Murphy Creek Spawning Channel Maintenance and Monitoring 2018-19

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Prepared for:
Fish and Wildlife Compensation Program

Author:
Amy Duncan, MSc, RPBio, Biologist
Okanagan Nation Alliance Fisheries Department
and
Al Mallette, Fisheries Director
Trail Wildlife Association

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Okanagan Nation Alliance
101-3535 Old Okanagan Highway,
Westbank, BC V4T 3L7
Phone: (250) 707-0095 Fax: (250) 707-0166

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EXECUTIVE SUMMARY

Murphy Creek is a primary tributary to the Columbia River located 7 km north of the City of Trail, British Columbia. Murphy Creek is a fish-bearing stream that was fragmented with the installation of a highway culvert considered a barrier to fish passage. As such, a resident Rainbow Trout population now exists above the highway culvert, and approximately 500 m of habitat is available below the highway culvert for migrating Rainbow Trout spawning and rearing.

In an attempt to increase spawning and rearing habitat below the highway culvert on Murphy Creek, the Trail Wildlife Association (TWA) built a spawning channel adjacent to Murphy Creek in 1992. The spawning channel inlet has been upgraded since the initial installation and is now comprised of 2 intakes embedded in a composite barrier wall adjacent to a plunge pool below the highway culvert. Water levels into the spawning channel can be manipulated through the intakes. The spawning channel begins at the outlet of a small reservoir used by the Birchbank Golf Course for irrigation. The reservoir acts as a sediment settling pond for inflowing water above the spawning channel. The spawning channel is 225 m long and consists of 23 pools in a step-pool morphology.

Activities at the spawning channel in 2018 included monitoring of the spawning channel during freshet, Rainbow Trout spawner and redd monitoring, dredging of the sediment settling pond, armoring of the barrier wall around the intakes, riparian planting, routine maintenance within the spawning channel (raking of gravels and removal of large woody debris), and community involvement. This project was funded by the Fish and Wildlife Compensation Program in alignment with their streams Action Plan Habitat-based Priorities.

A total of 120 Rainbow Trout spawners were counted in the spawning channel during bi-weekly surveys from May 23 – June 28, 2018. This is consistent with spawner counts in previous years. Water temperatures were monitored during spawner counts and were lower compared to water temperatures in 2013 – 2017. Ninety-five plants were planted in the riparian zone surrounding Murphy Creek in August 2018 by the ONA, TWA and volunteers. The TWA also led a site visit with Seven Summits Secondary School and an in-class presentation at Stanley Humphries Secondary as part of the community education and involvement initiatives.

The sediment settling pond was dredged on November 30, 2018. An archaeological assessment and preliminary field reconnaissance were conducted prior to the in-water works, and no archaeological sites were identified. A fish salvage was also conducted prior to dredging and a total of 33 Rainbow Trout juveniles were removed from the settling pond and relocated into the spawning channel.

High water levels in spring (late April / early May) at the spawning channel resulted in displacement of boulders and erosion around the intakes downstream of the highway culvert. It is recommended that the intakes undergo further restoration and armoring to better protect against high spring flows and avoid damage to the spawning channel. Other recommendations include conducting a geomorphological assessment on Murphy Creek to determine the effects of upstream logging on flows and to construct a secondary spawning channel downstream of the existing spawning channel outlet on the river-right bank.

ACKNOWLEDGEMENTS

We would like to acknowledge the financial contribution from the Fish and Wildlife Compensation Program (FWCP). The FWCP is a partnership between BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and public stakeholders to conserve and enhance fish and wildlife in watersheds impacted by BC Hydro dams.

We would like to recognize Teck Metals for permission to access this site on their property.

The following members of the Trail Wildlife Association volunteered their time and resources on this project:

- Al Mallette
- Rob Frew

The following employees of the Okanagan Nation Alliance have been involved in this project in various capacities:

- Michael Zimmer, MSc, RPBio, Project Oversight
- Amy Duncan, MSc, RPBio, Project Manager, Author
- Bronwen Lewis, BSc, RPBio, Interim Project Manager
- Evan Smith, BSc, BIT, Field Support
- Eleanor Duifhuis, BSc, Field Support
- Autumn Solomon, BSc, Field Support

Thank you to Karen Trebitz who volunteered her time to help with riparian planting. Jason Carter also volunteered to conduct instream channel maintenance. We would like to recognize the Birchbank Golf and Country Club, specifically Mark Lloyd, maintenance supervisor, for coordination in dredging the golf course water intake pond which acts as our sedimentation pond, and for granting the TWA to access the site. We would also like to thank Impact Equipment for improving access around the site and dredging the sediment pond. Thanks to Fraser Bonner at Ursus Heritage for conducting an archaeological assessment of the site.

In water works for this project were conducted under a Section 11 Approval A4-7464 Changes in and About a Stream Permit issued from the Ministry of Forests, Lands, Natural Resource Operations & Rural Development.

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1.0 INTRODUCTION

1.1 Background

The Murphy Creek Spawning Channel was built in the early 1990's by the Trail Wildlife Association (TWA) with the objective of mitigating the effects of a highway culvert blocking fish passage into the upper reaches of the stream (Arndt and Klassen 2004). The spawning channel provides 225 meters of step-pool habitat in a side channel fed by an intake from Murphy Creek proper. Ongoing maintenance and upgrades to the channel, intakes and settling pond has been a requirement over the years to maintain suitable spawning habitat for Rainbow Trout.

Various improvements have been made to the spawning channel since its inception:

- 1992 – initial development of the Murphy Creek Spawning Channel lead by members of the Trail Wildlife Association
- 1994 – extension of the spawning channel to a total length of ~225 m (R.L.& L. 1995)
- 2006 – instream maintenance including addition of gravels and large woody debris, removal of beaver dams and construction of check dams to improve Rainbow Trout access (Zimmer 2007)
- 2007 – dredging of settling pond via excavator (Zimmer 2008)
- 2008/09 – addition of gravels, log check dams and floating structures to provide cover for rearing Rainbow Trout, modification of the rock wier (Zimmer 2009)
- 2012 – major upgrade to two intakes and sediment settling pond (Adrain and Frew 2014)
- 2016 – raking of gravels and addition of spawning substrates to enhance spawning habitat, removal of large woody debris in channel (Mallette 2017)
- 2018 – raking of gravels, riparian planting, dredge settling pond via excavator, armoring of the intakes using boulders

This report summarizes the monitoring and maintenance activities conducted in 2018-19 at the Murphy Creek spawning channel including monitoring of Rainbow Trout spawner use, riparian planting, spawning habitat enhancement via instream maintenance, protective armoring of the intakes using boulders, dredging of the sediment settling pond and community education through a site visit from Seven Summits Learning Center to the spawning channel and a presentation to Stanley Humphries Secondary School. This project is in alignment with the Fish and Wildlife Compensation Program's Streams Action Plan Habitat-based Priorities.

1.2 Goals and Objectives

This project aligns with the FWCP's Streams Action Plan, specifically the priority to conduct habitat-based actions such as riparian revegetation, construction of aquatic structures (e.g., LWD) and construction of spawning channels. As well, the Murphy Creek Spawning Channel project aligns with a second priority to monitor and evaluate past and present enhancement projects.

The primary objectives of the 2018-19 Murphy Creek Spawning Channel Maintenance and Monitoring project were to:

- Monitor Rainbow Trout spawner use;

- Enhance Rainbow Trout spawning and rearing habitat within the Murphy Creek spawning channel by:
    - Planting native trees and shrubs in the riparian zone of the spawning channel in an attempt to outcompete invasive Black Locust and provide cover and shade;
    - Remove sediment accumulation from the settling pond downstream of the intakes;
    - Reduce sediment accumulation and compaction on gravels in the spawning channel to provide optimal spawning substrates;
    - Add gravel to the spawning channel where substrates have been displaced;
    - Increase armoring at the intakes using boulders in an attempt to better protect against the impacts from freshet;
- Engage community and school groups in maintenance and educational activities associated with the Spawning Channel.

2.0 METHODS

2.1 Study Area

The Murphy Creek Spawning Channel is a man-made channel off of the main stem of Murphy Creek proper (Figure 1). Murphy Creek is located approximately 7 km north of the City of Trail, British Columbia (Figure 2). It is approximately 14 km long and is a tributary to the Columbia River. Access into the upper reaches of Murphy Creek are restricted to fish by a highway culvert crossing Highway 22, therefore only approximately 500 m of habitat in Murphy Creek is currently available to migratory fish. The Murphy Creek Spawning Channel provides an additional 225 m of habitat to spawning Rainbow Trout.

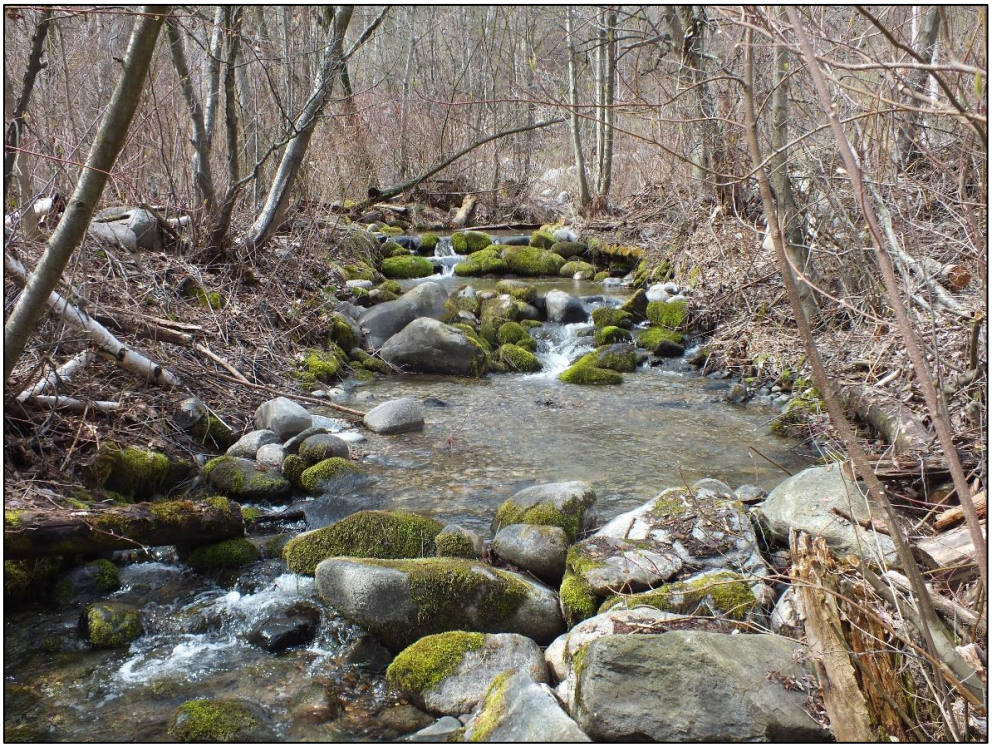

Figure 1: Upstream view of spawning channel showing pools 21, 22 and 23.

Figure 2: Location of Murphy Creek relative to the City of Trail, British Columbia.

2.2 Spawning Channel Maintenance and Monitoring

Early Spring Monitoring

Visits to the spawning channel are made throughout the year by TWA volunteers, especially in early spring during freshet to ensure the spawning channel remains protected from high flows. Photos and notes were taken in 2018 during freshet to document the severity of the high-flows and record steps taken to reduce damage to the intakes / spawning channel structures.

Water Temperature Monitoring

Water temperatures were monitored at Murphy Creek using Hobo Tidbit™ temperature loggers which were programed to log temperature every 4 hours. Temperature loggers were positioned at four locations: one in the downstream section of the spawning channel, one in the upstream section of the spawning channel, one in Murphy Creek proper and one in a tree near the bridge spawning the spawning channel to log air temperatures. Loggers were deployed on June 5 2018 and downloaded on August 24, 2018 and February 5, 2019.

Spawning Channel Maintenance

The following activities have been identified as methods of maintaining suitable spawning habitat for Rainbow Trout at Murphy Creek:

- Removal of compacted sediments on gravel
- Addition of 1-2” river run gravel in areas where gravel has been displaced
- Replacement of degraded wood (poles) used to create step-pool morphology
- Removal of accumulated woody debris, beaver dams, etc.

Dredging Settling Pond

Dredging of the sediment settling pond was required to reduce the amount of sediment available to be transported downstream into the spawning channel. As a requirement of the Section 11 Permit, an archaeological assessment was conducted by Ursus Heritage (Fraser Bonner) at Murphy Creek alongside Rob Frew, Al Mallette and Amy Duncan on November 26, 2018 (Appendix A). Dredging was conducted by an excavator (Impact Equipment) on November 30, 2018. Removal of fish from the spawning channel was conducted using a beach seine prior to the excavation on November 29 and 30, 2018.

2.3 Spawner and Redd Surveys

Rainbow Trout spawner / redd surveys were conducted from May 23 – June 28, 2018. In previous years, spawner surveys have started earlier (April), however survey conditions were unfavorable in April and May 2018 due to high water levels. The number of spawners or redds observed in each pool was documented during each visit. Photos and notes were also recorded. Survey data from previous years is also presented to show trends in annual spawner returns.

2.4 Riparian Planting

Native tree and shrub species were planted within the riparian zone of Murphy Creek in an attempt to provide competition for resources with the invasive Black Locust (*Robinia pseudoacacia*) on site. Native plants were acquired from Bron & Sons (Grand Forks) and were planted by members of the TWA, ONA and volunteers on September 17-18, 2018.

The initial proposal described removal of invasive Black Locust using repeated cutting as a management technique, however through further research we adapted our proposal to include only planting to increase competition for resources as a management technique. Black Locus is a highly successful invasive species that is very difficult to manage or remove.

2.5 Community Involvement

Two talks or site visits were proposed for educational community groups as part of the requirements of this project for public outreach and community involvement.

3.0 RESULTS

3.1 Spawning Channel Maintenance and Monitoring

Early Spring Monitoring

A large snowpack paired with unseasonably warm temperatures and heavy precipitation resulted in a very high freshet at Murphy Creek in May 2018 (Figure 3). The result of this freshet event was erosion of the creek bank proximate to the spawning channel and erosion of boulders from the barrier wall protecting the intake valves above the spawning channel. As well, the freshet caused significant resorting of creek bed materials and deposition of large woody debris in the plunge pool downstream of the highway culvert.

Figure 3: View of high water in Murphy Creek looking downstream from atop the intakes, May 18, 2018.

On May 9-10, 2018, water overtopped the barrier wall at the intakes and clogged the intakes with silt, nearly halting flows into the spawning channel. Due to unsafe conditions, the intakes were left in this state until May 21 when water levels decreased

and safe access was achieved; flows were re-established into the channel via the 24" intake and the next day Rainbow Trout were identified within the spawning channel. On May 25th TWA members restored flows through the 10" intake and flows were increased to facilitate scour and provide enhanced cover for spawning fish.

The 2018 freshet event was highly concerning to TWA volunteers as it posed a threat to the structure and efficacy of the spawning channel and its components. Works in 2019 will include a redesign of the intakes to prevent further damage from future high water events.

Water Temperature Monitoring

Water temperatures were monitored from June 5, 2018 to Feb 5, 2019 using a Hobo Tidbit™ temperature logger in Pool 5 of the spawning channel (Figure 4). In previous years, Rainbow Trout have been detected in the spawning channel when water temperatures reached an average of 5.0° C. The first official spawner survey in 2018 was conducted on May 23 when water temperatures were recorded at 5.2° C and 13 Rainbow Trout were counted in the spawning channel.

Water temperatures were also monitored during spawner counts each year since 2013. Figure 5 shows the same rising water temperature trend between April and June in each year, however water temperatures were highest in 2015 and 2016 and lowest in 2018.

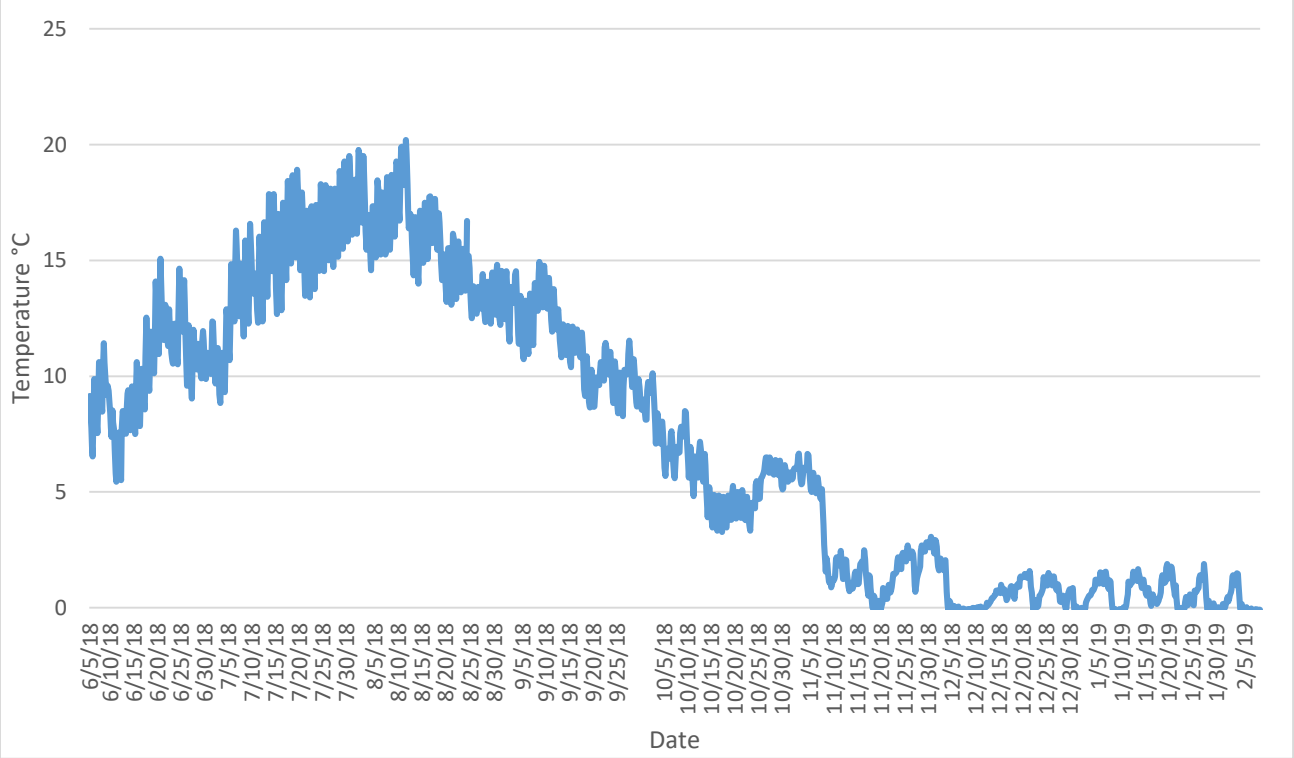

Figure 4: Water temperatures recorded in Pool 5 of Murphy Creek spawning channel from June 5, 2018 to Feb 5, 2019.

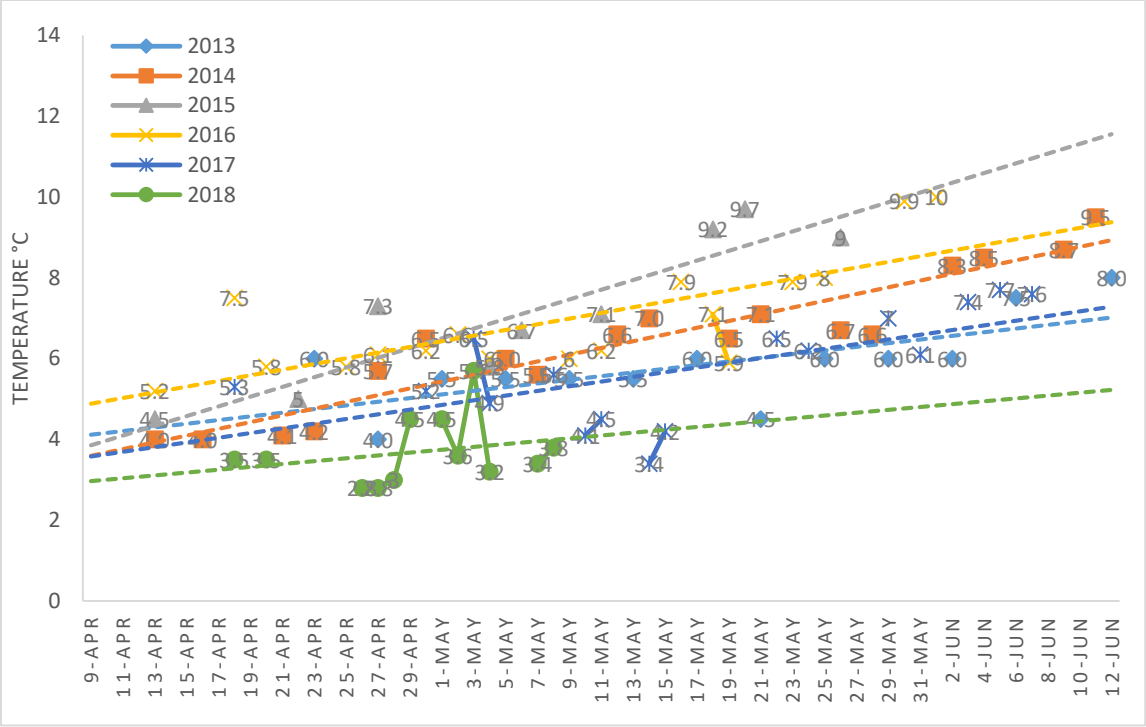

Figure 5: Water temperatures in the Murphy Creek spawning channel from April to June 2013 - 2018.

Spawning Channel Maintenance

On September 21, 2018, one dump truck load of 1-2" round drain rock was delivered to the Birchbank Golf Course, which was then staged along the spawning channel on September 25th by golf course staff and TWA volunteers. The gravel was purchased to be added to the spawning channel annually due to displacement and resorting of previously added gravels.

On November 30th, concurrent with the dredging work, Autumn Solomon (ONA), Al Mallette (TWA) and Jason Carter (volunteer) raked the extent of the spawning channel to free up deposited sediment and redistribute gravels.

Dredging Settling Pond

Dredging of the sediment settling pond is needed approximately every 3-5 years depending on deposition and freshet, as well as activities upstream in the Murphy Creek watershed (e.g., logging) that may increase siltation and change the severity of freshet. As a requirement of the Section 11 Changes in and About a Stream application, an archaeological assessment and Preliminary Field Reconnaissance (PFR) was conducted at Murphy Creek on November 26, 2018 prior to the in-water works being approved. No archaeological remains or areas of potential for the presence of archaeological sites were identified at Murphy Creek, and the site was considered low-risk for the presence of archaeological sites (see Appendix A for full report).

On November 29, 2018, the settling pond was isolated from the spawning channel so no fish could enter prior to dredging. The ONA and TWA conducted a fish salvage on November 29 using a beach seine. Four passes of the entire settling pond were completed and a total of 27 Rainbow Trout juveniles were removed from the settling pond (Figure 6). On November 30, prior to dredging, a final pass was completed with the

beach seine and another 6 Rainbow Trout juveniles were removed from the channel. Most of the fish removed were small (43-73 mm) however eight larger fish (over 100 mm) were also captured (Figure 7).

Figure 6: Rainbow Trout juvenile removed from sediment settling pond during salvage on Nov 29, 2018.

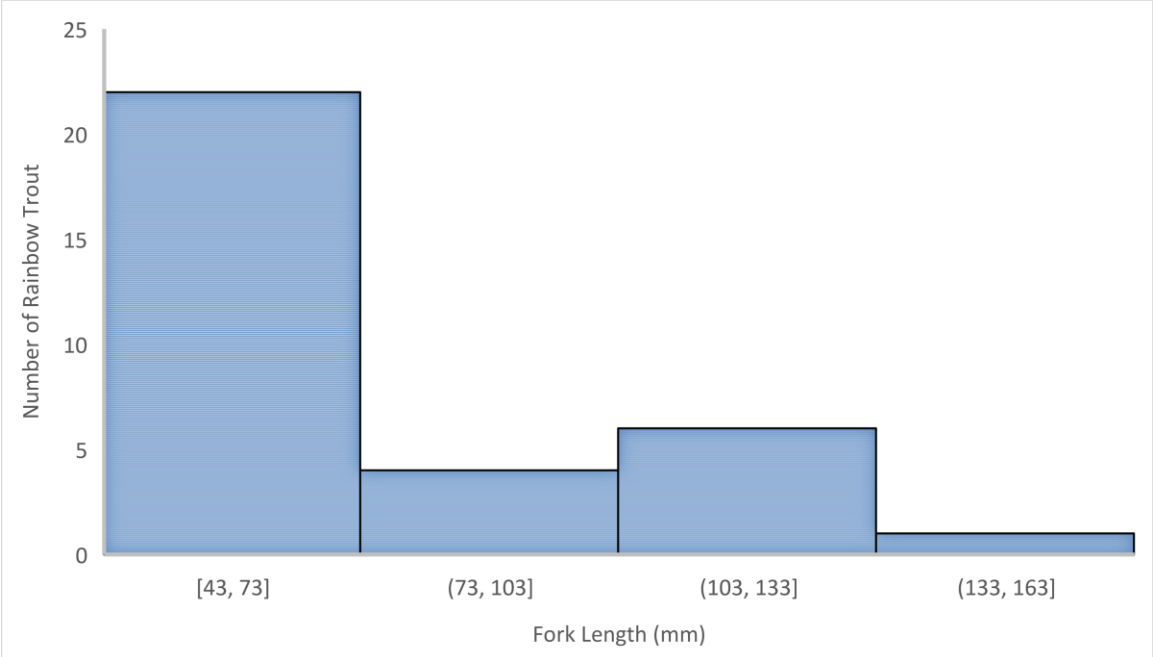

Figure 7: Distribution of Rainbow Trout (by fork length in mm) removed from settling pond on November 29 and 30, 2018.

Following the fish salvage, water from the intakes was diverted from entering the settling pond through a bypass structure. An excavator was then used to dredge sediment from the settling pond. Photos were taken before (Figure 8) and after in-water works. Sediment removed was piled on the banks adjacent to the settling pond, in areas it had been placed in previous years (Figure 9). The excavator was also used to re-contour the shore between the settling pond outlet and Pool 1 of the spawning channel, to increase safety and access (Figure 10). In addition, the excavator was used to place boulders (available onsite) around the top of the barrier wall surrounding the intakes to provide additional armoring for future high-water events (Figure 11). As well the excavator dug a swale to the settling pond adjacent to the culvert to prevent highway drainage from flowing directly into the settling pond. Water clarity was observed on Dec 1 and 2, 2018, following in water works (Figure 12).

Figure 8: North end of sediment settling pond (looking south) prior to in-water works.

Figure 9: Excavator dredging settling pond.

Figure 10: Excavator re-contouring and armoring bank between settling pond and spawning channel.

Figure 11: Placing boulders around and on top of the intake barrier wall to increase armoring.

Figure 12: North end of spawning channel (looking south) following dredging on December 2, 2018.

3.2 Spawner and Redd Surveys

A total of 15 surveys were conducted from May 23 to June 28, 2018 (Figure 13). A total of 120 Rainbow Trout spawners and 225 redds were counted in 2018, which is comparable to counts in previous years (Figure 14). Spawners were observed in 19 of the 23 pools available in 2018 (Figure 15). Pools 16 and 21-23 had the highest number of spawning Rainbow Trout observed in 2018.

Date	# Spawners
5/23/2018	14
5/25/2018	12
5/28/2018	19
5/30/2018	0
5/31/2018	15
6/2/2018	14
6/5/2018	3
6/7/2018	8
6/9/2018	12
6/11/2018	7
6/14/2018	5
6/19/2018	3
6/22/2018	8
6/26/2018	0
6/28/2018	0

Figure 13: Number of spawners counted at each site visit in 2018.

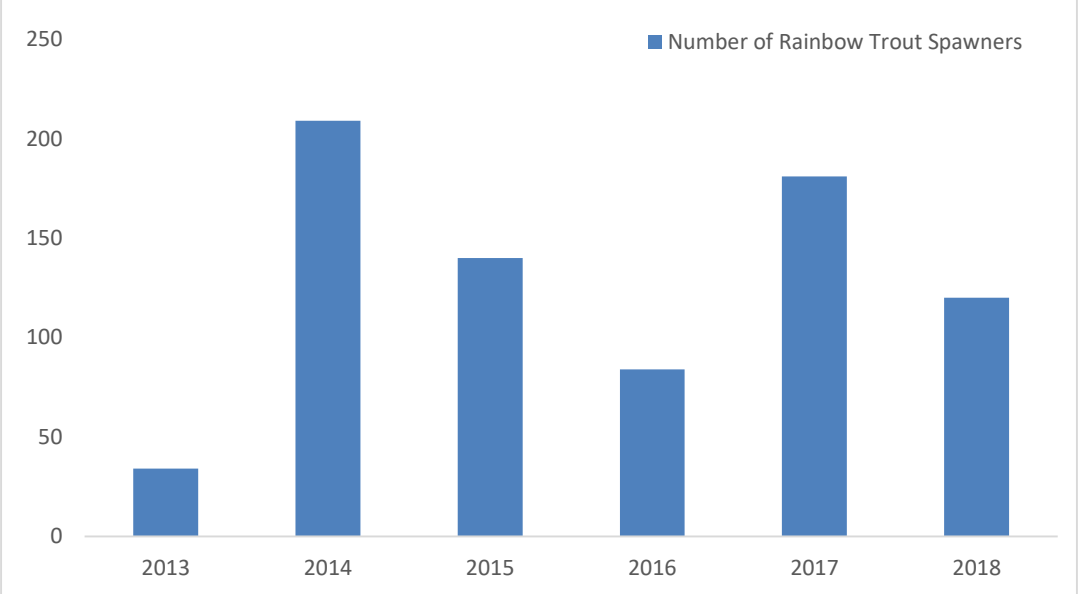

Figure 14: Number of Spawning Rainbow Trout counted in the Murphy Creek spawning channel 2013 – 2018.

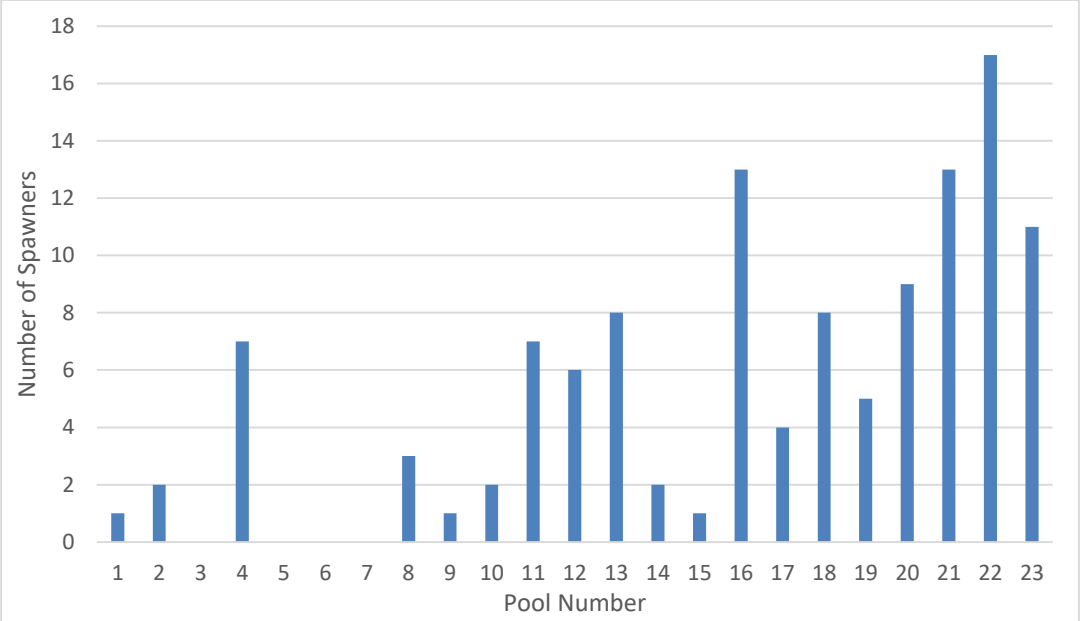

Figure 15: Number of Rainbow Trout spawners by pool observed in 2018.

3.3 Riparian Planting

A total of 95 plants were purchased from Bron & Sons Nursery Co. (Grand Forks, BC). The following species were planted at Murphy Creek on September 17-18, 2018.

- Rocky Mountain Maple (10)
- Red Osier Dogwood (15)
- Thimbleberry (5)
- Prickly Rose (5)
- White Snowberry (10)
- Western Red Cedar (5)
- Lodgepole Pine (5)
- Rocky Mountain Douglas Fir (5)
- Trembling Aspen (20)
- Western Chokecherry (15)

Members of the TWA, ONA and one volunteer (Karen Trebitz) completed the planting in six different locations throughout the Murphy Creek riparian area (Figures 16 and 17). Plants were monitored and watered as needed throughout the fall by Al Mallette and Rob Frew. Fortunately, fall rains assisted in watering and supplemental watering was not often required.

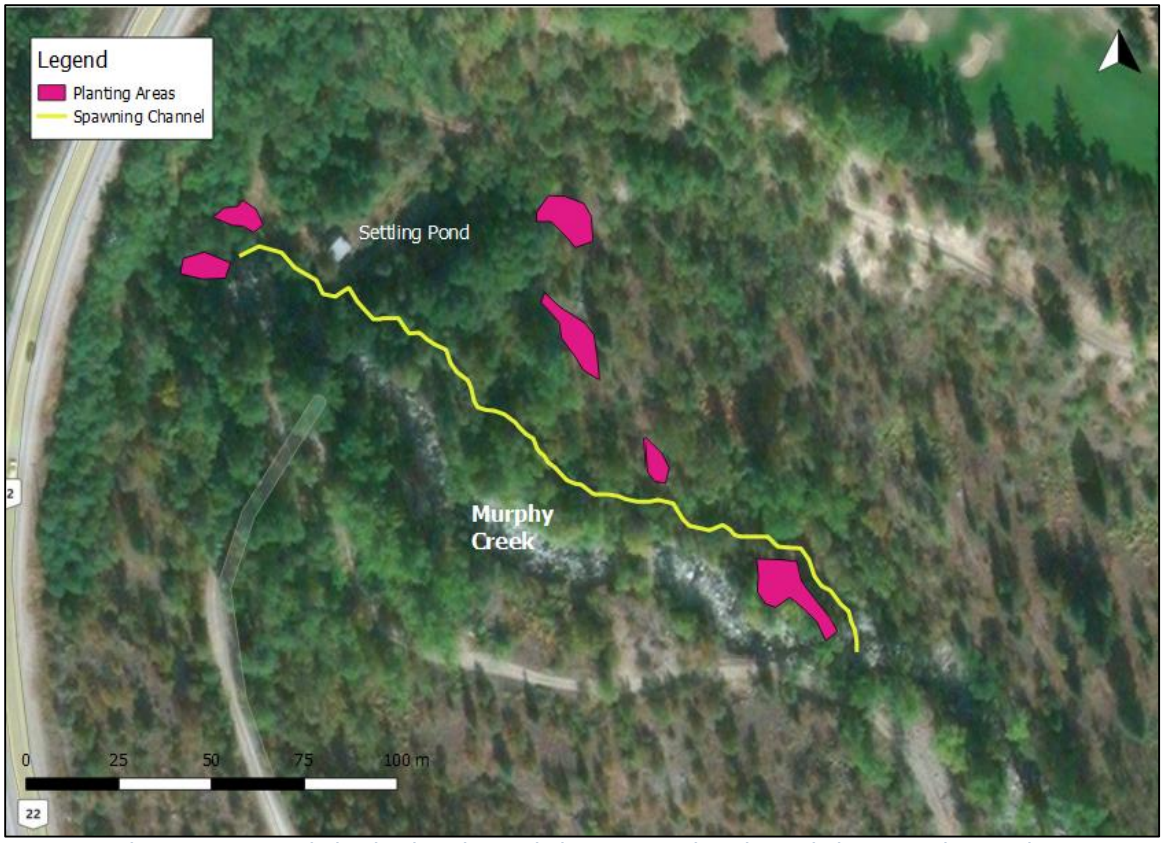

Figure 16: General planting locations relative to spawning channel along Murphy Creek.

Figure 17: (right) TWA volunteer Al Mallette planting Trembling Aspen near the highway culvert / spawning channel intakes at Murphy Creek, (left) Volunteer Karen Trebitz watering plants at Murphy Creek.

3.5 Community Involvement

On April 16, 2018, Rob Frew and Al Mallette delivered a presentation on the Murphy Creek Spawning Channel to junior high students at Stanley Humphries Secondary School. As well on May 9th, Al and Rob hosted a field trip to Murphy Creek for students at Seven Summits Learning Center which included sampling for benthic invertebrates and collection of water samples for quality testing (Figure 18).

Figure 18: Al Mallette (TWA) hosting field trip to Murphy Creek spawning channel for students of Seven Summits Secondary School in May 2018.

4.0 DISCUSSION AND RECOMMENDATIONS

The Murphy Creek spawning channel provides approximately 225 m of step-pool habitat for spawning Rainbow Trout in the Columbia River watershed. Annual spawner counts estimated approximately 128 (± 51) Rainbow Trout utilize the spawning channel in any given year, which aligns with previous spawner counts in the spawning channel (Arndt 2000). This number of spawners is estimated to produce approximately 108,000 – 180,000 eggs with a 17-28% survival rate producing approximately 30,000 fry from the spawning channel (Arndt 2000). A study by Arndt (2000) indicated the spawning channel produces approximately 75% of the total Rainbow Trout fry production for Murphy Creek.

Ongoing monitoring of the Murphy Creek spawning channel is recommended to ensure its efficacy in providing spawning substrates for Rainbow Trout. A long-term Management Plan for Murphy Creek would also be beneficial in providing historic information and scheduling requirements to maintain proper maintenance of the channel, to ensure its longevity. As TWA members age, a reference document would be helpful for others looking to continue operation of the spawning channel at Murphy Creek.

Both intakes were upgraded in 2013-14 however the integrity of the barrier wall surrounding the intakes has degraded since installation due to high flood events causing erosion. An increase in spring high-water events have been apparent in since 2015 (A. Mallette, pers. comm., Nov 2018). We recommend the barrier wall be restored and

improved to withstand a 1 in 200-year freshet. A detailed construction plan will be developed by a Professional Engineer to restore the existing intakes and provide better armoring and reinforcements to protect against future high water events. In addition, a fluvial geomorphological assessment should be conducted to determine the flood frequency and intensity of flood events as a result of logging in the upstream reaches of Murphy Creek. This information will aid in the restoration of the existing intakes and barrier wall.

Investigating more streamlined avenues for provincial permit approvals would be beneficial and more cost effective in conducting routine maintenance tasks within the stream. The present uncertainty around when a particular permit for maintenance will be granted additionally makes it difficult for teachers to schedule student field trips to the spawning channel. A more streamlined approval process would result in greater student participation in maintenance and improvement activities, such as in-channel maintenance. These discussions are underway with the Province of BC to determine a better solution.

Other improvements to increase spawning habitat at Murphy Creek include the addition of a second channel below the outlet of the existing spawning channel on the river-right bank. This idea was suggested by Alan Thomson, P. Eng. during a site visit in May 2018. To increase spawning habitat in the upper pools at Murphy Creek, it is recommended to add more gravels and maintain lower flows to reduce displacement of substrates downstream. If this does not promote spawning in the upper pools, we recommend re-assessing the efficacy of the step-pool morphology of these upper pools for providing spawning and rearing habitat.

5.0 REFERENCES

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Appendix A – Ursus Heritage Archaeological Report

Ursus Heritage Consulting

11500 Coldstream Creek Road, Coldstream, BC, V1B 1E3 T: 250-938-4662 ian@ursus-heritage.ca
www.ursus-heritage.ca

February 13, 2019

Amy Duncan, MSc, RPBio
Okanagan Nation Alliance
Columbia Region
1444 Columbia Ave.
Castlegar, BC V1N 3K3

RE: Archaeological Overview Assessment and Preliminary Field Reconnaissance of proposed maintenance project at Murphy Creek Spawning Channel, Trail, BC.

This letter reports the findings of the Archaeological Overview Assessment (AOA) and Preliminary Field Reconnaissance (PFR) of proposed maintenance project at the Murphy Creek Spawning Channel, approximately 7 km north of Trail, BC (Figure 1).

The objectives of the AOA/PFR are to:

- Identify and evaluate any areas of archaeological potential within the project area that warrant detailed archaeological investigation;
- Provide recommendations regarding the need and appropriate scope of further archaeological studies.

This AOA/PFR is concerned with identification of archaeological potential and archaeological sites within the identified AOA study areas in relation to the project area. It does not address potential for traditional use sites within the subject project area. It is not the intent of this report to document First Nations' interest in the land. The study was conducted without prejudice to First Nations' treaty negotiations, Aboriginal rights, or Aboriginal title.

Archaeological sites can be defined as physical evidence of past human use of an area that, in the subject region, is typically represented by artifacts, lithic debitage (byproducts of stone tool production), faunal remains, fire altered rock, hearth/fire pit features, habitation and subsistence features, quarry sites (for obtaining lithic raw materials), and ceremonial rock art sites (pictographs).

Project Background

Amy Duncan, Biologist for the Okanagan Nation Alliance (ONA), engaged Ursus Heritage Consulting Ltd. (Ursus) to conduct an AOA and PFR of proposed maintenance project at the Murphy Creek Spawning Channel following a request for the archaeological study by the Osoyoos Indian Band (OIB).

The PFR was conducted by Fraser Bonner of Ursus on November 26, 2018 accompanied by Amy Duncan. Additionally, maintenance project supervisors Al Mallette and Rob Frew of the Trail Wildlife Association (TWA) were also present during the PFR. An OIB archaeological technician was scheduled to participate in the PFR but was unable to attend.

Project Area Description

The Murphy Creek Spawning Channel consists of a diversion channel and settling pond located adjacent to the left bank of the lower reaches of Murphy Creek, immediately below Highway 22 and approximately 250 m upstream of the creek outlet into the Columbia River (Figures 1 and 2).

The spawning channel was built in 1992 under the leadership of the TWA in order to mitigate the effects of the Highway 22 culvert, which was blocking fish passage into the upper reaches of the stream (Arndt and Klassen 2004). The spawning channel was grafted onto an existing water diversion structure used to supply the neighbouring Birchbank Golf Course with irrigation water. When completed, a series of stepped pools containing spawning gravel was fed by an intake off the main stem of Murphy Creek to create a spawning channel. Since it was established several improvements to the channel have been undertaken including enhancement of the channel culvert, and upgrades to the channel intake and the sediment settling pond (Mallette 2017).

The Murphy Creek Spawning Channel is set within the floodplain of the lower reaches of Murphy Creek. Here the creek channel runs through a deeply incised valley before the landscape opens up at the alluvial fan of the creek outlet. The margins of the creek are forested by a mix of paper birch and black cottonwood.

In addition to the disturbance from the previous Birchbank Golf Course irrigation works and subsequent construction of the spawning channel the impacts from the Highway 22 construction are evident throughout the vicinity including those associated with the installation of the Murphy Creek highway culvert, which empties a short distance above the spawning channel diversion. Much earlier impacts to the landscape resulted from the construction of the former Trail-Castlegar Road and associated bridge crossing, which routed through the spawning channel area) as well as by a number of informal roads that provide access to the creek and river (Mallette personal communication).

Project Description

The maintenance project proposed for the Murphy Creek Spawning Channel focus primarily on the settling pond, which was constructed a short distance below the head of the creek diversion that feeds the channel. The settling pond is scheduled to be cleared of the accumulated sediment that rests on the bottom of the pond using a tracked excavator. The excavator will approach and access the settling pond along existing access trails.

Also encompassed within the maintenance project will be the placement of boulders at the intake site in order to protect it at high flow periods (spring freshet). This will involve moving boulders and placing them near the intake site using the tracked excavator, which will approach and access the pond along existing access trails. No ground disturbance to any intact natural sediments will result from any of the scheduled maintenance activities.

Previously Recorded Sites

A search of the BC Remote Access to Archaeological Data database (RAAD) identified one previously recorded archaeological site associated with Murphy Creek. Site DgQk-4 is mapped south of the Murphy

Creek outlet, approximately 200 m from the spawning channel project area. The site was originally recorded based on two faint depression features that were interpreted as cultural. During an Archaeological Impact Assessment of the proposed BC Hydro Murphy Creek Project undertaken by Baker (1983) shovel testing in and around these identified features was conducted with no cultural material recovered and no evidence of the use of these features as habitations.

AOA-PFR Methodology

The current AOA was conducted in accordance with the *British Columbia Archaeological Impact Assessment Guidelines* (Apland and Kenny 1998) issued by the Archaeology Branch at the Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO). For the current project the AOA involved:

- A review of pertinent regional archaeological, historical, ethnographic, geological, and biophysical literature;
- A review of the property's biophysical and topographic characteristics;
- An evaluation of the previous impacts to the natural landscape of the project area; and
- An evaluation of archaeological site potential.

The archaeological site potential assessment process considers a number of criteria in order to establish potential ratings for a given piece of landscape. A correlation exists between particular biophysical characteristics and the incidence of archaeological sites. The presence of particular biophysical characteristics can be used to predict the likelihood of a location being used prehistorically. Generally, people gravitate toward areas with access to water, shelter, and food and raw material resources, seeking out locations that are relatively level, well-drained, solar aspect, and provide a good vantage point. As such the biophysical characteristics that are considered are:

- Presence and nature of water features;
- Wildlife and fish values;
- Slope, aspect, and topography;
- Presence of bedrock exposures, karst, talus, or boulders suitable for rock art locations, caves, rock shelters, or lithic raw material sources;
- Vegetation and forest cover composition and age.

Archaeologically it is important to not only examine these biophysical characteristics as they appear currently but to also consider the changes in these biophysical characteristics over time, from the Late Pleistocene through to the Holocene.

Further to the biophysical characteristics, a number of cultural and archaeological criteria are considered in order to further refine the archaeological site potential assessment included:

- Connection of study area to First Nations' traditional use localities, oral history, and/or known traditional place names;
- Proximity of property to previously recorded archaeological sites;
- Prehistoric settlement and resource use of the region;
- Level and type of past historic land use and the resulting impacts;
- The previous archaeological experience of the researcher.

A PFR of the project area was conducted to provide an in-field assessment of archaeological potential. The field survey consisted of an archaeologist traversing the project area. Ground surfaces within the

proposed impact areas were intensively examined for the presence of artifacts, cultural materials, and other evidence of past human settlement and land use. The landscape was examined for archaeologically significant landforms such as naturally level benches, terraces and/or promontories. Landforms, vegetation, aspect, and sources of potable water were noted in the field; natural and manmade disturbance was examined and evaluated.

AOA-PFR Results

No archaeological remains or areas of potential for the presence of archaeological sites were identified during the PFR of the proposed project area. The spawning channel and settling pond are set within the floodplain of the creek, a locale that is subject to regular seasonal flooding. Although the spawning channel and settling pond are set adjacent to the Murphy Creek stream channel, there is an absence of well-drained elevated terraced or benched landforms generally associated with archaeological site locations. More suitable locations for potential archaeological sites exist outside of the project area, closer to the mouth of Murphy Creek and on the level river terrace features located above the project area, upon which the Birchbank Golf Course is located. Based on the absence of archaeologically significant landforms and the floodplain setting of the spawning channel the potential for the presence of archaeological sites within the entirety of the Murphy Creek Spawning Channel area is assessed as low. Figure 2 provides a map showing PFR survey coverage and Photos 1-4 provide views of the Murphy Creek Spawning Channel area including the settling pond and channel intake.

Recommendations

Based on the results of the AOA-PFR, the proposed maintenance project at the Murphy Creek Spawning Channel area is assessed with low potential for the presence of archaeological sites and it is the authors' opinion that no further archaeological work is warranted for the proposed project area.

Users of this report should be aware that even the most thorough investigation may fail to reveal all archaeological remains, including sites protected by the BC *Heritage Conservation Act*, that exist in an area. All users of this report should also be aware that: (1) archaeological remains in BC are protected from disturbance, intentional or inadvertent, by the *Heritage Conservation Act*; (2) in the event that archaeological remains are encountered, all ground disturbance in the immediate vicinity must be suspended at once; (3) it is the individual's responsibility to inform the Archaeology Branch, and appropriate First Nations as soon as possible, about the location of the archaeological remains and the nature of the disturbance; and (4) the *Heritage Conservation Act* may incur heavy fines and imprisonment for failing to comply with these requirements.

If you require further information regarding the AOA-PFR please contact Ursus Heritage Consulting Ltd.

With respect,

Fraser Bonner, BA
Senior Archaeologist
Ursus Heritage Consulting Ltd.

References

Apland, Brian, and Ray Kenny
1998 *Archaeological Impact Assessment Guidelines.* Archaeology Branch, Ministry of Forests, Lands, and Natural Resource Operations, Victoria.

Arndt, S. and K. Klassen
2004 Evaluation of Rainbow trout spawning migrations in Blueberry, China and Murphy Creeks from 1999 to 2003. Columbia Basin Fish and Wildlife Compensation Program.

Baker, James
1983 Murphy Creek Project Heritage Resource Detailed Impact Assessment. Heritage Inspection Permit 1982-0020. Report on file with BC Archaeology Branch, Victoria.

Mallette, Al (Trail Wildlife Association)
2017 Murphy Creek Rainbow Trout Spawning Channel Maintenance 2016 - 2017 - Project (COL-F17-F-1344). Columbia Basin Fish and Wildlife Compensation Program.

Figure 1: Murphy Creek Spawning Channel Maintenance Project AOA-PFR Location Map

Dig. Map	13-02-19	F.B.

Ursus Heritage Consulting Ltd.

Legend:
- Highway 22
- Previously Recorded Archaeological Site
- Project Area

Study Area

Base Map Source:
Google Earth Imagery 2009

Permit # N/A
Borden # N/A

Scale: 1:30000
0 300 600 900 1200 1500 m

Figure 2: Murphy Creek Spawning Channel Maintenance Project AOA-PFR Detailed Survey Coverage Map

Dig. Map	13-02-19	F.B.

Legend:
- Previously Recorded Arch Site
- Highway 22
- Roads
- Birchbank GC Pumphouse
- CPR Rail Line
- Murphy Creek Channel
- Spawning Channel / Settling Pond
- PFR Survey Coverage

Base Map Source: Google Earth 2009

Permit # N/A
Borden # N/A

Scale: 1:2500
0 25 50 75 100 125 m

Photo 1. View N of spawning channel intake with Birchbank Golf Course pumphouse in background. Note the boulders surrounding the intake, which have been transported in part by the seasonal flooding of the creek.

Photo 2. View SW of the settling pond. Note the shoreline of the pond, which provides easy access for the tracked excavator used in the removal of the pond sediment.

Photo 3. View W of spawning channel with Murphy Creek in background. Note the poorly drained floodplain terrain located along the margins of the channel and creek.

Photo 4. View W of Murphy Creek, looking upstream. Note the alluvial deposited boulders throughout the stream that are seasonally transported by spring freshet flooding.