

## APPENDICES

**Appendix A. 2014 Summary of Water Level Data for Brewster Lake, and the Upper and Lower Campbell Lake Reservoirs.**



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## MEMORANDUM

**TO:** Laich-Kwil-Tach Environmental Assessment Ltd. Partnership  
**FROM:** Adam Marriner, M.Sc., Nicole Wright, Ph.D., A.Sc.T., Ecofish Research Ltd.  
**DATE:** February 23, 2015  
**FILE:** 1230-02

**RE:** 2014 summary of water level data for Brewster Lake, and the Upper and Lower Campbell Reservoirs.

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### 1. INTRODUCTION

The purpose of this memorandum is to provide a hydrology update, including water level time series, of a newly installed gauge on Brewster Lake, for the monitoring period June 30 to December 31, 2014. Brewster Lake is approximately 23 km northwest of Campbell River, BC, it has an approximate elevation of 190 masl. The southern tip of Brewster Lake is approximately 6 km north of the west end of Lower Campbell Reservoir, and 10 km north of the northeast end of Upper Campbell Reservoir. In addition to documenting installation of the Brewster Lake gauge, this memorandum provides a comparison of daily average water surface elevations in the Upper and Lower Campbell Reservoirs, provided by BC Hydro, and the daily average water depth at the Brewster Lake gauge.

### 2. BREWSTER LAKE GAUGE (BRE-LG01)

A hydrometric gauging station was installed in Brewster Lake on June 30, 2014 to record lake water levels. The gauge (BRE-LG01), was installed and is being monitored to provincial standards (9RISC 2009). The gauge is comprised of a KPSI Series 500 SDI-12 pressure transducer connected to a Unidata Neon C data logger. The gauge was installed on the west shore approximately 1.5 km north of the lake outlet. A standpipe fastened to shoreline bedrock provided a protective housing for the submerged pressure transducer (Figure 1). The pressure transducer has a depth range of 0 to 4 m, and is programmed to log average water depth and temperature every 2 minutes calculated from scans taken at a 15 second interval. The 2 minute average data records are stored on the logger and transmitted via satellite every 4 hours. A 12 VDC sealed lead acid battery charged via a solar panel powers the data logger. The data logger and battery are installed in waterproof housings mounted to a nearby tree (Figure 2).

**Figure 1.** Brewster Lake Gauging Station (BRE-LG01): Submerged water level transducer in standpipe housing fastened to shoreline bedrock, as installed on June 30, 2014.



**Figure 2.** Brewster Lake Gauging Station (BRE-LG01): Data logger, solar panel, and battery box tree mounted, as installed on June 30, 2014.





Three permanent benchmarks were installed in the bedrock in the proximity of the transducer. Each benchmark was numbered, photo documented, and a relative level survey was completed to permit future quality assurance checks on the gauged water level data. A field team will re-visit the Brewster Lake Gauging Station in upcoming years to establish coordinates for the benchmarks and transducers with a GPS unit. Upon establishing coordinates for the transducer water depths will be converted to water surface elevations in metres above sea level (masl). On-going maintenance to the gauging station will be performed as needed.

### 3. WATER DEPTH AND RESERVOIR LEVELS

Daily average water surface elevations in the Upper and Lower Campbell Reservoirs as recorded by BC Hydro and the daily average water depths measured at the Brewster Lake gauging station are reported here. Data in the Upper and Lower Campbell Reservoirs are presented from January 1 to December 31, 2014; while Brewster Lake data is presented from July 1 to December 31, 2014 because the gauge station was installed on June 30, 2014. The mean, minimum, and maximum values are summarized in Table 1. The daily average water levels in the Upper Campbell Reservoir, Lower Campbell Reservoir, and Brewster Lake are shown in Figure 3, Figure 4, and Figure 5 respectively; and are summarized in Table 2.

**Table 1. 2014 annual minimum, maximum, and mean daily average water levels in the Upper and Lower Campbell Reservoirs and Brewster Lake.**

		Upper Campbell Reservoir		Lower Campbell Reservoir		Brewster Lake
		Average Daily Water Elevation (masl)		Average Daily Water Elevation (masl)		Gauged Stage (m)
	Date		Date		Date	
Annual Min.	07-Mar-14	213.637	06-Jan-14	175.02	21-Sep-14	0.368
Annual Max.	11-Dec-14	221.236	11-Dec-14	178.17	12-Dec-14	1.819
Annual Av.		216.084		177.08		0.841

Figure 3. Daily average water surface elevations in the Upper Campbell Reservoir, January 1 to December 31, 2014.

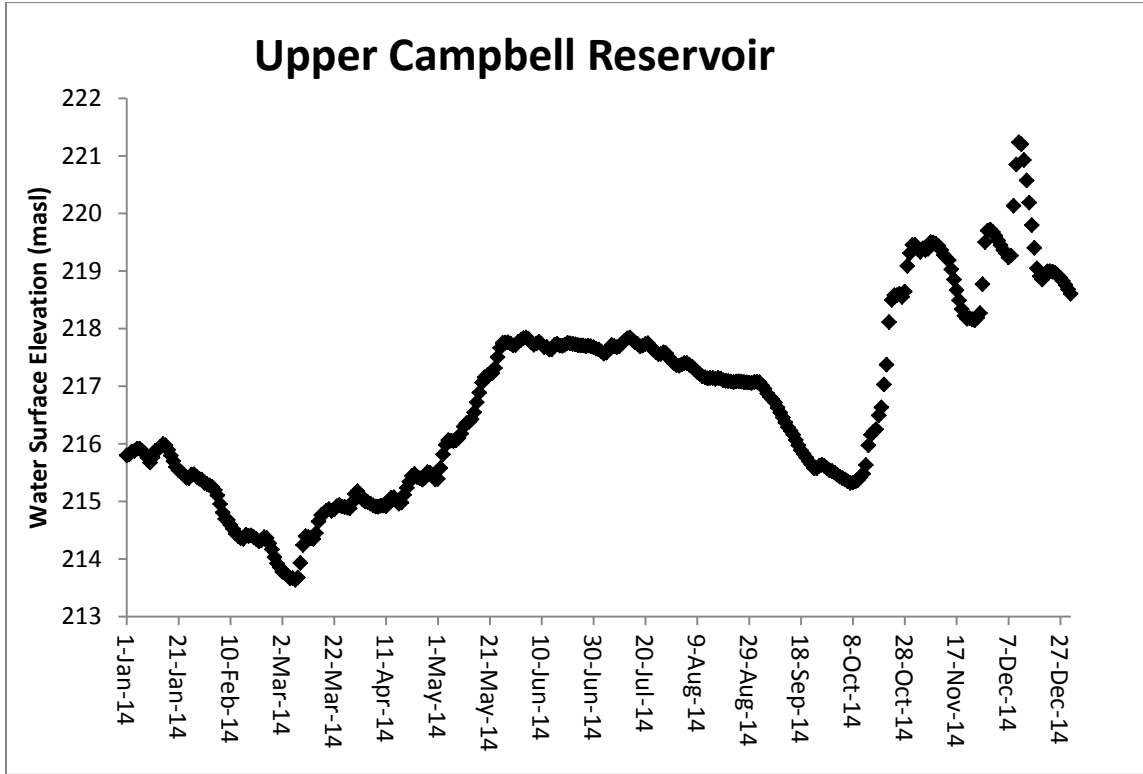


Figure 4. Daily average water surface elevations in the Lower Campbell Reservoir, August 10 to December 31, 2014.

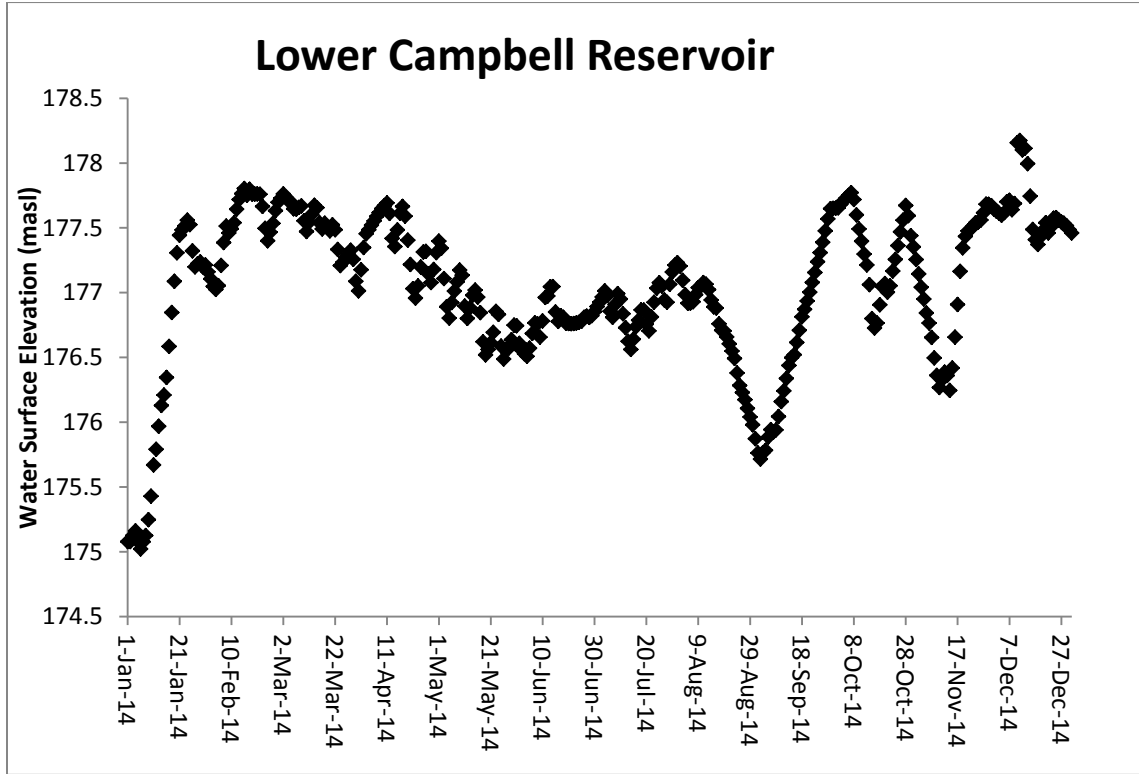
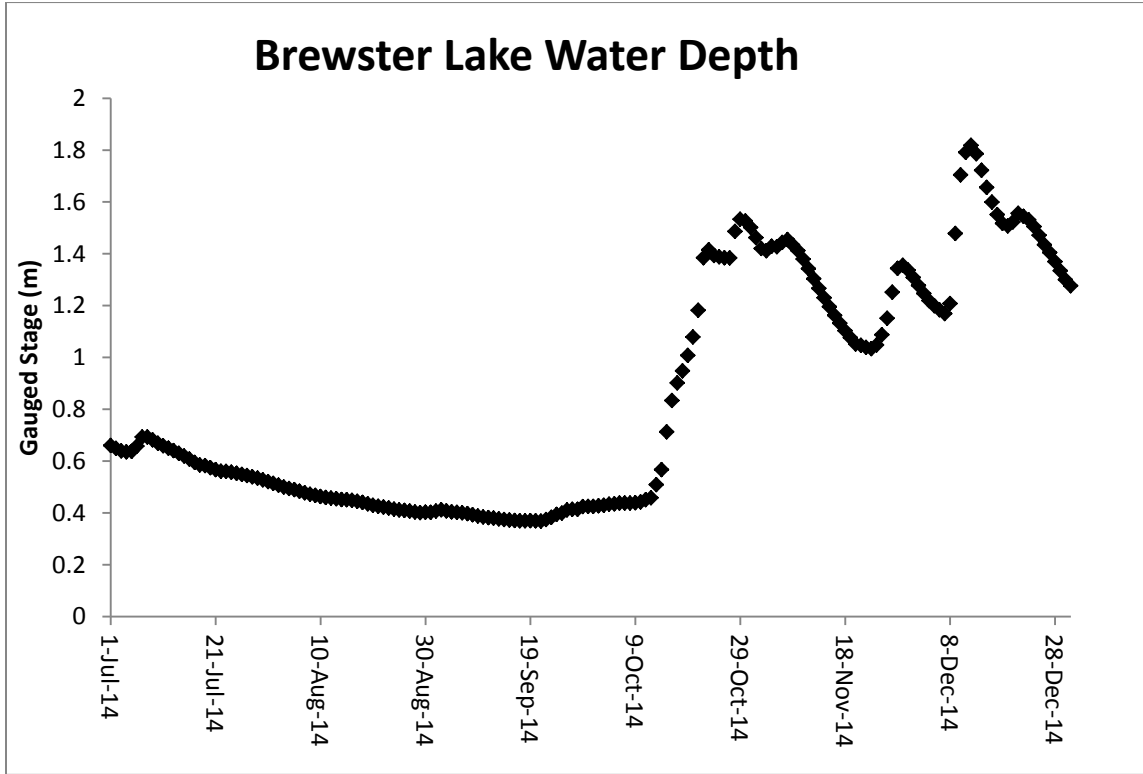


Figure 5. Daily average water surface levels at the Brewster Gauge Station in Brewster Lake, July 1 – December 31, 2014.





**Table 2. 2014 daily average water levels in the Upper and Lower Campbell Reservoirs and Brewster Lake.**

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
1-Jan-14	215.80	175.08	
2-Jan-14	215.81	175.08	
3-Jan-14	215.87	175.13	
4-Jan-14	215.88	175.16	
5-Jan-14	215.92	175.08	
6-Jan-14	215.92	175.02	
7-Jan-14	215.88	175.08	
8-Jan-14	215.84	175.13	
9-Jan-14	215.76	175.25	
10-Jan-14	215.67	175.43	
11-Jan-14	215.76	175.67	
12-Jan-14	215.88	175.79	
13-Jan-14	215.90	175.97	
14-Jan-14	215.95	176.13	
15-Jan-14	216.00	176.21	
16-Jan-14	215.98	176.35	
17-Jan-14	215.90	176.59	
18-Jan-14	215.80	176.85	
19-Jan-14	215.70	177.09	
20-Jan-14	215.60	177.31	
21-Jan-14	215.54	177.44	
22-Jan-14	215.51	177.48	
23-Jan-14	215.47	177.52	
24-Jan-14	215.41	177.56	
25-Jan-14	215.41	177.53	
26-Jan-14	215.47	177.32	
27-Jan-14	215.47	177.20	
28-Jan-14	215.43	177.22	
29-Jan-14	215.40	177.24	
30-Jan-14	215.38	177.20	
31-Jan-14	215.32	177.21	
1-Feb-14	215.30	177.16	





Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
2-Feb-14	215.28	177.11	
3-Feb-14	215.25	177.05	
4-Feb-14	215.20	177.03	
5-Feb-14	215.11	177.05	
6-Feb-14	214.96	177.21	
7-Feb-14	214.81	177.39	
8-Feb-14	214.70	177.51	
9-Feb-14	214.68	177.46	
10-Feb-14	214.59	177.49	
11-Feb-14	214.52	177.54	
12-Feb-14	214.44	177.65	
13-Feb-14	214.40	177.72	
14-Feb-14	214.36	177.76	
15-Feb-14	214.35	177.80	
16-Feb-14	214.42	177.75	
17-Feb-14	214.40	177.80	
18-Feb-14	214.41	177.76	
19-Feb-14	214.38	177.76	
20-Feb-14	214.35	177.76	
21-Feb-14	214.31	177.76	
22-Feb-14	214.33	177.67	
23-Feb-14	214.38	177.50	
24-Feb-14	214.37	177.40	
25-Feb-14	214.27	177.47	
26-Feb-14	214.17	177.53	
27-Feb-14	214.03	177.63	
28-Feb-14	213.92	177.70	
1-Mar-14	213.86	177.73	
2-Mar-14	213.78	177.76	
3-Mar-14	213.76	177.74	
4-Mar-14	213.72	177.71	
5-Mar-14	213.66	177.70	



Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
6-Mar-14	213.67	177.65	
7-Mar-14	213.64	177.64	
8-Mar-14	213.68	177.66	
9-Mar-14	213.93	177.67	
10-Mar-14	214.24	177.55	
11-Mar-14	214.40	177.47	
12-Mar-14	214.38	177.54	
13-Mar-14	214.36	177.61	
14-Mar-14	214.35	177.67	
15-Mar-14	214.45	177.66	
16-Mar-14	214.65	177.54	
17-Mar-14	214.76	177.49	
18-Mar-14	214.79	177.54	
19-Mar-14	214.84	177.50	
20-Mar-14	214.87	177.48	
21-Mar-14	214.83	177.52	
22-Mar-14	214.86	177.49	
23-Mar-14	214.92	177.33	
24-Mar-14	214.94	177.21	
25-Mar-14	214.91	177.24	
26-Mar-14	214.90	177.27	
27-Mar-14	214.89	177.30	
28-Mar-14	214.88	177.33	
29-Mar-14	214.98	177.26	
30-Mar-14	215.13	177.09	
31-Mar-14	215.18	177.01	
1-Apr-14	215.11	177.18	
2-Apr-14	215.03	177.35	
3-Apr-14	215.00	177.45	
4-Apr-14	214.99	177.49	
5-Apr-14	214.96	177.52	



Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
6-Apr-14	214.93	177.55	
7-Apr-14	214.91	177.59	
8-Apr-14	214.91	177.62	
9-Apr-14	214.92	177.65	
10-Apr-14	214.93	177.67	
11-Apr-14	214.91	177.69	
12-Apr-14	214.97	177.61	
13-Apr-14	215.06	177.42	
14-Apr-14	215.07	177.36	
15-Apr-14	215.01	177.48	
16-Apr-14	214.96	177.61	
17-Apr-14	214.98	177.67	
18-Apr-14	215.11	177.59	
19-Apr-14	215.23	177.41	
20-Apr-14	215.34	177.22	
21-Apr-14	215.44	177.03	
22-Apr-14	215.48	176.96	
23-Apr-14	215.43	177.05	
24-Apr-14	215.40	177.20	
25-Apr-14	215.38	177.31	
26-Apr-14	215.41	177.32	
27-Apr-14	215.51	177.14	
28-Apr-14	215.50	177.08	
29-Apr-14	215.44	177.18	
30-Apr-14	215.38	177.31	
1-May-14	215.39	177.40	
2-May-14	215.58	177.34	
3-May-14	215.82	177.11	
4-May-14	215.98	176.89	
5-May-14	216.06	176.80	
6-May-14	216.06	176.92	



Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
7-May-14	216.05	177.01	
8-May-14	216.06	177.08	
9-May-14	216.10	177.17	
10-May-14	216.18	177.13	
11-May-14	216.30	176.90	
12-May-14	216.36	176.80	
13-May-14	216.38	176.88	
14-May-14	216.43	176.98	
15-May-14	216.55	177.02	
16-May-14	216.72	176.97	
17-May-14	216.89	176.85	
18-May-14	217.06	176.62	
19-May-14	217.16	176.52	
20-May-14	217.19	176.56	
21-May-14	217.21	176.61	
22-May-14	217.23	176.69	
23-May-14	217.32	176.86	
24-May-14	217.51	176.83	
25-May-14	217.67	176.59	
26-May-14	217.75	176.49	
27-May-14	217.76	176.56	
28-May-14	217.76	176.57	
29-May-14	217.74	176.64	
30-May-14	217.71	176.75	
31-May-14	217.72	176.74	
1-Jun-14	217.78	176.61	
2-Jun-14	217.80	176.55	
3-Jun-14	217.84	176.53	
4-Jun-14	217.85	176.51	
5-Jun-14	217.82	176.57	
6-Jun-14	217.76	176.69	

Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
7-Jun-14	217.72	176.77	
8-Jun-14	217.74	176.76	
9-Jun-14	217.77	176.66	
10-Jun-14	217.73	176.78	
11-Jun-14	217.68	176.96	
12-Jun-14	217.68	176.97	
13-Jun-14	217.64	177.05	
14-Jun-14	217.64	177.05	
15-Jun-14	217.72	176.85	
16-Jun-14	217.74	176.78	
17-Jun-14	217.71	176.82	
18-Jun-14	217.70	176.81	
19-Jun-14	217.72	176.76	
20-Jun-14	217.75	176.76	
21-Jun-14	217.75	176.76	
22-Jun-14	217.74	176.76	
23-Jun-14	217.73	176.77	
24-Jun-14	217.71	176.77	
25-Jun-14	217.71	176.78	
26-Jun-14	217.71	176.81	
27-Jun-14	217.70	176.82	
28-Jun-14	217.71	176.81	
29-Jun-14	217.69	176.82	
30-Jun-14	217.68	176.85	
1-Jul-14	217.65	176.89	0.66
2-Jul-14	217.64	176.93	0.65
3-Jul-14	217.61	176.97	0.64
4-Jul-14	217.57	177.01	0.64
5-Jul-14	217.58	176.98	0.64
6-Jul-14	217.66	176.86	0.66
7-Jul-14	217.72	176.81	0.69





Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
8-Jul-14	217.70	176.91	0.69
9-Jul-14	217.68	176.99	0.68
10-Jul-14	217.70	176.95	0.67
11-Jul-14	217.75	176.84	0.66
12-Jul-14	217.79	176.73	0.65
13-Jul-14	217.83	176.62	0.64
14-Jul-14	217.85	176.56	0.63
15-Jul-14	217.81	176.64	0.62
16-Jul-14	217.76	176.74	0.61
17-Jul-14	217.73	176.79	0.60
18-Jul-14	217.69	176.87	0.58
19-Jul-14	217.71	176.87	0.58
20-Jul-14	217.73	176.76	0.57
21-Jul-14	217.75	176.71	0.57
22-Jul-14	217.69	176.81	0.56
23-Jul-14	217.64	176.93	0.56
24-Jul-14	217.60	177.04	0.56
25-Jul-14	217.56	177.08	0.55
26-Jul-14	217.56	177.05	0.55
27-Jul-14	217.59	176.94	0.54
28-Jul-14	217.57	176.93	0.54
29-Jul-14	217.50	177.06	0.53
30-Jul-14	217.44	177.16	0.53
31-Jul-14	217.40	177.21	0.52
1-Aug-14	217.37	177.23	0.51
2-Aug-14	217.36	177.21	0.51
3-Aug-14	217.38	177.10	0.50
4-Aug-14	217.40	176.98	0.49
5-Aug-14	217.40	176.92	0.49



Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
6-Aug-14	217.37	176.92	0.48
7-Aug-14	217.34	176.93	0.48
8-Aug-14	217.29	176.98	0.47
9-Aug-14	217.25	177.04	0.47
10-Aug-14	217.21	177.05	0.46
11-Aug-14	217.17	177.08	0.46
12-Aug-14	217.16	177.07	0.46
13-Aug-14	217.14	177.02	0.45
14-Aug-14	217.14	176.94	0.45
15-Aug-14	217.15	176.89	0.45
16-Aug-14	217.13	176.88	0.45
17-Aug-14	217.15	176.76	0.45
18-Aug-14	217.13	176.71	0.44
19-Aug-14	217.10	176.71	0.44
20-Aug-14	217.09	176.66	0.43
21-Aug-14	217.09	176.61	0.43
22-Aug-14	217.08	176.55	0.42
23-Aug-14	217.07	176.49	0.42
24-Aug-14	217.08	176.38	0.41
25-Aug-14	217.09	176.28	0.41
26-Aug-14	217.08	176.23	0.41
27-Aug-14	217.07	176.17	0.41
28-Aug-14	217.07	176.11	0.40
29-Aug-14	217.06	176.04	0.40
30-Aug-14	217.06	175.98	0.40
31-Aug-14	217.07	175.87	0.40
1-Sep-14	217.08	175.76	0.41
2-Sep-14	217.07	175.72	0.41
3-Sep-14	217.01	175.77	0.41
4-Sep-14	216.96	175.78	0.40

Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
5-Sep-14	216.87	175.89	0.40
6-Sep-14	216.82	175.94	0.40
7-Sep-14	216.77	175.92	0.40
8-Sep-14	216.72	175.94	0.39
9-Sep-14	216.63	176.04	0.39
10-Sep-14	216.54	176.16	0.38
11-Sep-14	216.46	176.24	0.38
12-Sep-14	216.37	176.34	0.38
13-Sep-14	216.29	176.44	0.38
14-Sep-14	216.22	176.50	0.37
15-Sep-14	216.16	176.52	0.37
16-Sep-14	216.07	176.62	0.37
17-Sep-14	215.97	176.71	0.37
18-Sep-14	215.89	176.81	0.37
19-Sep-14	215.83	176.87	0.37
20-Sep-14	215.76	176.94	0.37
21-Sep-14	215.70	177.00	0.37
22-Sep-14	215.64	177.08	0.37
23-Sep-14	215.58	177.16	0.38
24-Sep-14	215.58	177.24	0.39
25-Sep-14	215.62	177.31	0.40
26-Sep-14	215.63	177.39	0.41
27-Sep-14	215.62	177.48	0.41
28-Sep-14	215.58	177.57	0.41
29-Sep-14	215.54	177.65	0.42
30-Sep-14	215.53	177.65	0.43
1-Oct-14	215.50	177.65	0.43
2-Oct-14	215.46	177.65	0.43
3-Oct-14	215.43	177.68	0.43
4-Oct-14	215.40	177.71	0.43
5-Oct-14	215.38	177.73	0.43

Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
6-Oct-14	215.35	177.75	0.44
7-Oct-14	215.32	177.77	0.44
8-Oct-14	215.33	177.72	0.44
9-Oct-14	215.35	177.60	0.44
10-Oct-14	215.37	177.49	0.44
11-Oct-14	215.42	177.40	0.45
12-Oct-14	215.48	177.30	0.46
13-Oct-14	215.63	177.21	0.51
14-Oct-14	215.97	177.06	0.57
15-Oct-14	216.16	176.80	0.71
16-Oct-14	216.21	176.73	0.83
17-Oct-14	216.25	176.77	0.90
18-Oct-14	216.50	176.91	0.95
19-Oct-14	216.63	177.05	1.01
20-Oct-14	217.03	177.07	1.08
21-Oct-14	217.37	177.00	1.18
22-Oct-14	218.11	177.05	1.38
23-Oct-14	218.50	177.17	1.42
24-Oct-14	218.58	177.26	1.39
25-Oct-14	218.58	177.36	1.39
26-Oct-14	218.60	177.47	1.38
27-Oct-14	218.55	177.56	1.38
28-Oct-14	218.64	177.67	1.49
29-Oct-14	219.09	177.59	1.53
30-Oct-14	219.31	177.44	1.53
31-Oct-14	219.46	177.35	1.50
1-Nov-14	219.45	177.26	1.46
2-Nov-14	219.39	177.14	1.42
3-Nov-14	219.33	177.04	1.41
4-Nov-14	219.40	176.95	1.43

Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
5-Nov-14	219.37	176.84	1.43
6-Nov-14	219.39	176.77	1.44
7-Nov-14	219.50	176.65	1.46
8-Nov-14	219.50	176.50	1.43
9-Nov-14	219.47	176.36	1.41
10-Nov-14	219.44	176.27	1.38
11-Nov-14	219.37	176.33	1.34
12-Nov-14	219.28	176.39	1.30
13-Nov-14	219.23	176.36	1.27
14-Nov-14	219.19	176.25	1.23
15-Nov-14	219.03	176.42	1.20
16-Nov-14	218.85	176.66	1.16
17-Nov-14	218.67	176.91	1.13
18-Nov-14	218.49	177.16	1.10
19-Nov-14	218.34	177.35	1.08
20-Nov-14	218.22	177.43	1.05
21-Nov-14	218.17	177.48	1.05
22-Nov-14	218.18	177.49	1.04
23-Nov-14	218.16	177.51	1.03
24-Nov-14	218.14	177.54	1.05
25-Nov-14	218.19	177.55	1.09
26-Nov-14	218.27	177.56	1.15
27-Nov-14	218.77	177.62	1.25
28-Nov-14	219.50	177.68	1.34
29-Nov-14	219.70	177.68	1.36
30-Nov-14	219.72	177.67	1.34
1-Dec-14	219.68	177.64	1.31
2-Dec-14	219.61	177.63	1.28
3-Dec-14	219.53	177.61	1.25
4-Dec-14	219.45	177.60	1.22
5-Dec-14	219.37	177.62	1.20





Table 2. (Continued).

Date	Upper Campbell Reservoir	Lower Campbell Reservoir	Brewster Lake
	Average Daily Water Elevation (masl)	Average Daily Water Elevation (masl)	Gauged Stage (m)
6-Dec-14	219.31	177.70	1.18
7-Dec-14	219.24	177.71	1.17
8-Dec-14	219.27	177.64	1.21
9-Dec-14	220.13	177.69	1.48
10-Dec-14	220.85	178.16	1.70
11-Dec-14	221.24	178.17	1.79
12-Dec-14	221.20	178.10	1.82
13-Dec-14	220.93	178.11	1.79
14-Dec-14	220.57	178.00	1.72
15-Dec-14	220.19	177.75	1.66
16-Dec-14	219.80	177.49	1.60
17-Dec-14	219.40	177.41	1.55
18-Dec-14	219.05	177.37	1.52
19-Dec-14	218.91	177.43	1.51
20-Dec-14	218.85	177.48	1.52
21-Dec-14	218.93	177.54	1.56
22-Dec-14	219.00	177.46	1.54
23-Dec-14	219.00	177.51	1.53
24-Dec-14	218.99	177.57	1.50
25-Dec-14	218.97	177.58	1.47
26-Dec-14	218.93	177.56	1.43
27-Dec-14	218.88	177.55	1.40
28-Dec-14	218.83	177.54	1.37
29-Dec-14	218.76	177.52	1.33
30-Dec-14	218.68	177.49	1.30
31-Dec-14	218.60	177.46	1.28



Yours truly,

**Ecofish Research Ltd.**

*Signed*

Nicole Wright

Senior Environmental Scientist, Hydrology



## **REFERENCES**

RISC (Resources Inventory Standards Committee). 2009. Manual of British Columbia hydrometric standards (Version 1.0). Prepared by Ministry of Environment, Science and Information Branch, Victoria, BC. [Online].

**Appendix B. Literature Review Bibliography.**

**LIST OF FIGURES**

Table 1. Primary literature reviewed for the JHTMON10 study.....1



**Table 1. Primary literature reviewed for the JHTMON10 study.**

Author(s)	Year	Title	Citation	Topic	Summary/ Key Elements	Link to Document
Furey et al.	2004	Water level drawdown affects physical and biogeochemical properties of littoral sediments of a reservoir and a natural lake	Furey, P. C., Nordin, R. N., Mazumder, A. 2004. Water level drawdown affects physical and biogeochemical properties of littoral sediments of a reservoir and a natural lake. <i>Lake and Reservoir Management</i> 20: 280–295.	Aquatic macrophyte/water level relationships. Sediment physicochemistry.	Compared the seasonal littoral benthic dynamics of a reservoir (Sooke Reservoir, BC) with those of a nearby natural lake (Shawnigan Lake). The reservoir experienced seasonal drawdown of c. 6 m, whereas the lake experienced natural drawdown of < 0.5 m and thus provided a control to specifically examine the effects of drawdown. Despite both waterbodies being relatively deep, thermal stratification was much weaker in the reservoir, e.g. temperature differences between the surface and the bottom never exceeded 2°C in the reservoir whereas differences were up to 11.5°C in the lake. Unlike the reservoir, the lake experienced concomitant declines in dissolved oxygen concentrations in the thermocline. Macrophyte density was much lower in the reservoir and growth there was restricted to higher in the littoral zone. Macrophytes that became exposed in the upper littoral zone by the end of the summer and fall did not, however, die back. The authors contrast this result with that which would be expected in reservoirs situated further north where freezing would be expected to cause die back and increase exposure of the sediments. The lower extent of macrophyte coverage was also shown to shift downwards in response to drawdown in the reservoir, thus increasing the size of the effective littoral area. Sediment sampling indicated that bed sediments were finer-textured in the littoral zone of the lake, indicating that sediment erosion and focusing was more dominant in the littoral zone of the reservoir. The upper region of the littoral zone that was sampled in the reservoir was determined to be an erosional zone, whereas all of the littoral area that was sampled in the lake was determined to be an accumulation zone. Nutrient and organic matter concentrations were lower in the littoral zone of the reservoir, while stable isotope analysis indicated that a greater relative proportion of organic matter was derived from allochthonous sources in the reservoir compared with the lake.	<a href="http://www.aplxz.kx-g.com/15GP4M-WA30K2Q2~Q\J087UK~H\JV5CCX~5VLIIZP~OV\Furey_et_al_2004_Water_level_drawdown_affects_physical_&amp;_biogeochemical_properties_of_littoral_sediments.pdf">http://www.aplxz.kx-g.com/15GP4M-WA30K2Q2~Q\J087UK~H\JV5CCX~5VLIIZP~OV\Furey_et_al_2004_Water_level_drawdown_affects_physical_&amp;_biogeochemical_properties_of_littoral_sediments.pdf</a>
Hill et al.	1998	A hydrological model for predicting the effects of dams on the shoreline vegetation of lakes and reservoirs	Hill, N. M., Keddy, P. A., Wisheu, I. C. 1998. A hydrological model for predicting the effects of dams on the shoreline vegetation of lakes and reservoirs. <i>Environmental Management</i> 22: 723–736.	Terrestrial vegetation/water level relationships	a) The authors compare the hydrological regimes and vegetation of 13 regulated and 37 unregulated lakes in Nova Scotia b) Vegetation was surveyed at six sites per lake from 1 m below the water line to 1 m above the shrub line c) Shoreline vegetation of regulated systems was less diverse, contained more exotic species, and devoid of rare shoreline herbs d) Restoring the natural hydrological regime can restore shoreline vegetation communities. e) A general model is proposed which is designed to be applied to temperate reservoirs. It identifies a 'sweet spot' where moderate within and among year variation lead to maximum species abundance.	<a href="http://www.literature/hill_et_al_1998_A_hydrological_model_for_predicting_the_effects_of_dams.pdf">Literature\Hill et al_1998_A hydrological model for predicting the effects of dams.pdf</a>
Jansson et al.	2000	Effects of river regulation on river-margin vegetation: a comparison of eight boreal rivers	Jansson, R., Nilsson, C., Dynesius, M., Andersson, E. 2000. Effects of river regulation on river-margin vegetation: a comparison of eight boreal rivers. <i>Ecological Applications</i> 10: 203–224.	Terrestrial vegetation/water level relationships	a) The authors compared the flora in 200 m wide margins along the length of eight rivers in Sweden, four which were free-flowing and four which were regulated b) The number of species and cover per site were higher along the free flowing rivers than along storage reservoirs, with large fluctuations between low water levels in spring and high levels in late summer and fall c) Regulated systems had a higher proportion of wind-dispersed species than free-flowing rivers.	<a href="http://www.literature/jansson_et_al_2000_Effects_of_river_regulation_on_river-margin_vegetation.pdf">Literature\Jansson et al_2000_Effects of river regulation on river-margin vegetation.pdf</a>

**Table 1. (Continued).**

Author(s)	Year	Title	Citation	Topic	Summary/ Key Elements	Link to Document
Richardson and Mallik	2005	Shoreline vegetation change in upstream and downstream reaches of three temperate streams dammed for hydroelectric generation in British Columbia.	Mallik, A.U. and J.S. Richardson. 2005. Shoreline vegetation change in upstream and downstream reaches of three temperate streams dammed for hydroelectric generation in British Columbia. Report to BC Hydro.	Terrestrial vegetation/water level relationships	a) Vegetation transects were completed at three flow controlled rivers to detect differences in vegetation cover. b) Differences in vegetation communities amongst sites were larger for the flow controlled portion of the river as compared to upstream and downstream sections. c) Significantly fewer alder and redcedar were located downstream of reservoirs potentially due to reductions in extremes in flow variation.	<a href="http://a100.gov.bc.ca/app/sdata/acat/documents/r37343/Shoreline_Vegetation_hydro_BC_1375369315475_7dba697adde73e3dc78ddaa42180f912a6cac6f2911ee8efa2599f02137d7b9e.pdf">http://a100.gov.bc.ca/app/sdata/acat/documents/r37343/Shoreline_Vegetation_hydro_BC_1375369315475_7dba697adde73e3dc78ddaa42180f912a6cac6f2911ee8efa2599f02137d7b9e.pdf</a>
Riis & Hawes	2002	Relationships between water level fluctuations and vegetation diversity in shallow water of New Zealand lakes	Riis, T., Hawes, I. 2002. Relationships between water level fluctuations and vegetation diversity in shallow water of New Zealand lakes. Aquatic Botany 74: 133–148.	Aquatic macrophyte/water level relationships	a) A study to examine which aspects of the hydrological regime influence the 'low mixed community' of aquatic macrophytes in 21 New Zealand lakes. b) Vegetation in each lake was surveyed once and water level data for the previous 10 years was used to summarize historic water level fluctuations. c) Surveys were undertaken using SCUBA with 6 to 50 transects per lake. The upper and lower depth limit of each species was recorded along the transect. d) Diversity was quantified using: species richness, Shannon-Weiner Diversity Index and evenness. e) Regarding WL: "It is not a trivial task to parameterise water level fluctuations in lakes in a way that integrates both the spatial and temporal dimensions on an ecologically relevant scale. We approached the problem by calculating three groups of statistics, which a priori we considered likely to affect the habitat for LMC plants. Firstly, we used the quartile range (25–75%) instead of actual range to buffer for extremes, to describe the general conditions in the lakes during the 10 years prior to the vegetation survey, rather than the extreme events. Extreme events may be ecologically significant but also are the timing of the extreme events. If a long dry period had occurred several years prior to the vegetation survey it would not have had the same effect as if it had happened the last year prior to the survey. This confounding effect of timing led us to exclude extreme events for each lake. Secondly, to give an indication of the potential magnitude of desiccation events, we calculated the frequency and mean duration of events when the level fell below the median. Thirdly, to help define the hydrological requirements of the LMC, we determined the level on the shore where the mean dry period duration was 10, 30, 60, 120 and 180 days." f) Species richness was much higher in lakes with high intra-annual variability (e.g. UCR) rather than high inter-annual variability.	<a href="http://www.sciencedirect.com/science/article/pii/S0304377002000748">http://www.sciencedirect.com/science/article/pii/S0304377002000748</a>
Shafroth et al.	2002	Potential responses of riparian vegetation to dam removal	Shafroth, P. B., Friedman, J. M., Auble, G. T., Scott, L. M., Braatne, J. H. 2002. Potential Responses of riparian vegetation to dam removal: Dam removal generally causes changes to aspects of the physical environment that influence the establishment and growth of riparian vegetation BioScience 52: 703-712.	Terrestrial vegetation/water level relationships	a) Focuses on the effects of dam removal so of limited relevance to JHTMON10. b) Highlights potential for areas of high disturbance to favour invasive plant growth. c) Provides information on plant succession in response to altered hydroperiod, although the emphasis is on landscapes in the interior USA.	<a href="Literature\Shafroth et al_2002_Potential_responses_of_riparian_vegetation_to_dam_removal.pdf">Literature\Shafroth et al_2002_Potential_responses_of_riparian_vegetation_to_dam_removal.pdf</a>

Table 1. (Continued).

Author(s)	Year	Title	Citation	Topic	Summary/ Key Elements	Link to Document
Leira & Cantonati	2008	Effects of water-level fluctuations on lakes: an annotated bibliography	Leira, M., Cantonati, M. 2008. Effects of water-level fluctuations on lakes: an annotated bibliography. <i>Hydrobiologia</i> 613: 171–184.	Aquatic biology/water level relationships	A review of the literature on the effects of water-level fluctuations on lakes, 1991-2008. It is telling that the section on effects on biota includes only a very small section on terrestrial vegetation which notes that "much less attention has been paid to terrestrial plant communities, although terrestrial species are very sensitive to water-level changes". Only two papers (one is an Australian study and one from the tropics) are included in this section. Elsewhere, it notes that the duration of flooding has been shown to be more important in lacustrine wetlands than the depth. Note that the saved document consists of a special issue of <i>Hydrobiologia</i> which contains other papers of some relevance.	<a href="#">Literature\Leira &amp; Cantonati_2008_Effects of water level fluctuations on lakes.pdf</a>
Nilsson	1981	Dynamics of the shore vegetation of a north Swedish hydro-electric reservoir during a 5-year period.	Nilsson, C. 1981. Dynamics of the shore vegetation of a north Swedish hydro-electric reservoir during a 5-year period. <i>Acta Phytogeographica Suecica</i> 69. Doctoral Thesis. Uppsala University, Sweden.	Terrestrial vegetation/water level relationships	This thesis provides additional material relating to the Nilsson and Keddy (1988) study that is described above.	<a href="#">Literature\Nilsson_1981_Dynamics of the shore vegetation of a north Swedish hydro-electric reservoir.pdf</a>
Nilsson & Keddy	1988	Predictability of change in shoreline vegetation in a hydroelectric reservoir, northern Sweden	Nilsson, C. Keddy, PA. 1988. Predictability of change in shoreline vegetation in a hydroelectric reservoir, northern Sweden. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> 45: 1896-1904.	Terrestrial vegetation/water level relationships	a) A study of relationships between shoreline vegetation and water levels using 10 years of data for a reservoir in Sweden. b) The flora comprised sparse vegetation, and there was a strong positive relationship between abundance and richness, indicative of disturbed habitats. c) Vegetation was most stable when there was 40-60 days of flooding. d) At best, water level changes could only explain ~40% of the variability in species abundance and richness. <b>The simple system was not readily predictable.</b> e) Of the hydrological variables, the duration of flooding in the previous year was the best explanatory variable.	<a href="#">Literature\Nilsson &amp; Keddy_1988_Predictability of shoreline impacts.pdf</a>
Northcote & Atagi	1997	Ecological interactions in the flooded littoral zone of reservoirs: the importance and role of submerged terrestrial vegetation with special reference to fish, fish habitat and fisheries in the Nechako Reservoir of British Columbia, Canada	Northcote, T. G., Atagi, G. Y. 1997. Ecological interactions in the flooded littoral zone of reservoirs: the importance and role of submerged terrestrial vegetation with special reference to fish, fish habitat and fisheries in the Nechako Reservoir of British Columbia, Canada. Report prepared for the Ministry of Environment, Lands and Parks, Skeena Region. Skeena Fisheries Report SK-111. 71 p. Available online: <a href="http://www.env.gov.bc.ca/skeena/fish/skeena_reports/sk111.pdf">http://www.env.gov.bc.ca/skeena/fish/skeena_reports/sk111.pdf</a> [accessed May 07, 2014].	Ecological effects of flooding following reservoir construction	A review of the ecological interactions in the littoral zone of recently flooded reservoirs. Focuses on trophic upsurge due to mobilization of nutrients from recently flooded soils. Notes that "Macrophyte growth in reservoirs subject to much fluctuation in water level usually is restricted to the lowermost drawdown point or below, as was evident in Buttle Reservoir (Vancouver Island, B.C.) in October 1996 (TGN personal observations)". <b>Includes a summary of the history of inundation to Buttle Lake and Upper Campbell Reservoir, including aerial photographs.</b>	<a href="#">Literature\Northcote &amp; Atagi_1997_Ecological interactions in the flooded littoral zone of reservoirs.pdf</a>

Table 1. (Continued).

Author(s)	Year	Title	Citation	Topic	Summary/ Key Elements	Link to Document
Turner et al.	2005	Divergent impacts of experimental lake-level drawdown on planktonic and benthic plant communities in a boreal forest lake	Turner, M. A., Huebert, D. B., Findlay, D. L., Hendzel, L. L., Jansen, W. A., Bodaly, R. A., Armstrong, L. M., Kasian, S. E. M. 2005. Divergent impacts of experimental lake-level drawdown on planktonic and benthic plant communities in a boreal forest lake. Canadian Journal of Fisheries and Aquatic Sciences 62: 991–1003.	Aquatic macrophyte and phytoplankton/water level relationships.	An experimental study of a small oligotrophic lake in Ontario which was subject to water level manipulations by lowering surface water level by 2–3 m during winter and subsequently raising it in summer. The manipulations were specifically designed to mimic the effects of hydropower operations and the study focused on effects to both littoral and pelagic primary productivity. Contrary to expectations, nutrient release following summer water level increases were muted and, consequently, changes to pelagic primary productivity were minor. Macrophyte biomass decreased, particularly in the case of isoetids (slow growing perennials). Epilithon exhibited a minor response, reflecting short turnover times which permitted benthic algae to adapt to the changes and colonize new habitat. The authors concluded that “the trophic impacts of declining lake levels, whether due to hydroelectric reservoir manipulations or climate change, are likely to be much greater in the littoral zone than in the pelagic zone if major nutrients are unaltered”.	<a href="http://www.phix.kx-g.com/15GP4M~W\30K2Q2~Q\J087UK~HVJ5CCX~5\LHIZP~O\Turner et al. 2005-Divergent impacts of experimental lake-level drawdown on planktonic and benthic plant communities.pdf">http://www.phix.kx-g.com/15GP4M~W\30K2Q2~Q\J087UK~HVJ5CCX~5\LHIZP~O\Turner et al. 2005-Divergent impacts of experimental lake-level drawdown on planktonic and benthic plant communities.pdf</a>
Van Eck et al.	2004	Is tolerance to summer flooding correlated with distribution patterns in river floodplains? A comparative study of 20 terrestrial grassland species	Van Eck, W. H. J. M., Van De Steeg, H. M., Blom, C. W. P. M., de Kroon, H. 2004. Is tolerance to summer flooding correlated with distribution patterns in river floodplains? A comparative study of 20 terrestrial grassland species. Oikos 107: 393-405.	Terrestrial vegetation/water level relationships	a) The authors undertook experimental studies of the tolerance of 20 grass species to inundation. Results were compared with data collected from 123 vegetation surveys in the Rhine River basin. b) The elevations of plants that were surveyed were not normally-distributed thus median and other percentile values were used to characterize distributions. c) Experiments involved submerging species for 2 months and measuring survival and biomass recovery. d) Most species had a limited range of distribution along the elevation gradient. Survival was reduced for most species when inundation > 1 week. Flood tolerant species occurred at lower levels. Flood tolerant species were able to recover after flooding, and the success of this recovery was generally not affected by flood duration. e) The introduction provides a good summary of the physiological effects of inundation on plant growth. Oxygen deficiency is the major physiological constraint encountered by plants during inundation. Adaptions include aerenchyma formation or anaerobic respiration (energetically expensive). Post-anoxic injury can occur as metabolites formed during submergence are metabolized following re-emergence.	<a href="http://onlinelibrary.wiley.com/doi/10.1111/j.0030-1299.2004.13083.x/abstract?deniedAccessCustomisedMessage=&amp;userIsAuthenticated=false">http://onlinelibrary.wiley.com/doi/10.1111/j.0030-1299.2004.13083.x/abstract?deniedAccessCustomisedMessage=&amp;userIsAuthenticated=false</a>
Van Eck et al.	2006	Seasonal dependent effects of flooding on plant species survival and zonation: a comparative study of 10 terrestrial grassland species	Van Eck, W. H. J. M., Lenssen, J. P. M., Van De Steeg, H. M., Blom, C. W. P. M., de Kroon, H. 2006. Seasonal dependent effects of flooding on plant species survival and zonation: a comparative study of 10 terrestrial grassland species Hydrobiologia 565: 59-69.	Terrestrial vegetation/water level relationships	a) The authors conducted an experimental study of how variation in the seasonal variability of flooding affected the distribution of 10 grasses. b) All species survived longer under winter floods than under summer floods. The elevation of species was strongly related to their tolerance to summer (not winter) flooding. c) "zonation patterns as created by occasional summer floods may be maintained for a long time, probably due to the limited ability of species to re-colonise lower positions in the floodplain".	<a href="http://link.springer.com/chapter/10.1007%2F1-4020-5367-3_4">http://link.springer.com/chapter/10.1007%2F1-4020-5367-3_4</a>

**Table 1. (Continued).**

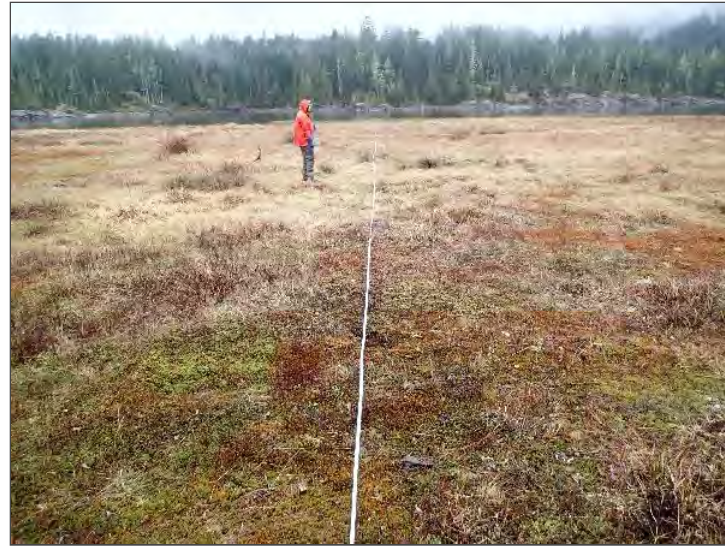
Author(s)	Year	Title	Citation	Topic	Summary/ Key Elements	Link to Document
Wilcox & Meeker	1991	Disturbance effects on aquatic vegetation in regulated and unregulated lakes in northern Minnesota	Wilcox, D. A., Meeker, J. E. 1991. Disturbance effects on aquatic vegetation in regulated and unregulated lakes in northern Minnesota. Canadian Journal of Botany 69: 1542–1551.	Aquatic macrophyte/water level relationships	a) Water level regulation can reduce macrophyte diversity in the littoral zone due to both too-little and too-much hydrological disturbance that is associated with water level stabilization and increased fluctuation respectively. The authors compared macrophyte communities in two lakes for which water level management was imposed, with a local unregulated lake. Their results showed that the unregulated lake, which had a moderate degree of natural variability in water level, had a much more structurally-diverse macrophyte community than the regulated lakes which had either artificially-imposed low or high levels of variability in water levels. b) Although the study did not explicitly consider productivity or biomass, the depauperate communities in the regulated lakes typically comprised less-extensive coverage than the communities in the unregulated lake. In particular, the macrophyte community in the lake that underwent large drawdown in early winter suffered from freezing damage in the upper region of the littoral zone. c) This lake was characterised by a general dominance of stress-tolerant species with thin stemmed, mat or low rosette architectures, with a lack of macrophytes in the upper water column.	<a href="http://www.phix.kx-g.com/doi/10.1002/eco.1543/abstract">http://www.phix.kx-g.com/doi/10.1002/eco.1543/abstract</a>
Xie et al.	2014	The impact of Three Gorges Dam on the downstream eco-hydrological environment and vegetation distribution of East Dongting Lake	Xie Y.-h., Yue T., Xin-sheng C., Feng L. and Zheng-miao D. 2014. The impact of Three Gorges Dam on the downstream eco-hydrological environment and vegetation distribution of East Dongting Lake, Ecohydrology, DOI: 10.1002/eco.1543.	Terrestrial vegetation/water level relationships	a) A study of the effects of water level fluctuations associated with the Three Gorges Dam in China on the elevation of vegetation in a very large downstream lake (Lake Dongting, 2625 km <sup>2</sup> ). The WL in the lake fluctuates by 12-14 m with a maximum in August and a minimum in January/February. b) Satellite remote sensing images (Landsat) were obtained for 6 dates between 1995 and 2011 when the water level was approximately the same (21 m). Land cover was classified as either vegetation (forest, reeds, grass), mud flat or water body. Land cover data were combined with a digital elevation model. c) Change in submergence duration is shown to drive the elevation of vegetation cover.	<a href="http://onlinelibrary.wiley.com/doi/10.1002/eco.1543/abstract">http://onlinelibrary.wiley.com/doi/10.1002/eco.1543/abstract</a>
Zohary & Ostrovsky	2011	Ecological impacts of excessive water level fluctuations in stratified freshwater lakes	Zohary, T., Ostrovsky, I. 2011. Ecological impacts of excessive water level fluctuations in stratified freshwater lakes. Inland Waters. 1: 47–59.	Aquatic biology/water level relationships	A general review of the ecological impacts of water level fluctuations. Highlights the potential for water level fluctuations to cause a shift in primary productivity from the littoral (macrophytes) to the pelagic (phytoplankton).	<a href="http://www.ecofishresearch.com/Literature/Zohary%20Ostrovsky%202011%20Ecological%20impacts%20of%20excessive%20water%20level%20fluctuations%20in%20stratified%20lakes.pdf">Literature\Zohary &amp; Ostrovsky 2011 Ecological impacts of excessive water level fluctuations in stratified lakes.pdf</a>

**Appendix C. Year 1 Vegetation Transect Data.**





Tall Sitka willow and upland forest



Trimmed short Sitka willow



Hairgrass - sedge



Spearwort mudflat

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	WSt	RF	0	71.2	222.159	220.23	3	260	2	90	deer browse; Douglas-fir, willow, and conifers (5-10 yrs old) abundant; vegetation has been maintained in front of campsite; some Scotch broom, blackberry, thistle, moss, grass, strawberry, St. John's wort, oxeye daisy
2	WSs		71.2	98.8	220.23	219.839	1	260	2	75	willows sparse - mostly grass, some rushes; flat gravel areas; invasive species include daisy, thistle
3	HS		98.8	132.3	219.839	219.296	3	260	2	95	grass dominated; lots of moss
4	HS	SL	132.3	159.4	219.296	219.23	3	260	3	95	likely exotic Calamagrostis
5	SL	HS	159.4	175.9	219.23	218.483	2	260	3	85	
6	SL		175.9	208	218.483	218.088	2	260	4	75	mudflat substrate dominant; heron, deer (buck prints)
7	SL		208								

Benchmark #: 2  
 Transect Length#: 208  
 Transect Direction: 260°

Directions: Located at Campsite #34 at Ralf River. Benchmark is on western hemlock on the west (left) side of pad.

Invasive Species: Invasive species include Scotch broom, Himalayan blackberry, thistle, St. John's wort, and oxeye daisy.

Comments:



**JHTMON 10**

Survey Date: January 15, 2015  
 Date Issued: March 2, 2015

Location: JHT-SVM01  
 Waterbody: Buttle Lake  
 UTM Coordinates: 10U 317286 5500786  
 Water Elevation: 218.088 Time: 17:48:00





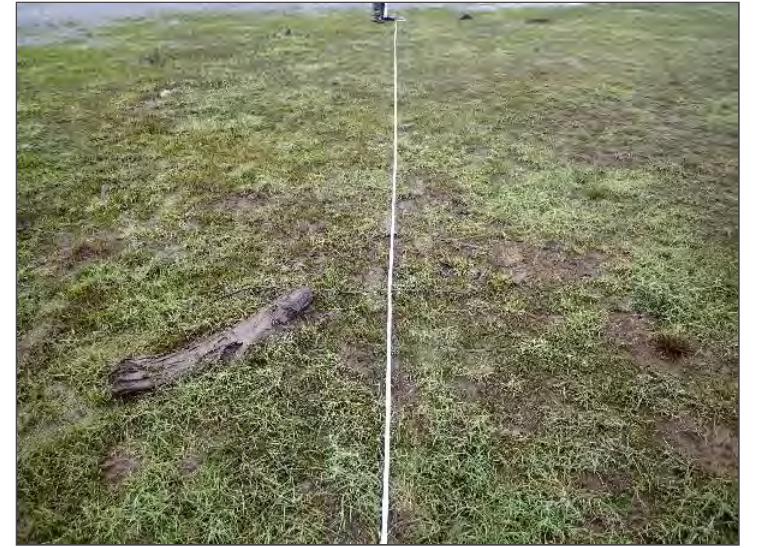
Young forest to water



Willow transition to conifers



Upslope to vegetation communities



Spearwort mudflat

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	WSt	HK	0	59.2	221.362	220.222	2	290	3	90	10-15 year old Douglas-fir infilling willows, i.e., changing community; St. John's wort
2	WSt		59.2	88.2	220.222	219.769	1.5	290	2	85	lots of grass, moss
3	HS		88.2	149	219.769	218.61	1.5	290	2	95	clumps of Calamagrostis, sparse short willow, mostly trimmed
4	HS	SL	149	186	218.61	218.191	2	290	4	95	deer
5	SL		186	210	218.191	218	3	290	4	80	

Benchmark #: 91  
 Transect Length#: 210  
 Transect Direction: 290°

Directions: Site moved to campsite #31(?) at Ralf River to capture a less disturbed area than the previous location. Benchmark is located on an approximately 20 year old Douglas-fir to the right (east) of the site, approximately 14 meters towards the water.

Invasive Species: St. John's wort

Comments: Willow and Douglas-fir are trimmed in the line of site of the campsite. Alder is infilling sites to the east with young grand fir in understory (RF).



**JHTMON 10**

Survey Date: January 15, 2015  
 Date Issued: March 2, 2015

Location: JHT-SVM02  
 Waterbody: Buttle Lake  
 UTM Coordinates: 10U 317371 5500923  
 Water Elevation: 218 Time: 19:28:00





Young red alder and Douglas-fir



Lake debris amongst alder



Upslope to vegetation communities



Sparse Spearwort

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	10	221.298	220.568	7	225	3	80	a few self thinning salmonberry, blackberry, Douglas-fir (browsed); approximately 15 year old alder with approximately 8 year old Douglas-fir in understory
2	WSt	RF	10	19.1	220.568	220.091	3	225	2	80	slashy; Douglas-fir and tall willow; lots of washed up coarse woody debris
3	WSt		19.1	23.4	220.091	219.798	3	225	3	40	red alder and willow
4	WSs		23.4	27.4	219.798	219.5	3	225	2	45	sparse, rocky, St. John's wort
5	HS	US	27.4	41	219.5	218.498	3	225	1	20	sparsely vegetated, Calamagrosits
6	SL	US	41	44	218.498	218.207	14	225	1	5	sparsely vegetated, coarse substrate
7	US		44	48.5	218.207	218.088	12	225	1	1	coarse substrate

Benchmark #: 51  
 Transect Length#: 48.5  
 Transect Direction: 225°

Directions: Benchmark is located on 2-stemmed alder in front of large Douglas-fir log approximately 15 meters southwest of creek.

Invasive Species: St. John's wort

Comments: Site is near 2001 baseline. Woody debris has washed up around the site and the alder is self-thinning.



**JHTMON 10**

Survey Date: January 15, 2015  
 Date Issued: March 2, 2015

Location: JHT-SVM03  
 Waterbody: Buttle Lake  
 UTM Coordinates: 10U 316134 5507590  
 Water Elevation: 218.088 Time: 21:17:00





Tall Sitka willow to upland forest



Sitka willow to water



Hairgrass to water



Spearwort mudflat to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RF	RS	0	3.818	219.336	219.226	2	140	3	65	red alder stand, some Douglas-fir regeneration
2	WSt		3.818	17.86	219.226	218.971	2	140	2	45	some small trees, open gravels, flooded?
3	WSt		17.86	62.76	218.971	218.62	2	140	2	60	willow dominated, some shore pine and red alder on gravels, minor broom encroachment
4	WSt		62.79	87.05	218.62	218.166	2	140	2	70	oxeye daisy, no trees, shrubs approximately 2 meters or above
5	WSs		87.05	111	218.166	217.791	2	140	2	85	shrubs less than 2 meters, grass and sedge, some sandwort
6	HS		111	119	217.791	217.631	1	140	2	85	
7	SL		119	143.41	217.631	217.446	1	140	2	70	sedge, spearwort, grass
8	SL		143.41	163.36	217.446	217.171	1	140	2	70	mostly spearwort; deer, dog, goose
9	SL		163.36	184.8	217.171	217.056	1	140	2	65	
10	MF	SL	184.8	186.59	217.056	216.951	1	140	2	65	

Benchmark #: 430  
 Transect Length#: 186.58  
 Transect Direction: 140°

Directions: Old benchmark not located. Site approximately 9 meters from original coordinates. Benchmark is on approximately 2 meter tall Douglas-fir with zip tag. Douglas-fir was triangulated with red alder (tag 78) - The Douglas- fir is 180°, 1.95 meters from alder.

Invasive Species: Some oxeye daisy, St. John's wort dispersed around site, single stem of Scotch broom.

Comments: Substrate dominated by gravels and thin soils. Vegetation is patchy and of moderate vigour. The area appears to be in transition as some young alder and pine are growing amongst the willows. Site is near campground and vegetation is likely trampled.



**JHTMON 10**

Survey Date: September 4, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM04  
 Waterbody: Buttle Lake  
 UTM Coordinates: 10U 311374 5523146  
 Water Elevation: 216.951 Time: 20:28:00





Upland forest to water



Young browsed conifers



Hairgrass shoreline



Spearwort mudflat to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK	WSt	0	3.75	221.089	221.089	15	36	2	15	young forest (~20 year old fir and red alder), elk scat and browse
2	WSt	HK	3.75	12.1		219.955	8	36	2	60	approximately 8 year old Douglas-fir, grass and moss; elk scat and browse, tall willow nearby at similar elevation
3	WSt		12.1	21.2	219.955	219.252	3	36	2	80	sparse willow, grassy; elk scat and browse
4	WSs		21.2	24.7	219.252	218.971	3	36		90	invasives include oxeye daisy; elk scat and browse
5	HS		24.7	48	218.971	218.699	3	36	3	90	
6	WSs		48.6	50.5	218.699	218.66	3	36		80	large Douglas-fir stump with cable; clumpy sedges, grass, dandelion, strawberry, rocky substrate
7	HS	MF	50.5	57	218.66	218.14	10	36	3	30	goose scat
8	SL	HS	57	59.95	218.14	217.923	7	36	3	20	small sedges, coarse rock, sandwort
9	SL	HS	59.95	70.7	217.923	217.264	7	36	3	20	
10	SL		70.7+					36			

Benchmark #: 316  
 Transect Length#: 70.7  
 Transect Direction: 36°

Directions: Site is located across the bay from the bridge over the creek at the west end of Buttle Lake. Benchmark is on an approximately 20 year old Douglas-fir on top of a mound.

Invasive Species:

Comments:

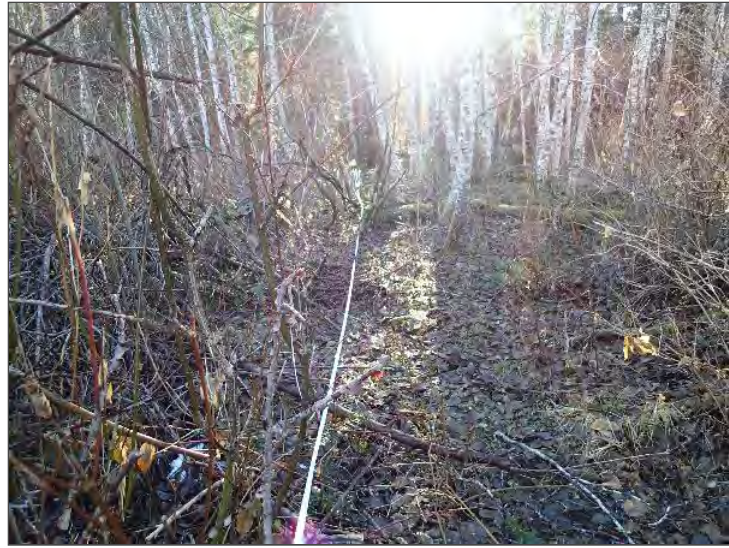


**JHTMON 10**

Survey Date: January 15, 2015  
 Date Issued: March 2, 2015

Location: JHT-SVM05  
 Waterbody: Buttle Lake  
 UTM Coordinates: 10U 315916 5493789  
 Water Elevation: 218.14 Time: 21:28:00





Tall Sitka willow to upland forest



Tall Sitka willow to water



Short Sitka willow



Hairgrass to water

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RS		0.3	15.6	222.745	221.479	8	342	3	80	start on Douglas-fir to mature alder; abundant elk browse and scat; thistle, herb Robert;
2	RS		15.6	35.6	221.479	220.837	5	342	3	90	young (~20 year old) alder, salmonberry, sword fern, salmonberry, saxifrage
3	WSt	RS	35.6	58.8	220.837	219.749	6	342	3	95	grass, red-osier dogwood, willows, young alder (~10 years)
4	WSt		58.8	67	219.749	219.488	4	342	3	95	willow, moss, strawberry, blackberry, grass
5	WSs		67	81.1	219.488	219.037	4	342	3	85	sedge, short willow
6	HS		81.1	94.8	219.037	218.165	4	342	4	90	sedge, rush, thick vegetation
7	HS	MF	94.8	120	218.165	217.878	4	342	3	70	with water moss, muddy, some spearwort, little sedge
8	HS	MF	120	141	217.878	217.684	4	342	3	70	mudflat, some hairgrass, likely spearwort in growing season

Benchmark #: 32  
 Transect Length#: 141  
 Transect Direction: 342°

Directions: Park at interpretive sign pullout before bridge at northwest end of Buttle Lake. The site is approximately 250 meters east. The benchmark is 30cm off the ground on a Douglas-fir (~70 yrs old) at the end of the alder fringe.

Invasive Species: herb Robert

Comments: Western redcedar stumps in the outflow of river into Buttle Lake.



**JHTMON 10**

Survey Date: January 15, 2015  
 Date Issued: March 2, 2015

Location: JHT-SVM06  
 Waterbody: Buttle Lake  
 UTM Coordinates: 10U 315789 5493515  
 Water Elevation: 218.165 Time: 18:58:00





Benchmark to water



Hairgrass to water



Upslope to vegetation communities



Spearwort - hairgrass to water

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	WSt	RF	0	8.25	219.836	219.618	4	226	3	100	tree frog
2	WSs		8.25	21.52	219.618	219.182	3	226	2	100	St. John's wort, thistle, mint, orchard grass
3	HS		21.52	45.93	219.182	218.591	3	226	2	95	orchard grass
4	SL	HS	45.93	127.21	218.591	218.307		226	3	85	toadlets
5	HS		127.21	129.38	218.307	218.762		226	3	85	garter snake, thick water sedge
6	HS		129.38	167.62	218.762	218.262		226	3	85	
7	SL		167.62	210.98	218.262	217.752		226	3	65	tree frog juvenile
8	MF		210.98	211.52	217.752	217.232	3	226	3	65	slope to channel water level; end approximately 0.5 foot above lake in channel,

Benchmark #: 13  
 Transect Length#: 111.52  
 Transect Direction: 226°

Directions: Original benchmark not located. Access is byway of a network of gravel roads and walk down ATV trail. The benchmark is on an old stump at the edge of the tall shrubs and alder, 74 cm off the ground.

Invasive Species: Orchard grass, St. John's wort, thistle.

Comments: A few dead alder are at the edge of the Sitka willow/tall shrub community. This community extends back beyond the benchmark. Sparse conifer regen within the tall shrubs. The upper elevations of the transect appear to be in transition and invasive grasses and other herbs are present. The site did not extend to the current lakeshore but to an inflow approximately 30 cm above current water level.



**JHTMON 10**

Survey Date: September 4, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM07  
 Waterbody: Upper Campbell  
 UTM Coordinates: 10U 310657 5527632  
 Water Elevation: 216.932 Time: 00:28:00





Benchmark to water



Tall Sitka willow



Sparse Spearwort - grass



Spearwort patches

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	DS		0	1.3	223.757	223.514	8	83	2	60	upland Douglas-fir forest with oregon grape, salal, and red alder
2	WSt		1.3	8.75	223.514	219.527	52	83	2	7	willow and red alder, trailing blackberry, scotch broom
3	SL	HS	8.75	18.25	219.527	217.022	27	83	2	3	spearwort, fireweed, St. Johns wort, grasses

Benchmark #: 47  
 Transect Length#: 18.25  
 Transect Direction: 83°

Directions: At unsanctioned campsite approximately 300 m above Strathcona Dam, near location of original survey. Benchmark is on a Douglas-fir tree.

Invasive Species: Several invasive species including Scotch broom, St. John's wort, oxeye daisy, and herb Robert

Comments: Short steep lakeshore. Representative vegetation communities are sparse and occur in thin bands. Human use may be contributing to low community vigour.



**JHTMON 10**

Survey Date: September 3, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM08  
 Waterbody: Upper Campbell  
 UTM Coordinates: 10U 314884 5540936  
 Water Elevation: 217.022 Time: 18:28:00





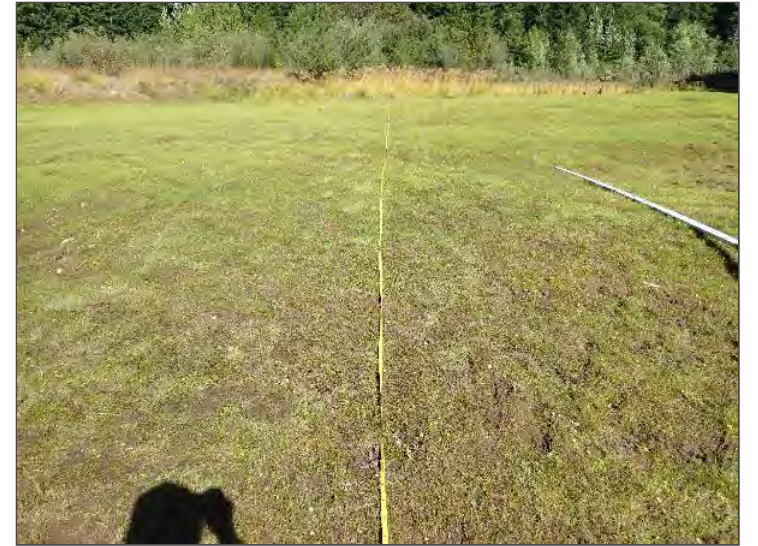
Benchmark to water



Short to tall Sitka willow



Hairgrass



Spearwort mudflat to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	UF		0	2.12	222.269	221.446	13	232	3	90	
2	WSt		2.12	16.65	221.446	220.892		232	1	70	garter snake, broom
3	WSt		16.65	30.25	220.892	219.694	6	232	1	70	
4	WSs		30.25	34.31	219.694	218.63	24	232	2	40	moved tripod to 23.75 meters (photo 1936)
5	HS		34.31	52.35	218.63	218.189	2	232	3	90	
6	SL		52.35	80.8	218.189	217.112	4	232	3	60	goose, dog, deer
7	MF		80.8	81.2	217.112	217.004	4	232		60	

Benchmark #: 89  
 Transect Length#: 81.2  
 Transect Direction: 232°

Directions: Near location of original site. Off of side road that leads to Strathcona Dam, follow double track trail to the site. Site is beside an inflow. The benchmark is on a Douglas -fir tree.

Invasive Species: Abundant Scotch broom, especially amongst tall shrubs, other invasive species sparse.

Comments: Human use area, appears to be popular dog walking spot. Upper elevations have a higher cover of Scotch broom than native vegetation. Substrate is rocky and dry. The edge of the shrub communities appears to be changing. Hairgrass and lower elevation communities appear to have good vigour.



**JHTMON 10**

Survey Date: September 3, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM09  
 Waterbody: Upper Campbell  
 UTM Coordinates: 10U 315285 5539502  
 Water Elevation: 217.004 Time: 22:28:00

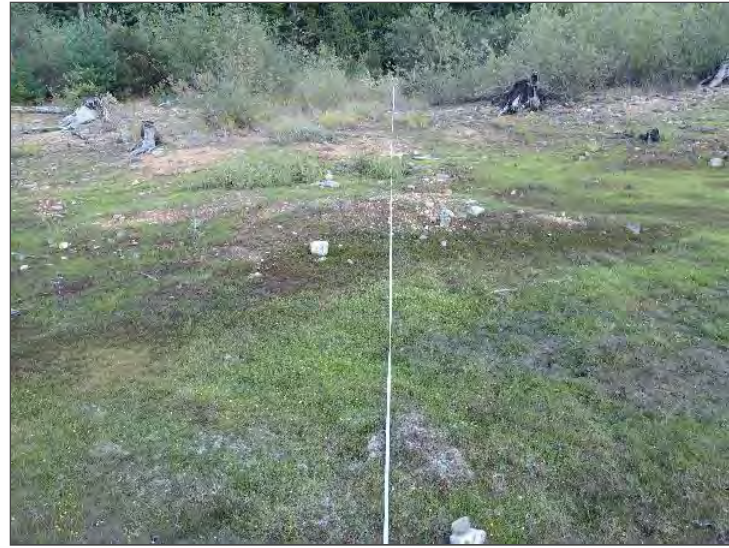




Benchmark to water



Willow transition to conifers



Spearwort mudflat upslope



Spearwort mudflat to water

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	2.7	222.337	221.425		276	3	95	
2	WSt		2.7	11.24	221.425	220.639		276	1	70	road/tall shrubs, lots of broom and western white pine/Douglas-fir regeneration, no water sedge
3	WSt		11.24	33.56	220.639	219.187	9	276	2	65	some water sedge in depression (Photo 1987-1993)
4	WSs		33.56	38.97	219.187	218.399	9	276	2	60	sparse vegetation between shrubs
5	SL		38.97	47.75	218.399	217.747	2	276	2	70	
6	MF		47.75	68.56	217.747	217.737	0	276	2	65	
7	SL		68.56	69.68	217.737	217.907	1	276	2	60	
8	SL		69.68	113.98	217.907	217.317		276	2	50	exposed shore, rocky with sparse vegetation
9	MF		113.98	115.7	217.317	216.997	20	276	1	8	some mudflat vegetation on sandy substrate; 18:45 water level; lots of invasives, odd mix

Benchmark #: 39  
 Transect Length#: 115.7  
 Transect Direction: 276°

Directions: Near location of original site. Take left off of road to Strathcona Dam to lakeshore. Park and follow trail to lakeshore. Benchmark is on Douglas-fir upslope of grown over double track.

Invasive Species: Abundant Scotch broom, especially amongst tall shrubs, St. John's wort and other invasive species sparse.

Comments: Renegade campsite near by. Upper elevations, in the tall shrub community, appear to be changing and have both a high cover of Scotch broom, encroaching alder and conifers (white pine, Douglas-fir), are sparsely vegetated, and have dry, thin soils. Lower elevations have various native and non-native herbs.



**JHTMON 10**

Survey Date: September 3, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM10  
 Waterbody: Upper Campbell  
 UTM Coordinates: 10U 314827 5538937  
 Water Elevation: 216.997 Time: 01:13:00





Willow transition to conifers



Willow - hardhack to water



Willow - hardhack upslope



Hairgrass - sedge - hardhack to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK	WSt	0	4.15	221.132	220.949	3	335	2	90	young forest - transition Pw, Bg, Dr, Cw
2	HK	WSt	4.15	6.5	220.949	220.484	3	335	2	95	forest slightly younger than first occurrence, transition to HL
3	WSt	WSs	6.5	11.9	220.484	219.828	2	335	3	98	Sitka willow, hardhack, end of moss, start of sedge
4	HL	WSs	11.9	25	219.828	219.43	2	335	3	98	hardhack, myrica gale, sparse red-osier dogwood, willow, sedge and grass; water at 25m
5	HS		25	27.65	219.43	218.929	3	335	2	80	hairgrass mudflat on old beaver log, high organic content, old cedar stumps to water's edge; community continues beyond end of transect

Benchmark #: 8  
 Transect Length#: 27.65  
 Transect Direction: 335°

Directions: Benchmark is on approximately 15 year old white pine at back of wetland.

Invasive Species:

Comments: Low exposure site. Upland forest is western redcedar and salal dominated.



**JHTMON 10**

Survey Date: September 3, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM31  
 Waterbody: Upper Campbell  
 UTM Coordinates: 10U 315116 5539248  
 Water Elevation: 219.43 Time: 17:28:00





Short Sitka willow to upland forest



Tall Sitka willow



Sparse Spearwort



Unvegetated shoreline to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	4.19	178.647	177.95	7	326	4	95	approximately 70 year old Douglas-fir forest, salal, bracken, red alder
2	WSt		4.19	8	177.95	177.78	4	326	1	35	logs, sparse willow and young red alder, some moss, trailing blackberry, twinflower
3	WSs		8	17.41	177.78	177.883	7	326	2	20	grass, moss, oxeye daisy, small red alder, Sitka willow, dandelion, plantain, thistle, trailing blackberry
4	SL	HS	17.41	21.73	177.883	176.945	5	326	1	15	spearwort, grass, sparse sedge (soft-leaved)
5	SL		21.73	24.23	176.945	176.688	5	326	1	3	sparse herb, sandwort, other in gravel
6	US		24.23	34.31	176.688	175.888	8	326		0	gravel, cobble; 14:00

Benchmark #: 54  
 Transect Length#: 24.23  
 Transect Direction: 326°

Directions: West of campsite. Benchmark is on a Douglas-fir tree.

Invasive Species: Oxeye daisy, some mustards, dandelion and thistles.

Comments: Poor vegetation community vigour / composition although vegetation healthy. Riparian communities sparsely vegetated and substrate is rocky. Sparse alder is encroaching in low and tall shrub areas.



**JHTMON 10**

Survey Date: September 5, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM11  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 326292 5544467  
 Water Elevation: 175.888 Time: 20:28:00





Tall Sitka willow and benchmark



Tall Sitka willow to water



Upslope to vegetation communities



Unvegetated shoreline to water

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	WSt		0	5.11	177.881	177.48	5	105	3	98	borders upland forest, red alder, hardhack, willows
2	WSs		5.11	14.24	177.48	177.301	3	105	3	90	hardhack, pacific willow, Sitka willow, sedge, mosses
3	HS	SL	14.24	20.79	177.301	177.13	4	105	2	65	spearwort, small sedge
4	SL		20.79	24.33	177.13	177.085	2	105	2	10	sparse herbs in gravel
5	US		24.33	40.11	177.085	175.898	7	105	0	0	16:00 at water level

Benchmark #: 49  
 Transect Length#: 40.11  
 Transect Direction: 105°

Directions: East of campsite, beside creek.  
 Benchmark is on a red alder beside the trail.

Invasive Species:

Comments: Decently healthy site with few invasive species. Tall and short shrubs growing moderately thickly, lower elevations become increasingly sparse. Soils are thin to non-existent. Area experiences heavy summer use from adjacent campsite.



**JHTMON 10**

Survey Date: September 5, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM12  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 325032 5547173  
 Water Elevation: 175.898 Time: 22:28:00





Benchmark



Upland forest to water






Sitka willow - hardhack - alder



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	Hk		0	3.5	179.116	178.225	23	108	3	65	Douglas-fir (some dying), salal, huckleberry; rod in front of BM pin
2	HK	WSt	3.56	4.75	178.225	177.997	7	108	2	15	salal, horsetail, twinberry, saskatoon
3	US		4.75	7.75	177.997	177.769	7	108	2	0	log debris, gravel and rock
4	WSs	US	7.75	9.6	177.769	177.638	2	108	2	10	sparse short willow, St. John's wort, gravel
5	WSs	HL	9.6	10.95	177.638	177.6	2	108	2	55	willow, red alder, myrica gale, old stumps, cobbles, water level is here
6	WSs	HL	10.95	13.65	177.6	177.395	5	108	2	55	willow, red alder, myrica gale, old stumps, cobbles
7	WSs	US	13.65	14.4	177.395	177.277	5	108	2	10	sparse willow, mostly cobble
8	MF	US	14.4	+	177.277			108	2		rocky shore with stumps; approximately 10 meters or more

Benchmark #: 344 Transect Length#: 14.4 Transect Direction: 108°	Directions: From Gosling Bay recreation site, walk south along shore approximately 80 meters to next point. Benchmark is on Douglas-fir in stand of snag-like firs.	Invasive Species: St. John's wort	Comments: Vegetation is sparse, likely partially due to trampling as the site is near a recreation site and partially due to site location factors. Shoreline rocky with old stumps.
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  	<b>JHTMON 10</b>		Location: JHT-SVM13
	Survey Date: October 9, 2014 Date Issued: March 2, 2015	Waterbody: Lower Campbell UTM Coordinates: 10U 321107 5545700 Water Elevation: 177.6 Time: 17:23:00	





Benchmark to water



Tall shrubs



Sweet gale



Water to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	DS		0	3.63	178.907	178.219	16	166	3	80	Douglas-fir, shore pine, western redcedar, cutbank
2	DS	US	3.63	5.9	178.219	177.925	13	166	1	15	sparse salal and willow, wood chip trail, bedrock
3	WSt	HL	5.9	9.14	177.925	177.646	9	166	2	98	pacific willow, myrica gale, red-osier dogwood, moss, alder
4	WSt	HL	9.14	9.3	177.646	177.6	9	166	3	98	pacific willow, myrica gale, red-osier dogwood, moss, alder
5	WSs	HL	9.3	10.9	177.6	177.436	10	166	3	98	Sitka willow, myrica gale, sedge
6	SW		10.9	13.65	177.436	177.245	10	166	2	75	sparse shrub, St. John's wort, herbs, spearwort, sedge
7	SL	US	13.65	15.83	177.245	176.888	10	166	1	3	stumps, spearwort, rushes, sparse vegetation, rocky
			15.83	+	176.888						rocky substrate

Benchmark #: 42  
 Transect Length#: 15.83  
 Transect Direction: 166°

Directions: Southwest end of Campbell lake recreation site, approximately 15 meters southwest of JHT-SVM13. Benchmark is on a Douglas-fir, beside a pine. A path runs through transect.

Invasive Species: St. John's wort

Comments: Site adjacent to recreation site and has had some vegetation maintenance done nearby and experiences some human traffic.



**JHTMON 10**

Survey Date: October 9, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM14  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 318479 5543527  
 Water Elevation: 177.6 Time: 18:58:00





Skunk cabbage swamp transition



Tall Sitka willow - shrub



Spearwort mudflat to upland forest



Spearwort mudflat

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	2.94	178.242	178.065	5	165	3	98	alder, salal
2	WSt	HK	2.94	6.95	178.065	177.921	10	165	3	90	red-osier dogwood, willow
3	WSs		6.95	13.55	177.921	177.777	0	165	3	95	pacific willow, Sitka willow, red-osier dogwood, grass
4	SW	US	13.55	14.92	177.777	177.58	6	165	2	25	sand, short sedge, burdock (x2), St. John's wort, gravel
5	SW	US	14.92	20.65	177.58	177.164	6	165	2	25	
6	SL	MF	20.65	29.35	177.164	176.59	6	165	2	30	bare, sparse spearwort and algae, fines

Benchmark #: 25  
 Transect Length#: 29.35  
 Transect Direction: 165°

Directions: Loon Bay recreation site, approximately 20 meters west of last site. Benchmark is on alder tree on the point.

Invasive Species: great burdock, St. John's wort

Comments: Near recreation site.



**JHTMON 10**

Survey Date: October 9, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM15  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 317303 5544640  
 Water Elevation: 177.58 Time: 20:23:00





Upland forest to shoreline



Short Sitka willow - hardhack



Sedge wetland



Water to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	7.45	178.972	178.451	7	220	2	80	Douglas-fir, salal, alder, step moss, path
2	WSt	HL	7.45	11.9	178.451	177.828	12	220	3	90	red-osier dogwood, hardhack, Sitka willow, sparse moss at top, sparse sedge and moss at bottom
3	WSs	HL	11.9	13.9	177.828	177.58	15	220	3	95	myrica gale, hardhack, Sitka willow, sedge
4	SW		13.9	15.6	177.58	178.031	26	220	2	65	water sedge
5	SL	MF	15.62	17.4	178.031	178.276	12	220	2	25	rocky sparse herb and spearwort, gravels
6	SL	MF	17.4	19	178.276	178.088	12	220	2		spearwort continuous past the end of surge; mudflat characteristics

Benchmark #: 55  
 Transect Length#: 19  
 Transect Direction: 220°

Directions: Fry lake recreation site, south end.  
 Benchmark is on Douglas-fir beside path

Invasive Species:

Comments:



**JHTMON 10**

Survey Date: October 9, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM16  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 315871 5544974  
 Water Elevation: 177.58 Time: 21:28:00





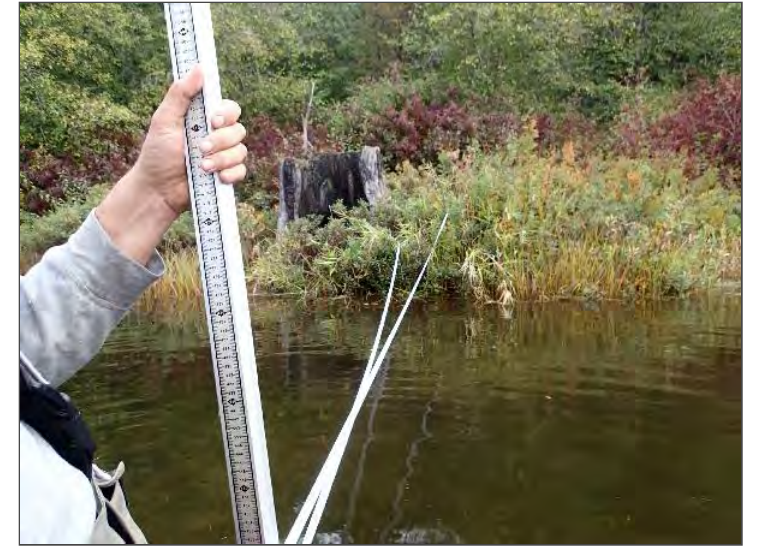
Skunk cabbage swamp transition



Short Sitka willow - hardhack



Shoreline vegetation communities



Water to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RS	WSt	0	6.3	178.009	177.602		175	3	90	alder, red-osier dogwood, moss; pacific sideband; back channel
2	WSs	HL	6.3	14	177.602	177.58	5	175	4	95	myrica gale, hardhack, some Sitka willow
2	WSs	HL	14	14.3	177.58	177.342	5	175	4	95	myrica gale, hardhack, some Sitka willow
3	SW		14.3	16.4	177.342	176.871	9	175	2	70	sparser at lower elevation, bamboo-like grass
4	SL		16.4	18.5	176.871	176.668	7	175	2	30	crayfish
5	SL		18.5	+	176.668			175			stumps

Benchmark #: 33  
 Transect Length#: 18.5  
 Transect Direction: 175°

Directions: Fry lake recreation site, take trail from campsite. Benchmark is on alder. Transect runs out to small point with burnt stumps

Invasive Species:

Comments:



### JHTMON 10

Survey Date: October 9, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM17  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 315496 5545131  
 Water Elevation: 177.58 Time: 23:03:00





Benchmark to water



Shoreline vegetation communities



Water to upland forest



Short Sitka willow-hardhack

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RS		0	1.36	178.457	178.259	10	120	3	85	alder, sword fern, moss; pacific sideband
2	WSt	RS	1.36	7.03	178.259	177.759	7	120	2	90	red-osier dogwood, grass, buttercup
3	WSt		7.03	8.42	177.759	177.57	7	120	3	95	
4	HL	WSs	8.42	12.75	177.57	177.285	6	120	3	95	hardhack, pacific willow, myrica gale, sedge
5	SW		12.75	13.11	177.285	177.257		120	2	80	sedge, thin band
6	SL	MF	13.11	17	177.257	176.851	8	120	2	30	some sedge
7	SL		17	+				120			

Benchmark #: 66  
 Transect Length#: 17  
 Transect Direction: 120°

Directions: Apple Orchard recreation site. Transect at south end of site, approximately 80 meters from end on east side of road. Benchmark is on alder.

Invasive Species:

Comments:



### JHTMON 10

Survey Date: October 9, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM18  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 315195 5545118  
 Water Elevation: 177.57 Time: 00:13:00





Upland forest to water



Hardhack - sedge wetland



Shoreline and flooded trees



Water to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	3.45	178.697	177.813	22	147	3	60	salal, western redcedar, end of step moss, Sitka spruce, western hemlock
2	HL	HK	3.45	5.1	177.813	177.708	6	147	3	80	red alder, end of moss, sedge, myrica gale, HK is in 3b structural stage
3	HL		5.1	6.1	177.708	177.59	6	147	3	96	myrica gale, water sedge; water between occurrence 3 and 4
4	HL		6.1	11.1	177.59	177.382	6	147	3	95	
5	SW		11.1	15.2	177.382	177.152	6	147	2	85	water sedge, hairgrass fringe
6	SL		15.2	20.45	177.152	176.994	6	147	2	70	sparse spearwort on gravelly substrate (1a)
			20.45					147	2		sparser vegetation past transect

Benchmark #: 25  
 Transect Length#: 20.45  
 Transect Direction: 147°

Directions: Benchmark is on a approximately 45 year old western redcedar

Invasive Species:

Comments:



**JHTMON 10**

Survey Date: October 9, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM19  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 315082 5544731  
 Water Elevation: 177.59 Time: 19:48:00





Upland forest to water



Water to upland forest



Sitka willow - hardhack



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	2.23	178.864	178.025	20	190	2	55	western hemlock, western redcedar, Kindbergia sp., salal
2	WSt	HL	2.23	4.7	178.025	177.59	6	190	3	98	red alder, red-osier dogwood, sedge, hardhack, willow; water between occurrence 2 and 3
3	HL		4.7	14.6	177.59	177.185	6	190	3	98	
4	SW		14.6	18.65	177.185	177.155	6	190	4	80	
5	SL		18.65	19.8	177.155	176.92	6	190	2	20	SL to mudflat with sparse SL (1a)

Benchmark #: 41  
 Transect Length#: 19.8  
 Transect Direction: 190°

Directions: Fry lake near the north end of Orchard campsite. Benchmark is on western redcedar in clump of 4, 1 meter from road

Invasive Species:

Comments: Western redcedar and Sitka spruce stumps.



**JHTMON 10**

Survey Date: October 9, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM30  
 Waterbody: Lower Campbell  
 UTM Coordinates: 10U 315014 5545213  
 Water Elevation: 177.59 Time: 21:08:00





Skunk cabbage swamp and benchmark



Hardhack to skunk cabbage swamp



Sedge wetland to water



Mudflat to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RC	HK	0	1.03	2.033	1.692		330	3	85	redcedar, salal, alder
2	HL		1.03	7.2	1.692	1.213	9	330	3	98	hardhack, horsetail, sedge
3	SW		7.2	14.75	1.213	0.9	4	330	3	65	tall water sedge, some willow
4	SW		14.75	17.2	0.9	0.758	4	330	3	65	small sedge
5	SW	MF	17.2	22.98	0.758	0.438	6	330	3	20	some horsetail and mulch like woody debris

Benchmark #: 69  
 Transect Length#: 22.98  
 Transect Direction: 330°

Directions: Site is approximately 150 meters north of campground in front of islet.

Invasive Species:

Comments:



**JHTMON 10**

Survey Date: October 7, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM20  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 315794 5551777  
 Water Elevation: 0.4383 Time: 18:08:00





Benchmark to water



Shoreline vegetation communities



Hardhack to upland forest



Hardhack to water

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RC		-1.7	1.14	1.938	1.394	10	240	3	95	hardhack, sedge (started behind benchmark), hairgrass, abundant leaf litter
2	HL		1.14	9.01	1.394	0.99	5	240	3	95	
3	HL	SW	9.01	13.18	0.99	0.821	4	240	2	70	hardhack
4	EM	MF	13.18	17.89	0.821	0.438	8	240	2	10	bullrush, sparse sperawort, sparse sedge, rock to mulch, transition area

Benchmark #: 57  
 Transect Length#: 17.89  
 Transect Direction: 240°

Directions: Site is approximately 400 meters north of campground at point beside leaning snag. Benchmark is on western redcedar in front of patch of salal.

Invasive Species:

Comments: Abundant woody debris present; water channels extend into upland forest.



**JHTMON 10**

Survey Date: October 7, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM21  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 315792 5552003  
 Water Elevation: 0.438 Time: 19:28:00





Skunk cabbage swamp to water



Sedge wetland to upland forest



Shoreline vegetation communities



Hardhack to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RS		0	1.22	1.824	1.318	12	95	3	98	red alder, sedge, red-osier dogwood, upper riparian forest type to a transitional redcedar, sword fern forest
2	HL	RC	5.56	7.6	1.318	1.236	5	95	4	98	red-osier dogwood, hardhack, fen type
3	HL		7.6	19.36	1.236	0.808	4	95	4	98	hardhack, myrica gale
4	HL		19.36	24.5	0.808	0.508	7	95	4	95	deer prints, hardhack, sedge, sandwort, flooded more than previous
5	SW	SL	24.5	28.2	0.508	0.438	3	95	4	80	raccoon prints; spearwort, sedge, buckbean, water lilies

Benchmark #: 97  
 Transect Length#: 28.2  
 Transect Direction: 95°

Directions: Site is on the west side of the bridge/south side of the road. Benchmark is on a large alder at the edge of the upland forest.

Invasive Species:

Comments: Low shore exposure. Vegetation is thick and vigorous.



**JHTMON 10**

Survey Date: October 7, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM22  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 314723 5550469  
 Water Elevation: 0.438 Time: 21:08:00





Benchmark to water



Hardhack to water



Sedge wetland to water



Water to upland forest

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		0	4.25	1.935	1.832	3.5	345	3	90	floods occasionally; alder, redcedar, cascara, hawthorn, high bush cranberry, grass, some sedge
2	HL	RC	4.25	8.05	1.832	1.395	9	345	2	90	boulders, native hawthorn, rose, hardhack
3	HL	WSs	8.05	11.55	1.395	0.991	9	345	3	95	hardhack, sedge, willow at fringe
4	SW	US	11.55	19.1	0.991	0.695	4	345	2	70	gravel, short sparse sedge, one plant wide band, sparse short willow around big rocks
5	US		19.1	23.45	0.695	0.438	5	345	2	0	gravel, sparse sedge clumps

Benchmark #: 30  
 Transect Length#: 23.45  
 Transect Direction: 315°

Directions: Site is on east side of bridge/north side of road at apple camp on point.

Invasive Species:

Comments: Shore dominated by gravels. The area is beside campsite and experiences human use.



**JHTMON 10**

Survey Date: October 7, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM23  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 314863 5550730  
 Water Elevation: 0.438 Time: 22:18:00

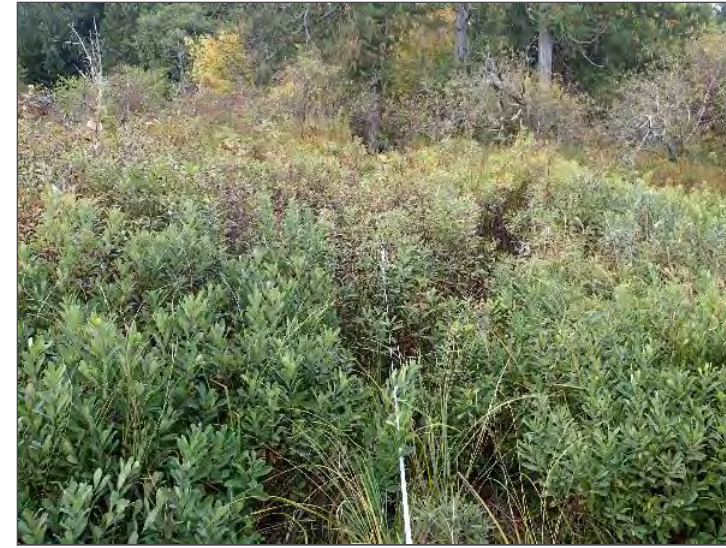




Skunk cabbage swamp and benchmark



Hardhack to water



Hardhack to swamp and benchmark



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RC	HK	-0.3	0	2.726	1.989		100	3	98	redcedar, salal, alder
2	RC	WSt	0	4.99	1.989	1.548	4	100	4	98	red-osier dogwood, hawthorn, sedge
3	HL		4.99	17.9	1.548	0.836	6	100	4	98	myrica gale, no herbs
4	HL		17.9	21.44	0.836	0.537	9	100	4	98	myrica gale, one sedge, and herbs
5	SW	SL	21.44	22.75	0.537	0.438	13	100	3	90	sedge, spearwort, unknown aquatic, water lillies

Benchmark #: 43  
 Transect Length#: 22.75  
 Transect Direction: 100°

Directions: From campsite #5's boat ramp, site is northeast approximately 50 meters. Benchmark is on a large western redcedar in a clump of redcedar trees.

Invasive Species:

Comments: Thick, vigorous vegetation.



**JHTMON 10**

Survey Date: October 7, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM24  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 314685 5550930  
 Water Elevation: 0.4383 Time: 23:43:00





Benchmark



Hardhack to water



Hardhack to upland forest



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK	RC	0	1.1	2.478	2.15	35	2	4	90	yew, salal, spruce
2	RC	WSt	1.1	2.65	2.15	1.479	35	2	4	95	red-osier dogwood, logs from lake
3	HL		2.65	8.4	1.479	0.688	14	2	4	95	hardhack, sparse sedge
4	HL	SW	8.4	11.17	0.688	0.438	14	2	3	90	approximately 50% hardhack/50% sedge, washed up debris

Benchmark #: 349  
 Transect Length#: 11.17  
 Transect Direction: 2°

Directions: Park on road and hike approximately 200 meters to outlet. The transect is approximately 40 meters right/east of corner where downed tree is located. Benchmark is on a live western yew next to a leaning large yew snag.

Invasive Species:

Comments: Lily mudflat in water beyond transect, spearwort occurs in patches at lowest elevations along shoreline.



**JHTMON 10**

Survey Date: October 8, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM25  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 314306 5553893  
 Water Elevation: 0.438 Time: 17:28:00





Benchmark



Sedge wetland to upland forest



Sedge wetland to water



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RC	WSt	0	4.2	1.8613	1.5523	5	74	3	98	old alder, tall hardhack, red-osier dogwood, salmonberry
2	HL	WSt	4.2	9.62	1.5523	1.3693	0	74	4	98	hardhack, few small red-osier dogwood, myrica gale
3	HL		9.62	16.8	1.3693	0.9573	5	74	4	98	hardhack, myrica gale
4	HL	SW	16.8	22.82	0.9573	0.5803	5	74	4	95	myrica gale, hardhack, sedge
5	SW		22.82	24.6	0.5803	0.4383	5	74	4	90	sedge

Benchmark #: 389  
 Transect Length#: 24.6  
 Transect Direction: 74°

Directions: From road, hike approximately 200 meters to corner of outlet with fallen snag. Walk west for approximately 25 meters. There is a clump of 3 snaggy looking alder, 2 are alive. Benchmark is on one of these.

Invasive Species:

Comments: Coarse wood stewn amongst shrubs. The shallow waters are populated with water lilies, spearwort and horsetails.



**JHTMON 10**

Survey Date: October 8, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM26  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 314264 5553933  
 Water Elevation: 0.438 Time: 18:43:00





Benchmark to water



Sedge wetland to upland forest



Sedge-Spearwort-mudflat



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	HK		-4	-2.54	2.734	2.024	23	138	3	70	salal, redcedar, undercut bank, logs
2	HL		-2.54	0	2.024	1.648	14	138	3	70	hardhack, sedge, myrica gale
3	HL		0	4.54	1.648	0.824	14	138	3	70	hardhack, sedge, myrica gale
4	SW	SL	4.54	7.09	0.824	0.438	13	138	2	25	sparse sedge, spearwort, bullrush, sundew, rocky

Benchmark #: 367  
 Transect Length#: 11.09  
 Transect Direction: 138°

Directions: Park on FSR and walk approximately 120 meters to shore. The benchmark is on a redcedar snag in shrubs.

Invasive Species:

Comments: Trees have been harvested along the shore. A bullrush community exists approximately 50 m southwest of site and sparse bullrush occur in shallow water beyond transect.



**JHTMON 10**

Survey Date: October 8, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM27  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 314350 5552119  
 Water Elevation: 0.438 Time: 20:28:00





Benchmark



Hardhack - sweet gale wetland



Mudflat to upland forest



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	LS		0	1.5	2.248	2.048	14	170	3	80	redcedar, salal, white pine, Labrador tea
2	LS	HL	1.5	6.5	2.048	1.853	3	170	3	85	dead hawthorn, hardhack, red-osier dogwood; RC transition
3	HL		6.5	32.56	1.853	0.822	3	170	4	98	hardhack, sparse Labrador tea at upper extent, sparse herbs (king gentian) at lower extent
4	SW	SL	32.5	34.53	0.822	0.664	5	170	4	25	sedge sparse, small myrica gale, mint, sandwort; deer, bear, and raccoon prints
5	SL	MF	34.53	39.3	0.664	0.439	5	170	4	20	emergent marsh

Benchmark #: 382  
 Transect Length#: 39.3  
 Transect Direction: 170°

Directions: From long lake FSR, take portage trail to water (bushwack from end of trail). From north end of lake, walk west approximately 80 meters to edge of inflow (with hardhack). Benchmark is on white pine in stand of mature western redcedar.

Invasive Species:

Comments: Vegetation present in soft bottomed, shallow waters beyond transect.



**JHTMON 10**

Survey Date: October 8, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM28  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 315623 5555745  
 Water Elevation: 0.439 Time: 22:48:00





From benchmark to water



Mudflat to upland forest



Spearwort mudflat



Shoreline vegetation communities

Occurrence	Dominant Community	Sub-Dominant Community	Start Distance	End Distance	Start Elevation	End Elevation	Slope	Aspect	Community Vigour	Vegetation Cover	Comments
1	RC	HK	0	1.75	2.316	1.881		70	4	95	alder, western redcedar, hemlock, salal, false azalea
2	HL		1.75	3.6	1.881	1.296	25	70	4	95	hardhack, myrica gale, sedge, Equisetum, rose
3	HL		3.6	11.43	1.296	0.681	5	70	4	95	hardhack, myrica gale
4	SL	MF	11.43	18.22	0.681	0.437	3	70	4	30	spearwort, sparse Equisetum, water lily, mint; raccoon track (2991), deer, bear

Benchmark #: 411  
 Transect Length#:  
 Transect Direction: 70°

Directions: From JHT-SVM28, walk approximately 80 meters along shore past point with cedar to next small bay. Benchmark is on an old burnt (spruce?) snag approximately 8 meters tall at the edge of the forest.

Invasive Species:

Comments:



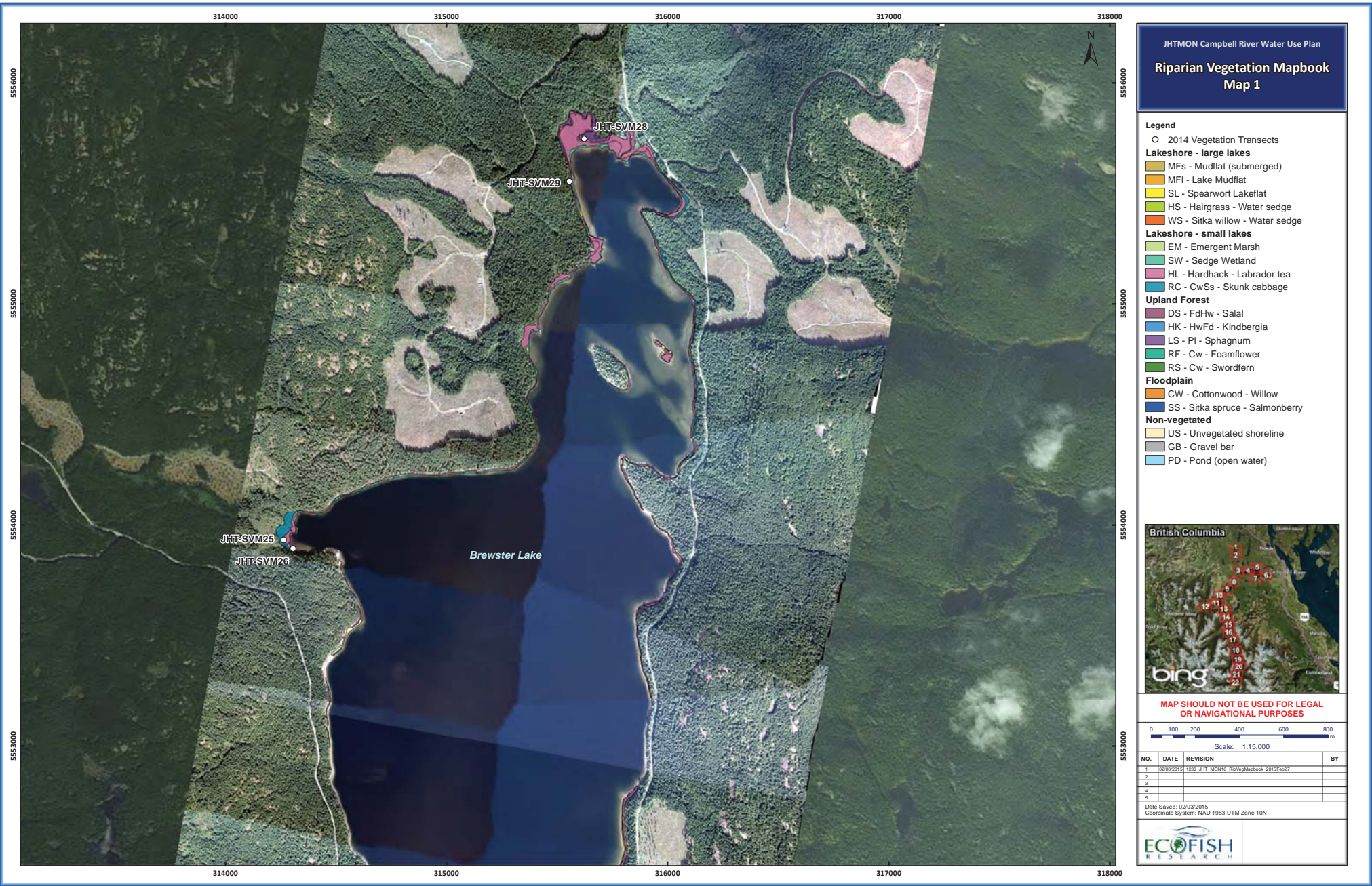
### JHTMON 10

Survey Date: October 8, 2014  
 Date Issued: March 2, 2015

Location: JHT-SVM29  
 Waterbody: Brewster Lake  
 UTM Coordinates: 10U 315555 5555554  
 Water Elevation: 0.437 Time: 23:38:00

**Appendix D. Vegetation Community Mapbook.**





JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 1**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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

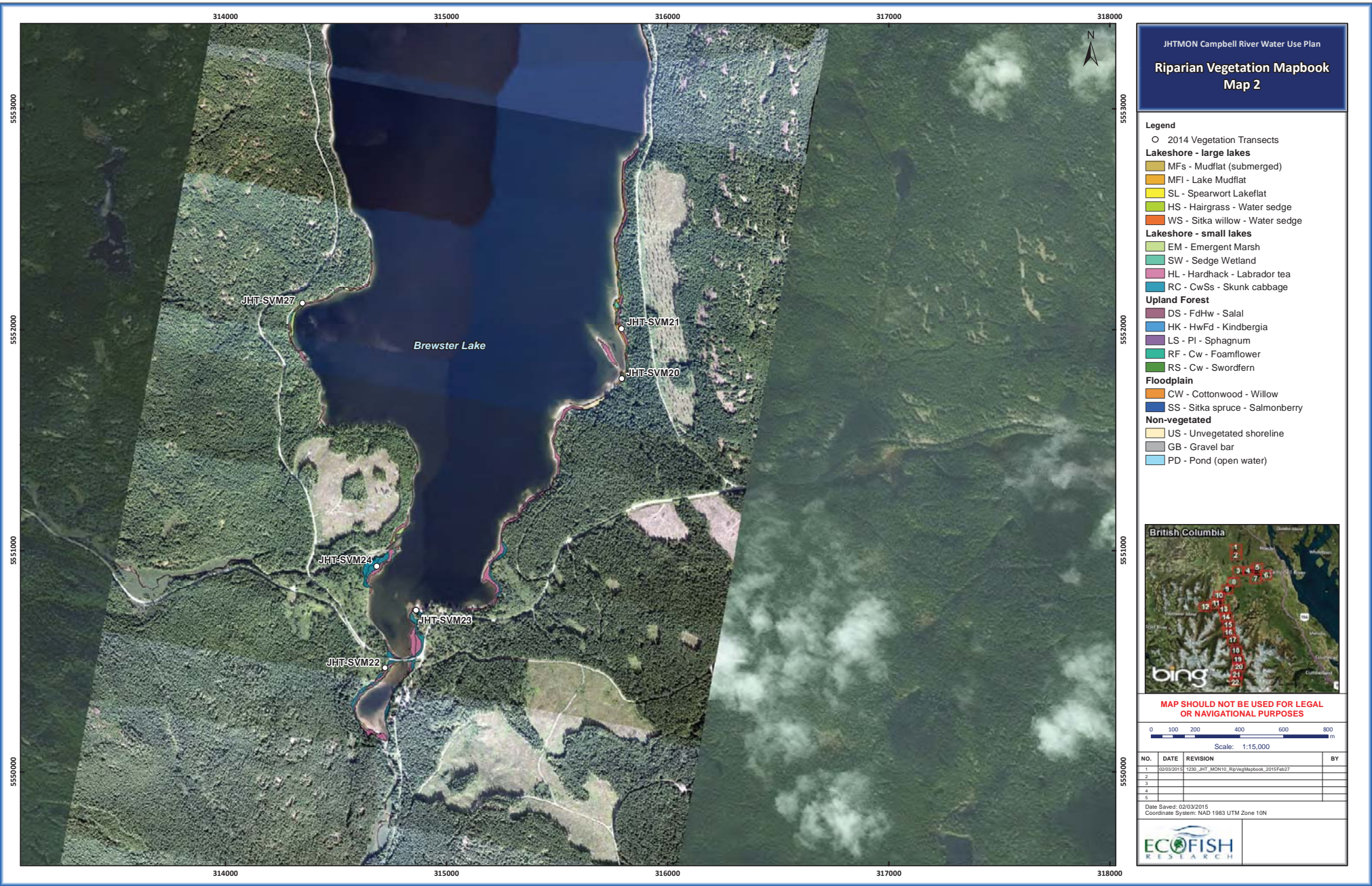


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2			
3			
4			
5			

Date Saved: 02/03/2015  
 Coordinate System: NAD 1983 UTM Zone 10N







JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 2**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 3**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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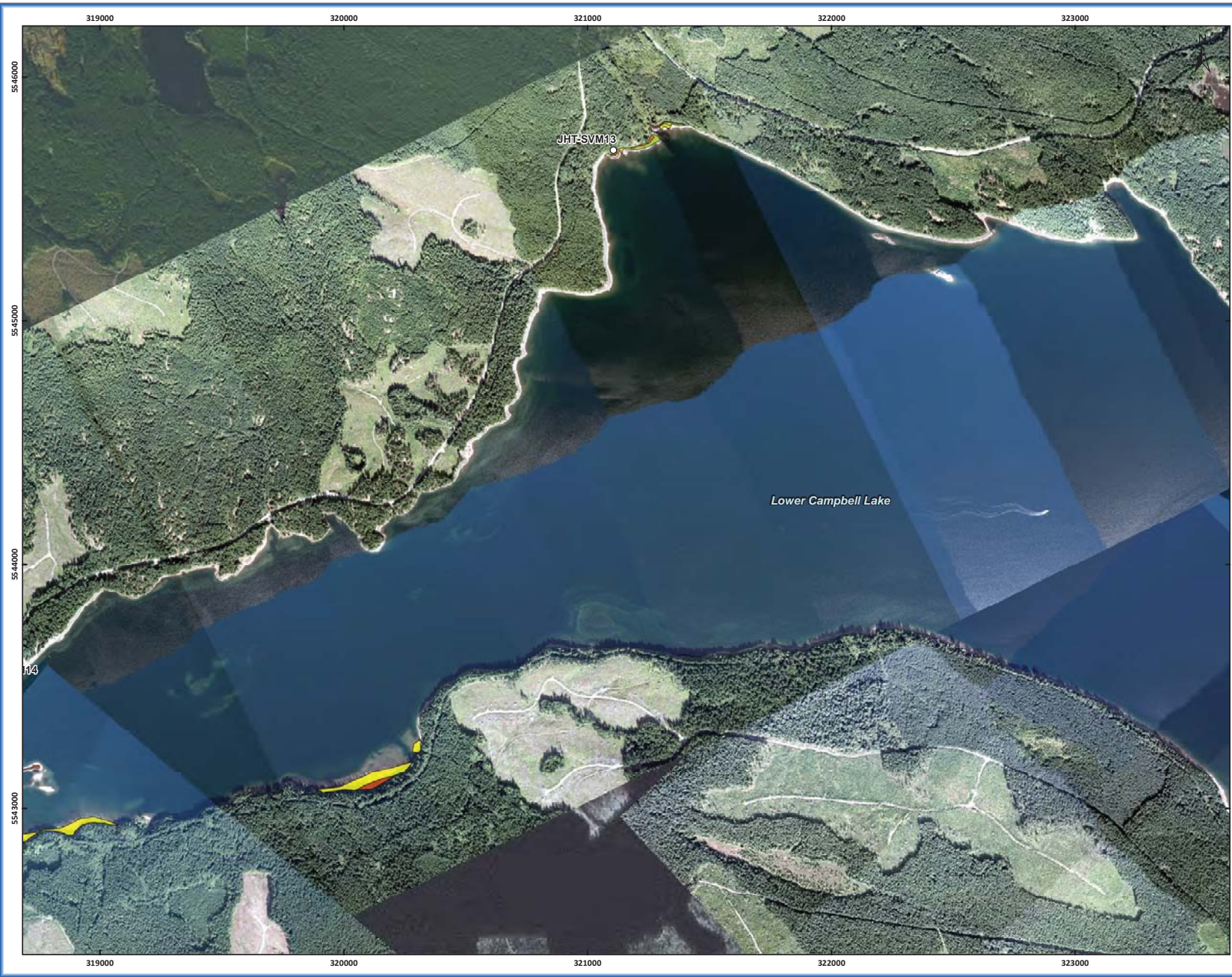
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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 4**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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

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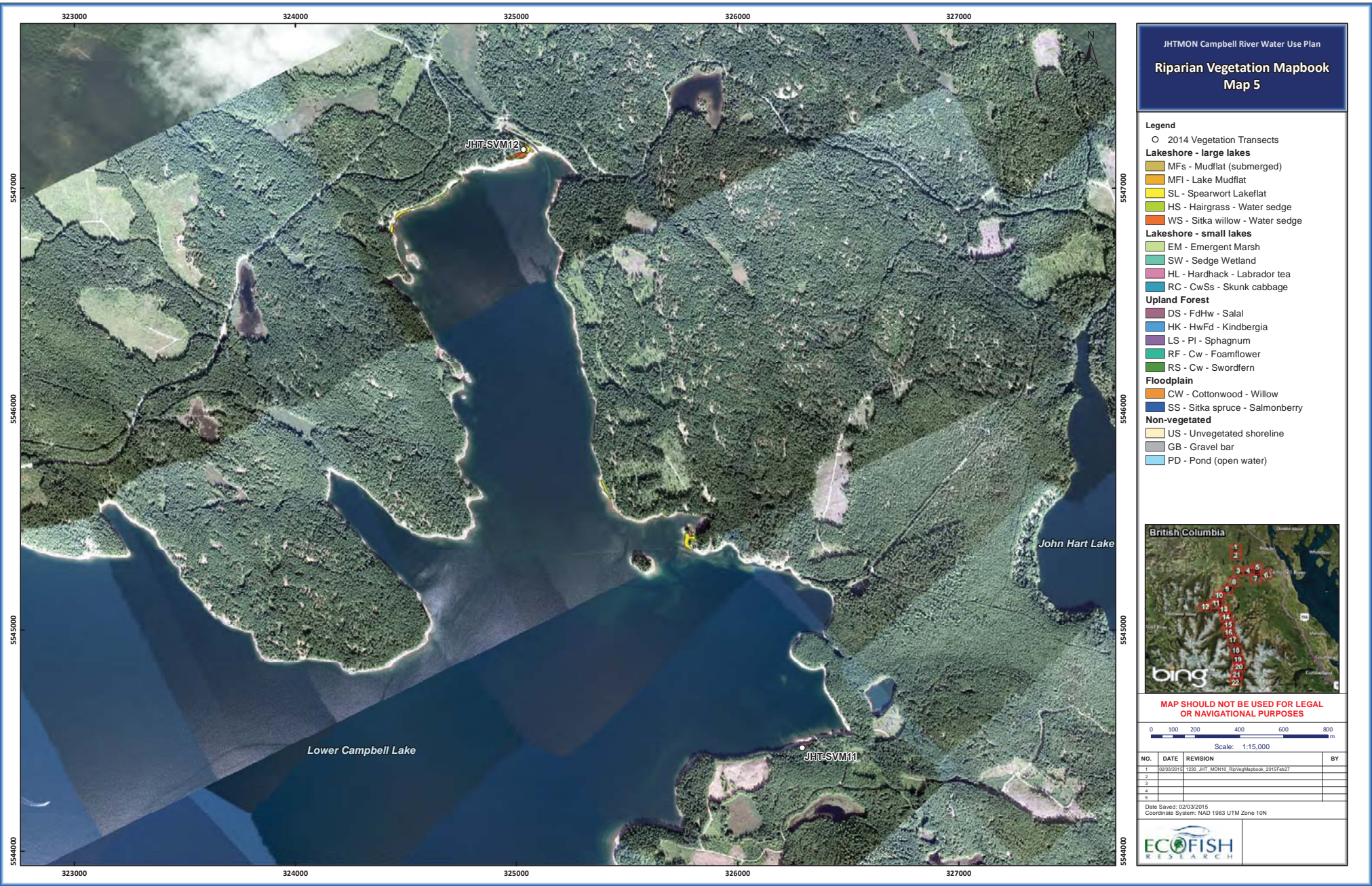
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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 5**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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

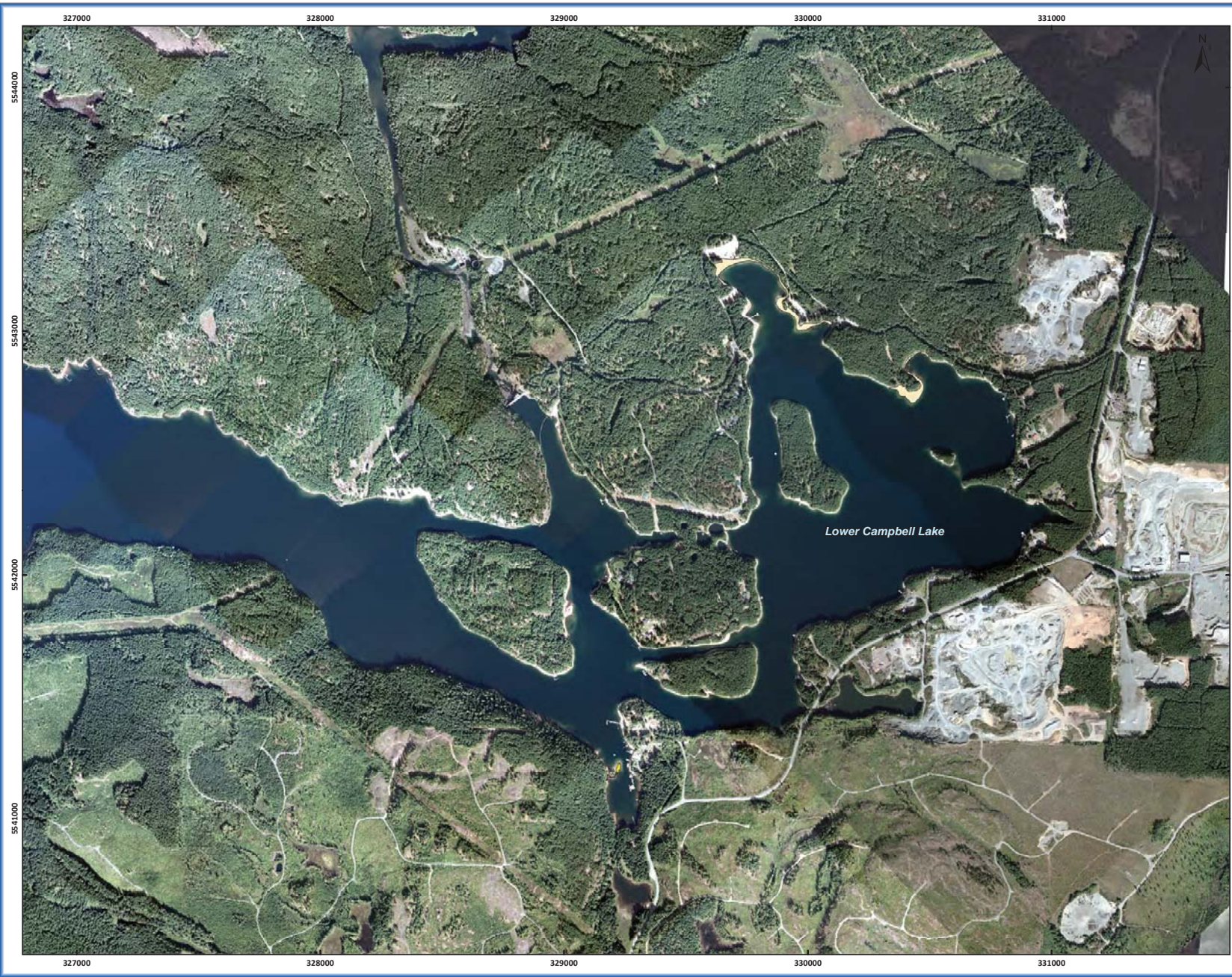


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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 6**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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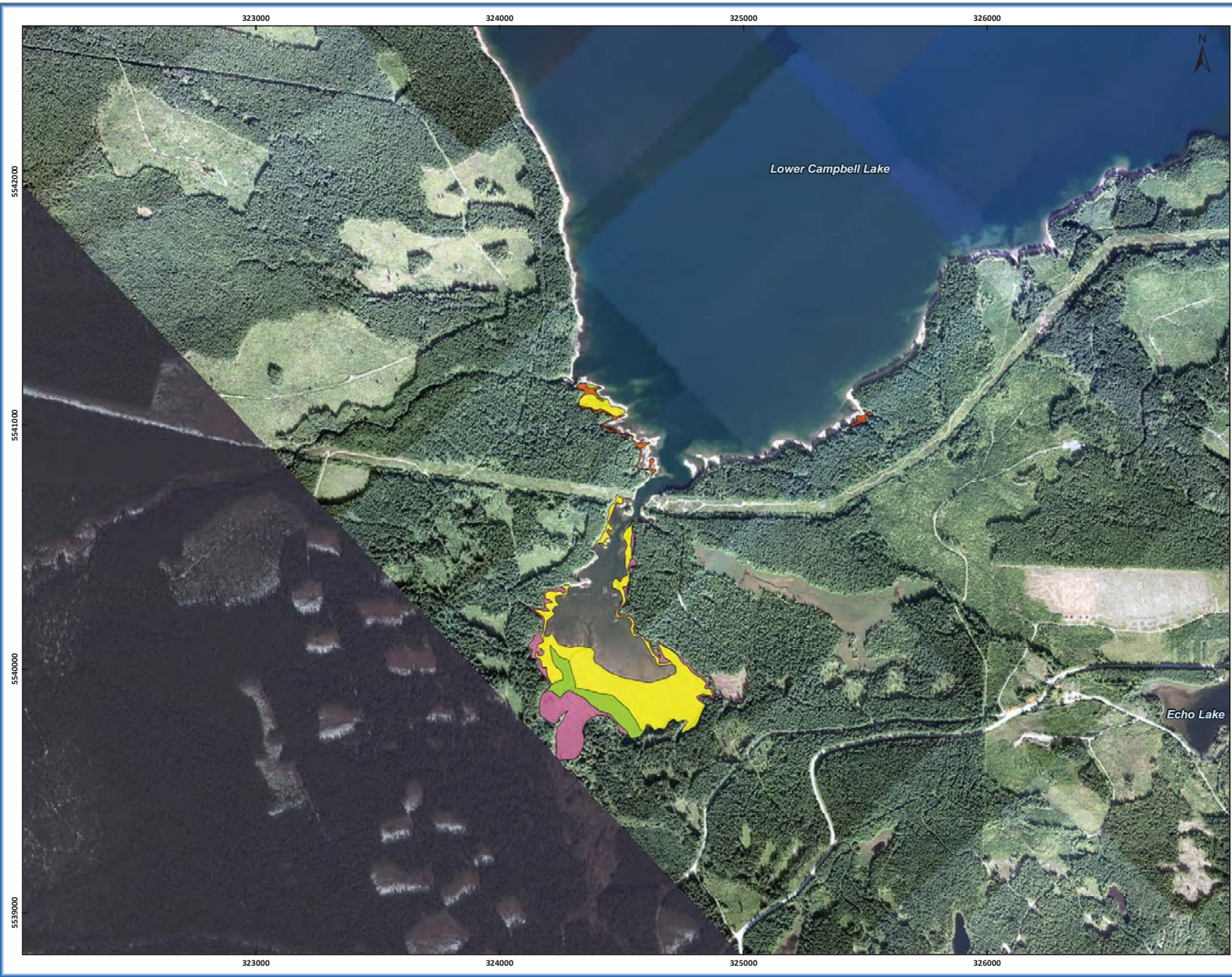


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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 7**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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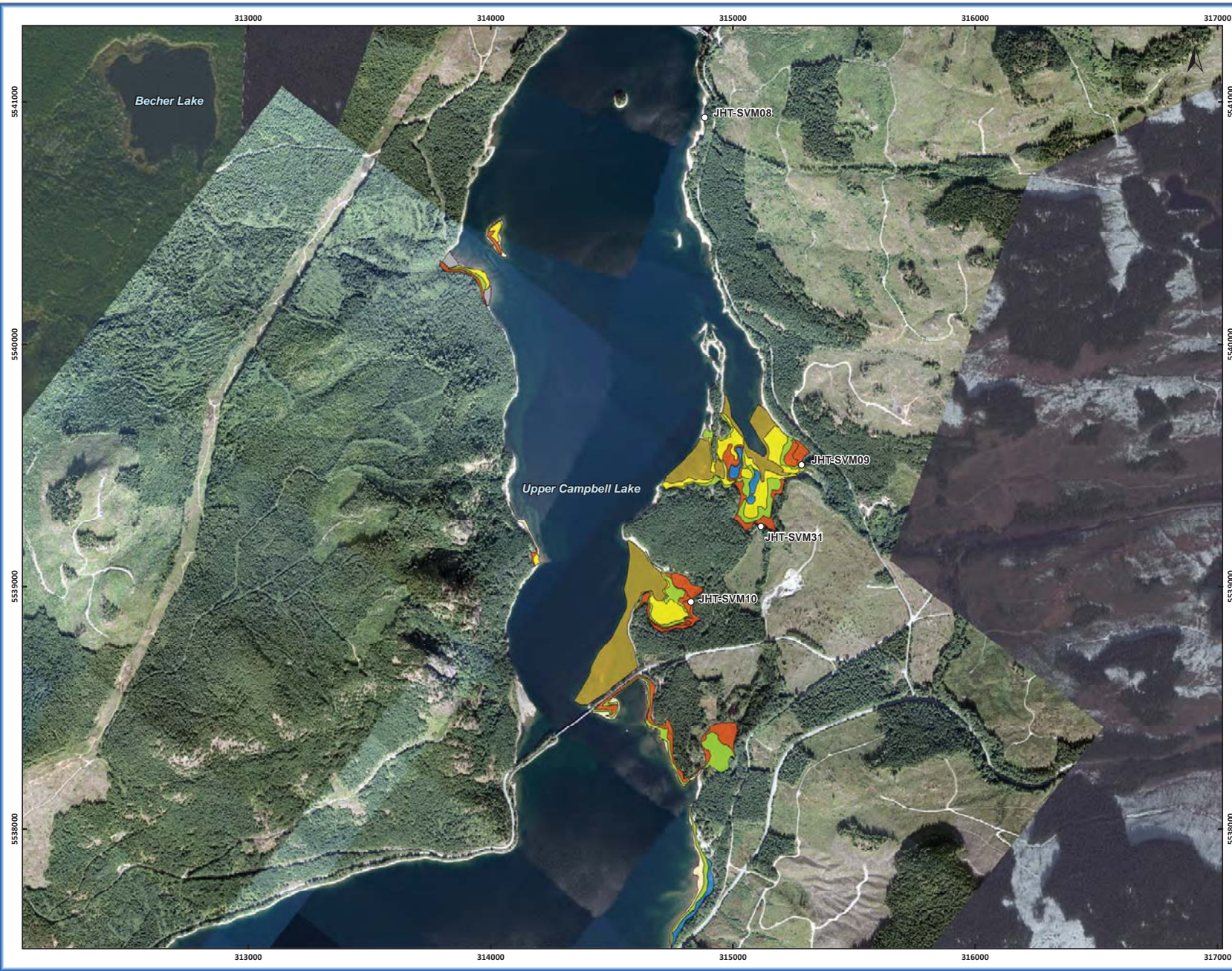
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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 8**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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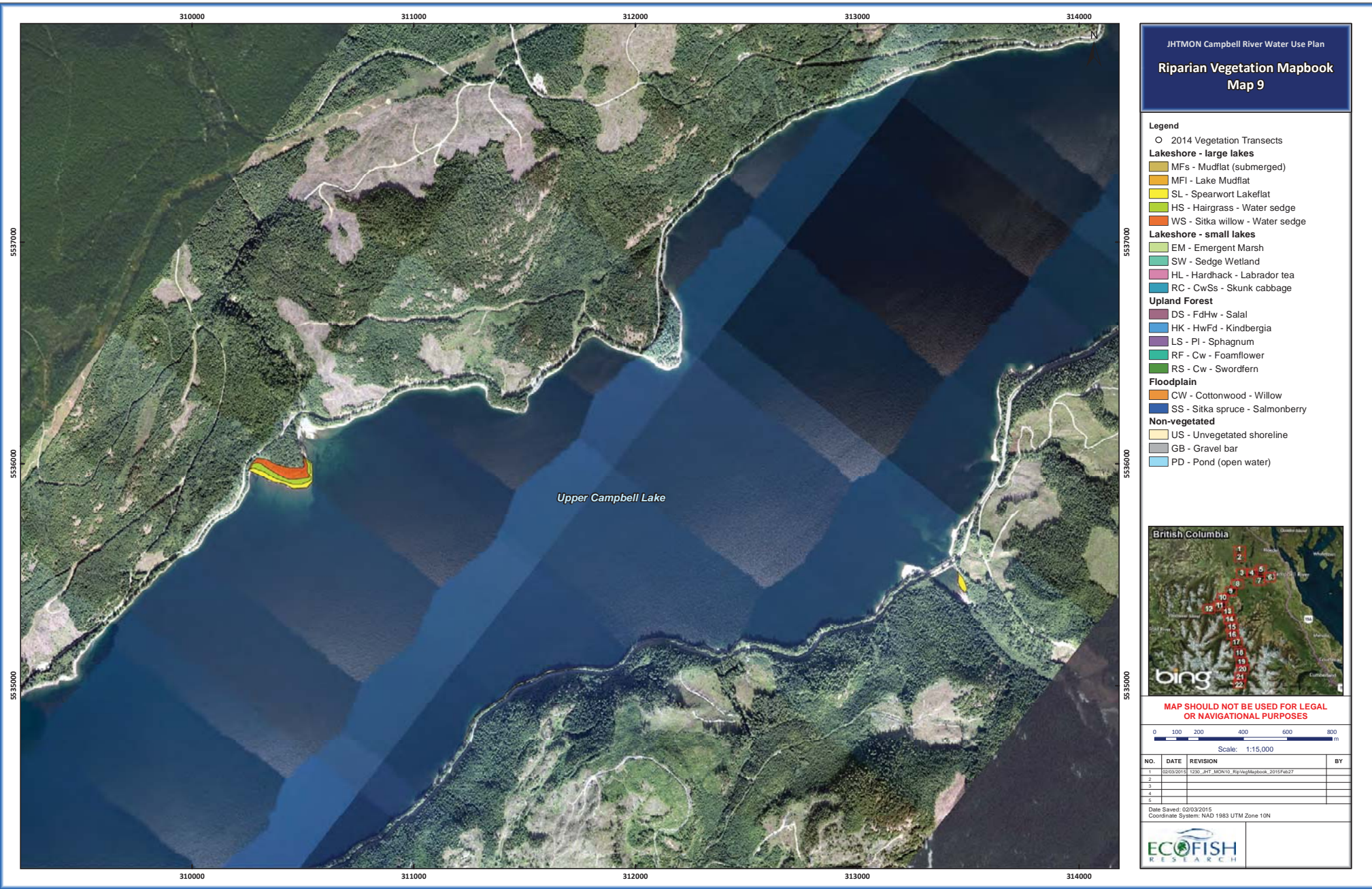


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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 9**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook  
 Map 10**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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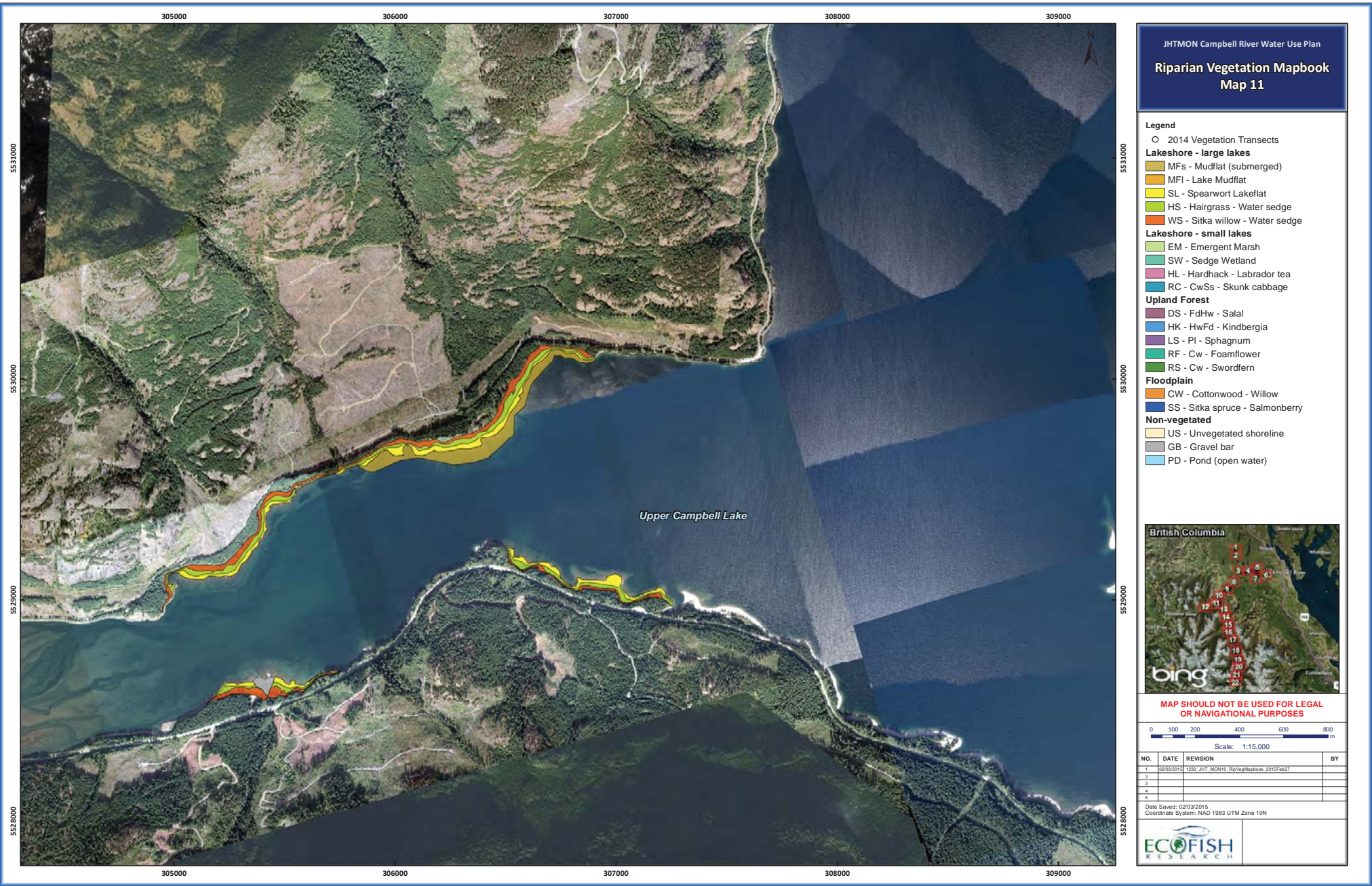


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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 11**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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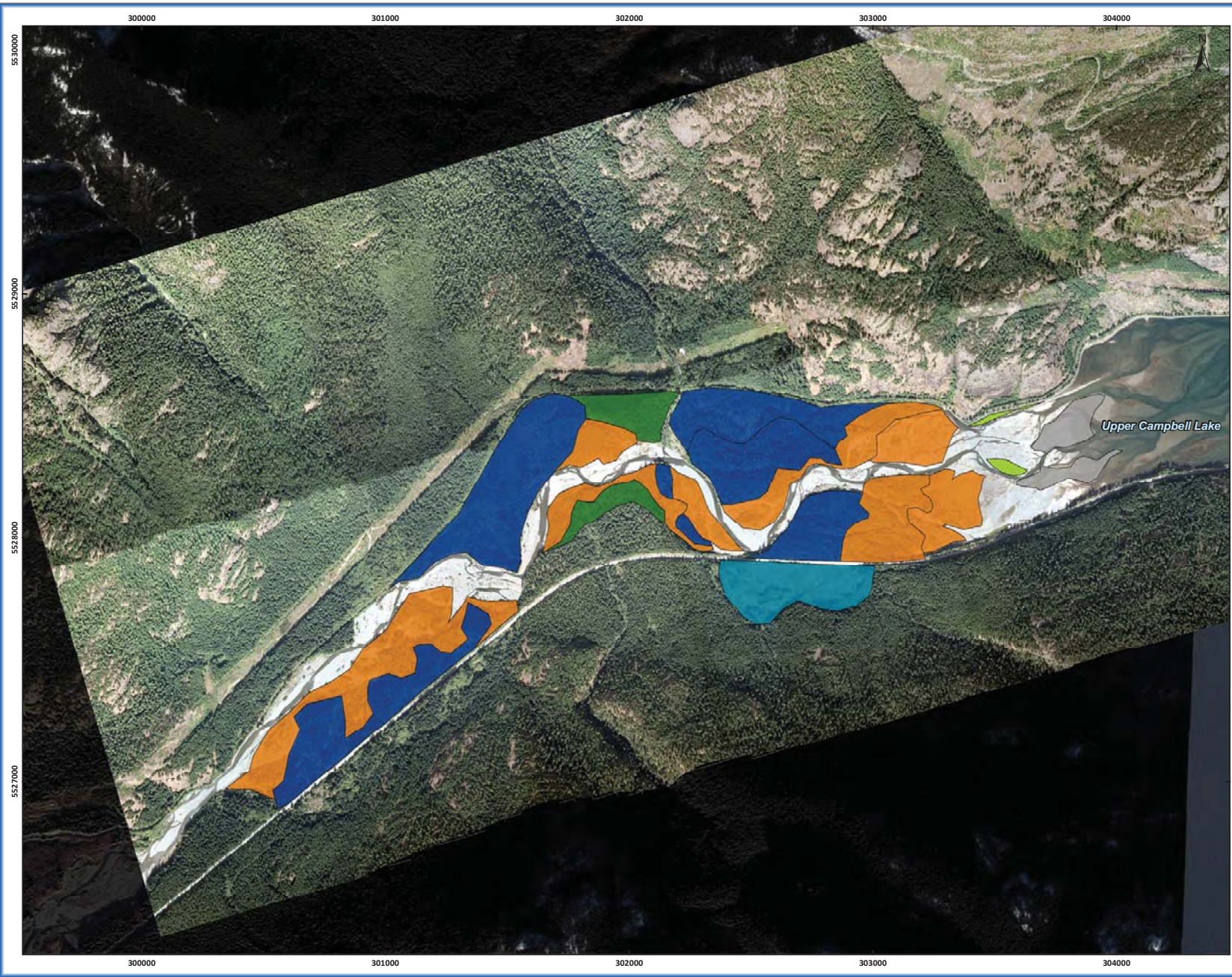


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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 12**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 13**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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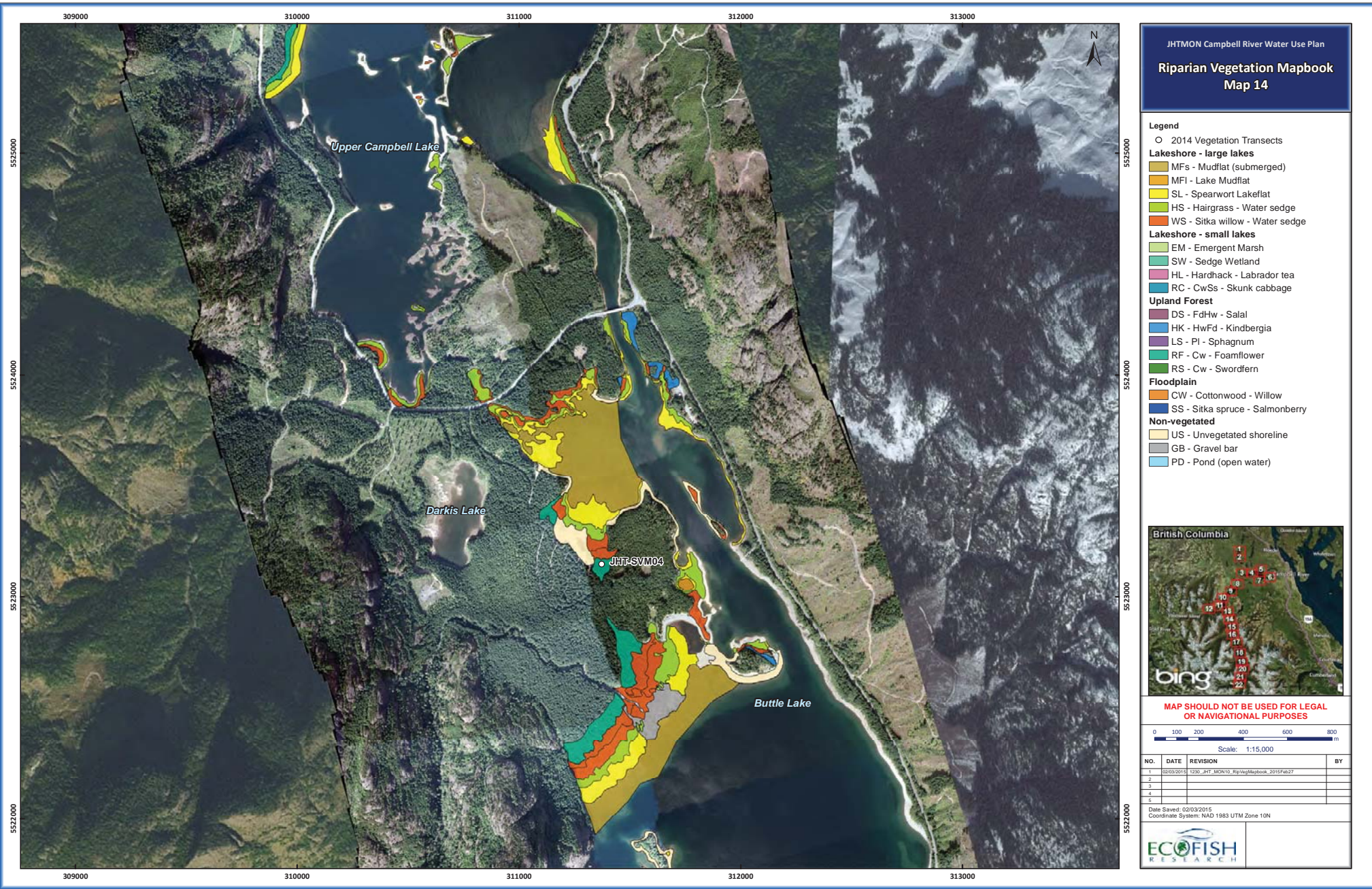
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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 14**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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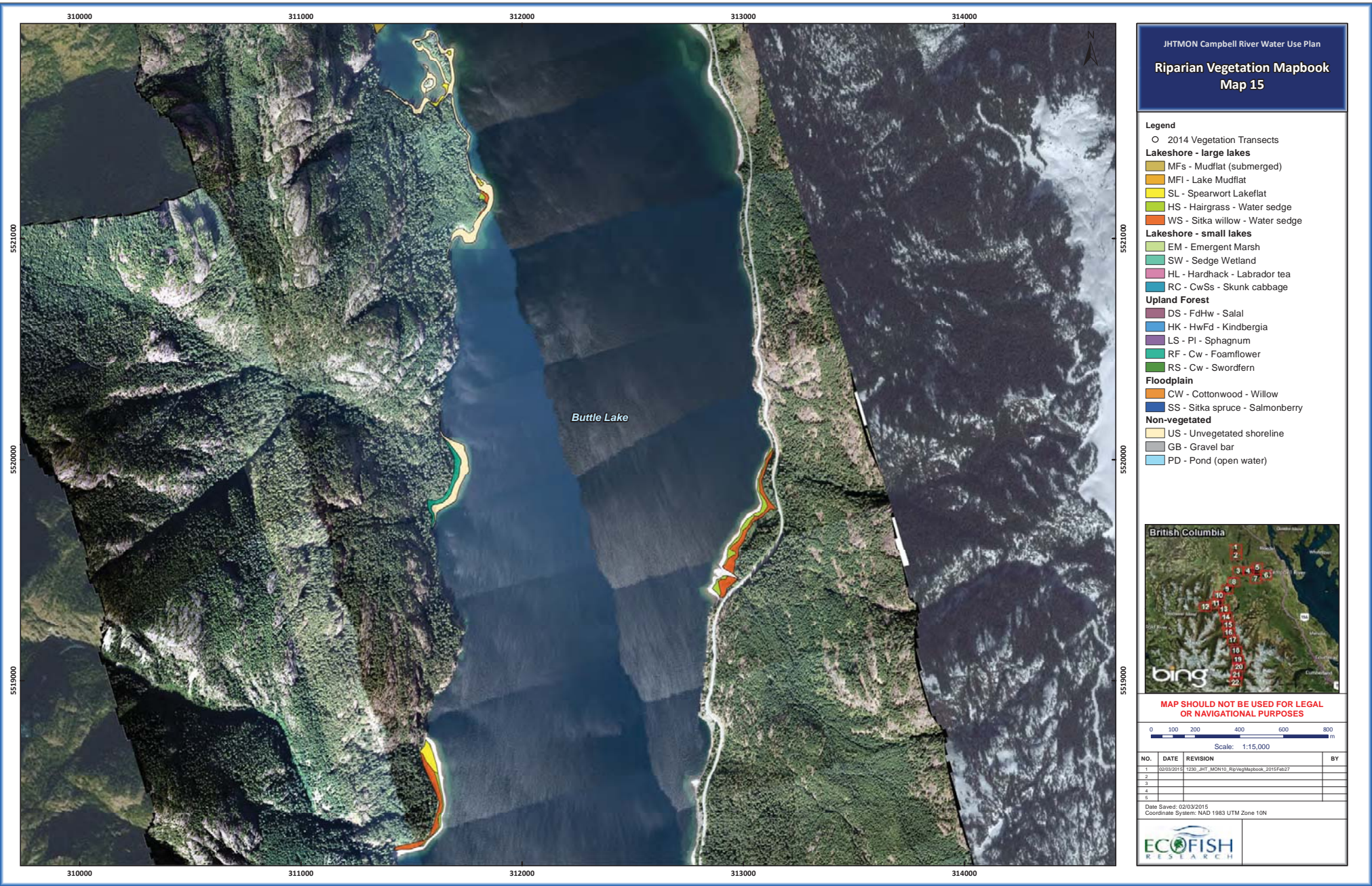


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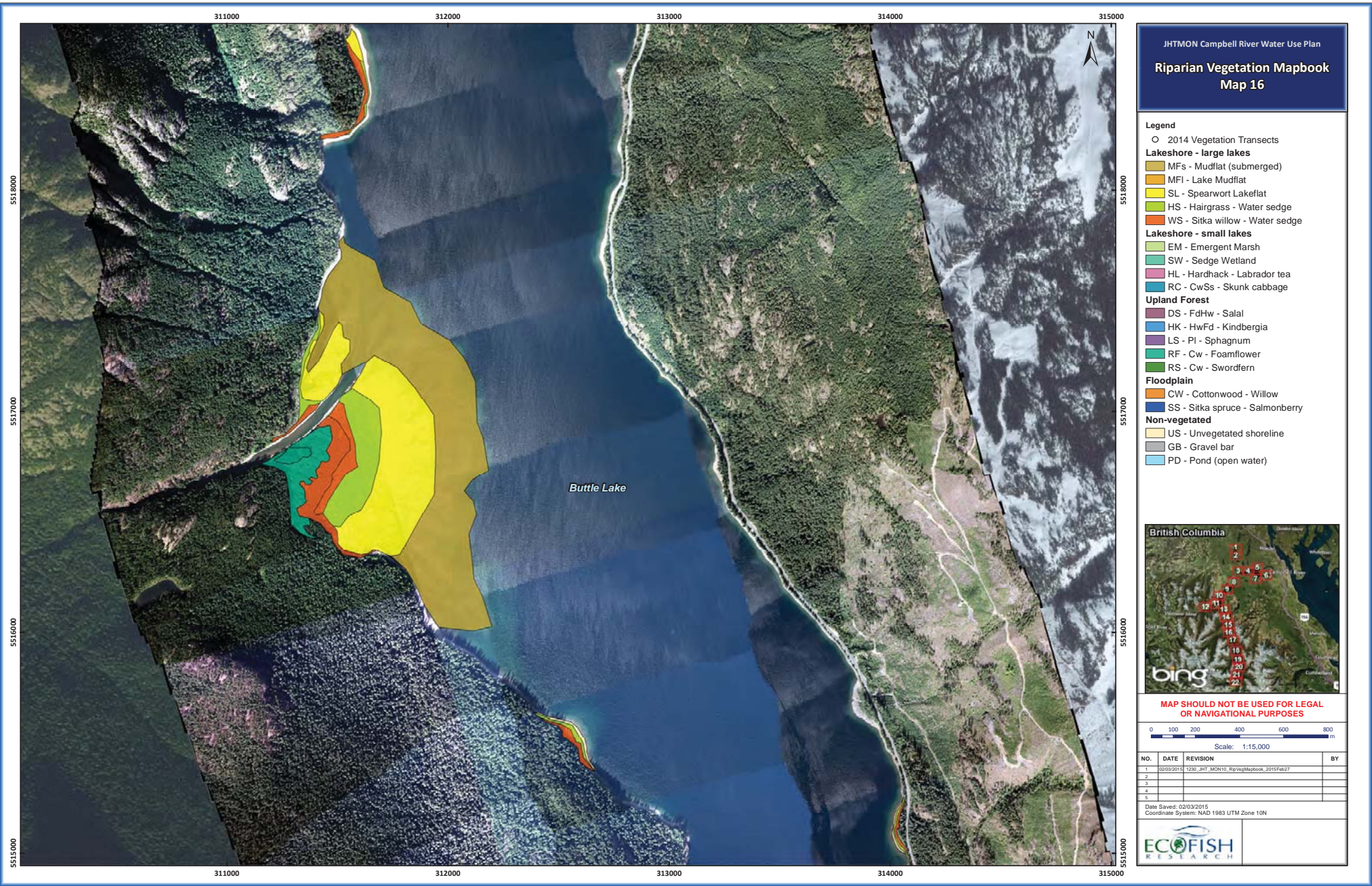
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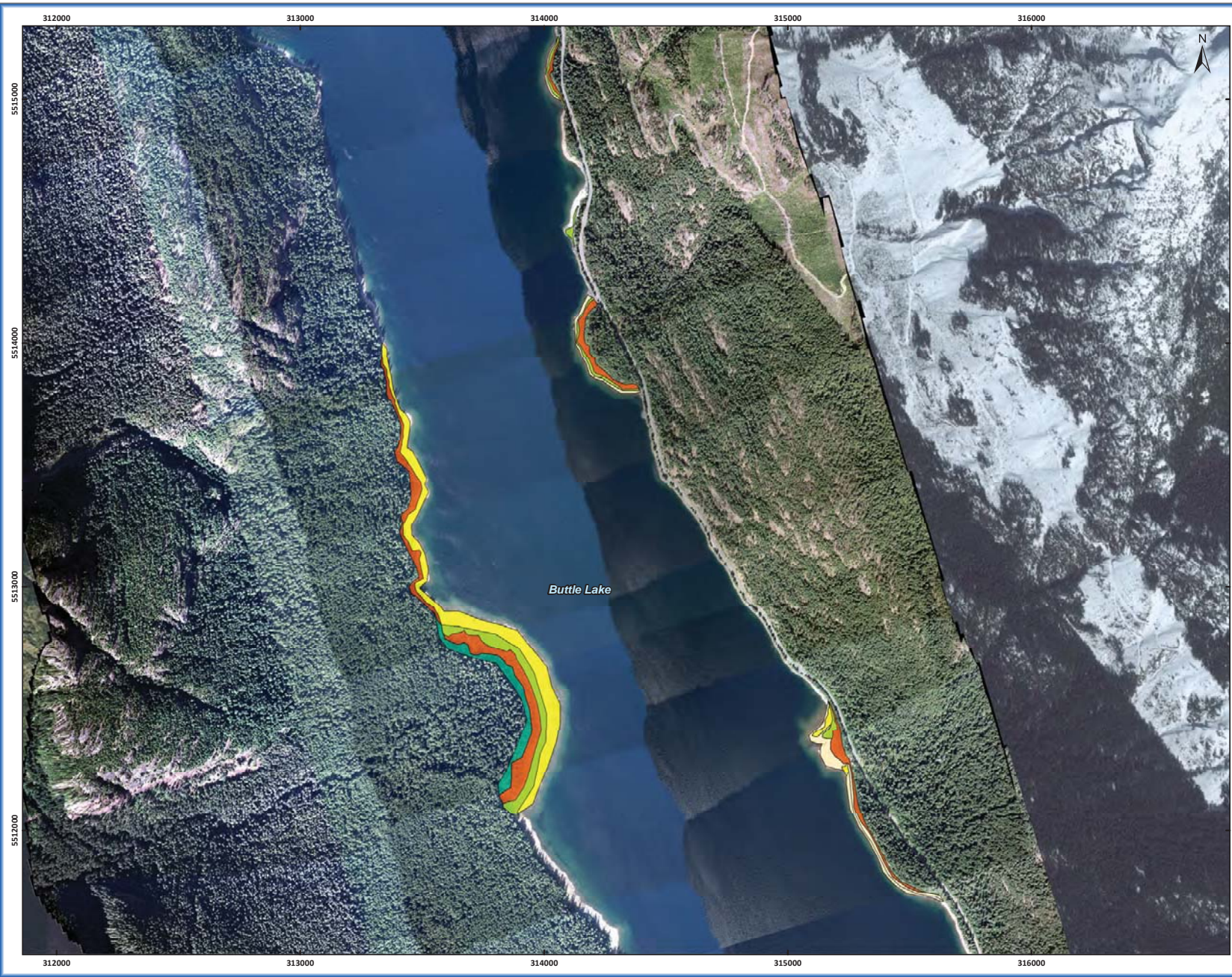












JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook  
 Map 17**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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

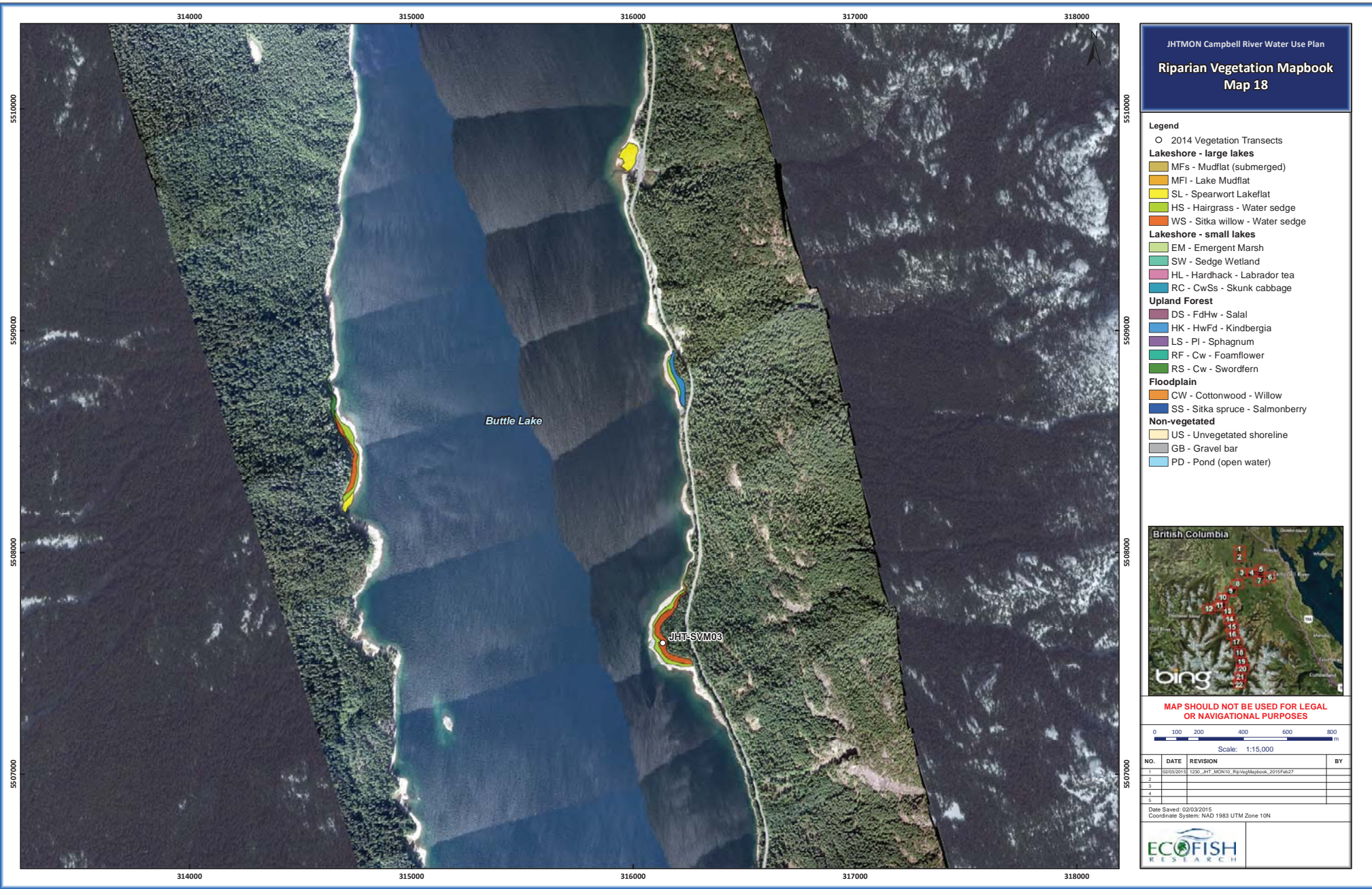


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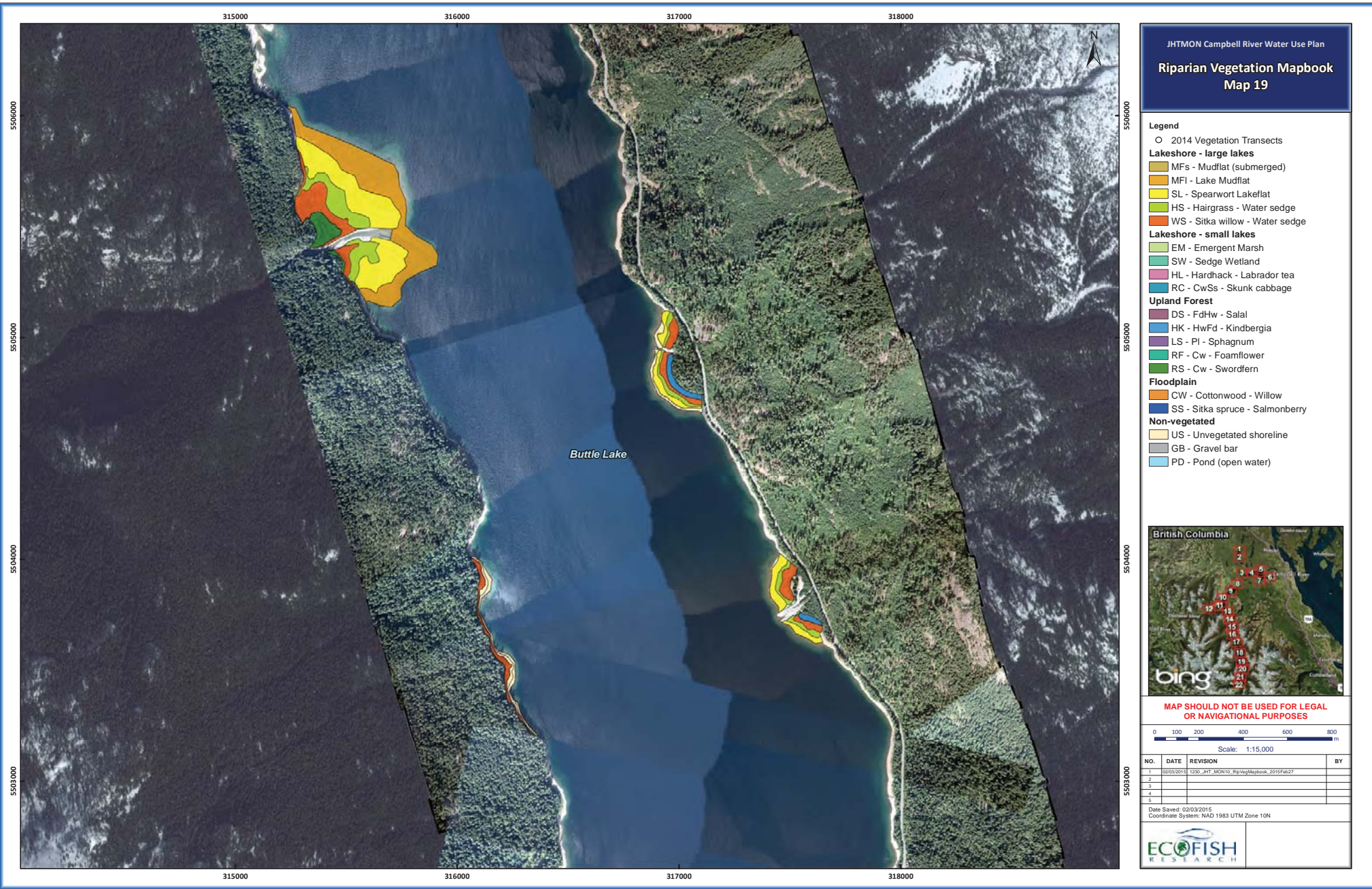
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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 19**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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

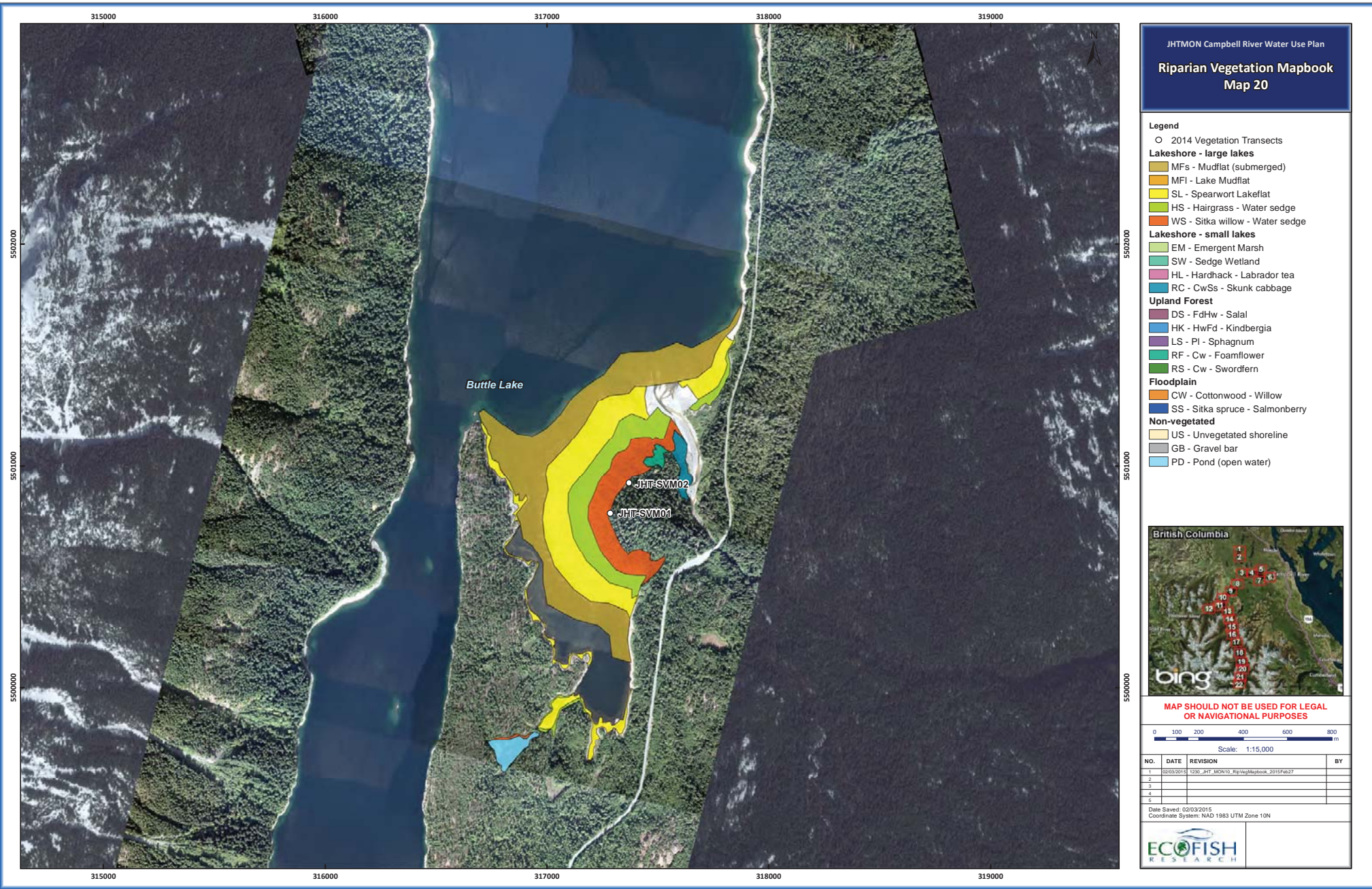


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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 20**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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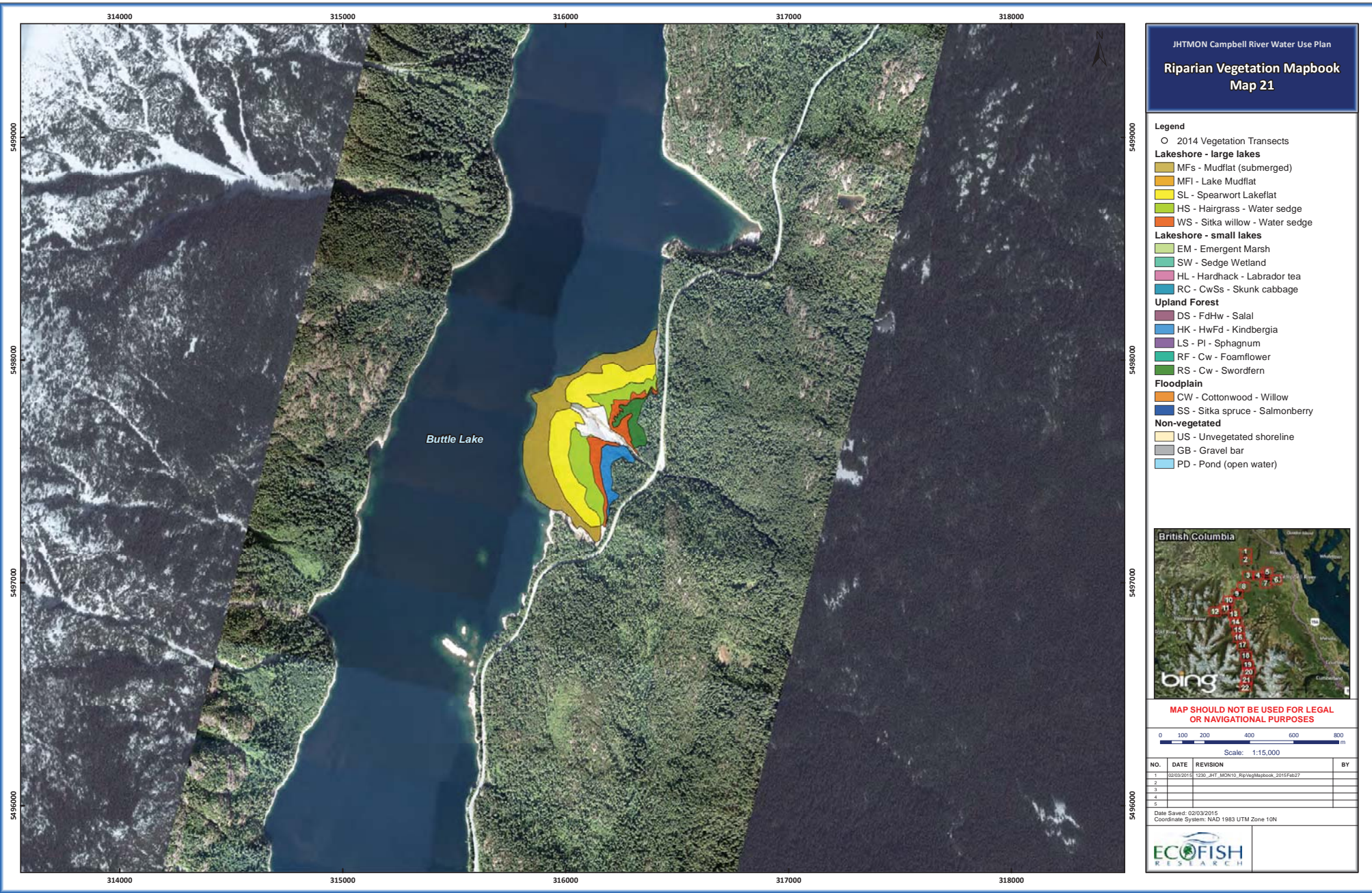


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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook  
 Map 21**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
    - SS - Sitka spruce - Salmonberry
  - Non-vegetated**
    - US - Unvegetated shoreline
    - GB - Gravel bar
    - PD - Pond (open water)



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



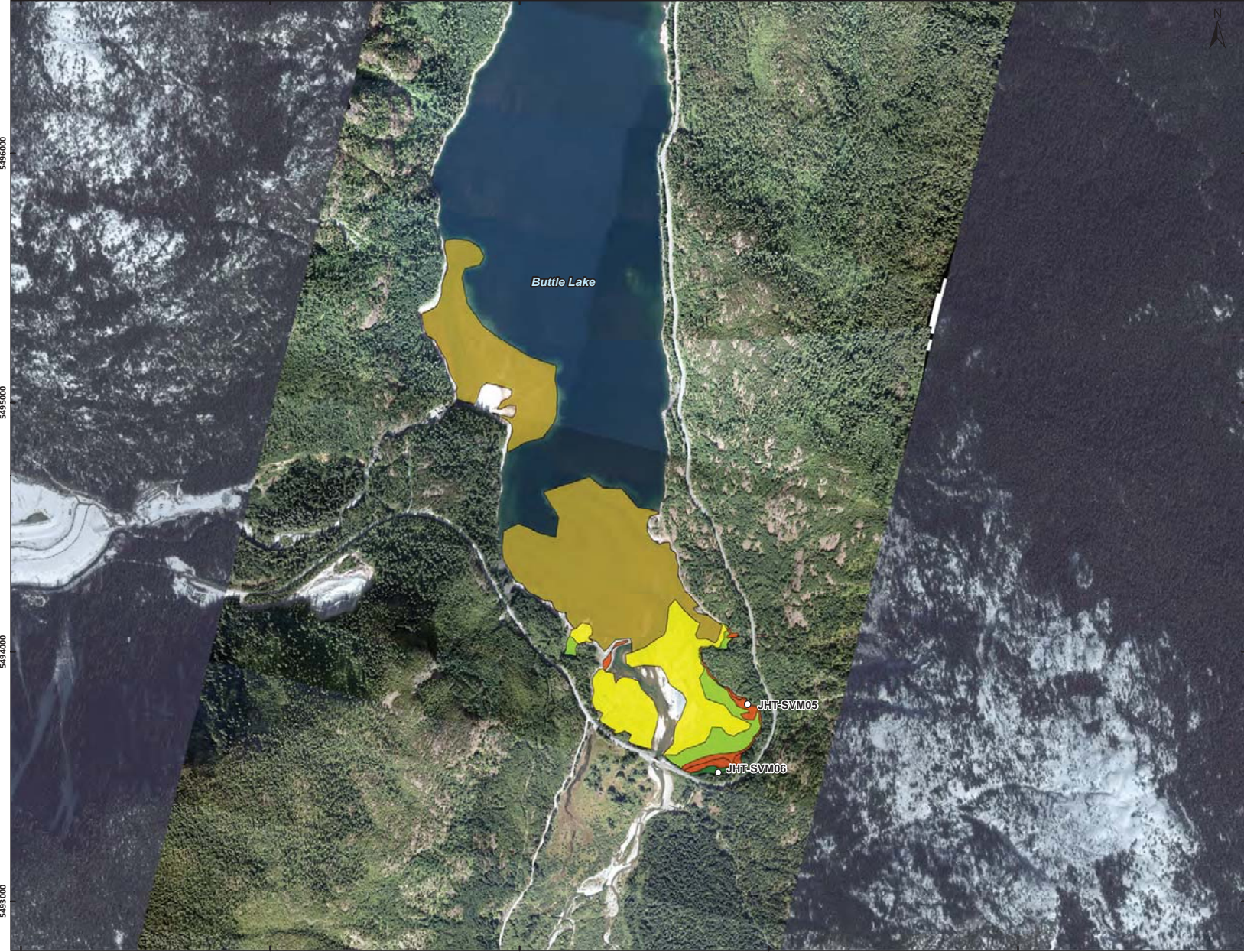
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 Coordinate System: NAD 1983 UTM Zone 10N





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JHTMON Campbell River Water Use Plan  
**Riparian Vegetation Mapbook**  
**Map 22**

- Legend**
- 2014 Vegetation Transects
  - Lakeshore - large lakes**
    - MFs - Mudflat (submerged)
    - MFI - Lake Mudflat
    - SL - Spearwort Lakeflat
    - HS - Hairgrass - Water sedge
    - WS - Sitka willow - Water sedge
  - Lakeshore - small lakes**
    - EM - Emergent Marsh
    - SW - Sedge Wetland
    - HL - Hardhack - Labrador tea
    - RC - CwSs - Skunk cabbage
  - Upland Forest**
    - DS - FdHw - Salal
    - HK - HwFd - Kindbergia
    - LS - PI - Sphagnum
    - RF - Cw - Foamflower
    - RS - Cw - Swordfern
  - Floodplain**
    - CW - Cottonwood - Willow
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