

MEMORANDUM

TO: Bill Payne, Kwagis Power Limited Partnership
FROM: Harlan Wright, Dip. Tech., and Sean Faulkner, M.Sc., R.P. Bio., Ecofish Research Ltd.
DATE: December 20, 2013
FILE: 1085-15

RE: Summary of fisheries monitoring completed on the Kokish River in 2013

This memorandum summarizes information relating to ongoing fisheries work on the Kokish River. The work was conducted by Ecofish Research Ltd. (Ecofish) and MJ Lough Environmental Consultants Ltd. (MJL) for Kwagis Power Limited Partnership (Kwagis) to meet requirements detailed in the Project's Operational Environmental Monitoring Plan (OEMP; Lewis *et al.* 2013).

Data summary for the 2013 monitoring of adult fish migration and abundance is provided below (Section 1). We also provided an overview of 2013 survey effort in regards to monitoring of flows at the 11.3 km falls (Section 2), juvenile fish abundance (Section 3), and indices of stream geomorphology (Section 4). Detailed reports will be included as supporting material to the OEMP.

1. ADULT FISH MIGRATION AND ABUNDANCE

Snorkel surveys were conducted along three sections of Kokish River during 2013 winter and summer fish migration periods (Map 1, Table 1). A summary of number of adult fish counted during snorkel surveys is provided in Table 2. For each individual species, a histogram of numbers counted within each survey section is provided in Figure 1 to Figure 7.

Surveys were conducted approximately once every two weeks in section 1 between February 18 and April 25 to assess winter Steelhead abundance. To assess summer Steelhead and salmon species migration, weekly surveys were conducted in sections 1 and 3 from June 5 to September 4. Full river surveys were conducted in late July and late August to monitor abundance of early-run salmon species and summer Steelhead. Survey effort in October and November targeted fall-runs of Coho and Chum salmon in sections 1 and 3.

Table 1. Snorkel survey locations for adult fish migration and abundance monitoring in Kokish River.

Location	Start Point	Finish Point
Section 1	km 4.4	km 0.0
Section 2	km 8.4	km 4.4
Section 3	km 12.0	km 8.4

The peak count of winter Steelhead occurred on April 25, when a total of five fish were observed in section 1. Low counts of winter Steelhead may be partly due to higher stream flows during that period, in comparison to the summer/fall surveys. The peak count of summer Steelhead occurred on the August 24-26 full river survey, when a total of 24 fish were observed in sections 1, 2, and 3. During that survey, nine Steelhead were observed upstream of the 11.3 km falls.

The peak count for Coho Salmon occurred on November 5-6, when a total of 313 adults were observed in sections 1 and 3, all of which were downstream of the 11.3 km falls. Surveys from July to early September targeted early run Coho, which are known to migrate further upstream than the late fall run (Lough and Hay 2009). On September 3-4, a peak count of 261 Coho Salmon were observed, of which four were observed above the 11.3 km selective barrier.

Sockeye were observed in low abundance, with a peak count of 17 observed in section 1 on August 18.

Very few Chinook were observed, with peak counts of two fish in section 1 on August 10 and September 4.

Pink Salmon were the most abundant adult salmon species observed, with a peak count of 724 observed in section 1 on September 4. This count was much lower than 2012, when 7,784 fish were observed, although this is to be expected as North East Coast Vancouver Island Pink Salmon stocks are typically even year dominant.

A peak count of 84 Chum Salmon was observed in section 1 on November 5.

Peak counts of resident and anadromous trout and char species in all sections combined were: nine Rainbow Trout on July 11-12, 22 Cutthroat Trout on November 5-6, and 68 Dolly Varden on August 24- 26. The Rainbow Trout observed were likely stream resident fish, whereas the Cutthroat Trout and Dolly Varden were likely anadromous fish that may spawn in section 1 of the Kokish River or its tributaries.

Table 2. Summary of fish observed during 2013 snorkel surveys in the Kokish River.

Trip	Section	Fish Observed								
		ST	CO	CH	CM	SK	PK	CT	EB	DV
18-Feb-13	1	1	0	0	0	0	0	0	5	0
8-Mar-13	1	1	0	0	0	0	0	2	4	0
25-Mar-13	1	2	0	0	0	0	0	0	0	0
4-Apr-13	1	2	0	0	0	0	0	0	0	0
8-Apr-13	1	1	0	0	0	0	0	5	0	0
16-Apr-13	1	3	0	0	0	0	0	5	6	0
25-Apr-13	1	5	0	0	0	0	0	4	0	0
5-6-Jun-13	1	0	0	0	0	0	0	8	6	0
5-6-Jun-13	3	0	0	0	0	0	0	0	1	0
13-14-Jun-13	1	1	0	0	0	0	0	8	0	0
13-14-Jun-13	3	0	0	0	0	0	0	0	0	0
23-Jun-13	1	1	0	0	0	0	0	2	4	0
23-Jun-13	3	1	0	0	0	0	0	0	0	0
27-28-Jun-13	1	2	0	0	0	0	0	3	2	0
27-28-Jun-13	3	2	0	0	0	0	0	0	3	0
6-7-Jul-13	1	0	0	1	0	1	2	2	5	0
6-7-Jul-13	3	8	0	0	0	0	0	0	2	0
11-12-Jul-13	1	1	2	0	0	0	4	9	5	0
11-12-Jul-13	3	9	0	0	0	0	0	0	0	0
20-21-Jul-13	1	0	0	0	0	10	11	7	6	0
20-21-Jul-13	3	13	3	0	0	0	0	0	3	0
25-27-Jul-13	1	1	11	0	0	10	17	12	3	5
25-27-Jul-13	2	2	5	0	0	0	0	0	3	0
25-27-Jul-13	3	9	7	0	0	0	0	0	0	0
3-4-Aug-13	1	1	3	0	1	13	39	7	3	2
3-4-Aug-13	3	7	12	0	0	0	0	0	0	0
10-11-Aug-13	1	1	3	2	0	7	108	10	4	5
10-11-Aug-13	3	18	26	0	0	0	0	0	0	0
17-18-Aug-13	1	0	17	0	0	17	243	6	8	2
17-18-Aug-13	3	11	47	0	0	0	0	0	0	0
24-26-Aug-13	1	4	93	0	0	11	645	15	7	57
24-26-Aug-13	2	3	113	0	0	4	2	0	0	11
24-26-Aug-13	3	17	67	0	0	0	0	0	0	0
3-4-Sept-13	1	1	135	2	0	9	724	13	2	3
3-4-Sept-13	3	11	126	0	0	0	0	2	0	0
12-Oct-13	1	0	60	1	1	4	22	2	0	6
12-Oct-13	3	8	138	0	0	0	0	0	4	0
5-6-Nov-13	3	8	182	0	0	0	0	0	0	0
5-6-Nov-13	1	0	131	0	84	0	0	22	1	6

Figure 1. Number of adult Steelhead observed during snorkel surveys in Kokish River during 2013.

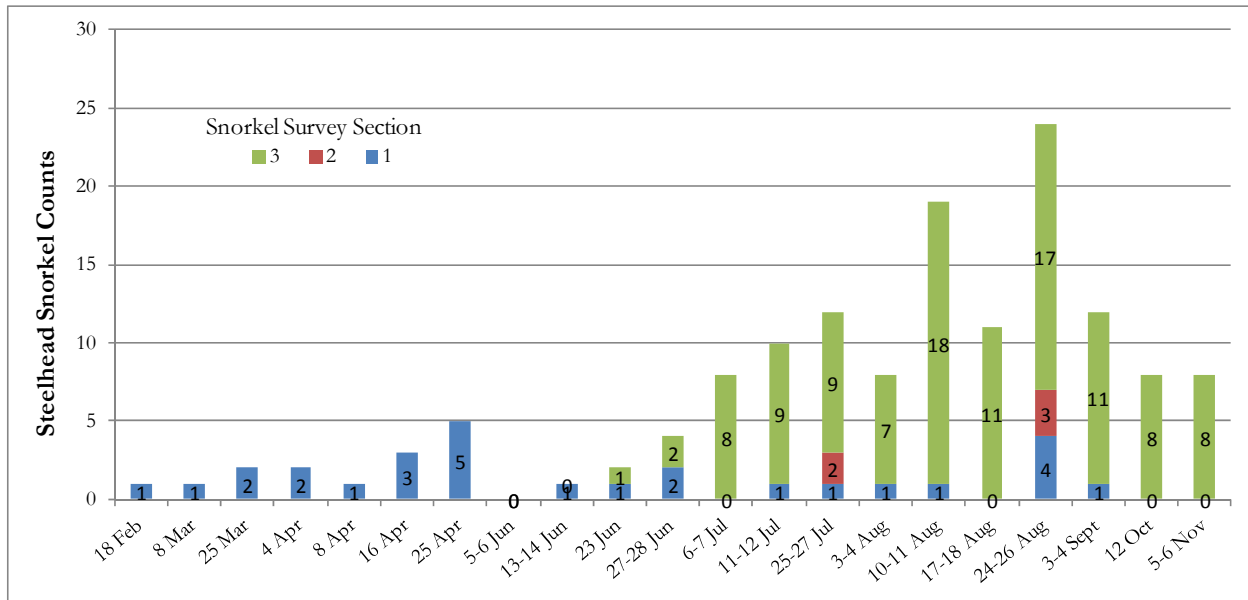


Figure 2. Number of adult Coho observed during snorkel surveys in Kokish River during 2013.

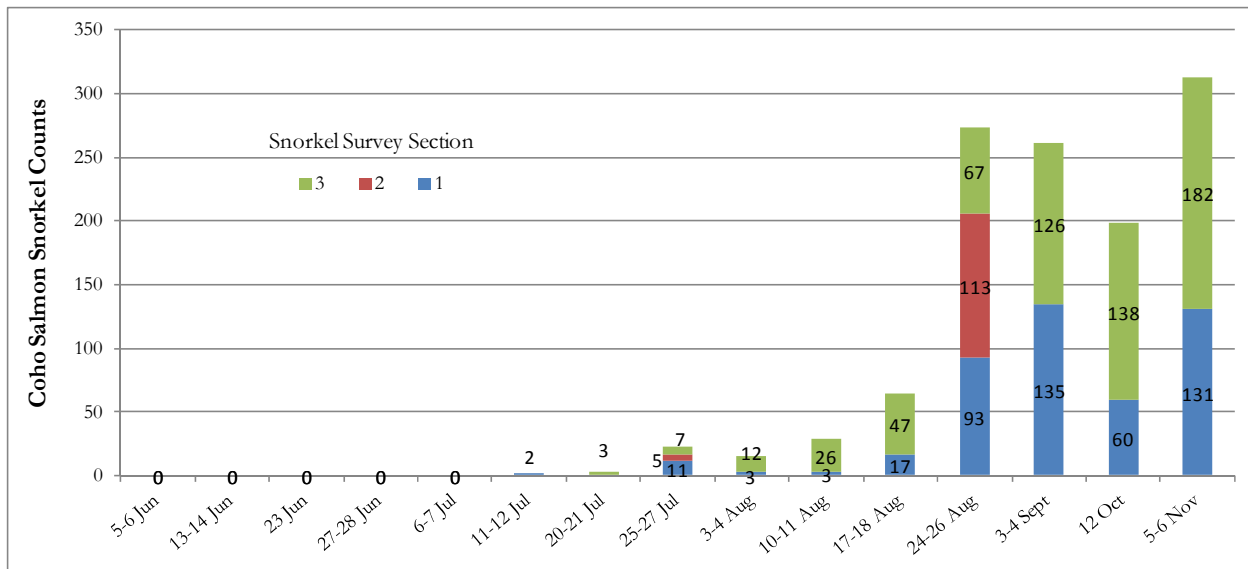


Figure 3. Number of adult Sockeye observed during snorkel surveys in Kokish River during 2013.

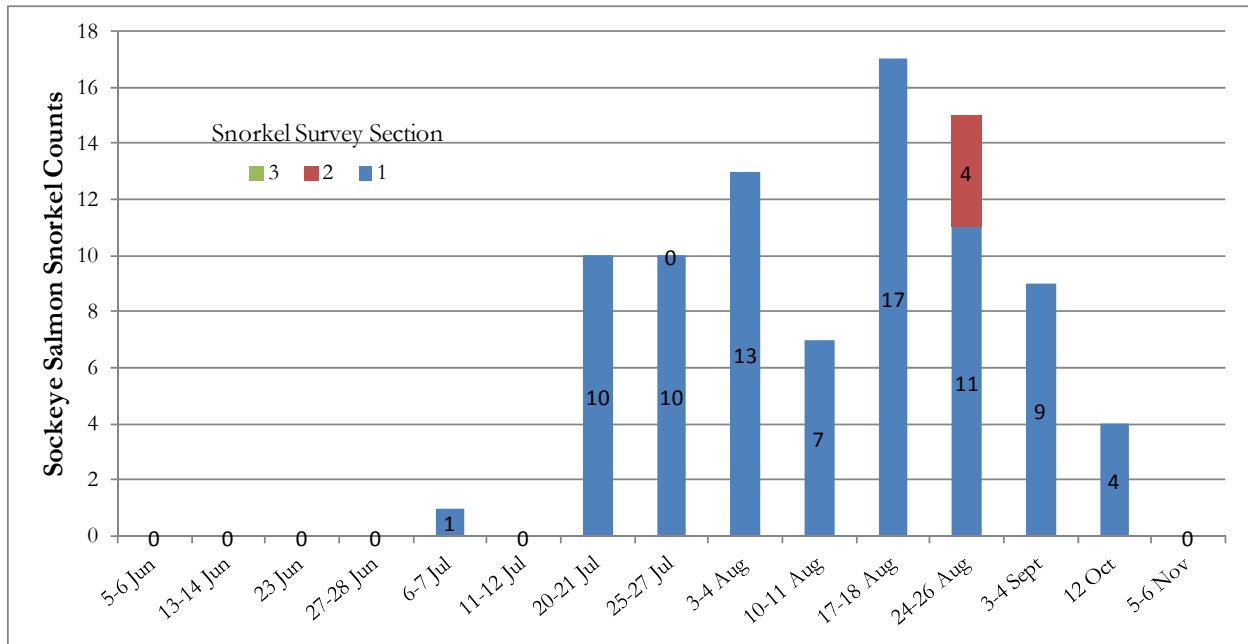


Figure 4. Number of adult Chinook observed during snorkel surveys in Kokish River during 2013.

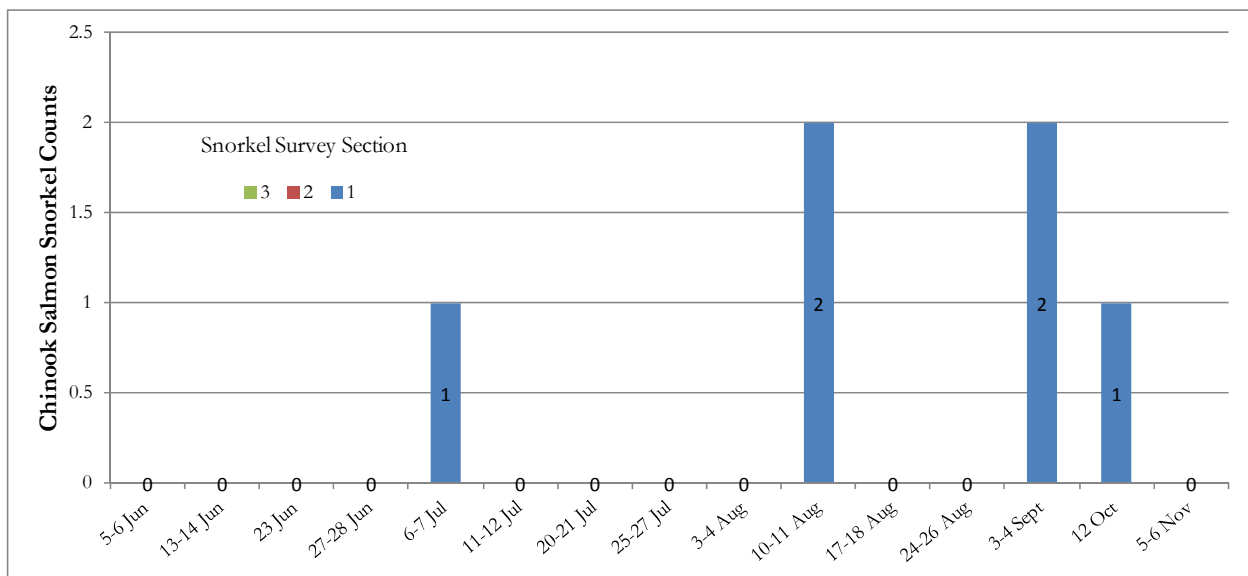


Figure 5. Number of adult Chum observed during snorkel surveys in Kokish River during 2013.

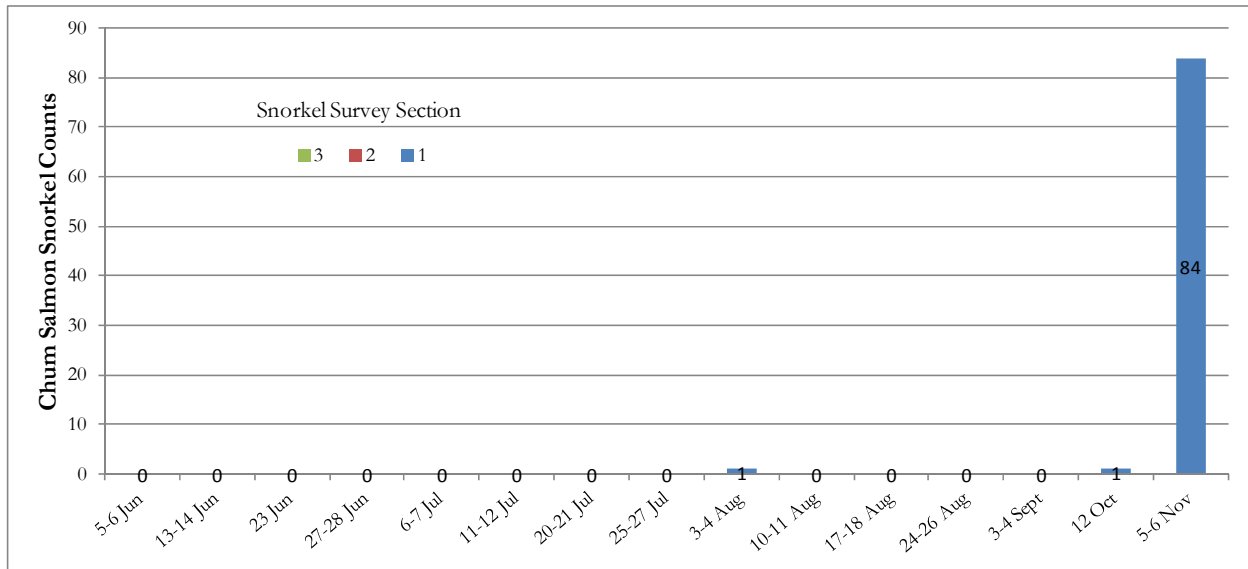


Figure 6. Number of adult Pink observed during snorkel surveys in Kokish River during 2013.

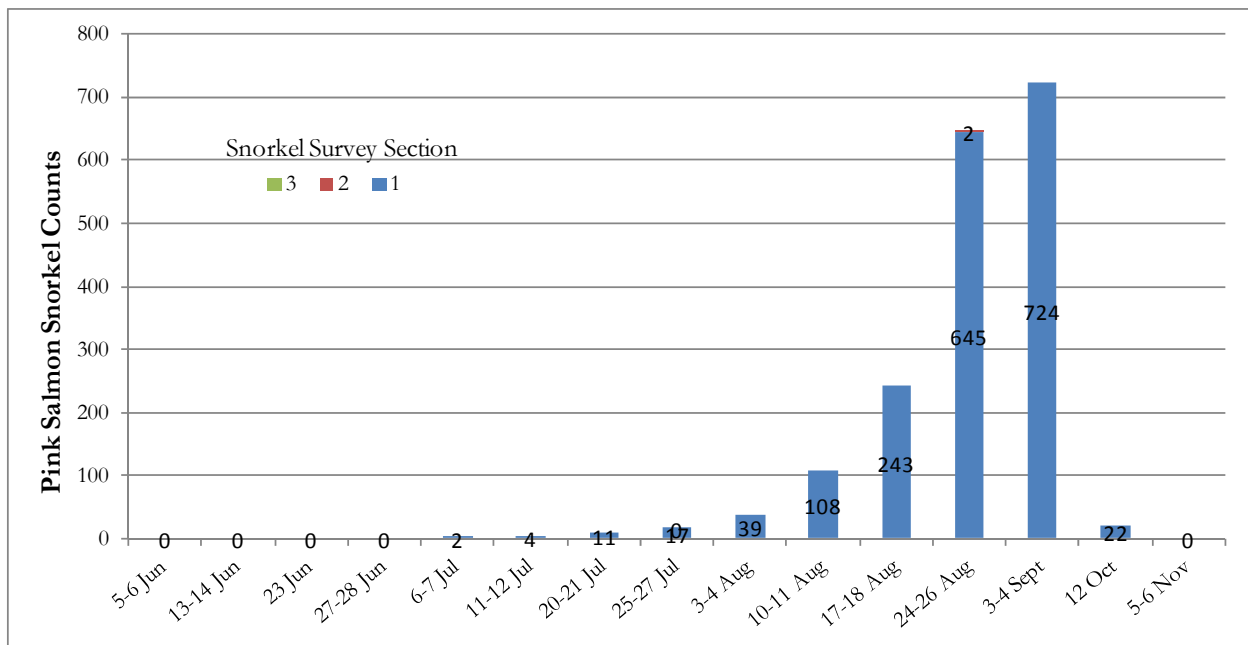
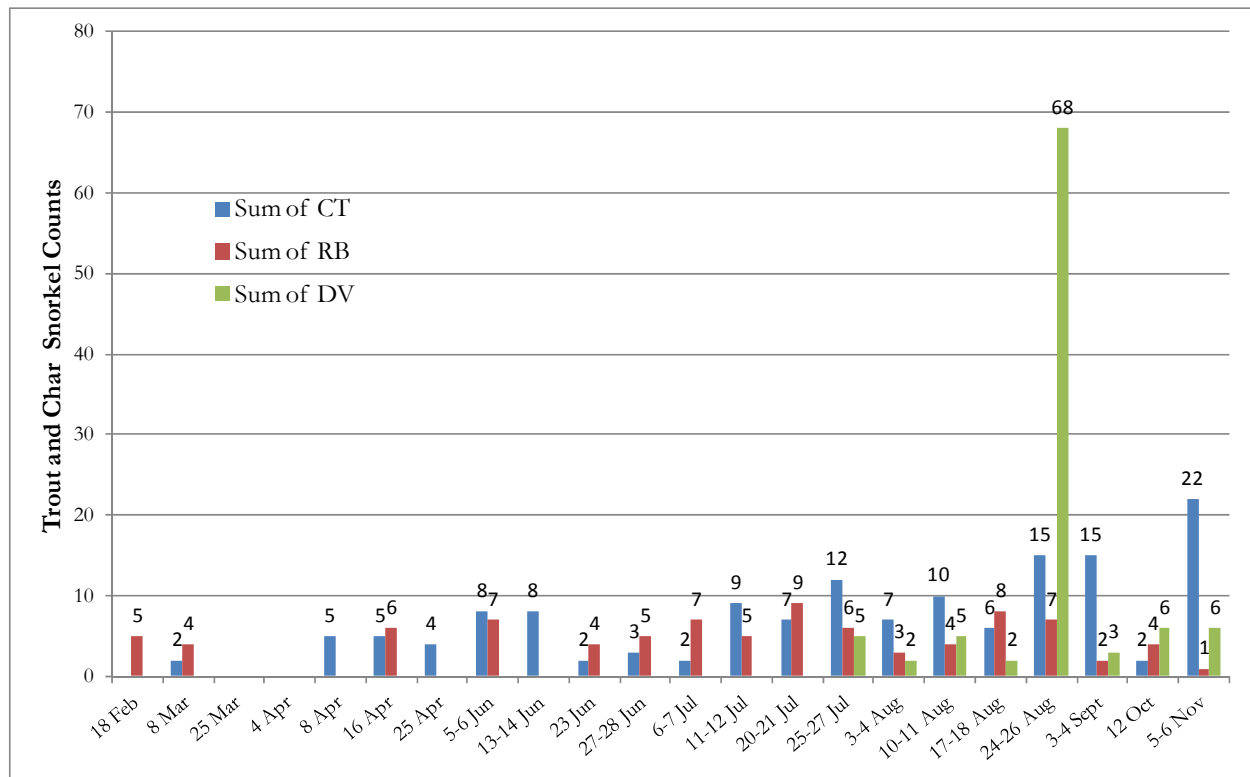


Figure 7. Number of adult Cutthroat, Rainbow, and Dolly Varden observed during snorkel surveys in Kokish River during 2013.



2. FLOW MONITORING AT THE SELECTIVE BARRIER (11.3 KM FALLS) BELOW THE INTAKE BYPASS CHANNEL

Fish passage conditions at the 11.3 km falls selective barrier were monitored using similar methods as in 2012: a temporary level logger was installed in the river left channel of the falls to monitor flows over the falls during the construction time period, and photos were collected at various flows to visually assess passage conditions.

The main objective of monitoring flow at this location was to assess whether intake construction activities at 11.4 km altered the flow split upstream of the island at the 11.3 km falls. Steelhead and Coho are known to travel up the left channel of the falls under specific flows, and therefore construction activities at the intake site (11.4 km) were to be conducted in a manner to maintain a natural flow split.

The weekly snorkel surveys conducted between June 5 and September 6 confirmed successful fish passage at the falls in 2013.

3. JUVENILE FISH ABUNDANCE

During September 2013, a second year of sampling for juvenile fish was conducted to support the baseline requirements of the OEMP. The fish monitoring focused on assessing the standing stock of juvenile Steelhead and Coho Salmon within the diversion section on the Kokish River. The Tsulton River was selected as a control stream.

Electrofishing was used as the primary method for enumerating fry (age 0+), and snorkelling surveys were used as the primary method for enumerating parr (age 1+ and 2+). Below is an update on 2013 survey effort.

3.1. Juvenile Electrofishing

Electrofishing was conducted at 15 sites in the Kokish River (impact) and 11 sites in the Tsulton River (control) (Map 2 and Map 3).

In the Kokish River, single pass electrofishing was conducted in 300 to 1,500 m² 'open' sites (i.e., without the use of stop nets). Mark-recapture was conducted in a subsample of sites (n=6 in 2012; n=8 in 2013) to determine capture efficiency. The Tsulton River was sampled using closed site multi-pass removal method (rather than open site mark-recapture). The Tsulton River is much smaller than the Kokish and therefore, it is feasible to net-off entire habitat units.

A Level 1 Fish Habitat Assessment Procedure (FHAP) was also conducted on the Tsulton River (and on the Kokish mainstem during previous baseline sampling by Lough and Hay 2009). Using the FHAP data, fish densities can be calculated within specific mesohabitat types (i.e., pool, riffle, glide, cascade) across the entire sampling reach to estimate the standing stock of Steelhead fry and parr, and Coho Salmon Fry.

3.2. Juvenile Snorkel Surveys

Snorkel surveys were completed to enumerate age 1+ and 2+ Steelhead in the Kokish and Tsulton rivers. There were a total of 18 sites surveyed in the Kokish River and 15 sites in the Tsulton River (Map 2 and Map 3). In a subsample of sites, fish were marked the night prior to each survey and 're-sighted' the following day to establish an observer efficiency rating. This mark-recapture method was used at seven sites on the Kokish, and three sites on the Tsulton.

4. STREAM GEOMORPHOLOGY

Baseline geomorphologic surveys were undertaken during low flows in October and November 2013 to provide a basis for comparison during project operations. Surveys were conducted at four specific locations: the upstream reach, the diversion reach, downstream of the powerhouse, and at a control reach outside of the area of project influence.

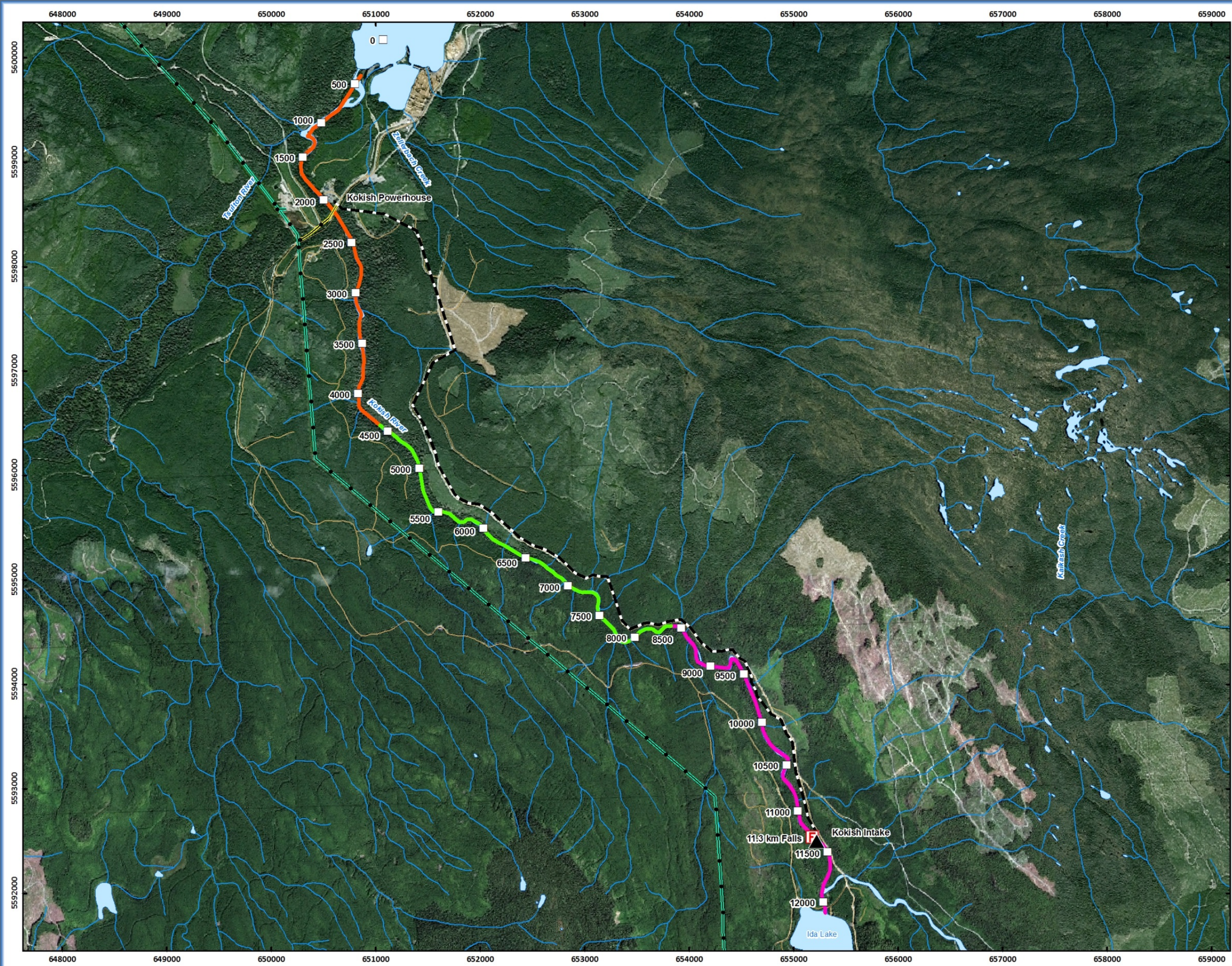
Within each of these stream sections, data collection included topographic monitoring, sediment sampling, photographic monitoring, and spawning gravel surveys.

REFERENCES

- Lewis, F. J. A., T. Hatfield, H. Wright, M. Lough, S. Hay, and X. Yu. 2013. Kokish River Hydroelectric Project: Operational Environmental Monitoring Plan. Draft V2. Consultant's report prepared by Ecofish Research Ltd. for Kwagis Power Limited Partnership, November 20, 2013.
- Lough, M. J., and S. E. Hay. 2009. Kokish River Fisheries Studies – 2008. Prepared for Kwagis Power, Brookfield Renewable Power Corporation, Vancouver, BC by MJ Lough Environmental Consultants, Nanaimo, BC Revision 2.



PROJECT MAPS



KOKISH RIVER HYDROELECTRIC PROJECT

Kokish River Fish Migration Snorkel Survey Sections

- Legend**
- Chainage (500m)
 - [F] Falls
- Snorkel Survey Sections**
- Section 1
 - Section 2
 - Section 3
- Infrastructure**
- ▲ Intake
 - Powerhouse
 - Road
 - - - Penstock
 - Transmission Line
 - Existing Transmission Line



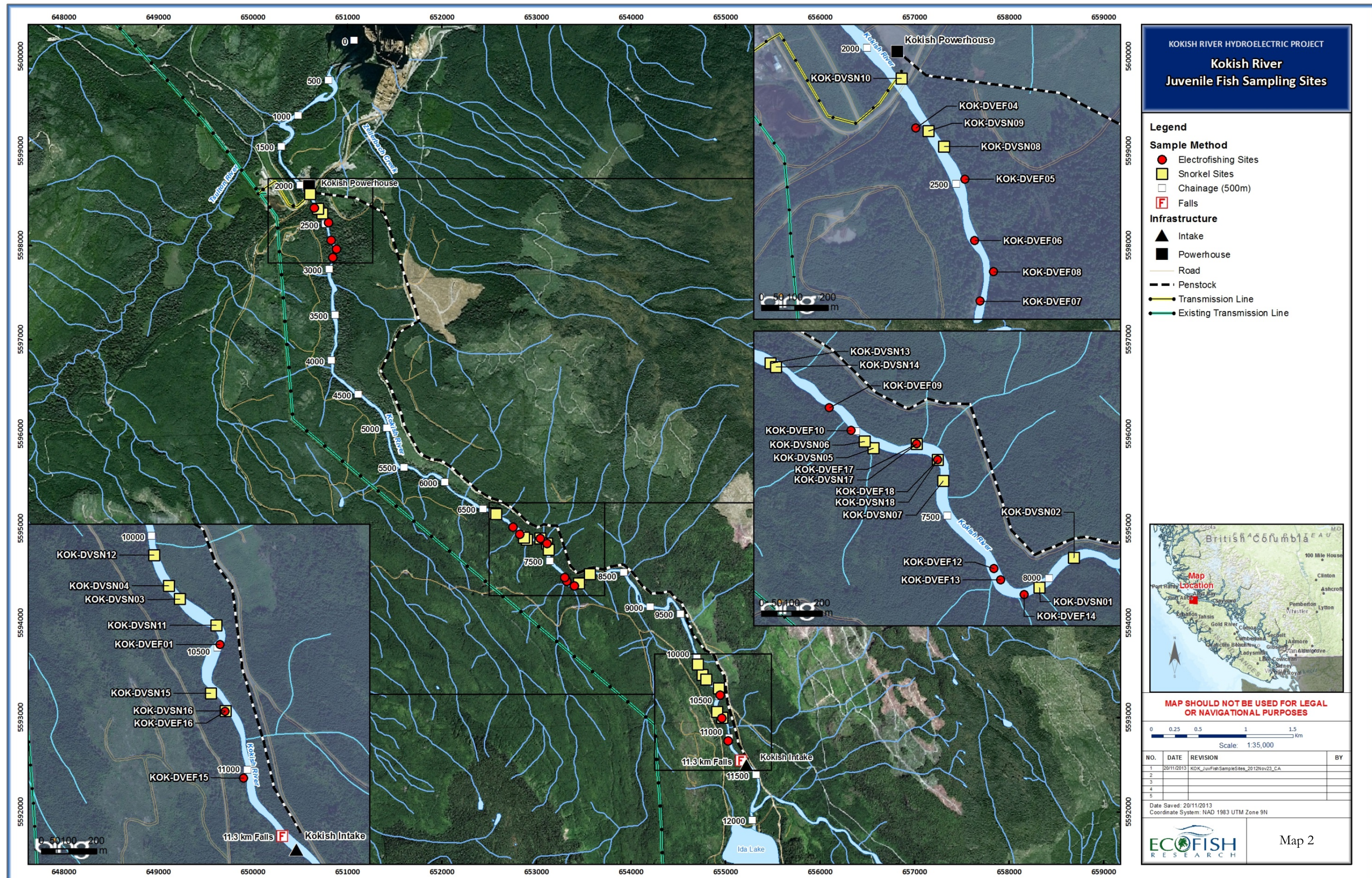
MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 0.25 0.5 1 1.5 km
Scale: 1:35,000

NO.	DATE	REVISION	BY
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2			
3			
4			
5			

Date Saved: 03/12/2012
Coordinate System: NAD 1983 UTM Zone 9N

Map 1



KOKISH RIVER HYDROELECTRIC PROJECT

Kokish River

Juvenile Fish Sampling Sites

- Legend**
- Sample Method**
- Electrofishing Sites
 - Snorkel Sites
 - Chainage (500m)
 - F Falls
- Infrastructure**
- ▲ Intake
 - Powerhouse
 - Road
 - - - Penstock
 - Transmission Line
 - Existing Transmission Line



MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

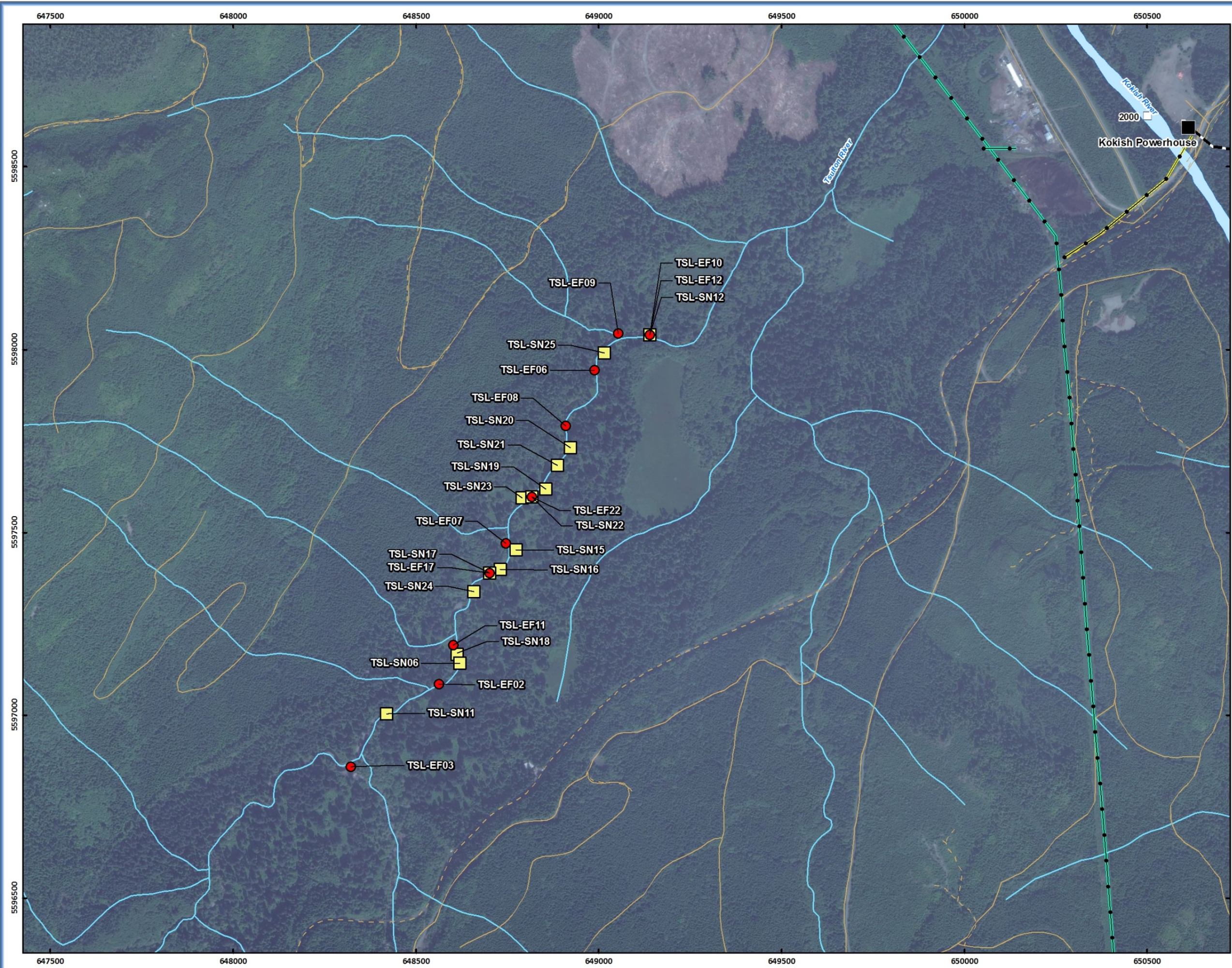
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NO.	DATE	REVISION	BY
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2			
3			
4			
5			

Date Saved: 20/11/2013
Coordinate System: NAD 1983 UTM Zone 9N

Map 2



KOKISH RIVER HYDROELECTRIC PROJECT

Tsulton River

Juvenile Fish Sampling Sites

Legend

Sample Method

- Electrofishing Sites
- Snorkel Sites
- Chainage (500m)
- Ⓡ Falls

Infrastructure

- ▲ Intake
- Powerhouse
- Penstock
- Transmission Line
- Existing Transmission Line
- Existing Road
- Forest Tenure Road



**MAP SHOULD NOT BE USED FOR LEGAL
OR NAVIGATIONAL PURPOSES**



Scale: 1:10,000

NO.	DATE	REVISION	BY
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2			
3			
4			
5			

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