

## Technical Memorandum

---

**DATE:** February 24, 2016

**TO:** Mr. James Hallisey, P.Eng., Resort Municipality of Whistler

**FROM:** Lawrence Francois, P.Eng.

**RE: FITZSIMMONS CREEK SURVEY AND MONITORING METHOD STATEMENT**  
**Fitzsimmons Creek Survey and Monitoring Method Statement**  
**Our File 029.256-300**

---

### 1. Introduction

The Resort Municipality of Whistler conducts an annual gravel removal program to control flood levels in Fitzsimmons Creek. This enables the dikes to perform as designed for flood protection of the community. A long term approval for this work was obtained from FLRNO and DFO in August 2015 based on a review of the Method Statement (*Fitzsimmons Creek Flood Protection Method Statement, April 2014, Tetra Tech EBA*). To further support and standardize the methodology for the annual gravel removal works, additional annual surveying and flow monitoring recommendations are to be incorporated into the current Method Statement. The purpose of the annual survey is to improve the accuracy of flood profile at key locations (e.g. bridges and gravel bars). The purpose of the flow monitoring is to improve the hydraulic model calibration.

This method statement on annual surveying and flow monitoring serves as an addendum to the existing *Fitzsimmons Creek Flood Protection Method Statement, April 2014, Tetra Tech EBA*. It should be used in conjunction with the original document.

### 2. Survey

#### 2.1 Pre-Construction Survey

Historically, the creek survey included 30 target creek cross sections between the Skate Park area and Green Lake. However, based on the onsite gravel accumulation data collected from past gravel removal works, it was identified that the gravel bars tend to migrate on an annual basis and the target sections don't always represent the changes in gravel bed elevations from gravel accumulation accurately. In order to mitigate this limitation, additional gravel bar surveys were conducted during the 2015 flood protection maintenance program.

The annual creek survey for the flood protection maintenance program will include the following:

- Target cross sections extending from Blackcomb Way Bridge to Green Lake.
- The target cross sections will be surveyed at a 100 m spacing and will extend to a minimum of 30 m from the top of each bank.



- The cross-section survey will be conducted at the upstream and downstream faces of bridges located within the study reach to capture conveyance through bridges appropriately in the model. This applies to locations where a gravel bar extends upstream and downstream of a bridge.
- Cross section survey will be conducted at each gravel bar within the extent of the study. At least three cross sectional profiles will be collected per gravel bar. Refer to Gravel Bar Survey section below for additional information.
- Dike crest and top of bank elevations will be checked for changes, e.g. changes to dike geometry or slippage of creek banks etc. will be checked and surveyed where identified.
- Water surface elevation survey will be conducted at each cross section and the Spruce Grove fish habitat channel intake to assess the performance of the compensation channel.

Table 2-1 provides the chainage of all the target cross sections to be surveyed annually. A location plan of the target cross sections is provided in Figures 1 through 5 at the end of this document.

**Table 2-1: Fitzsimmons Creek Target Cross Sections**

Sub Reach	Cross Section	River Station
Sub-Reach 0	1	-0+420
	2	-0+400
	3	-0+300
	4	-0+200
	5	-0+180
	6	-0+100
Sub-Reach 1	7	0+000
	8	0+040
	9	0+100
	10	0+138.253
	11	0+200
	12	0+276.182
	13	0+340
Sub-Reach 2	14	0+365
	15	0+410
	16	0+420
	17	0+454.148
	18	0+583.419
	19	0+733.027
	20	0+800
	21	0+878.157
	22	1+031.53
	23	1+100
	24	1+200
	25	1+235



Sub Reach	Cross Section	River Station
Sub-Reach 3	26	1+245
	27	1+279
	28	1+361
	29	1+378.434
	30	1+415.302
	31	1+441
	32	1+500
	33	1+585.015
	34	1+700
	35	1+808.317
	36	1+903.13
	Sub-Reach 4	37
38		2+000
39		2+060
40		2+075
41		2+200.769
42		2+300
43		2+356.094
44		2+400
Sub-Reach 5	45	2+500
	46	2+614.807
	47	2+750
	48	2+900
	49	2+985.714
	50	3+081.025
	51	3+200
	52	3+315
	53	3+400
	54	3+460.659
Sub-Reach 6	55	3+487.254
	56	3+514.723
Sub-Reach 7	57	3+530
	58	3+569.482
	69	3+361.722
	60	3+700
	61	3+800



## 2.2 Gravel Bar Survey

Due to the dynamic nature of Fitzsimmons Creek, an annual site walkover will be conducted by the RMOW surveyor and its consultant prior to the gravel bar survey. The purpose of the site reconnaissance is to inspect the creek conditions (i.e. flow conditions, gravel deposition, erosion), identify site constraints (accessibility, erosion) and to determine key gravel bar locations (candidate sites for gravel removal) to be surveyed.

The following data will be collected in the gravel bar survey:

- A minimum of three cross sections shall be surveyed at each of the key locations to capture the head, body and toe of the gravel bar. Each cross section will include bank, bed, and gravel bar elevations.
- Survey points will be collected on the gravel bar surface to define the footprint and the height of the gravel bar above the water level. This information will be used to refine the bed load calculations, as required in the Hydraulic Modelling Report.

## 2.3 Post-Construction Survey

The post-construction survey shall be conducted immediately following the gravel removal activity. The perimeter, side slope and depth of each gravel extraction site will be surveyed to verify that the construction method is in compliance with the *Environmental Management Plan (Cascade, 2015)*.

## 2.4 Survey Schedule

To meet the project timeline as identified in the long term approval (i.e. final hydraulic report submission by May 31), the annual field survey program, including the creek channel cross section survey and gravel bar survey, will be initiated in January and completed by mid-February. Survey data must be made available to the RMOW by late February.





### 3. Flow Monitoring Program

#### 3.1 Flow Monitoring

The purpose of the flow monitoring is to identify a critical flood event with a discharge equal to or greater than the mean annual flood in Fitzsimmons Creek. This critical flow triggers a field survey program to obtain the peak water level data during or immediately following a flood event. It is essential to obtain high water levels during such an event to calibrate the in-channel and bank Manning's roughness coefficients.

There are two flow gauges located on Fitzsimmons Creek, including one below Blackcomb Creek operated by Water Survey of Canada and one upstream at the debris barrier operated by Northwest Hydraulics Consultants (NHC). The NHC gauge will be used for flow monitoring, as it provides a near real-time discharge hydrograph and is updated on an hourly basis (<http://files.nhcweb.com/>). During and following a major rainfall event, the discharge hydrograph will be monitored closely to until a discharge of 19 m<sup>3</sup>/s (i.e. mean annual flood at the debris barrier) or greater is identified. Once the critical flow event is identified, the survey crew will be mobilized as soon as safely possible to carry out the water level survey. Weather forecasts can be used to assist the planning of the flow monitoring process. Heavy or continuous storm events in the fall, as well as significantly elevated temperatures during the spring/summer freshet, are both indicators of a possible requirement for flow monitoring.

#### 3.2 Water Level Survey

During and following a critical flood event, water levels in Fitzsimmons Creek will be surveyed at selected target/monitoring cross sections. Ideally, the survey will be completed before flood peak subsides. As the Fitzsimmons Creek basin is a flashy system (i.e. the flood wave passes along the creek quickly), only 11 locations were selected for the water level survey, given the time constraint. Site selection was based on channel stability considerations. Bridge crossings and channel sections with minimal sediment transport activity (i.e. degradation and aggradation) were selected as optimum locations for the water level survey. The locations are listed in Table 3-1.

Table 3-1: Fitzsimmons Creek Water Level Survey Locations

Cross Section	River Station
10	0+138.253
13	0+340
17	0+454.148
25	1+235
28	1+361
41	2+200.769
47	2+750
49	2+985.714
54	3+460.659
56	3+514.723
59	3+361.722



In addition to the water level survey, High Water Marks (HWM), if noticeable on the river bank and bridge piers should be surveyed. Examples of high water marks include, but are not limited to, flood water staining, debris deposition, and lines of dried sediment. Determination of HWMs may be challenging and will be conducted at the surveyor's discretion. Location plans showing water level survey locations are provided in Figures 6 to 10.

**KERR WOOD LEIDAL ASSOCIATES LTD.**

Prepared by:



Reviewed by:

*A. S. Chantler*

Lawrence Francois, P.Eng.  
Water Resources Engineer, Project Manager

Adrian Chantler, Ph.D., P.Eng.  
Senior Technical Specialist

LF/pm  
Attachments: Figures 1 – 10

This document is a copy of the sealed and signed hard copy original retained on file. The content of the electronically transmitted document can be confirmed by referring to the filed original.

**Statement of Limitations**

This document has been prepared by Kerr Wood Leidal Associates Ltd. (KWL) for the exclusive use and benefit of the intended recipient. No other party is entitled to rely on any of the conclusions, data, opinions, or any other information contained in this document.

This document represents KWL's best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practising under similar conditions. No warranty, express or implied, is made.

**Copyright Notice**

These materials (text, tables, figures and drawings included herein) are copyright of Kerr Wood Leidal Associates Ltd. (KWL). The Resort Municipality of Whistler is permitted to reproduce the materials for archiving and for distribution to third parties only as required to conduct business specifically relating to the Fitzsimmons Creek Survey and Monitoring Method Statement. Any other use of these materials without the written permission of KWL is prohibited.

**Revision History**





Revision #	Date	Status	Revision Description	Author
A	December 29, 2015	Draft	Issued for Client Review	LF
B	February 24, 2016	Final	Final Issue	LF

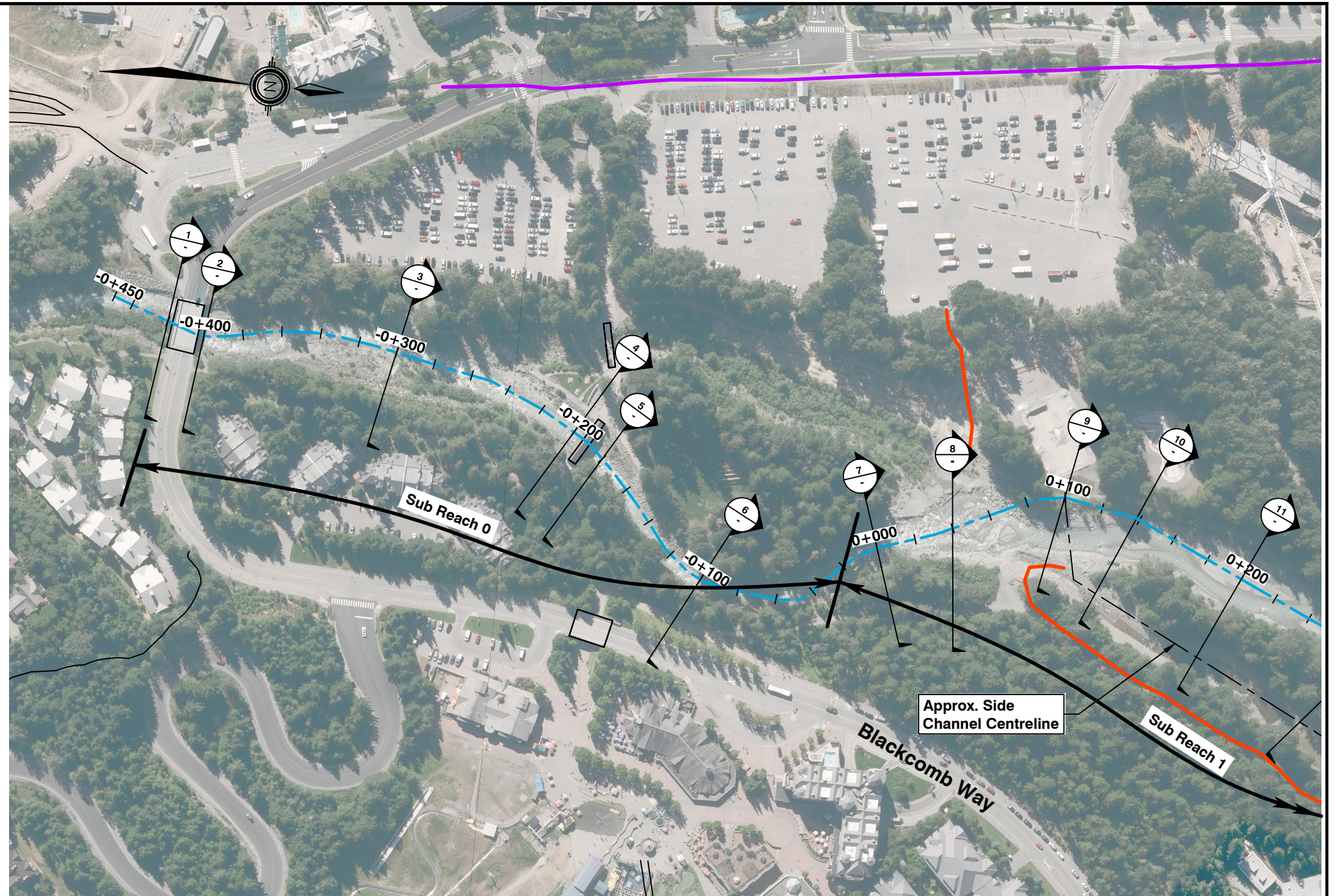




Cross Sections Table		Cross Sections Table		Cross Sections Table	
X-Sec No.	X-Sec Sta.	X-Sec No.	X-Sec Sta.	X-Sec No.	X-Sec Sta.
1	-0+420	21	0+878.157	41	2+200.769
2	-0+400	22	1+031.534	42	2+300
3	-0+300	23	1+100	43	2+356.094
4	-0+200	24	1+200	44	2+400
5	-0+180	25	1+235	45	2+500
6	-0+100	26	1+245	46	2+614.807
7	0+000	27	1+279	47	2+750
8	0+040	28	1+361	48	2+900
9	0+100	29	1+378.434	49	2+985.714
10	0+138.253	30	1+415.302	50	3+081.025
11	0+200	31	1+441	51	3+200
12	0+276.182	32	1+500	52	3+315
13	0+340	33	1+585.015	53	3+400
14	0+365	34	1+700	54	3+460.659
15	0+410	35	1+808.317	55	3+487.254
16	0+420	36	1+903.13	56	3+514.723
17	0+454.148	37	1+923.999	57	3+530
18	0+583.419	38	2+000	58	3+569.482
19	0+733.027	39	2+060	59	3+361.722
20	0+800	40	2+075	60	3+700
				61	3+800

**LEGEND**

-  RMOW - Watercourse
-  Existing Fitzsimmons Creek Access Routes
-  Existing Right Bank Dike
-  Existing Left Bank Dike



**Notes:**

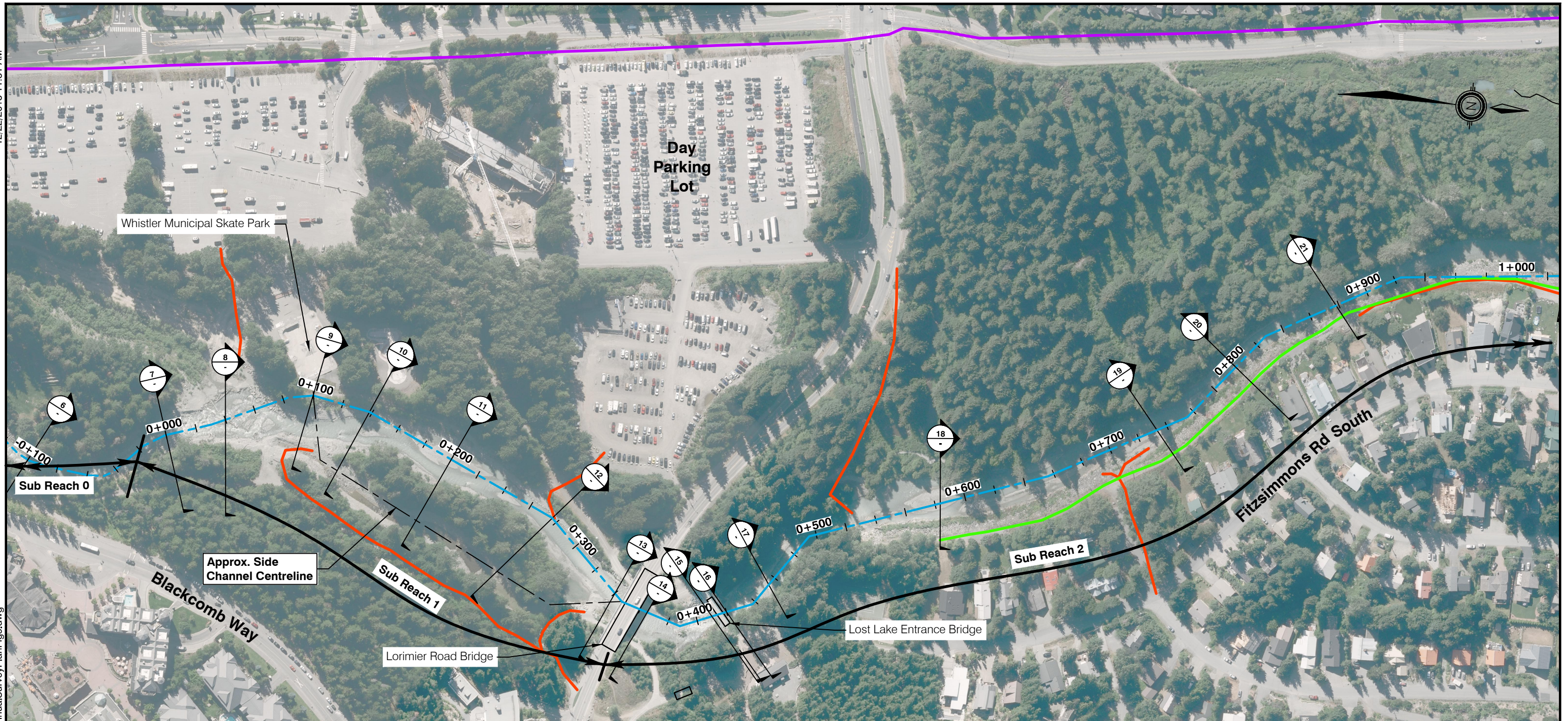
1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Annual gravel bar survey target locations as shown on the plan.
5. In addition to the XS shown on the plan, a minimum of 3 cross sections are required to capture the head, body and toe of each gravel bar.
6. Survey points will be collected on the gravel bar surface to define the footprint and height of the gravel bar above the water level.
7. Water surface elevation will be collected at each surveyed cross section.
8. For cross section survey extent, refer to the method statement for survey and flow monitoring.

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Annual Survey Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Annual Survey Plan

**Figure 1**





**PLAN**  
Scale: 1:2500

**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

**Notes:**

1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Annual gravel bar survey target locations as shown on the plan.
5. In addition to the XS shown on the plan, a minimum of 3 cross sections are required to capture the head, body and toe of each gravel bar.
6. Survey points will be collected on the gravel bar surface to define the footprint and height of the gravel bar above the water level.
7. Water surface elevation will be collected at each surveyed cross section.
8. For cross section survey extent, refer to the method statement for survey and flow monitoring.

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Annual Survey Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Annual Survey Plan

**Figure 2**





**PLAN**

Scale: 1:2500

**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

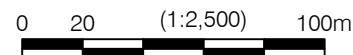
Notes:

1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Annual gravel bar survey target locations as shown on the plan.
5. In addition to the XS shown on the plan, a minimum of 3 cross sections are required to capture the head, body and toe of each gravel bar.
6. Survey points will be collected on the gravel bar surface to define the footprint and height of the gravel bar above the water level.
7. Water surface elevation will be collected at each surveyed cross section.
8. For cross section survey extent, refer to the method statement for survey and flow monitoring.

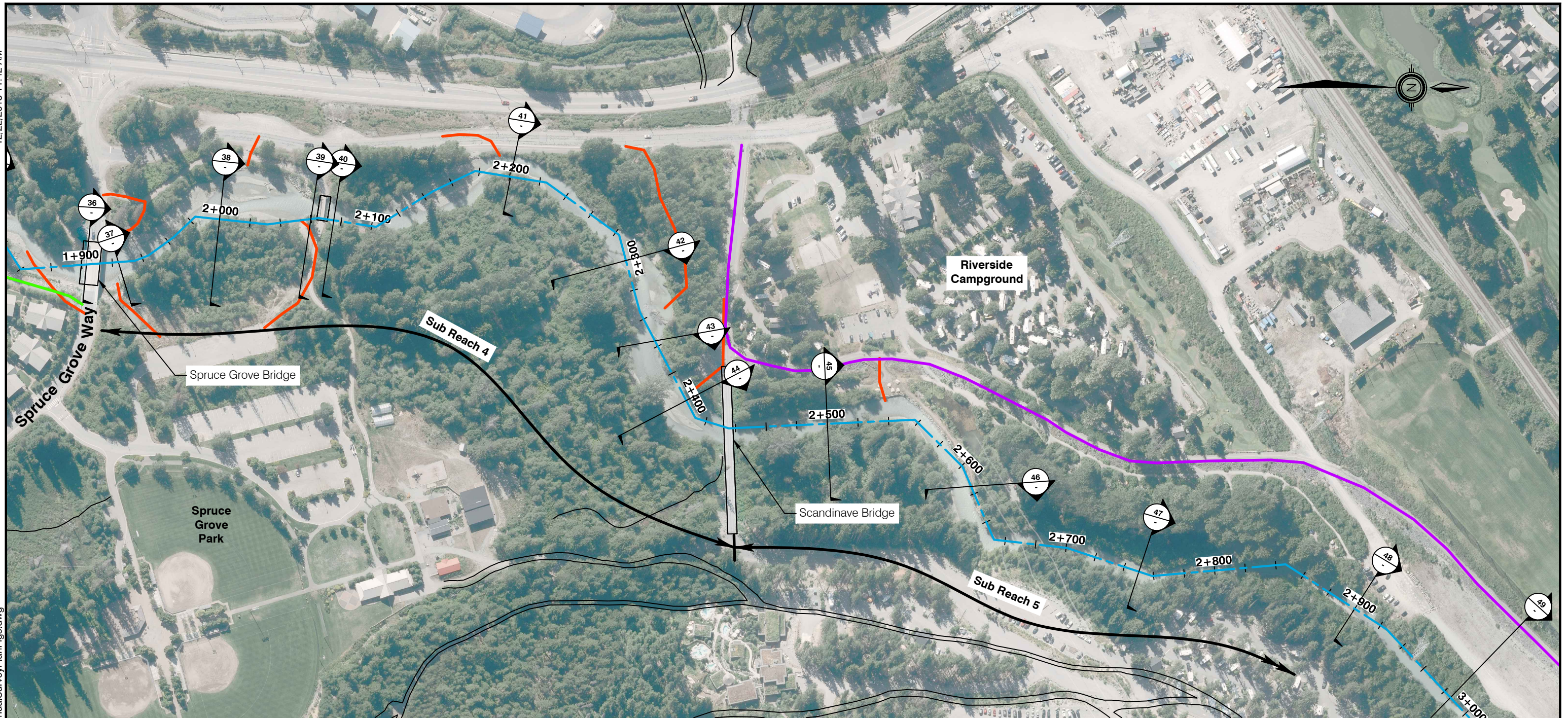
**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Annual Survey Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Annual Survey Plan

**Figure 3**







**PLAN**  
Scale: 1:2500

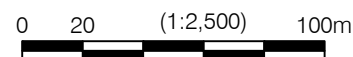
**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

Notes:

1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Annual gravel bar survey target locations as shown on the plan.
5. In addition to the XS shown on the plan, a minimum of 3 cross sections are required to capture the head, body and toe of each gravel bar.
6. Survey points will be collected on the gravel bar surface to define the footprint and height of the gravel bar above the water level.
7. Water surface elevation will be collected at each surveyed cross section.
8. For cross section survey extent, refer to the method statement for survey and flow monitoring.

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Annual Survey Plan**



Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Annual Survey Plan

**Figure 4**





**Notes:**

1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Annual gravel bar survey target locations as shown on the plan.
5. In addition to the XS shown on the plan, a minimum of 3 cross sections are required to capture the head, body and toe of each gravel bar.
6. Survey points will be collected on the gravel bar surface to define the footprint and height of the gravel bar above the water level.
7. Water surface elevation will be collected at each surveyed cross section.
8. For cross section survey extent, refer to the method statement for survey and flow monitoring.

**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

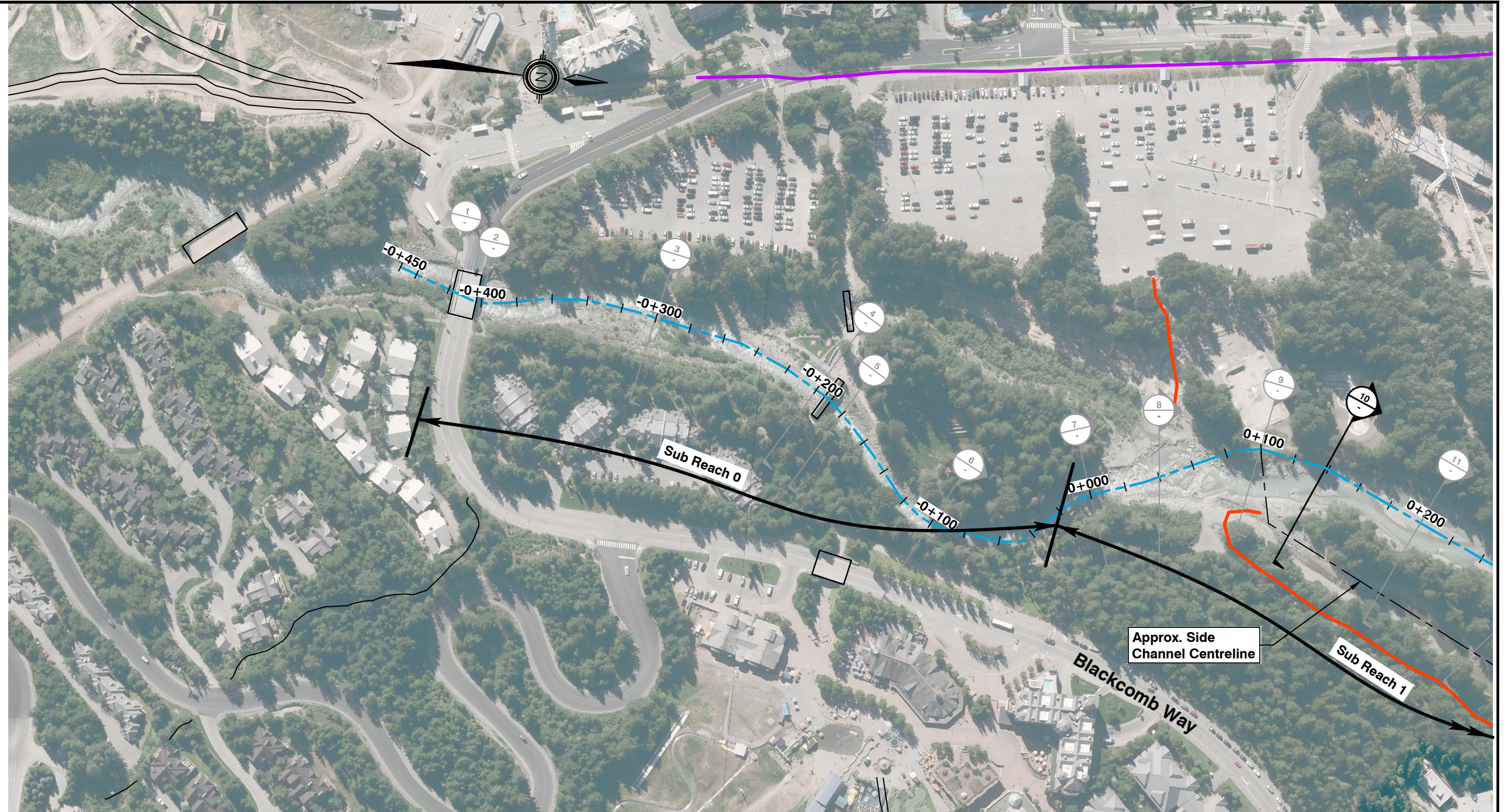
**PLAN**  
Scale: 1:2500

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Annual Survey Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Annual Survey Plan



Cross Sections Table	
X-Sec No.	X-Sec Sta.
10	0+138.253
13	0+340
17	0+454.148
25	1+235
28	1+361
41	2+200.769
47	2+750
49	2+985.714
54	3+460.659
56	3+514.723
59	3+361.722

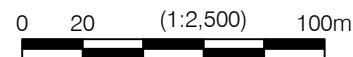


**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

**Notes:**

1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Water level survey should be conducted during or immediately following a flood event.
5. Locations of the water level survey as shown on the plan.
6. For details of the flow monitoring program, such as critical flood event, timing and high water marks (HWM), refer to the method statement for surveying and flow monitoring.

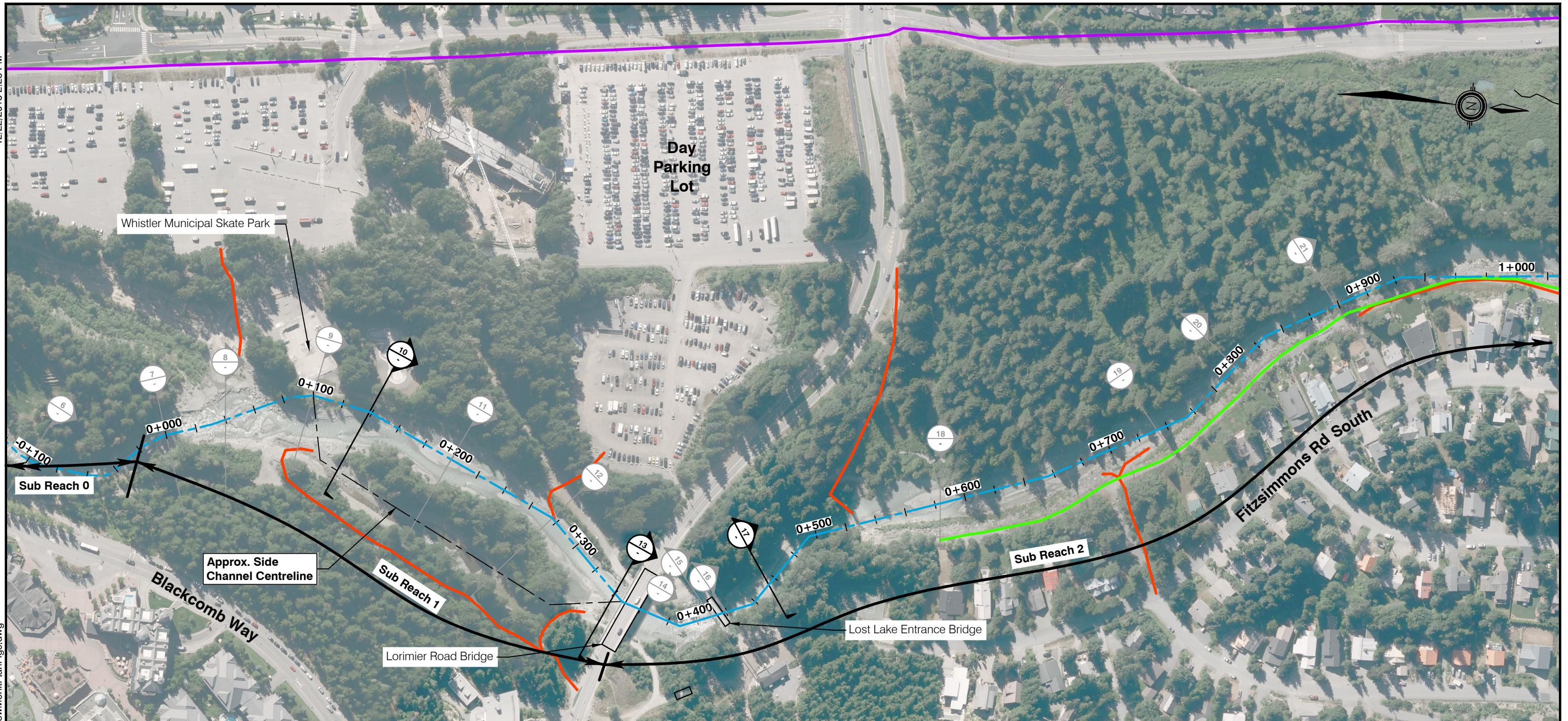


**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Flow Monitoring Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Flow Monitoring Plan

**Figure 6**





**PLAN**  
Scale: 1:2500

**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

**Notes:**

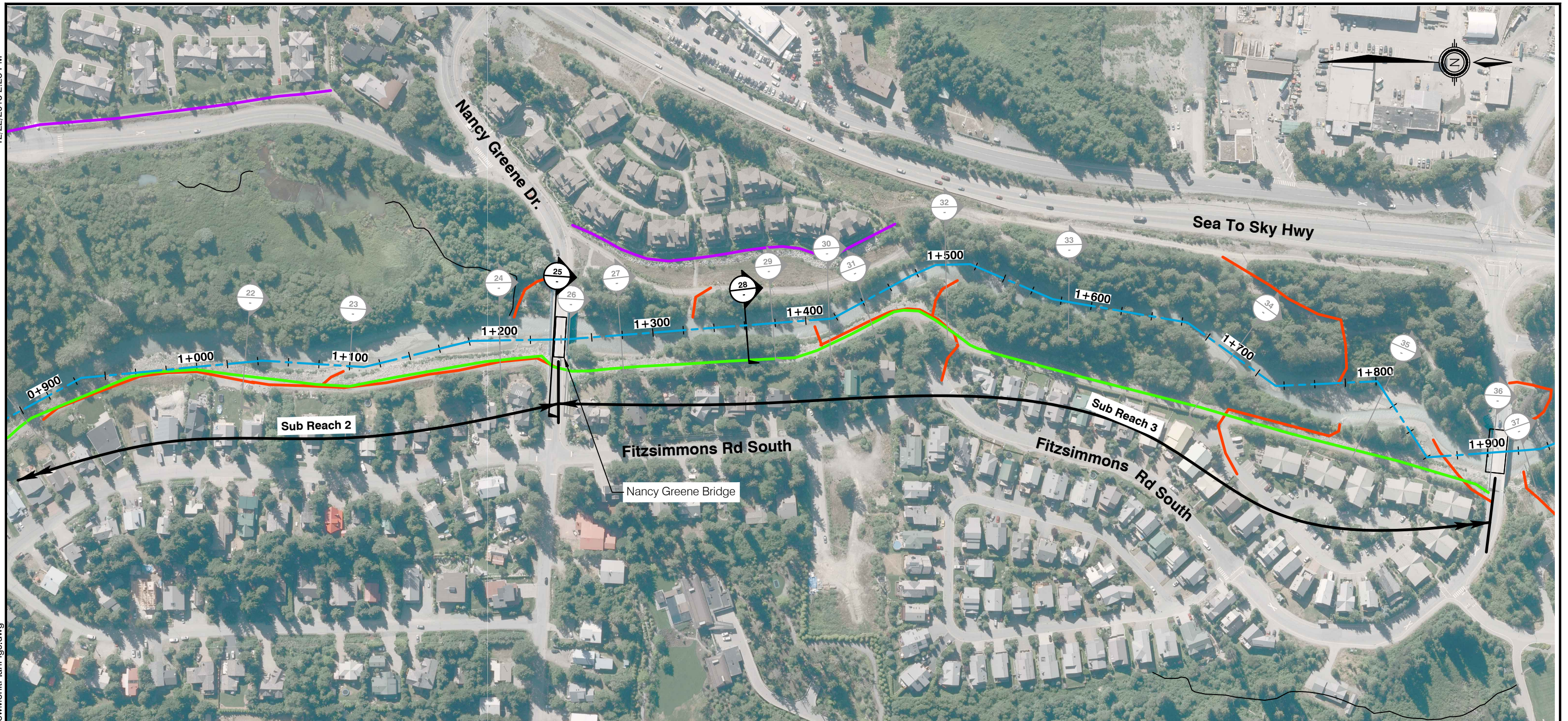
1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Water level survey should be conducted during or immediately following a flood event.
5. Locations of the water level survey as shown on the plan.
6. For details of the flow monitoring program, such as critical flood event, timing and high water marks (HWM), refer to the method statement for surveying and flow monitoring.

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Flow Monitoring Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Flow Monitoring Plan

**Figure 7**





**PLAN**

Scale: 1:2500

**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

Notes:

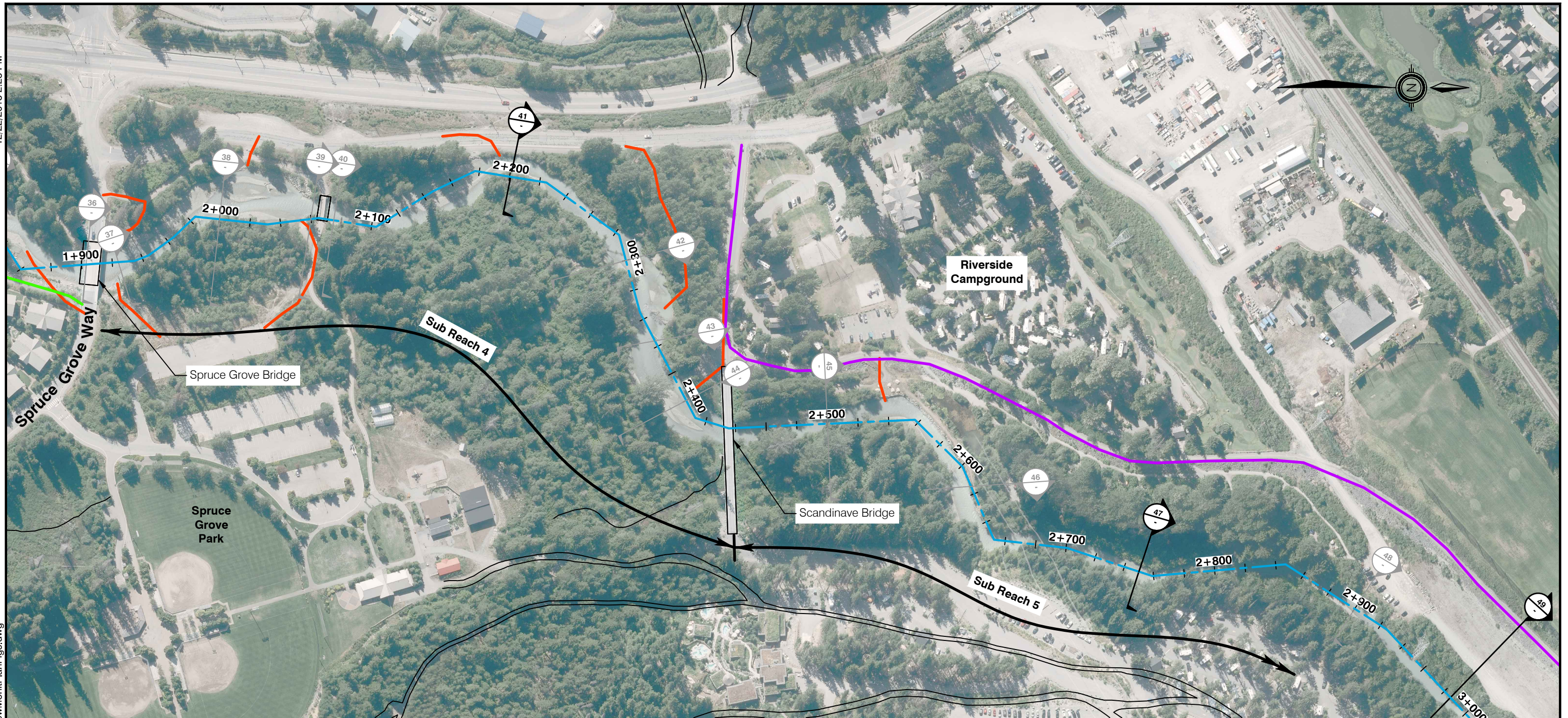
1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Water level survey should be conducted during or immediately following a flood event.
5. Locations of the water level survey as shown on the plan.
6. For details of the flow monitoring program, such as critical flood event, timing and high water marks (HWM), refer to the method statement for surveying and flow monitoring.

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Flow Monitoring Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Flow Monitoring Plan

**Figure 8**





**PLAN**  
Scale: 1:2500

**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

Notes:

1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Water level survey should be conducted during or immediately following a flood event.
5. Locations of the water level survey as shown on the plan.
6. For details of the flow monitoring program, such as critical flood event, timing and high water marks (HWM), refer to the method statement for surveying and flow monitoring.

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Flow Monitoring Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Flow Monitoring Plan

**Figure 9**





**Notes:**

1. Ortho layers provided by RMOW.
2. Data printed in these plans were reviewed by KWL.
3. 2015 surveys shown were provided by Doug Bush Surveys.
4. Water level survey should be conducted during or immediately following a flood event.
5. Locations of the water level survey as shown on the plan.
6. For details of the flow monitoring program, such as critical flood event, timing and high water marks (HWM), refer to the method statement for surveying and flow monitoring.

**LEGEND**

- RMOW - Watercourse
- Existing Fitzsimmons Creek Access Routes
- Existing Right Bank Dike
- Existing Left Bank Dike

**PLAN**  
Scale: 1:2500

**Fitzsimmons Creek Flood Protection  
Maintenance Plan  
Flow Monitoring Plan**

Date	Des	Dwn	Chk	Description of Revision
2015-12-22	EL	MP	LF	Flow Monitoring Plan