

## Memorandum

**To:** Ministry of Forests, Lands, Natural Resources Operations and Rural Development  
**Attention:** Michael Currie  
**cc:** Chelsey Roberts, Resort Municipality of Whistler  
**From:** Allanah Bonnici, SNC-Lavalin Inc.  
Beth Robertson, SNC-Lavalin Inc.  
**Subject:** Fitzsimmons Creek Flood Protection and Maintenance Program  
2022 Fitzsimmons Creek Completion Report  
Water Approval Reference: A2006185

**Date:** November 15, 2022  
**Ref:** 689494

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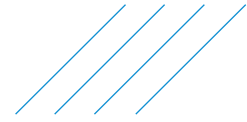
This memorandum documents the completion of gravel removal within Fitzsimmons Creek undertaken as part of the 2022 Fitzsimmons Creek Flood Protection and Maintenance Program.

### 1 Background

SNC-Lavalin Inc. (SNC-Lavalin) was retained by the Resort Municipality of Whistler (RMOW) to complete hydraulic modelling, a Gravel Removal Plan, and contract administration services for the Fitzsimmons Creek Flood Protection and Maintenance Program (“the Program”) for 2022. This year’s program included a hydraulic assessment and gravel bar ranking component providing rationale for proposed gravel removal, contract administration services for tendering the construction phase of work, construction monitoring to ensure the gravel removal process complied with proposed design, and this project completion memorandum to summarize 2022 gravel removal locations and excavated gravel volumes.

Gravel removal for flood protection has been completed on a regular basis within Fitzsimmons Creek since 1992. Works are completed in accordance with the *Fitzsimmons Creek Flood Protection Method Statement* (Tetra Tech EBA Inc., April 2014), the *Fitzsimmons Creek Survey and Monitoring Method Statement* (KWL, February 2016), and the *Environmental Management Plan Fitzsimmons Creek Channel Maintenance Program Version 3* (Cascade Environmental Resource Group, July 2017). For the purposes of this memorandum these documents are referred to as “Flood Protection Method Statement”, “Survey and Monitoring Method Statement”, and “Environmental Management Plan” (EMP), respectively.

All instream works are carried out during the annual least risk fish window of August 15 to August 31. The 2022 works were observed by the qualified environmental monitor, Cascade Environmental Resource Group (CERG), with periodic inspections conducted by SNC-Lavalin.



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## 2 Proposed 2022 Gravel Removal Plan

The 2022 Fitzsimmons Creek Flood Protection and Maintenance Program – Gravel Removal Plan (SNC-Lavalin, 2022) recommended a total in-situ gravel removal of 9,955 m<sup>3</sup>, understanding the actual gravel removal volumes would be dependant on field conditions, water levels, and accessibility at the time of excavation. The target gravel volume and gravel bar removal locations were recommended based on freeboard requirements, environmental impact, cost of gravel extraction, and ease of access. Priority was given to gravel bars that did not meet sufficient freeboard requirements posing a flood risk to the public and surrounding infrastructure.

Gravel bar volumes were estimated based on the following gravel bar extraction design criteria:

- 0.5 m high by 1.0 m wide berm around the perimeter of the gravel bar for isolation during excavation;
- 1H:1V excavated side slopes; and
- Maximum 2.0 m removal depth below the Fitzsimmons Creek water level at each gravel bar.

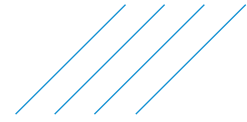
Gravel bar numbering is based on the March and April 2022 survey starting upstream and increasing downstream. All gravel bar locations are shown in the attached Drawings 689494 D-1 to D-4. Table 1 below provides detail on the proposed gravel bar locations, estimated gravel volumes, and hydraulic impact.

**Table 1: Proposed Gravel Removal Plan Locations, Volumes, and Hydraulic Impact for 2022**

| Gravel Bar # | Sub-Reach Area              | Notes                               | Station                   | Proposed Extracted Volume (m <sup>3</sup> ) | Modelled Water Level Difference (m) |
|--------------|-----------------------------|-------------------------------------|---------------------------|---|-------------------------------------|
| 27*          | Sub-Reach 6/<br>Sub-Reach 7 | Upstream and Downstream of CN ROW   | 3+487.254 to<br>3+569.482 | 442   | 0 (0.0 to -0.15)**                  |
| 26*          | Sub-Reach 5                 |                                     | 3+400                     | 519   | +0.01 (-0.01)                       |
| 23           | Sub-Reach 4                 | Removal lowers WEL at Gravel Bar 21 | 2+400                     | 444   | +0.03                               |
| 21*          | Sub-Reach 4                 |                                     | 2+300                     | 316   | -0.01                               |
| 8*           | Sub-Reach 2                 |                                     | 1+031.534                 | 272   | -0.03                               |
| 9            | Sub-Reach 2                 |                                     | 1+100                     | 1,402                                       | +0.03                               |
| 15           | Sub-Reach 3                 |                                     | 1+808.320                 | 2,669                                       | +0.05                               |
| 17           | Sub-Reach 3/<br>Sub-Reach 4 |                                     | 1+903.137 to<br>1+923.999 | 731   | -0.19                               |
| 18           | Sub-Reach 4                 |                                     | 2+000                     | 1,516                                       | -0.01                               |
| 19           | Sub-Reach 4                 |                                     | 2+200                     | 1,644                                       | -0.06                               |
| <b>Total</b> |                             |                                     |                           | <b>9,955</b>                                |                                     |

\* Required freeboard not met at or upstream of gravel bar

\*\* Water Level Difference in brackets represent removal of all of Gravel Bar 27 (including under CN Bridge)



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The initial Gravel Removal Plan recommended removal of ten (10) gravel bars as presented in Table 1. Through the program’s construction tendering phase, it was established that only three third priority gravel bars would be removed. This revised plan to remove only three (3) gravel bars was based on gravel bar access, site conditions, environmental considerations, and project funding. Revised gravel bars and volumes are presented in Table 2.

**Table 2: Revised Gravel Removal Plan**

| Gravel Bar # | Sub-Reach Area              | Station                | Proposed Extracted Volume (m <sup>3</sup> ) |
|--------------|-----------------------------|------------------------|---|
| 15           | Sub-Reach 3                 | 1+808.320              | 2,669                                       |
| 17           | Sub-Reach 3/<br>Sub-Reach 4 | 1+903.137 to 1+923.999 | 731   |
| 19           | Sub-Reach 4                 | 2+200                  | 1,644                                       |
| <b>Total</b> |                             | <b>5,044</b>           |   |

## 3 Completed 2022 Gravel Removal

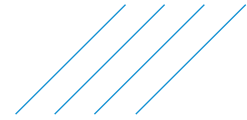
### 3.1 Schedule and Task Overview

Gravel extraction took place over a nine (9) day period between August 15 and 23, 2022 coinciding with the reduced risk window during the period of August 15 to August 31. Gravel extraction was conducted by Coastal Mountain Excavations Ltd. (CME) with periodic site inspections and contract administration from SNC-Lavalin, and environmental monitoring from CERG.

CME’s construction scope of works included all coordination and operation of equipment (excavator and haul trucks), traffic control, and survey.

CERG’s environmental monitoring scope of work included fish salvage, isolation, and water quality monitoring (specifically for turbidity) for the duration of gravel extraction activities.

SNC-Lavalin’s scope of work included site visits for both technical staff and contract administrators. Technical staff site visits included attending two technical site inspections on June 21, 2022 and August 17, 2022. Field reports for site inspections are attached. Contract administration site visits included a tenderers site meeting on July 12, 2022, site work planning and delivery of executed contract documents on August 9, 2022, and field inspections on August 17, and 22, 2022.



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The sequence of the gravel extraction scope of work completed between August 15<sup>th</sup> and 23<sup>rd</sup> for each gravel bar is as follows:

- i. Mobilization of equipment and set up of traffic control;
- ii. Installation of fish isolation fencing, electrofishing (where necessary), and ongoing environmental monitoring;
- iii. Pre-construction survey of gravel bar extents;
- iv. Establish access (where necessary) through stockpiling of bank armour stone, placement of fill, and/or vegetation clearing;
- v. Construction of a berm from existing sand and gravel to isolate active excavation from Fitzsimmons Creek wetted perimeter;
- vi. Excavation of sand and gravel to a maximum of 2.0 m below Fitzsimmons Creek water level;
- vii. Hauling of excavation material to predetermined stockpile location;
- viii. Post-construction survey of excavated gravel bar;
- ix. Removal of any temporary access routes or material and replacement of bank armour stone (where necessary); and
- x. Demobilization and final site clean-up.

## 3.2 Environmental Monitoring and Mitigation

The environmental monitoring scope of work was completed by CERG for the 2022 Gravel Removal scope of works. A detailed record of environmental monitoring and mitigation works was provided by CERG (see attached).

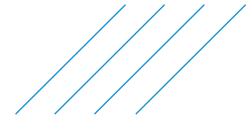
CERG informed SNC-Lavalin that the approval conditions by Department of Fisheries and Oceans (DFO) and the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) were complied with throughout, and the works adhered to the protocols outlined in the EMP. CERG confirmed that no environmental incidents were noted during the project.

## 3.3 2022 Gravel Removal Works

Execution of the revised Gravel Removal Plan (Table 2) progressed efficiently. In total, 4,470 m<sup>3</sup> of material, predominately sand and gravel, was removed from the Fitzsimmons Creek between Sub-Reach 3 and 5 (STA 1+750 and 3+500). This volume is not in excess of the estimated volume (5,044 m<sup>3</sup>). Actual gravel volume removal calculations are based on CME pre- and post-construction surveys and were reported by CME. SNC-Lavalin validated the gravel removal volume calculations and found CME reported values within 1%.

Table 3 provides a summary of estimated and actual gravel removal volumes by gravel bar. For gravel bar removal locations refer to Drawings 689494 D-1 to D-4 attached.





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**Table 3: Gravel Removal Completed in 2022; estimated vs. actual**

| Gravel Bar # | Estimated Gravel Removal (m <sup>3</sup> ) | Actual Gravel Removal (m <sup>3</sup> ) |
|--------------|--|---|
| 15           | 2,669                                      | 2,586                                   |
| 17           | 731  | 476                                     |
| 19           | 1,644                                      | 1,408                                   |
| <b>Total</b> | <b>5,044</b>                               | <b>4,470</b>                            |

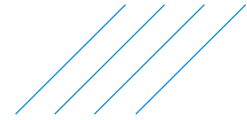
## 4 Conclusion

SNC-Lavalin completed hydraulic modelling, a Gravel Removal Plan (including revision for site specific conditions), and contract administration services for the Fitzsimmons Creek Flood Protection and Maintenance Program for 2022. The revised Gravel Removal Plan was carried out by CME from August 15 to August 23, 2022. A total of 4,470 m<sup>3</sup> of aggraded sediment (predominately sand and gravel) was removed from Fitzsimmons Creek, which was less than the estimated removal volume (5,044 m<sup>3</sup>). All works were monitored by CERG and completed in accordance approval conditions set out by regulators (DFO and FLNRORD) and complied with the Flood Protection Method Statement, Survey and Monitoring Method Statement, and EMP.

## 5 Recommendations

Based on SNC-Lavalin’s experience with the 2022 Fitzsimmons Creek Flood Protection and Maintenance Program we recommend the following future works:

1. Complete ongoing engineering services for assessment of gravel removal within Fitzsimmons Creek consistent with the Flood Protection Method Statement, Survey and Monitoring Method Statement, and EMP.
2. Monitor for high flow events within the modelled reach of Fitzsimmons Creek and mobilize a survey team to conduct high water mark (HWM) surveys at key locations, consistent with the Survey and Monitoring Method Statement. It is recommended future assessments utilize these HWM surveys to validate hydraulic models for future gravel removal programs.
3. Complete an assessment of dike locations and elevations based on hydraulic modelling efforts associated with this Fitzsimmons Creek Flood Protection and Maintenance Program specifically within Sub-Reach 4. It is understood from the RMOW that this assessment is currently underway for deficiencies associated with Sub-Reach 4.
4. Complete a detailed geomorphological watershed assessment to characterize the sediment transport regime with a goal of developing a comprehensive sediment management plan. This may result in mitigation measures that promote the collection of sediment in a centralized location for easier removal. It is understood from RMOW that a Fitzsimmons Creek watershed assessment is currently underway, with mitigation measures being recommended.



# Memorandum

## 6 Notice to Reader

This report has been prepared and the work referred to in this report have been undertaken by SNC-Lavalin Inc. (SNC-Lavalin) for the exclusive use of Resort Municipality of Whistler (RMOW), who has been party to the development of the scope of work and understands its limitations. The methodology, findings, conclusions and recommendations in this report are based solely upon the scope of work and subject to the time and budgetary considerations described in the proposal and/or contract pursuant to which this report was issued. Any use, reliance on, or decision made by a third party based on this report is the sole responsibility of such third party. SNC-Lavalin accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

The findings, conclusions and recommendations in this report (i) have been developed in a manner consistent with the level of skill normally exercised by professionals currently practicing under similar conditions in the area, and (ii) reflect SNC-Lavalin's best judgment based on information available at the time of preparation of this report. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our original contract and included in this report. The findings and conclusions contained in this report are valid only as of the date of this report and may be based, in part, upon information provided by others. If any of the information is inaccurate, new information is discovered, site conditions change or standards are amended, modifications to this report may be necessary. The results of this assessment should in no way be construed as a warranty that the subject site is free from any and all environmental impact.

This report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence. Nothing in this report is intended to constitute or provide a legal opinion.

The contents of this report are confidential and proprietary. Other than by RMOW, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of RMOW and SNC-Lavalin.

## 7 Closing

We trust this memorandum meets the requirements set out under the Fitzsimmons Creek Flood Protection and Maintenance Program for 2022. If there are questions or further information required, please contact the undersigned.

Allanah Bonnici  
Water Resources Professional

Environment Practice  
Engineering Services Canada

Beth Robertson, MSc, P.Eng.  
Hydrotechnical Engineer

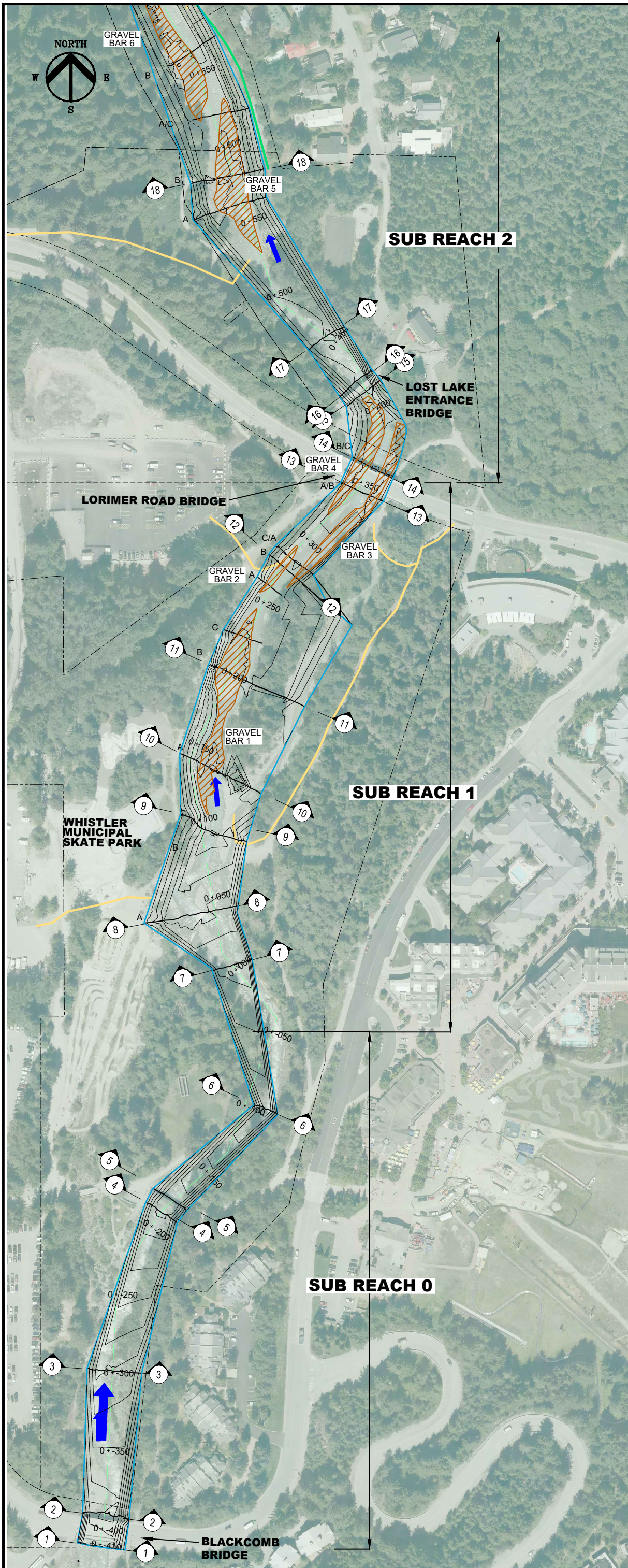
Environment Practice  
Engineering Services Canada

# Drawings

- Fitzsimmons Creek Flood Protection Plan 2022 Gravel Removal – Sub-Reach 1 & 2 (689494 D-1)
- Fitzsimmons Creek Flood Protection Plan 2022 Gravel Removal – Sub-Reach 2 & 3 (689494 D-2)
- Fitzsimmons Creek Flood Protection Plan 2022 Gravel Removal – Sub-Reach 3, 4 & 5 (689494 D-3)
- Fitzsimmons Creek Flood Protection Plan 2022 Gravel Removal – Sub-Reach 5 (689494 D-4)







**LEGEND**

- CN ROW
- LOT LINE
- CONTOUR (1m)
- SURVEY BOUNDARY
- STATION ALIGNMENT
- FITZSIMMONS CREEK ACCESS ROUTE
- EXISTING LEFT BANK DIKE
- EXISTING RIGHT BANK DIKE
- EXISTING GRAVEL BAR
- REMOVED GRAVEL BAR
- FLOW DIRECTION

**NOTES**

1. ORIGINAL DRAWING IN COLOUR.
2. GRAVEL BAR REMOVAL VOLUMES PROVIDED BY COASTAL MOUNTAIN EXCAVATION LTD. (CME) AND ARE BASED ON PRE-AND POST - CONSTRUCTION SURVEY DATA COLLECTED BY CME.
3. ALL GRAVEL BARS NOT EXCAVATED AS PART OF THE 2022 WORKS ARE BASED ON THE MARCH/APRIL 2022 GRAVEL BAR SURVEY COMPLETED BY MCELHANNEY.
4. ALL EXCAVATED GRAVEL BARS ARE REPRESENTED BASED ON CME SURVEY DATA COLLECTED PRE- AND POST-EXCAVATION ACTIVITIES IN AUGUST 2022.

**REFERENCE DRAWINGS**

| DWG. NO. | DATE | DESCRIPTION |
|----------|------|-------------|
|          |      |             |

**REVISIONS**

| REV. | DATE       | DESCRIPTION      | BY | CHK |
|------|------------|------------------|----|-----|
| 0    | 2022-09-23 | ISSUED TO CLIENT | JG | BR  |



CLIENT NAME:  
RESORT MUNICIPALITY OF WHISTLER

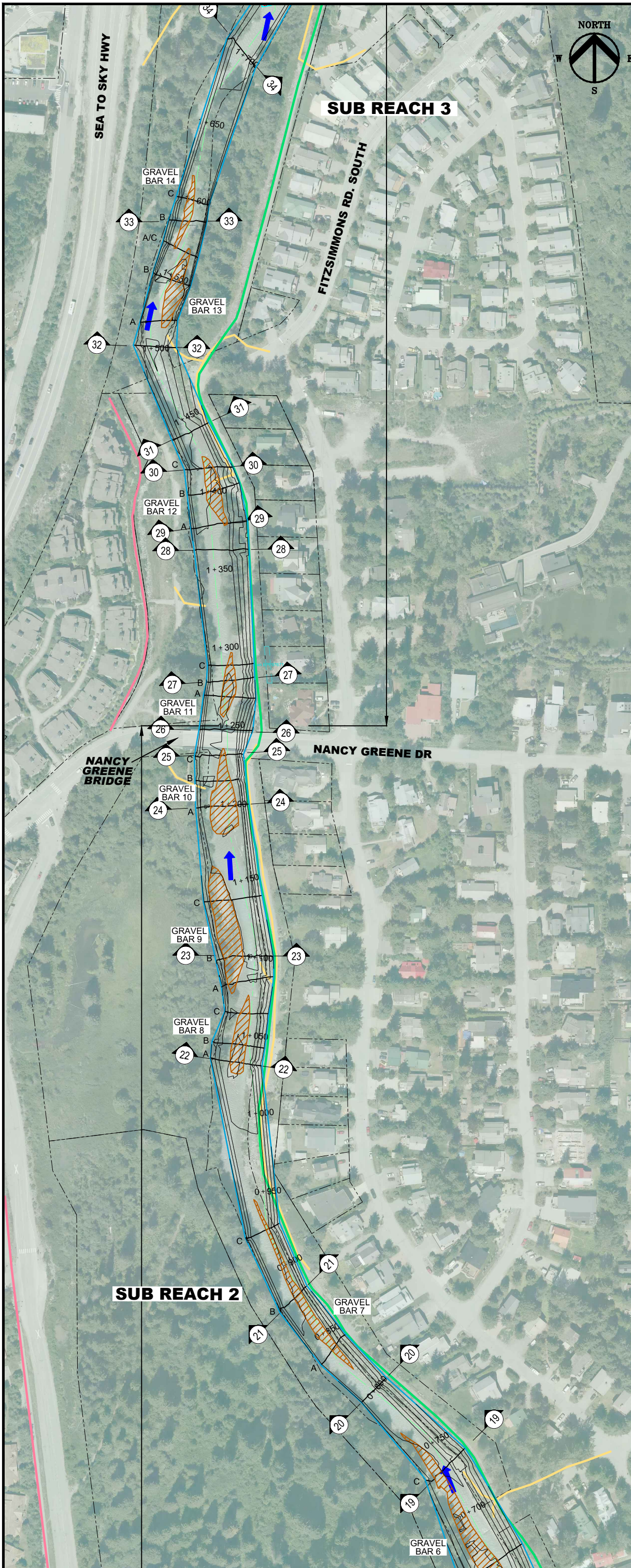
PROJECT LOCATION:  
FITZSIMMONS CREEK  
WHISTLER, BC



TITLE:  
**FITZSIMMONS CREEK FLOOD PROTECTION PLAN  
2022 GRAVEL REMOVAL**

|            |                     |                    |                   |         |
|------------|---------------------|--------------------|-------------------|---------|
| DRN BY: JG | SCALE: 1:2,500      | DATE: 2022-09-23   | DWG No:           | REV.: 0 |
| CHK'D: BR  | PLOT: 20220923.1502 | CADFILE: 689494-R0 | <b>689494 D-1</b> |         |





**LEGEND**

- CN ROW
- LOT LINE
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| 0    | 2022-09-23 | ISSUED TO CLIENT | JG | BR  |



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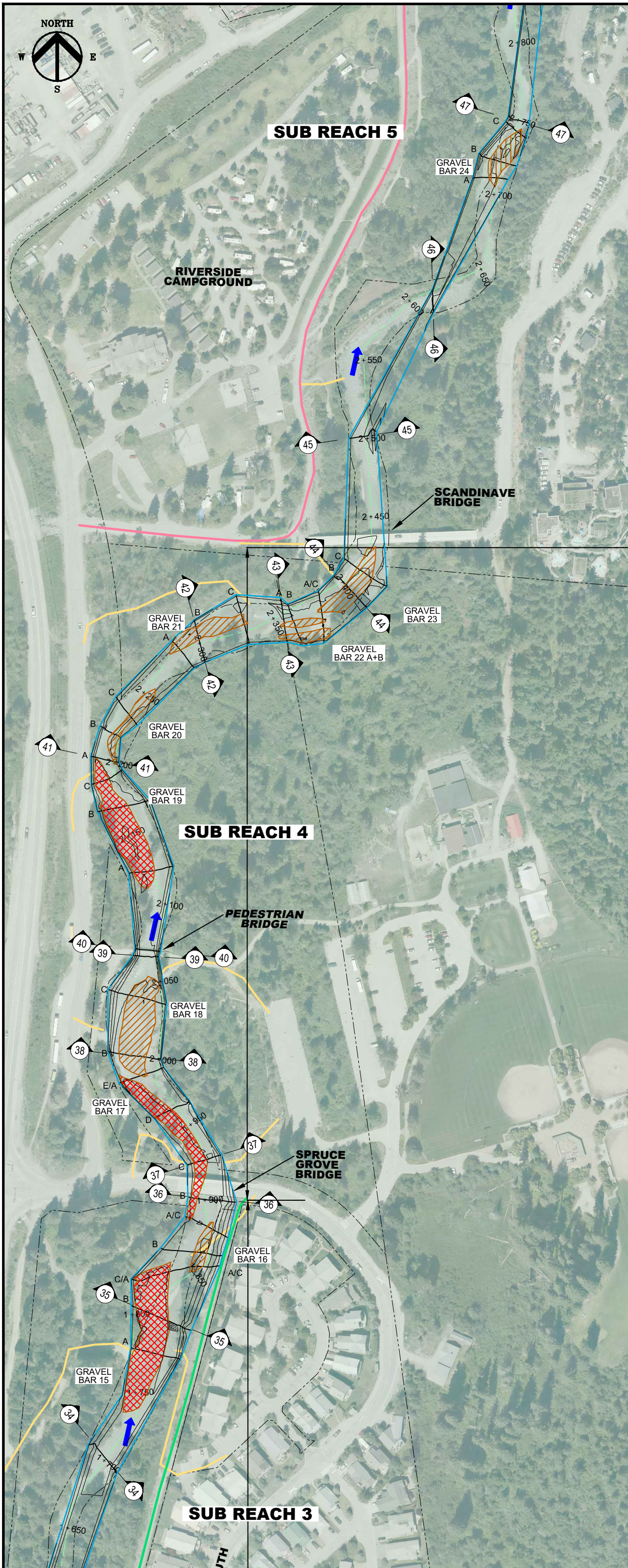
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|------------|---------------------|--------------------|-------------------|
| DRN BY: JG | SCALE: 1:2,500      | DATE: 2022-09-23   | DWG No: REV.: 0   |
| CHK'D: BR  | PLOT: 20220923.1504 | CADFILE: 689494-RO | <b>689494 D-2</b> |





**LEGEND**

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**REVISIONS**

| REV. | DATE       | DESCRIPTION      | BY | CHK |
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| 0    | 2022-09-23 | ISSUED TO CLIENT | JG | BR  |



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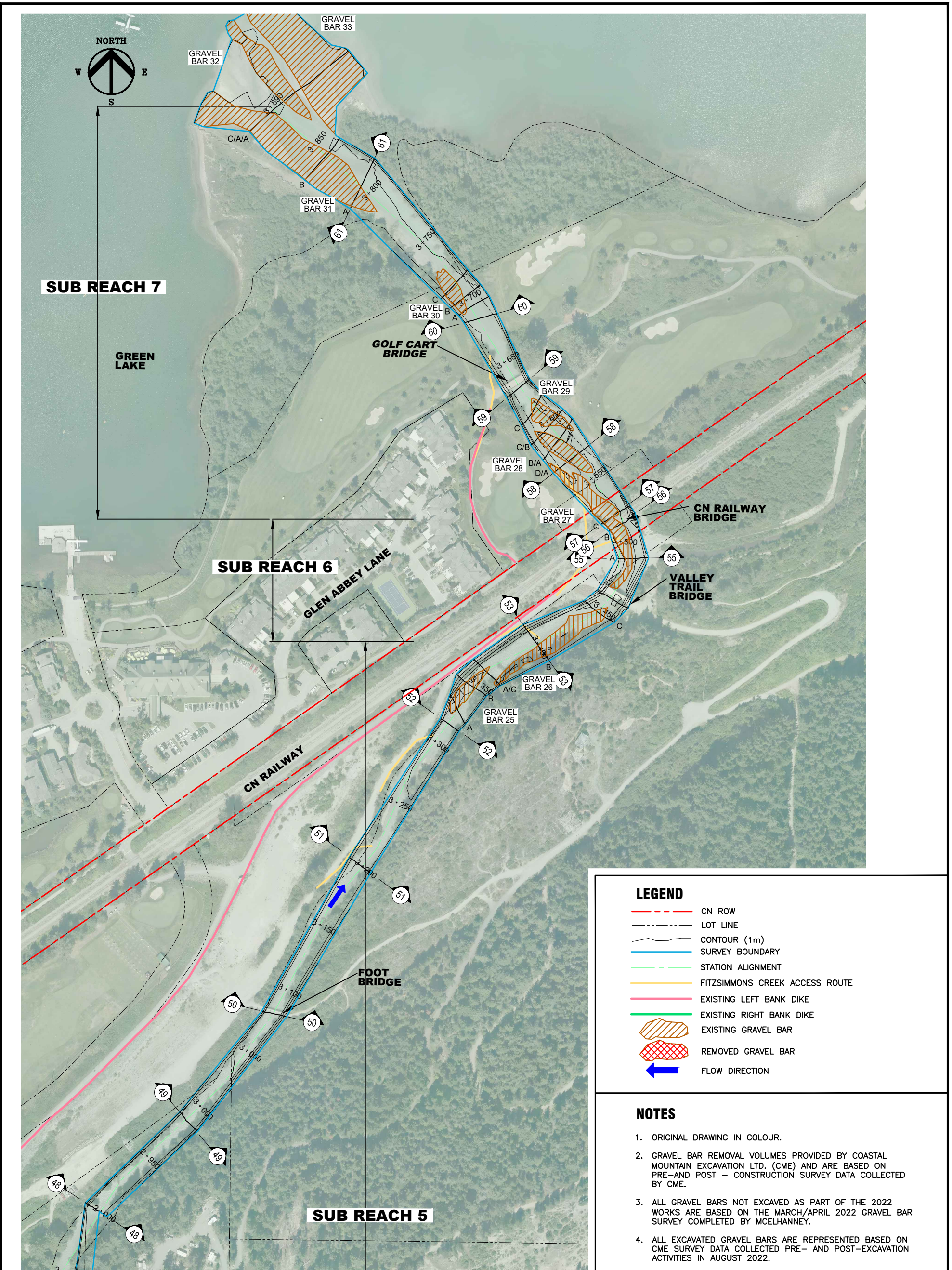
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WHISTLER, BC

TITLE:  
**FITZSIMMONS CREEK FLOOD PROTECTION PLAN  
2022 GRAVEL REMOVAL**



|            |                     |                    |                    |
|------------|---------------------|--------------------|--------------------|
| DRN BY: JG | SCALE: 1:2,500      | DATE: 2022-09-23   | DWG No: 689494 D-3 |
| CHK'D: BR  | PLOT: 20220923.1505 | CADFILE: 689494-RO | REV.: 0            |





**LEGEND**

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|--|------------------|---------------------------|
| CLIENT NAME:<br>RESORT MUNICIPALITY OF WHISTLER                                  |                  | <br><b>SNC • LAVALIN</b>  |
| PROJECT LOCATION:<br>FITZSIMMONS CREEK   |                  |                           |
| TITLE:<br><b>FITZSIMMONS CREEK FLOOD PROTECTION PLAN<br/>2022 GRAVEL REMOVAL</b> |                  |                           |
| DRN BY: JG   | SCALE: 1:2,500   | DATE: 2022-09-23          |
| REV. 0   | DATE: 2022-09-23 | DWG No: <b>689494 D-4</b> |
|  |                  |                           |





# Attachment 1

MFLNRO Approval Letter (File #A2006185)







## *Water Sustainability Act*

# **ORDER**

## **WATER SUSTAINABILITY ACT**

### **Section 26 (1)**

#### **Approval File Number: A2006185**

The British Columbia Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD) *Water Sustainability Act* having received an application for an amendment for Approval A2004899, and being satisfied that no person's rights will be injuriously affected, I hereby amend the following Clauses (b, h, u, ee) and add the following Clauses (ff, gg) to read as follows:

(b) The changes to be made in and about the stream are:

1. From August 14, 2015 December 31, 2019:  
To remove approximately 10,400 cubic meters of gravel from the stream bed of Fitzsimmons Creek from Blackcomb Way Bridge (Sub-Reach 1) to the Golf Cart Bridge near Green Lake (Sub-Reach 7) and to install several deflector structures (LTDJ5) and a debris catcher (LTDJ6DC); and
2. From June 2020 to December 31, 2024:  
To remove up to 10,000 cubic metres of gravel from the stream bed of Fitzsimmons Creek from Blackcomb Way Bridge (Sub-Reach 0) to the confluence with Green Lake (Sub-Reach 7).

All on land covered by water being part of the bed of Fitzsimmons Creek in the vicinity of District Lots 3859, 1757, 3860, 4753, 7922, Group 1, New Westminster District, including land held under Crown Land Licence of Occupation File 2410716.

(h) The work(s) authorized in this Approval shall be completed on or before December 31, 2024. This reflects a five-year extension to the original approval term which expired December 31, 2019. The holder of this Approval must notify the Regional Water Manager immediately if there are significant changes to the proposed works from the annual Hydraulic Report submitted to FLNRORD for the gravel removal. Significant changes may need to be authorized by FLNRORD prior to construction. The holder of

this Approval shall advise the Water Information Technician (WaterActReferralsLowerMainland@gov.bc.ca) when the changes have been completed.

- (u) The holder of this Approval shall comply with the following documents and any mutually agreed revisions hereafter.
1. “Fitzsimmons Creek Flood Protection Method Statement”, dated April 2014, prepared by Tetra Tech EBA Inc.
  2. “Fitzsimmons Creek Survey and Monitoring Method Statement”, dated February 24, 2016 prepared by Kerr Wood Leidal Associates Ltd.
  3. “Environmental Management Plan Fitzsimmons Creek Channel Maintenance Program Version 3.1”, dated July 10, 2017, prepared by Cascade Environmental Resource Group Ltd.
- (ee) The holder of this Approval must provide a brief post-construction report, within 60 days of completion of the works, for each year that gravel is removed.
- That report shall include a signed statement from the Environmental Monitor summarizing: the in-stream works undertaken, the timing of those works, the total in-stream area directly affected, quantity of gravel removed from each bar, fish salvage results, photos of the bars and work activities, frequency monitoring; whether or not they observed or were otherwise aware of any non-compliance with the terms and conditions of this Approval; and a description of any environmental incidents, non-compliance or other difficulties, and how these were addressed and reported.
- The report shall be sent to: WaterActReferralsLowerMainland@gov.bc.ca labelled with the file number of this approval.
- (ff) The holder of this approval shall submit a “Flood Protection Maintenance of Fitzsimmons Creek Hydraulic Model Report” no later than May 30 of each subsequent year, to the Water Manager for review prior to the commencement of annual construction.
- (gg) In order to address the permanent, long-term instream impacts associated with the project, the holder of this Approval must retain one or more appropriately qualified professionals to develop a separate offsetting plan that includes a minimum of the following:
1. The creation of instream habitat that is like for like or like for better habitat, in terms of structure, functionality (e.g. flow regime), and target species.
  2. A habitat balance that includes a rationale for any discrepancies between the aquatic habitat compensation area recommended in the Fitzsimmons Creek Biomonitoring 2011-2013 report prepared by InStream Fisheries Research Inc. and the newly proposed habitat compensation area.
  3. A five-year effectiveness monitoring plan for the compensation works whereby year 1 of the monitoring shall begin after the construction of offset measures are complete.
  4. A commitment to implement and report on the habitat effectiveness monitoring plan by December 1 of each year, for five consecutive years. The reports shall be sent to: [WaterActReferralsLowerMainland@gov.bc.ca](mailto:WaterActReferralsLowerMainland@gov.bc.ca) labelled with the file number of this approval. The annual reports shall include a minimum of the following:

- i. Documentation and summary of the survival of planted trees and shrubs. Plant survival rates must exceed 80% and replanting may be required to achieve this success rate.
  - ii. Observation and documentation related to flows and function of the new channel and its features.
  - iii. Fish presence, species composition, and if fish stranding is occurring within the newly constructed channel.
  - iv. Recommendations for additional channel complexing or modifications if required to address fish stranding.
  - v. Monitoring, maintenance and implementation of the above recommendations, when recommended by the appropriately qualified professional.
5. Submit the above requirements, per bullets (gg)(1-4), in a new request to construct and authorize the compensation works, either by Amendment to this Approval, a new Change Approval, and/or a Water Licence, whichever is most applicable to the offsetting proposal. This application must be submitted to Front Counter BC and the tracking number provided to [WaterActReferrals.LowerMainland@gov.bc.ca](mailto:WaterActReferrals.LowerMainland@gov.bc.ca) no later than December 31, 2020, unless otherwise specified in writing by the Water Manager. If a new application is submitted, this approval number shall be cross referenced in your application submission.

Dated at Surrey, BC this 4th day of June 2020.

A handwritten signature in black ink, appearing to read 'Malissa Smith', with a large, stylized circular flourish at the end.

Malissa Smith, R.P. Bio., P.Ag.  
Assistant Water Manager



June 4, 2020

Approval File: A2006185

Attention: Andrew Tucker  
Resort Municipality of Whistler (RMOW)  
c/o Kerr Wood Leidal Associates  
4325 Blackcomb Way  
Whistler BC VON 1B4

Sent by email to: [ATucker@whistler.ca](mailto:ATucker@whistler.ca)

Dear Andrew Tucker,

**Re: Order for Change Approval A2006185**

---

For reasons set out in the enclosed order, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Surface Water Authorizations, has deemed it appropriate to amend the Approval under Section 26(1) of the *Water Sustainability Act*.

This new documentation shall be attached to your copy of Approval A2006185.

All other conditions of the original Approval dated August 14, 2015 still apply.

This amendment continues the requirement for annual reporting submissions to our office, which we understand will also be reviewed as part of the Fitzsimmon's Creek Technical Committee. The 2015 Annual submission will be used as the template for the submissions from 2020 to 2024, such that reports include a minimum of the following:

1. Hydraulic Modelling Results.
2. Planned gravel bars for extraction and photos of the gravel bars.
3. Pre and Post Surveyed results for the quantity of gravel along with the total expected to remove.
4. Plan view of each gravel bar for total area and cross section for depth to show indicated gravel quantity.
5. Maps for the location of the gravel bars for extraction along with the cross-section markers and access points

Please note this Order requires additional compensation works to offset the long-term impacts associated with the project. The plan for compensation works must be submitted no later than December 31, 2020, unless otherwise specified in writing by the Water Manager, by way of an additional amendment application or a new change approval (whichever is your preference) and may also require a water licence for long-term conservation purposes, depending on the location and design of the compensation channel proposed.

The reason we have required additional compensation works is as follows:

---

Ministry of Forests, Lands, Natural  
Resource Operations and Rural  
Development

Surface Water Authorizations  
South Coast Natural Resource Region  
Website: [www.gov.bc.ca/water](http://www.gov.bc.ca/water)

200 - 10428 153 Street,  
Surrey BC V3R 1E1  
Phone: (604) 586-4400  
Fax: (604) 586-4444

As part of past gravel removals, DFO required mitigation to offset the harmful destruction of fish and fish habitat. A 350m long off-channel conversation project in Spruce Grove was constructed as mitigation as a result of the 2010 gravel removals and was required in the DFO 2010 HADD authorization (#10-HPAC-PA2-00140). The off-channel was designed to support spawning and rearing of Bull Trout and Rainbow Trout and was constructed in 2011.

A 3-year biomonitoring program was requested by DFO to evaluate the long and short-term effects on fish, fish habitat and benthic invertebrates of the gravel removal activities and determine if further habitat compensation was required. Instream Fisheries Research Ltd. conducted the program. The program also evaluated the mitigation channel at Spruce Grove to determine if the channel was deemed sufficient compensation for gravel removal effects and for the construction of the debris barrier. Instream Research conducted the study and stated that further compensation is required beyond what the RMOW has already constructed for the Spruce Grove compensation channel. Instream recommended construction of at least 4000 to 4500 m<sup>2</sup> of total functional fish habitat. This is the amount of habitat that is currently requested be offset at like-for-like or better ratio, with a specific request for an appropriately qualified professional to consider the existing habitat quality and area (size) in the offset proposal.

You are advised that any additional requests to amend this Approval will be subject to further consultation with First Nations. Amendment requests must be submitted to Front Counter BC with a copy to [WaterActReferrals.LowerMainland@gov.bc.ca](mailto:WaterActReferrals.LowerMainland@gov.bc.ca).

A right of appeal from my decision lies to the Environmental Appeal Board. Notice of any appeal must (1) be in writing, (2) include grounds for the appeal, (3) be directed by registered mail or personally delivered to the Chair, Environmental Appeal Board, 4th Floor, 747 Fort Street, Victoria BC V8W 9V1, (4) be delivered within 30 days from the date notice of the decision is given, and (5) be accompanied by a fee of \$ 25.00, payable to the Minister of Finance and Corporate Relations.

If you have any questions or concerns, please contact the Water Information Technician at 604-586-4400 or [WaterActReferrals.LowerMainland@gov.bc.ca](mailto:WaterActReferrals.LowerMainland@gov.bc.ca).

Yours truly,



Malissa Smith, R.P. Bio., P.Ag.  
Assistant Water Manager

pc: Mike Currie, [Michael.Currie@gov.bc.ca](mailto:Michael.Currie@gov.bc.ca)  
Lawrence Francois, [LFrancois@kwl.ca](mailto:LFrancois@kwl.ca)  
Lil'wat First Nation  
Squamish Nation

# Attachment 2

MFLNRO Royalty Letter (File #2410716)





September 28, 2021

File Number: 2410716

Resort Municipality of Whistler, Attn: Andrew Tucker  
4325 Blackcomb Way  
Whistler, Canada V8E 0X5  
BY EMAIL: [atucker@whistler.ca](mailto:atucker@whistler.ca)

Dear Andrew Tucker,

This letter is in follow-up to email correspondence in September 2019 regarding the Fitzsimmons Creek Gravel Removal Program taking place under Land File No. 2410716.

As confirmed in my September 4, 2019 email communication, I have reviewed the land file and land use policy and have confirmed that:

- The gravel removal works are for the purposes of public safety and flood mitigation.
- The gravel removal works are conducted by the local government (via contract).

Therefore, this material qualifies for Royalty Fee exemption and no royalty payments shall be required moving forward.

This letter provides notice – under section 3.3 of your licence – that the Royalty Fee effective September 4, 2019, is \$0.

As per section 3.2 of your licence, you shall continue to provide a Production Report for each Licence Period. I suggest you attach this letter to your Production Report submissions.

If you have any questions on the above, please contact me at [Danielle.Cunningham@gov.bc.ca](mailto:Danielle.Cunningham@gov.bc.ca).

Sincerely,

A handwritten signature in black ink, appearing to read "Danielle Cunningham".

Danielle Cunningham

# Attachment 3

SNC-Lavalin Field Reports

June 21, 2022

August 17, 2022







## FIELD REPORT

|                        |   |                      |                      |             |     |
|------------------------|---|----------------------|----------------------|-------------|-----|
| <b>Client:</b>         | Resort Municipality of Whistler   |                      |                      |             |     |
| <b>Project:</b>        | 2022 Fitzsimmons Creek Flood Protection and Maintenance Program - Gravel Removal Plan |                      |                      |             |     |
| <b>Location:</b>       | Whistler, BC along Fitzsimmons Creek  |                      |                      |             |     |
| <b>Purpose:</b>        | Site Walk – Gravel Bar and Access Review  |                      |                      |             |     |
| <b>SNC-Lavalin ID:</b> | 689494  | <b>Time Onsite:</b>  | 2:00 PM              |             |     |
| <b>Date:</b>           | June 21, 2022   | <b>Time Offsite:</b> | 4:15 PM              |             |     |
| <b>Weather:</b>        | Showers, 13°C   |                      | <b>Mobilization:</b> | 4 hrs       |     |
| <b>Mobilize from:</b>  | Vancouver   | <b>Mobilize to:</b>  | Whistler             | <b>KMs:</b> | 270 |

**Notes:**

- Met with Chesley and Tim (RMOW) and Vicki and Candace (Cascade Environmental) for Site walk meeting at Parking Lot 5
- Intention was to walk around and review each gravel bar planned for removal to assess current conditions, gravel bar access, and fish salvage
- Site walk around began at Gravel Bar #3 near the Lorimer Road Bridge and progressed downstream
- Gravel Bar #3; Doesn't extend as far as shown in drawings (the bar ends at the bridge crossing), access would be via the side channel on right bank
- Gravel Bar #4; Highly consolidated and mostly rock, will be difficult to remove and has poor access
- Gravel Bar #5; Historically accessed from left bank, but bar is closer to the right bank
- Gravel Bar #6; Mid-bar with poor access, historically accessed from right bank
- Gravel Bar #9; Vegetated bar with no access; wetland west of bar prevents mobilization near bar
- Gravel Bar #10; Historically this bar was accessible via bar #11 but at the time of the Site walk the bars were not connected making access difficult
- Gravel Bars # 15, #16, #17, #18, #19; Access to all these bars is confirmed to be good
  - #15 large bar with easy access from right bank
  - #16 small bar with easy access from left bank
  - #17 easy access from left bank, extends upstream of bridge
  - #18 accessible from both banks depending on channel depth, right bank likely more suitable
  - #19 easy access from left bank
- Gravel Bar #21; There is a deep pool on bank side of the bar which could make fish salvage difficult. Access is close from left bank, but might not be worth removing given relative size
- Gravel Bar #23; Mid-bar is closer to right bank; access would normally be from left bank but it appears too far away



- Walked upstream to gravel bar #26; access could be possible from right bank and it is a relatively small bar
- Gravel bar #27; gravel bar is possible to access but will require CN approval to cross tracks. Freeboard at the bridge is very low, but bridge is outside of the district's jurisdiction



**Photo 1:** Gravel Bar #3 facing downstream. Estimated gravel extraction volume = 255 m<sup>3</sup>.



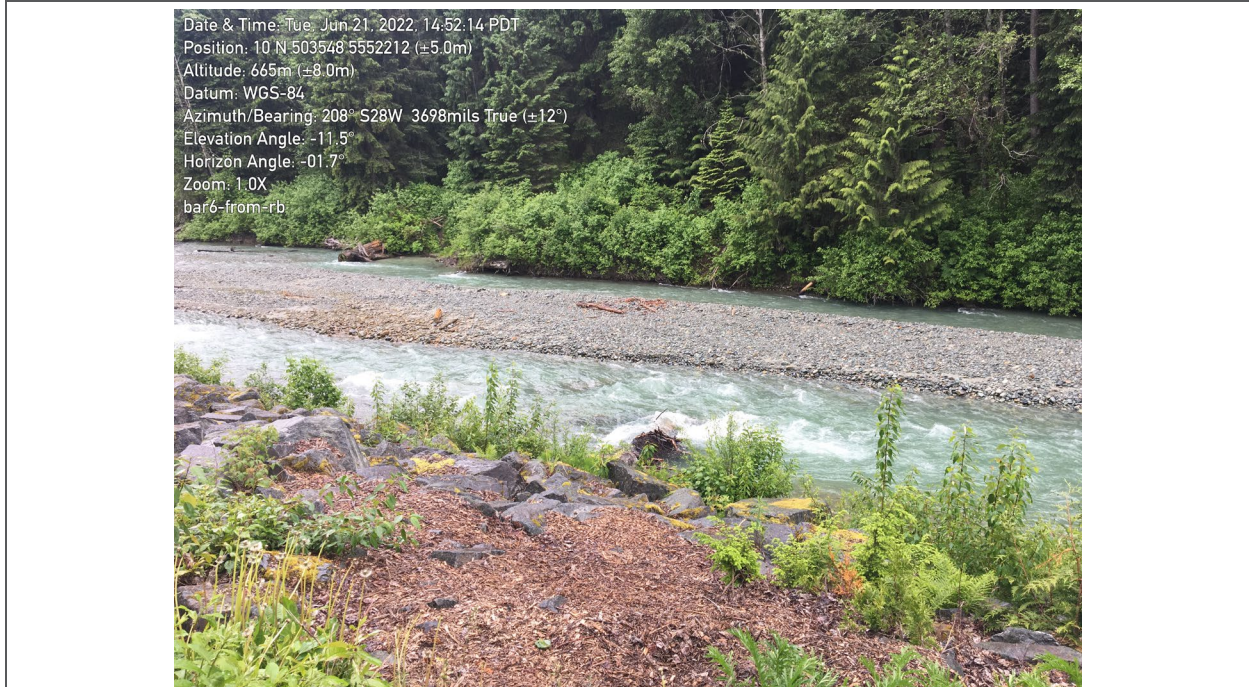


**Photo 2:** Gravel Bar #4 compacted. Estimated gravel extraction volume = 337 m<sup>3</sup>.



**Photo 3:** Gravel Bar #5 from left bank. Estimated gravel extraction volume = 1,644 m<sup>3</sup>.





**Photo 4:** Gravel Bar #6 from right bank. Estimated gravel extraction volume = 1,066 m<sup>3</sup>.



**Photo 5:** Gravel Bar #9 prior to excavation. Estimated gravel extraction volume = 1,402 m<sup>3</sup>.





**Photo 6:** Gravel Bar #10 from upstream. Estimated gravel extraction volume = 764 m<sup>3</sup>.



**Photo 7:** Gravel Bar #15 from right bank. Estimated gravel extraction volume = 2,669 m<sup>3</sup>.



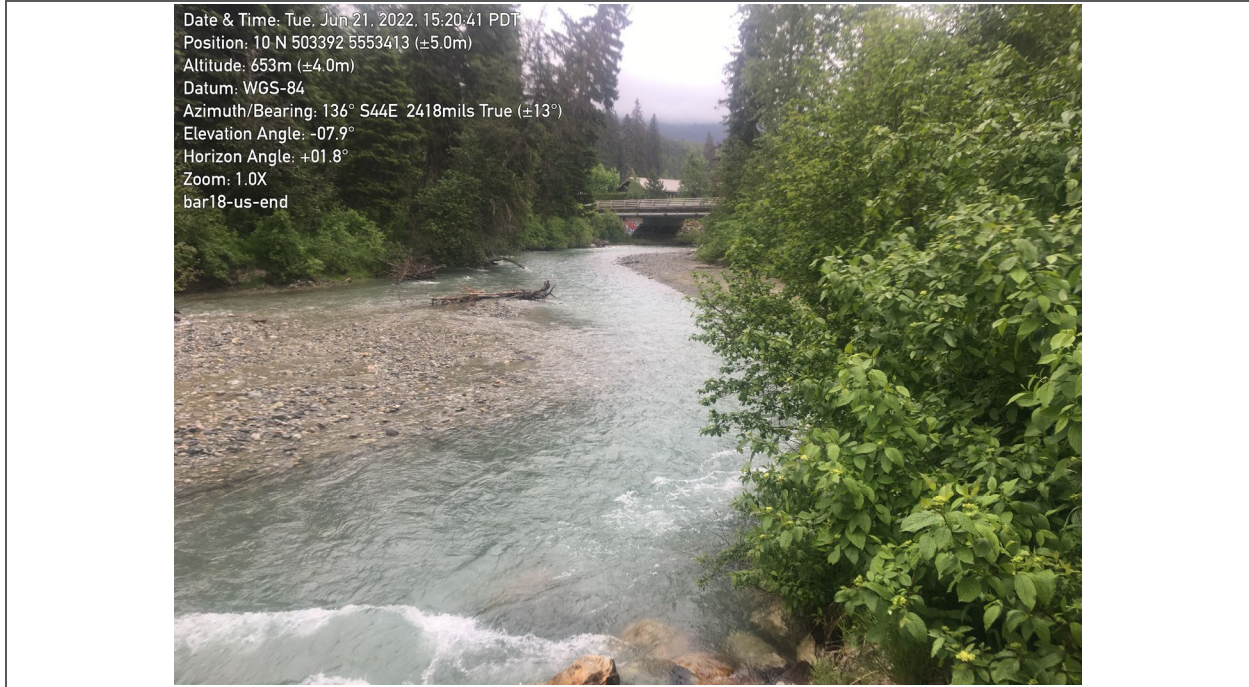


**Photo 8:** Gravel Bar #16 from bar #15. Estimated gravel extraction volume = 95 m<sup>3</sup>.



**Photo 9:** Gravel Bar #17 from left bank. Estimated gravel extraction volume = 731 m<sup>3</sup>.





**Photo 10:** Gravel Bar #18 upstream end. Estimated gravel extraction volume = 1,516 m<sup>3</sup>.



**Photo 11:** Gravel Bar #19 facing downstream. Estimated gravel extraction volume = 1,644 m<sup>3</sup>.





**Photo 12:** Gravel Bar #21 from left bank. Estimated gravel extraction volume = 316 m<sup>3</sup>.



**Photo 13:** Gravel Bar #23 from upstream. Estimated gravel extraction volume = 444 m<sup>3</sup>.





**Photo 14:** Gravel Bar #26 facing downstream. Estimated gravel extraction volume = 519 m<sup>3</sup>.



**Photo 15:** Gravel Bar #27 downstream side of CN railway bridge. Estimated gravel extraction volume = 442 m<sup>3</sup>.



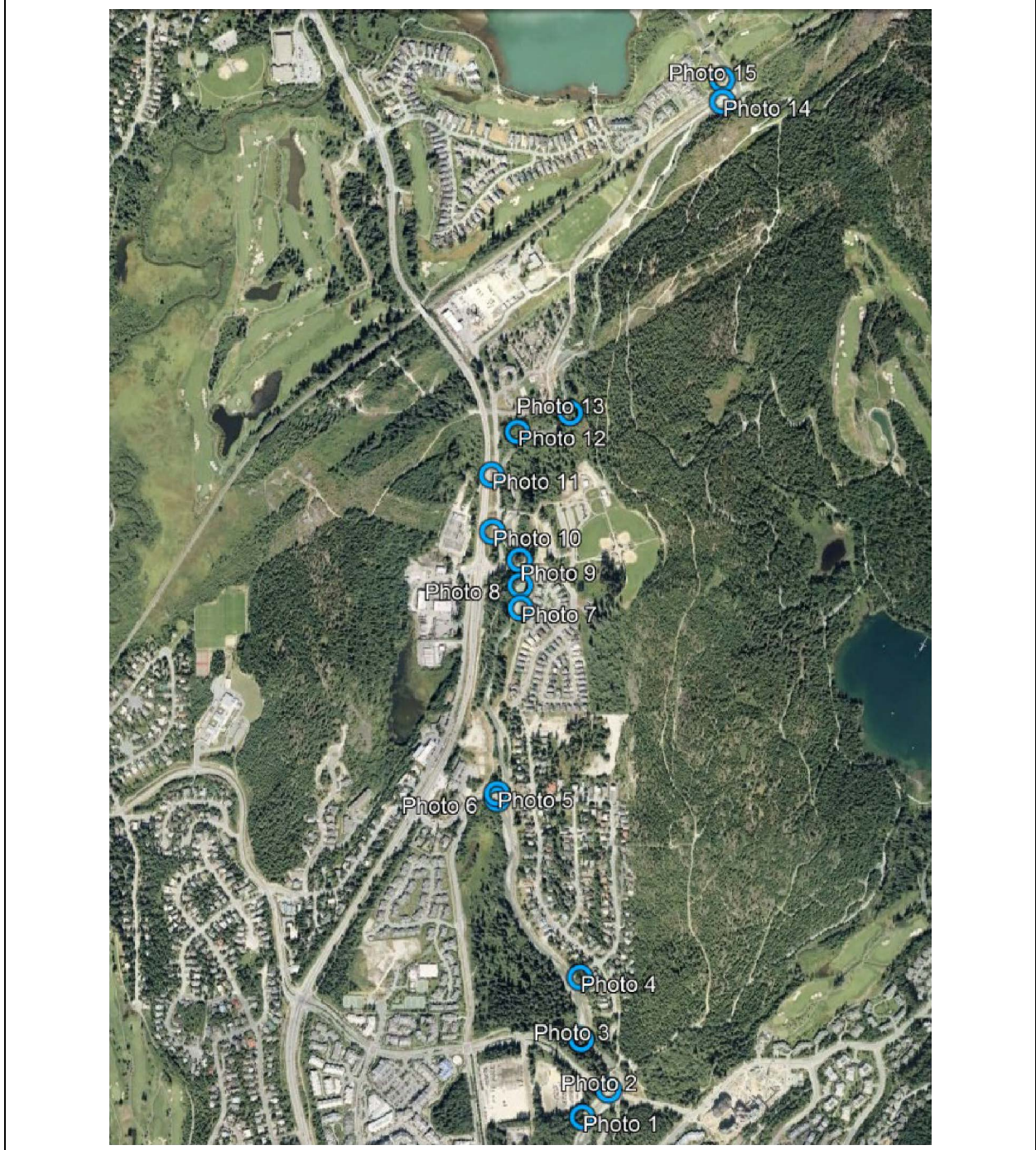


Photo Locations



**SNC • LAVALIN**

# FIELD REPORT

Project 689494 | June 21, 2022



**Allanah Bonnici, MSc**  
Water Resources Professional  
*Environment Practice*  
**Engineering Services Canada**



**Andrew Clow, MSc, EIT**  
Hydrotechnical EIT  
*Environment Practice*  
**Engineering Services Canada**

\\SLI43951\PROJECTS\CURRENT PROJECTS\RESORT MUNICIPALITY OF WHISTLER\689494-FITZSIMMONS CREEK GRAVEL REMOVAL\40\_EXECUTION\47\_WRKG\_VERSI\COMPLETION REPORT\APPENDICES\3\_20220628\_689494\_FIELDREPORT.DOCX



## FIELD REPORT

|                        |   |                      |          |             |     |
|------------------------|---|----------------------|----------|-------------|-----|
| <b>Client:</b>         | Resort Municipality of Whistler   |                      |          |             |     |
| <b>Project:</b>        | 2022 Fitzsimmons Creek Flood Protection and Maintenance Program - Gravel Removal Plan |                      |          |             |     |
| <b>Location:</b>       | Whistler, BC along Fitzsimmons Creek  |                      |          |             |     |
| <b>Purpose:</b>        | Gravel Removal Kick-off Meeting   |                      |          |             |     |
| <b>SNC-Lavalin ID:</b> | 689494  | <b>Time Onsite:</b>  | 12:00PM  |             |     |
| <b>Date:</b>           | August 17, 2022   | <b>Time Offsite:</b> | 14:00PM  |             |     |
| <b>Weather:</b>        | Sunny, 32°C   | <b>Mobilization:</b> | 5 hrs    |             |     |
| <b>Mobilize from:</b>  | Vancouver   | <b>Mobilize to:</b>  | Whistler | <b>KMs:</b> | 270 |

**Notes:**

- Met with Amir in North Vancouver at 10AM and carpooled to Whistler together.
- Met with Tim and Rob of CME onsite near Gravel Bar #19.
- Met with Nicki and Vicki from Cascade Environmental Monitoring.
- Gravel Bar #19 had fish net present for fish salvage. Fish caught in traps as well as with electric fishing.
- CME actively building ramp for truck ease-of-access to excavate Gravel Bar #19.
- Gravel Bar #15 excavation complete; CME estimated volumes to be provided in final survey deliverable; rocks in gravel bar #15 bigger than previous years.
- Gravel Bar #15 berms still intact with no creek flow through excavation area.
- Gravel Bar #21 planned to be excavated on Monday and Tuesday 22<sup>nd</sup> and 23<sup>rd</sup> August, 2022.
- Flows and water level are currently high.
- Construction estimated to be finished by Tuesday August 23<sup>rd</sup>, 2022.
- Visited Gravel Bars #18, #17, #10, and #11.
- **Special Note:** After the site visit Cascade Environmental requested to extract Gravel Bar #17 instead of Gravel Bar #21 due to high flows and the difficulty of maintaining fish isolation in these conditions. The project engineer approved extraction of Gravel Bar #17 instead of #21. At time of writing we are waiting for confirmation of this change by RMOW.





**Photo 1:** Gravel Bar #15 excavation complete – facing downstream. Berms still intact with no creek flow through excavation area.



**Photo 2:** Gravel Bar #19 preparing for excavation. Fish net present for fish salvage.





**Photo 3:** Gravel Bar #19 preparing for excavation. Building a ramp for truck ease of access during excavation.



**Photo 4:** Gravel Bar #18 in foreground and Gravel Bar #17 in background. Looking upstream





Photo 5: Downstream left bank portion of Gravel Bar #21 - planning excavation.



Photo 6: Upstream left bank portion of Gravel Bar #21 - planning excavation.



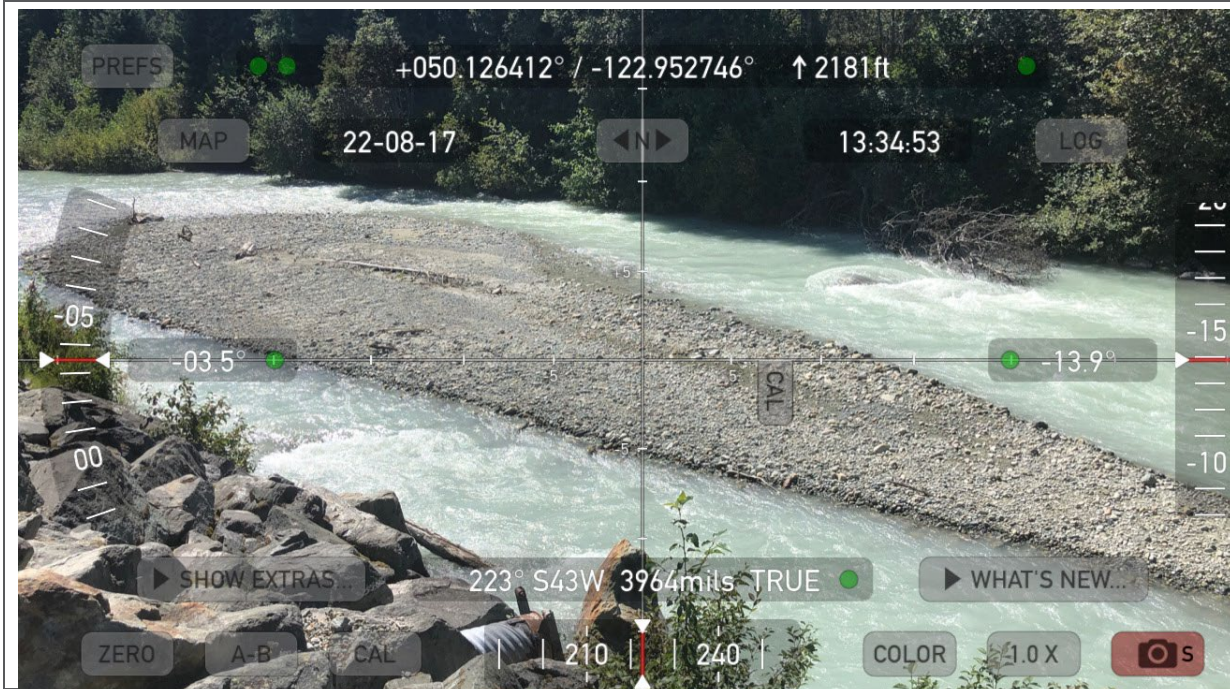


Photo 7: Gravel Bar #10 – looking upstream.



Photo 8: Gravel Bar #11 – looking downstream.



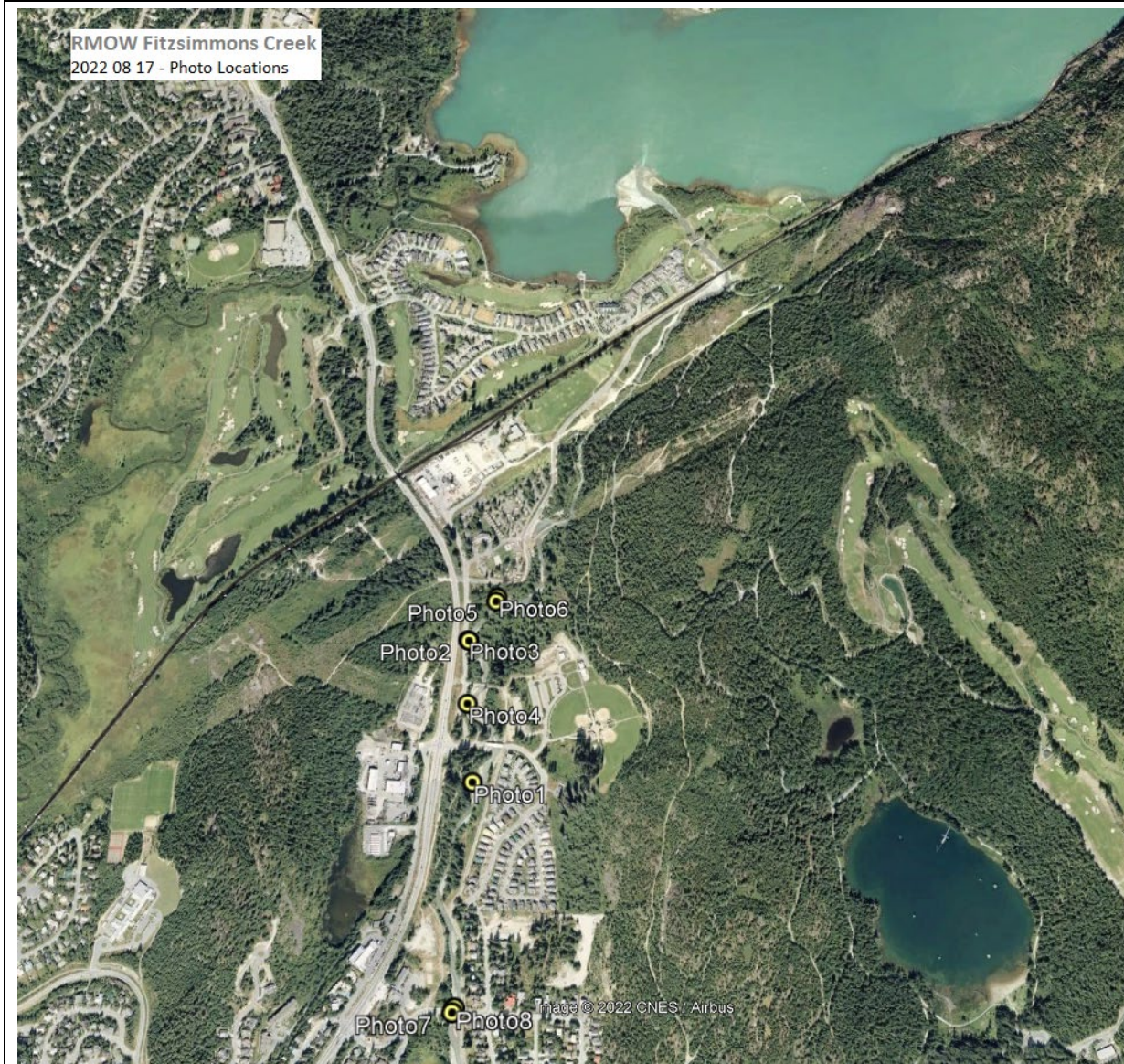


Photo Locations

*Allanah*

Allanah Bonnici, M.Sc, B.Sc

Water Resources Professional

Environment

Engineering Services Canada

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# Attachment 4

Cascade Environmental Monitoring Report

November 1, 2022







**CASCADE ENVIRONMENTAL**  
RESOURCE GROUP LTD

# Environmental Monitoring Report

---

## 2022 Fitzsimmons Creek Sediment Removal Program



**Prepared by:**

Cascade Environmental Resource Group Ltd.  
Unit 3 – 1005 Alpha Lake Road  
Whistler, BC  
V8E 0H5

**Prepared for:**

Resort Municipality of Whistler  
4325 Blackcomb Way  
Whistler, BC  
V8E 0X5

**Project No.:** 013-09-24

**Date:** November 1, 2022

[WWW.CERG.CA](http://WWW.CERG.CA)

WHISTLER: UNIT 3 - 1005 ALPHA LAKE ROAD WHISTLER BC CANADA V8E 0H5  
SQUAMISH: UNIT 205 - 39480 QUEENS WAY SQUAMISH BC CANADA V8B 0Z5

TEL 604.938.1949  
TEL 604.815.0901



## Executive Summary

Sediment was removed from Fitzsimmons Creek between August 15 and August 22, 2022, as part of an ongoing flood protection maintenance program administered by the Resort Municipality of Whistler (RMOW), which acts as the local Diking Authority for the municipality. Ten sediment bars were targeted for removal in 2022, extending from upstream of the Spruce Grove Bridge to upstream of the Nancy Greene bridge. Due to budget and accessibility constraints, sediment was extracted from three of the proposed bars: Bars 15, 17, and 19.

Environmental impacts to Fitzsimmons Creek were minimized by implementing mitigative strategies throughout the works as detailed in the *Environmental Management Plan Fitzsimmons Creek Channel Maintenance Program, Version 3.2* (Cascade, 2021). This included maintaining isolation of the work areas from flowing water, using Environ hydraulic fluid in the excavation machines and ensuring that all equipment was leak free and free of excess oil and dirt, and employing experienced machine operators that are familiar with and efficient at working in and around water.

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## 1 Introduction

Sediment removal in Fitzsimmons Creek was undertaken over 6 days between August 15 and August 22, 2022, as part of an ongoing flood protection maintenance program administered by the Resort Municipality of Whistler (RMOW), which acts as the local Diking Authority for the municipality. The 2022 sediment management program was developed with guidance from the Fitzsimmons Creek Technical Committee (FCTC), which is comprised of members of the RMOW, BC Ministry of Forests (MOF), and Fisheries and Oceans Canada (DFO). The RMOW has undertaken sediment removal in Fitzsimmons Creek on a roughly biennial basis since 1992 to maintain channel conveyance and target freeboard elevations in the lower 4 km of river that passes through Whistler Village and enters Green Lake. Cascade Environmental Resource Group Ltd. (Cascade) has provided environmental consulting services to the RMOW for these works since its inception and was retained by the RMOW to conduct environmental monitoring of sediment removal activities during the 2022 removal program.

Sediment removal was undertaken based on a sub-reach assessment conducted by SNC-Lavalin Inc. (SNC) with input from the FCTC (SNC, 2022). SNC used a hydraulic model of the 1:200-year flood to complete a free-board analysis and identify critical flood risk locations. The study reach was divided into eight sub-reaches from the most upstream at Blackcomb Way Bridge (Sub-reach 0) to the most downstream confluence with Green Lake (Sub-reach 7) (SNC, 2022). A minimum freeboard of 0.6 m in Sub-reaches 0-3 and 0.5 m in Sub-reaches 4-7 was applied to the model. The gravel removal plan was developed based on the following criteria:

- Improve freeboard along the channel and prioritize gravel bar extraction where there is insufficient freeboard.
- Minimise environmental impact by prioritizing gravel bars near banks as opposed to mid-channel.
- Minimise extraction cost through maximizing volume extracted at a particular gravel bar.
- Prioritize existing access to gravel bars.

Sediment was extracted from three of the third priority gravel bars, within sub-reach 3 and sub-reach 4, from the 2022 Fitzsimmons Creek Flood Protection and Maintenance Program – Gravel Removal Plan (SNC, 2022). Works finished after one week of the projected two week work period due to budget constraints and logistical consideration. Of the targeted bars, Bars 15, 17, and 19 were most accessible and therefore caused the least disturbance to the surrounding environment. As a stakeholder, CN Rail was provided with the 2022 Hydraulic Modelling Report. The sediment removal plan was implemented based on the routine maintenance dredging Interim Code of Practice of the federal *Fisheries Act*, the *FLNRORD Water Sustainability Act* Section 11 Approval A2006185 and the Environmental Management Plan Fitzsimmons Creek Channel Maintenance Program, Version 3.2 (Cascade, 2021). Copies of regulatory approvals and notifications are included in Appendix C.

Gravel extraction works took place during the Lower Mainland instream works window of August 1 – 31 for rainbow trout and bull trout, the species commonly found in Fitzsimmons Creek. Gravel extraction works commenced on August 15, 2022, and all wet crossings, fish salvages and site isolation works were completed by August 22, 2022. Gravel removal works were completed by Coastal Mountain Excavations Ltd. (CME), monitored by Cascade, and directed by SNC.

Works were monitored full time by Cascade personnel and fisheries technicians from the Lil'wat Nation Lands and Resources department under the direction of Vicki Legris, B.Sc., R.P.Bio., P.Biol., E.P., Qualified Environmental Professional (QEP). Fish salvages were carried out by Cascade personnel and Lil'wat fisheries technicians in compliance with Fish Collection Permit SU22-733083. Cascade personnel involved in the works included:

- Vicki Legris, B.Sc., E.P., R. P. Bio.
- Macaila Wagner, B.Sc., B.I.T.
- Tessa Craig, B.Sc., B.I.T.

## 2 Environmental Impact Mitigation Strategies

Mitigative strategies were developed by Cascade and implemented by the RMOW and its contractors to minimize the ecological impact of the sediment removal program on Fitzsimmons Creek. Table 1 summarizes the FLNRORD *Water Sustainability Act* Section 11 Approval and DFO Interim Code of Practice and steps undertaken by the RMOW and Cascade to ensure compliance with regulatory mitigation strategies. The FLNRORD Approval was initially issued in 2015 for a five-year period ending December 31, 2019. The Approval was extended for another five-year period from June 2020 to December 21, 2024 (Appendix C). Further mitigation strategies are detailed in the Environmental Management Plan: Fitzsimmons Creek Channel Maintenance Program, Version 3.2 (Cascade, 2021). In addition, a pre-construction meeting was held between Cascade, CME, SNC and the RMOW on August 9, 2022, with further on-site meetings and communications taking place daily throughout the sediment extraction works.

**Table 1: Mitigative strategies for the 2022 Fitzsimmons Creek sediment removal program.**

| DFO Code of Practice and FLNRORD Approval Conditions   | Environmental Mitigation Employed  |
|--|--|
| Reasonable care shall be taken to avoid damaging any land, works, trees or other property.   | No vegetation removal was required for access as each bar was accessed from existing access points. No trees, land or property were damaged during works.  |
| Works shall be completed on or before September 15, 2022.  | Gravel removal works were completed on August 22, 2022.  |
| Plan in water works, undertakings or activities to respect timing windows to protect fish including their eggs, juveniles, spawning adults and/or the organisms upon which they feed and migrate<br><br>Limit the duration of in-water work, undertaking and activity so that it does not diminish the ability of fish to carry out one or more of their life processes (e.g. spawning, rearing, feeding, migrating) | Instream works commenced August 15 and were completed by August 22, 2022. All works took place in the reduced-risk instream work window.   |
| All work shall be undertaken during favourable weather and low flow levels.<br><br>Schedule work to avoid wet, windy and rainy periods (and heed weather advisories)   | Flows in Fitzsimmons Creek during works were at low summer flow levels (Environment Canada, 2022). Works occurred during favourable weather and flows in Fitzsimmons Creek remained low throughout the work period. Work sites were isolated with the use of gravel berms following fish salvages of any wetted areas within the gravel extraction area. |
| Upon commencement of the project, work shall be pursued to completion as quickly as possible.  | Works were completed within a short time frame to minimize temporal impacts to the creek.  |
| Salvage, reinstate or match habitat structure (e.g., large wood debris, boulders, instream aquatic vegetation/substrate) to its initial state<br><br>Restore stream geomorphology (i.e., restore the bed and banks, gradient and contour of the waterbody) to its initial state<br><br>Replace/restore any other disturbed habitat features and remediate any areas impacted by the work, undertaking or activity    | Habitat features and structures such as large woody debris were salvaged and reinstated following the completion of instream works.  |





| DFO Code of Practice and FLNRORD Approval Conditions   | Environmental Mitigation Employed   |
|--|---|
| <p>Equipment and machinery operated in and about the stream must be in good operating condition, free of leaks, excess oil, and grease.</p> <p>All hydraulic machinery entering the stream channel must use environmentally sensitive hydraulic fluids that are non-toxic to aquatic life and that are readily or inherently biodegradable.</p>  | <p>Excavators were power washed and maintained prior to mobilization to the stream.</p> <p>Excavators used ENVIRON hydraulic fluid.</p> <p>Refuelling took place as far away from the creek as was physically possible.</p> <p>Dump trucks were inspected regularly for excess oil and grease and leaks.</p>  |
| <p>All proposed work shall be completed in isolation of the stream flows.</p>  | <p>Prior to gravel extraction works all wetted areas were isolated from fish passage with wire mesh, and a fish salvage of all isolated areas was conducted.</p> <p>Following the fish salvage, gravel berms were used to isolate sites from creek flows. Although site preparation at times required accessing and isolating the sites in flowing water, all sediment removal activities were carried out inside the isolation berms.</p>  |
| <p>Care shall be exercised during all phases of the work to prevent the release of silt, sediment, sediment-laden water, or any deleterious substances.</p> <p>Control measures to prevent the release of silt, sediment or sediment-laden water must be in place before starting works that may result in sediment mobilization.</p> <p>Inspect and regularly maintain erosion and sediment control measures and structures during all phases of the project.</p> <p>Monitor the watercourse to observe signs of sedimentation during all phases of the work, undertaking or activity and take corrective action.</p>   | <p>Communications with excavators emphasized the need to work in isolation and reduce the number of stream crossings.</p> <p>Berms were built to isolate the excavation work (see photos).</p> <p>Excavator operators isolated work areas as quickly as possible and started excavation only when isolated from the creek.</p> <p>The EM monitored turbidity regularly during all works.</p> <p>Access / egress routes were chosen to minimize riparian zone disturbance.</p> <p>Excavators used ENVIRON hydraulic fluid (non-toxic, biodegradable, recyclable).</p> <p>All dump trucks were inspected regularly by the EM to ensure they were leak free and free of excess oil and grease.</p> |
| <p>Limit impacts on riparian vegetation to those approved for the work, undertaking or activity.</p> <ul style="list-style-type: none"> <li>• Limit access to banks or areas adjacent to waterbodies</li> <li>• Prune or top the vegetation instead of grubbing/uprooting</li> <li>• Limit grubbing on watercourse banks to the area required for the footprint of work, undertaking or activity</li> <li>• Construct access points and approaches perpendicular to the watercourse or waterbody</li> <li>• Remove vegetation or species selectively and in phases</li> <li>• Re-vegetate the disturbed areas with native species suitable for the site</li> </ul> | <p>Each of the access ramps used for the 2022 gravel extraction works were not vegetated, therefore did not required revegetation.</p>  |
| <p>All excavated material and debris shall be removed from the site.</p>   | <p>Excavated material was directly placed into dump trucks and carried off site away from the high-water mark of the creek.</p>   |



| DFO Code of Practice and FLNRORD Approval Conditions  | Environmental Mitigation Employed   |
|---|---|
| <p>Project activities shall practice avoidance of wildlife trees, nests, roosting and rearing areas.</p> <p>Works shall be designed and installed so as not to restrict fish passage, and or lead to fish stranding, cause accidental harm, and/or entrain, and/or kill any fish or wildlife such as amphibians.</p>  | <p>All riparian trees and potential wildlife habitat areas were preserved.</p> <p>All sediment removal was conducted in a manner that protected aquatic life.</p>   |
| <p>Works will be conducted following practices outlined in:</p> <ul style="list-style-type: none"> <li>- Fitzsimmons Creek Flood Protection Method Statement (EBA, 2014)</li> <li>- Fitzsimmons Creek Survey and Monitoring Method Statement (KWL, 2016)</li> <li>- Environmental Management Plan Fitzsimmons Creek Channel Maintenance Program Version 3.1 (Cascade, 2017)</li> </ul>  | <p>All mitigation and best practices as outlined in the currently applicable documents were adhered to.</p>   |
| <p>Work shall be carried out in accordance with FLNRO "Standards and Best Practices for In-stream Works".</p>   | <p>Best practices as stated in the updated provincial Requirements and Best Management Practices were adhered to where possible.</p>  |
| <p>All fuel storage shall be carried out in compliance with the Ministry of Environment's Best Practices.</p>   | <p>A spill kit was readily accessible at all sites. No fuel was stored at the work sites. Machinery refueling was done at a minimum of 30 m from any water course or as far away from the creek as was possible.</p>  |
| <p>Approval holder shall retain a qualified Environmental Monitor to supervise all in-stream works.</p>   | <p>Cascade Environmental Resource Group Ltd. was retained by the RMOW to monitor works and was present during works on a full-time basis.</p>   |
| <p>Large woody debris and the stubs of large diameter trees must be left in place or retained on-site where it is safe to do so.</p>  | <p>Large woody debris and large diameter trees, if moved during excavation works were replaced in the creek following the completion of works.</p>  |
| <p>If dewatering or isolation of flow will be conducted, and the stream is known or suspected to contain fish and/or amphibians, the holder of this Approval will designate an appropriately qualified environmental professional to salvage any fish and amphibians present, prior to commencement of work in the stream channel. It is the responsibility of the holder of this Approval to obtain any permits needed prior to the salvage.</p> | <p>Fish salvages were conducted on all areas that were subjected to dewatering and isolation to prevent fish stranding and fish mortality.</p> <p>Prior to the commencement of works each bar was inspected for the presence of amphibians. If detected, the amphibians were salvaged and relocated outside of the works site. During excavation work the EM continued to monitor for the presence of amphibians.</p>                                   |
| <p>Sediment removal boundaries must be clearly delineated prior to commencement of work. All sediment excavation for removal purposes shall be completed in isolation of the stream flows.</p>  | <p>Sediment removal boundaries were delineated with pin flags prior to the commencement of works. All sediment excavation for removal purposes was conducted in isolation of the stream flows.</p>  |
| <p>The Environmental Monitor shall inspect the extraction area for fish stranding at least once during the fall and winter of each year, after water levels have declined.</p>  | <p>The Environmental Monitor (EM) inspected the extraction areas for fish stranding on November 1, 2022. The EM noted that unusually low autumn precipitation levels had resulted in the gravel bars being isolated from flowing water. The EM excavated outlets to all gravel bars using hand shovels on November 2, 2022 to restore connectivity of the gravel bar areas to flowing water. No stranded fish were observed in the extraction area.</p> |



### 3 Site Reports

Sediment was extracted from three of the proposed gravel bars. During the gravel extraction works period (August 15-22, 2022) the mean discharge in Fitzsimmons Creek was 5.99 m<sup>3</sup>/s, with a minimum and maximum discharge rate of 2.11 m<sup>3</sup>/s and 16.2 m<sup>3</sup>/s respectively. Discharge for Fitzsimmons Creek during the works period was lower than the average typically seen for the month of August of 6.33 m<sup>3</sup>/s, based on data collected by the Water Survey of Canada from 1993 to 2017 (Environment Canada, 2022).

Upstream and downstream turbidity measurements from the works areas were recorded during the gravel extraction works and compared against provincial approved water quality guidelines for aquatic species (BC MOECCS, 2021). Water turbidity measurements were recorded for all days of gravel extraction works and downstream levels remained within water quality guideline levels (within 8 NTU of background/upstream levels).

#### 3.1 Bar 15 (Sub-Reach 3)

##### 3.1.1 Plan

Bar 15 is located approximately 70 m upstream of the Spruce Grove Bridge (Spruce Grove Way) on river left in an area where the Valley Trail parallels Fitzsimmons Creek. Bar 15 had an expected gravel removal of 2,669 m<sup>3</sup> and a surveyed gravel removal of 2,586 m<sup>3</sup>. Access to Bar 15 was via a gravel road right-of-way that runs parallel to Hwy 99 for approximately 100 m and joins to access the Valley Trail. From the Valley Trail an existing cleared access leads directly to Bar 15.

##### 3.1.2 Fish Salvage

- On August 15, 2022, the side channel at Bar 15 was isolated with upstream and downstream fences.
- Following isolation, a fish salvage was carried out using minnow trapping and electrofishing methods. Details of these methods and the results of the fish salvage are found in Table 3 in Appendix A.
- A total of 3 fish were salvaged including: 1 bull trout (*Salvelinus confluentus*) and 2 prickly sculpin (*Cottus asper*).

##### 3.1.3 Implementation

- Once the fish salvage was complete, a ramp was constructed from the water's edge where an existing cleared access leads from the Valley Trail to Fitzsimmons Creek at Bar 15. The excavator built the ramp on river left with gravel from the creek.
- Gravel removal works on Bar 15 was carried out over a three-day period between August 15 and 17, 2022 (Photo 1 to Photo 4).

##### 3.1.4 Turbidity Measurements

- The work area was isolated from flowing water during the work period.
- Turbidity measurements were recorded throughout gravel extraction works and results are presented in Table 6 in Appendix B.





### 3.1.5 Photo Documentation



**Photo 1: Bar 15 side channel. August 12, 2022.**



**Photo 2: Constructing a ramp for Bar 15 access from Valley Trail. August 15, 2022.**



**Photo 3: Excavation of gravel on Bar 15. August 16, 2022.**



**Photo 4: View of gravel Bar 15 following the excavation. August 17, 2022.**



## **3.2 Bar 17 (Sub-Reach 4)**

### **3.2.1 Plan**

Access to Bar 17 is located approximately 100 m downstream of the Spruce Grove Bridge (Spruce Grove Way), opposite the Spruce Grove Park to the east (river right). This access route is adjacent to the Valley Trail and Mons Road to the west (river left). Bar 17 had an expected gravel bar removal of 731 m<sup>3</sup> and a surveyed gravel removal of 476 m<sup>3</sup>.

### **3.2.2 Fish Salvage**

- Bar 17 contained two stagnant pools on river left that were isolated from flowing water (Photo 5). On August 22, 2022, a fish salvage was carried out using electrofishing methods. The pools were too shallow to carry out any minnow trapping. Details of electrofishing methods are found in Table 4 in Appendix A.
- No fish were salvaged from Bar 17.

### **3.2.3 Implementation**

- Bar 17 was accessed from an existing un-vegetated access ramp from top of bank on river left downstream of the Spruce Grove Bridge, upstream of the pedestrian bridge and east of Mons Road (Photo 6).
- Following the fish salvage, a berm was constructed to isolate the bar from stream flows prior to gravel extraction works (Photo 7 and Photo 8).

### **3.2.4 Turbidity Measurements**

- During onsite works, the gravel bar was isolated from the mainstream flow of the creek.
- Upstream and downstream turbidity measurements from the works area were recorded during the gravel extraction works.
- Turbidity results are displayed in Table 7 in Appendix B.





### 3.2.5 Photo Documentation



**Photo 5:** View of one of the small, stagnant pools on river left of Bar 17. August 9, 2022.



**Photo 6:** View of the downstream end of Bar 17 and access ramp, looking north. August 18, 2022.



**Photo 7:** Excavation of Bar 17. August 22, 2022.



**Photo 8:** Looking north at the access ramp and constructed berm of Bar 17. August 22, 2022.



### **3.3 Bar 19 (Sub-Reach 4)**

#### **3.3.1 Plan**

Bar 19 runs parallel to the Valley Trail and Mons Road. This access route is an unvegetated access ramp adjacent to the Valley Trail and east of Mons Road (river left). Expected gravel removal from Bar 18 was 1,644 m<sup>3</sup>; surveyed gravel removal totaled 1,408 m<sup>3</sup> from this bar.

#### **3.3.2 Fish Salvage**

- Fish exclusion fencing was installed at the upstream and downstream ends of the side channel on Bar 19 (Photo 9).
- A fish salvage was carried out on August 16, 2022 using minnow trapping and electrofishing methods. Details of electrofishing methods and the results of the fish salvage are found in Table 5 in Appendix A.
- Following the fish salvage on August 16, 2022, the excavator operator made a wet crossing of the side channel (within the fish exclusion fencing) and a berm was constructed to isolate the bar from stream flows.
- A total of 46 fish were salvaged including: 2 bull trout, 13 rainbow trout (*Oncorhynchus mykiss*), 3 threespine stickleback (*Gasterosteus aculeatus*) and 28 prickly sculpin.

#### **3.3.3 Implementation**

- Bar 19 was accessed from an existing un-vegetated access ramp from top of bank on river right east of Mons Road (Photo 9 and Photo 10). Site works were conducted over a three-day period from August 17 to 19, 2022 (Photo 10 to Photo 12).
- The Cascade Environmental Monitor noted a hydrocarbon leak from the excavator after works were complete at 15:40 on August 18, 2022. The contractor advised the EM that the excavator operator had over-filled the fuel tank and an estimated 125 ml of diesel fuel leaked to ground beneath the machine. The machine was cleaned and all contaminated soil excavated by hand and removed off-site for disposal by GFL Environmental Inc. prior to initiating works the following day (August 19, 2022). No hydrocarbons entered Fitzsimmons Creek as a result of the spill.

#### **3.3.4 Turbidity Measures**

- During onsite works, the gravel bar was isolated from the mainstream flow of the creek.
- Water turbidity measurements were taken upstream and downstream of the worksite regularly during works.
- Water turbidity results are displayed in Table 8 in Appendix B.





### 3.3.5 Photo Documentation



**Photo 9: Installation of fish exclusion fencing at Bar 18. August 16, 2022.**



**Photo 10: Excavator operator preparing the Bar 18 access ramp. August 17, 2022.**



**Photo 11: Gravel extraction from Bar 18. August 17, 2022.**



**Photo 12: Gravel extraction from Bar 18. August 18, 2022.**

## 4 Summary

The 2022 Fitzsimmons Creek channel maintenance program took place from August 15 to August 22, 2022. The approval conditions by DFO and FLNRORD were complied with throughout, and the works adhered to the protocols outlined in the EMP v3.2 (Cascade, 2021). Works finished after six days of the projected ten day work period due to budget constraints and logistical considerations. Of the proposed extracted volume of 8,601m<sup>3</sup>, only 4,470 m<sup>3</sup> was removed. Expected gravel removal from Bars 15, 17 and 19, was 5,044 m<sup>3</sup>; and the surveyed gravel removed for the project totalled 4,470 m<sup>3</sup>.

Fish salvaged during the 2022 channel maintenance program totalled 49 fish; 3 bull trout, 13 rainbow trout, 3 threespine stickleback, and 30 prickly sculpin. A breakdown of fish species by location is included in Table 2. Detailed information on capture efforts, species captured, and fish lengths is included in Appendix A.

Turbidity increases in Fitzsimmons Creek were minimized in duration and intensity to the maximum extent possible for the works, and sediment extraction was conducted in isolation of stream flows. Background turbidity levels in Fitzsimmons Creek fluctuated during works, however downstream turbidity measurements complied with the BC guidelines, with the exception of brief isolated incidences on August 17, 18 and 19. In each of these instances, turbidity spikes were short in duration, and subsequent measurements demonstrated compliance with the guidelines.

All gravel bars were approached from existing non-vegetated access points to bars being utilized. No impacts to riparian vegetation were incurred during works. A spill of approximately 125 ml of diesel fuel to ground occurred outside of the creek area on August 18, 2022. The spill was mitigated, and all contaminated material disposed of appropriately.

During a routine inspection of the extraction areas for fish stranding on November 1, 2022, the Environmental Monitor (EM) noted that unusually low autumn rainfall and low creek flow levels had resulted in the gravel bars being isolated from flowing water. The EM excavated outlets to all gravel bars using hand shovels on November 2, 2022 to restore connectivity of the gravel bar areas to flowing water. No stranded fish were observed within the excavation areas.

**Table 2: Fish species captured during salvage efforts associated with the Fitzsimmons Creek 2022 flood maintenance program.**

| Bar          | Bull trout | Rainbow trout | Sculpin | Threespine stickleback | Total          |
|--------------|------------|---------------|---------|------------------------|----------------|
| 15           | 1          | 0             | 2       | 0                      | 3              |
| 17           | 0          | 0             | 0       | 0                      | No fish caught |
| 19           | 2          | 13            | 28      | 3                      | 46             |
| <b>Total</b> | 3          | 13            | 30      | 3                      | 49             |





## References

- BC Ministry of Environment & Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Website accessed November 1, 2022. [https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg\\_summary\\_aquaticlife\\_wildlife\\_agri.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf).
- Cascade. 2021. Environmental Management Plan: Version 3.2 Fitzsimmons Creek channel maintenance program. Prepared for: Resort Municipality of Whistler.
- Cascade. 2017b. Fish Habitat Feasibility Study, Diversion Channel Habitat Enhancement. Prepared for: Resort Municipality of Whistler.
- Environment Canada. Real-Time Hydrometric Data for FITZSIMMONS CREEK BELOW BLACKCOMB CREEK (08MG026) [BC]. Website: [https://wateroffice.ec.gc.ca/report/real\\_time\\_e.html?stn=08MG026](https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=08MG026). Accessed October 12, 2022.
- Fisheries and Oceans Canada. 2015. Fisheries Act Subsection 35(2)(b) Implementation of Mitigation Measures to Avoid and Mitigate Serious Harm to Fish. Authorization # 15-HPAC-00349.
- FLNRORD, 2015, 2020. Application for approval to make changes in and about Fitzsimmons Creek, Approval A2005951.
- Government of Canada, 2019. *Fisheries Act*. R.S.C., 1985, c. F-14.
- InStream Fisheries Research Inc. 2015. Fitzsimmons Creek Biomonitoring, 2011-2013. Prepared for: Resort Municipality of Whistler.
- Province of British Columbia, 2014. *Water Sustainability Act* [SBC 2014] CHAPTER 15
- SNC-Lavalin. 2022. 2022 Fitzsimmons Creek Flood Protection and Maintenance Program – Gravel Removal Plan. Prepared for Resort Municipality of Whistler.

## Appendices

### Appendix A: Fish Salvage Reports

Table 3: Fish Salvage Results for Bar 15

| Daily Fish Collection  |   |   |                             |   |                                    |   |         |
|--|---|---|-----------------------------|---|------------------------------------|---|---------|
| Date:  | 15-Aug-22                               |   | Project Number:             | 013-09-24   |                                    |   |         |
| Time:  | 06:45                                   |   | Field Crew:                 | VL, MCW, TC   |                                    |   |         |
| Location:  | Whistler                                |   | Weather:                    |   |                                    |   |         |
| Waterbody Name:  | Fitzsimmons Creek                       |   | Waterbody Type:             | Creek   |                                    |   |         |
| Location on Waterbody:   | Bar 15                                  |   | UTM Coordinates:            |   |                                    |   |         |
| MOE license number:  | SU22-733083                             |   | DFO license number:         |   |                                    |   |         |
| Water Quality Data   |   |   |                             |   |                                    |   |         |
| Turbidity (NTU):   | 20.5                                    |   | Visibility:                 | <input type="checkbox"/> Clear<br><input checked="" type="checkbox"/> Moderately Turbid<br><input type="checkbox"/> Lightly Turbid<br><input type="checkbox"/> Turbid |                                    |   |         |
| Water Temperature (°C):  | 8.7                                     |   | Conductivity (µS/cm):       | 66.7  |                                    |   |         |
| pH:  | 8.06                                    |   | D.O. (mg/L):                |   |                                    |   |         |
| Fish Collection Data   |   |   |                             |   |                                    |   |         |
| Method(s) Used:  | <input checked="" type="checkbox"/> EF  | <input checked="" type="checkbox"/> MT  | <input type="checkbox"/> NS | Project Type:   | <input type="checkbox"/> Inventory | <input checked="" type="checkbox"/> Salvage |         |
| Minnow trapping  |   |   |                             |   |                                    |   |         |
| Number of traps: 7   | Trap #                                  | Species                                 | Length (mm)                 | Stage   | Total Caught                       |   |         |
| Time set:  | 1                                       | BT                                      | 120                         | Juvenile  | 1                                  |   |         |
| Time retrieved: 07:00  | 2                                       | No fish caught                          |                             |   | 0                                  |   |         |
| Traps set at:<br><input type="checkbox"/> Surface<br><input type="checkbox"/> Midwater<br><input checked="" type="checkbox"/> Bottom | 3                                       | No fish caught                          |                             |   | 0                                  |   |         |
|  | 4                                       | No fish caught                          |                             |   | 0                                  |   |         |
|  | 5                                       | No fish caught                          |                             |   | 0                                  |   |         |
|  | 6                                       | No fish caught                          |                             |   | 0                                  |   |         |
|  | 7                                       | No fish caught                          |                             |   |                                    | 0   |         |
| Electrofishing (EF)  |   |   |                             |   |                                    |   |         |
| Block Nets:  | <input checked="" type="checkbox"/> U/S | <input checked="" type="checkbox"/> D/S | Start Time:                 | 07:30   | End Time:                          | 08:01                                       |         |
|  | <input type="checkbox"/> Partial        | <input type="checkbox"/> None           | Area Length (m):            |   | Area Width (m):                    |   |         |
| Pass #   | Voltage                                 |   | Frequency                   |   | Duty Cycle (%)                     |   | Seconds |
| 1  | 270                                     |   | 30                          |   | 12                                 |   | 235     |
| 2  | 270                                     |   | 30                          |   | 12                                 |   | 202     |
| 3  | 270                                     |   | 30                          |   | 12                                 |   | 44      |
| Pass #1  |   |   |                             |   |                                    |   |         |





| Species                                      | Length (mm)            | Stage    |           |          |           |          |           | Total Caught |
|--|------------------------|----------|-----------|----------|-----------|----------|-----------|--------------|
| SC   | 50                     |          |           |          |           |          |           | 2            |
| <b>Pass #2</b>                               |                        |          |           |          |           |          |           |              |
| Species                                      | Length (mm)            | Stage    |           |          |           |          |           | Total Caught |
| No fish caught                               |                        |          |           |          |           |          |           | 0            |
| <b>Pass #3</b>                               |                        |          |           |          |           |          |           |              |
| Species                                      | Length (mm)            | Stage    |           |          |           |          |           | Total Caught |
| No fish caught                               |                        |          |           |          |           |          |           | 0            |
| <b>Total number of fish collected:</b>       | <b>Minnow trapping</b> | 1        | <b>BT</b> | 1        | <b>RB</b> | 0        | <b>SC</b> | 0            |
|  | <b>Pass #1</b>         | 2        | <b>BT</b> | 0        | <b>RB</b> | 0        | <b>SC</b> | 2            |
|  | <b>Pass #2</b>         | 0        | <b>BT</b> | 0        | <b>RB</b> | 0        | <b>SC</b> | 0            |
|  | <b>Pass #3</b>         | 0        | <b>BT</b> | 0        | <b>RB</b> | 0        | <b>SC</b> | 0            |
|  | <b>Total</b>           | <b>3</b> |           | <b>1</b> |           | <b>0</b> |           | <b>2</b>     |
| <b>Comments (additional species caught):</b> |                        |          |           |          |           |          |           |              |

**Table 4: Fish Salvage Results for Bar 17**

| Daily Fish Collection                 |   |   |                             |                       |  |   |   |   |  |
|---------------------------------------|---|---|-----------------------------|-----------------------|--|---|---|---|--|
| Date:                                 | 22-Aug-22                               |   |                             | Project Number:       | 013-09-24  |   |   |   |  |
| Time:                                 | 07:40                                   |   |                             | Field Crew:           | VL   |   |   |   |  |
| Location:                             | Whistler                                |   |                             | Weather:              | Clear  |   |   |   |  |
| Waterbody Name:                       | Fitzsimmons Creek                       |   |                             | Waterbody Type:       | Creek  |   |   |   |  |
| Location on Waterbody:                | Bar 17                                  |   |                             | UTM Coordinates:      |  |   |   |   |  |
| MOE license number:                   | SU22-733083                             |   |                             | DFO license number:   |  |   |   |   |  |
| Water Quality Data                    |   |   |                             |                       |  |   |   |   |  |
| Turbidity (NTU):                      | 56.1                                    |   |                             | Visibility:           | <input type="checkbox"/> Clear<br><input type="checkbox"/> Moderately Turbid |   | <input type="checkbox"/> Lightly Turbid<br><input checked="" type="checkbox"/> Turbid |   |  |
| Water Temperature (°C):               | 6.52                                    |   |                             | Conductivity (µS/cm): | 50.1   |   |   |   |  |
| pH:                                   | 7.85                                    |   |                             | D.O. (mg/L):          |  |   |   |   |  |
| Fish Collection Data                  |   |   |                             |                       |  |   |   |   |  |
| Method(s) Used:                       | <input checked="" type="checkbox"/> EF  | <input type="checkbox"/> MT             | <input type="checkbox"/> NS | Project Type:         | <input type="checkbox"/> Inventory   | <input checked="" type="checkbox"/> Salvage |   |   |  |
| Electrofishing (EF)                   |   |   |                             |                       |  |   |   |   |  |
| Block Nets:                           | <input checked="" type="checkbox"/> U/S | <input checked="" type="checkbox"/> D/S | Start Time:                 | 07:50                 | End Time:  | 07:52                                       |   |   |  |
|                                       | <input type="checkbox"/> Partial        | <input type="checkbox"/> None           | Area Length (m):            |                       | Area Width (m):  |   |   |   |  |
| Pass #                                | Voltage                                 |   | Frequency                   | Duty Cycle (%)        | Seconds  |   |   |   |  |
| 1                                     | 315                                     |   | 30                          | 12                    | 76   |   |   |   |  |
| Pass #1                               |   |   |                             |                       |  |   |   |   |  |
| Species                               | Length (mm)                             |   | Stage                       |                       |  | Total Caught                                |   |   |  |
| No fish caught                        |   |   |                             |                       |  | 0   |   |   |  |
| Total number of fish collected:       | Pass #1                                 | 0                                       | BT                          | 0                     | RB   | 0   | SC  | 0 |  |
|                                       | Total                                   | 0                                       |                             | 0                     |  | 0   |   | 0 |  |
| Comments (additional species caught): |   |   |                             |                       |  |   |   |   |  |



**Table 5: Fish Salvage Results from Bar 19**

| Daily Fish Collection   |   |   |                              |   |                                    |  |                |  |
|---|---|---|------------------------------|---|------------------------------------|--|----------------|--|
| <b>Date:</b>  | 16-Aug-22                               |   | <b>Project Number:</b>       | 013-09-24   |                                    |  |                |  |
| <b>Time:</b>  | 08:20                                   |   | <b>Field Crew:</b>           | VL, MCW, TC   |                                    |  |                |  |
| <b>Location:</b>  | Whistler                                |   | <b>Weather:</b>              | Sunny   |                                    |  |                |  |
| <b>Waterbody Name:</b>  | Fitzsimmons Creek                       |   | <b>Waterbody Type:</b>       | Creek   |                                    |  |                |  |
| <b>Location on Waterbody:</b>   | Bar 19                                  |   | <b>UTM Coordinates:</b>      |   |                                    |  |                |  |
| <b>MOE license number:</b>  | SU22-733083                             |   | <b>DFO license number:</b>   |   |                                    |  |                |  |
| Water Quality Data  |   |   |                              |   |                                    |  |                |  |
| <b>Turbidity (NTU):</b>   |   |   | <b>Visibility:</b>           | <input type="checkbox"/> Clear<br><input checked="" type="checkbox"/> Moderately Turbid |                                    | <input type="checkbox"/> Lightly Turbid<br><input type="checkbox"/> Turbid |                |  |
| <b>Water Temperature (°C):</b>  | 8.7                                     |   | <b>Conductivity (µS/cm):</b> | 66.7  |                                    |  |                |  |
| <b>pH:</b>  | 8.06                                    |   | <b>D.O. (mg/L):</b>          |   |                                    |  |                |  |
| Fish Collection Data  |   |   |                              |   |                                    |  |                |  |
| <b>Method(s) Used:</b>  | <input checked="" type="checkbox"/> EF  | <input checked="" type="checkbox"/> MT  | <input type="checkbox"/> NS  | <b>Project Type:</b>  | <input type="checkbox"/> Inventory | <input checked="" type="checkbox"/> Salvage                                |                |  |
| Minnow trapping   |   |   |                              |   |                                    |  |                |  |
| <b>Number of traps: 9</b>   | <b>Trap #</b>                           | <b>Species</b>                          | <b>Length (mm)</b>           | <b>Weight (g)</b>   | <b>Stage</b>                       | <b>Total Caught</b>  |                |  |
| <b>Time set: 09:00</b>  | 1                                       | 0                                       |                              |   |                                    | 0  |                |  |
| <b>Time retrieved: 07:00</b>  | 2                                       | RB                                      | 95                           |   |                                    | 1  |                |  |
| <b>Soak time (hrs): 20</b>  |   |   |                              |   |                                    |  |                |  |
| <b>Traps set at:</b><br><input type="checkbox"/> Surface<br><input type="checkbox"/> Midwater<br><input checked="" type="checkbox"/> Bottom | 3                                       | 0                                       |                              |   |                                    |  |                |  |
|   | 4                                       | RB<br>RB                                | 110<br>85                    |   | Fry<br>Fry                         | 2  |                |  |
|   | 5                                       | 0                                       |                              |   |                                    | 0  |                |  |
|   | 6                                       | 0                                       |                              |   |                                    | 0  |                |  |
|   | 7                                       | 0                                       |                              |   |                                    | 0  |                |  |
|   | 8                                       | TSB                                     | 60                           |   |                                    | Fry  | 2              |  |
|   | 9                                       | SC                                      | 70                           |   |                                    | Fry  | 1              |  |
| Electrofishing (EF)   |   |   |                              |   |                                    |  |                |  |
| <b>Block Nets:</b>  | <input checked="" type="checkbox"/> U/S | <input checked="" type="checkbox"/> D/S | <b>Start Time:</b>           | 09:00   | <b>End Time:</b>                   | 10:0   |                |  |
|   | <input type="checkbox"/> Partial        | <input type="checkbox"/> None           | <b>Area Length (m):</b>      |   | <b>Area Width (m):</b>             |  |                |  |
| <b>Pass #</b>   | <b>Voltage</b>                          |   | <b>Frequency</b>             |   | <b>Duty Cycle (%)</b>              |  | <b>Seconds</b> |  |
| 1   | 445                                     |   | 30                           |   | 12                                 |  | 678            |  |
| 2   | 445                                     |   | 30                           |   | 12                                 |  | 636            |  |
| 3   | 445                                     |   | 30                           |   | 12                                 |  | 546            |  |



| 4       | 445         | 30       | 12 | 347          |
|---------|-------------|----------|----|--------------|
| 5       | 445         | 30       | 12 | 397          |
| Pass #1 |             |          |    |              |
| Species | Length (mm) | Stage    |    | Total Caught |
| RB      | 160         | Juvenile |    | 1            |
| RB      | 80          | Fry      |    | 1            |
| RB      | 90          | Fry      |    | 4            |
| RB      | 110         | Juvenile |    | 1            |
| SC      | 70          | Fry      |    | 2            |
| SC      | 86          | Juvenile |    | 1            |
| TSB     | 55          | Fry      |    | 1            |
| SC      | 60          | Fry      |    | 2            |
| SC      | 50          | Fry      |    | 6            |
| Pass #2 |             |          |    |              |
| Species | Length (mm) | Stage    |    | Total Caught |
| SC      | 85          | Juvenile |    | 1            |
| BT      | 110         | Juvenile |    | 1            |
| SC      | 90          | Fry      |    | 1            |
| SC      | 80          | Fry      |    | 1            |
| SC      | 30          | Fry      |    | 1            |
| SC      | 40          | Fry      |    | 1            |
| SC      | 60          | Fry      |    | 2            |
| RB      | 110         | Juvenile |    | 1            |
| SC      | 50          | Fry      |    | 1            |
| RB      | 70          | Fry      |    | 1            |
| Pass #3 |             |          |    |              |
| Species | Length (mm) | Stage    |    | Total Caught |
| SC      | 75          | Fry      |    | 1            |
| SC      | 60          | Fry      |    | 2            |
| SC      | 80          | Fry      |    | 1            |
| RB      | 110         | Juvenile |    | 1            |
| BT      | 60          | Fry      |    | 1            |
| Pass #4 |             |          |    |              |
| Species | Length (mm) | Stage    |    | Total Caught |
| SC      | 70          | Fry      |    | 2            |
| SC      | 80          | Fry      |    | 1            |





| Pass #5                               |                 |           |       |          |    |           |     |          |              |           |
|---------------------------------------|-----------------|-----------|-------|----------|----|-----------|-----|----------|--------------|-----------|
| Species                               | Length (mm)     |           | Stage |          |    |           |     |          | Total Caught |           |
| SC                                    | 55              |           | Fry   |          |    |           |     |          | 1            |           |
| Total number of fish collected:       | Minnow trapping | 6         | BT    |          | RB | 3         | TSB | 2        | SC           | 1         |
|                                       | Pass #1         | 19        | BT    | 0        | RB | 7         | TSB | 1        | SC           | 11        |
|                                       | Pass #2         | 11        | BT    | 1        | RB | 2         | TSB | 0        | SC           | 8         |
|                                       | Pass #3         | 6         | BT    | 1        | RB | 1         | TSB | 0        | SC           | 4         |
|                                       | Pass #4         | 3         | BT    | 0        | RB | 0         | TSB | 0        | SC           | 3         |
|                                       | Pass #5         | 1         | BT    | 0        | RB | 0         | TSB | 0        | SC           | 1         |
|                                       | <b>Total</b>    | <b>46</b> |       | <b>2</b> |    | <b>13</b> |     | <b>3</b> |              | <b>28</b> |
| Comments (additional species caught): |                 |           |       |          |    |           |     |          |              |           |



**Appendix B: Turbidity Measurements**

**Table 6: Turbidity levels of Fitzsimmons Creek at Bar 15**

| Date      | Time (hrs) | Activity       | Turbidity (NTU) |            |
|-----------|------------|----------------|-----------------|------------|
|           |            |                | Upstream        | Downstream |
| 15-Aug-22 | 08:33      | Prior to works |                 | 29.6       |
| 15-Aug-22 | 08:40      | Prior to works | 29.3            |            |
| 15-Aug-22 | 08:53      | During works   | 26.7            |            |
| 15-Aug-22 | 09:01      | During works   |                 | 27.8       |
| 15-Aug-22 | 09:33      | During works   | 32.3            |            |
| 15-Aug-22 | 09:40      | During works   |                 | 31.5       |
| 15-Aug-22 | 10:05      | During works   |                 | 30.6       |
| 15-Aug-22 | 10:13      | During works   | 31.3            |            |
| 15-Aug-22 | 10:41      | During works   |                 | 30.3       |
| 15-Aug-22 | 10:47      | During works   | 38.1            |            |
| 15-Aug-22 | 11:20      | During works   | 25.9            |            |
| 15-Aug-22 | 11:30      | During works   |                 | 29.3       |
| 15-Aug-22 | 12:00      | During works   |                 | 29.5       |
| 15-Aug-22 | 12:10      | During works   | 28.0            |            |
| 15-Aug-22 | 13:00      | During works   | 25.5            |            |
| 15-Aug-22 | 13:10      | During works   |                 | 25.6       |
| 15-Aug-22 | 13:40      | During works   |                 | 26.3       |
| 15-Aug-22 | 13:50      | During works   | 24.4            |            |
| 15-Aug-22 | 14:20      | During works   | 30.3            |            |
| 15-Aug-22 | 14:30      | During works   |                 | 30.9       |
| 15-Aug-22 | 15:00      | During works   |                 | 30.1       |
| 15-Aug-22 | 15:10      | During works   | 39.1            |            |
| 15-Aug-22 | 15:30      | During works   | 36.0            |            |
| 15-Aug-22 | 15:35      | During works   |                 | 36.4       |
| 15-Aug-22 | 16:20      | Works complete |                 | 40.7       |
| 16-Aug-22 | 07:19      | Prior to works |                 | 41.8       |
| 16-Aug-22 | 07:25      | Prior to works | 41.1            |            |
| 16-Aug-22 | 08:00      | During works   | 38.4            |            |
| 16-Aug-22 | 08:10      | During works   |                 | 37.6       |
| 16-Aug-22 | 08:30      | During works   |                 | 37.5       |
| 16-Aug-22 | 08:40      | During works   | 38.5            |            |
| 16-Aug-22 | 09:00      | During works   | 38.0            |            |
| 16-Aug-22 | 09:10      | During works   |                 | 37.1       |
| 16-Aug-22 | 09:30      | During works   |                 | 33.6       |
| 16-Aug-22 | 09:40      | During works   | 37.3            |            |
| 16-Aug-22 | 10:00      | During works   | 37.0            |            |





| Date      | Time (hrs) | Activity       | Turbidity (NTU) |            |
|-----------|------------|----------------|-----------------|------------|
|           |            |                | Upstream        | Downstream |
| 16-Aug-22 | 10:10      | During works   |                 | 34.3       |
| 16-Aug-22 | 10:30      | During works   |                 | 34.1       |
| 16-Aug-22 | 10:40      | During works   | 36.8            |            |
| 16-Aug-22 | 11:00      | During works   | 35.3            |            |
| 16-Aug-22 | 11:10      | During works   |                 | 35.9       |
| 16-Aug-22 | 11:30      | During works   |                 | 33.4       |
| 16-Aug-22 | 11:40      | During works   | 34.2            |            |
| 16-Aug-22 | 12:00      | During works   | 35.3            |            |
| 16-Aug-22 | 12:10      | During works   |                 | 36.7       |
| 16-Aug-22 | 12:30      | During works   |                 | 34.1       |
| 16-Aug-22 | 12:40      | During works   | 36.8            |            |
| 16-Aug-22 | 13:00      | During works   | 33.6            |            |
| 16-Aug-22 | 13:10      | During works   |                 | 30.4       |
| 16-Aug-22 | 13:30      | During works   |                 | 30.9       |
| 16-Aug-22 | 13:40      | During works   | 32.6            |            |
| 16-Aug-22 | 14:00      | During works   | 34.1            |            |
| 16-Aug-22 | 14:10      | During works   |                 | 33.7       |
| 16-Aug-22 | 14:40      | Works complete |                 | 38.1       |
| 17-Aug-22 | 07:30      | Prior to works |                 | 48.4       |
| 17-Aug-22 | 07:40      | Prior to works | 50.9            |            |
| 17-Aug-22 | 08:00      | During works   | 48.7            |            |
| 17-Aug-22 | 08:10      | During works   |                 | 46.8       |
| 17-Aug-22 | 08:30      | During works   |                 | 47.9       |
| 17-Aug-22 | 08:40      | During works   | 46.7            |            |
| 17-Aug-22 | 09:00      | During works   | 44.2            |            |
| 17-Aug-22 | 09:10      | During works   |                 | 45.6       |
| 17-Aug-22 | 09:30      | During works   |                 | 45.9       |
| 17-Aug-22 | 09:40      | During works   | 48.8            |            |
| 17-Aug-22 | 10:00      | During works   |                 | 47.9       |
| 17-Aug-22 | 10:10      | During works   | 46.3            |            |



**Table 7: Turbidity levels of Fitzsimmons Creek at Bar 17**

| Date      | Time (hrs) | Activity       | Turbidity (NTU) |            |
|-----------|------------|----------------|-----------------|------------|
|           |            |                | Upstream        | Downstream |
| 22-Aug-22 | 08:10      | Prior to works |                 | 45.6       |
| 22-Aug-22 | 08:20      | Prior to works | 52.2            |            |
| 22-Aug-22 | 09:10      | During works   |                 | 55.8       |
| 22-Aug-22 | 09:20      | During works   | 49.6            |            |
| 22-Aug-22 | 09:40      | During works   |                 | 55.1       |
| 22-Aug-22 | 09:50      | During works   | 51.8            |            |
| 22-Aug-22 | 10:10      | During works   |                 | 53.4       |
| 22-Aug-22 | 10:20      | During works   | 54.0            |            |
| 22-Aug-22 | 10:40      | During works   |                 | 66.2       |
| 22-Aug-22 | 10:50      | During works   | 57.6            |            |
| 22-Aug-22 | 11:10      | During works   |                 | 62.6       |
| 22-Aug-22 | 11:20      | During works   | 51.0            |            |
| 22-Aug-22 | 11:40      | During works   |                 | 58.7       |
| 22-Aug-22 | 11:50      | During works   | 54.6            |            |
| 22-Aug-22 | 12:15      | During works   |                 | 49.7       |
| 22-Aug-22 | 12:25      | During works   | 53.4            |            |
| 22-Aug-22 | 12:40      | During works   |                 | 61.2       |
| 22-Aug-22 | 12:50      | During works   | 50.8            |            |
| 22-Aug-22 | 12:55      | During works   |                 | 48.1       |
| 22-Aug-22 | 13:05      | During works   |                 | 48.5       |
| 22-Aug-22 | 13:10      | During works   | 42.8            |            |
| 22-Aug-22 | 13:35      | During works   |                 | 52.8       |
| 22-Aug-22 | 13:40      | During works   | 52.4            |            |
| 22-Aug-22 | 14:05      | During works   |                 | 49.2       |
| 22-Aug-22 | 14:10      | During works   | 46.1            |            |
| 22-Aug-22 | 14:35      | During works   | 55.8            |            |
| 22-Aug-22 | 14:40      | During works   |                 | 50.3       |
| 22-Aug-22 | 15:05      | During works   |                 | 50.3       |
| 22-Aug-22 | 15:10      | During works   | 51.4            |            |
| 22-Aug-22 | 15:30      | Works complete |                 | 50.7       |





**Table 8: Turbidity levels of Fitzsimmons Creek at Bar 19**

| Date      | Time (hrs) | Activity       | Turbidity (NTU) |            |
|-----------|------------|----------------|-----------------|------------|
|           |            |                | Upstream        | Downstream |
| 17-Aug-22 | 10:30      | Prior to works | 50.7            |            |
| 17-Aug-22 | 10:40      | Prior to works |                 | 56.2       |
| 17-Aug-22 | 11:40      | During works   | 51.0            |            |
| 17-Aug-22 | 11:45      | During works   |                 | 54.7       |
| 17-Aug-22 | 11:46      | During works   |                 | 65.3       |
| 17-Aug-22 | 11:47      | During works   |                 | 69.7       |
| 17-Aug-22 | 11:49      | During works   |                 | 60.1       |
| 17-Aug-22 | 11:53      | During works   |                 | 130        |
| 17-Aug-22 | 11:59      | During works   |                 | 214        |
| 17-Aug-22 | 12:00      | During works   |                 | 102        |
| 17-Aug-22 | 12:02      | During works   |                 | 73.8       |
| 17-Aug-22 | 12:03      | During works   |                 | 61.3       |
| 17-Aug-22 | 12:04      | During works   |                 | 58.1       |
| 17-Aug-22 | 12:05      | During works   |                 | 59.9       |
| 17-Aug-22 | 12:12      | During works   |                 | 55.3       |
| 17-Aug-22 | 12:15      | During works   |                 | 65.7       |
| 17-Aug-22 | 12:16      | During works   |                 | 77.2       |
| 17-Aug-22 | 12:17      | During works   |                 | 72.5       |
| 17-Aug-22 | 12:18      | During works   |                 | 65.1       |
| 17-Aug-22 | 12:20      | During works   |                 | 59.9       |
| 17-Aug-22 | 12:29      | During works   |                 | 58.3       |
| 17-Aug-22 | 12:47      | During works   |                 | 60.1       |
| 17-Aug-22 | 13:04      | During works   | 71.8            |            |
| 17-Aug-22 | 13:17      | During works   |                 | 61.5       |
| 17-Aug-22 | 13:32      | During works   | 72.8            |            |
| 17-Aug-22 | 13:41      | During works   |                 | 73.6       |
| 17-Aug-22 | 13:45      | During works   |                 | 74.8       |
| 17-Aug-22 | 14:03      | During works   | 85.9            |            |
| 17-Aug-22 | 14:16      | During works   |                 | 78.7       |
| 17-Aug-22 | 14:31      | During works   |                 | 79.0       |
| 17-Aug-22 | 14:44      | During works   | 84.7            |            |
| 17-Aug-22 | 14:54      | During works   |                 | 84.2       |
| 17-Aug-22 | 15:05      | During works   |                 | 92.5       |
| 17-Aug-22 | 15:22      | During works   | 115             |            |
| 17-Aug-22 | 15:36      | During works   |                 | 128        |
| 17-Aug-22 | 15:37      | During works   |                 | 123        |
| 17-Aug-22 | 15:44      | During works   |                 | 123        |
| 17-Aug-22 | 15:50      | Works complete | 135             |            |



| Date      | Time (hrs) | Activity       | Turbidity (NTU) |            |
|-----------|------------|----------------|-----------------|------------|
|           |            |                | Upstream        | Downstream |
| 18-Aug-22 | 07:30      | Prior to works |                 | 83.5       |
| 18-Aug-22 | 07:38      | Prior to works | 82.0            |            |
| 18-Aug-22 | 07:50      | During works   | 90.2            |            |
| 18-Aug-22 | 07:51      | During works   | 102             |            |
| 18-Aug-22 | 07:52      | During works   | 81.4            |            |
| 18-Aug-22 | 07:53      | During works   | 91.1            |            |
| 18-Aug-22 | 07:58      | During works   |                 | 96.1       |
| 18-Aug-22 | 07:59      | During works   |                 | 88.1       |
| 18-Aug-22 | 08:00      | During works   |                 | 93.1       |
| 18-Aug-22 | 08:01      | During works   |                 | 95.9       |
| 18-Aug-22 | 08:08      | During works   |                 | 130        |
| 18-Aug-22 | 08:09      | During works   |                 | 99.4       |
| 18-Aug-22 | 08:10      | During works   |                 | 93.5       |
| 18-Aug-22 | 08:25      | During works   |                 | 108.0      |
| 18-Aug-22 | 08:27      | During works   |                 | 92.0       |
| 18-Aug-22 | 08:28      | During works   |                 | 113        |
| 18-Aug-22 | 08:32      | During works   |                 | 119        |
| 18-Aug-22 | 08:40      | During works   | 75.2            |            |
| 18-Aug-22 | 08:44      | During works   |                 | 106        |
| 18-Aug-22 | 09:04      | During works   |                 | 98.0       |
| 18-Aug-22 | 09:15      | During works   | 95.3            |            |
| 18-Aug-22 | 09:30      | During works   |                 | 110        |
| 18-Aug-22 | 09:40      | During works   | 116             |            |
| 18-Aug-22 | 10:00      | During works   | 89.2            |            |
| 18-Aug-22 | 10:10      | During works   |                 | 87.0       |
| 18-Aug-22 | 10:30      | During works   |                 | 92.0       |
| 18-Aug-22 | 10:40      | During works   | 102.0           |            |
| 18-Aug-22 | 11:00      | During works   | 96.6            |            |
| 18-Aug-22 | 11:10      | During works   |                 | 106        |
| 18-Aug-22 | 11:30      | During works   |                 | 111        |
| 18-Aug-22 | 11:40      | During works   | 106             |            |
| 18-Aug-22 | 12:00      | During works   | 97.4            |            |
| 18-Aug-22 | 12:10      | During works   |                 | 93.9       |
| 18-Aug-22 | 12:30      | During works   | 117             |            |
| 18-Aug-22 | 12:40      | During works   |                 | 96.2       |
| 18-Aug-22 | 13:08      | During works   |                 | 96.3       |
| 18-Aug-22 | 13:13      | During works   |                 | 91.4       |
| 18-Aug-22 | 13:30      | During works   | 127             |            |
| 18-Aug-22 | 13:40      | During works   |                 | 106        |





| Date      | Time (hrs) | Activity        | Turbidity (NTU) |            |
|-----------|------------|-----------------|-----------------|------------|
|           |            |                 | Upstream        | Downstream |
| 18-Aug-22 | 14:00      | During works    | 127             |            |
| 18-Aug-22 | 14:10      | During works    |                 | 121        |
| 18-Aug-22 | 14:30      | During works    | 140             |            |
| 18-Aug-22 | 4:40       | During works    |                 | 141        |
| 18-Aug-22 | 15:00      | During works    | 159             |            |
| 18-Aug-22 | 15:10      | During works    |                 | 165        |
| 18-Aug-22 | 15:30      | During works    | 175             |            |
| 18-Aug-22 | 15:37      | Works complete  |                 | 172        |
| 19-Aug-22 | 07:08      | Prior to works  |                 | 140        |
| 19-Aug-22 | 07:35      | Prior to works  | 138             |            |
| 19-Aug-22 | 08:00      | Prior to works  | 152             |            |
| 19-Aug-22 | 08:10      | During works    |                 | 122        |
| 19-Aug-22 | 08:30      | During works    |                 | 131        |
| 19-Aug-22 | 08:40      | During works    | 129             |            |
| 19-Aug-22 | 09:00      | During works    | 131             |            |
| 19-Aug-22 | 09:10      | During works    |                 | 140        |
| 19-Aug-22 | 09:30      | During works    | 141             |            |
| 19-Aug-22 | 09:40      | During works    |                 | 128        |
| 19-Aug-22 | 10:00      | During works    | 129             |            |
| 19-Aug-22 | 10:10      | During works    |                 | 142        |
| 19-Aug-22 | 10:30      | During works    |                 | 128        |
| 19-Aug-22 | 10:40      | During works    | 122             |            |
| 19-Aug-22 | 11:00      | During works    | 120             |            |
| 19-Aug-22 | 11:10      | During works    |                 | 116        |
| 19-Aug-22 | 11:25      | During works    | 115             |            |
| 19-Aug-22 | 11:30      | During works    |                 | 110        |
| 19-Aug-22 | 11:50      | During works    | 137             |            |
| 19-Aug-22 | 12:00      | During works    |                 | 120        |
| 19-Aug-22 | 12:30      | During works    | 121             |            |
| 19-Aug-22 | 12:37      | During works    |                 | 117        |
| 19-Aug-22 | 12:38      | During works    |                 | 113        |
| 19-Aug-22 | 12:39      | During works    |                 | 120        |
| 19-Aug-22 | 12:40      | During Works    |                 | 114        |
| 19-Aug-22 | 12:55      | During works    | 141             |            |
| 19-Aug-22 | 13:00      | During works    |                 | 115        |
| 19-Aug-22 | 13:25      | During works    | 111             |            |
| 19-Aug-22 | 13:35      | During works    |                 | 117        |
| 19-Aug-22 | 14:00      | Works completed | 121             |            |
| 19-Aug-22 | 14:10      | Works completed |                 | 115        |



| Date      | Time (hrs) | Activity        | Turbidity (NTU) |            |
|-----------|------------|-----------------|-----------------|------------|
|           |            |                 | Upstream        | Downstream |
| 19-Aug-22 | 14:32      | Works completed |                 | 113        |