted to follow up just in case there remained any confusion as to the date.

Thanks folks

Dwayne Adams
Landscape Architect

<< OLE Object: Picture (Device Independent Bitmap) >>
705 W. 13th Ave.
Anchorage, AK 99501

P 907.279.2688

-----Original Appointment-----

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, May 14, 2014 4:02 PM
To: Dwayne Adams; Duvall, Shina A (DNR); 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'
Cc: Griffin, David W (DNR)
Subject: INHT Meeting
When: Tuesday, July 15, 2014 9:00 AM-4:00 PM (GMT-09:00) Alaska.
Where: Grant Lake

From the looks of it, this works for almost everyone. Bring spray for critters large and small.

Dwayne

From: [Schick, Lesli J \(DNR\)](#)
To: [Dwayne Adams](#)
Subject: RE: INHT Meeting
Date: Friday, July 11, 2014 10:40:37 AM

Hi Dwayne,

Unfortunately, I will not be able to attend next week. I have been out there to look at the location of the current route and the proposed route(s).

Thank you for the invitation,
-lesli

Lesli Schick
Iditarod Trail Easements
Department of Natural Resources
550 W 7th Ave, Suite 900C
Anchorage, AK 99501
Phone: (907) 334-2679, Fax: (907) 269-8930
Email: lesli.schick@alaska.gov

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Friday, July 11, 2014 9:48 AM
To: Duvall, Shina A (DNR); 'Stovall, Robert -FS'; Russell, Pamela J (DNR); Schick, Lesli J (DNR); 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS'; 'Kime, Sherry D -FS'; 'Mike Salzetti'; mmueller@borough.kenai.ak.us; Bittner, Judith E (DNR); 'Cory Warnock'; 'Matt McMillan'; mry@crcalaska.com
Subject: RE: INHT Meeting

I haven't received any responses thus far as to who is able to attend the INHT site walk next week. I'd appreciate knowing whether you will be able to attend so we can make sure to have enough lunches and be sure we wait an appropriate amount of time before walking away from the trailhead.

Please let me know if you are able to attend. I know some of you did respond a couple months ago but I'd appreciate re-confirmation.

Thanks much

Dwayne

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, July 09, 2014 11:47 AM

To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Matt McMillan'
Cc: 'Griffin, David W (DNR)'
Subject: RE: INHT Meeting

This is a friendly reminder that we're slated to do a hike of an alternative proposed for the INHT trail in the vicinity of Grant Creek next Tuesday, the 15th. Following is the proposed itinerary. Things are a little complicated as the creek level is pretty high and the weir we used last year to cross the creek has been removed. Thus we will probably need a couple different stages, one for south of Grant Creek, one for north of Grant Creek.

- 8:30 Meet at Vagt Lake trail head which is at the southern end of Lower Trail Lake. Hike the 1.75 miles +/- to Vagt Lake.
- Hike the proposed re-route to the southern bank of Grant Creek.
- Return to the Vagt Lake Trail Head.
- 12:00 eat lunch—We will provide sandwiches/lunch. Let me know if you have specific dietary requirements.
- After lunch, carpool to MP26.9. We will have a canoe and will ferry people across Upper Trail Lake, to the north side of Grant Creek.
- We will review the possible alternate trail for the north side of the creek.
- Return around 4:30 or so to ferry back across the lake.

I know it's a full day and it does provide an opportunity to visit only one half of the trail if that is all the time you have. However, we certainly encourage you to view the proposed alternative in whole.

Please let me know if you will be attending so we know how many lunches and snacks to provide. Also, let me know your dietary needs if appropriate.

Thanks much folks.

Dwayne Adams

Landscape Architect

<< OLE Object: Picture (Device Independent Bitmap) >>

705 W. 13th Ave.

Anchorage, AK 99501

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Tuesday, May 27, 2014 1:58 PM
To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'
Cc: 'Griffin, David W (DNR)'
Subject: RE: INHT Meeting

This is to confirm that the date of July 15 seemed to be the best fit for the majority of people, based on a number of back and forth emails. I'll follow up with particulars about meeting location and ferrying across the lake.

I wanted to follow up just in case there remained any confusion as to the date.

Thanks folks

Dwayne Adams

Landscape Architect

<< OLE Object: Picture (Device Independent Bitmap) >>

705 W. 13th Ave.

Anchorage, AK 99501

-----Original Appointment-----

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, May 14, 2014 4:02 PM
To: Dwayne Adams; Duvall, Shina A (DNR); 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'
Cc: Griffin, David W (DNR)
Subject: INHT Meeting
When: Tuesday, July 15, 2014 9:00 AM-4:00 PM (GMT-09:00) Alaska.
Where: Grant Lake

From the looks of it, this works for almost everyone. Bring spray for critters large and small.

Dwayne

Begin forwarded message:

From: Dwayne Adams <wdadams@earthscape.alaska.com>
Date: July 11, 2014 at 10:48:07 AM PDT
To: "'Duvall, Shina A (DNR)'" <shina.duvall@alaska.gov>, "'Stovall, Robert -FS'" <rstovall@fs.fed.us>, "'Russell, Pamela J (DNR)'" <pamela.russell@alaska.gov>, "'lesli.schick@alaska.gov'" <lesli.schick@alaska.gov>, "'Fitzpatrick, Mike -FS'" <mfitzpatrick@fs.fed.us>, "'Eavis, John -FS'" <jeavis@fs.fed.us>, "'Kime, Sherry D -FS'" <sherrydkime@fs.fed.us>, 'Mike Salzetti' <msalzetti@HomerElectric.com>, "'mmueller@borough.kenai.ak.us'" <mmueller@borough.kenai.ak.us>, "'judy.bittner@alaska.gov'" <judy.bittner@alaska.gov>, Cory Warnock <cory.warnock@mcmillen-llc.net>, 'Matt McMillan' <mmcmillan@uskh.com>, "'mry@crcalaska.com'" <mry@crcalaska.com>
Subject: RE: INHT Meeting

I haven't received any responses thus far as to who is able to attend the INHT site walk next week. I'd appreciate knowing whether you will be able to attend so we can make sure to have enough lunches and be sure we wait an appropriate amount of time before walking away from the trailhead.

Please let me know if you are able to attend. I know some of you did respond a couple months ago but I'd appreciate re-confirmation.

Thanks much

Dwayne

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Wednesday, July 09, 2014 11:47 AM
To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS' (jeavis@fs.fed.us); 'Kime, Sherry D -FS'; 'Mike Salzetti' (msalzetti@HomerElectric.com); 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Matt McMillan'
Cc: 'Griffin, David W (DNR)'
Subject: RE: INHT Meeting

This is a friendly reminder that we're slated to do a hike of an alternative proposed for the INHT trail in the vicinity of Grant Creek next Tuesday, the 15th. Following is the proposed itinerary. Things are a little complicated as the creek level is pretty high and the weir we used

last year to cross the creek has been removed. Thus we will probably need a couple different stages, one for south of Grant Creek, one for north of Grant Creek.

- 8:30 Meet at Vagt Lake trail head which is at the southern end of Lower Trail Lake. Hike the 1.75 miles +/- to Vagt Lake.
- Hike the proposed re-route to the southern bank of Grant Creek.
- Return to the Vagt Lake Trail Head.
- 12:00 eat lunch—We will provide sandwiches/lunch. Let me know if you have specific dietary requirements.
- After lunch, carpool to MP26.9. We will have a canoe and will ferry people across Upper Trail Lake, to the north side of Grant Creek.
- We will review the possible alternate trail for the north side of the creek.
- Return around 4:30 or so to ferry back across the lake.

I know it's a full day and it does provide an opportunity to visit only one half of the trail if that is all the time you have. However, we certainly encourage you to view the proposed alternative in whole.

Please let me know if you will be attending so we know how many lunches and snacks to provide. Also, let me know your dietary needs if appropriate.

Thanks much folks.

Dwayne Adams

Landscape Architect

<< OLE Object: Picture (Device Independent Bitmap) >>

705 W. 13th Ave.

Anchorage, AK 99501

P 907.279.2688

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]

Sent: Tuesday, May 27, 2014 1:58 PM

To: 'Dwayne Adams'; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS (jeavis@fs.fed.us)'; 'Kime, Sherry D -FS'; 'Mike Salzetti (msalzetti@HomerElectric.com)'; 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'

Cc: 'Griffin, David W (DNR)'

Subject: RE: INHT Meeting

This is to confirm that the date of July 15 seemed to be the best fit for the majority of people, based on a number of back and forth emails. I'll follow up with particulars about meeting location and ferrying across the lake.

I wanted to follow up just in case there remained any confusion as to the date.

Thanks folks

Dwayne Adams

Landscape Architect

<< OLE Object: Picture (Device Independent Bitmap) >>

705 W. 13th Ave.

Anchorage, AK 99501

P 907.279.2688

-----Original Appointment-----

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]

Sent: Wednesday, May 14, 2014 4:02 PM

To: Dwayne Adams; Duvall, Shina A (DNR); 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; 'kvanmassenhove@fs.fed.us'; 'lesli.schick@alaska.gov'; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS' (jeavis@fs.fed.us); 'Kime, Sherry D -FS'; 'Mike Salzetti' (msalzetti@HomerElectric.com); 'mmueller@borough.kenai.ak.us'; 'judy.bittner@alaska.gov'; 'Cory Warnock'; 'Kim Graham'

Cc: Griffin, David W (DNR)

Subject: INHT Meeting

When: Tuesday, July 15, 2014 9:00 AM-4:00 PM (GMT-09:00) Alaska.

Where: Grant Lake

From the looks of it, this works for almost everyone. Bring spray for critters large and small.

Dwayne

From: [Leclair, Claire H \(DNR\)](#)
To: wdadams@earthscape.alaska.com
Cc: [Russell, Pamela J \(DNR\)](#)
Subject: INHT tour today
Date: Tuesday, July 15, 2014 8:12:04 AM

Dwayne-

I'm sorry for the late notice, but there is no one available to participate in the INHT tour today. Thank you for keeping us informed of the schedule and other activities related to your work on this project.

-Claire

Claire Holland LeClair
Deputy Director/Chief of Field Operations
Division of Parks & Outdoor Recreation
907-269-8702

The Division of Parks & Outdoor Recreation provides outdoor recreation opportunities and conserves and interprets natural, cultural, and historic resources for the use, enjoyment and welfare of the people.

Memorandum

Project: Grant Lake Hydroelectric Project Licensing

Date: July 16, 2014

Regarding: INHT Field Trip

From: Dwayne Adams, Earthscape

To: File

KHL and representatives met and conducted an on-site walk with agency personnel on July 15, 2014, to discuss possible alternatives to a current alignment of the commemorative Iditarod National Historic Trail (INHT). The current easement for the planned INHT is co-located with the location of the power house of the proposed hydroelectric project.

Following were participants in the meeting:

- Judy Bittner, SHPO
- Shina Duval, SHPO
- Robert Stovall, USFS
- John Eavis, USFS
- Tim George, USFS
- Mike Fitzpatrick, USFS
- Marcus Mueller, Kenai Peninsula Borough
- Mike Salzetti, KHL
- Mike Yarborough, Cultural Resource Consultants
- Sarah Meitl, Cultural Resource Consultants
- Matt McMillen, USKH/Stantec
- Dwayne Adams, Earthscape

The participants hiked from the Vagt Lake trailhead at the southern end of Lower Trail Lake, connecting to the INHT, and departing from it at the point at which the proposed INHT alternative varies from the current proposed layout. They then hiked the proposed re-route to the proposed crossing of Grant Creek. The group hiked up Grant Creek and reviewed possible crossing points, examining potential for bridge crossings as well as hand tram possibilities. The group also hiked to the proposed crossing at the western end of Grant Creek Canyon, then returned to the Vagt Lake trailhead parking lot via the existing proposed INHT layout, and then the Vagt Lake Trail.

In discussions, the group achieved some consensus on the following:

- There is some agreement among agencies that were present to consider re-alignment options, but further discussion and examination needs to take place.
- To facilitate further discussions, A Memorandum of Agreement (MOA) is needed. Key parties include KHL, USFS, SHPO, DNR, State Parks, and the Kenai Peninsula Borough.
- KHL should provide a letter requesting agencies consideration of the alternative route and attach a draft MOA to outline the conditions and process to allow realignment. The letter and MOA need to clearly articulate that KHL agrees to be responsible for any costs for an alternative re-route that would be in excess of the cost of the existing INHT alignment.
- The Section 106 review will need to include evaluation of historic/archaeological resources that could be disturbed or affected by any proposed corridor location. The evaluation needs to include not just the trail itself, but also areas potentially affected by construction activity.
- Providing the necessary evaluation will require a specific location for the proposed re-routing.
- Once a location is determined, an estimate needs to be provided of what the “delta” might be between the cost of the existing trail alignment and the proposed re-alignment. That will provide the basis of cost mitigation required of KHL for the realignment proposal.

- The USFS needs to provide KHL the Trail Management Objectives (TMOs) for the existing INHT. The proposed trail must meet those TMOs. The TMOs provide information such as maximum slopes, cross-slopes, trail tread treatments, etc., that guide the detailing and construction of the INHT.
- The TMOs are essential to providing the layout and costing/delta of the proposed reroute.

Action Items:

- USFS will provide the TMOs for the INHT, particularly as it exists in the project area.
- To the extent available, USFS will provide cost estimate information to use as a basis for determining cost of the proposed alternative location, relative to the existing alignment.
- KHL will provide a letter formally requesting consideration of the INHT alternative layout.
- KHL will draft an MOA and attach the MOA to their letter to initiate the evaluation process.
- KHL will have its consultants lay out the proposed re-route in conformance with the TMO requirements.
- KHL will have its consultants prepare an assessment of potentially affected historical and archaeological resources.
- KHL will have its consultants prepare a cost report detailing costs of the existing alignment and the proposed re-route, identifying the delta in cost between the two.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Thursday, July 17, 2014 10:25 AM
To: Klein, Joseph P (DFG); Miller, Monte D (DFG); Jason Mouw
Cc: John Stevenson; Cory Warnock; Emily Andersen
Subject: Draft transect weighting document
Attachments: Draft Habitat Quantification Methodology 07-17-2014.docx

Importance: High

Good Morning:

Here is the draft transect weighting document that John Stevenson and I have put together. Sorry for the delay in getting this to you – John and I were tweaking it up until a few minutes ago.

John and I will run everyone through what we did, answer any questions, and give you all some time to examine and make any revisions needed.

Thanks – Talk to you in about a half hour.

John

John P. Blum
Senior Fisheries Scientist

McMillen, LLC
112 Ohio Street Ste 117 Bellingham, WA 98225
p 360-483-2807
f 360-734-5918
c 360-220-0694
john.blum@mcmillen-llc.com | www.mcmillen-llc.com

DRAFT
Habitat Quantification/Transect Weighting Methodology

Introduction

As part of the IFIM assessment of habitat within Grant Creek, it is necessary to identify habitat types within reaches of Grant Creek, to quantify those habitats, and to weight them in proportion to their availability within lower Grant Creek. These analyses are then used to weight the transects that were selected and modeled within Reaches 1 through 4. As such, we have undertaken a process to identify and quantify habitat within the various reaches of Grant Creek. Our assessment has been tailored to provide metrics consistent with the work conducted by Flory (1999) on Falls Creek, AK; a summary of these results was provided by Alaska Department of Fish and Game. This document is a brief summary of the methodology used in our analysis.

Map Layout

A scaled map of Grant Creek which depicted meso-habitats was overlaid with reach breaks and transect locations. An 8.5 x 11 inch map of each reach was prepared, and the area (ft²) associated within a given transect was added to each map; the up and downstream boundaries associated with each transect was based on one of two criteria. In the event another transect was relatively close to the transect of interest, the boundary was located an equidistance from each transect. If the nearest transect was more than one meso-habitat away, then the boundary was located at the edge of the meso-habitat associated with that transect or some obvious geophysical feature within Grant Creek (Figure 1). All non-transect sections of Grant Creek were also categorized, and numbered sequentially starting within the Reach 1 Distributary and working upstream (e.g., S1, S2, etc.).

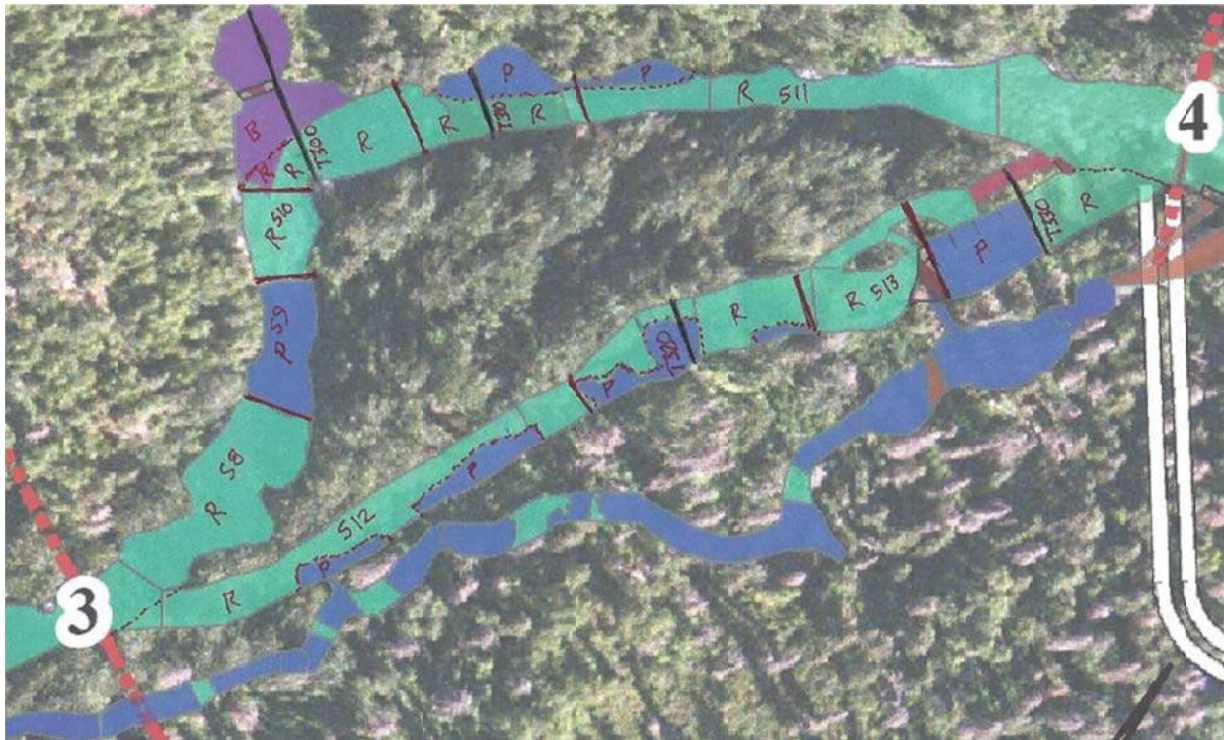


Figure 1. A map of Reach 3 that identifies transects, transect breaks and habitat types that was used to assess habitat weighting.

Measurement of Habitat

With the prepared maps, it was then possible to measure the length (in millimeters) of each habitat type within a given reach. Each habitat type was associated with either a specific transect (e.g., T300, T310, etc.) or a non-transect area (e.g., S8, S9, etc.). In the event a single habitat type fell within a specific area, such as S8 (Figure 1), measurement of that habitat was relatively straight forward and was simply confined by the boundaries located at the Reach 2/3 break (downstream) and the boundary with S9 (upstream). In the event more than one habitat type existed within a specific area, it was then necessary to subjectively proportion the length of each habitat type for that site. A good example of this scenario is most of the Primary Secondary Channel of Reach 3 (Figure 1), where multiple meso-habitats occurred in all segments with the exception of S13, which consisted only of riffle habitat.

With each habitat type measured by reach, each transect and non-transect segment of Grant Creek quantified, and with additional information from the GIS database (i.e., reach length and overall area of each habitat type (square feet)), it was then possible to calculate area of habitat associated with each segment within Grant Creek, and linear feet of habitat by segment. It was also possible to compile those data and generate results consistent with work by Flory (1999) on Falls Creek, AK. Figure 2 and Table 1 show an example of the first level of analysis where transect and non-transect segments of Reach 1 are summarized to provide the proportion of habitat within the reach, and the overall area of habitat associated within those segments.

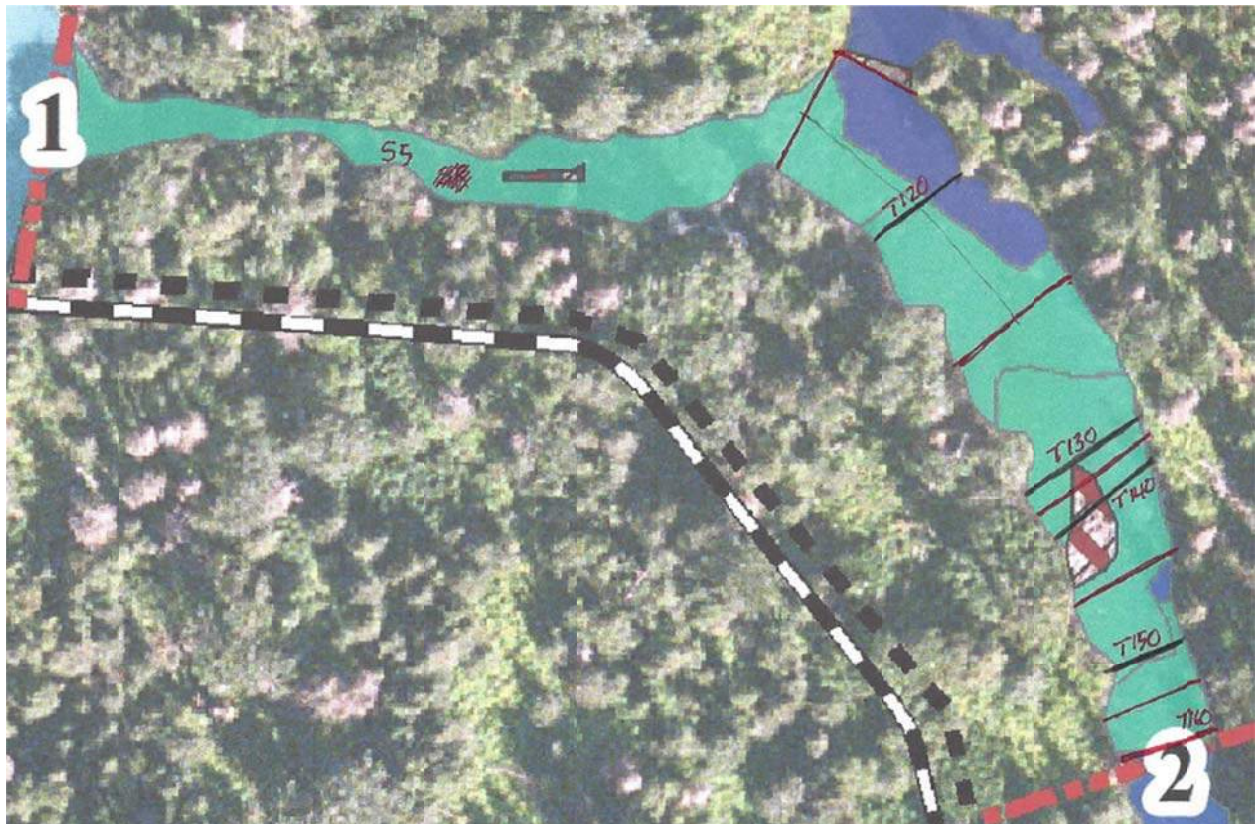


Figure 2. A map of Reach 1 that identifies transects, transect breaks and habitat types that was used to assess habitat weighting.

Once habitat frequencies were established for each transect, available habitat (by type) were then scaled in proportion to their availability within that reach. The results were then summed and each transect was weighted in accordance with its area and assigned a length (in ft)

For example, in the Reach 1 Distributary, there are 7,495 ft² of pool habitat, and 6,004 ft² of riffle habitat, for a total of 13,499 ft² (Table 3). Of the habitat associated with Transects 100 and 110, T100 had 20.6% of the pool habitat and 70% of the riffle habitat; T110 had 79.4% of the pool habitat and 30% of the riffle habitat. For reach weighting, therefore, T100 had 20.6% of the 7,495 ft of pool habitat (1,543 ft²) and 70% of the 6,004 ft² of riffle habitat for a total of 5,746 ft² in the Reach 1 Distributary. That constituted 42.6% of the habitat within this reach. Given a length of 396 ft, T100 was weighted 169 ft (42.6% X 396). Each transect in each reach was weighted using the same method. The only deviation was in the Reach 2/3 side channels, where habitat was aggregated in both channels and weighted accordingly. Transect 210 was a backwater and was excluded from the analysis.

Table 2 shows the lengths of each reach. There are 396 linear ft of habitat in the Distributary in Reach 1, 2,433 linear ft of habitat in mainstem Reaches 1 – 4, and 1,479 linear ft in the Reach 2/3 side channels. Tables 3 – 8 show calculation details for each reach in lower Grant Creek. Table 9 summarizes weighting for all transects.

Table 1. A summary of the proportion and area (ft²) of habitat by type for transect and non-transect areas of Grant Creek, AK.

Reach	Transect or Segment	Habitat	Reach Length	Unit Measurement	Proportion of Habitat Within Reach	Overall Habitat Area	Transect Area
Reach 1 Distributary	S1	Pool	396	26	0.333333	7,495	2,498.3
	S2	Riffle	396	17	0.212500	6,004	1,275.9
	S3	Pool	396	13	0.166667	7,495	1,249.2
	S3	Riffle	396	13	0.162500	6,004	975.7
	S4	Pool	396	5	0.064103	7,495	480.4
	S4	Riffle	396	20	0.250000	6,004	1,501.0
	T100	Riffle	396	21	0.262500	6,004	1,576.1
	T100	Pool	396	7	0.089744	7,495	672.6
	T110	Riffle	396	9	0.112500	6,004	675.5
	T110	Pool	396	27	0.346154	7,495	2,594.4
Reach 1 Mainstem	S5	Riffle	355	130	0.572687	23,168	13,268.0
	T120	Riffle	374	33	0.135802	23,168	3,146.3
	T120	Pool	374	17	0.944444	3,143	2,968.4
	T130	Riffle	374	31	0.136564	23,168	3,163.9
	T140	Riffle	374	19	0.083700	23,168	1,939.2
	T150	Riffle	374	21	0.092511	23,168	2,143.3
	T150	Pool	374	1	0.029412	3,143	92.4
	T160	Riffle	374	9	0.039648	23,168	918.6
Reach 2 Mainstem	S6	Pool	820	20	0.850000	3,834	3,258.9
	T200	Riffle	820	23	0.121053	23,669	2,865.2
	T200	Backwater	820	---	0.400000	4,837	1,934.8

Reach	Transect or Segment	Habitat	Reach Length	Unit Measurement	Proportion of Habitat Within Reach	Overall Habitat Area	Transect Area
	T220	Riffle	820	11	0.057895	23,669	1,370.3
	T230	Glide	820	11	1.000000	1,613	1,613.0
	T230	Backwater	820	---	0.600000	4,837	2,902.2
	T230	Riffle	820	12	0.063158	23,669	1,494.9
	T240	Backwater	820		0.000000		
		Riffle	820	17	0.089474	23,669	2,117.8
	S7	Riffle	820	127	0.668421	23,669	15,820.9
	S7	Pool	820	---	0.150000	3,834	575.1
Reach 3 Mainstem	S8	Riffle	808	50	0.215517	25,585	5,514.0
	S9	Pool	808	24	0.600000	3,997	2,398.2
	S10	Riffle	808	16	0.068966	25,585	1,764.5
	T300	Riffle	808	29	0.125000	25,585	3,198.1
	T300	Backwater	808		1.000000	3,697	3,697.0
	T310	Riffle	808	31	0.133621	25,585	3,418.7
	T310	Pool	808		0.250000	3,997	999.3
	S11	Riffle	808	106	0.456897	25,585	11,689.7
	S11	Pool	808		0.150000	3,997	599.6
Reach 3 Primary Side Channel	S12	Riffle	606	62	0.466165	11,672	5,441.1
	S12	Pool	606	23	0.403509	5,018	2,024.8
	T320	Riffle	606	28	0.210526	11,672	2,457.3
	T320	Pool	606	15	0.263158	5,018	1,320.5
	S13	Riffle	606	25	0.187970	11,672	2,194.0
	T330	Pool	606	19	0.333333	5,018	1,672.7
	T330	Riffle	606	18	0.135338	11,672	1,579.7
	T330	Glide	873				

Reach	Transect or Segment	Habitat	Reach Length	Unit Measurement	Proportion of Habitat Within Reach	Overall Habitat Area	Transect Area
	T330	Rapid	606	---	1.000000	511	511.0
Reach 3 Secondary Side Channel		Cascade	873			114	
	T330-SC	Glide	873			1,588	
		Pool	873			9,908	
	T330-TC	Riffle	873			2,683	
		Run	873			576	
Reach 4 Mainstem	T400	Riffle	468	16	0.116788	17,649	2,061.2
	T410	Riffle	468	24	0.175182	17,649	3,091.8
	T410	Pocket Water	468	3	0.085714	3,709	317.9
	S14	Riffle Pocket	468	97	0.708029	17,649	12,496.0
	S14	Water	468	32	0.914286	3,709	3,391.1
	T430	Pool	468	11	1.000000	1,195	1,195.0

Table 2. Lower Grant Creek reach lengths.

Reach	Length (ft)
R 1 Distributary	396
R 1 Mainstem	692
R 2	820
R 3 Mainstem	808
R 3 Side Channel	606
R 2/3 Side Channel	873
R 4	468
Total	
Distributary	396
Main Channel	2,788
Side Channel	1,479
Total	4,663

Table 3. Reach 1 Distributary area and transect weighting.

Total Length (ft) 396									
Trans	Pool		Riffle		Total			% age	Length
	Area	% age	Area	% age	Pool	Riffle	Total		
T100	673	20.6%	1,576	70.00%	1,543	4,203	5,746	42.6%	169
T110	2,594	79.4%	675	30.00%	5,952	1,801	7,753	57.4%	227
Total	3,267		2,252		7,495	6,004	13,499		396

Table 4. Reach 1 main channel area and transect weighting.

Total Length (ft) 692									
Trans	Pool		Riffle		Total			% age	Length
	Area	% age	Area	% age	Pool	Riffle	Total		
T120	2,968	97.0%	3,146	27.8%	2,968	6,837	9,805	35.5%	245
T130	0		3,164	28.0%	0	6,875	6,875	24.9%	172
T140			1,939	17.1%	0	4,214	4,214	15.2%	105
T150	92.4	3.0%	2,143	18.9%	92	4,657	4,750	17.2%	119
T160			919	8.1%	0	1,996	1,996	7.2%	50
Total	3,061		11,311		3,061	24,579	27,640		692

Table 5. Reach 2 area and transect weighting.

Total Length (ft) = 820															
	Pool		Backwater		Glide		Riffle		Total						
Trans	Area	% age	Area	% age	Area	% age	Area	% age	Pool	BackW	Glide	Riffle	Total	% age	Length
T200	0	N/A	1,935	100.0%	0	0.0%		0.0%	0	1,935	0	0	1,935	7.1%	58
T220	0	N/A	0	0.0%	0	0.0%	1,370	47.8%	0	0	0	11,320	11,320	41.6%	341
T230	0	N/A	0	0.0%	1,613	100.0%	1,495	52.2%	0	0	1,613	12,349	13,962	51.3%	421
Total	0		1,935		1,613		2,865		0	1,935	1,613	23,669	27,217		820

Table 6. Reach 3 area and transect weighting.

Table 6. Reach 3 area and transect weighing.												
Total Length (ft) =		808										
	Pool		Backwater		Riffle		Total					
Trans	Area	% age	Area	% age	Area	% age	Pool	BackW	Riffle	Total	% age	Length
T300	0	0.0%	3,697	100.0%	0	0.0%	0	3,697	0	3,697	11.1%	90
T310	999	100.0%	0	0.0%	3,419	100.0%	3,997	0	25,585	29,582	88.9%	718
Total	999		3,697		3,419		3,997	3,697	25,585	33,279		808

Table 7. Reach 2/3 side channels area and transect weighting.

Total Length (ft) = 1,479															
	Pool		Riffle		Glide		Rapids		Total						
Trans	Area	% age	Area	% age	Area	% age	Area	% age	Pool	Riffle	Glide	Rapids	Total	% age	Length
T320	1,321	44.1%	2,457	60.9%		0.0%		0.0%	6,586	8,737	0	0	15,323	48.8%	722
T330	1,673	55.9%	1,580	39.1%	1,588	100.0%	511	100.0%	8,342	5,617	1,588	511	16,058	51.2%	757
Total	2,993		4,037		1,588		511		14,928	14,354	1,588	511	31,381		1,479

Table 8. Reach 4 area and transect weighting.

Total Length (ft) =		468											
	Pool		Pocket Water		Riffle		Total						
Trans	Area	% age	Area	% age	Area	% age	Pool	PocketW	Riffle\	Total	% age	Length	
T400		0.0%	0	0.0%	2,061.2	40.0%	0	0	7,060	7,060	31.3%	146	
T410		0.0%	317.9	100.0%	3,091.8	60.0%	0	3,709	10,589	14,298	63.4%	297	
T430	1,195	100.0%	0	0.0%	0	0.0%	1,195	0	0	1,195	5.3%	25	
Total	1,195		318		5,153		1,195	3,709	17,649	22,553		468	

Table 9. Summary of reach and transect weighting (ft).

Reach	Transect	Length (ft)
1 - Distributary	100	169
	110	227
	Total	396
1 - Main Channel	120	246
	130	172
	140	105
	150	119
	160	50
	Total	692
2 - Main Channel	200	58
	210	0
	220	341
	230	421
	Total	820
3 - Main Channel	300	90
	310	718
	Total	808
2/3 Side Channels	320	722
	330	757
	Total	1,479
4 - Main Channel	400	146
	410	297
	430	25
	Total	468
Total		
Distributary		396
Main Channel		2,788
Side Channel		1,479
Total		4,663

Grant Lake Hydroelectric Project (FERC No. 13212) Licensing

Consultation Record

Phone/E-mail/One-on-One Meeting Log

Contact Name: Joe Klein, Monte Miller; John Stevenson

Agency/Organization: Alaska Department of Fish and Game; BioAnalysts

Phone No./E-mail Address: joe.klein@alaska.gov; monte.miller@alaska.gov;
john.stevenson@bioanalysts.net

Date: July 17, 2014

Time: 11:00 am (Pacific Time)

Grant Lake Licensing Team Contact: John Blum

Summary of Conversation and/or E-mail Exchange:

John Stevenson and John Blum developed a draft transect weighting report in order to finalize Weighted Useable Area (WUA) for the Grant Creek Instream Flow Report. The draft was sent to ADF&G on the morning of the 17th.

During the conference call, John Stevenson and John Blum reviewed the methodology used to weight the transects. Both Joe and Monte requested clarification re: how habitat was measured, and offered several suggestions for improving the document. Joe and Monte said they would send a follow-up email to John Blum with suggested revisions. The conference call ended at 11:45 am.

[Note: comments were received later on July 17th; these comments were incorporated into the next revised report].

*

From: Miller, Monte D (DFG) [<mailto:monte.miller@alaska.gov>]
Sent: Thursday, July 17, 2014 3:21 PM
To: John Blum (john.blum@mcmillen-llc.com)
Cc: Klein, Joseph P (DFG)
Subject: FW: Grant Lake Habitat Assessment Comments

John,

Joe and I have discussed the call this morning and the attached comments sum up our issues with what was proposed. Joe's comments are included below with my additions in red. I would add that tables should also have the unit of measure (Joe's third bullet) either in the table or in the title for the table so that the ~~reader does not have to refer to text in the supplemental document to make sure of the units of measure....just a little clean up for the reader to reduce misunderstandings and eliminate potential questions.~~ We appreciate the extra work which you and staff have accomplished to assist us with a conversion of this effort to a habitat based result which then can be informed with the inclusion of biological information to answer potential impact questions. I hope that this review is useful and look forward to continued progress on the modeling and on identification of operational scenarios. This evaluation is nearing completion and we look forward to further discussions, as necessary, prior to license application filing.

Monte D. Miller
Statewide FERC Hydropower Coordinator
Alaska Department of Fish and Game
Division of Sport Fish / RTS
333 Raspberry Road
Anchorage, Alaska, 99518-1565

907 267-2312

From: Klein, Joseph P (DFG)
Sent: Thursday, July 17, 2014 11:53 AM
To: Miller, Monte D (DFG)
Subject: Grant Lake Habitat Assessment Comments

Monte- After our meeting this morning and review of the materials provided, I think the information provided adequately quantified and weighted habitat transects in Grant Creek. I have only the following minor comments.

- Add a comments **column** to explain any variances/differences in tables (e.g. note differences in reach lengths in Table 1, Transect 210 was a **backwater** habitat that ... and was excluded in Table 9, etc.;
- Recommend removing 'Unit Measurement' column; **It is only relevant to the information developer and would change under a different plat scale;**
- Add units **of measure to tables** where applicable; and
- Suggest only 2 significant digits, **or less if not justified**, on 'Proportion of Habitat Within Reach' column.

Let me know if you have any questions, Joe

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4716 / Virus Database: 3986/7870 - Release Date: 07/17/14

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4716 / Virus Database: 3986/7901 - Release Date: 07/22/14

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4716 / Virus Database: 3986/7901 - Release Date: 07/22/14

From: John Stevenson <john.stevenson@bioanalysts.net>
Sent: Thursday, July 17, 2014 11:41 AM
To: 'John Blum'; 'Klein, Joseph P (DFG)'; 'Miller, Monte D (DFG)'; 'Jason Mouw'
Cc: Cory Warnock; Emily Andersen
Subject: RE: Draft transect weighting document
Attachments: Habitat Calculation by Transect - June 20 2014.pdf

Hi Joe and Monte,

Attached is a PDF file with the maps used to make the measurements discussed during our call. Let me know if you have any questions.

Thanks, John

From: John Blum [mailto:john.blum@mcmillen-llc.com]
Sent: Thursday, July 17, 2014 10:25 AM
To: Klein, Joseph P (DFG); Miller, Monte D (DFG); Jason Mouw
Cc: John Stevenson; 'Cory Warnock'; 'Emily Andersen'
Subject: Draft transect weighting document
Importance: High

Good Morning:

Here is the draft transect weighting document that John Stevenson and I have put together. Sorry for the delay in getting this to you – John and I were tweaking it up until a few minutes ago.

John and I will run everyone through what we did, answer any questions, and give you all some time to examine and make any revisions needed.

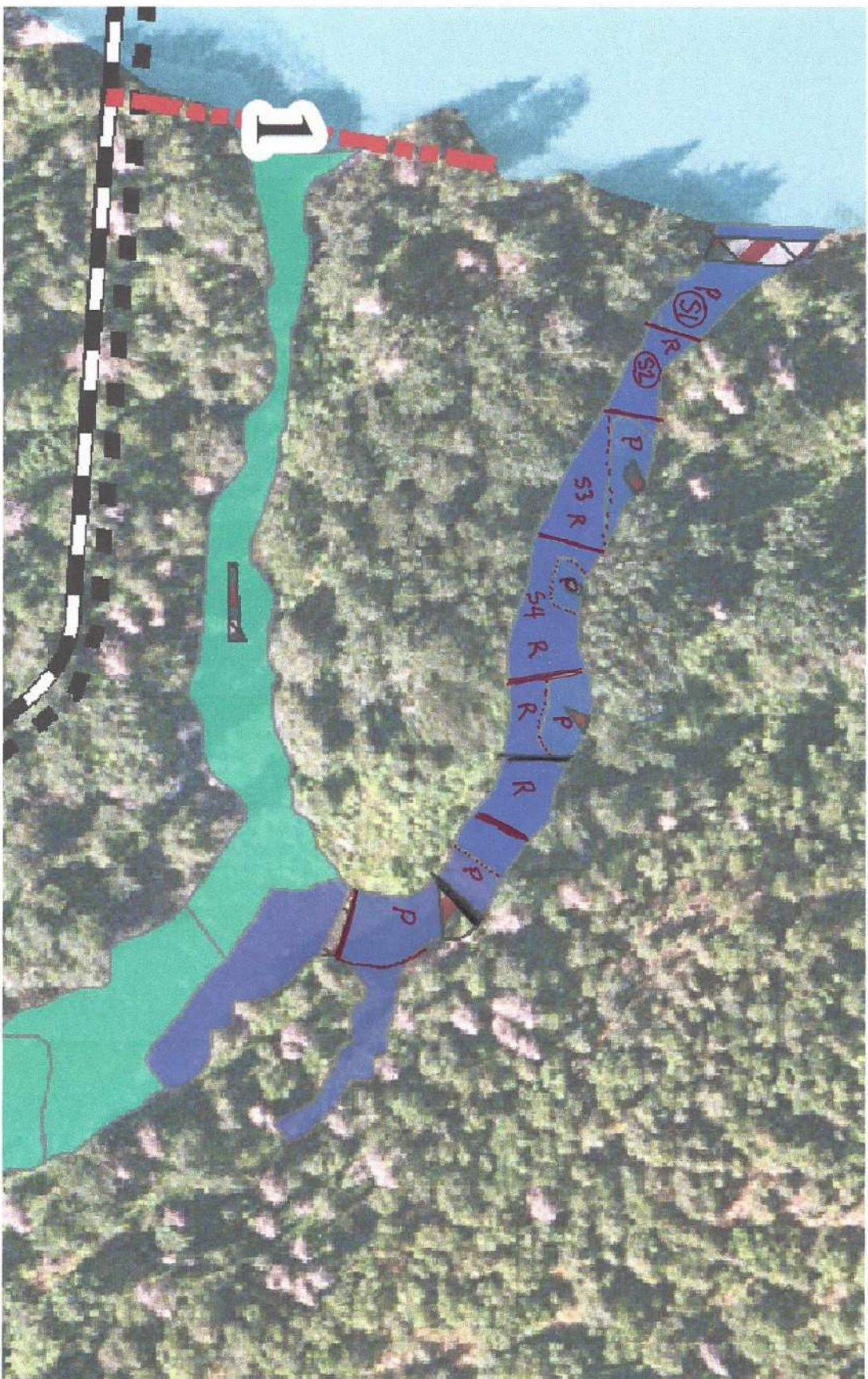
Thanks – Talk to you in about a half hour.

John

John P. Blum
Senior Fisheries Scientist

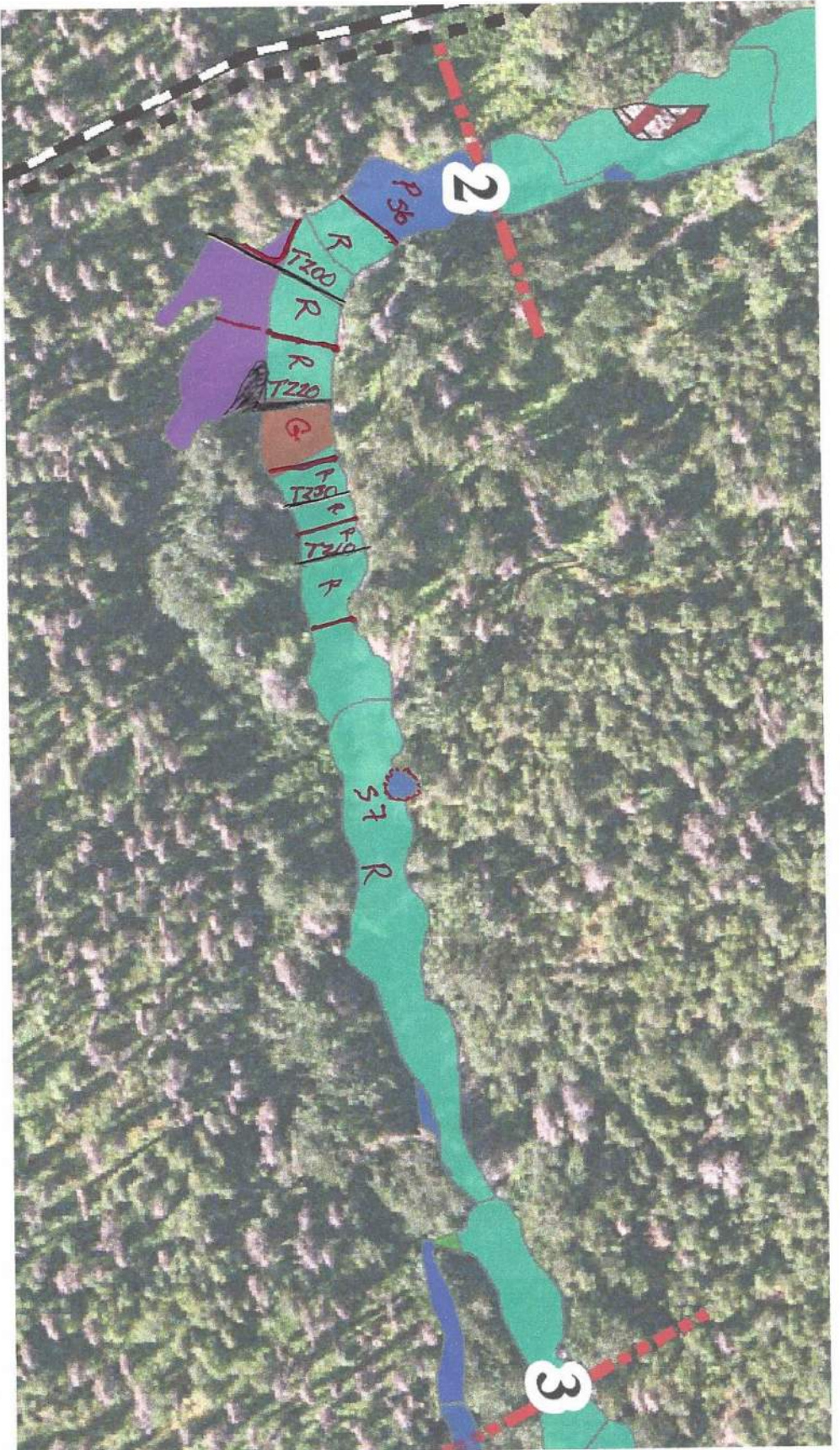
McMillen, LLC
112 Ohio Street Ste 117 Bellingham, WA 98225
p 360-483-2807
f 360-734-5918
c 360-220-0694
john.blum@mcmillen-llc.com | www.mcmillen-llc.com

RJ-Distributary



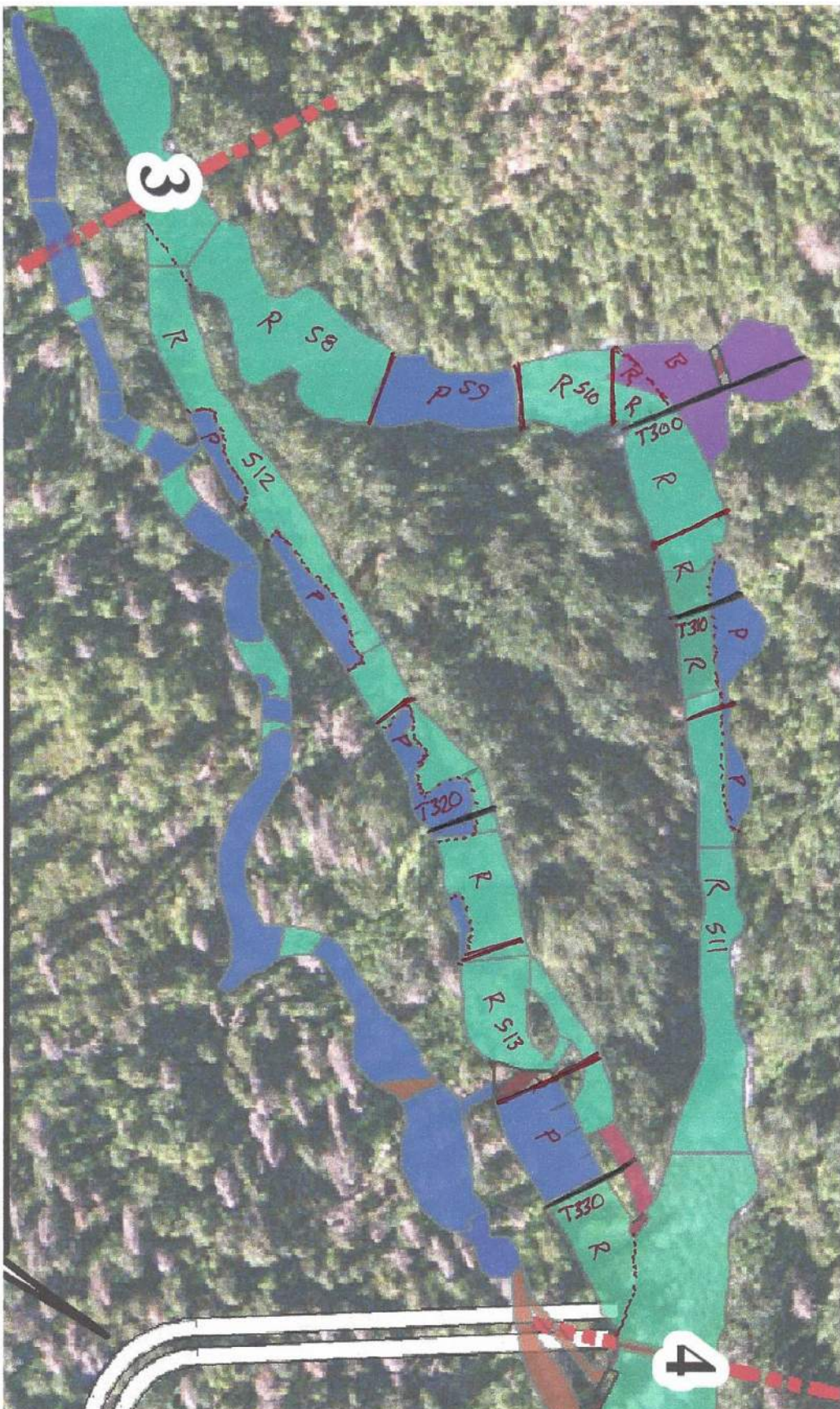
S1	Pool	26	T100	Riffle	21	28
S2	Riffle	17	"	Pool	+	
S3	Pool	13				
S3	Riffle	13	T110	Riffle	9	
S4	Pool	5	"	Pool	27	
S4	Riffle	20				
		25				

R2



S6 Pool - 20 (85%)
 T200 Riffle - 23
 T200 BackH2O (40%)
 T220 Riffle 11
 T220 Glide 11
 T220 BackH2O (60%)

T230 Riffle 12
 T210 Riffle 17
 S7 Riffle 127
 S7 Pool --- 15%



Mainstem

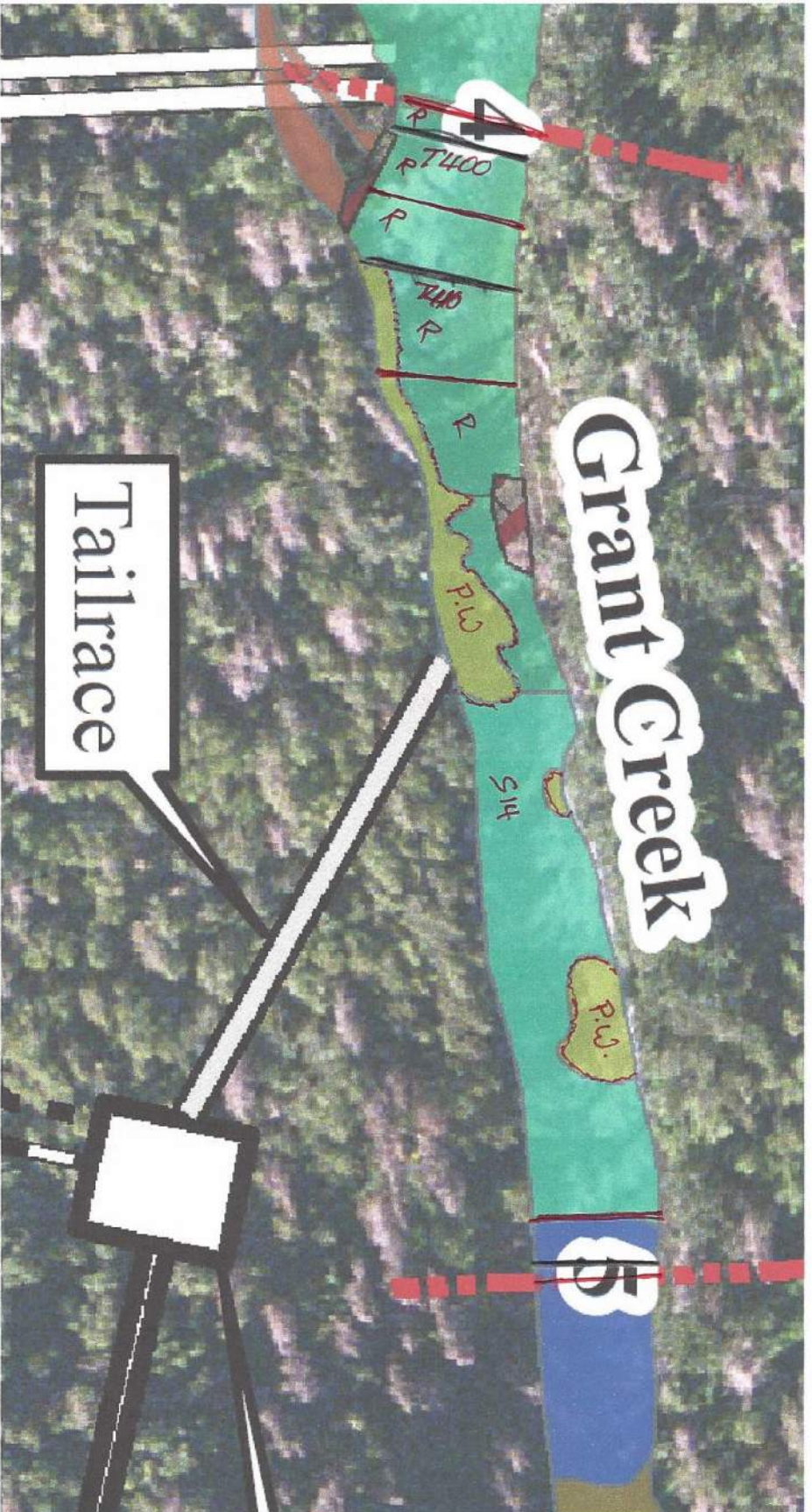
S8 Riffle 50
 S9 Pool 24 (60%)
 S10 Riffle 16
 T300 Riffle 29
 T320 BackH2O (100%)

T310 Riffle 31
 T310 Pool (25%)
 S11 Riffle 106
 S11 Pool (15%)

Secondary

S12 Riffle 62 } 85 T330 Pool 19
 S12 Pool 23 } T330 Riffle 18
 T320 Riffle 28 } 43 T330 R2013 100%
 T320 Pool 15
 S13 Riffle 25

R4



T400	Rifle	16
T410	Rifle	24
T410	Rocket+H2O	3
S14	Rifle	9+7
S14	Rocket+H2O	32
T436	Pool	11

27
129

125



S15 Pool 11
 S16 S.P. 16
 T510 S.P. 9 }
 T510 Cascade 1 } 10
 T520 Cascade 9
 S17 Cascade 9
 S18 S.P. 40

S19 Cascade 20 }
 S19 S.P. 1 } 21
 S20 S.P. 7
 S21 Cascade 120
 S22 Pool 13

From: Cory Warnock
Sent: Friday, July 18, 2014 4:18 PM
To: McCracken, Betsy
Cc: Emily Andersen
Subject: RE: Grant Lake Study Reports

Will do.

Thanks.

From: McCracken, Betsy [mailto:betsy_mccracken@fws.gov]
Sent: Friday, July 18, 2014 3:48 PM
To: Cory Warnock
Cc: Emily Andersen
Subject: Re: Grant Lake Study Reports

Hi Cory,

Sure, I can do that. Let me know when they are "up", and I will grab them.

Thank you!

Betsy

Betsy McCracken
Fish and Wildlife Biologist
U. S. Fish and Wildlife Service
Anchorage Fish and Wildlife Field Office
605 W. 4th Avenue
Anchorage, Alaska 99501

Work phone: (907) 271-2783
Personal cell phone: (907) 360-3553
Fax: (907) 271-2786
Betsy_McCracken@fws.gov

On Fri, Jul 18, 2014 at 2:46 PM, Cory Warnock <cory.warnock@mcmillen-llc.net> wrote:

Ok. As an alternative, we will be filing our report package with FERC very soon. Synonymous with this, we will be placing the reports on the KHL website. Would it be ok if I notified you when they were up and you could access them there?

Thanks,

Cory

From: McCracken, Betsy [mailto:betsy_mccracken@fws.gov]
Sent: Friday, July 18, 2014 3:33 PM
To: Cory Warnock
Cc: Emily Andersen
Subject: Re: Grant Lake Study Reports

Hi Cory,

Thanks for following up on the information request for Grant Lake hydro.

The Fish and Wildlife Service does not have an external .ftp site, unfortunately.

The best way to share the large files is via cd and snail mail.

Thank you,

Betsy

Betsy McCracken

Fish and Wildlife Biologist

U. S. Fish and Wildlife Service

Anchorage Fish and Wildlife Field Office

605 W. 4th Avenue

Anchorage, Alaska 99501

Work phone: (907) 271-2783

Personal cell phone: (907) 360-3553

Fax: (907) 271-2786

Betsy_McCracken@fws.gov

On Thu, Jul 17, 2014 at 1:34 PM, Cory Warnock <cory.warnock@mcmillen-llc.com> wrote:

Hi Betsy,

Per my commitment to you at our meeting last week, I'd like to get you the Grant Lake Project Study Reports. Due to the size of some of the files I'm wondering if you have an .ftp site I can place them in. Let me know and I'll get them headed your way.

Thanks,

Cory

Cory Warnock

Senior Licensing and Regulatory Consultant

McMillen, LLC

www.mcmillen-llc.com

5771 Applegrove Ln.

Ferndale, Wa. 98248

O – 360-384-2662

C – 360-739-0187

F – 360-542-2264

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, July 25, 2014 9:46 AM
To: Miller, Monte D (DFG); Klein, Joseph P (DFG); Jason Mouw
Cc: John Stevenson; Cory Warnock; Emily Andersen
Subject: Revised Transect Weighting Analysis
Attachments: Habitat Quantification Methodology 07-24-2014.docx

Good Morning:

Please find attached a revised transect weighting report. John Stevenson and I made some corrections to transect locations, which were slightly off in Reaches 2 and 3, which revised some of the areas calculated. We also made all the lengths of reaches in the text and tables consistent. I believe we responded to all your comments – thanks very much for your input.

Let me know if you have any concerns with the revised text and numbers. If you can get back to me with any comments by COB on Monday, July 28th, I will finalize the draft, distribute to the rest of the Instream Flow Group, and move forward with the final analysis.

Thanks very much – have a good weekend!

John

John Blum
Sr. Fisheries Scientist

DRAFT
Habitat Quantification/Transect Weighting Methodology
Revised July 24, 2014

Introduction

As part of the IFIM assessment of habitat within Grant Creek, it is necessary to identify habitat types within reaches of Grant Creek, to quantify those habitats, and to weight them in proportion to their availability within lower Grant Creek. These analyses are then used to weight those transects that were selected and modeled within Reaches 1 through 4. As such, we have undertaken a process to identify and quantify habitat within the various reaches of Grant Creek. Our assessment has been tailored to provide metrics consistent with the work conducted by Flory (1999) on Falls Creek, AK; a summary of these results was provided by Alaska Department of Fish and Game. This document is a brief summary of the methodology used in our analysis.

Map Layout

A scaled map of Grant Creek, which depicted meso-habitats, was overlaid with reach breaks and transect locations. An 8.5 x 11 inch map of each reach was prepared, and the area (ft²) associated within a given transect was added to each map; the upstream and downstream boundaries associated with each transect were based on one of two criteria:

1. In the event another transect was relatively close to the transect of interest, the boundary was located an equidistance from each transect, or
2. If the nearest transect was more than one meso-habitat away, then the boundary was located at the edge of the meso-habitat associated with that transect or some obvious geophysical feature within Grant Creek (Figure 1).

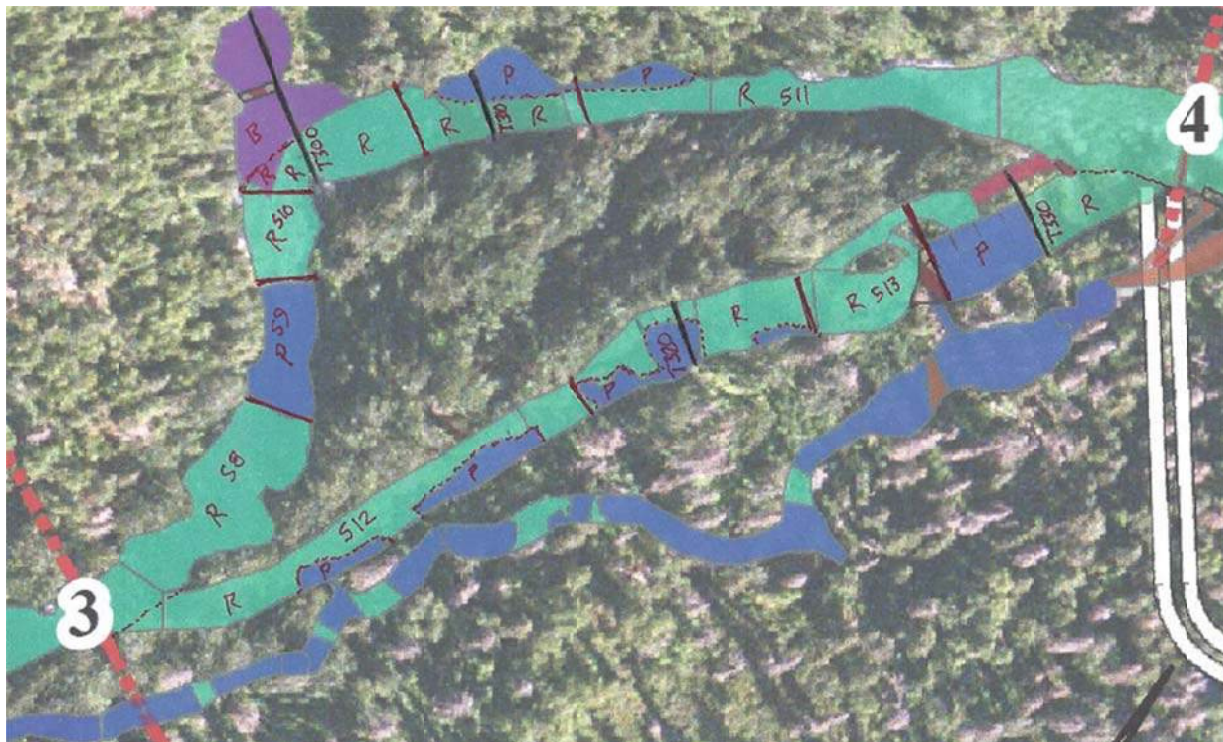
All non-transect sections of Grant Creek were also categorized, and numbered sequentially starting within the Reach 1 Distributary and working upstream (e.g., S1, S2, etc.).

Measurement of Habitat

With the prepared maps, it was then possible to measure the length (in millimeters) of each habitat type within a given reach. Each habitat type was associated with either a specific transect (e.g., T300, T310, etc.) or a non-transect area (e.g., S8, S9, etc.). In the event a single habitat type fell within a specific area, such as S8 (Figure 1), measurement of that habitat was relatively straight forward and was simply confined by the boundaries located at the Reach 2/3 break (downstream) and the boundary with S9 (upstream). In the event more than one habitat type existed within a specific area, it was then necessary to subjectively proportion the length of each habitat type for that site. A good example of this scenario is most of the Primary Secondary Channel of Reach 3 (Figure 1), where multiple meso-habitats occurred in all segments with the exception of S13, which consisted only of riffle habitat.

With each habitat type measured by reach, each transect and non-transect segment of Grant Creek quantified, and with additional information from the GIS database (i.e., reach length and overall area of each habitat type (ft²)), it was then possible to calculate area of habitat associated with each segment within Grant Creek, and linear feet of habitat by segment. It was also possible to compile those data and generate results consistent with work by Flory (1999) on Falls Creek, AK. Figure 2 and Table 1 show an example of the first level of analysis where transect and non-transect segments of Reach 1 are summarized to provide the proportion of habitat within the reach, and the overall area of habitat

associated within those segments. Appendix 1 shows Grant Creek reaches and calculations of habitat areas within each reach.



Once habitat frequencies were established for each transect, available habitat (by type) were then scaled in proportion to their availability within that reach. The results were then summed and each transect was weighted in accordance with its area and assigned a length (in ft).

For example, in the Reach 1 Distributary, there are 7,495 ft² of pool habitat, and 6,004 ft² of riffle habitat, for a total of 13,499 ft² (Table 3). Of the habitat associated with Transects 100 and 110, T100 had 20.6% of the pool habitat and 70% of the riffle habitat; T110 had 79.4% of the pool habitat and 30% of the riffle habitat. For reach weighting, therefore, T100 had 20.6% of the 7,495 ft² of pool habitat (1,543 ft²) and 70% of the 6,004 ft² of riffle habitat for a total of 5,746 ft² in the Reach 1 Distributary. That constituted 42.6% of the habitat within this reach. Given a length of 396 ft, T100 was weighted 169 ft (42.6% X 396). Each transect in each reach was weighted using the same method. The only deviation was in the Reach 2/3 side channels, where habitat was aggregated in both channels and weighted accordingly. Transect 210 was a backwater and was excluded from the analysis; the backwater section of Transect 230 was also excluded for the same reason.

Table 2 shows the lengths of each reach. There are 396 linear ft of habitat in the Distributary in Reach 1, 2,788 linear ft of habitat in mainstem Reaches 1 – 4, and 1,479 linear ft in the Reach 2/3 side channels. Tables 3 – 8 show calculation details for each reach in lower Grant Creek. Table 9 summarizes weighting for all transects. Transect 210, a backwater transect, and the backwater portion of Transect 230 were excluded from the analysis and were not weighted.

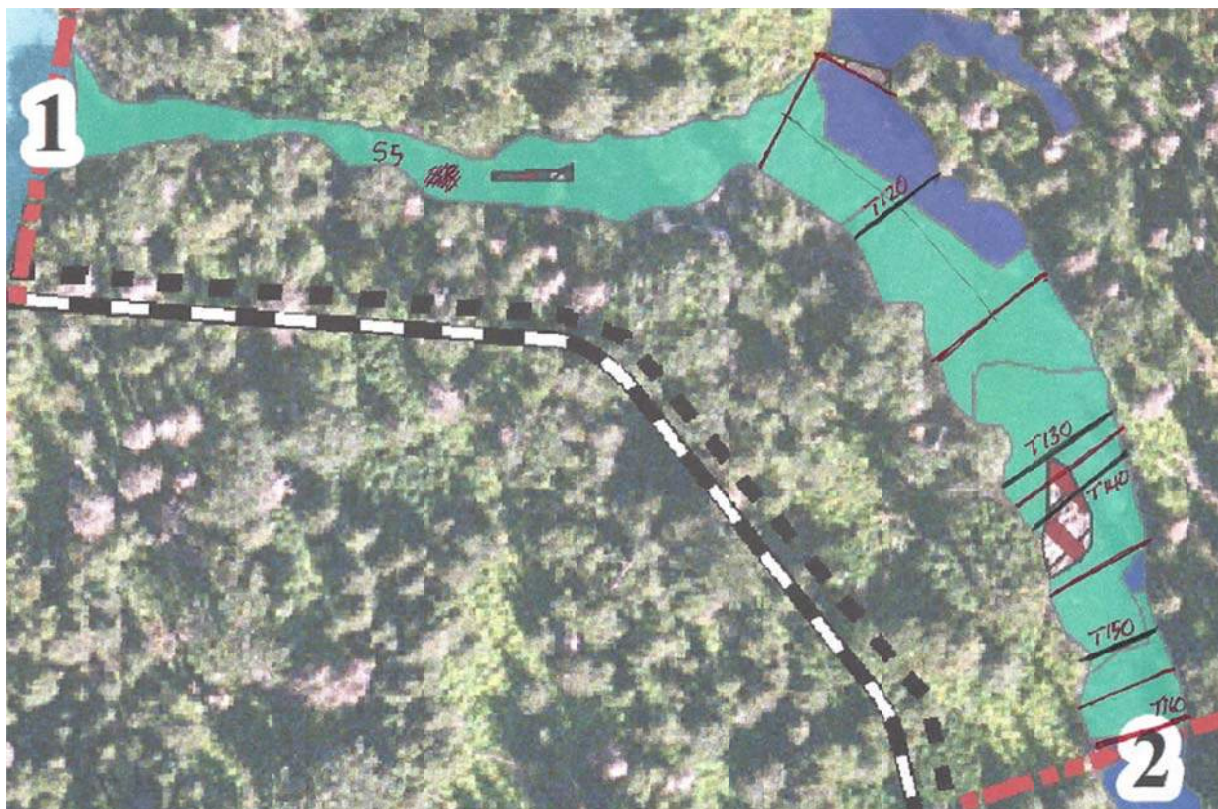


Figure 2. A map of Reach 1 that identifies transects, transect breaks and habitat types that was used to assess habitat weighting.

Table 1. A summary of the proportion and area (ft²) of habitat by type for transect and non-transect areas of Grant Creek, AK.

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
Reach 1 Distributary	S1	Pool	396	33.3%	7,495	2,498
	S2	Riffle	396	21.3%	6,004	1,276
	S3	Pool	396	16.7%	7,495	1,249
	S3	Riffle	396	16.3%	6,004	976
	S4	Pool	396	6.4%	7,495	480
	S4	Riffle	396	25.0%	6,004	1,501
	T100	Riffle	396	26.3%	6,004	1,576
	T100	Pool	396	9.0%	7,495	673
	T110	Riffle	396	11.3%	6,004	675
	T110	Pool	396	34.6%	7,495	2,594
	Total	Pool			7,495	
		Riffle			6,004	
Reach 1 Mainstem	S5	Riffle	692	53.5%	23,168	12,394
	T120	Riffle	692	13.6%	23,168	3,146
	T120	Pool	692	94.4%	3,143	2,968
	T130	Riffle	692	12.8%	23,168	2,956
	T140	Riffle	692	7.8%	23,168	1,811
	T150	Riffle	692	8.6%	23,168	2,002
	T150	Pool	692	5.6%	3,143	175
	T160	Riffle	692	3.7%	23,168	858
	Total	Pool			3,143	
		Riffle			23,168	
Reach 2 Mainstem	S6	Pool	820	86.4%	3,834	3,311
	T200	Backwater	820	38.9%	4,837	1,881
	T220	Riffle	820	16.8%	23,669	3,968
	T220	Glide	820	30.0%	1,613	484

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T230	Glide	820	70.0%	1,613	1,129
	T230 ^{1/}	Backwater	820	44.4%	4,837	2,150
	T230	Riffle	820	10.8%	23,669	2,551
	T210 ^{1/}	Backwater	820	16.7%	4,837	806
	S7	Riffle	820	72.5%	23,669	17,149
	S7	Pool	820	13.6%	3,834	523
	Total	Backwater			1,881	
		Riffle			23,669	
		Glide			1,613	
		Pool			3,834	
Reach 3 Mainstem	S8	Riffle	808	22.9%	25,585	5,866
	S9	Pool	808	66.7%	3,997	2,665
	S10	Riffle	808	22.4%	25,585	5,741
	T300	Backwater	808	100.0%	3,697	3,697
	T310	Riffle	808	5.9%	25,585	1,498
	T310	Pool	808	27.3%	3,997	1,090
	S11	Riffle	808	48.8%	25,585	12,480
	S11	Pool	808	6.1%	3,997	242
	Total	Riffle			25,585	
		Pool			3,997	
Reach 3 Primary Side Channel	S12	Riffle	606	48.8%	11,672	5,698
	S12	Pool	606	41.5%	5,018	2,083
	T320	Riffle	606	18.9%	11,672	2,206
	T320	Pool	606	24.5%	5,018	1,231
	S13	Riffle	606	18.9%	11,672	2,206
	T330	Pool	606	34.0%	5,018	1,704

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T330	Riffle	606	13.4%	11,672	1,562
	T330	Rapid	606	100.0%	511	511
Reach 3 Secondary Side Channel	S14	Cascade	873	100.0%	114	114
	S15	Run	873	100.0%	576	576
	S16	Pool	873	11.0%	9,908	1,094
	S17	Riffle	873	9.5%	2,683	256
	S18	Pool	873	13.0%	9,908	1,287
	S19	Riffle	873	7.1%	2,683	192
	S20	Pool	873	3.2%	9,908	322
	S21	Riffle	873	14.3%	2,683	383
	S22	Pool	873	16.2%	9,908	1,608
	S23	Riffle	873	21.4%	2,683	575
	S24	Pool	873	1.9%	9,908	193
	S25	Riffle	873	4.8%	2,683	128
	S26	Pool	873	24.0%	9,908	2,380
	S27	Riffle	873	14.3%	2,683	383
	S28	Pool	873	16.2%	9,908	1,608
	S29	Glide	873	10.7%	1,588	170
	S30	Pool	873	14.3%	9,908	1,415
	T330	Riffle	873	28.6%	2,683	767
	S31	Glide	873	89.3%	1,588	1,418
	Total	Riffle			14,355	
	Side	Pool			14,926	
	Channel	Glide			1,588	
		Rapid			511	
		Cascade			114	
Reach 4 Mainstem	T400	Riffle	468	11.7%	17,649	2,061

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T410	Riffle	468	17.5%	17,649	3,092
	T410	Pocket Water	468	8.6%	3,709	318
	S32	Riffle	468	70.8%	17,649	12,496
	S32	Pocket Water	468	91.4%	3,709	3,391
	T430	Pool	468	100.0%	1,195	1,195
	Total	Riffle			17,649	
		Pocket Water			3,709	
		Pool			1,195	

^{1/} Backwater on Transect 210 and 230 not quantified; these were eliminated from the subsequent analysis.

Table 2. Lower Grant Creek reach lengths.

Reach	Length (ft)
R 1 Distributary	396
R 1 Mainstem	692
R 2	820
R 3 Mainstem	808
R 3 Side Channel	606
R 2/3 Side Channel	873
R 4	468
Total	
Distributary	396
Main Channel	2,788
Side Channel	1,479
Total	4,663

Table 3. Reach 1 Distributary area and transect weighting.

Total Length (ft) 396									
Trans	Pool		Riffle		Total			% age	Length
	Area	% age	Area	% age	Pool	Riffle	Total		
T100	673	20.6%	1,576	70.0%	1,543	4,203	5,746	42.6%	169
T110	2,594	79.4%	675	30.0%	5,952	1,801	7,753	57.4%	227
Total	3,267		2,252		7,495	6,004	13,499		396

Table 4. Reach 1 main channel area and transect weighting.

Total Length (ft) 692									
Trans	Pool		Riffle		Total			% age	Length
	Area	% age	Area	% age	Pool	Riffle	Total		
T120	2,968	94.4%	3,146	29.2%	2,968	6,766	9,734	37.0%	256
T130	0	0.0%	2,956	27.4%	0	6,356	6,356	24.2%	167
T140	0	0.0%	1,811	16.8%	0	3,896	3,896	14.8%	102
T150	175	5.6%	2,002	18.6%	175	4,306	4,480	17.0%	118
T160	0	0.0%	858	8.0%	0	1,845	1,845	7.0%	49
Total	3,143		10,774		3,143	23,168	26,311		692

Table 5. Reach 2 area and transect weighting.

Total Length (ft) = 820															
	Pool		Backwater		Glide		Riffle		Total						
Trans	Area	% age	Area	% age	Area	% age	Area	% age	Pool	BackW	Glide	Riffle	Total	% age	Length
T200	0	N/A	1,881	100.0%	0	0.0%	0	0.0%	0	1,881	0	0	1,881	6.9%	57
T210 ^{1/}	0	N/A			0	0.0%	0	0.0%	0	0	0	0		0.0%	0
T220	0	N/A	N/A	N/A	484	30.0%	3,968	60.9%	0	0	484	14,407	14,891	54.8%	450
T230 ^{1/}	0	N/A	N/A	N/A	1,129	70.0%	2,551	39.1%	0	0	1,129	9,262	10,391	38.3%	314
Total	0		1,881		1,613		6,520		0	1,881	1,613	23,669	27,163		820
^{1/} Backwater channels excluded from analysis															

Table 6. Reach 3 main channel area and transect weighting.

Total Length (ft) = 808												
	Pool		Backwater		Riffle		Total					
Trans	Area	% age	Area	% age	Area	% age	Pool	Backwater	Riffle	Total	% age	Length
T300	0	0.0%	3,697	100.0%	0	0.0%	0	3,697	0	3,697	11.1%	90
T310	1,090	100.0%	0	0.0%	1,498	100.0%	3,997	0	25,585	29,582	88.9%	718
Total	1,090		3,697		1,498		3,997	3,697	25,585	33,279		808

Table 7. Reach 2/3 side channels area and transect weighting.

Total Length (ft) = 1,479												
Trans	Pool		Riffle		Rapids		Total					
	Area	% age	Area	% age	Area	% age	Pool	Riffle	Rapids	Total	% age	Length
T320	1,231	41.9%	2,206	48.6%	0	0.0%	2,104	5,677	0	7,782	45.2%	669
T330	1,704	58.1%	2,329	51.4%	511	100.0%	2,914	5,995	511	9,419	54.8%	810
Total	2,935		4,535		511		5,018	11,672	511	17,201		1,479

Table 8. Reach 4 area and transect weighting.

Total Length (ft) =		468										
	Pool		Pocket Water		Riffle		Total					
Trans	Area	% age	Area	% age	Area	% age	Pool	PocketW	Riffle	Total	% age	Length
T400	0	0.0%	0	0.0%	2,061	40.0%	0	0	7,060	7,060	31.3%	146
T410	0	0.0%	318	100.0%	3,092	60.0%	0	3,709	10,589	14,298	63.4%	297
T430	1,195	100.0%	0	0.0%	0	0.0%	1,195	0	0	1,195	5.3%	25
Total	1,195		318		5,153		1,195	3,709	17,649	22,553		468

Table 9. Summary of reach and transect weighting (ft).

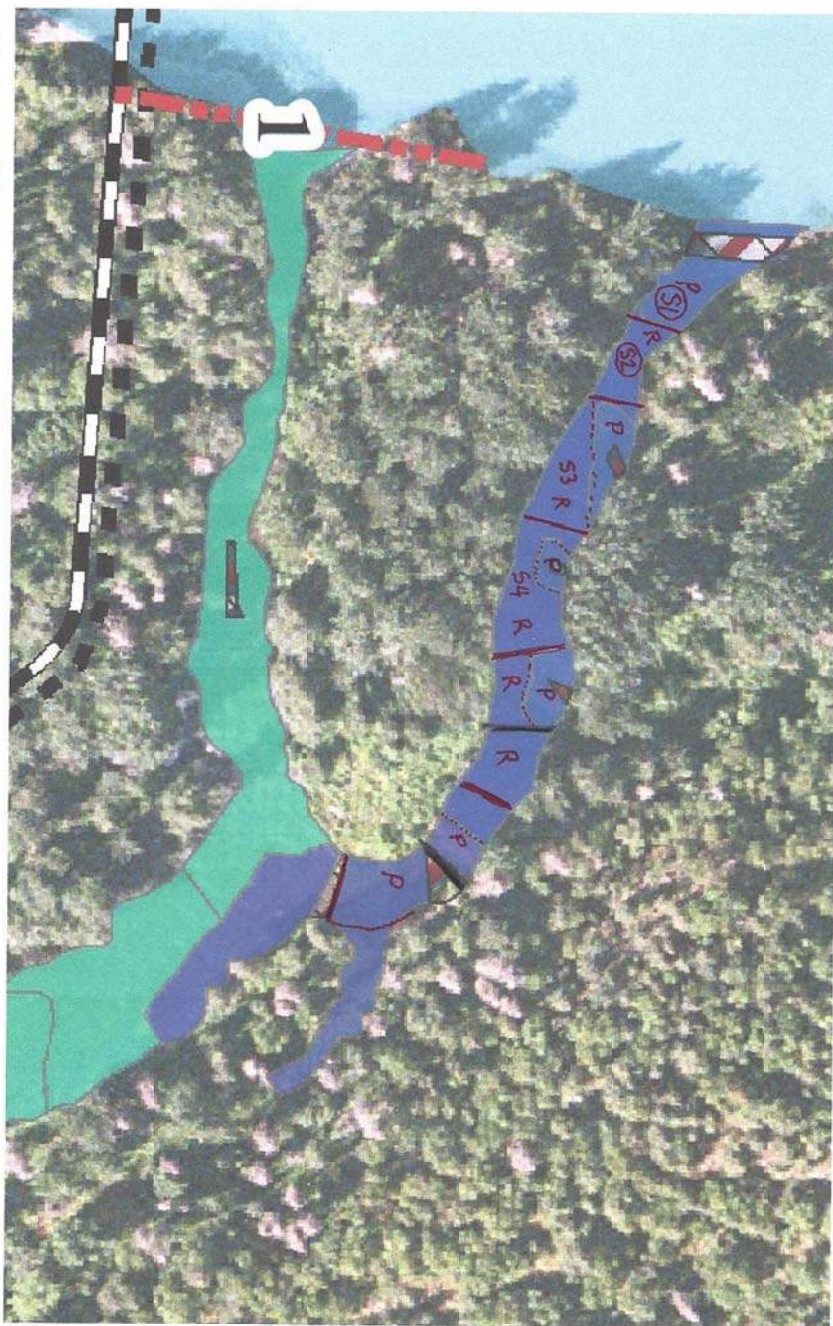
Reach	Transect	Length (ft)
1 - Distributary	100	169
	110	227
	Total	396
1 - Main Channel	120	256
	130	167
	140	102
	150	118
	160	49
	Total	692
2 - Main Channel	200	57
	210	0
	220	450
	230	314
	Total	820
3 - Main Channel	300	90
	310	718
	Total	808
2/3 Side Channels	320	669
	330	810
	Total	1,479
4 - Main Channel	400	146
	410	297
	430	25
	Total	468
Total		
Distributary		396
Main Channel		2,788
Side Channel		1,479
Total		4,663

APPENDIX 1

CALCULATION OF REACH HABITAT TYPES AND TRANSECT WEIGHTING

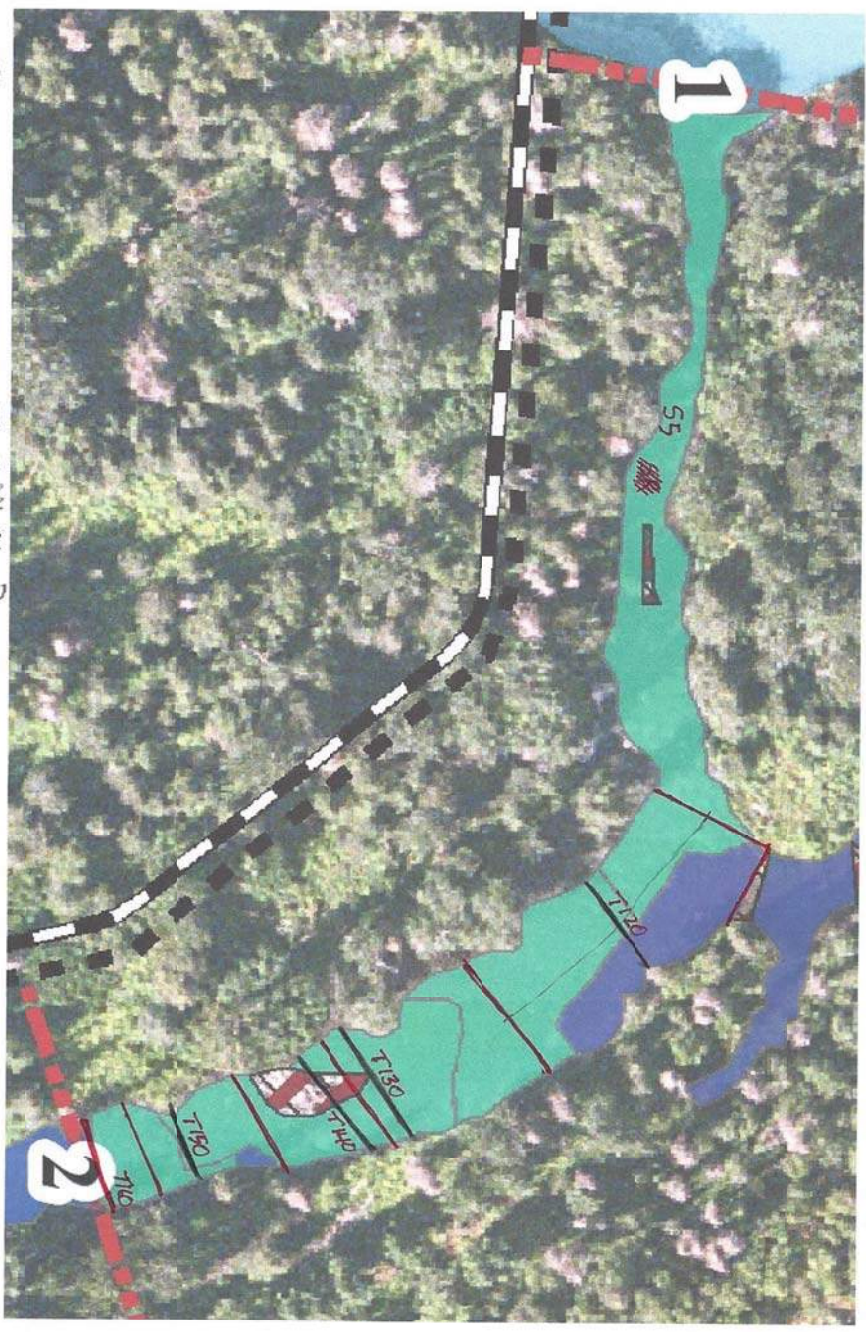
GRANT CREEK INSTREAM FLOW STUDY

RJ- Distributary



S1	Pool	26	T100	Riffle 21	28
S2	Riffle	17	"	Pool 7	
S3	Pool	13			
S3	Riffle	13	T110	Riffle 9	38
S4	Pool	5	"	Pool 27	
S4	Riffle	20			
		25			

R1

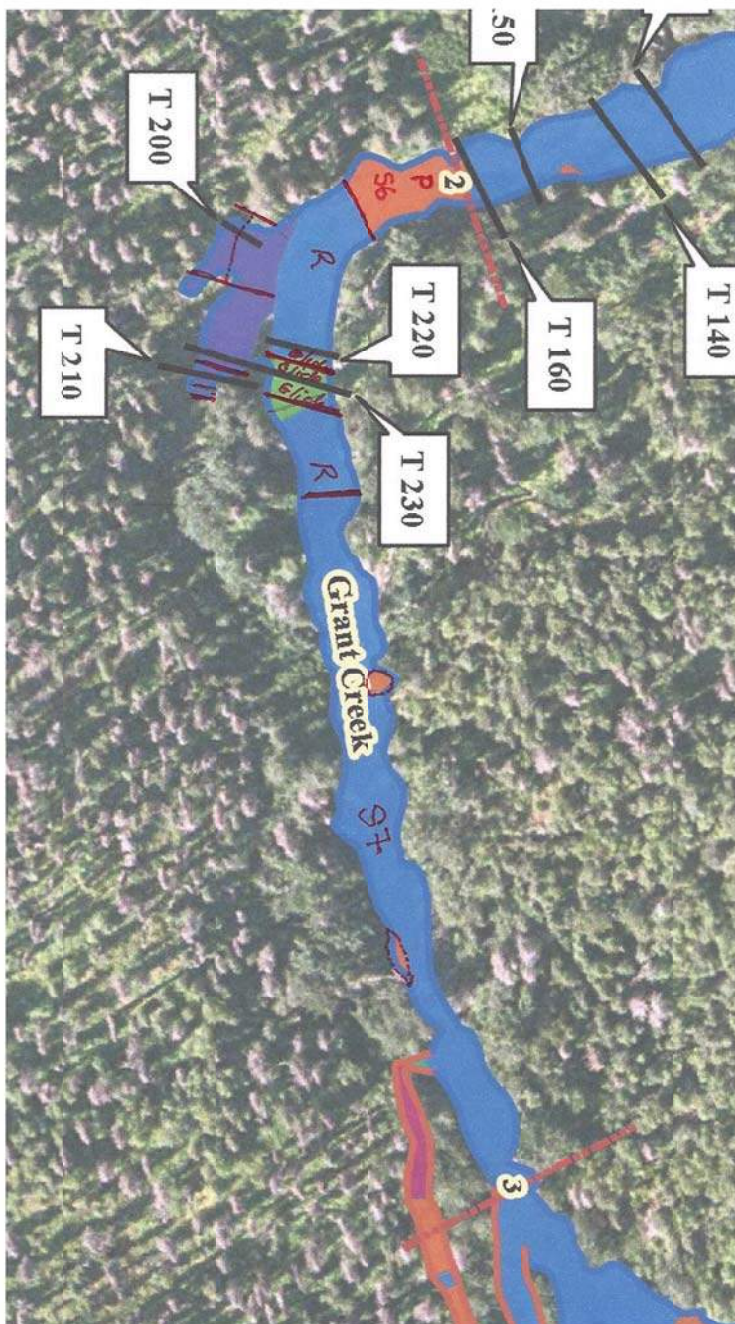


55 Rifle 130
 T120 Rifle 33 } 50
 T120 Pool 17
 T130 Rifle 31
 T140 Rifle 19

T150 Rifle 21 } 22
 T150 Pool 1
 T160 Rifle 9

Pool = 18
 Rifle = 243

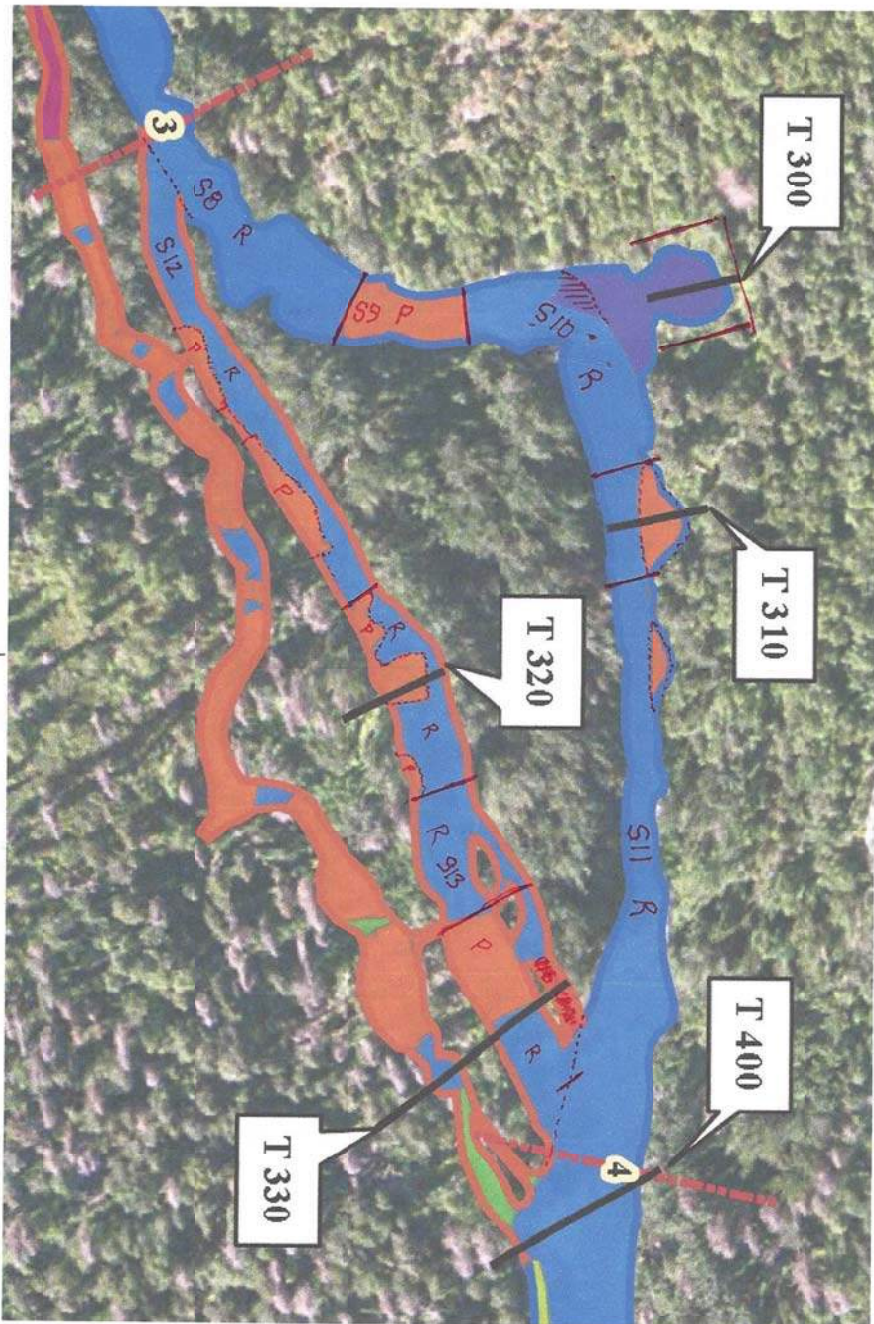
July 18, 2014



T200	Beck H ₂ O	14			
T220	Riffle	28	}	31	
	Glide	3	}		
T230	Glide	7			
T230	Beck H ₂ O	16			
T230	Riffle	18			

Reach 3

July 18, 2014



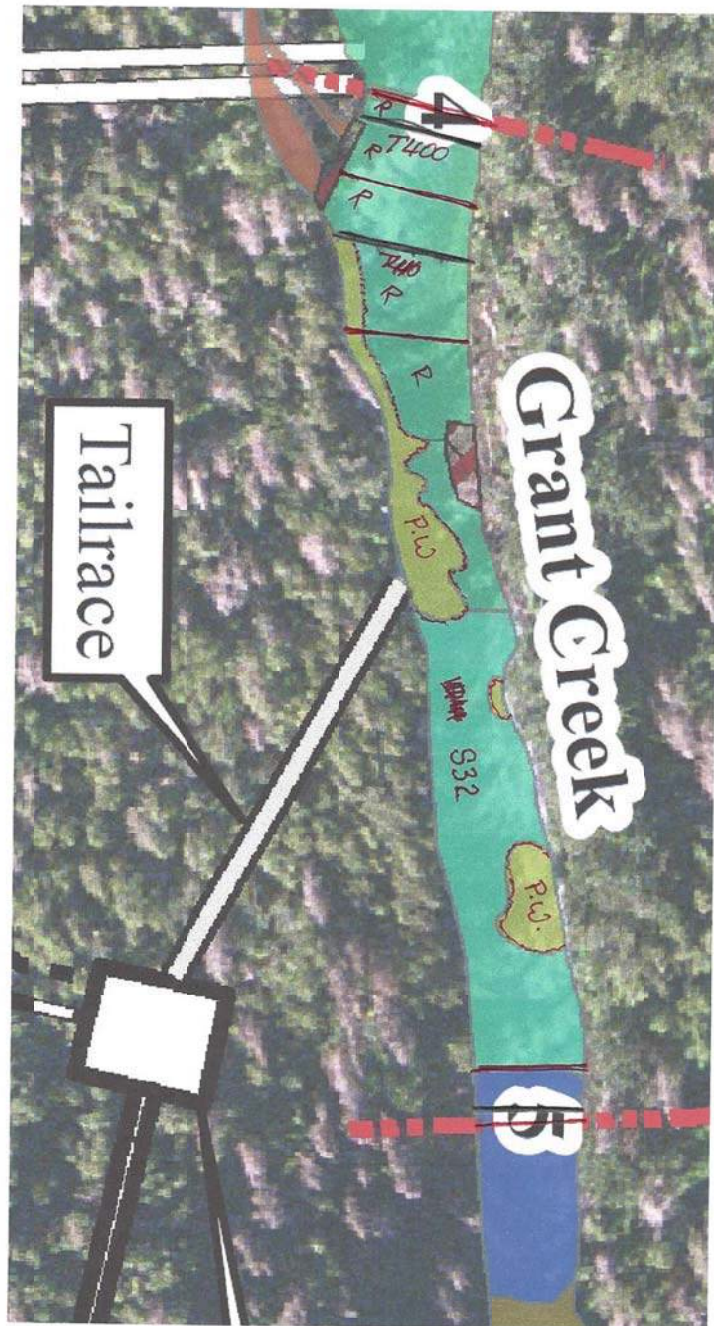
Mainstem				
S8	Riffle	47	T310	Riffle 12
S9	Pool	22	T310	Pool 9
S10	Riffle	46	S11	Riffle 100
T300	Back H'd	20	S11	Pool 2
			{ 21	
			{ 102	

Secondary				
S12	Riffle	62	S13	Riffle 24
S12	Pool	22	T330	Pool 18
T320	Riffle	24	T330	Riffle 17
T320	Pool	13	T330	Rapid ---
			{ 84	
			{ 37	
			{ 35	

July 18 2014



R4



T400	Rifle	16
T410	Rifle	24
T410	Rocket H2O	3
S32	Rifle	97
S32	Rocket H2O	37
T430	Pool	11

From: Cory Warnock
Sent: Tuesday, July 29, 2014 5:53 PM
To: Dwayne Adams; 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; kvanmassenhove@fs.fed.us; lesli.schick@alaska.gov; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS'; 'Kime, Sherry D -FS'; 'Mike Salzetti'; mmueller@borough.kenai.ak.us; judy.bittner@alaska.gov; 'Matt McMillan'
Cc: 'Griffin, David W (DNR)'; Emily Andersen
Subject: RE: INHT Meeting

Hi all,

As a quick addition to Dwayne's message, if we could hear back from you with any comments you may have by COB on August 6th, it would be much appreciated.

Thanks,

Cory

Cory Warnock
Senior Licensing and Regulatory Consultant

McMillen, LLC
www.mcmillen-llc.com
5771 Applegrove Ln.
Ferndale, Wa. 98248
O – 360-384-2662
C – 360-739-0187
F – 360-542-2264

From: Dwayne Adams [mailto:wdadams@earthscope.alaska.com]
Sent: Tuesday, July 29, 2014 5:47 PM
To: 'Duvall, Shina A (DNR)'; 'Stovall, Robert -FS'; 'Russell, Pamela J (DNR)'; kvanmassenhove@fs.fed.us; lesli.schick@alaska.gov; 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS'; 'Kime, Sherry D -FS'; 'Mike Salzetti'; mmueller@borough.kenai.ak.us; judy.bittner@alaska.gov; Cory Warnock; 'Matt McMillan'
Cc: 'Griffin, David W (DNR)'
Subject: RE: INHT Meeting

Attached are meeting minutes from the field trip to the INHT trail on the 15th. Please review them and see if they capture our discussions during and after the field trip.

Thanks much-it was a nice trip. << File: 2014-07-15-INHT Field Trip Memo.pdf >>

Memorandum

Project: Grant Lake Hydroelectric Project Licensing

Date: July 16, 2014

Regarding: INHT Field Trip

From: Dwayne Adams, Earthscape

To: File

KHL and representatives met and conducted an on-site walk with agency personnel on July 15, 2014, to discuss possible alternatives to a current alignment of the commemorative Iditarod National Historic Trail (INHT). The current easement for the planned INHT is co-located with the location of the power house of the proposed hydroelectric project.

Following were participants in the meeting:

- Judy Bittner, SHPO
- Shina Duval, SHPO
- Robert Stovall, USFS
- John Eavis, USFS
- Tim George, USFS
- Mike Fitzpatrick, USFS
- Marcus Mueller, Kenai Peninsula Borough
- Mike Salzetti, KHL
- Mike Yarborough, Cultural Resource Consultants
- Sarah Meitl, Cultural Resource Consultants
- Matt McMillen, USKH/Stantec
- Dwayne Adams, Earthscape

The participants hiked from the Vagt Lake trailhead at the southern end of Lower Trail Lake, connecting to the INHT, and departing from it at the point at which the proposed INHT alternative varies from the current proposed layout. They then hiked the proposed re-route to the proposed crossing of Grant Lake. The group hiked up Grant Creek and reviewed possible crossing points, examining potential for bridge crossings as well as hand tram possibilities. The group also hiked to the proposed crossing at the western end of Grant Creek Canyon, then returned to the Vagt Lake trailhead parking lot via the existing proposed INHT layout, and then the Vagt Lake Trail.

In discussions, the group achieved some consensus on the following:

- There is some agreement among agencies that were present to consider re-alignment options, but further discussion and examination needs to take place.
- To facilitate further discussions, A Memorandum of Agreement (MOA) is needed. Key parties include KHL, USFS, SHPO, DNR, State Parks, and the Kenai Peninsula Borough.
- KHL should provide a letter requesting agencies consideration of the alternative route and attach a draft MOA to outline the conditions and process to allow realignment. The letter and MOA need to clearly articulate that KHL agrees to be responsible for any costs for an alternative re-route that would be in excess of the cost of the existing INHT alignment.
- The Section 106 review will need to include evaluation of historic/archaeological resources that could be disturbed or affected by any proposed corridor location. The evaluation needs to include not just the trail itself, but also areas potentially affected by construction activity.
- Providing the necessary evaluation will require a specific location for the proposed re-routing.
- Once a location is determined, an estimate needs to be provided of what the “delta” might be between the cost of the existing trail alignment and the proposed re-alignment. That will provide the basis of cost mitigation required of KHL for the realignment proposal.

- The USFS needs to provide KHL the Trail Management Objectives (TMOs) for the existing INHT. The proposed trail must meet those TMOs. The TMOs provide information such as maximum slopes, cross-slopes, trail tread treatments, etc., that guide the detailing and construction of the INHT.
- The TMOs are essential to providing the layout and costing/delta of the proposed reroute.

Action Items:

- USFS will provide the TMOs for the INHT, particularly as it exists in the project area.
- To the extent available, USFS will provide cost estimate information to use as a basis for determining cost of the proposed alternative location, relative to the existing alignment.
- KHL will provide a letter formally requesting consideration of the INHT alternative layout.
- KHL will draft an MOA and attach the MOA to their letter to initiate the evaluation process.
- KHL will have its consultants lay out the proposed re-route in conformance with the TMO requirements.
- KHL will have its consultants prepare an assessment of potentially affected historical and archaeological resources.
- KHL will have its consultants prepare a cost report detailing costs of the existing alignment and the proposed re-route, identifying the delta in cost between the two.

Grant Lake Hydroelectric Project (FERC No. 13212) Licensing

Consultation Record

Phone/E-mail/One-on-One Meeting Log

Contact Name: John Eavis, Robert Stovall, Alison Rein

Agency/Organization: USFS

Phone No./E-mail Address: Eavis 907-288-7701, Stovall-907-743-9474, Rein 907-754-2329

Date: July 29, 2014

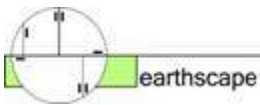
Time: 9:50am, 9:55am, 10:10am

Grant Lake Licensing Team Contact:

Dwayne Adams

Summary of Conversation and/or E-mail Exchange:

I called each asking about the possibility of getting a copy of the Trail Management Objectives for the INHT in the affected area. I was not able to get in touch with any and left messages with each.



From: Eavis, John -FS [mailto:jeavis@fs.fed.us]
Sent: Wednesday, July 30, 2014 11:28 AM
To: Dwayne Adams
Cc: Stovall, Robert -FS
Subject: RE: USFS INHT TMOs

Dwayne, Here is the draft TMO for that section of the INHT. The design specifications are accurate. Along with this TMO I suggest, if you have not done so before, you walk portions of the trail that have been built to get the feel for the type of trail desired. There are some in the Falls Creek/Ptarmigan Creek area, as well as Trails in the Meridian/Grayling lakes are closer to Seward.

john

From: Dwayne Adams [mailto:wdadams@earthscape.alaska.com]
Sent: Friday, July 25, 2014 12:28 PM
To: Eavis, John -FS
Cc: Stovall, Robert -FS
Subject: USFS INHT TMOs

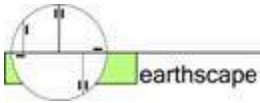
John,

Thanks for meeting with us on site a couple weeks ago to look at possible INHT alternative locations in the Grant Creek area. I would like to go out and provide more definition to the trail, such that we can appropriately site the trail to recognize slope, gradient, and construction requirements as mandated by the TMOs for the INHT in that area.

Could you possibly send me the TMOs so that we can better locate the trail for you and your trail planners/constructors to better be able to analyze alternatives as we move forward? I'd like to do some work on the trail late next week thus would greatly appreciate getting a look at the TMOs before we go out there.

Thanks John

Dwayne Adams
Landscape Architect



1343 G Street, Suite 101
Anchorage, AK 99501

P 907.279.2688

This electronic message contains information generated by the USDA solely for the intended recipients. Any unauthorized interception of this message or the use or disclosure of the information it contains may violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.



Trail Management Objectives

Inht: Moose Pass Trail #P365 (Standard/Terra)

TMO Status : DRAFT

Region : 10

Forest : Chugach National Forest

District : 100430 - Seward Ranger District

Beginning Milepost : 0.0000
Ending Milepost : 15.8000
Trail Length : 15.8000

Beginning Termini : Seward Hwy. MP 18
Ending Termini : Jct w/ INHT: Johnson Pass Tr @ Trail Crk

TMO **BMP (mi):** 0.0000 **EMP (mi):** 15.8000

This TMO documents the intended purpose and management of National Forest System trail segments, and may or may not reflect the current condition of the trail.

Travel Management Strategies

ATM Managed Use

Strategy	Travel ID	Mode of Travel	BMP (mi)	EMP (mi)	Length	From	To	Comments
Manage	2.1	HIKER/PEDESTRIAN	0.0000	15.8000	15.8000	05/15	10/15	
Manage	2.3.1	BICYCLE	6.1000	15.8000	9.7000	06/30	10/15	

ATM Prohibited Use

Strategy	Travel ID	Mode of Travel	BMP (mi)	EMP (mi)	Length	From	To	Primary Reason
Prohibit	2.3.3	ANIMAL PULLED VEHICLE	0.0000	15.8000	15.8000	04/01	06/30	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES
Prohibit	1.2.2.1.1	ATV	0.0000	15.8000	15.8000	01/01	12/31	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES
Prohibit	2.3.1	BICYCLE	0.0000	15.8000	15.8000	04/01	06/30	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES
Prohibit	1.2.2.1.2	MOTORCYCLE	0.0000	15.8000	15.8000	01/01	12/31	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES
Prohibit	1.2.1	OHV > 50"	0.0000	15.8000	15.8000	01/01	12/31	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES
Prohibit	3.1.2.2	OTHER OSV <= 50"	0.0000	15.8000	15.8000	01/01	12/31	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES
Prohibit	2.2	PACK AND SADDLE	0.0000	15.8000	15.8000	04/01	06/30	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES
Prohibit	3.1.2.1	SNOWMOBILE	0.0000	15.8000	15.8000	01/01	12/31	PREVENT DAMAGE TO ROAD OR TRAIL SURFACES

Designed Use Objectives

ROS/WROS Class

BMP (mi)	EMP (mi)	Length	Value	Comments
0.0000	15.8000	15.8000	SPM - SEMIPRIMITIVE MOTORIZED	On state land.

Trail Class

BMP (mi)	EMP (mi)	Length	Value	Comments
0.0000	15.8000	15.8000	TC3 - DEVELOPED	

Designed Use

BMP (mi)	EMP (mi)	Length	Value	Comments
0.0000	6.1000	6.1000	HIKE - HIKER/PEDESTRIAN	
6.1000	15.8000	9.7000	BIKE - BICYCLE	



Trail Management Objectives

Inht: Moose Pass Trail #P365 (Standard/Terra)

TMO Status : DRAFT

Region : 10

Forest : Chugach National Forest

District : 100430 - Seward Ranger District

Beginning Milepost : 0.0000
Ending Milepost : 15.8000
Trail Length : 15.8000

TMO **BMP (mi):** 0.0000 **EMP (mi):** 15.8000

Design Parameter Segment

BMP (mi)	EMP (mi)	Length	Trail Class - Designed Use
0.0000	6.1000	6.1000	TC3 - HIKER/PEDESTRIAN
Design Parameter		Trail DP Value	Exceptions
Design Tread Width - Wilderness (Single Lane)		18" Exception: may be 36" - 48" at steep side slopes	
Design Tread Width - Non-Wilderness 1 (Single Lane)		36"	
Design Tread Width - Non-Wilderness 2 (Double Lane)		Not applicable	
Design Tread Width - Structures (Minimum Width)		18"	
Design Surface - Type		Native with some onsite borrow or imported material where needed for stabilization, occasional grading Intermittently rough	
Design Surface - Protrusions		3" May be common, not continuous	
Design Surface - Obstacles (Maximum Height)		10"	
Design Grade - Target Grade		12%	
Design Grade - Short Pitch Maximum		25%	
Design Grade - Maximum Pitch Density		15% of trail	
Design Cross Slope - Target Cross Slope		5%	
Design Cross Slope - Maximum Cross Slope		15%	
Design Clearing - Height		8'	
Design Clearing - Width		96"	Outside national DPs. Need explanation.
Design Clearing - Shoulder Clearance		12"	
Design Turn - Radius		6'	



Trail Management Objectives

Inht: Moose Pass Trail #P365 (Standard/Terra)

TMO Status : DRAFT

Region : 10

Forest : Chugach National Forest

District : 100430 - Seward Ranger District

Beginning Milepost : 0.0000
Ending Milepost : 15.8000
Trail Length : 15.8000

TMO **BMP (mi):** 0.0000 **EMP (mi):** 15.8000

Design Parameter Segment

BMP (mi)	EMP (mi)	Length	Trail Class - Designed Use	
6.1000	15.8000	9.7000	TC3 - BICYCLE	
		Design Parameter	Trail DP Value	Exceptions
		Design Tread Width - Single Lane	36"	
		Design Tread Width - Double Lane	Not applicable	
		Design Tread Width - Structures (Minimum Width)	36"	
		Design Surface - Type	Native with some onsite borrow or imported material where needed for stabilization, occasional grading Intermittently rough Sections of soft or unstable tread on grades < 5% may be present, but not common	
		Design Surface - Protrusions	3" May be common, not continuous	
		Design Surface - Obstacles (Maximum Height)	10"	
		Design Grade - Target Grade	10%	
		Design Grade - Short Pitch Maximum	15%	
		Design Grade - Maximum Pitch Density	10% of trail	
		Design Cross Slope - Target Cross Slope	5%	
		Design Cross Slope - Maximum Cross Slope	8%	
		Design Clearing - Height	8'	
		Design Clearing - Width	120"	Outside national DPs. Need explanation.
		Design Clearing - Shoulder Clearance	12"	
		Design Turn - Radius	10'	Outside national DPs. Need explanation.



Trail Management Objectives

Inht: Moose Pass Trail #P365 (Standard/Terra)

TMO Status : DRAFT

Region : 10

Forest : Chugach National Forest

District : 100430 - Seward Ranger District

Beginning Milepost : 0.0000
Ending Milepost : 15.8000
Trail Length : 15.8000

TMO BMP (mi): 0.0000 EMP (mi): 15.8000

Target Task Frequency

Routine Tasks

Task ID	Description	BMP (mi)	EMP (mi)	Length	Frequency	TMO Reference Information
TW-CLR-01F	Trail Opening	0.0000	15.8000	15.8000	1.000	By 5/15
TW-TRD-01A	Tread Maintenance	0.0000	6.1000	6.1000	0.200	
TW-TRD-01A	Tread Maintenance	6.1000	15.8000	9.7000	0.200	
TW-TRD-01B	Tread Drainage	0.0000	6.1000	6.1000	0.500	
TW-TRD-01B	Tread Drainage	6.1000	15.8000	9.7000	0.500	
TW-CLR-01A	Logging Out	0.0000	6.1000	6.1000	1.000	
TW-CLR-01A	Logging Out	6.1000	15.8000	9.7000	1.000	
TW-CLR-01B	Brushing Or Mowing	0.0000	6.1000	6.1000	0.330	
TW-CLR-01B	Brushing Or Mowing	6.1000	15.8000	9.7000	0.330	
TW-S&D-01A	Tracs Survey	0.0000	15.8000	15.8000	0.200	

Special Considerations

Consideration	BMP (mi)	EMP (mi)	Length	Comments
Existing easement requirements/considerations (specify in Comments)	0.0000	15.8000	15.8000	Comments read " I think there is one through Rocky Creek" - PLEASE VERIFY and provide MP if easement exists. Please identify all easements for this trail based on bmp/emp.

TMO Status : DRAFT

Line Officer : Name :
Title :

Signature :
Date :

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, August 01, 2014 10:55 AM
To: Miller, Monte D (DFG); Klein, Joseph P (DFG); Jason Mouw
Cc: John Stevenson; Cory Warnock; Emily Andersen
Subject: FW: Grant Lake Habitat Quantification and Aggregation
Attachments: Habitat Quantification Methodology 07-31-2014.docx

Good afternoon, Monte and Joe:

Thank you for looking at the report again, and giving us your comments. Our responses are in red, below. Where needed, we have revised the report to reflect your concerns. Let us know if you have any additional comments. If not, I will mark it as final and send it out to the group.

Thanks again for all your work on this. Have a good weekend!

John

John Blum
Sr. Fisheries Scientist

From: Miller, Monte D (DFG) [<mailto:monte.miller@alaska.gov>]
Sent: Tuesday, July 29, 2014 11:46 AM
To: John Blum (john.blum@mcmillen-llc.com)
Cc: Klein, Joseph P (DFG)
Subject: FW: Grant Lake Habitat Quantification and Aggregation

John,

Attached are some comments from Joe. We would appreciate some follow-up on these comments, particularly bullets 1 and 4.

Thanks for your patience.

Monte D. Miller
Statewide FERC Hydropower Coordinator
Alaska Department of Fish and Game
Division of Sport Fish / RTS
333 Raspberry Road
Anchorage, Alaska, 99518-1565

907 267-2312

From: Klein, Joseph P (DFG)
Sent: Monday, July 28, 2014 3:49 PM
To: Miller, Monte D (DFG)
Subject: Grant Lake Habitat Quantification and Aggregation

Monte-

Per your request, I have reviewed the revised draft dated July 24, 2014. The goal of this effort is to determine how to proportion selected transects in relation to available habitat characterized by the habitat inventory for the PHABSIM/IFIM model. This will provide baseline habitat results that can then be compared to alternative operation scenarios for evaluation of project impacts. The report and tables along with the addition of the maps in Appendix 1 provides a good description of the method and basis for this assessment. Following are some comments for consideration that may improve the document.

- Page 1, 1st para: minor comment but the example given for S13 as a riffle appears to show pool habitat at the edges of the stream. Not sure if this amount of pool habitat is so small as to be insignificant, an artifact of mapping, or what but it does show up and caused me confusion.

Response: Segment 13 (S13) is comprised only of riffle habitat, and is bordered on the downstream margin by riffle and pool habitat, and on the upstream margin by the log jam. It appears that Joe was looking at the figure on page 16 instead of page 2. On page 16, the outline of the channel is the same color as the pool habitat, which is most likely the cause of the confusion. We'd rather not have to revise the maps, which would take quite a bit of work, so if you are alright with this clarification, we'll leave them as is in the report. We will put a clarifying comment in the report.

- Page 1, last para: there is an extra “)”.

Response: We have corrected this.

- Page 1, last para: Here is the citation for Flory (1999) however I was unable to put my hands on the actual document to verify

- Flory, E.A. 1999. Fish and fish habitats of the Falls Creek area. Prepared by Icy Strait Environmental Services, Gustavus, AK. Prepared for Gustavus Electric Company, Gustavus, AK. 46 pp.

Response: We have added this citation. Thank you.

- Page 3, 2nd para: It is not clear why the backwater habitats in transects 210 and 230 were excluded from the analysis? According to Table 5, Transect 200 was included as backwater habitat. Either a specific reason for the exclusions should be provided or the habitats should be included.

Response: The backwater associated with Transect 200 actually has some flow on its outer edge, and provides both spawning and rearing habitat. The backwater associated with Transect 210 and that portion of Transect 230 is truly a backwater. It has absolutely no flow or velocities at all, and water surface elevation (stage) is completely dependent upon the hydraulic controls downstream. Since the velocity is 0 ft/s, WUA for virtually all species and life history stages was 0. For this reason, we excluded these parts of the transects from the analysis, since they did not contribute to overall habitat. We added a clarifying comment in the report.

- Tables 3 – 8: suggest adding the header “Reach Weights” to the last column for the % age and length results.

Response: We have revised the header to reflect this suggestion.

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4716 / Virus Database: 3986/7944 - Release Date: 07/29/14

DRAFT
Habitat Quantification/Transect Weighting Methodology
Revised July 31, 2014

Introduction

As part of the IFIM assessment of habitat within Grant Creek, it is necessary to identify habitat types within reaches of Grant Creek, to quantify those habitats, and to weight them in proportion to their availability within lower Grant Creek. These analyses are then used to weight those transects that were selected and modeled within Reaches 1 through 4. As such, we have undertaken a process to identify and quantify habitat within the various reaches of Grant Creek. Our assessment has been tailored to provide metrics consistent with the work conducted by Flory (1999) on Falls Creek, AK; a summary of these results was provided by Alaska Department of Fish and Game. This document is a brief summary of the methodology used in our analysis.

Map Layout

A scaled map of Grant Creek, which depicted meso-habitats, was overlaid with reach breaks and transect locations. An 8.5 x 11 inch map of each reach was prepared, and the area (ft²) associated within a given transect was added to each map; the upstream and downstream boundaries associated with each transect were based on one of two criteria:

1. In the event another transect was relatively close to the transect of interest, the boundary was located an equidistance from each transect, or
2. If the nearest transect was more than one meso-habitat away, then the boundary was located at the edge of the meso-habitat associated with that transect or some obvious geophysical feature within Grant Creek (Figure 1).

All non-transect sections of Grant Creek were also categorized, and numbered sequentially starting within the Reach 1 Distributary and working upstream (e.g., S1, S2, etc.).

Measurement of Habitat

With the prepared maps, it was then possible to measure the length (in millimeters) of each habitat type within a given reach. Each habitat type was associated with either a specific transect (e.g., T300, T310, etc.) or a non-transect area (e.g., S8, S9, etc.). In the event a single habitat type fell within a specific area, such as S8 (Figure 1), measurement of that habitat was relatively straight forward and was simply confined by the boundaries located at the Reach 2/3 break (downstream) and the boundary with S9 (upstream). In the event more than one habitat type existed within a specific area, it was then necessary to subjectively proportion the length of each habitat type for that site. A good example of this scenario is most of the Primary Secondary Channel of Reach 3 (Figure 1), where multiple meso-habitats occurred in all segments with the exception of S13, which consisted only of riffle habitat.

With each habitat type measured by reach, each transect and non-transect segment of Grant Creek quantified, and with additional information from the GIS database (i.e., reach length and overall area of each habitat type, in ft²), it was then possible to calculate area of habitat associated with each segment within Grant Creek, and linear feet of habitat by segment. It was also possible to compile those data and generate results consistent with work by Flory (1999) on Falls Creek, AK. Figure 2 and Table 1 show an example of the first level of analysis, where transect and non-transect segments of Reach 1 are summarized to provide the proportion of habitat within the reach, and the overall area of habitat

associated within those segments. Appendix 1 shows Grant Creek reaches and calculations of habitat areas within each reach.

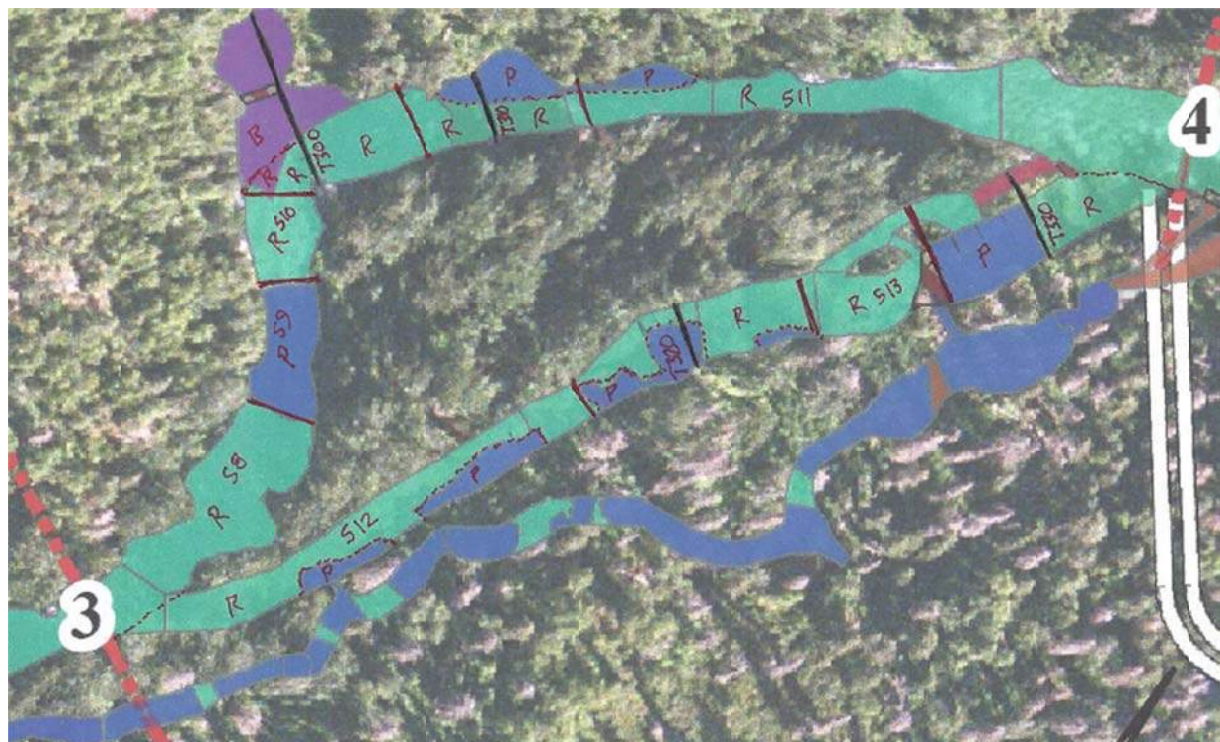


Figure 1. A map of Reach 3 that identifies transects, transect breaks and habitat types that was used to assess habitat weighting.

Once habitat frequencies were established for each transect, available habitat (by type) were then scaled in proportion to their availability within that reach. The results were then summed and each transect was weighted in accordance with its area and assigned a length (in ft).

For example, in the Reach 1 Distributary, there are 7,495 ft² of pool habitat, and 6,004 ft² of riffle habitat, for a total of 13,499 ft² (Table 3). Of the habitat associated with Transects 100 and 110, T100 had 20.6% of the pool habitat and 70% of the riffle habitat; T110 had 79.4% of the pool habitat and 30% of the riffle habitat. For reach weighting, therefore, T100 had 20.6% of the 7,495 ft² of pool habitat (1,543 ft²) and 70% of the 6,004 ft² of riffle habitat for a total of 5,746 ft² in the Reach 1 Distributary. That constituted 42.6% of the habitat within this reach. Given a length of 396 ft, T100 was weighted 169 ft (42.6% X 396). Each transect in each reach was weighted using the same method. The only deviation was in the Reach 2/3 side channels, where habitat was aggregated in both channels and weighted accordingly. *[Note: Transect 200 was a backwater area that also included an outer portion that had velocity. There was known spawning and rearing at this transect. By comparison, Transect 210 and the side channel of Transect 230 were backwaters that were ponded, with 0 velocity at any station. WUA for Transect 210 and the backwater area of Transect 230 was 0, so these two areas were excluded from the analysis].*

Table 2 shows the lengths of each reach. There are 396 linear ft of habitat in the Distributary in Reach 1, 2,788 linear ft of habitat in mainstem Reaches 1 – 4, and 1,479 linear ft in the Reach 2/3 side channels. Tables 3 – 8 show calculation details for each reach in lower Grant Creek. Table 9 summarizes weighting for all transects. Transect 210, a backwater transect, and the backwater portion of Transect 230 were excluded from the analysis and were not weighted.

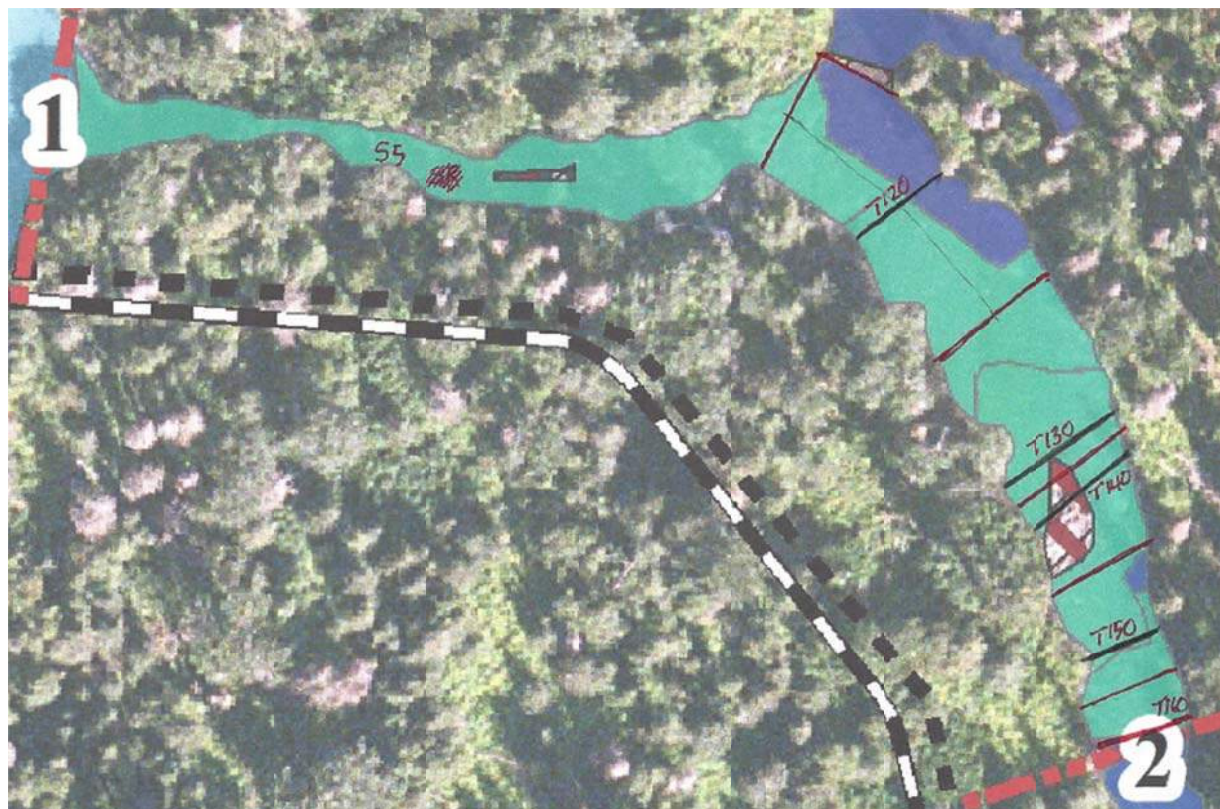


Figure 2. A map of Reach 1 that identifies transects, transect breaks and habitat types that was used to assess habitat weighting.

Table 1. A summary of the proportion and area (ft²) of habitat by type for transect and non-transect areas of Grant Creek, AK.

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
Reach 1 Distributary	S1	Pool	396	33.3%	7,495	2,498
	S2	Riffle	396	21.3%	6,004	1,276
	S3	Pool	396	16.7%	7,495	1,249
	S3	Riffle	396	16.3%	6,004	976
	S4	Pool	396	6.4%	7,495	480
	S4	Riffle	396	25.0%	6,004	1,501
	T100	Riffle	396	26.3%	6,004	1,576
	T100	Pool	396	9.0%	7,495	673
	T110	Riffle	396	11.3%	6,004	675
	T110	Pool	396	34.6%	7,495	2,594
	Total	Pool			7,495	
		Riffle			6,004	
Reach 1 Mainstem	S5	Riffle	692	53.5%	23,168	12,394
	T120	Riffle	692	13.6%	23,168	3,146
	T120	Pool	692	94.4%	3,143	2,968
	T130	Riffle	692	12.8%	23,168	2,956
	T140	Riffle	692	7.8%	23,168	1,811
	T150	Riffle	692	8.6%	23,168	2,002
	T150	Pool	692	5.6%	3,143	175
	T160	Riffle	692	3.7%	23,168	858
	Total	Pool			3,143	
		Riffle			23,168	
Reach 2 Mainstem	S6	Pool	820	86.4%	3,834	3,311
	T200	Backwater	820	38.9%	4,837	1,881
	T220	Riffle	820	16.8%	23,669	3,968
	T220	Glide	820	30.0%	1,613	484

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T230	Glide	820	70.0%	1,613	1,129
	T230 ^{1/}	Backwater	820	44.4%	4,837	2,150
	T230	Riffle	820	10.8%	23,669	2,551
	T210 ^{1/}	Backwater	820	16.7%	4,837	806
	S7	Riffle	820	72.5%	23,669	17,149
	S7	Pool	820	13.6%	3,834	523
	Total	Backwater			1,881	
		Riffle			23,669	
		Glide			1,613	
		Pool			3,834	
Reach 3 Mainstem	S8	Riffle	808	22.9%	25,585	5,866
	S9	Pool	808	66.7%	3,997	2,665
	S10	Riffle	808	22.4%	25,585	5,741
	T300	Backwater	808	100.0%	3,697	3,697
	T310	Riffle	808	5.9%	25,585	1,498
	T310	Pool	808	27.3%	3,997	1,090
	S11	Riffle	808	48.8%	25,585	12,480
	S11	Pool	808	6.1%	3,997	242
	Total	Riffle			25,585	
		Pool			3,997	
Reach 3 Primary Side Channel	S12	Riffle	606	48.8%	11,672	5,698
	S12	Pool	606	41.5%	5,018	2,083
	T320	Riffle	606	18.9%	11,672	2,206
	T320	Pool	606	24.5%	5,018	1,231
	S13	Riffle	606	18.9%	11,672	2,206
	T330	Pool	606	34.0%	5,018	1,704

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T330	Riffle	606	13.4%	11,672	1,562
	T330	Rapid	606	100.0%	511	511
Reach 3 Secondary Side Channel	S14	Cascade	873	100.0%	114	114
	S15	Run	873	100.0%	576	576
	S16	Pool	873	11.0%	9,908	1,094
	S17	Riffle	873	9.5%	2,683	256
	S18	Pool	873	13.0%	9,908	1,287
	S19	Riffle	873	7.1%	2,683	192
	S20	Pool	873	3.2%	9,908	322
	S21	Riffle	873	14.3%	2,683	383
	S22	Pool	873	16.2%	9,908	1,608
	S23	Riffle	873	21.4%	2,683	575
	S24	Pool	873	1.9%	9,908	193
	S25	Riffle	873	4.8%	2,683	128
	S26	Pool	873	24.0%	9,908	2,380
	S27	Riffle	873	14.3%	2,683	383
	S28	Pool	873	16.2%	9,908	1,608
	S29	Glide	873	10.7%	1,588	170
	S30	Pool	873	14.3%	9,908	1,415
	T330	Riffle	873	28.6%	2,683	767
	S31	Glide	873	89.3%	1,588	1,418
	Total	Riffle			14,355	
	Side	Pool			14,926	
	Channel	Glide			1,588	
		Rapid			511	
		Cascade			114	
Reach 4 Mainstem	T400	Riffle	468	11.7%	17,649	2,061

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T410	Riffle	468	17.5%	17,649	3,092
	T410	Pocket Water	468	8.6%	3,709	318
	S32	Riffle	468	70.8%	17,649	12,496
	S32	Pocket Water	468	91.4%	3,709	3,391
	T430	Pool	468	100.0%	1,195	1,195
	Total	Riffle			17,649	
		Pocket Water			3,709	
		Pool			1,195	

^{1/} Backwater on Transect 210 and 230 had WUA values of 0; these were eliminated from the subsequent analysis (see text for further explanation).

Table 2. Lower Grant Creek reach lengths.

Reach	Length (ft)
R 1 Distributary	396
R 1 Mainstem	692
R 2	820
R 3 Mainstem	808
R 3 Side Channel	606
R 2/3 Side Channel	873
R 4	468
Total	
Distributary	396
Main Channel	2,788
Side Channel	1,479
Total	4,663

Table 3. Reach 1 Distributary area and transect weighting.

Total Length (ft) 396									
	Pool		Riffle		Total			Reach Weights	
Trans	Area	% age	Area	% age	Pool	Riffle	Total	% age	Length
T100	673	20.6%	1,576	70.0%	1,543	4,203	5,746	42.6%	169
T110	2,594	79.4%	675	30.0%	5,952	1,801	7,753	57.4%	227
Total	3,267		2,252		7,495	6,004	13,499		396

Table 4. Reach 1 main channel area and transect weighting.

Total Length (ft) 692									
	Pool		Riffle		Total			Reach Weights	
Trans	Area	% age	Area	% age	Pool	Riffle	Total	% age	Length
T120	2,968	94.4%	3,146	29.2%	2,968	6,766	9,734	37.0%	256
T130	0	0.0%	2,956	27.4%	0	6,356	6,356	24.2%	167
T140	0	0.0%	1,811	16.8%	0	3,896	3,896	14.8%	102
T150	175	5.6%	2,002	18.6%	175	4,306	4,480	17.0%	118
T160	0	0.0%	858	8.0%	0	1,845	1,845	7.0%	49
Total	3,143		10,774		3,143	23,168	26,311		692

Table 5. Reach 2 area and transect weighting.

Total Length (ft) = 820															
	Pool		Backwater		Glide		Riffle		Total					Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Area	% age	Pool	BackW	Glide	Riffle	Total	% age	Length
T200	0	N/A	1,881	100.0%	0	0.0%	0	0.0%	0	1,881	0	0	1,881	6.9%	57
T210 ^{1/}	0	N/A			0	0.0%	0	0.0%	0	0	0	0		0.0%	0
T220	0	N/A	N/A	N/A	484	30.0%	3,968	60.9%	0	0	484	14,407	14,891	54.8%	450
T230 ^{1/}	0	N/A	N/A	N/A	1,129	70.0%	2,551	39.1%	0	0	1,129	9,262	10,391	38.3%	314
Total	0		1,881		1,613		6,520		0	1,881	1,613	23,669	27,163		820

^{1/} Backwater channels excluded from analysis; see clarifying text in report.

Table 6. Reach 3 main channel area and transect weighting.

Total Length (ft) = 808												
Trans	Pool		Backwater		Riffle		Total				Reach Weights	
	Area	% age	Area	% age	Area	% age	Pool	Backwater	Riffle	Total	% age	Length
T300	0	0.0%	3,697	100.0%	0	0.0%	0	3,697	0	3,697	11.1%	90
T310	1,090	100.0%	0	0.0%	1,498	100.0%	3,997	0	25,585	29,582	88.9%	718
Total	1,090		3,697		1,498		3,997	3,697	25,585	33,279		808

Table 7. Reach 2/3 side channels area and transect weighting.

Total Length (ft) = 1,479												
Trans	Pool		Riffle		Rapids		Total				Reach Weights	
	Area	% age	Area	% age	Area	% age	Pool	Riffle	Rapids	Total	% age	Length
T320	1,231	41.9%	2,206	48.6%	0	0.0%	2,104	5,677	0	7,782	45.2%	669
T330	1,704	58.1%	2,329	51.4%	511	100.0%	2,914	5,995	511	9,419	54.8%	810
Total	2,935		4,535		511		5,018	11,672	511	17,201		1,479

Table 8. Reach 4 area and transect weighting.

Total Length (ft) =		468										
	Pool		Pocket Water		Riffle		Total				Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Pool	PocketW	Riffle	Total	% age	Length
T400	0	0.0%	0	0.0%	2,061	40.0%	0	0	7,060	7,060	31.3%	146
T410	0	0.0%	318	100.0%	3,092	60.0%	0	3,709	10,589	14,298	63.4%	297
T430	1,195	100.0%	0	0.0%	0	0.0%	1,195	0	0	1,195	5.3%	25
Total	1,195		318		5,153		1,195	3,709	17,649	22,553		468

Table 9. Summary of reach and transect weighting (ft).

Reach	Transect	Length (ft)
1 - Distributary	100	169
	110	227
	Total	396
1 - Main Channel	120	256
	130	167
	140	102
	150	118
	160	49
	Total	692
2 - Main Channel	200	57
	210	0
	220	450
	230	314
	Total	820
3 - Main Channel	300	90
	310	718
	Total	808
2/3 Side Channels	320	669
	330	810
	Total	1,479
4 - Main Channel	400	146
	410	297
	430	25
	Total	468
Total		
Distributary		396
Main Channel		2,788
Side Channel		1,479
Total		4,663

Literature Cited

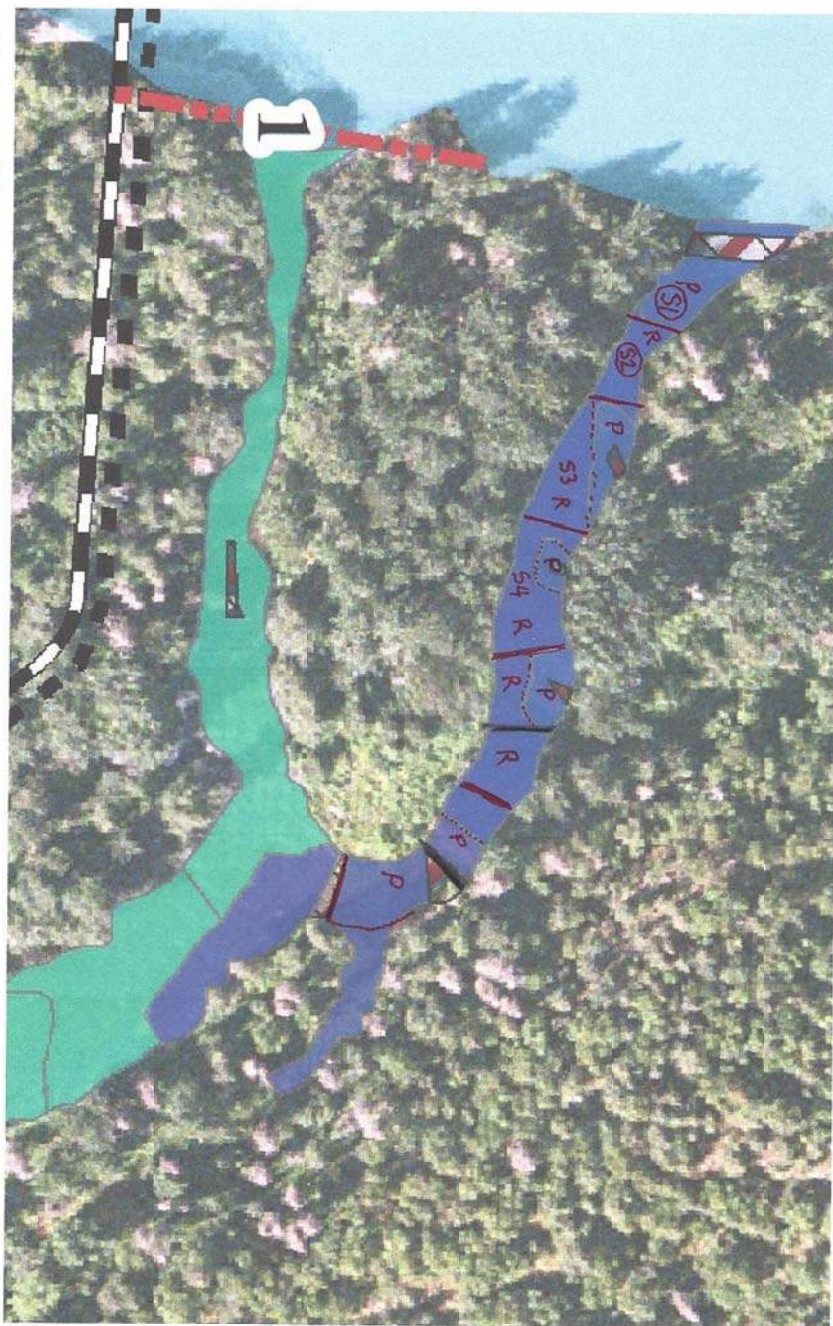
Flory, E. A. 1999. Fish and fish habitats of the Falls Creek area. Prepared by Icy Strait Environmental Services, Gustavus, AK. Prepared for Gustavus Electric Company, Gustavus, AK. 46 pp.

APPENDIX 1

CALCULATION OF REACH HABITAT TYPES AND TRANSECT WEIGHTING

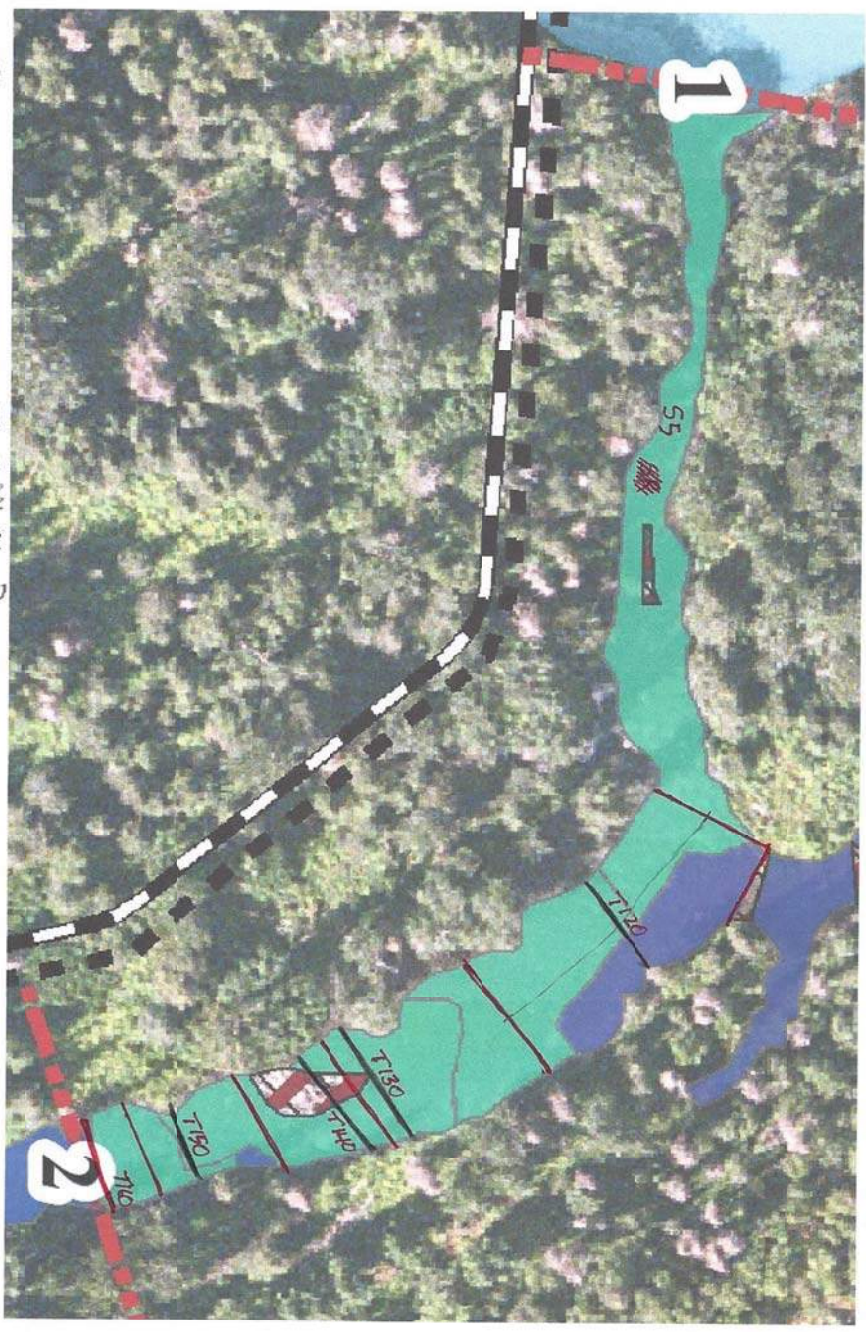
GRANT CREEK INSTREAM FLOW STUDY

RJ- Distributary



S1	Pool	26	T100	Riffle 21	28
S2	Riffle	17	"	Pool 7	
S3	Pool	13			
S3	Riffle	13	T110	Riffle 9	38
S4	Pool	5	"	Pool 27	
S4	Riffle	20			
		25			

R1

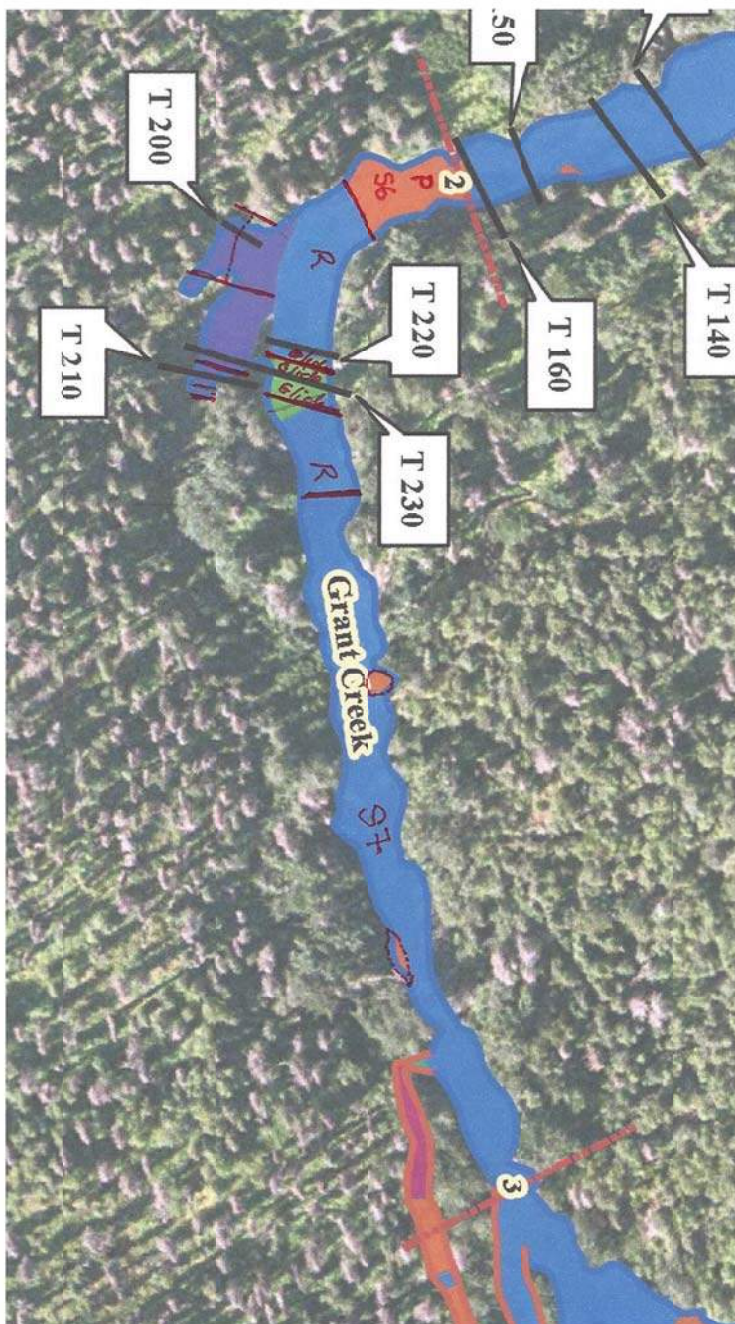


55 Rifle 130
 T120 Rifle 33 } 50
 T120 Pool 17
 T130 Rifle 31
 T140 Rifle 19

T150 Rifle 21 } 22
 T150 Pool 1
 T160 Rifle 9

Pool = 18
 Rifle = 243

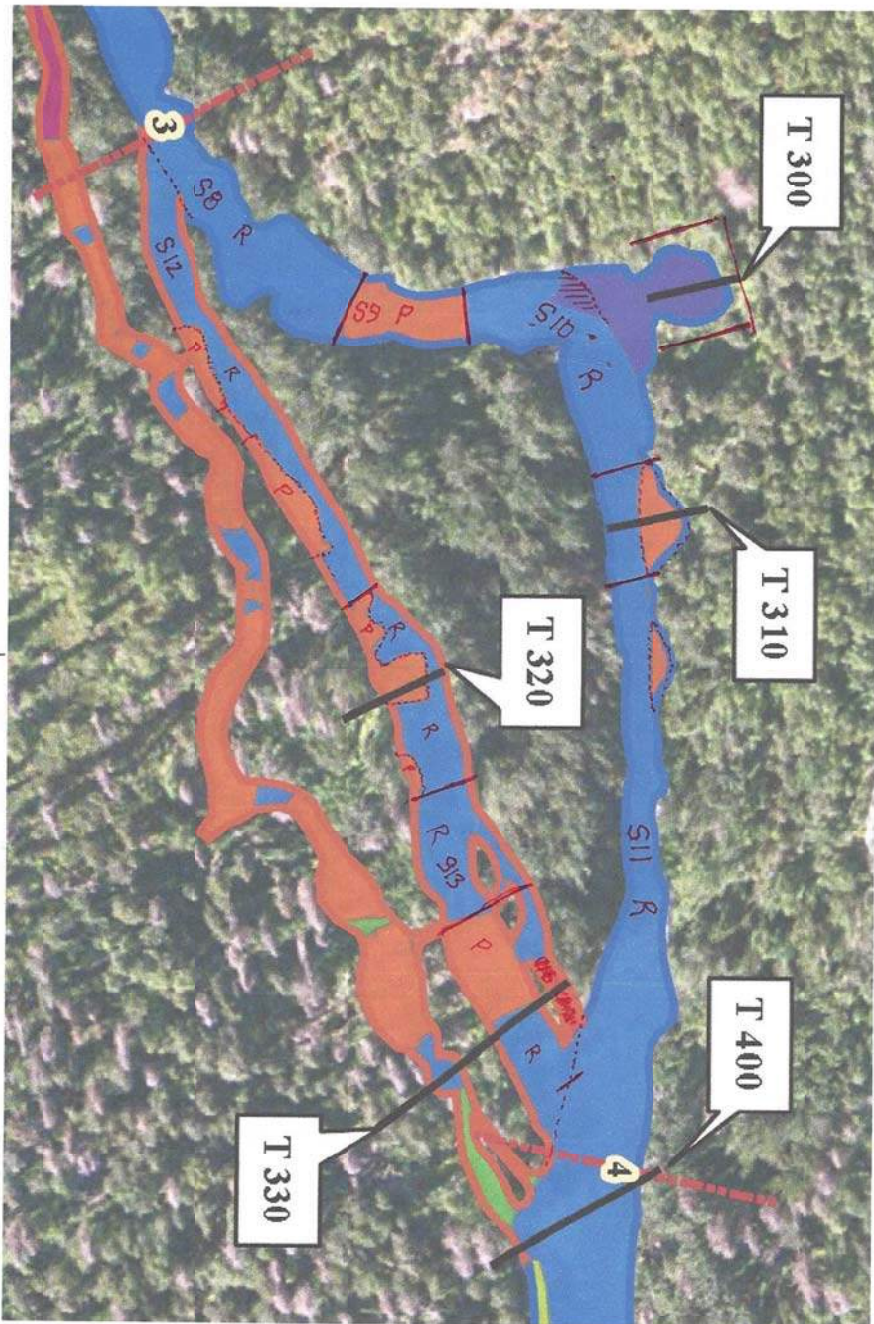
July 18, 2014



T200	Beck H ₂ O	14			
T220	Riffle	28	}	31	
	Glide	3	}		
T230	Glide	7			
T230	Beck H ₂ O	16			
T230	Riffle	18			

Reach 3

July 18, 2014

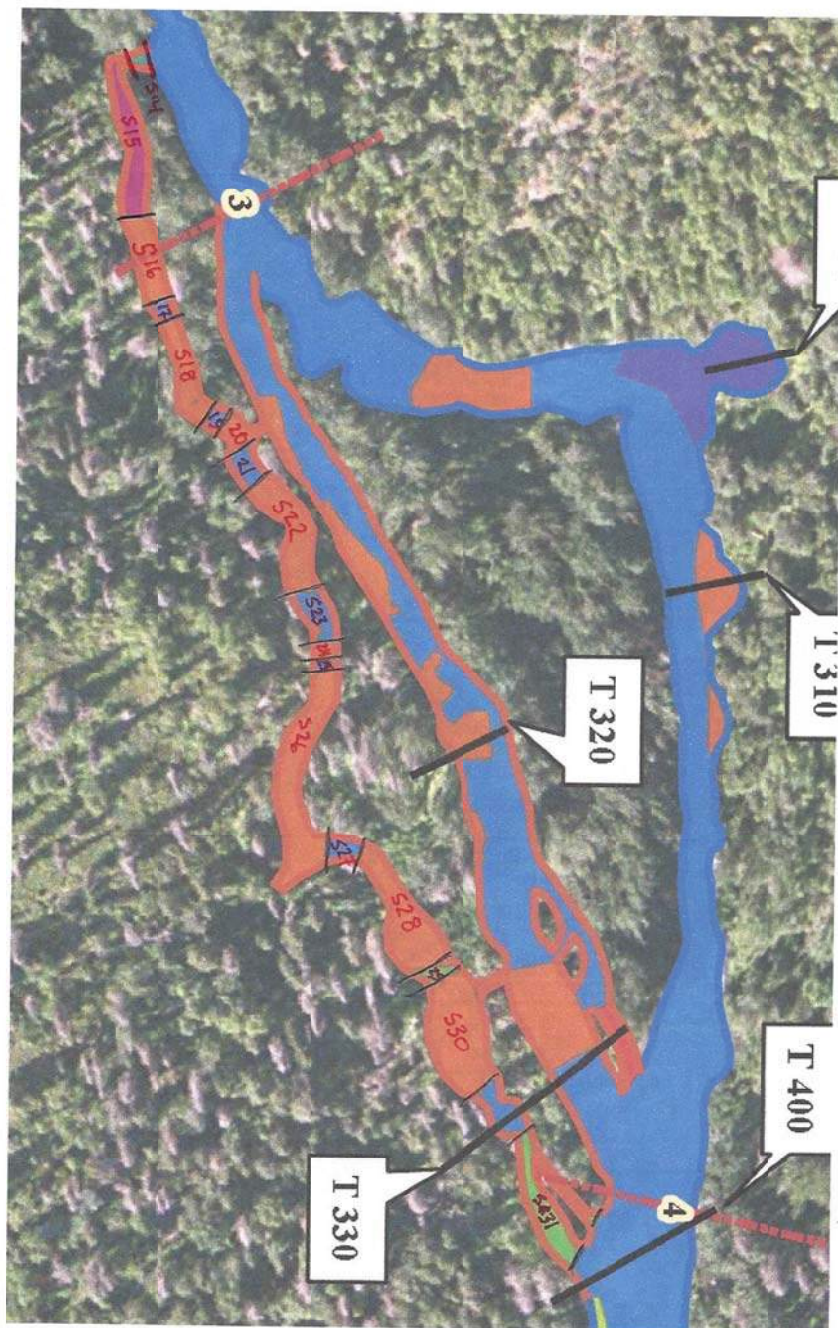


Mainstem			
S8	Riffle	47	T310
S9	Pool	22	T310
S10	Riffle	46	S11
T300	Back H'd	20	S11
			Pool
			12
			9
			100
			2
			102

Secondary			
S12	Riffle	62	S13
S12	Pool	22	T330
T320	Riffle	24	T330
T320	Pool	13	T330
			Rapid
			24
			18
			17

			35

July 18 2014



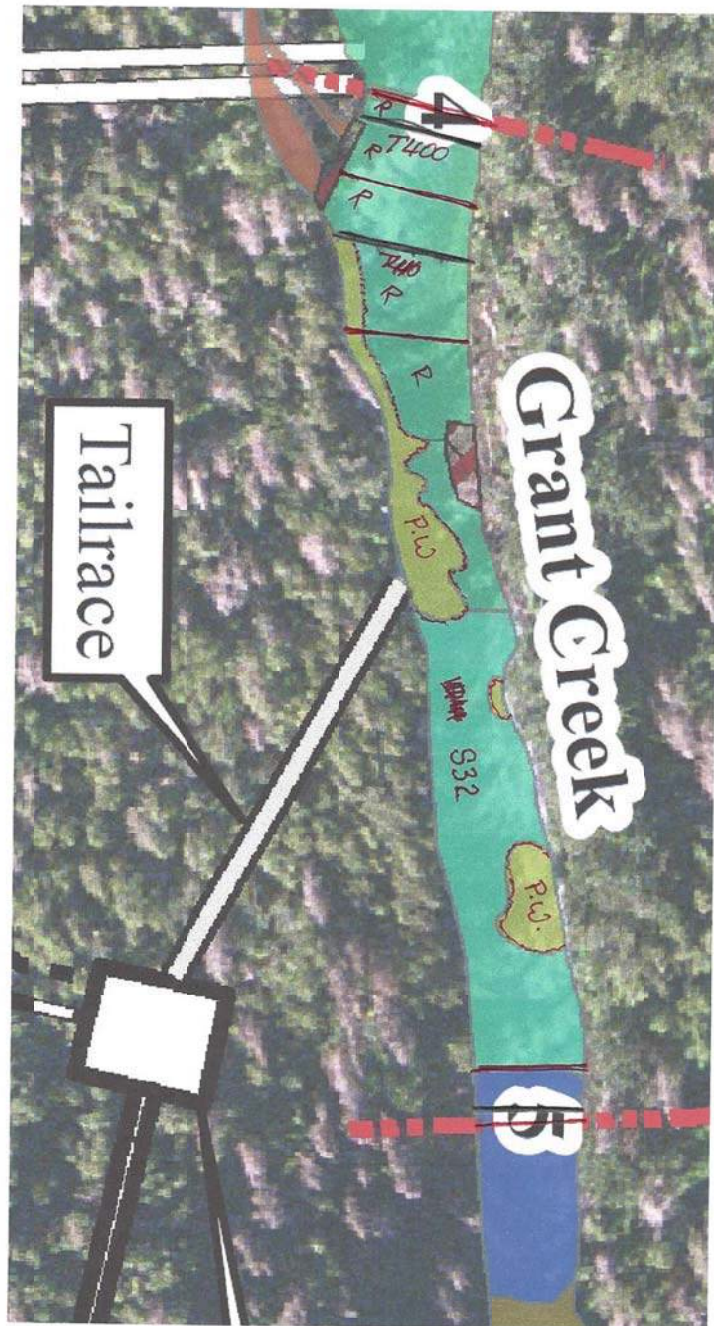
	Case	Control
514	Case	3
515	Rum	31
516	Pool	17
517	Riffle	4
518	Pool	20
519	Riffle	3

S20	Pool	5
S21	Riffle	6
S22	Pool	25
S23	Riffle	9
S24	Pool	3
S25	Riffle	2

Sample	Pool	Rifle	3T
S26	Pool		3T
S27	Rifle	6	
S28	Pool	25	
S29	Glide	3	
S30	Pool	42	
T330	Rifle	12	

531 Glide 25

R4



T400	Rifle	16
T410	Rifle	24
T410	Rocket H2O	3
S32	Rifle	97
S32	Rocket H2O	37
T430	Pool	11

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Friday, August 01, 2014 3:58 PM
To: 'Klein, Joseph P (DFG)'; Miller, Monte D (DFG); Jason Mouw
Cc: John Stevenson; Cory Warnock; Emily Andersen
Subject: RE: Grant Lake Habitat Quantification and Aggregation

Good comments, Joe – after I left you a message stating the issues with velocity, I found a way to trick the model. I'm not very often smarter than the model (like never), so I guess the odds were with me to do it once!

I'll incorporate T210 and T230 (the backwater part) into the final WUA numbers. There will not be any WUA for Chinook, Dolly Varden or Rainbow spawning, or Dolly Varden and Rainbow juvenile rearing, since the HSI value for 0 velocity is 0, but I should get something for the other species and life history stages. I'll redo the transect weighting paper to reflect their incorporation.

Thanks for making me rethink this – have a good weekend!

John

John Blum
Sr. Fisheries Scientist

From: Klein, Joseph P (DFG) [<mailto:joe.klein@alaska.gov>]
Sent: Friday, August 01, 2014 12:27 PM
To: John Blum; Miller, Monte D (DFG); Mouw, Jason E B (DFG)
Cc: John Stevenson; 'Cory Warnock'; Emily Andersen
Subject: RE: Grant Lake Habitat Quantification and Aggregation

Thanks John – I think we are fine with everything except I wanted to discuss the 4th bullet regarding Tr 200, 210 & 230 a little more. The preference would be to define the physical habitat as best we can with the and model and let the HSC info drive the biological criteria and associated WUA results. I have not looked at the HSC data for this project, but in other projects the HSC for some species/life stages have included a biological response to zero velocity. If that's not the case for this project, then habitat simulations for backwater habitats with zero velocities will provide WUA results equal to zero. This accomplishes the same end result without pre-determining decisions.

Joe Klein, P.E.
Aquatic Resources Unit Supervisor
Alaska Department of Fish and Game
333 Raspberry Rd
Anchorage, AK 99518
(907) 267-2148

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Friday, August 01, 2014 9:55 AM
To: Miller, Monte D (DFG); Klein, Joseph P (DFG); Mouw, Jason E B (DFG)
Cc: John Stevenson; 'Cory Warnock'; Emily Andersen
Subject: FW: Grant Lake Habitat Quantification and Aggregation

Good afternoon, Monte and Joe:

Thank you for looking at the report again, and giving us your comments. Our responses are in red, below. Where needed, we have revised the report to reflect your concerns. Let us know if you have any additional comments. If not, I will mark it as final and send it out to the group.

Thanks again for all your work on this. Have a good weekend!

John

John Blum
Sr. Fisheries Scientist

From: Miller, Monte D (DFG) [<mailto:monte.miller@alaska.gov>]
Sent: Tuesday, July 29, 2014 11:46 AM
To: John Blum (john.blum@mcmillen-llc.com)
Cc: Klein, Joseph P (DFG)
Subject: FW: Grant Lake Habitat Quantification and Aggregation

John,

Attached are some comments from Joe. We would appreciate some follow-up on these comments, particularly bullets 1 and 4.

Thanks for your patience.

Monte D. Miller
Statewide FERC Hydropower Coordinator
Alaska Department of Fish and Game
Division of Sport Fish / RTS
333 Raspberry Road
Anchorage, Alaska, 99518-1565

907 267-2312

From: Klein, Joseph P (DFG)
Sent: Monday, July 28, 2014 3:49 PM
To: Miller, Monte D (DFG)
Subject: Grant Lake Habitat Quantification and Aggregation

Monte-

Per your request, I have reviewed the revised draft dated July 24, 2014. The goal of this effort is to determine how to proportion selected transects in relation to available habitat characterized by the habitat inventory for the PHABSIM/IFIM model. This will provide baseline habitat results that can then be compared to alternative operation scenarios for evaluation of project impacts. The report and tables along with the addition of the maps in Appendix 1 provides a good description of the method and basis for this assessment. Following are some comments for consideration that may improve the document.

- Page 1, 1st para: minor comment but the example given for S13 as a riffle appears to show pool habitat at the edges of the stream. Not sure if this amount of pool habitat is so small as to be insignificant, an artifact of mapping, or what but it does show up and caused me confusion.

Response: Segment 13 (S13) is comprised only of riffle habitat, and is bordered on the downstream margin by riffle and pool habitat, and on the upstream margin by the log jam. It appears that Joe was looking at the figure on page 16 instead of page 2. On page 16, the outline of the channel is the same color as the pool habitat, which is most likely the cause of the confusion. We'd rather not have to revise the maps, which would take quite a bit of work, so if you are alright with this clarification, we'll leave them as is in the report. We will put a clarifying comment in the report.

- Page 1, last para: there is an extra “)”.

Response: We have corrected this.

- Page 1, last para: Here is the citation for Flory (1999) however I was unable to put my hands on the actual document to verify

o Flory, E.A. 1999. Fish and fish habitats of the Falls Creek area. Prepared by Icy Strait Environmental Services, Gustavus, AK. Prepared for Gustavus Electric Company, Gustavus, AK. 46 pp.

Response: We have added this citation. Thank you.

- Page 3, 2nd para: It is not clear why the backwater habitats in transects 210 and 230 were excluded from the analysis? According to Table 5, Transect 200 was included as backwater habitat. Either a specific reason for the exclusions should be provided or the habitats should be included.

Response: The backwater associated with Transect 200 actually has some flow on its outer edge, and provides both spawning and rearing habitat. The backwater associated with Transect 210 and that portion of Transect 230 is truly a backwater. It has absolutely no flow or velocities at all, and water surface elevation (stage) is completely dependent upon the hydraulic controls downstream. Since the velocity is 0 ft/s, WUA for virtually all species and life history stages was 0. For this reason, we excluded these parts of the transects from the analysis, since they did not contribute to overall habitat. We added a clarifying comment in the report.

- Tables 3 – 8: suggest adding the header “Reach Weights” to the last column for the % age and length results.

Response: We have revised the header to reflect this suggestion.

No virus found in this message.

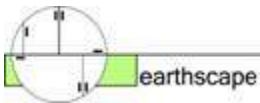
Checked by AVG - www.avg.com

Version: 2014.0.4716 / Virus Database: 3986/7944 - Release Date: 07/29/14

No virus found in this message.

Checked by AVG - www.avg.com

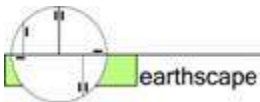
Version: 2014.0.4716 / Virus Database: 3986/7962 - Release Date: 08/01/14



From: Dwayne Adams [mailto:wdadams@earthscape.alaska.com]
Sent: Friday, August 01, 2014 12:46 PM
To: 'Duvall, Shina A (DNR)'
Subject: RE: INHT Meeting

Thanks Shina.

Dwayne Adams
Landscape Architect



1343 G Street, Suite 101
Anchorage, AK 99501

P 907.279.2688

From: Duvall, Shina A (DNR) [mailto:shina.duvall@alaska.gov]
Sent: Friday, August 01, 2014 12:36 PM
To: Dwayne Adams
Cc: Bittner, Judith E (DNR)
Subject: RE: INHT Meeting

Dwayne,

We do not have any additional comments/edits on the meeting minutes.

Best regards,
Shina

Shina duVall, RPA
Archaeologist, Review and Compliance Coordinator
Alaska State Historic Preservation Office / Office of History and Archaeology
550 W. 7th Ave., Suite 1310
Anchorage, Alaska 99501
907-269-8720 (phone) 907-269-8908 (fax)
shina.duvall@alaska.gov

From: Dwayne Adams [<mailto:wdadams@earthscape.alaska.com>]
Sent: Tuesday, July 29, 2014 4:47 PM
To: Duvall, Shina A (DNR); 'Stovall, Robert -FS'; Russell, Pamela J (DNR); kvanmassenhove@fs.fed.us; Schick, Lesli J (DNR); 'Fitzpatrick, Mike -FS'; 'Eavis, John -FS'; 'Kime, Sherry D -FS'; 'Mike Salzetti'; mmueller@borough.kenai.ak.us; Bittner, Judith E (DNR); 'Cory Warnock'; 'Matt McMillan'
Cc: Griffin, David W (DNR)
Subject: RE: INHT Meeting

Attached are meeting minutes from the field trip to the INHT trail on the 15th. Please review them and see if they capture our discussions during and after the field trip.

Thanks much-it was a nice trip. << File: 2014-07-15-INHT Field Trip Memo.pdf >>

Dwayne Adams
Landscape Architect



1343 G Street, Suite 101
Anchorage, AK 99501

P 907.279.2688

Grant Lake Hydroelectric Project (FERC No. 13212) Licensing

Consultation Record

Phone/E-mail/One-on-One Meeting Log

Contact Name: Robert Stovall

Agency/Organization: USFS, Chugach Forest

Phone No./E-mail Address: 743-9474

Date: August 1, 2014

Time: 10:06 am

Grant Lake Licensing Team Contact:

Dwayne Adams

Summary of Conversation and/or E-mail Exchange:

Bob had called based on my request for the Trail Management Objectives (TMOs) for the INHT through the project area and I returned his call. I confirmed that John Eavis (USFS) had provided the TMOs to me. I noted they were in 'draft' format and we discussed that while some changes might occur, they were reasonably accurate and reflected what has been built. Robert explained that a constructed portion of the INHT has access from the USFS Ptarmigan Campground, using a linking trail approximately $\frac{3}{4}$ mile long. That provides a good idea of what is expected.

I told Robert we laid in a routing for the proposed alternate with flagging about 40' to 50' apart. It should provide a good idea of what we have in mind and should be reasonably easy to follow. I told him that John Eavis had suggested that they might take a look at the trail in the autumn, when leaves are off and bugs are down.

Robert also said he had reviewed the meeting minutes from the July 15 trail walk. They looked good except that he noted that the paragraph after the attendees notes a walk to "the Trail Lake crossing." That should read "Trail Creek crossing." He was good with the rest of the memo.

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Monday, August 04, 2014 10:35 AM
To: Klein, Joseph P (DFG); Miller, Monte D (DFG); Jason Mouw
Cc: John Stevenson; Cory Warnock; Emily Andersen
Subject: Transect weighting report
Attachments: Habitat Quantification Methodology 08-01-2014.docx

Good morning:

Here is a revised Transect Weighting Report. I was able to trick the model into running 0 velocities, so I was able to include those backwaters in the analysis.

If you are ok with this, I will finalize and send it to the group.

Thanks for continuing to ask about those backwaters. It made me think outside the box, and gave us a better product.

John

John Blum
Sr. Fisheries Scientist

DRAFT
Habitat Quantification/Transect Weighting Methodology
Revised August 1, 2014

Introduction

As part of the IFIM assessment of habitat within Grant Creek, it is necessary to identify habitat types within reaches of Grant Creek, to quantify those habitats, and to weight them in proportion to their availability within lower Grant Creek. These analyses are then used to weight those transects that were selected and modeled within Reaches 1 through 4. As such, we have undertaken a process to identify and quantify habitat within the various reaches of Grant Creek. Our assessment has been tailored to provide metrics consistent with the work conducted by Flory (1999) on Falls Creek, AK; a summary of these results was provided by Alaska Department of Fish and Game. This document is a brief summary of the methodology used in our analysis.

Map Layout

A scaled map of Grant Creek, which depicted meso-habitats, was overlaid with reach breaks and transect locations. An 8.5 x 11 inch map of each reach was prepared, and the area (ft²) associated within a given transect was added to each map; the upstream and downstream boundaries associated with each transect were based on one of two criteria:

1. In the event another transect was relatively close to the transect of interest, the boundary was located an equidistance from each transect, or
2. If the nearest transect was more than one meso-habitat away, then the boundary was located at the edge of the meso-habitat associated with that transect or some obvious geophysical feature within Grant Creek (Figure 1).

All non-transect sections of Grant Creek were also categorized, and numbered sequentially starting within the Reach 1 Distributary and working upstream (e.g., S1, S2, etc.).

Measurement of Habitat

With the prepared maps, it was then possible to measure the length (in millimeters) of each habitat type within a given reach. Each habitat type was associated with either a specific transect (e.g., T300, T310, etc.) or a non-transect area (e.g., S8, S9, etc.). In the event a single habitat type fell within a specific area, such as S8 (Figure 1), measurement of that habitat was relatively straight forward and was simply confined by the boundaries located at the Reach 2/3 break (downstream) and the boundary with S9 (upstream). In the event more than one habitat type existed within a specific area, it was then necessary to subjectively proportion the length of each habitat type for that site. A good example of this scenario is most of the Primary Secondary Channel of Reach 3 (Figure 1), where multiple meso-habitats occurred in all segments with the exception of S13, which consisted only of riffle habitat.

With each habitat type measured by reach, each transect and non-transect segment of Grant Creek quantified, and with additional information from the GIS database (i.e., reach length and overall area of each habitat type, in ft²), it was then possible to calculate area of habitat associated with each segment within Grant Creek, and linear feet of habitat by segment. It was also possible to compile those data and generate results consistent with work by Flory (1999) on Falls Creek, AK. Figure 2 and Table 1 show an example of the first level of analysis, where transect and non-transect segments of Reach 1 are summarized to provide the proportion of habitat within the reach, and the overall area of habitat

associated within those segments. Appendix 1 shows Grant Creek reaches and calculations of habitat areas within each reach.



Once habitat frequencies were established for each transect, available habitat (by type) were then scaled in proportion to their availability within that reach. The results were then summed and each transect was weighted in accordance with its area and assigned a length (in ft).

Table 2 shows the lengths of each reach. There are 396 linear ft of habitat in the Distributary in Reach 1, 2,788 linear ft of habitat in mainstem Reaches 1 – 4, and 1,479 linear ft in the Reach 2/3 side channels. Tables 3 – 8 show calculation details for each reach in lower Grant Creek. Table 9 summarizes weighting for all transects.

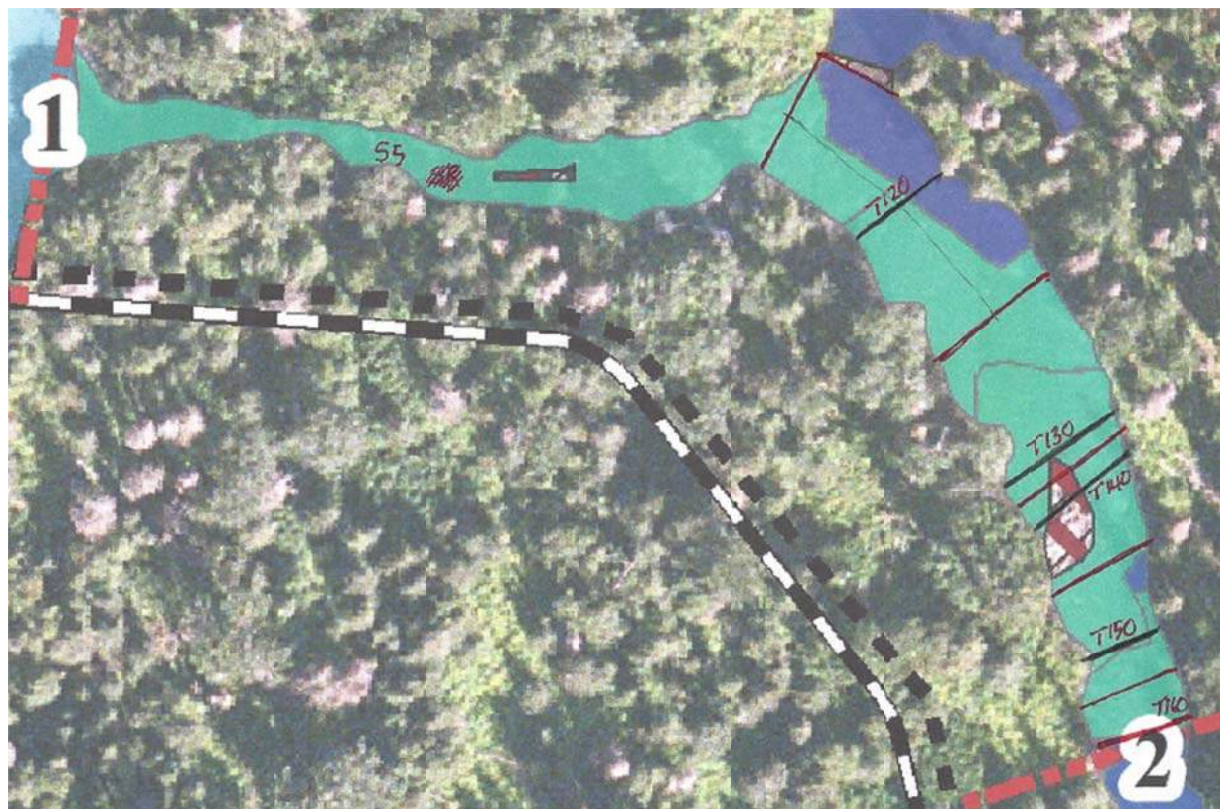


Figure 2. A map of Reach 1 that identifies transects, transect breaks and habitat types that was used to assess habitat weighting.

Table 1. A summary of the proportion and area (ft²) of habitat by type for transect and non-transect areas of Grant Creek, AK.

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
Reach 1 Distributary	S1	Pool	396	33.3%	7,495	2,498
	S2	Riffle	396	21.3%	6,004	1,276
	S3	Pool	396	16.7%	7,495	1,249
	S3	Riffle	396	16.3%	6,004	976
	S4	Pool	396	6.4%	7,495	480
	S4	Riffle	396	25.0%	6,004	1,501
	T100	Riffle	396	26.3%	6,004	1,576
	T100	Pool	396	9.0%	7,495	673
	T110	Riffle	396	11.3%	6,004	675
	T110	Pool	396	34.6%	7,495	2,594
	Total	Pool			7,495	
		Riffle			6,004	
Reach 1 Mainstem	S5	Riffle	692	53.5%	23,168	12,394
	T120	Riffle	692	13.6%	23,168	3,146
	T120	Pool	692	94.4%	3,143	2,968
	T130	Riffle	692	12.8%	23,168	2,956
	T140	Riffle	692	7.8%	23,168	1,811
	T150	Riffle	692	8.6%	23,168	2,002
	T150	Pool	692	5.6%	3,143	175
	T160	Riffle	692	3.7%	23,168	858
	Total	Pool			3,143	
		Riffle			23,168	
Reach 2 Mainstem	S6	Pool	820	86.4%	3,834	3,311
	T200	Backwater	820	38.9%	4,837	1,881
	T220	Riffle	820	16.8%	23,669	3,968
	T220	Glide	820	30.0%	1,613	484

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T230	Glide	820	70.0%	1,613	1,129
	T230	Backwater	820	44.4%	4,837	2,150
	T230	Riffle	820	10.8%	23,669	2,551
	T210	Backwater	820	16.7%	4,837	806
	S7	Riffle	820	72.5%	23,669	17,149
	S7	Pool	820	13.6%	3,834	523
	Total	Backwater			4,837	
		Riffle			23,669	
		Glide			1,613	
		Pool			3,834	
Reach 3 Mainstem	S8	Riffle	808	22.9%	25,585	5,866
	S9	Pool	808	66.7%	3,997	2,665
	S10	Riffle	808	22.4%	25,585	5,741
	T300	Backwater	808	100.0%	3,697	3,697
	T310	Riffle	808	5.9%	25,585	1,498
	T310	Pool	808	27.3%	3,997	1,090
	S11	Riffle	808	48.8%	25,585	12,480
	S11	Pool	808	6.1%	3,997	242
	Total	Riffle			25,585	
		Pool			3,997	
Reach 3 Primary Side Channel		Backwater			3,697	
	S12	Riffle	606	48.8%	11,672	5,698
	S12	Pool	606	41.5%	5,018	2,083
	T320	Riffle	606	18.9%	11,672	2,206
	T320	Pool	606	24.5%	5,018	1,231
	S13	Riffle	606	18.9%	11,672	2,206
	T330	Pool	606	34.0%	5,018	1,704

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T330	Riffle	606	13.4%	11,672	1,562
	T330	Rapid	606	100.0%	511	511
Reach 3 Secondary Side Channel	S14	Cascade	873	100.0%	114	114
	S15	Run	873	100.0%	576	576
	S16	Pool	873	11.0%	9,908	1,094
	S17	Riffle	873	9.5%	2,683	256
	S18	Pool	873	13.0%	9,908	1,287
	S19	Riffle	873	7.1%	2,683	192
	S20	Pool	873	3.2%	9,908	322
	S21	Riffle	873	14.3%	2,683	383
	S22	Pool	873	16.2%	9,908	1,608
	S23	Riffle	873	21.4%	2,683	575
	S24	Pool	873	1.9%	9,908	193
	S25	Riffle	873	4.8%	2,683	128
	S26	Pool	873	24.0%	9,908	2,380
	S27	Riffle	873	14.3%	2,683	383
	S28	Pool	873	16.2%	9,908	1,608
	S29	Glide	873	10.7%	1,588	170
	S30	Pool	873	14.3%	9,908	1,415
	T330	Riffle	873	28.6%	2,683	767
	S31	Glide	873	89.3%	1,588	1,418
	Total	Riffle			14,355	
	Side	Pool			14,926	
	Channel	Glide			1,588	
		Rapid			511	
		Cascade			114	
Reach 4 Mainstem	T400	Riffle	468	11.7%	17,649	2,061

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T410	Riffle	468	17.5%	17,649	3,092
	T410	Pocket Water	468	8.6%	3,709	318
	S32	Riffle	468	70.8%	17,649	12,496
	S32	Pocket Water	468	91.4%	3,709	3,391
	T430	Pool	468	100.0%	1,195	1,195
	Total	Riffle			17,649	
		Pocket Water			3,709	
		Pool			1,195	

Table 2. Lower Grant Creek reach lengths.

Reach	Length (ft)
R 1 Distributary	396
R 1 Mainstem	692
R 2	820
R 3 Mainstem	808
R 3 Side Channel	606
R 2/3 Side Channel	873
R 4	468
Total	
Distributary	396
Main Channel	2,788
Side Channel	1,479
Total	4,663

Table 3. Reach 1 Distributary area and transect weighting.

Total Length (ft) 396									
	Pool		Riffle		Total			Reach Weights	
Trans	Area	% age	Area	% age	Pool	Riffle	Total	% age	Length
T100	673	20.6%	1,576	70.0%	1,543	4,203	5,746	42.6%	169
T110	2,594	79.4%	675	30.0%	5,952	1,801	7,753	57.4%	227
Total	3,267		2,252		7,495	6,004	13,499		396

Table 4. Reach 1 main channel area and transect weighting.

Total Length (ft) 692									
	Pool		Riffle		Total			Reach Weights	
Trans	Area	% age	Area	% age	Pool	Riffle	Total	% age	Length
T120	2,968	94.4%	3,146	29.2%	2,968	6,766	9,734	37.0%	256
T130	0	0.0%	2,956	27.4%	0	6,356	6,356	24.2%	167
T140	0	0.0%	1,811	16.8%	0	3,896	3,896	14.8%	102
T150	175	5.6%	2,002	18.6%	175	4,306	4,480	17.0%	118
T160	0	0.0%	858	8.0%	0	1,845	1,845	7.0%	49
Total	3,143		10,774		3,143	23,168	26,311		692

Table 5. Reach 2 area and transect weighting.

Total Length (ft) = 820															
	Pool		Backwater		Glide		Riffle		Total					Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Area	% age	Pool	BackW	Glide	Riffle	Total	% age	Length
T200	0	0.0%	1,881	38.9%	0	0.0%	0	0.0%	0	1,881	0	0	1,881	6.2%	51
T210	0	0.0%	806	16.7%	0	0.0%	0	0.0%	0	806	0	0	806	2.7%	22
T220	0	0.0%	0	0.0%	484	30.0%	3,968	60.9%	0	0	484	14,407	14,891	49.4%	405
T230-M	0	0.0%	0	0.0%	1,129	70.0%	2,551	39.1%	0	0	1,129	9,262	10,391	34.5%	283
T230-BW	0	0.0%	2,149.8	44.4%	0	0.0%	0	0.0%	0	2,150	0	0	2,150	7.1%	58
Total	0		4,837		1,613		6,520		0	4,837	1,613	23,669	30,119		819

Table 6. Reach 3 main channel area and transect weighting.

Total Length (ft) = 808												
	Pool		Backwater		Riffle		Total				Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Pool	Backwater	Riffle	Total	% age	Length
T300	0	0.0%	3,697	100.0%	0	0.0%	0	3,697	0	3,697	11.1%	90
T310	1,090	100.0%	0	0.0%	1,498	100.0%	3,997	0	25,585	29,582	88.9%	718
Total	1,090		3,697		1,498		3,997	3,697	25,585	33,279		808

Table 7. Reach 2/3 side channels area and transect weighting.

Total Length (ft) = 1,479												
Trans	Pool		Riffle		Rapids		Total				Reach Weights	
	Area	% age	Area	% age	Area	% age	Pool	Riffle	Rapids	Total	% age	Length
T320	1,231	41.9%	2,206	48.6%	0	0.0%	2,104	5,677	0	7,782	45.2%	669
T330	1,704	58.1%	2,329	51.4%	511	100.0%	2,914	5,995	511	9,419	54.8%	810
Total	2,935		4,535		511		5,018	11,672	511	17,201		1,479

Table 8. Reach 4 area and transect weighting.

Total Length (ft) =		468										
	Pool		Pocket Water		Riffle		Total				Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Pool	PocketW	Riffle	Total	% age	Length
T400	0	0.0%	0	0.0%	2,061	40.0%	0	0	7,060	7,060	31.3%	146
T410	0	0.0%	318	100.0%	3,092	60.0%	0	3,709	10,589	14,298	63.4%	297
T430	1,195	100.0%	0	0.0%	0	0.0%	1,195	0	0	1,195	5.3%	25
Total	1,195		318		5,153		1,195	3,709	17,649	22,553		468

Table 9. Summary of reach and transect weighting (ft).

Reach	Transect	Length (ft)
1 - Distributary	100	169
	110	227
	Total	396
1 - Main Channel	120	256
	130	167
	140	102
	150	118
	160	49
	Total	692
2 - Main Channel	200	51
	210	22
	220	405
	230-M ^{1/}	283
	230-BW ^{2/}	58
3 - Main Channel	Total	820
	300	90
	310	718
2/3 Side Channels	Total	808
	320	669
	330	810
4 - Main Channel	Total	1,479
	400	146
	410	297
	430	25
Total		468
Total		
Distributary		396
Main Channel		2,788
Side Channel		1,479
Total		4,663

^{1/} Main Channel; ^{2/} Backwater

Literature Cited

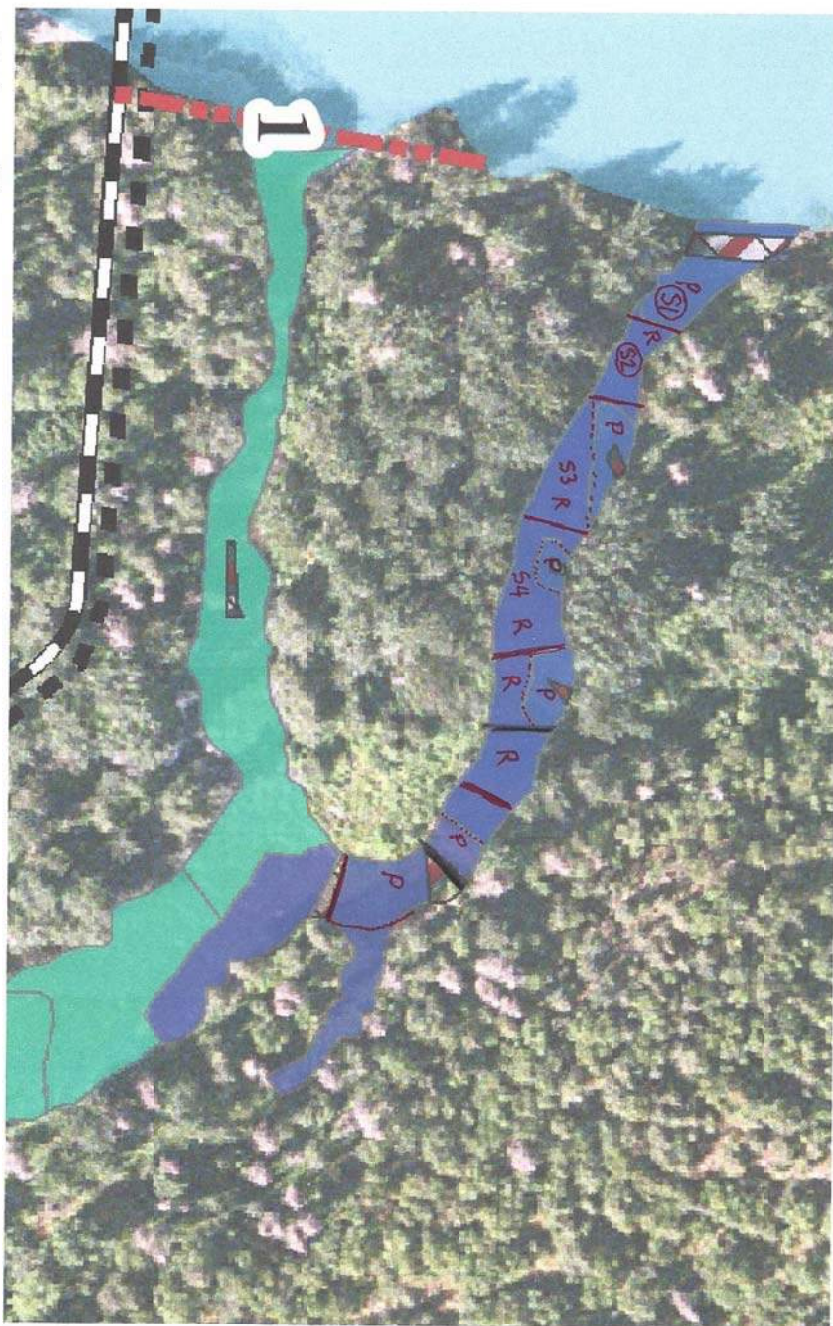
Flory, E. A. 1999. Fish and fish habitats of the Falls Creek area. Prepared by Icy Strait Environmental Services, Gustavus, AK. Prepared for Gustavus Electric Company, Gustavus, AK. 46 pp.

APPENDIX 1

CALCULATION OF REACH HABITAT TYPES AND TRANSECT WEIGHTING

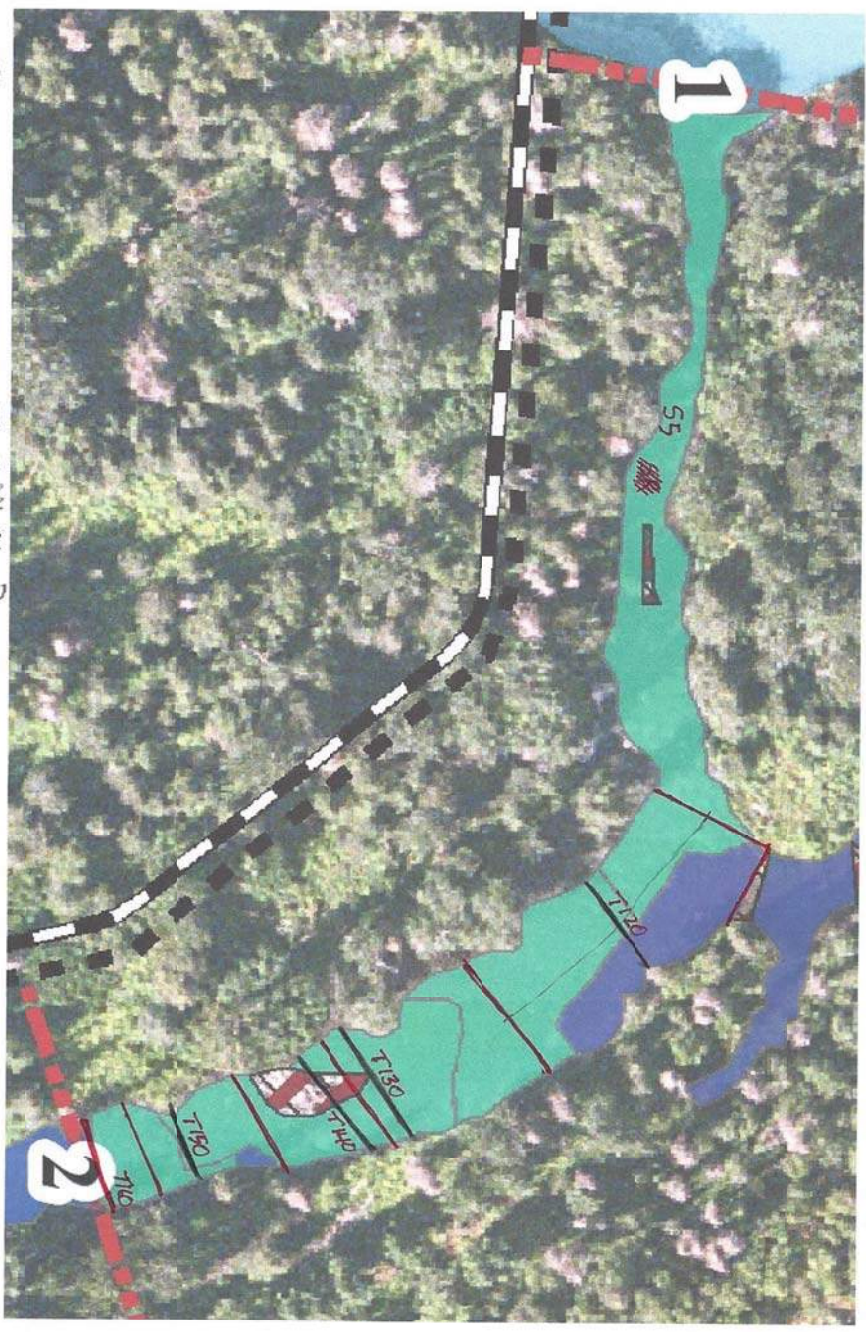
GRANT CREEK INSTREAM FLOW STUDY

RJ- Distributary



S1	Pool	26	T100	Riffle 21	28
S2	Riffle	17	"	Pool 7	
S3	Pool	13			
S3	Riffle	13			
S4	Pool	5	T110	Riffle 9	38
S4	Riffle	20	"	Pool 27	
		25			

R1

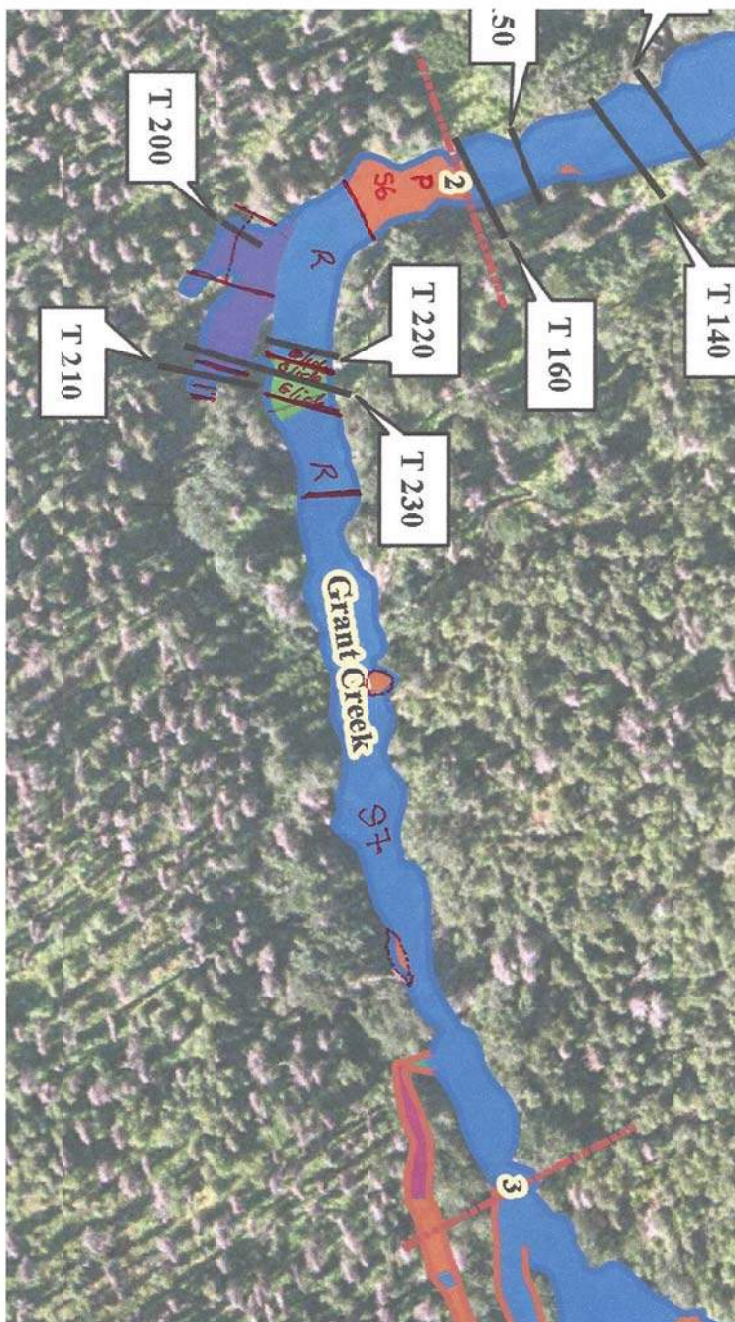


SS Rifle 130
 T120 Rifle 33 } 50
 T120 Pool 17
 T130 Rifle 31
 T140 Rifle 19

T150 Rifle 21 } 22
 T150 Pool 1
 T160 Rifle 9

Pool = 18
 Rifle = 243

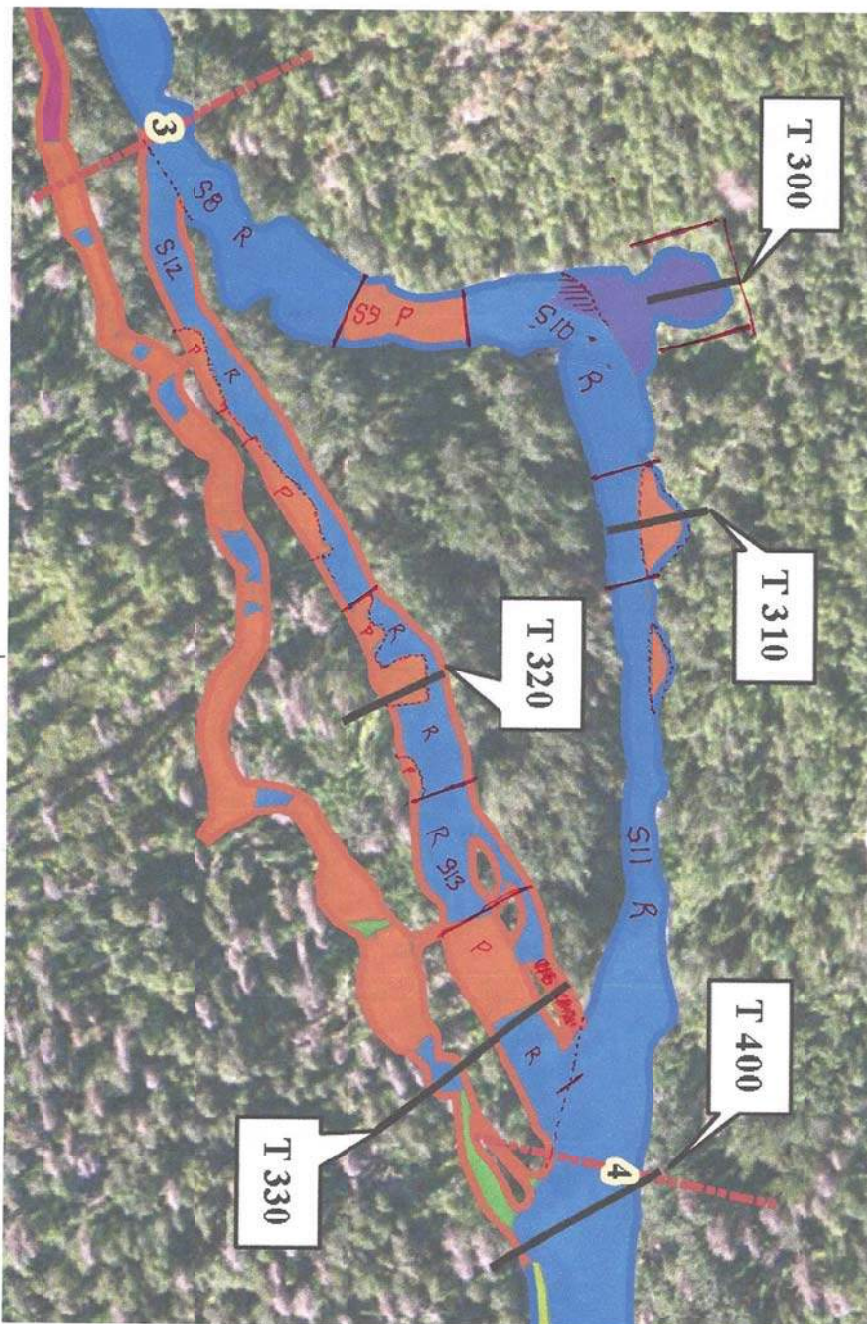
July 18, 2014



Sample	Pool	19	210	BeckH ₂ O	6
56	Pool	19	57	Riffle	121
T200	BeckH ₂ O	14	57	Pool	3
T220	Riffle	28			
	Glide	3			
		31			
T230	Glide	7			
T230	BeckH ₂ O	16			
T230	Riffle	18			

Reach 3

July 18, 2014

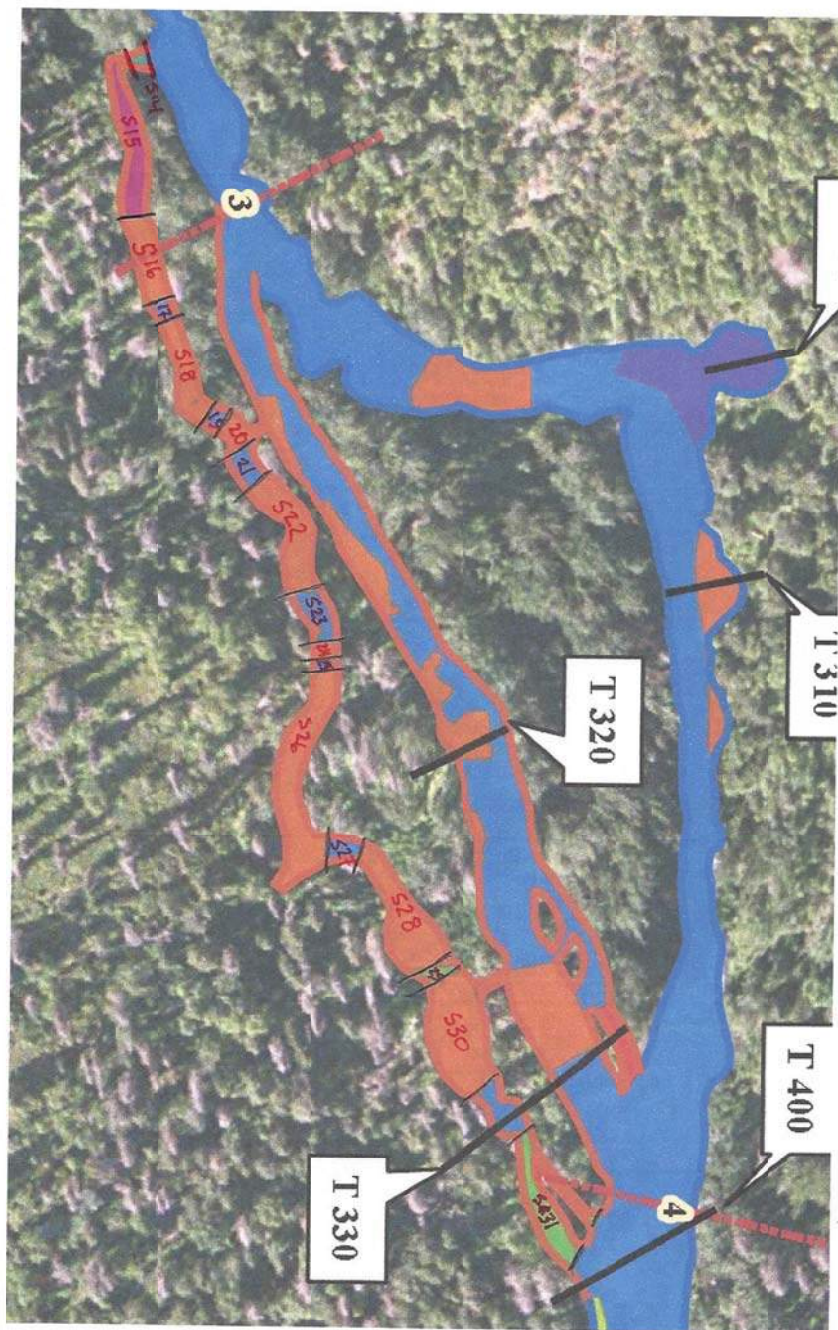


Mainstem			
S 8	Riffle	47	T 310
S 9	Pool	22	T 310
S 10	Riffle	46	S 11
T 300	Back H'd	20	S 11
			Pool
			12
			9
			100
			2
			102

Secondary			
S 12	Riffle	62	S 13
S 12	Pool	22	T 330
T 320	Riffle	24	T 330
T 320	Pool	13	T 330
			Rapid

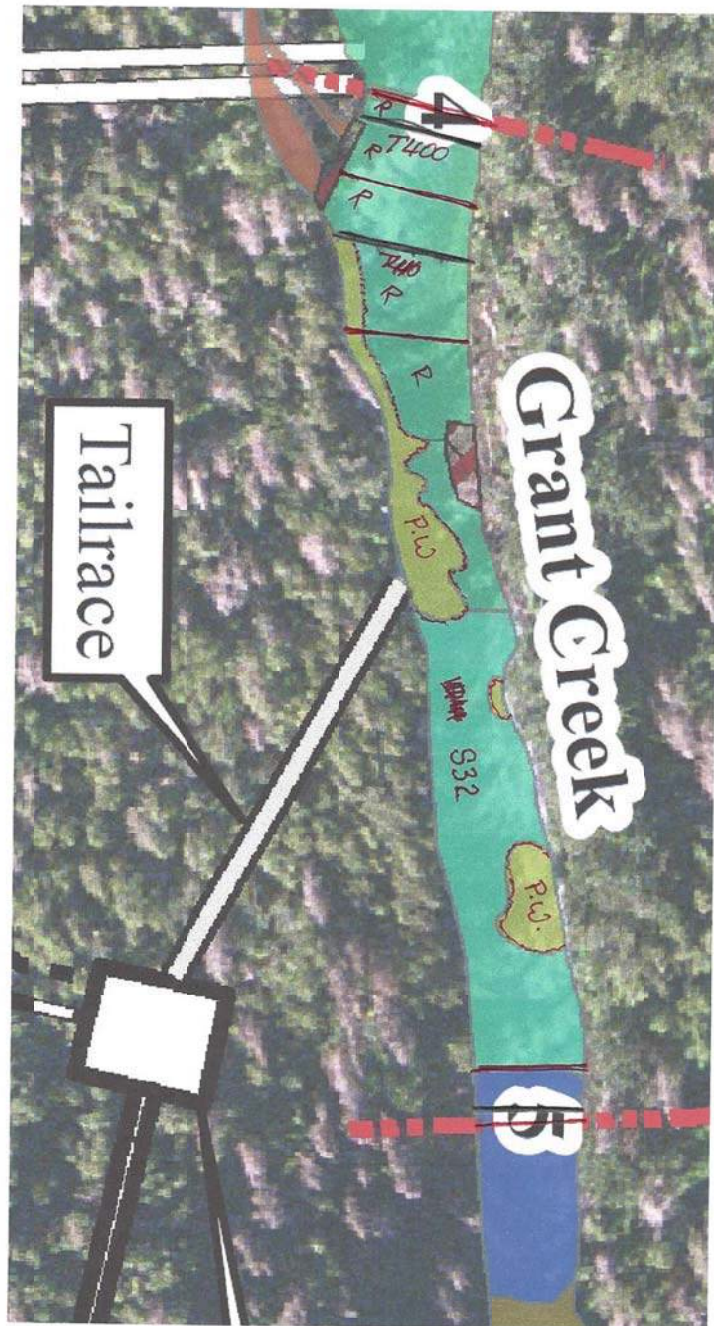
			24
			18
			17
			35

July 18 2014



531 Glide 25

R4



T400	Rifle	16
T410	Rifle	24
T410	Rocket H2O	3
S32	Rifle	97
S32	Rocket H2O	37
T430	Pool	11

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Monday, August 04, 2014 2:28 PM
To: 'Klein, Joseph P (DFG)'
Cc: 'Miller, Monte D (DFG)'; 'John Stevenson'; Cory Warnock; Emily Andersen; 'Mouw, Jason E B (DFG)'
Subject: RE: Transect weighting report

Thanks, Joe. I'll finalize it and send it out to the Instream Flow Workgroup.

Thanks again for yours, Monte's and Jason's help.

John Blum
Sr. Fisheries Scientist

From: Klein, Joseph P (DFG) [<mailto:joe.klein@alaska.gov>]
Sent: Monday, August 04, 2014 10:56 AM
To: John Blum
Cc: Miller, Monte D (DFG); John Stevenson; 'Cory Warnock'; 'Emily Andersen'; Mouw, Jason E B (DFG)
Subject: RE: Transect weighting report

John- The report looks good. Thanks for the vm last Friday explaining the challenges and working with us.

Joe

From: John Blum [<mailto:john.blum@mcmillen-llc.com>]
Sent: Monday, August 04, 2014 9:35 AM
To: Klein, Joseph P (DFG); Miller, Monte D (DFG); Mouw, Jason E B (DFG)
Cc: John Stevenson; 'Cory Warnock'; 'Emily Andersen'
Subject: Transect weighting report

Good morning:

Here is a revised Transect Weighting Report. I was able to trick the model into running 0 velocities, so I was able to include those backwaters in the analysis.

If you are ok with this, I will finalize and send it to the group.

Thanks for continuing to ask about those backwaters. It made me think outside the box, and gave us a better product.

John

John Blum
Sr. Fisheries Scientist

No virus found in this message.

Checked by AVG - www.avg.com

Version: 2014.0.4716 / Virus Database: 3986/7979 - Release Date: 08/04/14

From: John Blum <john.blum@mcmillen-llc.com>
Sent: Tuesday, August 05, 2014 9:37 AM
To: 'Miller, Monte D (DFG)'; 'Mouw, Jason E B (DFG)'; 'Klein, Joseph P (DFG)'; jeffry_anderson@fws.gov; dglass@ciri.com; susan.walker@noaa.gov; 'Mark Miller'; 'John Stevenson'; Cory Warnock
Cc: 'Mike Salzetti'; Emily Andersen
Subject: Transect Weighting Report
Attachments: Final Habitat Quantification Methodology 08-04-2014.docx

Good morning:

Please find attached the Final Transect Weighting report. This report was vetted extensively with Alaska Department of Fish and Game. With the transect weighting finalized, we will be able to develop final Weighted Usable Area for the species and life history stages in Grant Creek, as well as the Habitat Duration Analysis. Once we have these developed, we will forward them to the Instream Flow Work Group.

Thanks very much – I hope you are all enjoying your summer.

John

John Blum
Sr. Fisheries Scientist

FINAL
Habitat Quantification/Transect Weighting Methodology
Revised August 4, 2014

Introduction

As part of the Instream Flow assessment of habitat within Grant Creek, it is necessary to identify habitat types within reaches of Grant Creek, to quantify those habitats, and to weight them in proportion to their availability within lower Grant Creek. These analyses are then used to weight those transects that were selected and modeled within Reaches 1 through 4. As such, we have undertaken a process to identify and quantify habitat within the various reaches of Grant Creek. Our assessment has been tailored to provide metrics consistent with the work conducted by Flory (1999) on Falls Creek, AK; a summary of these results was provided by Alaska Department of Fish and Game. This document is a brief summary of the methodology used in our analysis.

Map Layout

A scaled map of Grant Creek, which depicted meso-habitats, was overlaid with reach breaks and transect locations. An 8.5 x 11 inch map of each reach was prepared, and the area (ft²) associated within a given transect was added to each map; the upstream and downstream boundaries associated with each transect were based on one of two criteria:

1. In the event another transect was relatively close to the transect of interest, the boundary was located an equidistance from each transect, or
2. If the nearest transect was more than one meso-habitat away, then the boundary was located at the edge of the meso-habitat associated with that transect or some obvious geophysical feature within Grant Creek (Figure 1).

All non-transect sections of Grant Creek were also categorized, and numbered sequentially starting within the Reach 1 Distributary and working upstream (e.g., S1, S2, etc.).

Measurement of Habitat

With the prepared maps, it was then possible to measure the length (in millimeters) of each habitat type within a given reach. Each habitat type was associated with either a specific transect (e.g., T300, T310, etc.) or a non-transect area (e.g., S8, S9, etc.). In the event a single habitat type fell within a specific area, such as S8 (Figure 1), measurement of that habitat was relatively straight forward and was simply confined by the boundaries located at the Reach 2/3 break (downstream) and the boundary with S9 (upstream). In the event more than one habitat type existed within a specific area, it was then necessary to subjectively proportion the length of each habitat type for that site. A good example of this scenario is most of the Primary Secondary Channel of Reach 3 (Figure 1), where multiple meso-habitats occurred in all segments with the exception of S13, which consisted only of riffle habitat.

With each habitat type measured by reach, each transect and non-transect segment of Grant Creek quantified, and with additional information from the GIS database (i.e., reach length and overall area of each habitat type, in ft²), it was then possible to calculate area of habitat associated with each segment within Grant Creek, and linear feet of habitat by segment. It was also possible to compile those data and generate results consistent with work by Flory (1999) on Falls Creek, AK. Figure 2 and Table 1 show an example of the first level of analysis, where transect and non-transect segments of Reach 1 are summarized to provide the proportion of habitat within the reach, and the overall area of habitat

associated within those segments. Appendix 1 shows Grant Creek reaches and calculations of habitat areas within each reach.



Once habitat frequencies were established for each transect, available habitats (by type) were then scaled in proportion to their availability within that reach. The results were then summed and each transect was weighted in accordance with its area and assigned a length (in ft).

Table 2 shows the lengths of each reach. There are 396 linear ft of habitat in the Distributary in Reach 1, 2,788 linear ft of habitat in mainstem Reaches 1 – 4, and 1,479 linear ft in the Reach 2/3 side channels. Tables 3 – 8 show calculation details for each reach in lower Grant Creek. Table 9 summarizes weighting for all transects.

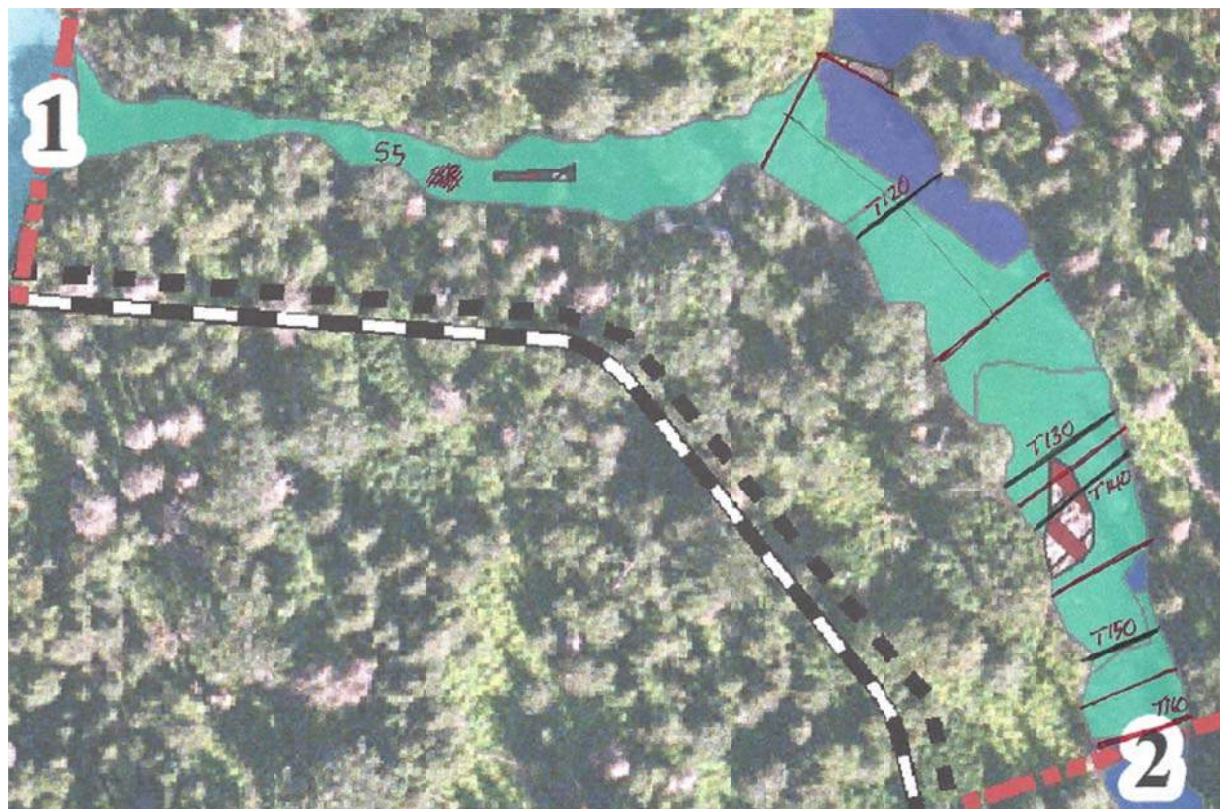


Figure 2. A map of Reach 1 that identifies transects, transect breaks and habitat types that was used to assess habitat weighting.

Table 1. A summary of the proportion and area (ft²) of habitat by type for transect and non-transect areas of Grant Creek, AK.

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
Reach 1 Distributary	S1	Pool	396	33.3%	7,495	2,498
	S2	Riffle	396	21.3%	6,004	1,276
	S3	Pool	396	16.7%	7,495	1,249
	S3	Riffle	396	16.3%	6,004	976
	S4	Pool	396	6.4%	7,495	480
	S4	Riffle	396	25.0%	6,004	1,501
	T100	Riffle	396	26.3%	6,004	1,576
	T100	Pool	396	9.0%	7,495	673
	T110	Riffle	396	11.3%	6,004	675
	T110	Pool	396	34.6%	7,495	2,594
	Total	Pool			7,495	
		Riffle			6,004	
Reach 1 Mainstem	S5	Riffle	692	53.5%	23,168	12,394
	T120	Riffle	692	13.6%	23,168	3,146
	T120	Pool	692	94.4%	3,143	2,968
	T130	Riffle	692	12.8%	23,168	2,956
	T140	Riffle	692	7.8%	23,168	1,811
	T150	Riffle	692	8.6%	23,168	2,002
	T150	Pool	692	5.6%	3,143	175
	T160	Riffle	692	3.7%	23,168	858
	Total	Pool			3,143	
		Riffle			23,168	
Reach 2 Mainstem	S6	Pool	820	86.4%	3,834	3,311
	T200	Backwater	820	38.9%	4,837	1,881
	T220	Riffle	820	16.8%	23,669	3,968
	T220	Glide	820	30.0%	1,613	484

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T230	Glide	820	70.0%	1,613	1,129
	T230	Backwater	820	44.4%	4,837	2,150
	T230	Riffle	820	10.8%	23,669	2,551
	T210	Backwater	820	16.7%	4,837	806
	S7	Riffle	820	72.5%	23,669	17,149
	S7	Pool	820	13.6%	3,834	523
	Total	Backwater			4,837	
		Riffle			23,669	
		Glide			1,613	
		Pool			3,834	
Reach 3 Mainstem	S8	Riffle	808	22.9%	25,585	5,866
	S9	Pool	808	66.7%	3,997	2,665
	S10	Riffle	808	22.4%	25,585	5,741
	T300	Backwater	808	100.0%	3,697	3,697
	T310	Riffle	808	5.9%	25,585	1,498
	T310	Pool	808	27.3%	3,997	1,090
	S11	Riffle	808	48.8%	25,585	12,480
	S11	Pool	808	6.1%	3,997	242
	Total	Riffle			25,585	
		Pool			3,997	
		Backwater			3,697	
Reach 3 Primary Side Channel	S12	Riffle	606	48.8%	11,672	5,698
	S12	Pool	606	41.5%	5,018	2,083
	T320	Riffle	606	18.9%	11,672	2,206
	T320	Pool	606	24.5%	5,018	1,231
	S13	Riffle	606	18.9%	11,672	2,206
	T330	Pool	606	34.0%	5,018	1,704

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T330	Riffle	606	13.4%	11,672	1,562
	T330	Rapid	606	100.0%	511	511
Reach 3 Secondary Side Channel	S14	Cascade	873	100.0%	114	114
	S15	Run	873	100.0%	576	576
	S16	Pool	873	11.0%	9,908	1,094
	S17	Riffle	873	9.5%	2,683	256
	S18	Pool	873	13.0%	9,908	1,287
	S19	Riffle	873	7.1%	2,683	192
	S20	Pool	873	3.2%	9,908	322
	S21	Riffle	873	14.3%	2,683	383
	S22	Pool	873	16.2%	9,908	1,608
	S23	Riffle	873	21.4%	2,683	575
	S24	Pool	873	1.9%	9,908	193
	S25	Riffle	873	4.8%	2,683	128
	S26	Pool	873	24.0%	9,908	2,380
	S27	Riffle	873	14.3%	2,683	383
	S28	Pool	873	16.2%	9,908	1,608
	S29	Glide	873	10.7%	1,588	170
	S30	Pool	873	14.3%	9,908	1,415
	T330	Riffle	873	28.6%	2,683	767
	S31	Glide	873	89.3%	1,588	1,418
	Total	Riffle			14,355	
	Side	Pool			14,926	
	Channel	Glide			1,588	
		Rapid			511	
		Cascade			114	
Reach 4 Mainstem	T400	Riffle	468	11.7%	17,649	2,061

Reach	Transect/ Segment	Habitat	Reach Length (ft)	% of Habitat Within Reach	Habitat Area (ft ²)	Trans/Seg Area (ft ²)
	T410	Riffle	468	17.5%	17,649	3,092
	T410	Pocket Water	468	8.6%	3,709	318
	S32	Riffle	468	70.8%	17,649	12,496
	S32	Pocket Water	468	91.4%	3,709	3,391
	T430	Pool	468	100.0%	1,195	1,195
	Total	Riffle			17,649	
		Pocket Water			3,709	
		Pool			1,195	

Table 2. Lower Grant Creek reach lengths.

Reach	Length (ft)
R 1 Distributary	396
R 1 Mainstem	692
R 2	820
R 3 Mainstem	808
R 3 Side Channel	606
R 2/3 Side Channel	873
R 4	468
Total	
Distributary	396
Main Channel	2,788
Side Channel	1,479
Total	4,663

Table 3. Reach 1 Distributary area and transect weighting.

Total Length (ft) 396									
	Pool		Riffle		Total			Reach Weights	
Trans	Area	% age	Area	% age	Pool	Riffle	Total	% age	Length
T100	673	20.6%	1,576	70.0%	1,543	4,203	5,746	42.6%	169
T110	2,594	79.4%	675	30.0%	5,952	1,801	7,753	57.4%	227
Total	3,267		2,252		7,495	6,004	13,499		396

Table 4. Reach 1 main channel area and transect weighting.

Total Length (ft) 692									
	Pool		Riffle		Total			Reach Weights	
Trans	Area	% age	Area	% age	Pool	Riffle	Total	% age	Length
T120	2,968	94.4%	3,146	29.2%	2,968	6,766	9,734	37.0%	256
T130	0	0.0%	2,956	27.4%	0	6,356	6,356	24.2%	167
T140	0	0.0%	1,811	16.8%	0	3,896	3,896	14.8%	102
T150	175	5.6%	2,002	18.6%	175	4,306	4,480	17.0%	118
T160	0	0.0%	858	8.0%	0	1,845	1,845	7.0%	49
Total	3,143		10,774		3,143	23,168	26,311		692

Table 5. Reach 2 area and transect weighting.

Total Length (ft) = 820															
	Pool		Backwater		Glide		Riffle		Total					Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Area	% age	Pool	BackW	Glide	Riffle	Total	% age	Length
T200	0	0.0%	1,881	38.9%	0	0.0%	0	0.0%	0	1,881	0	0	1,881	6.2%	51
T210	0	0.0%	806	16.7%	0	0.0%	0	0.0%	0	806	0	0	806	2.7%	22
T220	0	0.0%	0	0.0%	484	30.0%	3,968	60.9%	0	0	484	14,407	14,891	49.4%	405
T230-M	0	0.0%	0	0.0%	1,129	70.0%	2,551	39.1%	0	0	1,129	9,262	10,391	34.5%	283
T230-BW	0	0.0%	2,149.8	44.4%	0	0.0%	0	0.0%	0	2,150	0	0	2,150	7.1%	58
Total	0		4,837		1,613		6,520		0	4,837	1,613	23,669	30,119		819

Table 6. Reach 3 main channel area and transect weighting.

Total Length (ft) = 808												
	Pool		Backwater		Riffle		Total				Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Pool	Backwater	Riffle	Total	% age	Length
T300	0	0.0%	3,697	100.0%	0	0.0%	0	3,697	0	3,697	11.1%	90
T310	1,090	100.0%	0	0.0%	1,498	100.0%	3,997	0	25,585	29,582	88.9%	718
Total	1,090		3,697		1,498		3,997	3,697	25,585	33,279		808

Table 7. Reach 2/3 side channels area and transect weighting.

Total Length (ft) = 1,479												
Trans	Pool		Riffle		Rapids		Total				Reach Weights	
	Area	% age	Area	% age	Area	% age	Pool	Riffle	Rapids	Total	% age	Length
T320	1,231	41.9%	2,206	48.6%	0	0.0%	2,104	5,677	0	7,782	45.2%	669
T330	1,704	58.1%	2,329	51.4%	511	100.0%	2,914	5,995	511	9,419	54.8%	810
Total	2,935		4,535		511		5,018	11,672	511	17,201		1,479

Table 8. Reach 4 area and transect weighting.

Total Length (ft) =		468										
	Pool		Pocket Water		Riffle		Total				Reach Weights	
Trans	Area	% age	Area	% age	Area	% age	Pool	PocketW	Riffle	Total	% age	Length
T400	0	0.0%	0	0.0%	2,061	40.0%	0	0	7,060	7,060	31.3%	146
T410	0	0.0%	318	100.0%	3,092	60.0%	0	3,709	10,589	14,298	63.4%	297
T430	1,195	100.0%	0	0.0%	0	0.0%	1,195	0	0	1,195	5.3%	25
Total	1,195		318		5,153		1,195	3,709	17,649	22,553		468

Table 9. Summary of reach and transect weighting (ft).

Reach	Transect	Length (ft)
1 - Distributary	100	169
	110	227
	Total	396
1 - Main Channel	120	256
	130	167
	140	102
	150	118
	160	49
	Total	692
2 - Main Channel	200	51
	210	22
	220	405
	230-M ^{1/}	283
	230-BW ^{2/}	58
3 - Main Channel	Total	820
	300	90
	310	718
2/3 Side Channels	Total	808
	320	669
	330	810
4 - Main Channel	Total	1,479
	400	146
	410	297
	430	25
Total		468
Total		
Distributary		396
Main Channel		2,788
Side Channel		1,479
Total		4,663

^{1/} Main Channel; ^{2/} Backwater

Literature Cited

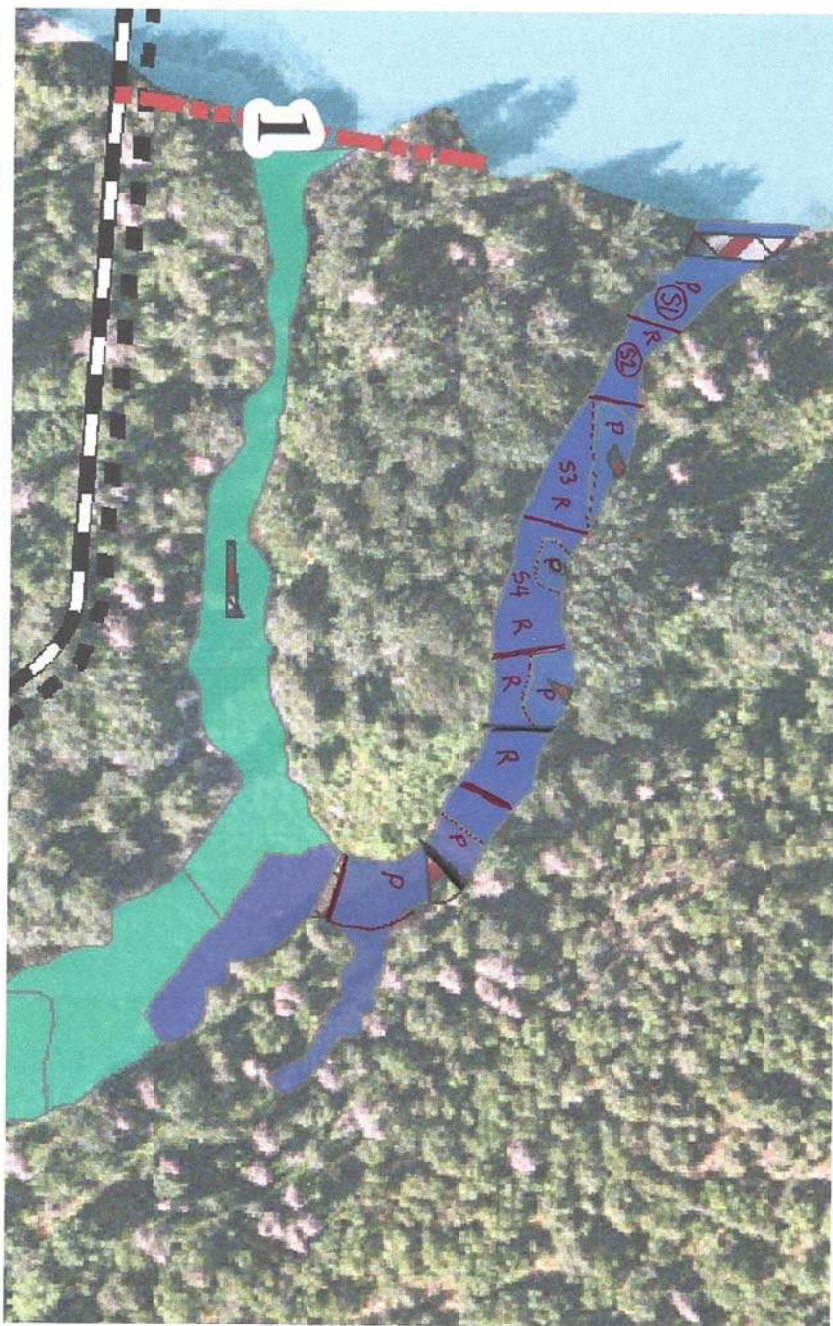
Flory, E. A. 1999. Fish and fish habitats of the Falls Creek area. Prepared by Icy Strait Environmental Services, Gustavus, AK. Prepared for Gustavus Electric Company, Gustavus, AK. 46 pp.

APPENDIX 1

CALCULATION OF REACH HABITAT TYPES AND TRANSECT WEIGHTING

GRANT CREEK INSTREAM FLOW STUDY

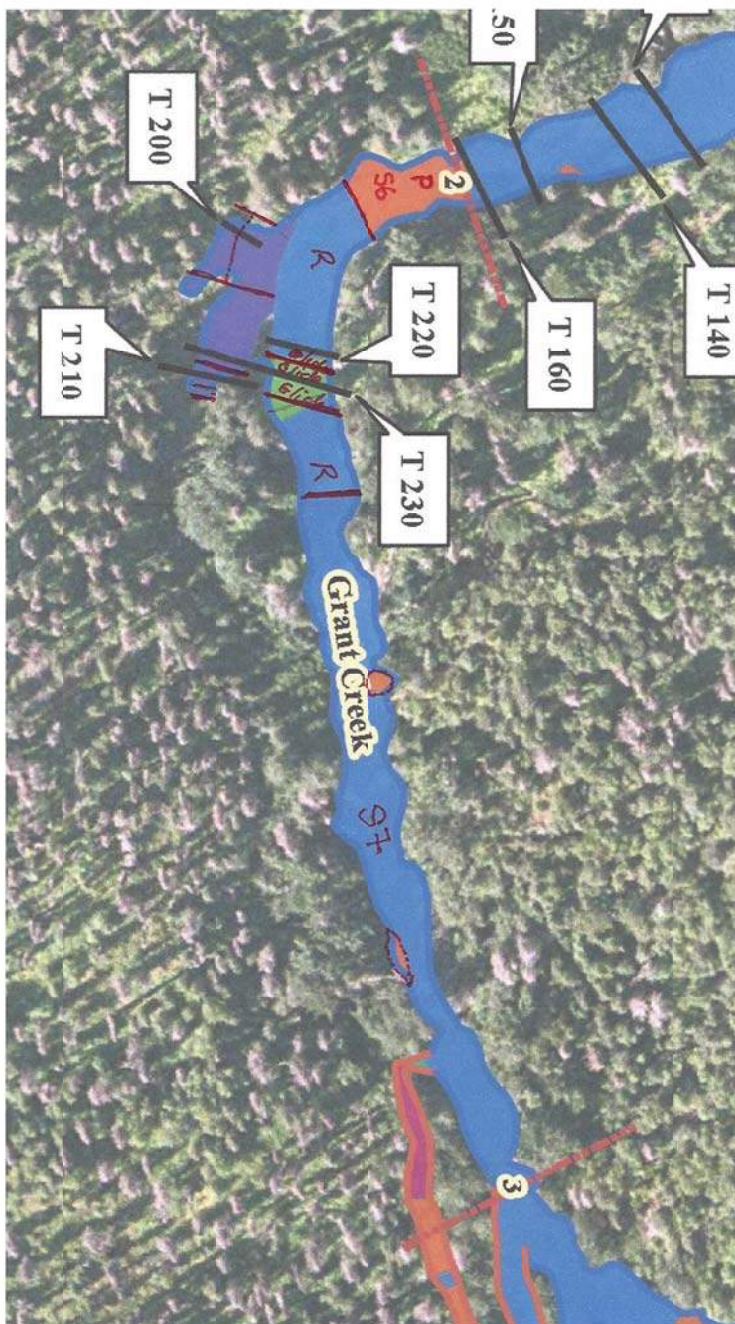
RJ- Distributary



S1	Pool	26	T100	Riffle 21	28
S2	Riffle	17	"	Pool 7	
S3	Pool	13			
S3	Riffle	13	T110	Riffle 9	38
S4	Pool	5	"	Pool 27	
S4	Riffle	20			
		25			

Pool = 18
Rifle = 243

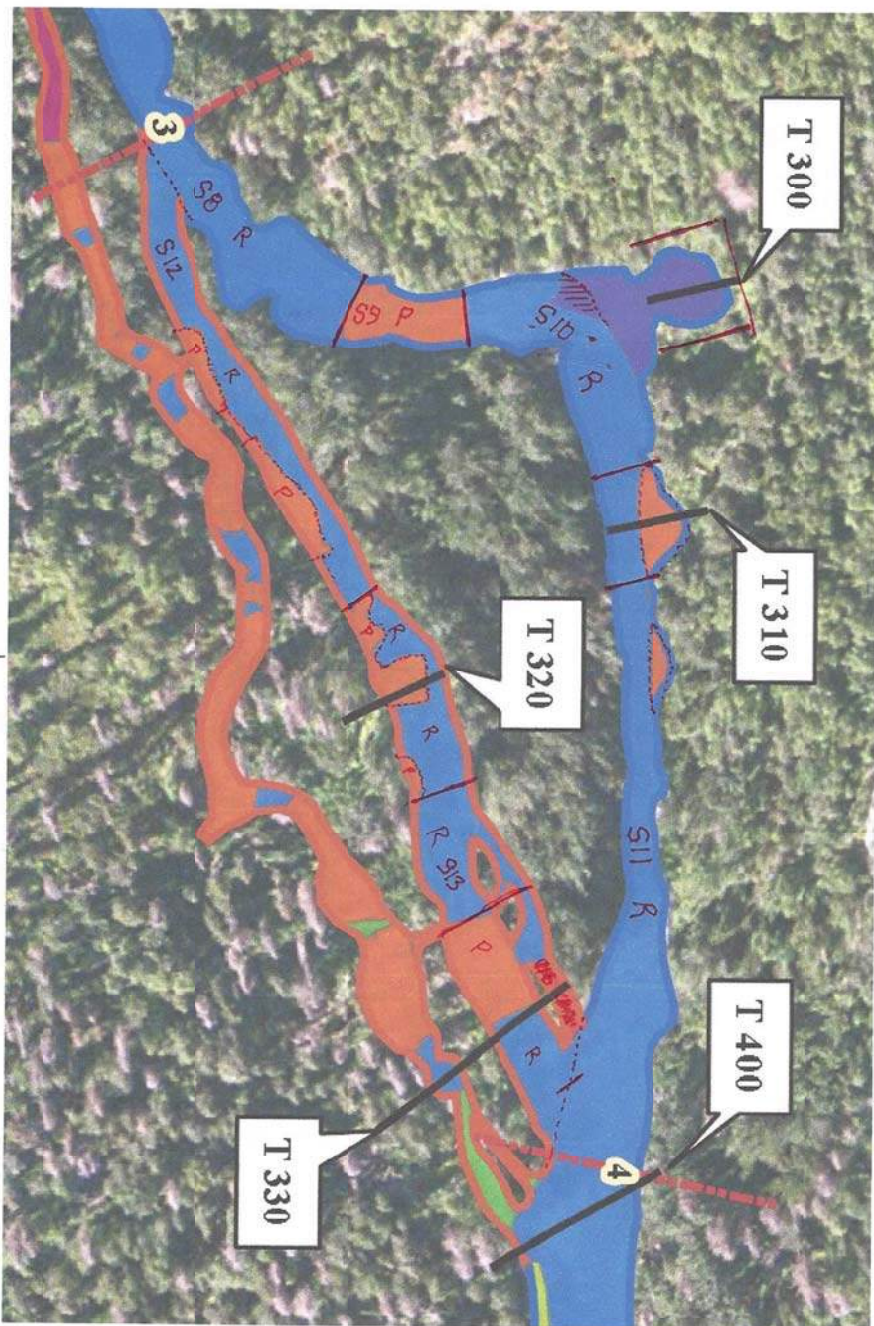
July 18, 2014



Sample	Pool	19	210	Back H ₂ O	6
56	Pool	19	57	Riffle	121
T200	Back H ₂ O	14	57	Pool	3
T220	Riffle	28			
	Glide	3			
		31			
T230	Glide	7			
T230	Back H ₂ O	16			
T230	Riffle	18			

Reach 3

July 18, 2014



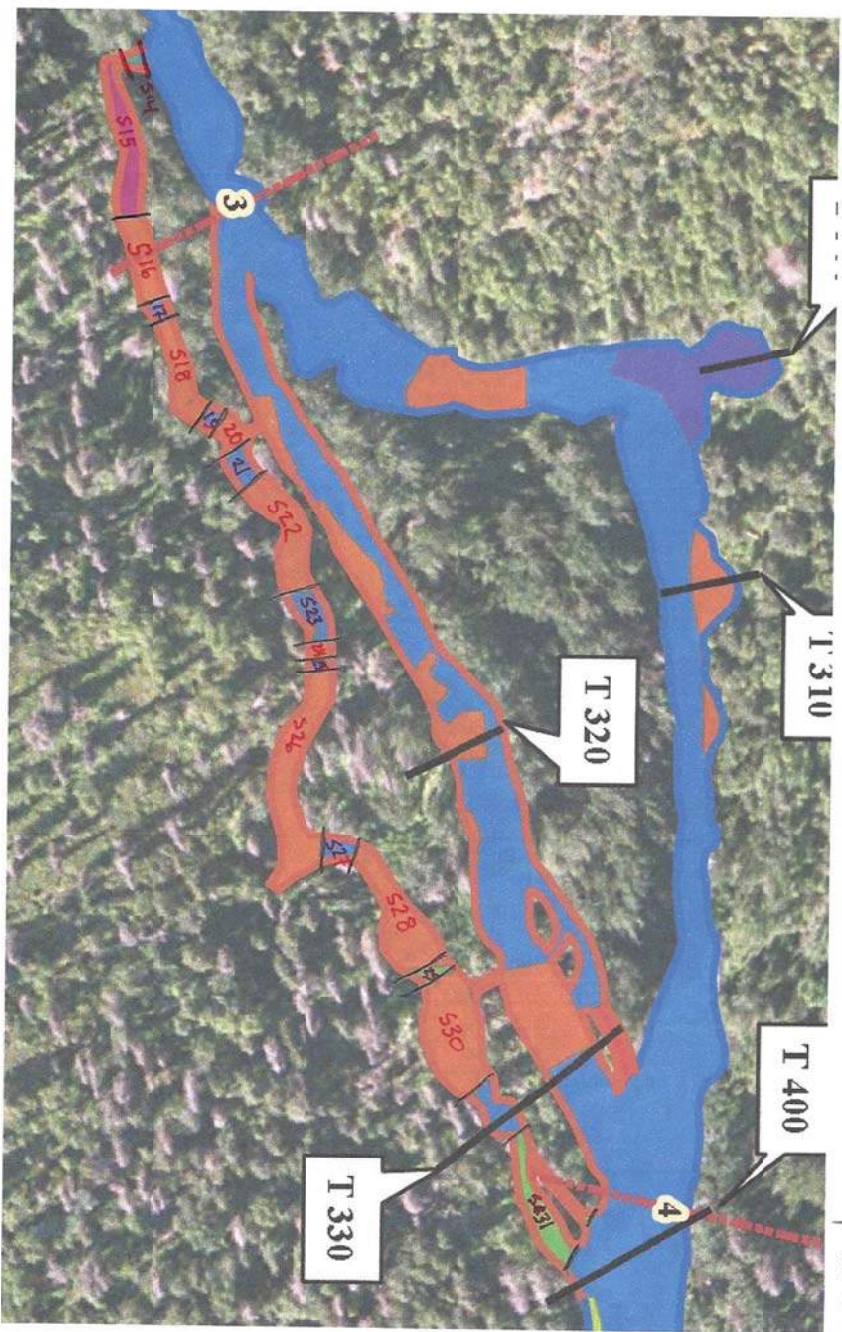
Mainstem			
S 8	Riffle	47	T 310
S 9	Pool	22	T 310
S 10	Riffle	46	S 11
T 300	Back H'd	20	S 11
			Pool
			12
			9
			100
			2
			102

Secondary			
S 12	Riffle	62	S 13
S 12	Pool	22	T 330
T 320	Riffle	24	T 330
T 320	Pool	13	T 330
			Rapid

			24
			18
			17
			35

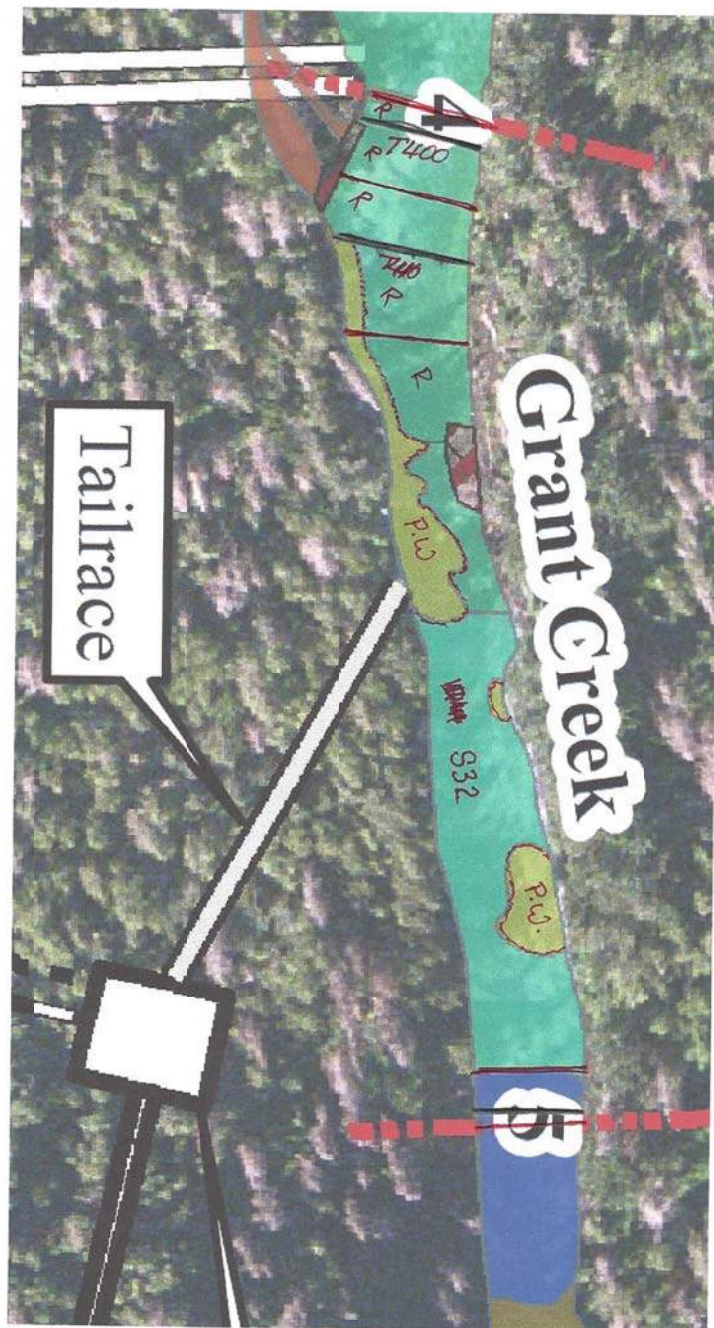
Reach 3 Secondary Side Channel

July 18 2014



S14	Cascade	3	S20	Pool	5	S26	Pool	37	S31	Glide	25
S15	Run	31	S21	Riffle	6	S27	Riffle	6			
S16	Pool	17	S22	Pool	25	S28	Pool	25			
S17	Riffle	4	S23	Riffle	9	S29	Glide	3			
S18	Pool	20	S24	Pool	3	S30	Pool	12			
S19	Riffle	3	S25	Riffle	2	T330	Riffle	12			

R4



T400	Rifle	16
T410	Rifle	24
T410	Rocket H2O	3
S32	Rifle	97
S32	Rocket H2O	37
T430	Pool	11