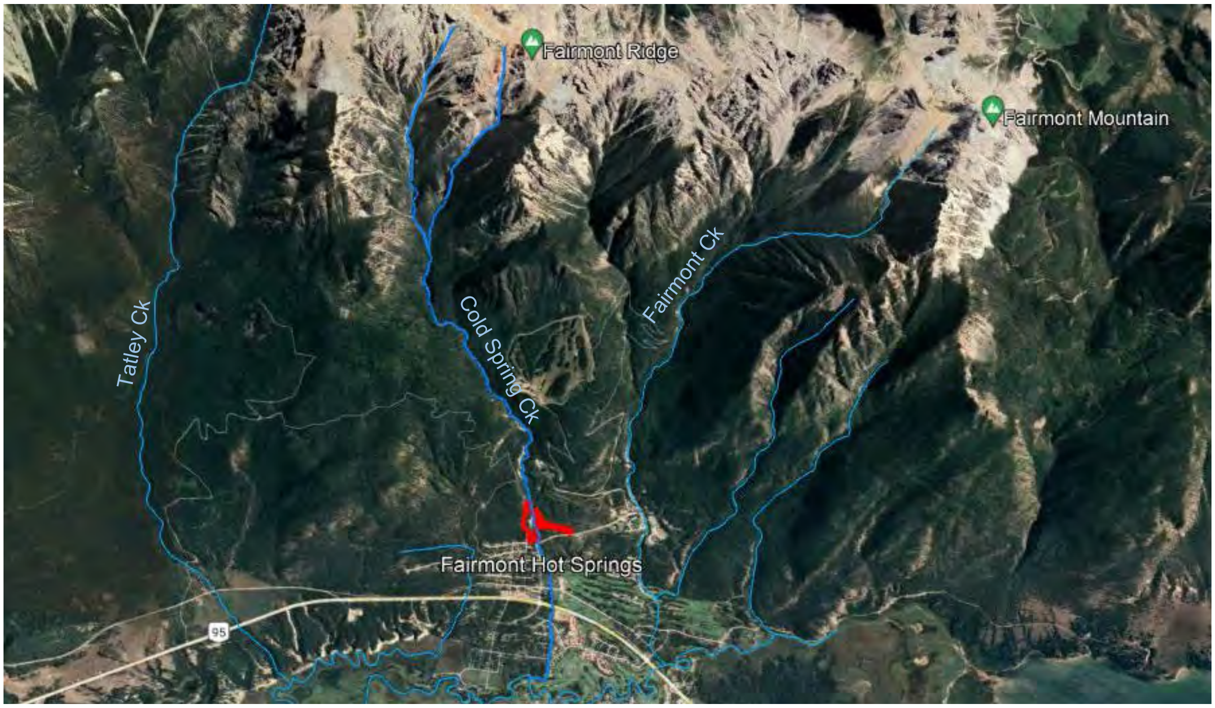
Cold Spring Creek Debris Flow Basin Mitigation (preliminary design) – Environmental Assessment & Best Management Practices



Version 2 – Permit application

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Prepared for
McElhanney Ltd.
Unit C -402 Highway 3
Fernie, BC
V0B 2M0

Prepared by
Lotic Environmental Ltd.
2193 Mazur Road
Cranbrook, BC
V1C 6V9

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I trust this document satisfactorily meets the requirements to provide an Environmental Assessment & Best Management Practices for the Cold Spring Creek debris flow basin mitigation project. Please do not hesitate to contact me with any inquiries regarding this document.

Sincerely,

Sherri McPherson (BSc, RPBio)
Senior Aquatic Biologist
250.464.4564
Sherri.mcpherson@lotic.co

Acknowledgements

Several professionals contributed to the preparation of the various iterations of this report that I wish to thank. These included McElhanney staff Kevin Mohr as the project manager, and Katy Bosma as the project engineer, BCG Engineering Ltd. Patrick Nolan also an engineer, and Regional District of East Kootenay Project Manager, Kara Zandbergen. I am grateful for all the valuable contributions and time of these individuals.

Cover Photo: Debris flow basin mitigation footprint (red polygon), within the Cold Spring Creek drainage, and relative to Fairmont Hot Springs.

Contact list

Company	Name/Role	Email	Phone
Regional District of East Kootenay – Project Owner			
	Kara Zandbergen, Engineering Technician	kzandbergen@rdek.bc.ca	**O** 250.489.2791 **C** 250.417.6652
McElhanney - Project Management and Design			
	Kevin Mohr, P.Eng. Civil Engineer	kmohr@mcelhanney.com	**O** 403.776 9674 **C** 250.425 5434
BGC Engineering Inc. - Design			
	Patrick Nolan, Senior Civil/Geotechnical Engineer	pnolan@bgcengineering.ca	O 604 373-0966 C 604 376-1562
Lotic Environmental Ltd. – QA/QC Environmental Monitor (as required)			
	Sherri McPherson Senior Aquatic Biologist	sherri.mcpherson@lotic.co	**C** 250 464 4564
Prime Contractor			
	To be determined		

Document revision summary

Version	Date	Details
1	March 8	Draft based on preliminary design. Submitted to government managers (i.e., water licencing) for initial review, and First Nations (Shuswap Indian Band) for archaeological assessment.

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1. Background

1.1 *Issue*

BGC Engineering Ltd. (BGC 2020a) conducted a Hazard Assessment of Cold Spring Creek and identified the debris-flow hazards and associated risks to be very high. Further, given the high development density in the high hazard zones, the Cold Spring Creek fan (along with the Fairmont Creek fan) was identified to be the highest risk fan within the RDEK (BGC 2020a). The following pertinent background was obtained from the BGC hazard assessment report (2020):

> *The community of Fairmont Hot Springs is located on two fans that partially overlap: Cold Spring Creek and Fairmont Creek. These fans have developed by debris flood and debris flow processes. Both are more destructive than normal floods. Debris flows can be life threatening. The July 2012 event on Fairmont Creek, gives a sense of how powerful such events can be. The lack of known extreme events in the historic record on Cold Spring Creek can give the perception that the problem is manageable as only nuisance property flooding is expected. This is a severe and consequential misconception.*
>
> *Debris floods are characterized by abnormally high rates of sediment movement with boulders, logs and other debris being transported downstream. Debris floods can clog culverts and bridges, jump out of the confines of the channel and erode its banks or road fills. Damage to buildings during debris floods can occur through bank undercutting and flooding. Such events have and will occur with an annual likelihood of 1 - 30% on Cold Spring Creek. The lower the annual likelihood of debris flood occurrence, the larger and more destructive the event will be. The latest (May 31, 2020) debris flood had an estimated return period of 5 - 10 years. Even at a 1% annual likelihood of occurrence, there is still about a 64% likelihood that it will occur in a person's lifetime (80 years).*
>
> *Debris flows occur at a lower annual probability (<1% likelihood). Debris flows are a landslide process and they are typically even more destructive than debris floods. The forces associated with a wall of mud and boulders over 2 m in diameter, which can be found on Cold Spring Creek fan, can fully destroy homes. Debris flows often come without warning. They can be triggered by intense rain, or a landslide damming the creek upstream of the community and then bursting. According to numerical debris flow modeling, should a debris flow occur on Cold Spring Creek there is a significant risk that people will die or be injured, and the economic outcomes from damage are substantial.*
>
> *Various effects of a warming climate are very likely to worsen the situation by creating more and potentially larger debris floods and debris flows in the future. There are three primary influencing factors. One is that in a warming climate more moisture can be held in the air and with more available energy, with air masses becoming more unstable. This means more frequent extreme rainfalls and higher intensity rainfalls are expected, even when the total annual rainfall may be unchanged or even be reduced. In addition, under warmer conditions, trees in the watershed will increasingly be stressed through drought and beetle infestation. This, in combination with a century of fire suppression has created substantial fuel loads, meaning hotter and more severe wildfires. Debris flows can become particularly destructive after wildfires, while the important buffer of trees and duff layer re-establishes. Finally, the upper watershed of Cold Spring Creek is likely underlain by permafrost, which is continually frozen ground that thaws only surficially by a metre or so and then refreezes in the winter. In permafrost terrain, when water ingresses into rock cracks or soil voids it freezes and holds rock or soil together like glue. In a warming climate, this "glue" will disappear, with a resulting increase in rockfall and other landslides in the upper watershed. This process feeds the channel system with debris that is then ready for transport to the fan where people live. Figure 1 provides an example of the kind of damage that can be expected given the flow depths and flow velocities modeled at Cold Spring Creek.*

Figure 1. Downstream impacts of a post-fire debris-flow in California in 2010 (Source USGS); example of event possible at Cold Spring Creek (BGC 2020a).

1.2 *Project Status*

BGC and McElhanney Ltd (McElhanney), with the support of Gygax Engineering Associates Ltd. are completing a mitigation design to reduce the risk of debris-flows at Cold Spring Creek for the Regional District of East Kootenay (RDEK). The preliminary design and supporting engineering study were completed in early 2022. The first draft of this Environmental Assessment and Best Management Practices (EA and BMP) report was based on those documents.

Since the preliminary design milestone, the team has continued to advance the design and is currently in the final stages. The final design drawings and design report will be completed by the end of 2022 to allow for tendering and construction in 2023. Due to the criticality of this project and the anticipated time to receive permits and approvals, applications for environmental approvals are being submitted in advance of the final design. This was done at the suggestion of the Provincial Dam Safety Officer responsible for the file at the Deputy Inspector of Dikes (Kate Forbes).

As such, the content of this report is largely based on the preliminary design information, with some available design updates being reflected. When available, the final design drawings and design report will be submitted to supersede the initial submittals. The major differences that are anticipated between the preliminary and final design are described in section 2.3.

1.3 *Mitigation Approach*

The design is supported by a detailed engineering study titled Cold Spring Creek Debris-Flow Mitigation - Preliminary Design Report and Site Investigation (herein, debris-flow mitigation report; BGC and McElhanney 2022). The design is a debris-flow barrier and basin located at a partial narrowing of the valley near the fan apex (the project). Summary details are as follows (BGC and McElhanney 2022):

> *The project was designed for a 100-to-300-year debris flow event, providing 65,000 m^3 of storage for debris flow slurry. The main objective is to reduce life loss risk on the fan and of the existing development downslope. This will be achieved by filtering debris sediment (gravel to boulders and woody debris) during the design event, and retaining it in the debris basin, while allowing a much smaller controlled discharge (with reduced sediment concentration) from the basin to pass the barrier through a functionally designed outlet. The outlet will only partially or minimally block smaller events and will allow normal and annual peak flows to pass the structure. The mitigation structures will reduce the intensity and extent of debris flow hazards on the creek and fan downstream of the barrier. The location was selected because it provides a naturally confined basin and is efficient for sediment and debris retention.*

A similar debris-flow mitigation approach has been used elsewhere in Canada and around the world (e.g., thousands of similar structures named "Sabo" dams in Japan, numerous examples in Switzerland and France, and near Lions Bay, BC). A similar system is being planned to be installed on the Cheekeye River in Squamish (BGC and McElhanney 2022).

Future risks may be further managed using other tools, such as a real-time warning system and/or restrictive covenants for future developments on the Cold Spring Creek fan. These additional items are not currently part of this project scope.

1.4 *Funding*

This project was funded by the following sources:

- Union of BC municipalities (UCBM) Structural Mitigation Program
- Fairmont Flood and Landslide Service Area reserves
- Community Works Funds
- Canada Infrastructure Program- Covid-19 Resilience Infrastructure Stream- Adaptation, Resilience and Disaster Mitigation Stream (ARDM)

1.5 *Previous design - debris net*

BGC conducted conceptual pre-screening and options analysis (BGC 2020). Solutions included flexible nets, various locations for debris basins, berm solutions (deflection) in multiple locations, watershed stabilization, and multiple check dams. Considering the funds available at the time (in 2021), a flexible debris net was designed, with a BC *Water Sustainability Act* Works in and About a Stream Approval application submitted. However, it was recognized that further risk reduction would be desirable if more mitigation funding could be acquired.

Upon receipt of additional ARDM grant funding, the advantages of combining grants to create a single basin and barrier solution were reviewed (BGC 2021a). The debris basin and barrier option was determined to be the best approach based on the following (BGC 2021):

1. *It had a lower technical complexity. This included less complex access roads since the flexible net was on a relict landslide feature.*
2. *It had lower lifecycle costs, with savings over a 100-year time frame.*
3. *It protected against the design debris flow, whereas multiple flexible nets would be required to achieve the same storage volume.*
4. *It required less maintenance, whereas the flexible net required more regular cleanout and component replacement, and at least one full net replacement within the project life.*

The two grant agencies agreed to combine funding for a single barrier and basin project.

1.6 *Report objectives*

Lotic Environmental Ltd. (Lotic Environmental) was retained by McElhanney to prepare this Environmental Assessment & Best Management Practices (EA & BMP) report, and to prepare and submit the environmental regulatory applications. This report identifies environmental values in the project footprint, project related risks to the environment values, and mitigation details to minimize the potential for impacts.

The report was prepared using:

1. A desktop review of existing environmental information.
2. Site visits conducted in June and July 2021 (during BGC's investigative study).
3. Communications with the McElhanney and BGC engineers, Kevin Mohr and Patrick Nolan, respectively.

4. Preliminary project designs and the debris-flow mitigation report (BGC and McElhanney 2022).
5. Detailed design information provided by McElhanney and BGC (in progress as of November 2022).

1.7 *First Nations Consultation & Archaeological Assessment*

Formal First Nations consultation will commence upon submittal of the water license application, led by the provincial regulator. However, the RDEK and their consultants (McElhanney, Nupqu Resource Limited Partnership [Nupqu]) have been in contact with the Shuswap Indian Band and the Ktunaxa First Nation about the project.

Nupqu completed initial non-permit archaeological assessments, and a preliminary field reconnaissance in summer 2021 and 2022 (Nupqu 2021 and 2022; Appendix A). Two areas of potential (AOP) were identified within the project area, and these are being considered as part of the detailed design (shown on Figure 3). The design team will strive to avoid any ground disturbance within these areas during the project. An application has been submitted to complete an AIA (Archeological Impact Assessment) in early 2023 in advance of construction.

2. Design

2.1 *Location*

Fairmont Hot Springs is an unincorporated resort community located in south-eastern BC. The community has a year-round population of 476, and receives frequent tourists, with the summer population being several times larger than the permanent resident population (Wikipedia 2022). The project is in the middle of the Cold Spring Creek watershed, with the barrier located immediately downstream of the Fairmont Hot Springs Resort (FHSR) irrigation reservoir and dam, and immediately upslope of residences (Figure 2, Figure 3).

Figure 2. Project footprint relative to Cold Spring Creek drainage (Google Earth 2021).

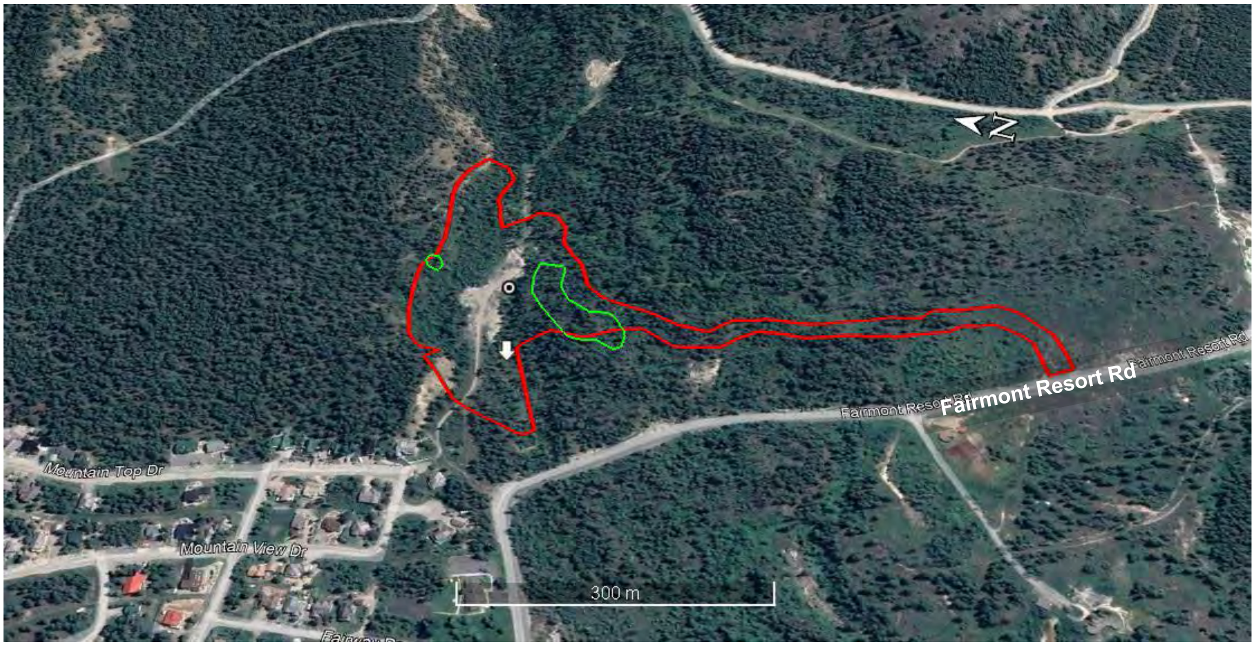

Figure 3. Close-up of approximate project footprint - red outline (access road, basin, barrier [center is depicted with the arrow] and laydown areas; the Archaeological Areas of Interest - green polygons; and the current FHSR dam - bullseye (Google Earth 2021).

Benefits of this location are as follows (BGC and McElhanney 2022):

1. *Most suitable location in the watershed, since it is at a natural constriction of the valley near the fan apex, with no evidence of geotechnical instability. This location has the benefit of preventing outflanking issues and is an economically feasible location for construction.*
2. *Access is relatively simple compared to further up the watershed.*
3. *Excavation of basin provides a good cost-benefit.*
4. *Sufficient borrow material is available onsite.*
5. *Minimal encroachment on residential areas.*
6. *Area already used for debris storage.*
7. *Area is relative flat for clearing and grubbing.*
8. *Minimal expected environmental impacts.*

The UTM coordinates for the center of the barrier are 11U 582121.126 m E, 5576741.391 N. The primary existing access to the project area is:

- Turn east off Highway 95 onto Wills Road.
- Drive 0.57 km and turn right on Mountain Top Drive.
- Turn left at the end of the paved road and go through the gate onto the gravel road that heads up the watershed.
- Drive for 0.25 km to the Fairmont Hot Springs Resort irrigation dam/reservoir.

The access will be different once the permanent access road is built off Fairmont Resort Road and the barrier construction begins.

2.2 *Land ownership and tenure*

The project infrastructure footprint is on private land owned by the Fairmont Hot Springs Resort (FHSR). The parcel identifier (PID) is 010-501-746, the plan number is NEP32X, and the parcel type is subdivision (Figure 4). Within the project footprint is the FHSR holds a water license to the irrigation reservoir named "FHSR Pond" below on Figure 5. The is formed by a concrete dam and intake structure, which allows the FHSR to supply irrigation water to the Mountainside Golf Course. Because of the land ownership, the RDEK has been in consultation with FHSR and is seeking a letter of support for the project to be permitted and constructed. Following construction, statutory rights-of-way will be established such that the project can be adequately operated and maintained.

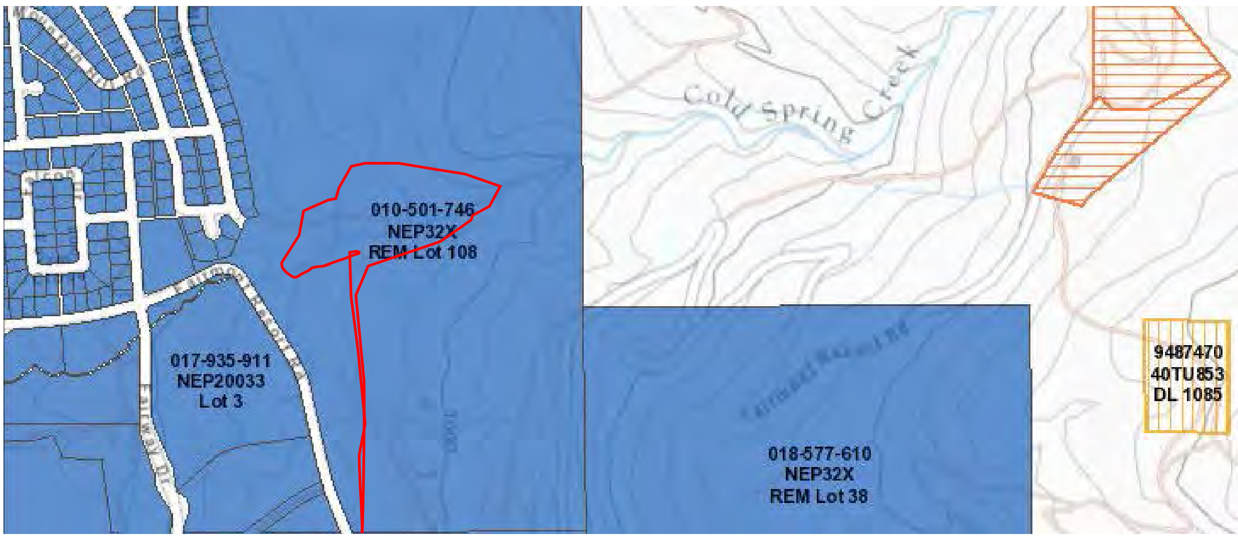

Figure 4. Project footprint (approximate; red outline) relative to lot boundaries (ParcelMap 2022).

2.3 *Components (BGC and McElhanney 2022b)*

As per the debris-flow mitigation report, the barrier and basin design concept is for routine clearwater flows and up to debris floods to pass, and for debris-flow sediment, large woody debris, and boulders to be captured (Figure 5, BGC and McElhanney 2022). This debris is captured in the basin by a combination of physical blockage (i.e., outlet grillage) and deposition that occurs in the ponded flow upstream of the barrier. When flow is low to moderate, all creek flow is diverted through the tyrolean weir, existing reservoir and through the new outlet structure. When flows are moderate and higher, most of the flow will be diverted through the basin and out the outlet structure.

There are several components to the design, and a brief description of each has been provided below. The debris-flow mitigation report provides the analyses used to determine the design specifications and describes each project component in detail. It also identifies potential design refinements, and additional information and assessments that are needed to advance and complete the detailed design.

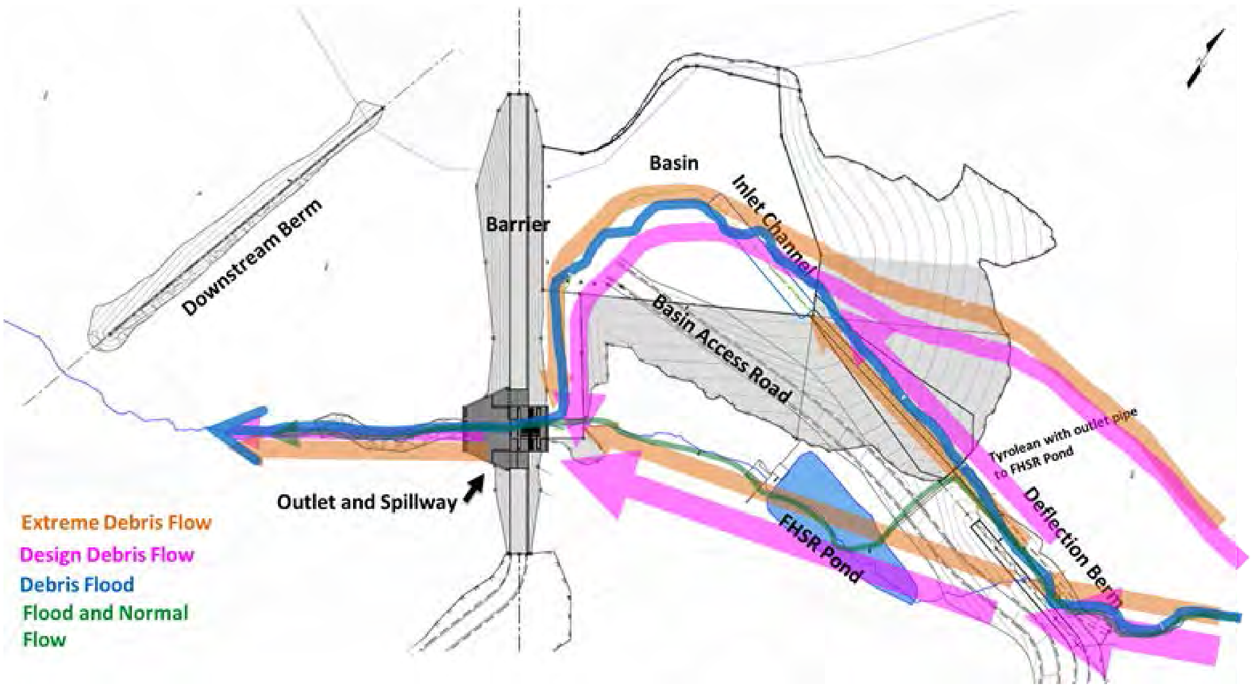

Figure 5. Individual structures forming the barrier and basin mitigation system, with the routing of different event scenarios illustrated with colored arrows (McElhanney and BGC 2022).

2.3.1 Access road

A new access road will be constructed to be used during construction and will remain in place after completion to provide maintenance access. The road will be approximately 600 m long and will extend from the barrier area to Fairmont Resort Road. The road was aligned to avoid an archaeological AOP as shown on the drawings. The road was also designed to provide a suitable gradient for construction and maintenance traffic, to align with FHSR development plans, and to reduce the aesthetic impact to the area. A gate will be installed at the road entrance to restrict access to construction and maintenance personnel only.

The road construction work will include clearing, grubbing, stripping, placement, and compaction of fill (material cut from the basin excavation). In some places, cut slopes may be required to achieve the proper gradient. Drainage will be managed with ditches along the road connecting to culverts to convey water downslope. A temporary creek crossing will be constructed to gain access to the basin and barrier area from the new access road. This crossing will be located upstream of the FHSR reservoir and will likely consist of twin CSP culverts (to be designed by the contractor). The culverts will be sized to handle the temporary design flow specified by the engineers. The culvert crossing will remain in place until the Tyrolean weir is operational, at which time the creek will be directed to the weir and into the reservoir in normal conditions.

2.3.2 Upstream deflection berm

A deflection berm is located ~50 m upstream of the FHSR reservoir. At the base of the deflection berm is an armored 15-20 m long diversion channel that conveys all Cold Spring Creek flow toward flume/weir and sediment basin. Should the location of the Cold Spring Creek thalweg shift upstream (due to bedload/debris accumulation), the berm and channel will continue to intercept and divert the watercourse. The deflection berm is 2 m high measured from the upstream diversion channel's base, with a 2H:1V upstream face. The downstream face varies in slope, with an access road to the debris basin located on the downstream face.

The downstream end of the diversion channel enters a 2 m wide, 10 m long concrete flume. The upstream end of the flume has 45° vertical wing walls to funnel flow into the flume. The flume conveys flow to the Tyrolean weir located immediately downstream of the flume.

The deflection berm and channel will intercept and divert up to the 30-100 year (5.2 m^3/s) debris flood event. The deflection berm is expected to be overtopped and mostly likely severely damaged during the 100-300 year debris flow event. The additional material that may be entrained in the 100-300 debris flow because of damage to the berm would be stopped by the downstream barrier's outlet grillage and would not increase the risk to that element, as the material specified is smaller than the design boulder size.

2.3.3 Tyrolean weir

The Tyrolean Weir (Figure 6) is a common method of extracting water from sediment laden watercourses. It is often applied for water supply and small hydroelectric projects on watercourse in steep, mountainous terrain. It is comprised of an inclined steel grate set atop a concrete box chamber. At the chamber's base, is a culvert that will convey the flow to the FHSR reservoir.

The Tyrolean weir will intercept flow under most conditions (i.e., most of the time), where it will be conveyed through a 600 mm diameter culvert to the FHSR reservoir. When flow exceeds ~ 0.8 m^3/s, the excess flow will continue over the weir into the debris basin. The bar size and spacing on the weir will restrict the size of sediment/bedload that can drop into the chamber to silts, sands, and small gravels. Larger calibre sediment and debris, typically mobilized during larger flow events, will continue over the weir, and drop into the debris basin.

Smaller sediment entrained in the water column during low flows, and a portion of the smaller calibre sediment during larger flows, will drop into the weir's chamber and be conveyed to the FSHR reservoir; this is unavoidable. However, the amount of maintenance to the reservoir, in the form of sediment removal, will be dramatically reduced from present conditions. Most of the weir details will be developed during the detailed design stage.

Figure 6. Tyrolean weir examples (BGC and McElhanney 2022).

2.3.4 Basin & inlet channel

The basin and inlet channel designs are in progress and will deviate from the design shown in the preliminary drawings. Downstream of the Tyrolean weir, flow will be directed into the basin through an armored channel excavated into the slope and contained by a berm on the downslope side. This channel will guide the flow into the basin and provide a more moderate slope to begin dissipating energy and reduce scour and erosion. The channel and basin grading are currently under design optimization, with the goal of providing energy dissipation, directing flow through the basin to allow for settlement of debris, and protecting the barrier toe, existing watermains and other features from excessive scour and erosion. Material excavated from the basin and channel will be used to construct the access road and berms. The basin area and inlet channel will be cleared, grubbed and stripped to allow for grading and construction of the channel. Following construction completion, vegetation within the basin area will regrow, but will be cleared every 5 – 10 years to maintain the storage area for debris events.

2.3.5 Guiding channel

A guiding ("low-flow") channel will be excavated into the basin floor, from the inlet channel to the outlet of the basin, and from the outlet to the downstream deflection berm in Cold Spring Creek (a minimal distance within the permitted boundary). The guiding channel provides a flow path for normal flow to move sediment out of the basin. It is sized to closely match the natural channel bankfull width and depth. The channel will convey up to the largest debris floods, and during debris-flow events the slurry will spill across the basin to dissipate the energy. The channel will not be protected from erosion. Instead, it will migrate as the creek develops a natural course through the basin and self-armour. Survey markers on the upstream barrier face will show an idealized channel, to allow simple regrading of channel in future.

2.3.6 Watermain Protection

The watermain work is currently under design and will deviate from the preliminary design drawings. The drawings show complete replacement of the watermains within the barrier and basin areas. However, that will not be undertaken and only a small portion of the watermains will be replaced.

There are four existing watermains that cross under the future barrier footprint. The watermains connect to the FHSR reservoir and are used for drinking water and irrigation. Because the watermains underlay the barrier, additional protection measures must be taken. New sections of watermain pipe will be installed under the barrier, inside steel casings and encased in a cementitious fill. This treatment will improve foundation conditions for the barrier and will reduce the risk of piping along the watermains which can lead to internal erosion of the barrier foundation. The watermain replacements will be done using open cut trenching, in advance of the barrier construction. Pumps will be used to dewater the trenches, pumping to a suitable location in accordance with the contractor's erosion and sediment control plan (Section 4).

2.3.7 Barrier

The debris-flow barrier is located across the natural constriction in the valley. Its purpose is to capture debris flows up to the design storage volume, and convey flows before, during, and after design events. The barrier is a concrete gravity dam made of roller compacted concrete (RCC), which can withstand overtopping and impacts that may occur during extreme debris-flows. The bottom of the barrier will be sloped and there will be a vertical portion at the top. The barrier crest width is 5 m. The barrier height is designed to achieve the design storage volume and direct flows that exceed the design storage level to the spillway. The centerline height above the existing Cold Spring Creek is 7 m (above the outlet invert), which increases to a 15 m maximum height away from the outlet. A permanent access road is designed to be located on the south side only. Vertical joints, perpendicular to the barrier alignment, from base to crest are included to control the locations of cracks. Control joints and other RCC cracks that occur throughout operation of the barrier will be monitored for change as part of the operation and maintenance plan. The vertical face of the barrier located along the outlet opening has a structural concrete facing, to resist weathering, abrasion and erosion (Figure 7). Steel facing plates cover the lower concrete at the outlet constriction to further protect against abrasion caused by sediment transport.

Figure 7. Examples of RCC downstream face with flat face and benching (BGC & McElhanney 2022).

2.3.8 Outlet

The outlet is proposed to be a vertical slit through the barrier, with a steel grillage to retain debris by mechanical trapping (Figure 8). Its purpose is to control/regulate discharge during all event types and normal flow. Typical clearwater flows will pass through the outlet unimpeded, with estimated flow depth less than 1 m and no upstream ponding. The outlet is designed to be partially blocked by boulders and logs carried in debris floods and debris-flows, causing deposition in the basin, but to allow a portion of the smaller debris to pass with water downstream during the event. Allowing sediment to move downstream of the barrier is important for downstream environment and function. Following events, the creek normal flow will pass on top of deposited debris through the upper portion of the outlet, gradually entraining sediment from the basin and transporting it downstream. The outlet is in the left side of the barrier, essentially in the existing creek channel. The outlet width is 3 m. A steel grillage that reduces the effective outlet opening width of the outlet is provided to block entrained debris of all but low flows. The grillage is comprised of four primary beams that span horizontally across the slot. The primary beams in turn support secondary beams that provide the required maximum passage width. The outlet discharge was chosen to be higher than the maximum debris flood discharge so that hydraulic control will not cause ponding upstream. The vertical walls of the outlet are of reinforced concrete. Steel plates are provided for wear protection on the vertical walls at the bottom of the outlet control section and steel covers close-off the bottom two primary beam slots.

The outlet structure is located withing the existing creek channel, so will require diversion and dewatering during construction to allow for placement of cast in place concrete. The creek diversion plan is the responsibility of the contractor, guided by the project specifications written by the design engineers (Section 4). It is envisioned that a temporary channel will be constructed to the north of the outlet structure and the creek will be diverted into that channel while the outlet is constructed. After the base of the outlet structure is cured and it is safe to do so, the creek will be diverted back into the permanent channel and through the outlet. High groundwater conditions are expected within the outlet foundation excavation, which will be managed with pumps. The creek diversion for the outlet structure is anticipated to last 2 to 3 months (Section 2.5).

Figure 8. Example of proposed sloping outlet steel at McKay Creek East, District of North Vancouver (BGC and McElhanney 2022).

2.3.9 Spillway

A spillway is located over the barrier and outlet slit. The spillway controls where flows pass the barrier when the slit outlet capacity is exceeded or is blocked by debris. The spillway discharges flow into the stilling basin and along the existing alignment of the creek. The spillway is 20 m wide, based on the existing creek high water and bank widths. This width allows most logs identified in the basin to pass over the spillway while being oriented perpendicular to the flow direction. The spillway depth at the barrier crest is 1 m. This depth controls the spillway discharge capacity. The spillway surface is conventional reinforced concrete without additional erosion protection. Concrete sills (1 m high) are located parallel to the flow direction at each side of the spillway on the 1H:1V downstream face to direct the short duration flow that extends beyond the spillway width back into the stilling basin.

2.3.10 Stilling basin

The stilling basin is directly downstream of the spillway and outlet. Its width is equal to the spillway and narrows towards the downstream channel. The purpose of this basin is to deal with overflow from the spillway in the extreme design event whilst limiting scour potential. This component is currently designed as reinforced concrete, but alternative material construction will be considered in the detailed design. There is a lip at the end of the stilling basin to create a pond of sediment and water, to cushion the overflow slurry when it drops ~ 7 m height and hits a near horizontal surface. This pond is expected to exist at all times and normal water flow shall flow over the edge of the lip into the creek channel.

2.3.11 Downstream creek armoring

The outlet channel continues in alluvial and debris flow material beyond the downstream barrier toe at approximately 9 - 11% thalweg grade. The creek channel will be armored to prevent erosion from retrogressing and undermining the stilling basin or outlet structure or entraining natural creek bed material.

2.3.12 Downstream berm

The downstream berm is the preliminary concept of a secondary structure to re-direct sediment laden flow that avulses from the downstream existing Cold Spring Creek channel during the design events, that may cause a significant risk downstream. The berm is currently a considered a provisional item and will only be constructed if budget allows. It will be an earth fill berm, with riprap armoring on the upstream face.

2.4 *Project environmental impact summary*

Overall, the project will impact the environment, primarily through the following:

1. Temporary construction and maintenance activities within or near the creek, including water diversion and temporary creek crossing (to be designed by contractor).
2. Removal of vegetation within the footprint of structures, access roads, and laydown areas.
3. Permanent diversion of the creek through the Tyrolean weir and culvert into the reservoir.
4. In high flow events, changing the course of the creek for approximate 270 m distance, by diverting it over the Tyrolean weir and through the basin.
5. Permanent diversion of the creek through the concrete outlet structure, spillway and stilling basin (under all flow conditions).
6. Changes to sediment transportation regime. The project will decrease the chance of all sediment in a year and bigger event making it past the barrier.
   - During normal flows, conditions will remain as status quo, with small sediment (<0.4m) becoming trapped in the FHSR reservoir and requiring removal from the site mechanically (e.g., excavator) and deposited offsite. Downstream of the FHSR irrigation dam and the barrier, sediment will continue to enter the system as it has been (degradation will not be an issue), with the RDEK sediment trap below the highway expected to still be required.

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The area to be disturbed through this project has been summarized in Table 1 for a variety of aspects, including temporary (restricted and unrestricted) footprint, permanent footprint, and riparian area. The footprint area is comprised of three disturbance types to limit the extent of disturbance in select areas:

1. Permanent – this infrastructure will be in place in perpetuity and includes all the project components described above.
2. Temporary unrestricted – this includes the two laydown areas. In these areas, it is expected that all vegetation will be removed. However, the area will be reclaimed at the end of the project with hydroseeding at minimum.
3. Temporary restricted – these are the riparian buffer areas within 15 m of the top of the stream banks, situated alongside the laydown areas. Disturbance here will be minimal (e.g., minor brushing) and the riparian area will largely stay intact. However, as required, these areas may be used for minor works such as access, temporary stream diversions (pumps to bypass construction), or as required by the engineer, debris removal works (e.g., Fairmont Resort Road culvert outlet).

Table 1. Estimated Disturbance areas – temporary and permanent (rounded)

Description	Area (m^2)
Total footprint	**50,000**
• Permanently disturbed footprint – e.g., deflection berm and channel, basin, barrier, stilling basin, downstream berm, downstream creek armoring	14,000
• Permanent access road	6,000
• Temporary disturbed footprint (unrestricted - upper and lower laydown areas)	25,000
• Temporary restricted – within 15 m buffer along laydown areas	5,000
Other considerations	
• Existing disturbed area (FHSR reservoir, dam, access, reservoir, and spoil area).	5,000
• Permanent footprint below high-water mark	600
• Permanent footprint within 15 m riparian area (excluding existing reservoir)	1,200
• Previously disturbed footprint within the 15 m riparian area (to remain, reservoir)	1,000

2.5 *Schedule*

Schedule details were obtained from BGC and McElhanney (2022). As of November, 2022 the project is in the final stages of design, and will be tendered in February 2023. The proposed design thus assumes the following construction sequence, with works commencing once applicable permits/permissions are obtained (see Section 3.4):

1. *Spring – fall 2023:*
    a. *Clearing and brushing of access road alignment, laydown areas, barrier, and basin areas. (In advance of bird nesting window)*
    b. *Stripping of access road, laydown areas, barrier, and basin area*
    c. *Excavation of basin and construction of access road install temporary culvert crossing, Access Road slopes to be dressed with salvaged topsoil and hydroseeded.*
    d. *Install new watermains under barrier footprint. Backfill with control density fill (CDF) and structural fill where required*
    e. *Construct temporary diversion channel around outlet structure. Divert creek into channel.*
    f. *Construction of outlet structure base and walls (cast in place concrete with formwork).*
    g. *Divert Cold Spring Creek into its final position through the outlet structure.*
    h. *Excavate foundation for the RCC barrier, including the stepped benches on abutments. RCC barrier construction.*
    i. *Complete construction of concrete outlet structure in conjunction with barrier construction.*
    j. *Construct upstream deflection berm, Tyrolean weir and inlet channel.*
    k. *Divert Cold Spring Creek into its final position through Tyrolean weir after its completion.*
    l. *Construct guiding channel in basin to the upstream end of the outlet.*
    m. *Reclamation of laydown areas with topsoil ad hydroseeding, or per prescriptions of the project.*
    n. *Site clean-up and demobilization*

A preliminary construction schedule is provided (Appendix B). This will be further developed by the Contractor upon award. The activities requiring Qualified Environmental Monitor (QEP) involvement during construction are outlined in the Section 5 – Roles and responsibilities . These are to be incorporated into the Construction Schedule.

3. Environmental values

3.1 *Fish and fish habitat values*

The project is situated in the Cold Spring Creek watershed (Watershed Code 300-989000), with the footprint including Cold Spring Creek riparian and stream habitat. The project is located at elevations from 922 – 975 masl. Cold Spring Creek is a second order stream, with a mainstem length of 7.3 km (Province of BC 2022). The FHSR irrigation dam and reservoir infrastructure in the vicinity of the project have been in place for many years; records obtained by the RDEK indicate it was existing in 1988 and is currently planned to remain in place following project completion (Figure 9). The dam would preclude upstream fish migration if fish were present (see next section). The stream downstream of the dam, in the vicinity of the project footprint, was comprised of step pools, interspersed with long riffles (Figure 10). The reach to be impacted ends at the Fairmont Resort Road, which had a culvert crossing (Figure 9). This culvert, in addition to the Highway 95 culvert, were determined to be barriers to upstream fish migration (see next section). The riparian habitat in the project footprint was young forest, with good overhead cover, up to the irrigation reservoir.

Figure 9. Fairmont Hot Springs Resort dam and irrigation reservoir within the project footprint (left), and Fairmont Resort Road crossing immediately downstream from the project (right); both are fish migration barriers.

Figure 10. Cold Spring Creek near the proposed barrier location, June 21, 2021.

3.1.1 Fish presence/absence assessment

The Provincial Habitat Wizard Database (Province of BC 2022a) did not identify that any fish were previously sampled in Cold Spring Creek. The nearest fish accounts were in the Columbia River, 1.75 km downstream from the project. A review of the BC Ecological Catalogues (EcoCat) website[1], found no fish related reports on Cold Spring Creek.

[1] Available: EcoCat Ecological Reports Catalogue - Province of British Columbia (gov.bc.ca).

Lotic Environmental conducted presence/absence sampling on July 21 - 22, 2020, to verify and supplement the desktop findings. Sampling involved electrofishing the full stream length from the outlet at the Columbia River, upstream 400 m past the FHSR Irrigation Reservoir, and setting minnow traps over a 24-hour period (Figure 11). The minnow traps were set in pools at the pond near the creek outlet, at each of the seven culvert crossings, in the Irrigation Reservoir, and in pools upstream of the reservoir.

Fish were present in the downstream most 1 km of Cold Spring Creek, up to the Highway 93 culvert. In the flowing (lotic) habitat, the primary species present were Eastern Brook Trout (EB, a non-native species; Table 2). Although fewer in number, Bull Trout (BT), were also present in lotic areas. Redside Shiners (RSC) were present in the golf course pond immediately upstream of the creek outlet. Also, immediately downstream of the outlet, there is an important Kokanee spawning habitat in the Columbia River. There were no fish sampled upstream of the Highway 93 culvert.

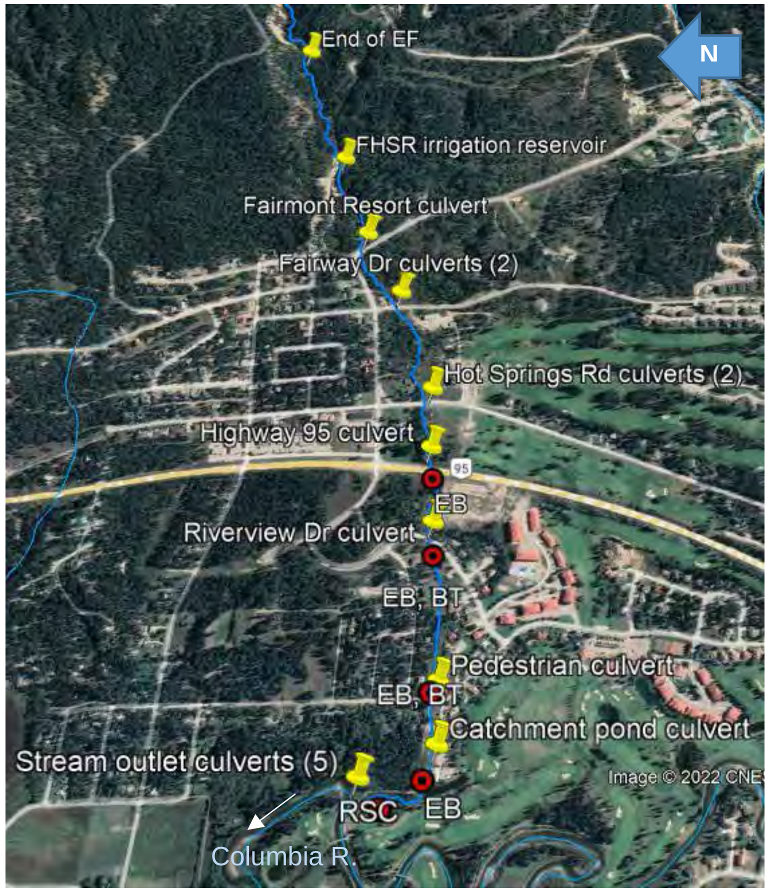


Figure 11. Cold Spring Creek fish sampling and capture locations, July 21/22, 2000. Fish codes: Bull Trout (BT), Redside Shiner (RSC), and Eastern Brook Trout (EB).

Table 2. Cold Spring Creek, fish sampling results, July 21 and 22, 2020.

Species	Count	Size range (mm)	Habitat comments (fish only present downstream of Highway 93 culvert)
Eastern Brook Trout (EB)	16	102 - 220	In pools throughout the channel downstream of the Highway culvert. Included the downstream most section where flows were slower and fine substrates were present.
Bull Trout (BT)	4	105-175	In pools, from the pedestrian culvert upstream to the Riverview Rd culvert.
Redside Shiners (RSC)	22	49 – 91	In the golf course pond at the outlet of Cold Spring Creek.

3.1.2 Fish passage assessment

The outlet of Cold Spring Creek and all road crossings upstream to the project had culvert crossings, for a total of eight crossing locations (Figure 11). A preliminary[2] culvert assessment was also completed to determine the fish passage potential. Standard field measurements and photos were collected. Data were entered into the Provincial Stream Crossing Information System (PSCIS) culvert assessment worksheet, which scored and identified if the culvert was likely a barrier or passable (Province of BC 2015). Several of the culverts were determined to be potential barriers to upstream fish migration (Appendix C).

Starting downstream at the Columbia River, access was limited upstream via the five culverts through the dike. Fish access was expected during flood flows. The next two culverts upstream to the highway culvert had PSCIS scores indicating that they were impassable; however, the scoring was considered conservative and just a tool, as the presence of fish during sampling confirmed passage at least under some flows. Also, the scores downstream of the highway culvert were lower (26 – 29 score) indicating improved passage conditions compared to the highway culverts and the next three upstream (34 – 42 score).

The first definite barrier was the Highway 93 culvert, located 0.85 km downstream of the project. This culvert was a determined to be barrier based on the fish absence upstream. This was validated through the following high measurements: outlet drop height (0.6 m), gradient (4%), length (30 m), and stream width: culvert diam ratio (1.7). As well, the highway culvert lacked embedment into the substrate (as did all the other culverts reviewed). Overall, the highway culvert scored the poorest (42).

The remaining three crossings upstream to the project also had either sizable outlet drops heights without a suitably sized outlet pool, and/or other physical characteristics that likely limited if not precluded upstream fish migration (at certain flows and for the younger life stages at least). As indicated above (Figure 9), the Fairmont Resort Road culvert was a definite barrier based on its outlet drop height (1.05 m) relative to outlet pool depth (0.36 m). Finally, the FHSR irrigation dam, located within the project footprint, was also a fish barrier given its height. Overall, the project area was determined to not provide fish or fish habitat.

3.1.3 Overall fish and fish habitat benefits / concerns

Given that the project is not in fish bearing waters, there is no potential for a harmful alteration, disruption or destruction of fish habitat (HADD), as defined by the Federal *Fisheries Act* administered by Fisheries and Oceans Canada (DFO; Table 3). Conversely, the project will be beneficial in protecting downstream fish habitat. This is because the objective of installing the debris flow basin is to mitigate larger debris flows that would otherwise be transported downstream, damaging infrastructure as well as fish habitat. However, the project will be designed to transport regular annual flow and sediment in a natural fashion to downstream habitat. This will ensure that the stream does not aggrade downstream (BGC and McElhaney 2022). Albeit, it is worthwhile to note that as is, even with the upper FHSR reservoir in place, the creek experiences high bed movement, with maintenance at downstream culverts and the downstream sediment catchment pond necessary nearly annually.

Although there was no fish habitat present in the project footprint, downstream impacts are to be mitigated during construction. In particular, during the period of August 31 – July 15. This period spans the fall through the spring, as this is sensitive spawning and incubation period for native species (Westslope Cutthroat Trout, Kokanee and Bull Trout) that reside in the Columbia River downstream 1.7 km (BC Ministry of Environment [BC MoE] 2009). Kokanee spawning habitat is specifically known to be present in the Columbia River, near the Cold Spring Creek outlet. Cold Spring Creek did not have spawning habitat for these species, and access upstream from the Columbia River appeared to be inhibited by culverts at all but flood flows. Impacts on fish bearing waters will need to be mitigated by ensuring deleterious substances do not enter the watercourse both during and after construction (Section 4). During construction, this will

[2] The culvert assessment was included as an extra to help understand the fish absence findings. More complex analysis techniques are available to confirm passage, namely collection of velocity data (under various flows) followed by a comparison to species and life stage specific swimming capabilities (Parker 2000).

involve, for example, isolating the construction area from Cold Spring Creek flows so turbidity meets the BC Water Quality Guidelines (Section 4.7) 0.85 km downstream of the project at the highway culvert year-round; and whenever possible, completing activities with the potential for short-term turbidity spikes (e.g., during install and removal of a diversion) from July 16 to August 30. This is when the sensitive life-stages described above are not present. Following construction, the site is to be left in a stable condition where erosion and sedimentation resulting from the project do not occur.

3.2 *Terrestrial habitat sensitivities*

3.2.1 General

A review of terrestrial species and habitats was conducted in the core footprint area and along the permanent access route on June 21 and July 12, 2021 while monitoring the site investigation (borehole, test pit and geophysical) work conducted by BGC. The assessment objective was to provide general observations and to look for Species at Risk, nests protected under the BC *Wildlife Act*, and other high value habitats.

The project is located in the Interior Douglas-fir very dry and cool biogeoclimatic (BEC) zone (IDFxk) (Province of BC 2022). In the East Kootenays, the IDF Zone spreads across low- to mid-elevations (BC Ministry of Forests [BC MoF] 1996). The ecology of this zone reflects the shortage of moisture, and frequent stand-maintaining fires (BC MoF 1996). The lower elevation areas nearer to the creek were generally a mixed forest. Up the slopes, the forest was dominated by coniferous trees. The forest overall was immature; however, a few larger mature trees were present (circumference of ~ 1.0 m). No wildlife or veteran trees of note were observed.

Plants identified were as follows (Figure 12 - Figure 14):

- Trees: Douglas-fir (*Pseudotsuga menziesii* – dominant, especially on the slopes), Trembling Aspen (*Populus tremuloides*), White Birch (*Betula papyrifera*), and Spruce spp (*Picea* spp.).
- Shrubs: Green Alder (*Alnus viridis*), Willow (Salix spp. - near the water), Rocky Mountain Maple (*Acer glabrum*), Creeping Juniper (*Juniper horizontalis*), Common Juniper (*Juniper communis*), Oregon Grape (*Mahonia aquifolium*), Common Snowberry (*Symphoricarpos albus*), Red Osier Dogwood (*Cornus Sericea*), Buffalo Berry (*Shepherdia canadensis*), Silverberry (*Elaeagnus commutate*), Common Bearberry (*Arctostaphylos uva-ursi*), Saskatoon Berry (*Amelanchier alnifolia*), Twinning Honeysuckle (*Lonicera dioica*), and Choke cherry (*Prunus virginiana*).
- Wildflowers: Brown-eyed Susan (*Rudbeckia Triloba*), Wood Lilly (*Lilium Philadelphicum*), Mountain Death-Camas (*Zigadenus elegans*), Star-Flowered False Solomon's-Seal (*Maianthemum stellatum*), Yarrow (*Achillea millefolium*), Narrow-leaved Skullcap (*Scutellaria angustifolia*), Smooth Fleabane (*Erigeron glabellus*), Long-Stalked Starwort (*Stellaria longipes*), Red Clover (*Trifolium pratense*), and Geyer's Onion (*Allium geyeri*).
- Introduced wildflowers were observed in the disturbed soil alongside the road and near the irrigation reservoir spoil piles. These included: Tufted Vetch (*Vicia cracca*), Spotted Knapweed (*Centaurea Stoebe*), Oxeye Daisy (*Leucanthemum vulgare*), Creeping Thistle (*Cirsium arvense*), and Yellow Salsify (*Tragopogon Dubius*).
    - Of these the following species are classified as invasive species in BC (Invasive Species Council of BC 2021): Spotted Knapweed, Canada Thistle, and Oxeye Daisy. Measures are to be taken to remove (or bury to compost) soil from areas where these species are present, and not -reintroduce these species into reclaimed areas.

Two Osprey (*Pandion haliaetus*) were observed near upstream end of the project (in the proposed laydown area), but no stick nests were observed in the area. On June 21, one small nest was found with an empty blue egg (perhaps from an American Robin), indicating that a young bird had hatched and fledged.

Figure 12. Representative photos of proposed north west basin area: looking south from top of north slope (left), and the forested valley at the base of the slope (right).

Figure 13. Proposed lower laydown area, in the previously distrubed area set back from the stream (left) and nearer to the stream (right).

Figure 14. View to west of disturbed area alongside the existing irrigation reservoir proposed to be the upper portion of the basin (the irrigation reservoir shown will be kept intact).

3.2.2 Sensitive species potential

A desktop review for potential sensitive terrestrial values was first conducted. Based on provincial database mapping (Province of BC 2022a), three sensitive species were potentially present in the project footprint - American Badger, Vivid Dancer and Nuttall's Sunflower (Province of BC 2022a; Figure 15). However, there was no evidence of these values being present during field reviews conducted on June 21 and July 12, 2021. Specifics on each species are as follows:

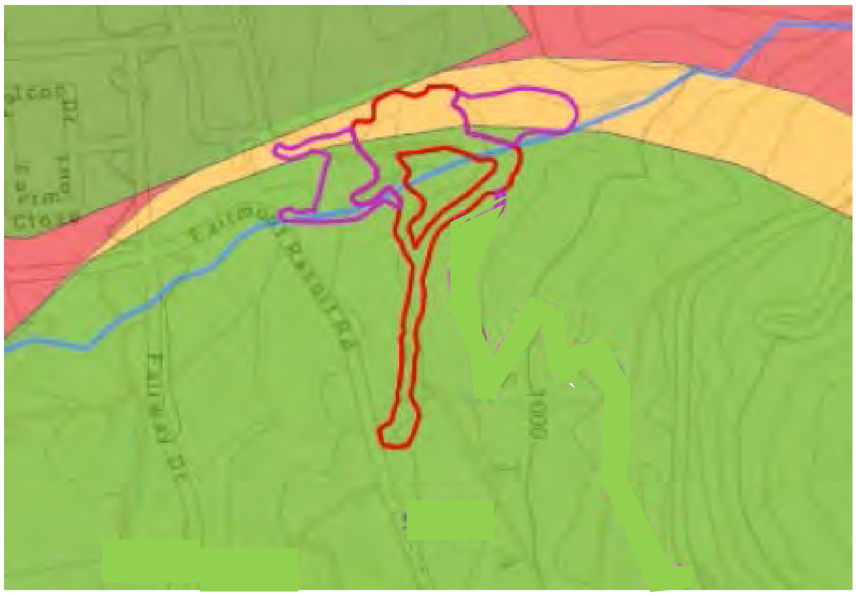


Figure 15. Sensitive species relative to the permanent (red outline) and temporary (purple outline) project footprint: American Badger (red and underlies all colours), Vivid Dancer (orange and underlies all colours) and Nuttall's Sunflower (lime green). Source Province of BC 2022a.

1. American Badger (*Taxidea taxus*) is listed as endangered both federally (*Species at Risk Act* [SARA] Schedule 1[3]; Figure 16) and provincially (red-listed). The mapped local area for this species is broad (424,315 ha), spanning the East Kootenay Trench. A summary of habitat details of relevance is as follows (Water Land and Air Protection [BC WLAP] 2002): *Females raise their young in dens* ***from late winter through spring.*** *A maternal den is evidenced by a large mound of soil at the entrance, with droppings and shed hair. From late June to August, juvenile badgers begin to disperse in search of suitable home ranges of their own, which may take them up to 100 km from their birth area and involve crossing rivers, highways and farmland. This is the period of highest mortality for Badgers.* During the 2021 field review no badger dens were evident. However,

Figure 16. American Badger emerging from its den (Enyclopedia Britannica 2022).

[3] Schedule 1 is the official federal list of wildlife species at risk, which receive legal protection under SARA. On private, provincial or territorial land, the general prohibitions apply only to: aquatic species listed as endangered, threatened or extirpated; and migratory birds listed in the *Migratory Birds Convention Act* (1994) and also listed as endangered, threatened or extirpated in Schedule 1. However, the intent is that these species or their sensitive habitats will also not be harmed through this project.

a survey will be conducted prior to clearing and grubbing with a protection plan prepared if present in the construction area.

2. Vivid Dancer (*Argia vivida*; Figure 17*)* is a species of Special Concern federally (SARA 1) and provincially (blue listed)*.* As per the species profile (Government of Canada 2011): "*The Vivid Dancer is a robust damselfly 29.5 – 35mm long. Adult males are typically bright blue or occasionally violet blue, both forms with black markings. Females resemble males or may have more subdued colours, typically orange or red-brown and black. Vivid Dancer is distinguished from similar damselflies in other genera by wing venation patterns, the shape of reproductive structures, and comparatively longer leg spines. Vivid Dancer larvae are short, stocky and flattened, with broad, heavily pigmented, leaf-like gills*." The species has been mapped as being potentially present over a broad area (313 ha), with observations outside of the project, at Columbia Wetlands in 2008 and Fairmont Hot Springs in 1991 and 2013 (Figure 15; Province of BC 2022). However, rank comments indicate that there were very few individuals seen, and that habitat was greatly altered, with little appropriate habitat left (J. Zloty, pers. comm.).

   As per the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2015: "The Vivid Dancer is the only documented odonate adapted to breed in geothermal springs in North America. This damselfly is found in Southern BC and Banff, Alberta. Through much of its Canadian range it is restricted to thermal springs, but in the hot valleys of the Okanagan and Fraser it is also found in cooler, spring-fed creeks. Habitat loss and degradation have led to population declines. The eggs of this species require a minimum water temperature of 11 oC for development. The larvae hatch and overwinter in warm aquatic environments and emerge as adults from late April to mid October. Adults forage and roost in adjacent water and forest habitats".

   The project is located at the northern tip of the mapped area. No warm springs were identified in the project footprint during the field investigations. If found during subsequent reviews, additional consultation with the provincial and likely federal regulators will occur to ensure this unique warm water habitat is not disturbed, regardless of whether this species is evident or not.

Figure 17. Vivid Dancer adult and larva (COSEWIC 2015).

Figure 18. Outflow of tufa mounds at Fairmont Hot Springs where three adult Vivid Dancers were observed in July 21, 2013 (COSEWIC 2015 Photo by Rob Foster).

3. Nuttall's sunflower (*Helianthus nuttallii* ssp. *Rydbergii;* Figure 19). Although this vascular plant was mapped as a sensitive species, it was classified as provincially unrankable or unknown in 2019 (SU) and was not listed federally. This species was last reported in Fairmont in 1964, and is known in grassland, shrub, meadow, and wetland/marsh habitats (BC CDC 2021b). No further information was found in the provincial database. For this reason, this plant is not expected at the project, and if present, will not be treated as particularly sensitive. Additionally, this plant was not observed during the 2021 field review, although another similar flower was, the Brown-eyed Susan. The Brown-eyed Susan is not a sensitive species.

Figure 19. Nuttall's sunflower (left, Photo: J. Riley 2004 [E-flora 2020]), compared to the Brown-eyed Susan seen at the project (right).

3.2.3 Ungulate winter range

Ungulate winter range was mapped to be present throughout most of the undeveloped west facing low elevation land in the Columbia River valley, including along both sides of Cold Spring Creek in the project footprint (Province of BC 2022a; Figure 20). Ungulate winter range is habitat that is necessary to meet the winter habitat requirements of ungulate species (i.e., mule and white-tailed deer, elk, and moose). In BC, this designation was established under the *Forest and Range Practices Act (FRPA;*) and means the area is a conditional harvest zone for logging activities (Province of BC 2022a). However, provincial ungulate winter range mapping was also included in the Fairmont Hot Springs & Columbia Lake Area Official Community Plan (OCP) (RDEK 2017). In the OCP, ungulate winter range falls under Section 12.1 - Wildlife and Habitat Corridors and has the stated objective that future development is not to compromise the integrity of this habitat. Class 2 winter range is present in the footprint, with no specifics on how this is discerned from Class 1 (RDEK 2017).

A cross reference with the Wildlife Telemetry Observation Points layer in iMap BC indicated that ungulates largely utilize areas outside of the project footprint, including the residential areas downslope from the project. This additional information will be useful to help confirm the relevancy of the telemetry data to potential ungulate winter range use near the project.

Overall, to protect ungulate winter range, it is recommended that: a) the footprint be kept as small as possible, b) previously disturbed areas be utilized to the greatest extent possible; and c) temporary disturbed areas be reclaimed with a suitable grass seed mix (native seed mix conducive to grazing). Also, construction crews should be cognisant of animals during winter construction.

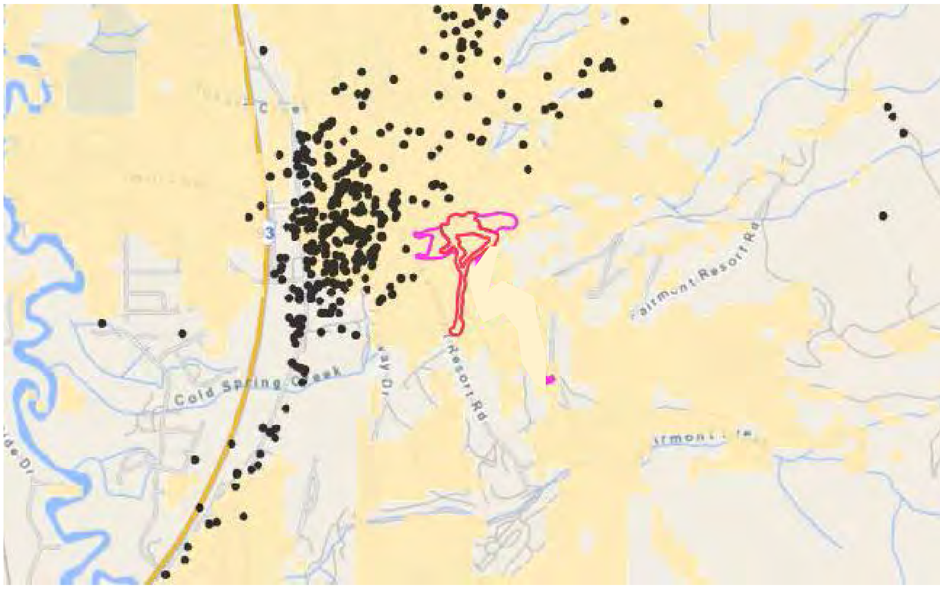


Figure 20. Ungulate winter range (orange shaded areas) and ungulate telemetry (black dots) relative to the project (red and pink outline) (Province of BC 2022b).

3.2.4 Birds

Bird nesting is one of the most likely sensitive species/life stages to utilize the vegetated areas in the project footprint. There are two pieces of legislation protecting birds that are to be adhered to:

1. Under the *Canadian Migratory Birds Convention Act* and its regulations, nests or nesting birds are not to be disturbed during breeding and nesting periods. In the Northern Rockies, this period is generally mid-April to mid-August (Figure 22; Environment Canada 2018). If the work is done within the nesting period, a nesting survey will be conducted prior to clearing, with mitigation measures outlined to protect any nests (waiting until the birds have fledged and establishing a 30 m buffer zone).
2. Regardless of timing a nesting survey will need to be conducted prior to clearing to ensure that no permanent bird nests protected under the *BC Wildlife Act* are present. This includes the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl. Other than the Burrowing Owl, these tend to be large (1 m diam) stick nests. As noted previously an Osprey

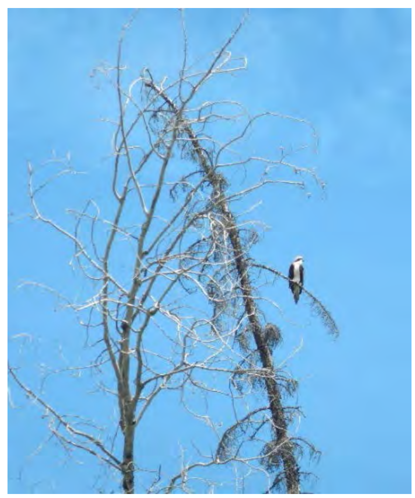
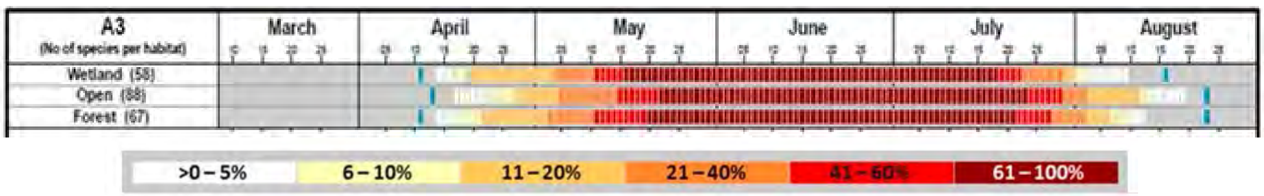


Figure 21. One of a pair of Osprey seen near the upstream end of the project, on June 21, 2021.

pair were evident at the upstream end of the project (Figure 21). Although no nest was evident, a more extensive survey is to be completed prior to clearing.

As per Government of Canada (2021) Burrowing Owls nest underground in the abandoned burrows of mammals such as badgers, ground squirrels, prairie dogs, and marmots. Nests are typically located on flat to gently rolling grasslands (usually grazed cattle pastures, but also roadside ditches, golf courses or other areas with lawn, and occasionally cultivated land). Burrows can often be recognized by the owl feces (‘whitewash’) and food pellets around their entrance and mound. There may also be shredded livestock manure surrounding the entrance. In addition to being protected under the *BC Wildlife Act*, these nests are protected federally under SARA.

If a nest described above is present, a suitable buffer (e.g., 30 m) will be established to protect the nest. The option to obtain a permit from the provincial and/or federal government will also be considered, but it is recognized that the regulatory review would likely take considerable time, and there is a potential for the application to be denied.



Legend: *Number of species in percentage (blue markers show extreme dates predicted for some atypical parts of the nesting zone where nesting could be earlier or later).*

Figure 22. Bird nesting calendar for Northern Rockies Zone (Environment Canada 2018).

3.2.5 Other potential values reviewed

The desktop review also investigated the potential for other high value habitats to be present (Province of BC 2022a and 2022b), with none of the following features mapped in the project footprint:

- No Wildlife Habitat Features, Wildlife Habitat Areas or Old Growth Management Areas protected under the Forest and Range Practices Act (FRPA) were present.
- No grasslands were identified in the OCP, although they were mapped as being present elsewhere in the bylaw area.
- Additionally, no Bighorn Sheep habitat was identified in the OCP, although this habitat was mapped as being present elsewhere in the bylaw area.
- There was no Critical Habitat protected under SARA present.

3.3 *Environmental Impact Summary*

3.3.1 OCP Development Permit Area requirements

Under the RDEK’s OCP for the area, the project is situated in a Development Permit Area (DPA) based on the presence of Environmentally Sensitive Areas (ESAs) of wetland and riparian ecosystem habitat and habitat for species at risk (RDEK 2017; Figure 23). The wetland and riparian ecosystem mapping was completed through the application of a standard 30 m buffer to Cold Spring Creek in undeveloped areas, and species at risk habitat was mapped using the outputs from the provincial database iMap BC (McPherson and Marcotte 2017). Although not present within the project boundary, grasslands and Big Horn Sheep habitats were mapped in the OCP using the professional input from Forests, Lands and Natural Resource Operations and Rural Development (FLNRORD; habitat officer [McPherson and Marcotte 2017]). Grasslands were also mapped considering the input from FLNRORD as well as resources available through the Rocky Mountain Trench Society (McPherson and Marcotte 2017).

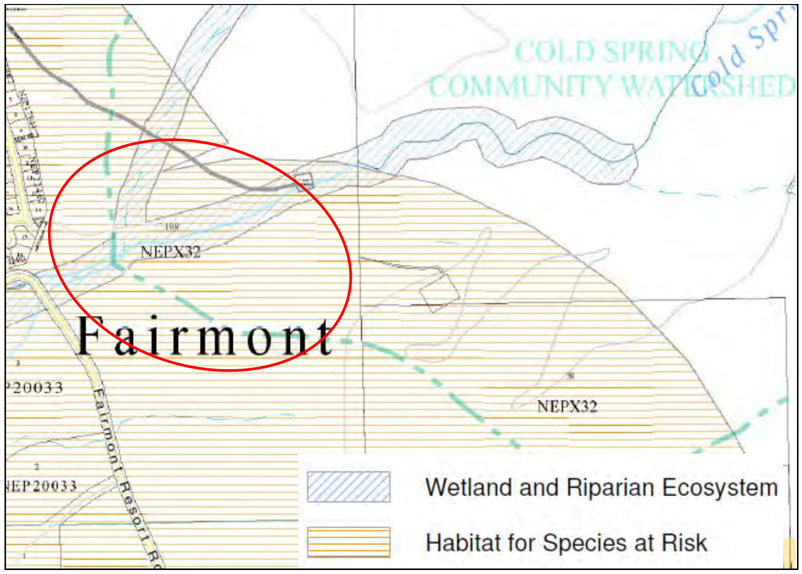


Figure 23. General project location (red circle) relative to the Fairmont OCP, ESA areas (RDEK 2017).

In accordance with the Section 20.3 of the OCP, the guidelines for these DPAs are as follows:

Wetland and Riparian Ecosystem: *A riparian buffer for watercourses, lakes, ponds and wetlands must be established within which no development or alteration of land is permitted. Unless an Environmental Impact Assessment Report (IEA) by a QEP indicates otherwise, the size of the riparian buffer must be no less than 15 m. If disturbance within this buffer is necessary, the EIA is to:*

A. *Identify appropriate measures to protect hydrology and ecological processes.*
B. *Incorporate mitigation measures to minimize adverse environmental effects and be in compliance with federal or provincial legislation or regulations.*
C. *If there are negative impacts, include compensatory enhancement or restoration measures in order to minimize the net loss of wetlands and riparian ecosystems.*
D. *Identify the potential for upland development to impact riparian ecosystem areas through increased runoff, sedimentation, loss of shade, or increased watercourse temperature.*

Species at risk: *An EIA report completed by a QEP may be required. When required, the report may need to include an inventory of any habitat that supports species at risk, to be completed as part of the identification of relevant baseline information. If habitat that supports species at risk is identified, the EIA must:*

A. *Document the species at risk and their habitat which may be impacted by the proposed activity or development.*
B. *Identify and describe any potential and likely impacts of the activity or development on the species at risk and their habitat, including any cumulative effects when combined with other projects proposed or under development.*
C. *Evaluate the impacts in terms of their significance and the extent to which they might be mitigated.*
D. *Make recommendations as to conditions of approval that may be appropriate to ensure that undesirable impacts are mitigated or avoided; in accordance with accepted impact assessment methodology.*

3.3.2 Summary of environmental values and design measures to reduce impacts in the project footprint/DP area

Overall, these values, mitigation measures/efforts to reduce impacts have been described in previous sections of this document and the debris-flow mitigation report (McElhanney and BGC 2022). Key items of note are that:

1. There were no wetlands present in the project footprint.
2. There were no fish or fish habitat values present in the footprint area and downstream 0.85 m to below the Highway 95 crossing, reducing the potential impacts on the watercourse.
3. The objective of the project is to reduce the potential for environmental impacts and loss of life downstream/downslope in Cold Spring Creek and the community of Fairmont.
4. The natural sediment supply will still be permitted to pass with the given design.
5. The desktop and field reviews found there to be a low potential for the terrestrial species at risk to be present.
6. Sections of the creek and riparian area in the footprint are already impacted, as a result of the FHSR irrigation dam and reservoir and associated infrastructure being present (spoil area, laydown area etc.).
7. The project has been designed to minimize the riparian footprint area. The temporary restricted area specifically has been identified to protect vegetation within 15 m of the creek alongside the laydown areas. Where possible, temporary footprint areas will be reclaimed, by replacing topsoil that is stockpiled at the project outset and grass seeding.
8. The road access network takes advantage of the existing or relict roads in the area to the greatest extent possible.
9. Disturbance of mature trees will be reduced during construction, where possible. This will be achieved by avoiding mature tree removal along the access road, and in the 15 m buffer alongside the laydown areas (shown as temporary restricted footprint).
10. Other potential mechanisms to reduce environmental impacts will be identified through input provided through the design and construction stages, following consultation with local First Nations, FHSR, FHSR community residents, and other stakeholders.
11. Appropriate mitigation measures will be in place during construction, consistent with best management practices for environmental protection. This will involve:
    a. Adherence to the BMP provided in this document during construction (Section 4).
    b. Having a Qualified Environmental Professional (QEP) prepare a Construction Environmental Management Plan (CEMP) that builds on the BMP, by adding the Contractor specific mitigation plan details to be adhered to during construction.

3.4 *Environmental regulatory requirements*

The applicable environmental regulatory requirements to be adhered to are summarized in Table 3. Also included are other associated but non-environmental requirements (i.e., *BC Dike Maintenance Act* and *BC Heritage Conservation Act*).

Table 3. Environmental (and associated) regulatory requirements.

Legislation (Estimated permitting time)	Conditions and/or mitigation measures
Federal *Fisheries Act* (6 months)	Department of Fisheries and Oceans Canada (DFO) is responsible for administering the *Federal Fisheries Act*. Under Section 35 of the Act, no person shall carry on any work, undertaking or activity that results in the death of fish or harmful alteration, disruption or destruction of fish habitat (HADD). The *Act* defines other requirements to protect fish and fish habitat including safe passage, and the prohibition of the introduction of deleterious substances. ■ It has been determined that there are no fish and thus no fish habitat present near the project, with the potential for a HADD thus being very low. ■ Even though there is no fish or fish habitat present in the vicinity of the project, the details of the project were submitted to DFO for Review. This was done as a precaution, given the size of the project. ■ Once obtained, the outcome of the DFO Review (e.g., Letter of Advice) will be attached to the final EA & BMP report (Appendix D).
BC Water Sustainability Act – Water Licence (6 months)	A BC *Water Sustainability Act* (WSA) Water Licence will be applied for to authorize the diversion of flow and installation and maintenance of the project. ■ The Water Licence must be received prior to the main components of this project proceeding. ■ Once obtained, the Licence will be attached to the final EA & BMP report (Appendix E).
BC Water Sustainability Act - Short Term Use of Water Approval	A Short-Term Use Approval under the BC WSA permits diversion and use of water for a term not exceeding 24 months.
BC Water Sustainability Act - Groundwater Protection Regulation	Under the WSA, the Groundwater Protection Regulation (GWPR) ensures that activities related to wells and groundwater are performed in an environmentally safe manner. The GWPR: • Regulates minimum standards for well construction, maintenance, deactivation and decommissioning, and • Recognizes the types of qualified people certified to drill wells, install well pumps and perform related services. All wells under the GWPR are regulated, including: Water supply wells, monitoring wells, recharge/injection wells, dewatering/drainage wells, remediation wells, Geotechnical wells, and Closed-loop geoexchange wells. During construction, the well driller, professional or other person responsible for constructing a well is required to comply with the provisions of the GWPR related to how the well is constructed. This person must ensure that the well meets the minimum standards for the casing material, wellhead completion, surface seal, well caps and covers and well identification. The person must also submit a well construction report to the province if required. Different types of wells have different requirements. A well pump installer or other professional is responsible for complying with the provisions of the GWPR when installing a pump in

Legislation (Estimated permitting time)	Conditions and/or mitigation measures
	a well. Provisions include ensuring that the casing is not damaged, maintaining the surface seal, using appropriate materials and installing related equipment.
BC Land Act	A Crown Land tenure to occupy the creek bottom and banks to the normal high-water mark may be required. This typically is processed by the Province as part of WSA water Licence permitting.
BC Environmental Assessment Act	An environmental assessment (EA) is not required for this project. Based on formal documentation on recent similar debris-flow mitigation projects, the EA office has noted that this project would be excluded from the EA process (BGC and McElhanney 2022). BGC's review of similar projects in BC found that none had been through the EA process. Additionally, the proposed design will have a slot opening in the outlet structure and therefore the barrier is not watertight or storing water and therefore dam safety regulations or water licenses for storage do not apply, nor do the definition of "dam" within the EA regulations apply.
Fairmont Hot Springs & Columbia Lake area Official Community Plan (OCP)	Under the RDEK's OCP for the area, the Project is situated in a Development Permit Area (DPA) based on the presence of Environmentally Sensitive Areas (ESAs) of wetland and riparian ecosystem habitat and habitat for species at risk (RDEK 2017). These values have been described in previous sections of this document. ▪ Prior to undertaking any works within the ESA, an application for a Development Permit (DP) is typically required to be submitted to the RDEK. The RDEK is determining whether the project requires a DP, since the RDEK is the proponent. ▪ If required, the DP will be attached to the final EA & BMP report.
Canadian Migratory Birds Convention Act and its regulations	No disturbance to nests or nesting birds will occur during breeding and nesting periods as a result of the Project. In the Northern Rockies, where the Project is located, this period is generally mid-April to mid-August (Environment Canada 2018). ▪ If clearing and grubbing are planned during the nesting period, a nesting survey will be first completed a qualified environmental professional (QEP). If a nest is found, the QEP will prepare suitable mitigation measures to ensure its protection (e.g., 30 m buffer and waiting until the birds have fledged).
Canada Species At Risk Act (SARA)	As per Section 32 (1) of SARA, no person shall kill, harm, harass, capture, or take an individual of a wildlife species that is listed as an extirpated species, endangered species, or a threatened species (Species at Risk or SAR). ▪ The American Badger and Vivid Dancer are the known potential SAR in the project area. An inspection by the QEP is thus to be conducted prior to clearing and grubbing to ensure their absence (timing and species are summarized in Sections 3.2.2 and 5). If present, measures are to be taken to protect them or obtain appropriate SARA permitting as required based on the SARA Registry for the species.

Legislation (Estimated permitting time)	**Conditions and/or mitigation measures**
BC Wildlife Act – Permit to Possess, Take or Destroy Bird Nest and/or Egg	Section 34 of the *BC Wildlife Act* prohibits possessing, taking or destroying: (i) a bird or its egg, (ii) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl, or (iii) the nest of a bird not mentioned in (ii), when the nest is occupied by a bird or its egg unless authorized under permit. Vegetation clearing is to be done only when the nests are not occupied. ▪ *See Canadian Migratory Birds Convention Act* nesting survey requirements above. ▪ A survey will be conducted prior to clearing and grubbing, to ensure no permanent bird nests protected under the *BC Wildlife Act* are present. ▪ If the survey finds protected nests to be present, then suitable mitigation measures will be employed (realign project with 30 m buffer, or perhaps obtaining a permit to destroy the nest).
BC Heritage Conservation Act (HCA)	The HCA recognizes the historical, cultural, scientific, and educational value of archaeological sites. Archaeological sites on both public and private land are protected under the HCA and must not be altered or damaged without a permit issued by the Province of BC Archaeology Branch. If an archaeological site is encountered, development activities must be halted and the Archaeology Branch is to be contacted for direction (250.953.3334). Chance find procedures for archaeological material (Ktunaxa Nation Council 2012), will be reviewed by all onsite contractors and adhered to throughout the project (Appendix F).
Interior Health	An Interior Health Waterworks Construction Permit
Ministry of Transportation and Infrastructure (MOTI)	The design team will consult with MOTI with respect to the access road, which will be accessed off Fairmont Resort Road.

4. Mitigation measures

The mitigation measures provided in this BMP are to be followed as a minimum to protect aquatic and terrestrial values. An overriding objective is to reduce the potential for the introduction of deleterious substances to the environment.

4.1 *BMP versus CEMP*

Following the tender process, the selected Prime Contractor is to arrange for a QEP to oversee environmental aspects of the project. As a first step, the QEP is to update the BMP with the project specific details. This updated document will be named Construction Environmental Management Plan (CEMP) and will include but not limited to:

1. Contacts – complete the table at the start of this report (page iii)
2. Schedule –chart detailing each task and subtask associated with completion of the project, the duration and estimated start and end dates for completion of these individual tasks. The activities/periods that the QEP is to be onsite are to be included in this schedule. The schedule is to also describe the regular project work hours, days off (on weekend or long weekends).
3. Description of works and equipment – if there is anything over and above that provided in this EA and BMP report.
4. List and copies of permits received – if there are any not already provided in this EA and BMP report.
5. Simple summary or cross reference to the environmental values and general environmental protection measures in this EA and BMP report.
6. Communications plan – outline for chain of command regarding communications (scheduling, progress etc) with the public and complaint response etc.
7. Erosion control plan – see Section 4.4 for more details.
8. Temporary access stream crossing plan (BMP Section 4.5).
9. Sediment control plan – see Section 4.5 for more details
10. Concrete management plan – see Section 4.6 for more details.
11. Traffic and access control plan – this plan is to include but not be limited to identification of a) measures to reduce the potential for incidents both on the worksite and on the highway; b) activities and locations when flaggers are required; c) any offsite locations for hauling materials to or from; measures to reduce tracking of dirt offsite onto the residential and highway roads, d) and any restrictions as identified by FHSR or others.
12. Noise and vibration management plan – This will include periods that a high level of noise or vibration are expected and the abatement plan. Abatement may include limited hours of operation; matting; notification to the McElhanney PM, so residents may be informed 1-2 days advance; and complaint management.
13. Adverse weather plan – to include implementation plan to follow during floods and wildfires. Generally, work should stop and the site is to be secured.
14. Reclamation plan (BMP in Section 4.8)– specifics to add to the details outlined in the BMP below
15. Post-construction monitoring – as required by the Contract.

Further details on the requirements for most of the plans listed above are provided in the sections below.

4.2 *Machinery*

1. Machinery that will be working in the existing or future stream channel (including in the basin) are required to use environmentally sensitive hydraulic fluids, which are free of heavy metals, non-toxic, and biodegradable. Note that readily biodegradable products (e.g., Cat® Bio HYDOTM

Advanced, Panolin) are preferred as they have a biodegradation of more than 60 percent within 28 days. Inherently biodegradable products (e.g., Petro Canada EnvironMV, Chevron Clarity) would be accepted, although these biodegrade more slowly (20 to 59 percent in 28 days).

2. Before arriving onsite, clean machinery of oil, grease and other contaminants, and inspect machinery for leaks or worn hoses, fittings, etc.
3. Power wash machinery prior to arriving onsite, to clean machinery of soil and vegetation debris to prevent the spread of invasive species.

4.3 *Wildlife (and fish)*

1. Prior to clearing and grubbing conducted from mid-April to mid-August, the QEP will complete a bird nesting survey. The review will be valid for a period of 5 days, after which the survey will need to be repeated. If present, suitable mitigation measures will be developed to protect the nest from disruption (e.g., 30 m buffer until fledging, re-design), or will obtain a Wildlife permit to destroy the nest.
2. Prior to clearing and grubbing in March through May, the QEP will conduct survey for Badger dens. If found, suitable mitigation measures will be developed to protect the badger from disruption (e.g., 30 m buffer, re-design).
3. Prior to clearing and grubbing during any time, the QEP will conduct surveys for other species at risk identified in this EA (Section 3.2) and permanent bird nests protected under the *BC Wildlife Act* (Section *3.2).* If any of these species or their unique habitats are identified, suitable mitigation measures will be developed to protect these from disruption (e.g., suitably sized buffer, relocation, re-design) or obtain an applicable permit.
4. If wildlife are present (e.g., moving through the area during construction), provide them space to pass.
5. No fish are expected, however, if any are seen during dewatering activities, etc, they are to be salvaged (moved to downstream waters) and the QEP is to be notified immediately.
6. The QEP is to be informed of any wildlife identified onsite throughout the project.

4.4 *Erosion control*

The Contractor is to maintain erosion control measures until all disturbed ground has been permanently stabilized, as follows:

1. Prior to any construction, flag the limits of clearing required to facilitate construction. When planning for clearing:
    a. Keep the footprint for vegetation removal as small as possible to reduce the amount of soil that may erode during rainfall events.
    b. Minimize removal of established trees and shrubs – consider only pruning vegetation, and/or laying down geo-fabric for temporary access areas, to minimize disturbance.
    c. Do not disturb an area until it is necessary to proceed with construction.
2. Collect topsoil from any areas where vegetation removal is required. Stockpile the topsoil on level ground, where it will not have the potential to erode into the river. Cover the topsoil if there is the potential for erosion.
    - The one area where topsoil is not to be stockpiled is from the disturbed roadside and spoils area in the vicinity of FHSR irrigation reservoir. Here several invasive species were identified (Section 3.2.1), with Spotted Knapweed being the most prevalent. Here, the surface soils (top 0.2 m) are to be stockpiled and removed offsite to a landfill or buried in a pit (at a 1 m depth to compost). Prior to clearing and grubbing here the QEP is to flag areas where invasive species are present.

3. In areas where there are exposed soils with the potential to erode into a watercourse, install suitable erosion control measures. This may include covering exposed soils with geo-fabric or plastic.
4. Where barriers or other erosion control measures may not be fully effective in limiting sedimentation, properly install sediment control structures such as sediment fencing, diversion ditches/berms, and/or settling basins, to prevent sediment entry to the watercourse. Ensure these structures remain functioning throughout the project, should precipitation events occur. When sediment fencing is employed, ensure effectiveness by:
    a. Trenching the bottom of the fence 15-20 cm below the soil surface, so the fence is not undercut by runoff.
    b. Backfilling and compacting the trench.
    c. Conducting regular inspections and maintenance.
5. Halt work during adverse weather conditions.
6. Notify the McElhanney Project Manager and QEP if there are potential stability issues not addressed through the design, which may require additional resources to address.
7. Site-specific details are to be provided in an **Erosion Control Plan** in the CEMP. This plan is to include details of where and how erosion potential will be mitigated throughout the site.

4.5 *Sediment control*

During all instream work, suitable mitigation measures will be employed to ensure that sedimentation is controlled in a manner that protects downstream aquatic life (see Section 4.7).

1. Temporary stream crossings required for construction access are to be stable structures that do not result in ongoing sedimentation. This may include the installation of a culvert, working bridge, rig mat or equivalent) that is suitably sized for the given flow. The **Temporary Access Stream Crossing Plan** is to be provided in the CEMP, which details the locations, crossing type, installation approach, and timing for these installations.
2. Sediment control will involve diverting streamflow around the areas requiring instream work to reduce the potential for sedimentation as follows. Site-specific sediment control plan details will be presented in a **Sediment Control Plan** in the CEMP. BMPs to be adhered to are as follows:
    a. If works require the stream to be diverted for an extended period, standard approaches are to divert the stream around the working area using temporary channel that is plastic lined, or a culvert.
    b. For temporary works (e.g., for culvert installation or culvert inlet cleaning), the standard approach is to divert the stream by:
        i. Installing a suitably sized sump - this is recommended to be done by installing a cofferdam that will dam up the flow. An excavated sump may be acceptable if turbidity guidelines can be met.
        ii. Installing suitably sized pumps in the sump to divert clean flow around the working area back into the watercourse.
    c. If there is dirty water generated within the construction area, another system (e.g., sump and pump) is to be installed to divert turbid water into a suitable location (vegetation, pit or settling pond), where it will filter before flowing into the creek again.
    d. Where pumps are employed, redundancy is to be planned should a pump break down or run out of gas.
3. The **Sediment Control Plan** is to include contingency details should the isolation and diversion become ineffective (e.g., through pumps malfunction, or during high water events).
4. Diverting streamflow during other activities with a smaller amount of sedimentation and shorter duration (such as pile driving or initial stream crossing) will be at the discretion of the QEP, who is to ensure the water quality guidelines are met (Section 4.7).

5. During works that result in sedimentation, the QEP is to monitor water quality guidelines to ensure the turbidity guidelines for the protection of aquatic life are met before flow reaches fish habitat (Section 4.7).
6. If cast in place concrete installations are required within the wetted channel, stream diversion will also be required (see next section).

4.6 *Working with uncured concrete*

Concrete leachate is alkaline and can instantly change the PH of water. This change in pH can harm or kill fish and pose risks to other aquatic life. Therefore, raw concrete grout, cement, or mortars used in close proximity to water, must be done so with care. Prevent deposition of these deleterious substances into any waterbody, through the following BMPs:

1. As outlined in the Roles and Responsibilities (Section 5), the QEP will be present for concrete works during any period that there is a risk of uncured concrete contact with the watercourse.
2. Divert stream flow away the working area (see above). This is to be achieved using a mechanism that is confirmed to be acceptable by the QEP. For example, it may involve pumping clean flow around the working area, setting up sandbags to divert flow into a temporary culvert or plastic lined channel etc.
3. Sealed framework will be constructed to hold the concrete in place.
4. There shall be no contact of concrete work with any watercourse through spillage, hosing off surfaces, cleaning tools or equipment, or rain events.
5. Concrete will cure a minimum of 48 hours in complete isolation from any road runoff or surface water; and any runoff from curing concrete will be contained and prevented from entering any watercourse.
6. Do not discharge wash water into a watercourse or drainage ditch. If required, concrete wash water may be disposed in an upland, contained location (e.g., rock pit or grassy area), at least 30 m away from the high-water mark. The area must be pre-approved by the QEP. Clean and reseed any disturbed areas as appropriate.
7. Compressed CO_2 gas with an appropriate diffusion system will be available to aerate any contaminated water to reduce the pH level and ensure guidelines for aquatic life (pH 6.5 - 8.0) are met. This system will be required for any water that must be discharged to a watercourse.
8. The CO_2 diffusion system is to be onsite if there is a high risk that a spill could reach the watercourse, which is to be confirmed by the EM. Examples of this are when the work is right at the water's edge or over the water, with no containment should a spill occur.
9. Remove excess concrete from the site.
10. Water quality measurements (pH and turbidity) will be taken by the QEP if there is any evidence of a spill. The BC approved water quality guidelines for the protection of aquatic life will be adhered to.
11. The CEMP is to include a **Concrete Management Plan.** This plan is to include, but not be limited to identification of works requiring concrete pours, timing, the isolation plan, wash water disposal location, monitoring requirements (treatment) and contingency should a spill occur.

4.7 *Water quality monitoring*

During instream work, the QEP will monitor and document water quality to ensure downstream values do not exceed acceptable levels for the protection of freshwater aquatic life, as defined by the British Columbia Water Quality Guidelines (Province of BC 2021). Two water quality parameters that may be influenced by this project are turbidity and pH. Acceptable levels for both parameters are referenced against background stream conditions (Table 4). Turbidity is used to measure the extent of instream sediment generated. Turbidity is field measured in nephelometric turbidity units (NTUs).

The QEP is to work with the Contractor to determine the timing for works that may impact water quality and is to conduct monitoring during those times. It is recommended that the water quality guidelines be monitored and met by the Fairmont Hot Springs Resort Road, which is 100 m downstream of the permanent construction footprint. This is a conservative target location that is accessible and ensures aquatic life (invertebrates that are food sources for fish) are not impacted. Since the flow is fast and direct, meeting the guidelines here will also ensure that the fish present 850 m downstream of the project at the Highway 93 culvert outlet are also not impacted by deleterious substances. The monitoring frequency is recommended to be approximately every half hour. This can be increased or decreased as determined by the QEP. Once it has been determined that works are isolated with no potential harm to the environment, the QEP does not have to be onsite permanently (weekly site visits are typically acceptable).

Table 4. Turbidity and pH guidelines for the protection of aquatic life (Province of BC 2021).

Parameter	Background condition	Acceptable increases
Turbidity (NTU)	Clear flow period	▪ Maximum increase of 8 NTU from background levels for a short-term exposure (24-h period). ▪ Maximum average increase of 2 NTU from background levels for a longer-term exposure (30-d).
	High flow or period of naturally turbid waters	▪ Maximum increase of 5 NTU from background levels at any one time, when background levels are between 8 and 50 NTU. ▪ Maximum increase is to be less than 10% at any one time, when background is >50 NTU.
pH (pH units)	< 6.5	▪ No statistically significant decrease in pH from background. No restriction on the increase in pH except in boggy areas that have a unique fauna or flora.
	6.5-9.0	▪ Unrestricted change permitted within this pH range. This component of the freshwater WQGs should be used cautiously if the pH changes causes the carbon dioxide concentrations to exceed a 10 µmol/L minimum or a 1360 µmol/L short-term. Carbon dioxide concentrations below 10 µmol/L can cause a shift in the phytoplankton community to cyanobacteria, while CO_2 concentrations above 1360 µmol/L can be toxic to fish.
	> 9.0	▪ No statistically significant * increase in pH from background. Short-term increases (2- 3 days) to pH 9.5 are permitted for lake restoration projects. Decreases in pH are permitted as long as carbon dioxide concentrations are not elevated above 1360 µmol/L. CO_2 concentrations above 1360 µmol/L may be toxic to fish.

4.8 *Site reclamation*

The site will be stabilized upon completion, as follows:

1. Remove all construction equipment, supplies, and waste materials from the site.
2. Leave the site in a stable condition with no erosion concerns (see Section 4.4).
3. Remove any granular material above the native soil (e.g., laydown areas) that is not deemed suitable for reclamation.
4. Roughen the ground surface using the excavator.
5. Replace the original topsoil material that was stockpiled at the clearing and grubbing stage.
6. Grass seed exposed soil areas that have been disturbed during the project. The seed mix is to be appropriate for the environmental conditions of the area, to promote immediate growth/soil stabilization and minimize the establishment of invasive species.
    - Native grass seed is recommended to reclaim the laydown area, and any temporary construction road, as well as any other areas. This seed is recommended to support biodiversity and wildlife (ungulate winter range).
    - The mix is to be approved by the McElhanney Project Manager and QEP.
7. The above details are to be confirmed in the **Reclamation Plan**.

4.9 *Spill prevention and preparedness*

Adhere to the following terms to reduce the risk and the impact of spills:

1. Establish the Equipment Laydown Area(s) that is at least 30 m from the high-water mark (HWM) of any waterbody including a drainage ditch. The laydown area will be where equipment, and fuel are stored; as well as where machinery are fueled, parked overnight, and repaired. Supplies with the no potential to leak contaminants and soil may be stockpiled within 15 m, as long as it does not have the potential to erode into the watercourse.
2. Do not store fuels and/or other petroleum or combustible products in any large quantity on site. Only store small fuel containers, such as approved safety containers or double walled Tidy Tanks, properly mounted in the back of a pickup onsite for any extended period. Label all containers with appropriate Transportation of Dangerous Goods, WHMIS, and safety markings.
3. Ensure that personnel transferring fluids and fueling equipment understand the environmental risks of the area, are equipped with adequate spill prevention and response measures, have appropriate training, and are following acceptable practices.
4. Locate emergency spill response kits in areas where oil/fuel filled equipment will be working and provide additional spill response materials in sufficient quantities on site to catch drips, minor leaks and spills.
5. Have absorbent booms included in the spill kit.
6. Ensure the crew is trained in the proper spill clean-up procedures and the contents within the kit.
7. Restock spill kits immediately if supplies are used.
8. Place oil absorbent sheets and/or containers under vehicles and equipment that is leaking regardless of its location.
9. Equip gas-powered pumps and generators with a suitably sized drip tray, if operated within 30 m of the HWM of a waterbody including a ditch.
10. Park fuel vehicles only in designated areas, with brakes applied and wheels locked.
11. Ensure the operator is in attendance during all fuel transfers.

4.10 *Environmental emergency response procedures*

A contaminant spill to the land or water is a potential incident that may impact the environment associated with this project. This could occur from a release of fuels, oils, or lubricants associated with heavy machinery, or concrete. Implement spill response procedures immediately following any accidental spill or release of a deleterious substance. The spill response procedure is:

1. Prior to the spill, the Contractor will ensure their staff are properly trained in use of the spill containment and clean-up.
2. If safe to do so, stop the leak or move the source of the leak away from any watercourse if within 30 m.
3. Notify the Site Manager.
4. Use emergency spill response kits, and/or other materials necessary to clean-up the spill immediately, so as not to result in further release or dispersal of deleterious substances.
5. For concrete spills into the watercourse use the CO_2 diffuser to neutralize the pH, as described in Section 4.6.
6. Isolate the hazardous wastes cleaned-up from the environment.
7. Remove all hazardous waste materials from the site to an appropriate facility, as soon as possible in accordance with all applicable standards and regulations.
8. Appropriately document details of the spill (Appendix G)
9. Report as required to the appropriate authorities:
    a. Notify the EM of spills of any size.
    b. The Provincial Emergency Program (PEP) is to be contacted (1-800-663-3456) for spills of any volume into a watercourse, or on land if Reportable Levels as identified in the *Waste Management Act* are exceeded. Reportable levels for products likely to be onsite are:
        - Flammable liquids, including fuel, motor oil and paints is 100 L.
        - Toxic substances, such as concrete or grout is 5 L or 5 kg.

4.11 *Air quality*

Maintain air quality through the following measures:

1. Ensure that dust does not become airborne. Water will be sprayed over the exposed soils to control dust, when required.
2. Cover topsoil or other erodible materials, if there is the potential for erosion, such as if conditions are windy and dry, or rainy.
3. Turn off vehicles when not in active use (minimize idling). It is recognized that there are periods of time when running a vehicle is necessary, such as when auxiliary equipment is in use, or under extreme hot or cold outdoor temperatures to keep the operator safe and comfortable. During periods of inactivity and while stopped within a queue formed under the direction of a traffic control person or device, idling shall be minimized and not exceed the following:
    a. Motor vehicle and light diesel trucks – 1 minute
    b. Heavy duty diesel vehicles – 5 minutes

4.12 *Waste management*

The site is to be kept clean of debris, materials and trash. Wastes are not to become airborne and travel off the project site. General measures to manage wastes are as follows:

1. Categorize and separate all waste materials appropriately.
2. Establish a specific receptacle for proper disposal of oil ridden materials, such as cloths used to wipe spills, oil cans etc., and dispose at an acceptable facility.

3. Transport all other materials to an acceptable offsite facility prior to project completion.
4. Remove all personal waste (e.g., food and beverage debris) daily to minimize the potential for wildlife encounters at the project.

5. Roles and responsibilities

5.1 *Prime Contractor*

In association with the QEP, the Prime Contractor will be responsible for maintaining the environmental controls and addressing any environmental issues or questions that arise. Associated responsibilities include:

1. Arrange for a QEP to oversee environmental aspects of the project. As a first step, the QEP is to outline project specific environmental mitigation details in the CEMP (Section 4.1).
2. Ensure all project personnel review and understand the BMP and CEMP and any associated regulatory requirements. These details will be presented in full during the pre-construction meeting, and the site orientation meeting(s). Relevant items will also be presented during the daily site meetings.
3. Ensure all crew are adequately trained and equipped to deal with potential environmental incidents related to their work.
4. Conduct daily tailboard meetings to ensure that environmental risks have been identified and adequately addressed.
5. Inform the QEP of the project schedule, so that the QEP can be onsite to observe the environmentally sensitive aspects of the project.
6. When the QEP is not onsite, upon request, submit daily photos to the QEP depicting project progress.
7. Bring any changes to the work plan to the attention of the QEP, so that the CEMP can be updated.
8. Bring concerns regarding preparedness for environmental incidents to the attention of the QEP, prior to starting work.
9. Ensure any environmental incidents are brought to the immediate attention of the QEP.

5.2 *QEP - Environmental Monitor*

The QEP will be responsible to:

1. Update the BMP with the project specific details to produce the CEMP.
2. Present details of the BMP and CEMP and any other regulatory requirements to project personnel.
3. Monitor on-site activities <u>a minimum of weekly</u> during construction to ensure the BMP and CEMP requirements are adhered to, with no environmental harm. Provide additional advice as needed.
4. Confirm with the Prime Contractor when critical activities are being completed that have the potential to impact the environment, and conduct onsite monitoring during these activities. Examples of activities requiring onsite monitoring are:
    a. Project initiation (e.g., review laydown area, erosion and sediment control measures).
    b. Prior to clearing and/or grubbing to conduct nesting/wildlife surveys and ensure the mitigation measures as outlined in Section 4.3. The following are the periods when these sensitive species/life stages may be present, and thus when these surveys must be done:
        i. Bird nesting - from mid April to mid August.
        ii. Badgers denning – March through May.

iii. Permanent bird stick nests protected under the BC *Wildlife Act* (Section 3.4) - year-round.
iv. The other sensitive plant and invertebrate species potentially present as identified in Section 3.2.2 (Vivid Dancer, and Nuttal's Sunflower are to also be inspected for during the above surveys.
v. Additionally, the QEP is to flag the areas in the vicinity of the FHSR Irrigation Reservoir that may contain invasive plant species (notably Spotted Knapweed) and ensure mitigation measures are conducted as outlined in Section 4.4 are adhered to.

c. During instream work that has the potential to cause a sediment release (turbidity) in the watercourse . Examples of this are during:
   i. Diversion installation
   ii. Diversion removal
   iii. Bridge foundation installation

d. During any period that cast in place concrete work (grouting or application of another deleterious substance) has the potential to enter the watercourse. Examples include:
   i. Prior to the initial concrete pour following form-work (or isolation) installation.
   ii. During the initial concrete pour, to ensure the isolation is effective.
   iii. When the concrete pour is over the watercourse.
   iv. When any water within 48 hours that has been in contact with uncured concrete is released into the watercourse.

e. Reclamation - to ensure the site is stable, topsoil re-applied and seeded, with no erosion or sedimentation concerns.

f. During heavy rain events.

5. Complete daily environmental monitoring (EM) report for each day on-site, outlining (Appendix G) that include: a) time onsite, b) prime contractor site supervisor, c) summary of construction activities, environmental issues, mitigation measures and planned corrective measures to address deficiencies that arose, d) summary of incident reports, and e) representative site photographs.
6. Submit an EM report in electronic format to the McElhanney Project Manager, bi-weekly, within one week of the last onsite visit conducted.
7. Ensure the CEMP is complete and up to date.
8. In the event of an environmental incident, work with the Site Supervisor to ensure the incident is appropriately halted, cleaned, and reported.
9. Provide deficiencies identified during monitoring to the Prime Contractor immediately, so they are addressed as soon as possible.

The QEP will have the authority to order the shutdown of the operation if environmental protection is compromised.

5.3 *QA/QC Environmental Monitor*

1. Unless hired as the QEP, Lotic Environmental is to provide a quality assurance/quality control environmental monitor (QA/QC EM) during construction. The QA/QC EM will be a qualified environmental professional that will conduct spot checks bi-weekly targeting activities with a high risk to impact the environment.

2. The QA/QC EM will submit a report as described above documenting their observations, within one week of every site visit.

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Appendix A. Nupqu Resource Limited Partnership, Preliminary Field Reconnaissance Reports (Nupqu 2021 and 2022).

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Preliminary Field Reconnaissance Report

(Non-Permit)

McElhanney Ltd.
PO Box #1505, Unit C – 402 Highway 3
Fernie, BC
V0B 1M0

Date: December 15th, 2021
Attention: Karen Prezelj, Civil Engineer

RE: **Cold Spring Creek Preliminary Debris Flow Basin Mitigation Investigation Preliminary Field Reconnaissance**

McElhanney Ltd. (McElhanney or the Proponent) contracted Nupqu Resource Limited Partnership (Nupqu) to complete a non-permitted Preliminary Field Reconnaissance (PFR) on the Regional District of East Kootenay's (RDEK) proposed Cold Spring Creek Preliminary Debris Flow Basin Mitigation Investigation (the Project). During McElhanney's geotechnical survey (June 24, 2021), a potential precontact (*i.e.* pre-1846) artifact was found within a debris pile scheduled to be moved off-site as part of the RDEK's project on Cold Spring Creek. The PFR was completed on July 7, 2021, Nupqu field staff was accompanied by a Ktunaxa Nation Council (KNC) representative and the Proponent. The Project is situated in the unincorporated resort community of Fairmont Hot Springs in southeastern BC, approximately 100 m east of the south end of municipal road Mountain Top Drive (*Appendix A*: *Figure 1*) and can be located on map sheets 82J/031 (BC TRIM) and 82J.05 (NTS).

Background Research: Determining the potential of precontact archaeological resources (*i.e.* pre-dating AD 1846) within the Project area prior to the in-field assessment consisted of the analysis of archaeological overview assessments (AOA), the Remote Access to Archaeological Data (RAAD [maintained by the BC Archaeology Branch]), satellite imagery performed on Google Earth and a review of results from previously completed assessments in proximity to the project's location.

Archaeological Overview Assessment (AOA) of Landscape Unit I13 contains 63 AOA polygons with the potential to contain unrecorded precontact archaeological sites (Choquette 1998 [*Appendix A: Figure 2*]). Archaeological potential is based on characteristics of the landscape such as (but not limited to) proximity to watercourses, (micro)topographic features, local geology, proximity to previously recorded archaeology sites (*ibid.*). The landform-based criteria (*i.e.* AOA polygons) were then numerically scored, resulting in archaeological potential polygon area(s) which were labeled as having increased potential for the presence of significant archaeological sites (15 ranking high or 48 ranking moderate). The methodology utilized to delineate the AOA polygons included analysis of stereoscopic air photos to determine areas of potential precontact occupation and are derived from precontact land and resource use models for the southern Canadian Rocky Mountain Trench. AOAs by Choquette are generally completed within Crown Land, or on private property under contract. As the Project is located within the municipal boundaries of Fairmont Hot Springs, it does not overlap with an AOA polygon; however, this does not negate the presence of archaeological potential within or in proximity to the Project location.

A review of the Provincial archaeological inventory (*i.e.* RAAD) indicated that there are five precontact archaeological sites situated within a 2 km radius of the Project, and an additional 24 precontact sites have been recorded within a 5 km radius. Recorded archaeological sites measured within a 2 km radius of the project area, are summarized in Table 1 (below). Based on a review of the Provincial Archaeology Report Library (PARL), maintained by the Archaeology Branch, no archaeological assessments have taken place within the Project location.

Table 1. Precontact Archaeological Sites in Vicinity of Project

Borden Number	Location/Distance	Site Type	*HCA* Permit Number
EcPx-72	0.69 km NNW	Precontact, Cultural Material, Subsurface, Lithics	2003-0240
EcPx-29	1.06 km WSW	Precontact, Subsistence Feature, Cultural Depression, Cache Pit	1977-0036 1984-0003
EbPx-60	1.19 km SW	Precontact, Cultural Material, Surface, Lithics	1977-0036 1984-0003
EbPx-59	1.35 km SW	Precontact, Cultural Material, Surface, Lithics, Cultural Depression, Other Feature	1977-0036 1984-0003
EbPx-18	1.93 km SW	Precontact, Cultural Material, Surface, Lithics	1954-NP 1971-NP 1977-0036

This Project is situated within a region with an increased density of recorded archaeological sites; in addition to the precontact sites listed in Table 1, numerous other precontact archaeological sites have been recorded along Columbia Lake, Columbia River and Windermere Lake within the Rocky Mountain Trench (*Appendix A: Figure 1*).

Results: The Project is situated on the northern bank of Cold Spring Creek, which has been subject to previous ground disturbance in the form of a dam and manmade reservoir, existing road and a debris pile of excess sediment and rocks removed from the reservoir (*Appendix A*: *Figure 3*, *Appendix B*: *Photos 1-3*). It is evident that this area has been subject to sediment extraction, mechanical levelling and flooding, all of which has extensively impacted the local terrain and would have removed or displaced potentially culturally-relevant stratum.

The potential artifact was situated in an increasingly disturbed context, on the south side of the (approx.) 500 m³ debris pile situated north of the reservoir (location flagged by McElhanney); excess sediment was regularly excavated from the reservoir as it would obstruct the dam's water intake system (*Appendix B*: *Photos 4 and 5*). The potential artifact consists of a brown argillite material with bifacial scarring along one lateral edge and visible crushing on either end of the rock. Upon extensive examination of the rock, it was determined the observed scarring and crushing was more conducive to water transport than precontact tool manufacture. The specimen had likely travelled downstream, via water current, from an unknown location and the crushing/impact points were created by contact with submerged stationary rocks in the creek.

The Proponent indicated that a proposed road is situated on the south side of Cold Spring Creek and would be subject to geotechnical test pits in the near future. The proposed road is situated within the footprint of an existing road, adjacent to (south of) irregular terrain, sloping approximately 5 to 7° to the north (*Appendix A*: *Figure 3*, *Appendix B*: *Photo 6*). Terrain north of the proposed road was identified as an area of archaeological potential (AOP 1) as it may contain archaeological materials due to its location overlooking the drainage to the north, topography, and intact cultural strata (*Appendix A: Figures 2-3*). AOP 1 was not flagged in the field, as the Proponent was present in the field and could identify the AOP.

Recommendations: Archaeological monitoring is recommended during the excavation of any geotechnical test pits associated with the proposed road south of Cold Spring Creek and in proximity to AOP 1. Should future developments be proposed within or adjacent to the area of potential, future archaeological assessments that would require a *Heritage Conservation Act* Section 12.2 Heritage Inspection Permit may be necessary.

With regard to proposed work on the north bank of Cold Spring Creek, no further recommendations for archaeological management is necessary, as this area has been subject to extensive impacts that have removed any intact terrain that may have contained culturally-relevant stratum.

It is further recommended that the proponent inform all staff and contractors that archaeological remains predating AD 1846, located on both public and private lands, or sites containing rock art or human burials, are automatically protected within the Province of British Columbia from intentional and inadvertent disturbance by the *Heritage Conservation Act* (RSBC 1996, Chapter 187).

To properly address any unanticipated discoveries of archaeological materials as a result of this development please ensure staff and contractors are aware of the following:

- All ground disturbance in the immediate vicinity of the suspected find(s) must be suspended at once;
- The Ministry of Forest, Lands, Natural Resource Operations and Rural Development, Archaeology Branch (250-953-3334) be informed, as soon as possible, of the location of the archaeological remains and the nature of the disturbance, and;
- Any relevant First Nation communities are promptly informed about particulars of the unanticipated discoveries.

Lindsey Neill, BA
Archaeologist/Project Manager
lindsey.neill@nupqu.com

References Cited:

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Heritage Conversation Act

1996 BC Law, Revised Statues of British Columbia (RSBC) Chapter 187, Queen's Printer, Victoria, BC.

Appendix A

Maps

Non Permit PFR

McElhanney

Cold Spring Creek Preliminary Debris Flow

Basin Mitigation Investigation

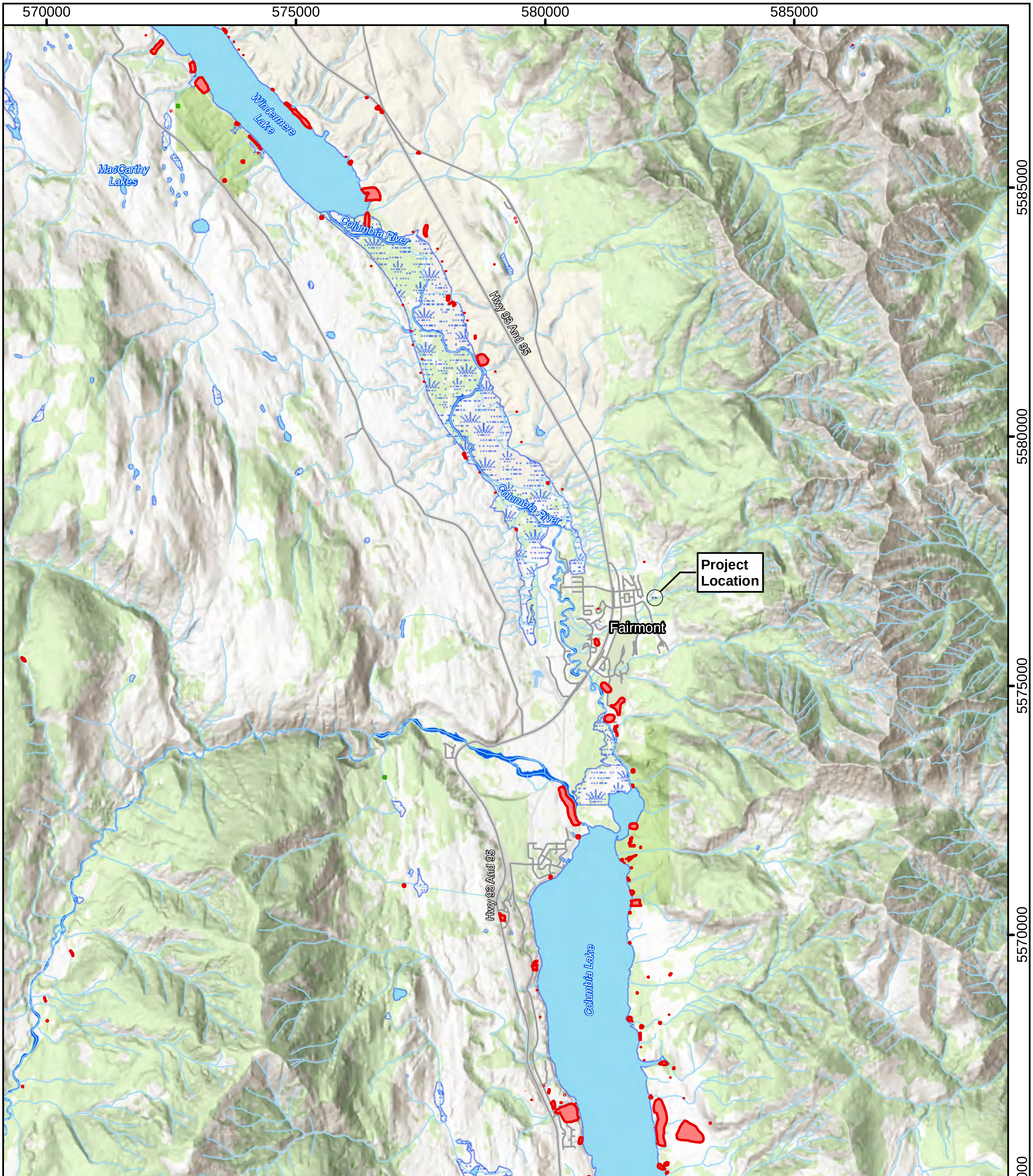
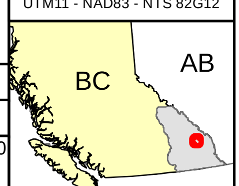


Figure: 1	Client: McElhanney	UTM11 - NAD83 - NTS 82G12
Permit: Non-Permit	Survey Date: 07/07/2021	
Title: Preliminary Field Reconnaissance Overview Map	Mapping Date: 15/12/2021	
Project: Cold Spring Creek Preliminary Debris Flow Basin Mitigation	1:100,000 0 0.5 1 2 km	INSET 1:40,000,000



Mapping by: Nupqu

Legend:

- Precontact Arch Site Boundary (RAAD 2021)
- Historical Arch Site Boundary (RAAD 2021)
- Legacy Arch Site Boundary (RAAD 2021)
- Lakes
- Rivers
- Wetlands
- Water Feature
- Primary Road

Base Data: DataBC; Base Map: ESRI; Arch Site: Arch Branch; Project: Client; Field: Nupqu

Disclaimer: Information relating to the location and nature of archaeological sites is considered sensitive cultural heritage information. Archaeological Overview Assessments, polygons, and other site-specific information provided to the Proponent's name is confidential and must not be shared with the public, individuals or other entities without written permission from Nupqu Resource LP.

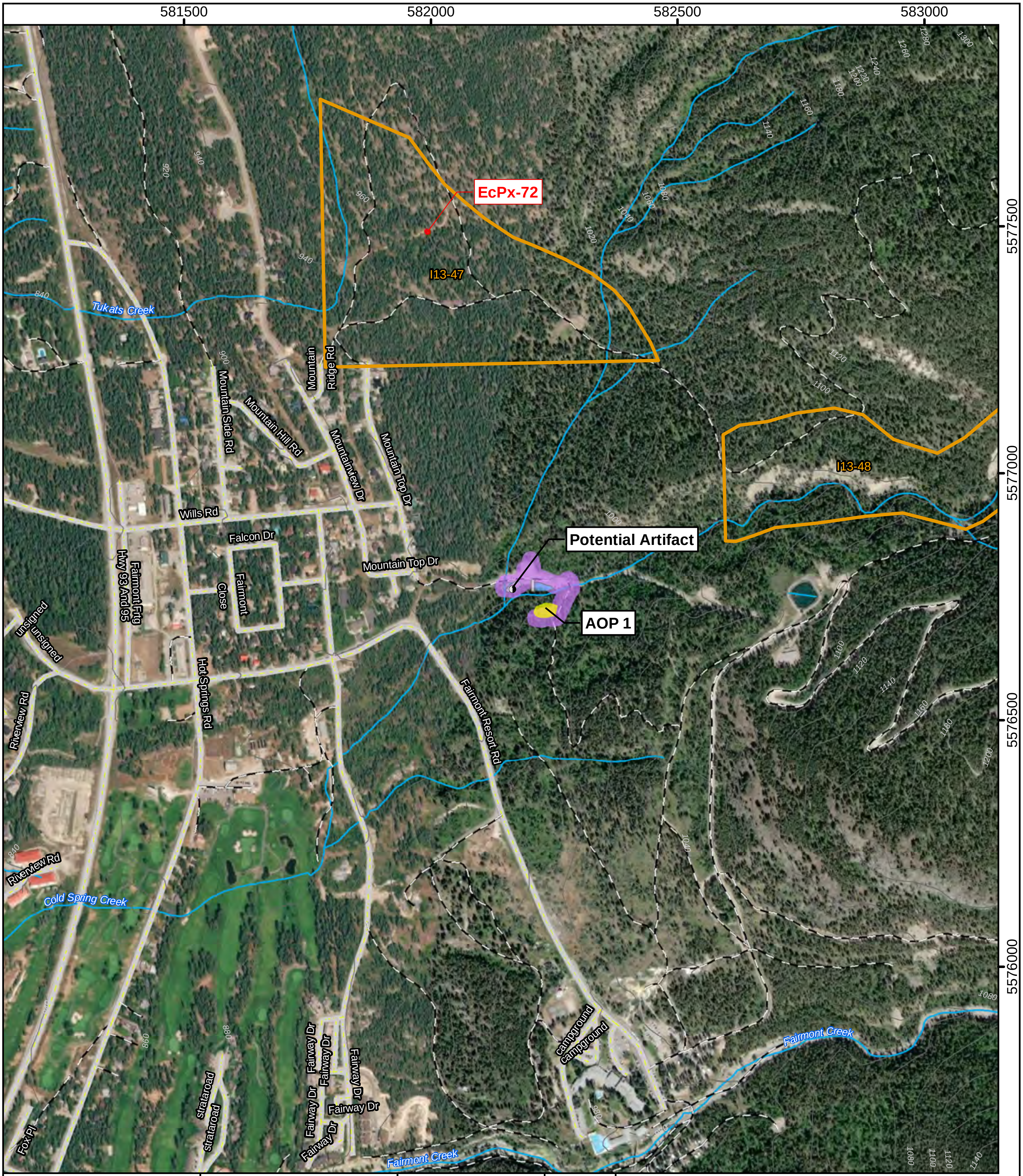
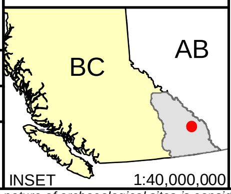


Figure: 2	Client: McElhanney	UTM11 - NAD83 - NTS 82G12
Permit: Non-Permit	Survey Date: 07/07/2021	
Title: Preliminary Field Reconnaissance Midrange Map	Mapping Date: 15/12/2021	
Project: Cold Spring Creek Preliminary Debris Flow Basin Mitigation	1:10,000	



Mapping by: Nupqu

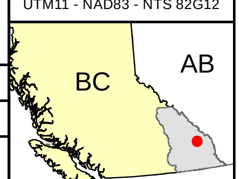
Legend:

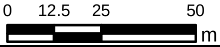
- Precontact Arch Site Boundary (RAAD 2021)
- Area of Potential
- AOA - Choquette
- Cold Spring Creek Dam
- Cold Spring Creek Reservoir
- Debris pile to be removed off site
- Traverse
- Primary Road
- Secondary Road
- Water Feature
- Contour Lines
- Potential Artifact

Base Data: DataBC; Base Map: ESRI; Arch Site: Arch Branch; Project: Client; Field: Nupqu

Disclaimer: Information relating to the location and nature of archaeological sites is considered sensitive cultural heritage information. Archaeological Overview Assessments, polygons, and other site-specific information provided to the Proponent's name is confidential and must not be shared with the public, individuals or other entities without written permission from Nupqu Resource LP.

Figure: 3	Client: McElhanney	UTM11 - NAD83 - NTS 82G12	Mapping by: Nupqu
Permit: Non-Permit			
Title: Preliminary Field Reconnaissance Detailed Map	Survey Date: 07/07/2021		
	Mapping Date: 15/12/2021		
Project: Cold Spring Creek Preliminary Debris Flow Basin Mitigation	1:2,000		





Legend:

- Area of Potential
- Cold Spring Creek Dam
- Cold Spring Creek Reservoir
- Debris pile to be removed off site
- Traverse
- Primary Road
- Secondary Road
- Water Feature
- Contour Lines
- Potential Artifact

Base Data: DataBC; Base Map: ESRI; Arch Site: Arch Branch; Project: Client; Field: Nupqu

Disclaimer: Information relating to the location and nature of archaeological sites is considered sensitive cultural heritage information. Archaeological Overview Assessments, polygons, and other site-specific information provided to the Proponent's name is confidential and must not be shared with the public, individuals or other entities without written permission from Nupqu Resource LP.

Appendix B

Photos

Non Permit PFR

McElhanney

Cold Spring Creek Preliminary Debris Flow

Basin Mitigation Investigation

Photo 1. Existing road and evidence of flooding (view: east)

Photo 2. Debris pile from excess sediment/rocks flowing into reservoir, situated to the south and left out of the linew of sight in this photo (view: west).

Photo 3. Cold Spring Creek reservoir and dam (view: southwest).

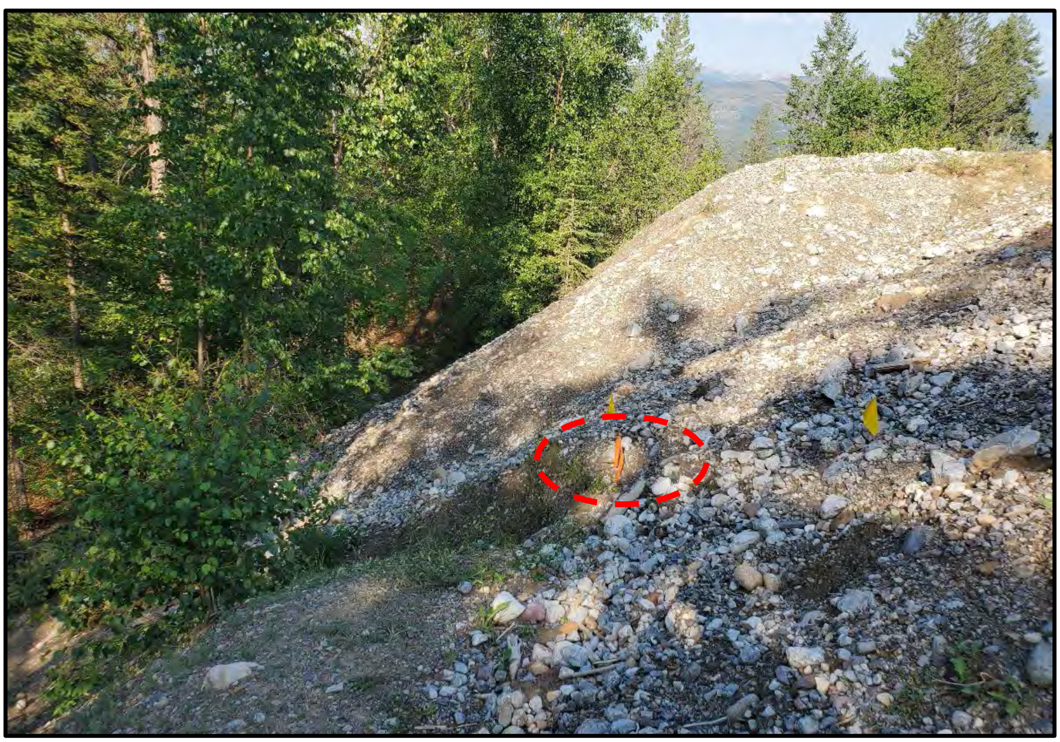


Photo 4. Flagged location of potential artifact within debris pile, indicated with red dashed circle (view: west-southwest).

Photo 5. Potential artifact at flagged location, confirmed to be naturally scarred.

Photo 6. AOP 1: north of the existing road and south of Cold Spring Creek (view: north).

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LETTER OF NOTICE

Non-Permit
Preliminary Field Reconnaissance

Date: June 12th, 2022

Company: McElhanney

To: Kevin Mohr, Division Manager (McElhanney)

Prepared by: Lindsey Neill, Archaeologist (Nupqu)

Re: **Cold Spring Creek Debris Flow Basin Mitigation, Fairmont Hot Springs, BC.**

Summary Results: On June 8th, 2022, Nupqu Resource Limited Partnership (Nupqu), accompanied by a representative of the Shuswap Band (SIB) and the Regional District of East Kootenay (RDEK), completed a non-permit preliminary field reconnaissance (PFR) of the above proposed and identified development.

The PFR returned negative results for precontact archaeological materials or features; however, two Areas of Potential (*i.e.* AOPs 1 and 2) were identified within the boundaries of the project. The AOP boundaries are flagged in the field with yellow and black "A.I.A. ZONE" flagging tape.

AOP 1: 0582229e 5576862n (25 m x 15 m)
Bench with a western aspect, situated north of a relict drainage and Cold Spring Creek. Appears to overlap with northern periphery of the project.
Please refer to the attached site map for approximate location.

AOP 2: 0582185 e 5576695n (130 m x 45 m)
Northwest facing terrace with margins overlooking Fairmont Hot Springs to the west and Cold Spring Creek to the north. Overlaps with proposed road development of the project. Please note that AOP 2 also encompasses the AOP identified during the 2021 field season (Neill 2021).
Please refer to the attached site map for approximate location.

Summary Recommendations: Nupqu therefore recommends avoidance of the AOPs by altering the proposed development plan to avoid overlapping with the areas. Should avoidance be unattainable, Nupqu recommends that McElhanney hire an eligible archaeologist to obtain a *Heritage Conservation Act* Section 12(2) Heritage Inspection Permit and conduct a subsurface inspection program prior to the commencement of proposed ground disturbing work.

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It is further recommended that the proponent inform all staff and contractors that archaeological remains predating AD 1846, located on both public and private lands, or sites containing rock art or human burials, are automatically protected within the Province of British Columbia from intentional and inadvertent disturbance by the *Heritage Conservation Act* (RSBC 1996, Chapter 187).

To properly address any unanticipated discoveries of archaeological materials as a result of this development please ensure staff and contractors are aware of the following:

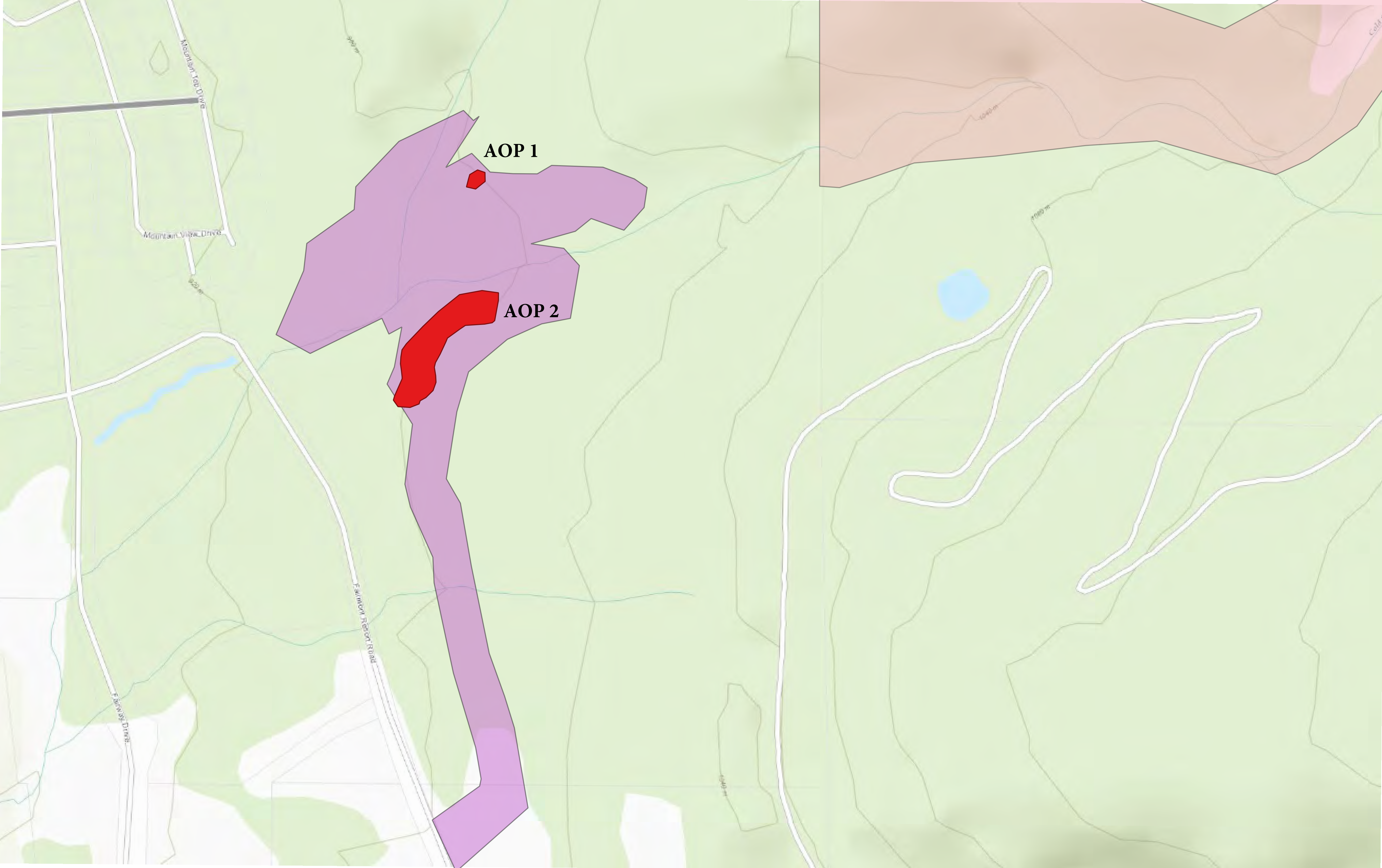
- All ground disturbance in the immediate vicinity of the suspected find(s) must be suspended at once,
- The Ministry of Forest, Lands and Natural Resource Operations, Archaeology Branch (250-953-3334) be informed, as soon as possible, of the location of the archaeological remains and the nature of the disturbance, and
- Any relevant First Nation communities are promptly informed about particulars of the unanticipated discoveries.

This letter is not intended to serve as a results report. A PFR results report will be forwarded to your office in the near future.

Should you have any questions or require further information please contact me at your convenience.

Lindsey Neill
Archaeologist, BA
Office: 250-420-2724 ext. 2
Phone: 250.421.4066
Email: lindsey.neill@nupqu.com

Cc. Jesse Thomas, Archaeology Coordinator (KNC)
Joshua Martin, Field Technician Coordinator (SIB)
Elizabeth Ahlgren, Project Supervisor (RDEK)


AOP 1
AOP 2
Mountain Top Drive
Mountain View Drive
Fairmont Resort Road
Fairway Drive

Appendix B. Preliminary construction schedule (prepared by McElhanney, November 2022)

Construction Schedule

Cold Spring Creek Debris Flow Barrier

McElhanney

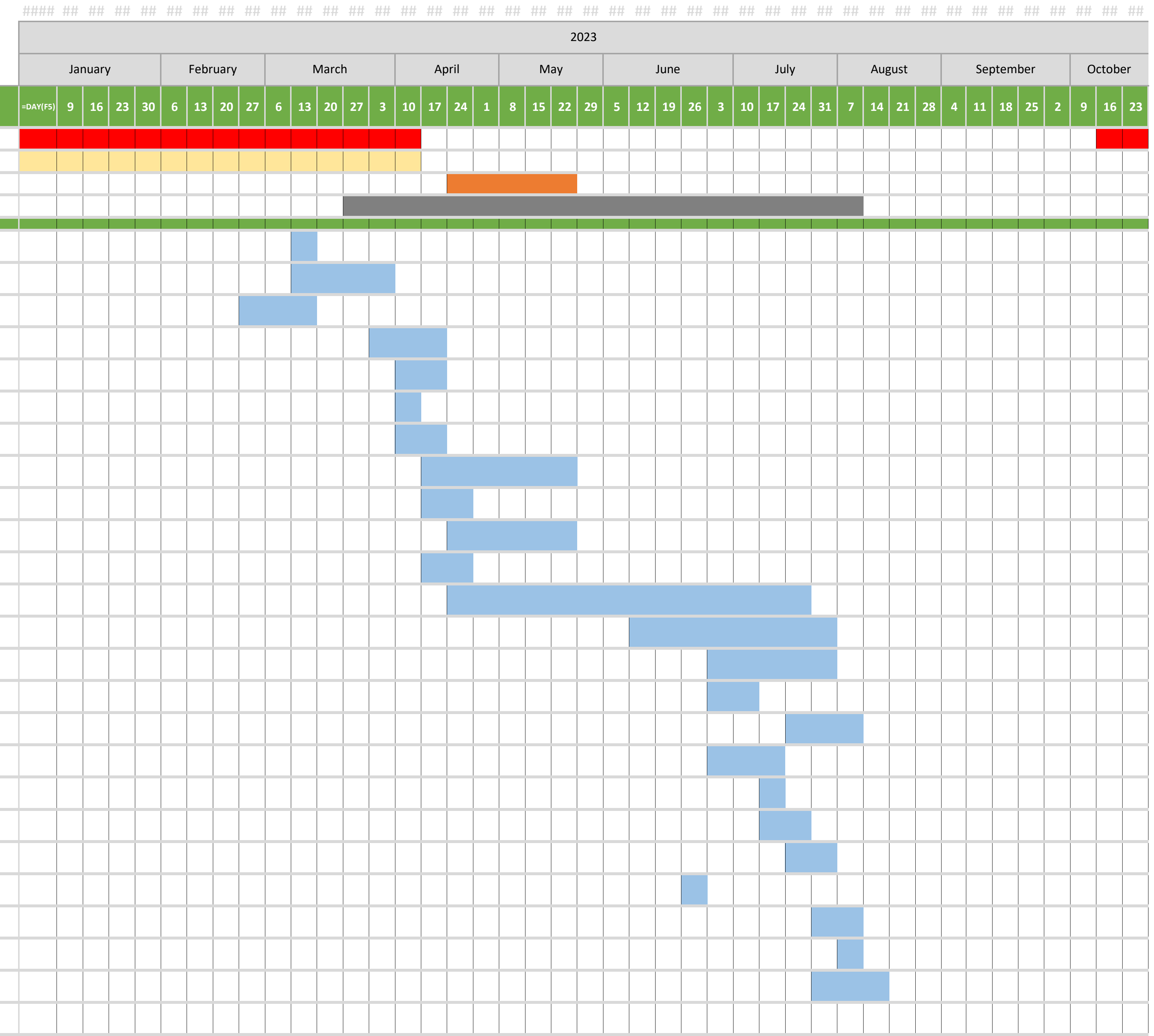
Calendar Start: 1/2/2023

Show Week: 1

Last edited by: Kevin Mohr, P.Eng.

Date: Oct 25, 2022

TASK DESCRIPTION	PLAN START	PLAN END	Days	Sequence	TYPE
Cold Weather - Environmental Constraint					
All Clearing Completed by April 15 in advance of nesting					
Snowmelt freshet window (low risk item, simple to mitigate)	4/24/2023	5/28/2023	34		c
Construction Inspection Required	4/1/2023	8/8/2023	129		
Contract Award (March Board Meeting)	3/19/2023	3/19/2023	0	1	B
Submittals, startup, mobilzation	3/19/2023	4/9/2023	21	2	B
Tree clearing (Separate contract to Barrier and Basin) - Dates flexible	3/5/2023	3/19/2023	14	0	B
Stripping	4/9/2023	4/22/2023	13	3	B
Establish laydown areas	4/14/2023	4/20/2023	6	4	B
Relocate debris stockpile to upper area	4/13/2023	4/16/2023	3	4	B
Install Temporary Culvert Crossing	4/13/2023	4/19/2023	6	4	B
Access Road Constrution	4/22/2023	5/27/2023	35	4	B
Watermain Crossing Treatments (3 stay, 1 abandon)	4/20/2023	4/28/2023	8	5	B
RCC barrier subgrade preparaton	4/28/2023	5/25/2023	27	6	B
Establish diversion channel around outlet structure	4/19/2023	4/25/2023	6	5	B
Outlet structure construction	4/25/2023	7/25/2023	91	6	B
RCC barrier	6/13/2023	8/1/2023	49	7	B
Tyrolean weir, Culvert	7/4/2023	8/1/2023	28	8	B
Upstream Deflection Berm	7/4/2023	7/11/2023	7	8	B
Diversion Channel	7/25/2023	8/7/2023	13	8	B
Downstream Deflection Berm	7/4/2023	7/17/2023	13	8	B
Erosion Protection	7/17/2023	7/23/2023	6	9	B
Topsoil onto finished berms	7/17/2023	7/30/2023	13	9	B
Hydroseeding	7/30/2023	8/5/2023	6	10	B
Diversion Channel removed	6/27/2023	6/29/2023	2	7	B
Temporary Culvert Crossing Removed	8/3/2023	8/8/2023	5	7	B
Substantial Completion Inspection	8/8/2023	8/8/2023	0	12	B
Final Completion, Site Cleanup, Demobilzation	8/1/2023	8/15/2023	14	11	B



Appendix C. Culvert assessment

Table C-1. Cold Spring creek culvert review, July 21/22, 2020[4].

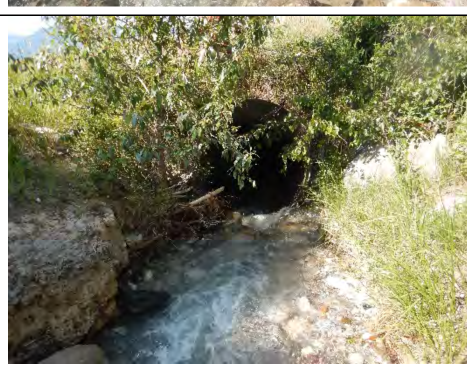
Culvert location	D/S channel width (m)	Channel slope (%)	Diam-eter (m)	Length (m)	Embed-dedment depth (m)	Backwater (%)	Outlet drop (m)	Outlet pool depth (m)	Inlet drop (m)	Culvert slope (%)	Potn'l barrier[5] - Yes/No & (PCSIS score)	Potn't jumping barrier[6] – life stages likely not capable to jump into culvert listed.
Creek outlet to Columbia River-east dual culverts through dike.	1.5	1	0.18	6.3	0	0	0.60	0.29	0.0	1.0	Yes (31)	All
Creek outlet to Columbia - middle east culvert through dike	1.5	1	0.65	4.03	0	0	0.25	0.06	0	1.0	Yes - based on PSCIS (26). No - based on u/s fish presence.	Adults uncertain, especially at low flow (culvert nearly dry during assessment). Juveniles (50 mm and 125 mm).
Creek outlet to Columbia - middle west culvert through dike.	1.5	1	-	-	0	0	-	-	-	-	Yes – culvert dry	All – culvert dry.
Creek outlet to Columbia - west culvert through dike.	1.5	1	0.40	3.96	0	0	0.22	0.30	0	1.0	Yes - based on PSCIS (26). No - based on u/s fish presence.	-

[4] Note, this review did not consider swimming capabilities, whereby culvert velocities are compared to maximum swim speeds for various life-stages of Cutthroat Trout (Parker 2000). Velocity data would need to be collected.
[5] As determined using the Provincial Stream Crossing Information System (PSCIS) culvert assessment worksheet, Form v1.1.0 (Province of BC 2015). The scoring determiners are culvert length, embeddedment, outlet drop, culvert slope and streamwidth;culvert diameter ratio. Higher score indicates poorer conditions, with the following scores relating to fish passage: Passable <15, Potential 15-19, Barrier >19.
[6] Jumping barrier determined using Fish Passage Culvert Inspection Procedures (Parker 2000), where outlet drop and outlet pool depth were compared to maximum jump height and minimum pool depths for Cutthroat Trout by life stage. The limits of jump height and minimum pool depth required are as follows: adults 1.5 & 1.88 m, juveniles (125 mm) 0.6 & 0.75 m, and juveniles (50 mm) 0.3 & 0.38. A pool depth of at least 1.25 times the height of the obstacle provides of ideal leaping conditions (Whyte et al. 1997).

Culvert location	D/S channel width (m)	Channel slope (%)	Diam-eter (m)	Length (m)	Embed-dedment depth (m)	Backwater (%)	Outlet drop (m)	Outlet pool depth (m)	Inlet drop (m)	Culvert slope (%)	Potn'l barrier[5] - Yes/No & (PCSIS score)	Potn't jumping barrier[6] – life stages likely not capable to jump into culvert listed.
Golf course culvert	1.5	1.5	1.53	50	0	40	0	0	0	5.1	Yes - based on PSCIS (26). No - based on u/s fish presence.	-
Pedestrian culvert (missed in the assessment).	-	-	-	-	-	-	-	-	-	-	-	-
Riverview Drive	2.0	4	1.0	22	0	0	0	0	0.05	4.0	Yes - based on PSCIS (29). No - based on u/s fish presence.	-
Highway 95	2.5	4	1.47	30	0	0	0.6	0.5	0.17	14.0	Yes (42)	All
Hot Springs Road -dual culverts (*no data collected due to onsite construction*)	-	-	-	-	0	0	Y	-	-		Yes – based on photo.	Unknown
Fairway Dr – dual culverts (measurements taken on north culvert)	2.5	4	1.0	15	0	0	0.30	0.41	0.1	2.0	Yes (34)	-
Fairmont Resort Road	2.0	4	1.25	20	0	0	1.05	0.36	0.05	2.0	Yes (34)	All

Figure C1. Cold Spring creek culvert review photos, July 21/22, 2020 (unless otherwise noted).

Location	Inlet	Outlet
Creek outlet to Columbia River- east culvert through dike.		
Creek outlet to Columbia - middle east culvert through dike.		
Creek outlet to Columbia - middle west culvert through dike.	-	
Creek outlet to Columbia - west culvert through dike.		

Location	Inlet	Outlet
Golf course culvert		
Pedestrian culvert	 Nov 27, 2020	 Sept, 2020.
Riverview Drive		
Highway 95		

Location	Inlet	Outlet
Hot Springs Road	 Intake prior to maintenance dredging (completed annually; June 23, 2020).	 Left bank outlet, right bank was elevated and dry (Oct 10, 2019)
Fairway Drive dual culverts (measurements taken on right bank culvert)		
Fairmont Resort Road		

Appendix D. Department of Fisheries and Oceans (DFO) Project Review outcome

To be obtained prior to project commencement and attached to the final EA & BMP Report

Appendix E. *BC Water Sustainability Act Water Licence*

To be obtained prior to project commencement and attached to the final EA & BMP Report

Appendix F. Chance Find Procedures for Archaeological Material (Ktunaxa Nation Council 2013).

Ensure most updated version (version provided through the WSA Licence) is attached.

Appendix G. Spill Incident Report Form

Date of Incident:	Time of Incident:
Name of Company or Person Causing Spill:	Contact Number:
Type of substance Spilled:	Quantity Spilled:
Location of Spill and Description of Surrounding Area:	
Source of Spill (e.g., equipment, storage container):	
Cause of spill or contributing factors (choose all that apply) ☐ Equipment Failure ☐ Training Deficiencies ☐ Operator Error ☐ Weather Conditions ☐ Faulty Process Design ☐ Other________________________________	
Effect of Spill (choose all that apply): ☐ Entered the watercourse ☐ Entered the riparian zone ☐ Maintained in Upland area (on road) Other________________________________	
Surface Area Affected (meters squared):	
Immediate Actions Taken (choose all that apply): ☐ Stop the Source ☐ Containment ☐ Use of spill kit ☐ Other________________________________	
Environmental Agencies Contacted:	
Name of Environmental Representatives Onsite:	
Further Action Contemplated/Required:	
Report Completed by:	Date:

Appendix H. Daily Monitoring Form

Project code:	**Date:**
Monitor name:	**Contractor site manager:**
Monitor time Onsite: Offsite:	**Environmental conditions:**

Construction Objectives:

Crew Onsite:

EM Notes/Observations:

Turbidity readings:

Time	Turbidity (NTU)		Comments
	Location 1	Location 2	
			Background value
X hr construction average			
24-hour average			
BC Guideline			Note on whether the guideline was met.

Environmental Issues/Concerns/Resolution:

Photo documentation

Date	Time	Photo #	Description