Fraser Valley Watersheds Coalition
Unit 1 - 45950 Cheam Avenue
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www.fvwc.ca

A Restoration and Enhancement Guide to Ryder Creek in Chilliwack B.C.

Prepared by Bridgette Knowlan & Natashia Cox of the Fraser Valley Watersheds Coalition for the use as a guide by the Chilliwack Fish and Game Protective Association.

Acknowledgements: Fraser Valley Watersheds Coalition, Department of Fisheries and Oceans Canada,
11-21-2019

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Glossary of Terms

Bioengineering: Bioengineering combines engineering practices with biological principles to create something useful. For example, using willow stakes to stabilize a stream bank and reduce erosion.

Enhancement: Enhancement refers to building up an area that already has established biological values by creating and adding habitat components to increase those values. An example of enhancement is planting native vegetation on a stream bank to increase stream cover for salmon to hide from predators and find shade in hot weather.

Fragmentation: Fragmentation refers to a method of plant growth in which a cutting or fragment of a plant can regrow new roots and grow into a new plant.

Gee's minnow trap: A Gee's minnow trap (Figure 1) is a trap used to catch small fish such as juvenile Pacific salmon. The trap has two half cylinder metal baskets that are attached in the centre with a large metal safety pin and a string with a wooden stake attached at the end. Each end of the trap has a small hole designed to allow fish to enter the trap but prevent fish from leaving the trap.

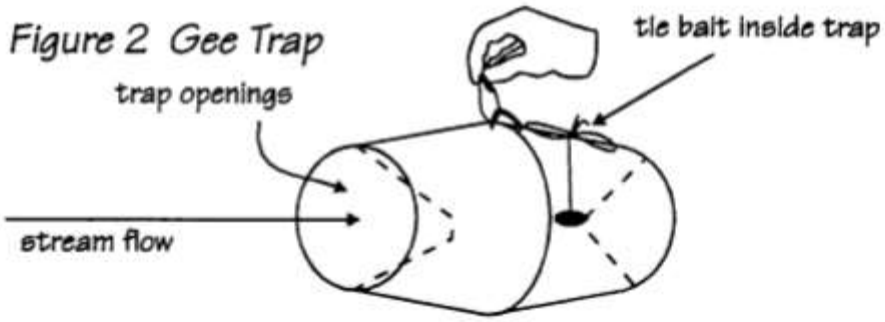

Figure 1. Drawing of a Gee's Minnow Trap from the Streamkeepers handbook Module 11 (https://www.pskf.ca/publications/Module11.pdf.).

Habitat complexity: Habitat complexity is a measure of how diverse an area is in terms of habitat types. For example, a stream that is straight with no vegetation along the bank has less habitat types and therefore less habitat complexity than a stream that is s-shaped with lots of overhanging vegetation and large woody debris and boulders in the stream.

Large woody debris: Large woody debris is an industry term for logs of a certain size that stick out of the bank into a stream. Large woody debris provides cover and shade for fish in addition to more variable water velocities which also create different habitat types in a stream leading to increased habitat complexity.

Live staking: Live staking is a form of bioengineering where branches of trees and shrubs such as willow (*Salix spp.*) and red-osier dogwood (*Cornus sericea*) are collected and stuck into the ground where they will grow into new shrubs and trees. Live stakes act as bank stabilizers to prevent erosion and are a quick and relatively inexpensive way to revegetate a stream bank.

Off-channel: An off-channel refers to a section of stream or wetland that is located adjacent to a main section of a stream. Off-channels are important because they provide rest and feeding areas for fish.

Restoration: Restoration refers to the act of returning an area that has been degraded over time back to its original natural state as best as possible. For example, many agricultural fields were historically wetlands so a restoration project could include taking an abandoned or unused agricultural field and returning it back into a wetland by digging a channel or pond.

Riparian area: A riparian area is the transition zone between a stream and an upland area. The riparian area is characterized by wetter soils and therefore has a specific plant community consisting of herbs, shrubs, and trees that like to grow in a wetter environment (Figure 2).

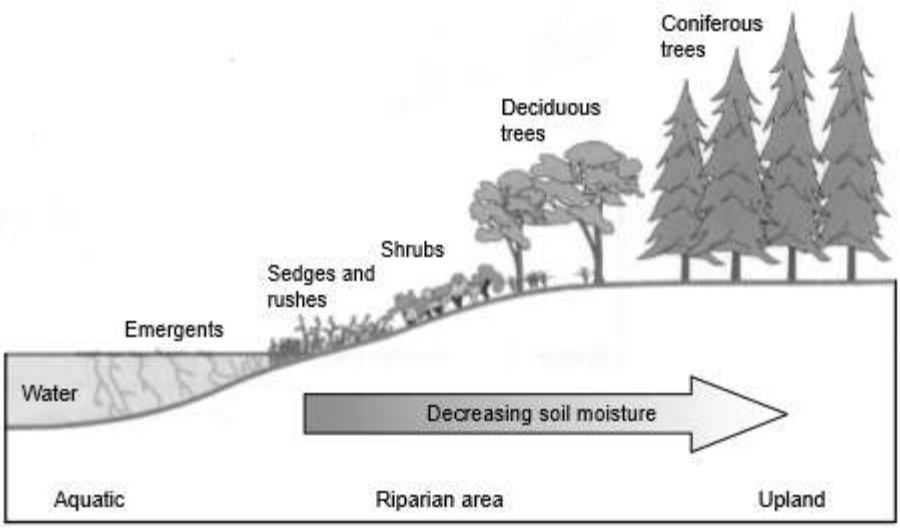

Figure 2. An illustration showing the soil moisture gradient of a riparian area as it transitions into an upland area and the types of plant communities found along this gradient (Stevens et al. 1995).

Sedimentation: Sedimentation is the process of sediment collecting in a stream usually due to geological instability of the stream bank or neighbouring hill slopes causing sediment to fall into a stream where gets carried downstream and collects in areas of lower water velocities. Sedimentation can result in sections of a stream or other water body to infill and eventually block the flow if water.

Staff Gauge: A staff gauge is a tool that can be installed in a body of water to easily read the water level and water flow of a site.

Water velocity: Water velocity refers to the speed at which water travels in a stream. Many factors can contribute to water velocity (e.g. the downhill grade, width, depth, and shape of a channel).

1. Introduction

Ryder creek in Chilliwack B.C. is slowly infilling due to geological instability in the surrounding hillsides resulting in the loss of salmon habitat and an unstable water system with increased flood risk. Conserving and creating creeks and off-channels for salmon habitat is not only important for the health of salmon which have cultural, economical, and recreational values, and can support genetic variability and resilience, it is important for the over-all health of the surrounding watershed. The section of Ryder creek adjacent to the Chilliwack Fish and Game Protective Association (CFGPA) has had some restoration work completed more than 10 years ago and recently in the summer of 2019. In 2019, a pond was recreated at the upper range of the property to act as a sediment catch and create off-channel salmon habitat. Additionally, invasive species work was done to control the Japanese knotweed (*Polygonum japonica*) present on the property. The purpose of this report is to act as an advisory for the Chilliwack Fish and Game Protective Association for future maintenance and enhancement work in and adjacent to Ryder creek.

2. Rationale

Protecting and enhancing salmon bearing streams is important for creating habitat suitable for salmon to complete all life-stages to ensure salmon populations are around for future generations. Salmon are biologically important because they provide an important, nutrient dense food source for other animals including whales and bears. They also provide nutrients for plants in neighbouring forests either from natural decay after death or by being spread by other animals through excrement. Salmon are also culturally, economically, and recreationally important for humans as they play a large role in food and fun.

Sedimentation in salmon bearing streams can be detrimental to salmon because it alters the stream conditions to those that are not suitable for salmon. Salmon require stream systems with varying water velocity and high complexity such as overhanging bank vegetation and large wood for them to complete each life-stage. For example, salmon spawn in faster flowing water with larger sediment size for egg deposition but require slower moving pools to rest and grow before migrating to the ocean. Sedimentation also increases flood risk due to the creation of unstable stream morphology which creates a flashier water system especially during high rain or snow events. It is important to reduce sedimentation by creating off-channels to act as sediment catches and to complex these channels with

vegetation, large wood, and boulders to create salmon habitat and to build up the riparian area to reduce flood risk. Future work is required at Ryder creek to enhance the stream and riparian area to meet these habitat conditions for salmon and to reduce erosion, sedimentation, and flooding.

3. Location

The Chilliwack Fish and Game Protective Association is located on Chilliwack Lake Road in Chilliwack B.C. The property is located southeast of downtown Chilliwack, B.C. and northeast of Cultus Lake, Chilliwack, B.C. (figure 1). Adjacent to the property is a segment of Ryder creek that is a known salmon bearing stream. This section of Ryder creek has had previous restoration work completed and has space for future restoration and enhancement projects (Figure 3).

4. Restoration Process

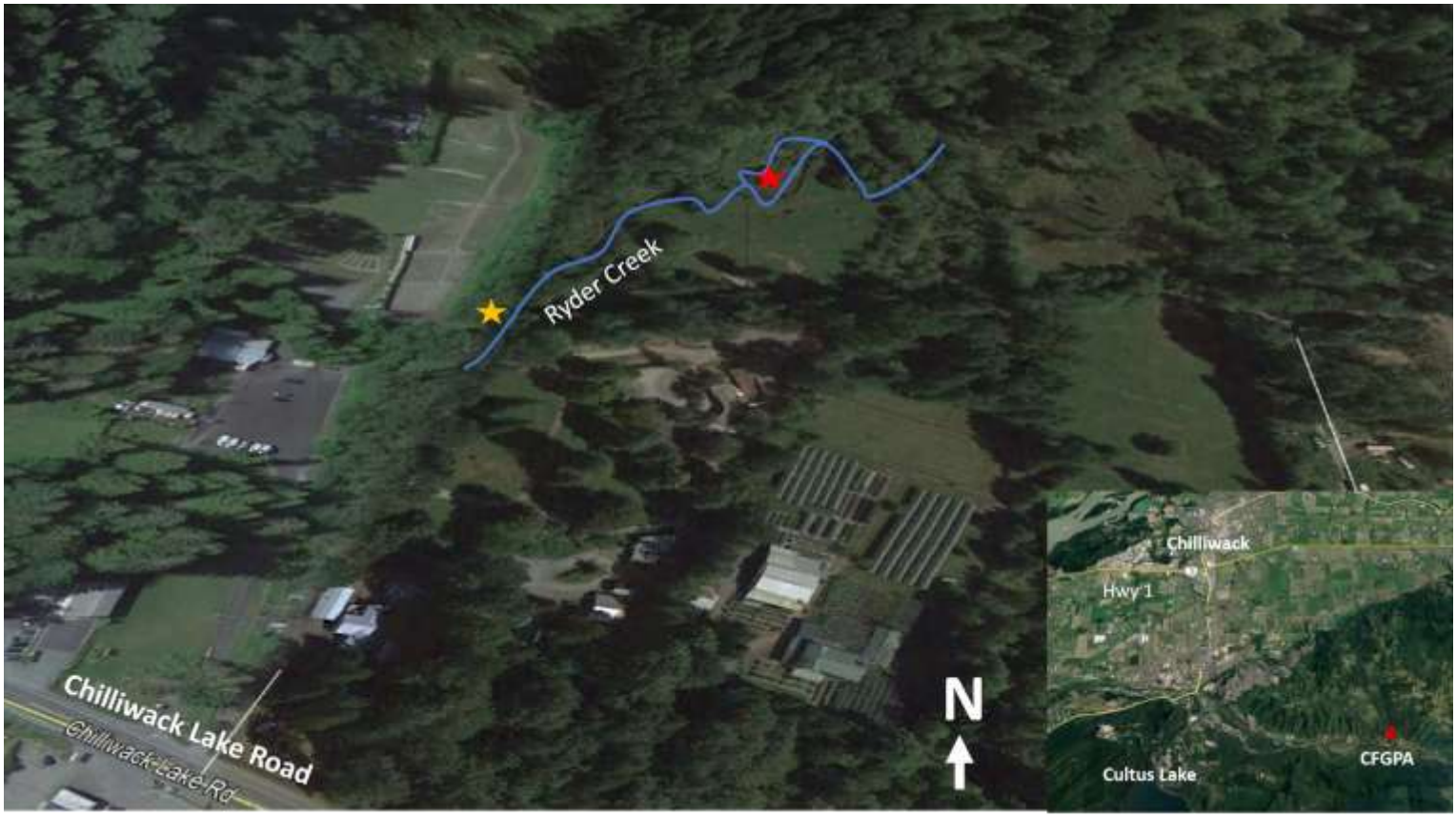

Figure 3. A map showing the Chilliwack Fish and Game Protective Association property and its location relative to Chilliwack B.C. The blue line indicates the section of Ryder creek that has previously had restoration work completed and where future restoration and enhancement work should be completed. The red star indicates the sediment bar that has formed due to sedimentation in the creek. The yellow star indicates the location of the re-created pond that was constructed to act as a sediment catch and off-channel salmon habitat.

Prior to completing any work, it is important to identify the goal of the project. In the instance of the Chilliwack Fish and Game Protective Association creating a land management plan would be beneficial to assess the current conditions of the property and identify the species that the plan will benefit. A land management plan will help determine what values are important for the association to conserve and help create short-term and long-term goals. Linked below are some examples of land management plans to follow:

1. http://www.islandstrust.bc.ca/media/345747/appendix-b-itf_2018-05-17_management-plan-standard_fnl.pdf
2. http://cmp-openstandards.org/wp-content/uploads/2014/03/CMP-OS-V3-0-Final.pdf
3. https://conservationgateway.org/Documents/cfop-chapter7.pdf
4. https://www.rdn.bc.ca/cms/wpattachments/wpID2040atID3337.pdf
5. http://fraservalleyconservancy.ca/wp-content/uploads/2015/08/MaclureManagementPlan2015.pdf

Once a goal is determined, a method of comparing the results of the project to the starting conditions needs to be determined to document the success of restoration. For example, if the goal is to enhance the habitat for salmon by reducing sedimentation and increasing habitat complexity a method for comparison would be to measure the rate of sedimentation in the stream, measure the habitat complexity by recording the vegetation along the bank and counting the number of in-stream boulders and large wood, and to seasonally sample for fish species and size in the stream.

If construction is required, isolation and salvage work need to be completed to make sure water and fish cannot enter the restoration site. Additionally, any instream work must be completed during the fish window that runs in the summer months of each year and exact timing is dependent on the type of work being completed, the goal of the project, and the target species of the project (https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/bc-s-eng.html#area-28). Proper permits need to be acquired from both the provincial and federal governments to state that instream work can be completed. All details of construction need to be determined prior to start including details such as size and depth, where to place removed soil, and the type of equipment required. Resources and help with project details can be provided by organizations such as the Department of Fisheries and Oceans Canada and the Fraser Valley Watersheds Coalition.

After creating the goal habitat type (e.g. an off-channel pond), the site will need to be replanted with native trees and shrubs, large wood and boulders should be added to the site to increase habitat complexity (these can also be added during the construction process when heavy machinery is available), and invasive species should be removed and controlled to reduce their impact on native species. It is important to note that restoration is an on-going process. Monitoring the project site to assess success is required sometimes for multiple years after restoration is complete and maintenance will likely be required to ensure the project continues to meet its goal(s), and adaptive management and adjustments can be made regularly which helps ensure project longevity.

Additional information and a complete guide to Ecological Restoration in B.C. can be found at http://www.env.gov.bc.ca/fia/documents/restorationguidelines.pdf.

5. Restoration Works Completed in 2019

In the summer of 2019, an off-channel pond was recreated along Ryder creek on CFGPA property to act as a sediment catch and off-channel salmon habitat. Figure 7 and Figure 8 show a conceptual drawing of past and future work to be done on CFGPA property as it related to the property boundaries and Ryder creek. Figure 4 and Figure 5 show the section of CFGPA property to be excavated and its relation to Ryder creek. Figure 6 shows the same section of CFGPA property after construction. Revegetation of the site will happen naturally as the seed bank from surrounding trees and shrubs is already in the soil. However, revegetating by planting the area with potted native species and live stakes is a good method of revegetating the area quicker and reducing the potential of invasive species establishing. Additional restoration work in 2019 included the herbicide treatment of Japanese knotweed by the Fraser Valley Invasive Species Society. Additional treatment will likely be required and other patched of Japanese knotweed present on the CFGPA property should also be dealt with.

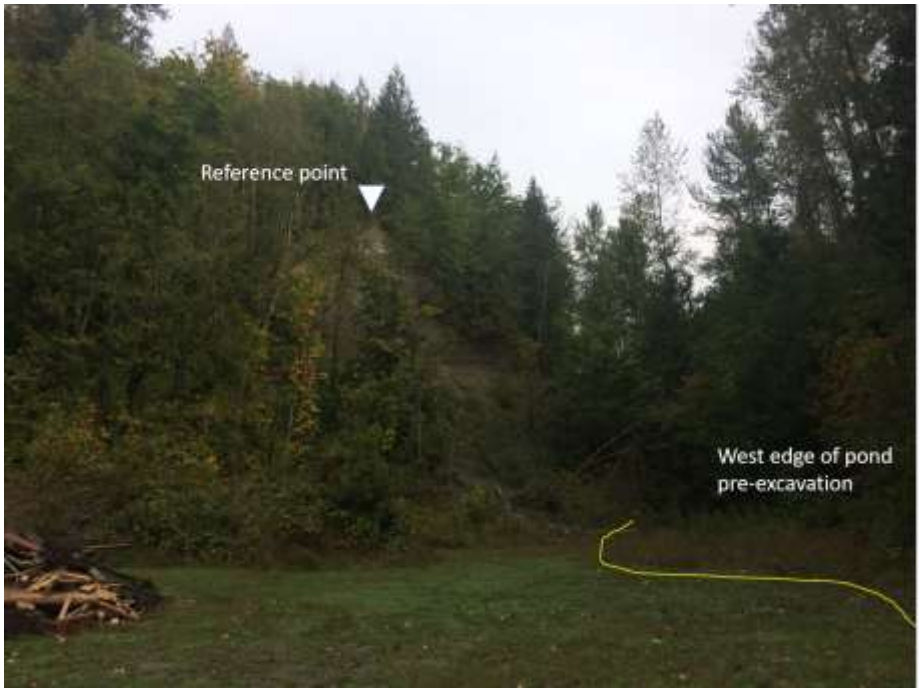

Figure 4. A photo showing the approximate location of the off-channel pond on the CFGPA property.

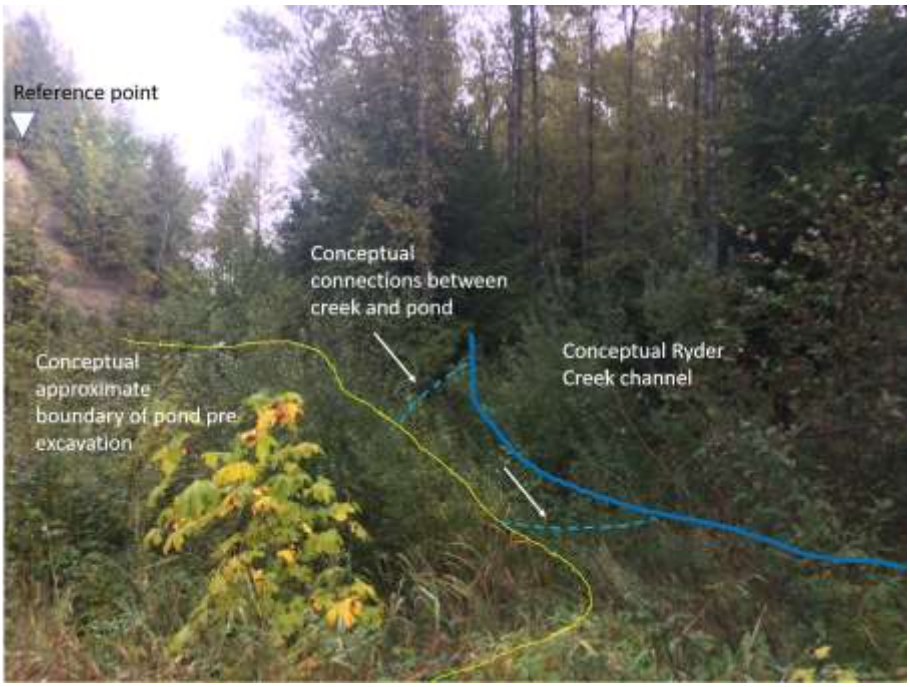

Figure 5. A photo showing the approximate location of the pond that was constructed on CFGPA property pre-excavation in relation to the channel of Ryder creek. The dotted blue lines indicate the connections between Ryder creek and the constructed pond.

Figure 6. A photo showing the recreated off-channel pond on the CFGPA property after excavation was completed.

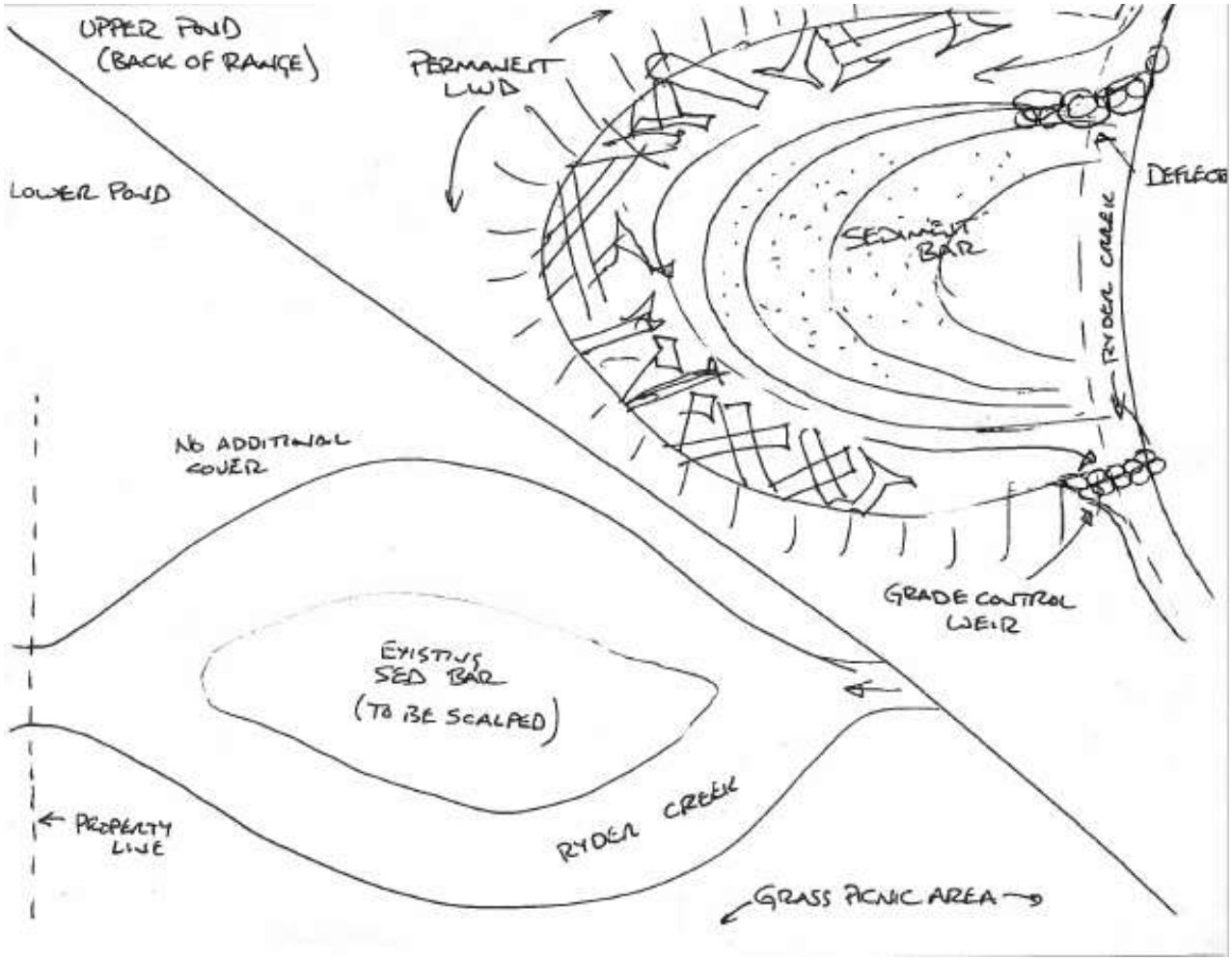

Figure 7. Conceptual drawing of restoration and enhancements for the CFGPA property.

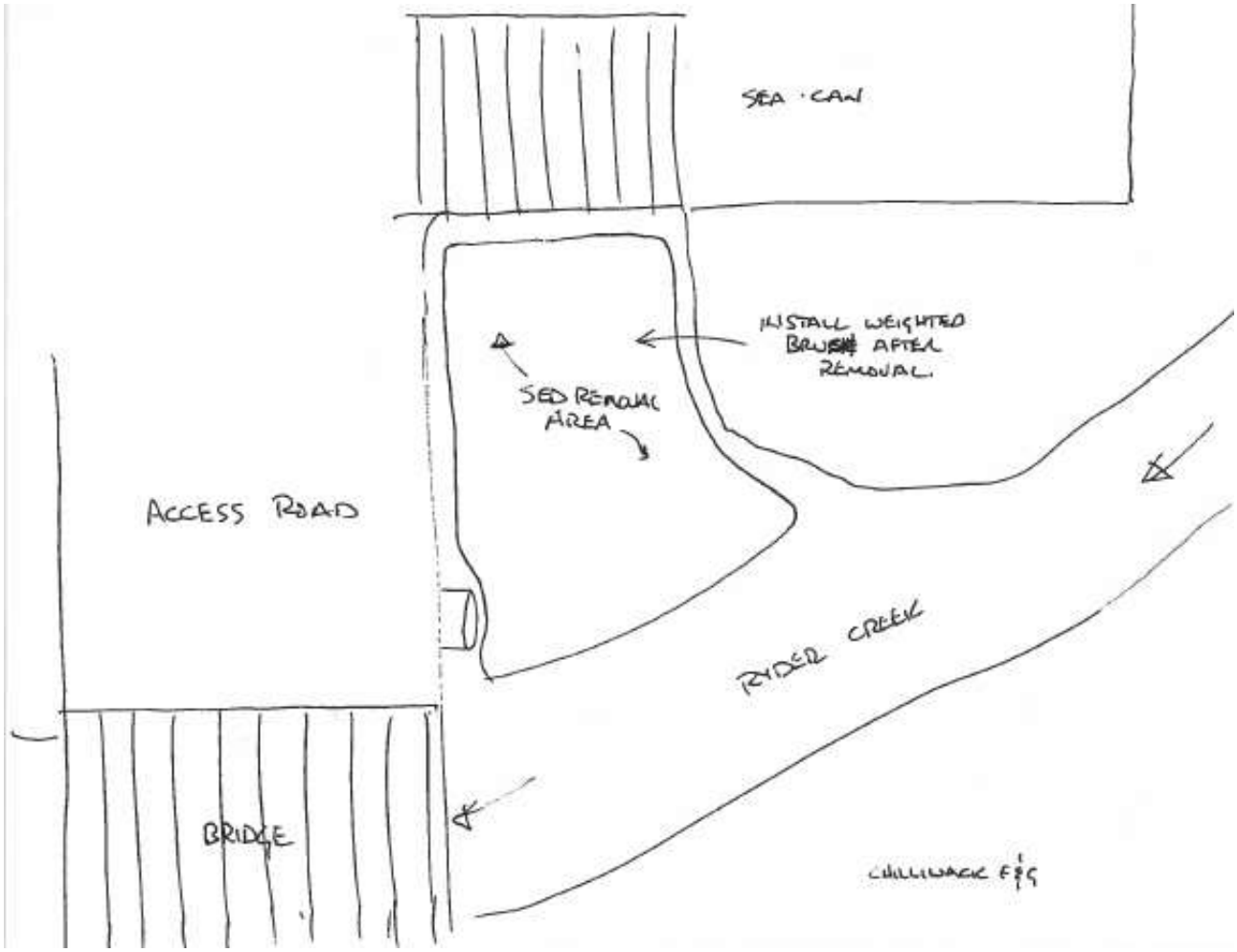

Figure 8. Conceptual drawing of restoration and enhancements for the CFGPA property.

6. Recommendations and Next Steps

Moving forward it is important to continue the enhancement of Ryder creek for the use of salmon and the reduction of flood risk by focusing on assessing the extent of sedimentation, enhancing the riparian area along the bank, and monitoring the creek for salmon use. Additionally, a land management plan should be created by the Chilliwack Fish and Game Protective Association to determine the goals and values they see for their property and to determine future salmon habitat creation and enhancement projects that fit those goals and values.

In the fall, funding can be applied for through grants and financial support requests. Restoration activities such as planting native trees and shrubs and removing invasive species can be completed. Additionally, monitoring can be completed to assess fish species and size using the creek and the

quality of water in the creek. The winter months should be spent developing the plans for restoration and construction for the following year and grants and financial support requests should be wrapped up and submitted. Additional water quality and fish sampling should be completed so that the data collected can be compared between seasons of each year. In the spring, all specific details of plans for all restoration and construction work should be confirmed. Verify the who, what, where, when, and why of the project. Clarify the goal(s) of the project and relate all aspects of the project back to it. Spring is a good time to continue the removal of invasive plants because it is the beginning of the growing season, thus plants are easier to identify. Native plants can also be planted during spring and monitoring of fish species and water quality should be continued. Summer marks the window for restoration and construction to be completed. The team and all contractors should be secured before starting any restoration activities and construction and all work to be completed should be isolated. Additionally, invasive species can be removed and monitoring of fish species and size, and water quality in the stream can be done to complete the seasonal monitoring data. Figure 9 shows the timeline of restoration activities that can be completed at Ryder creek.

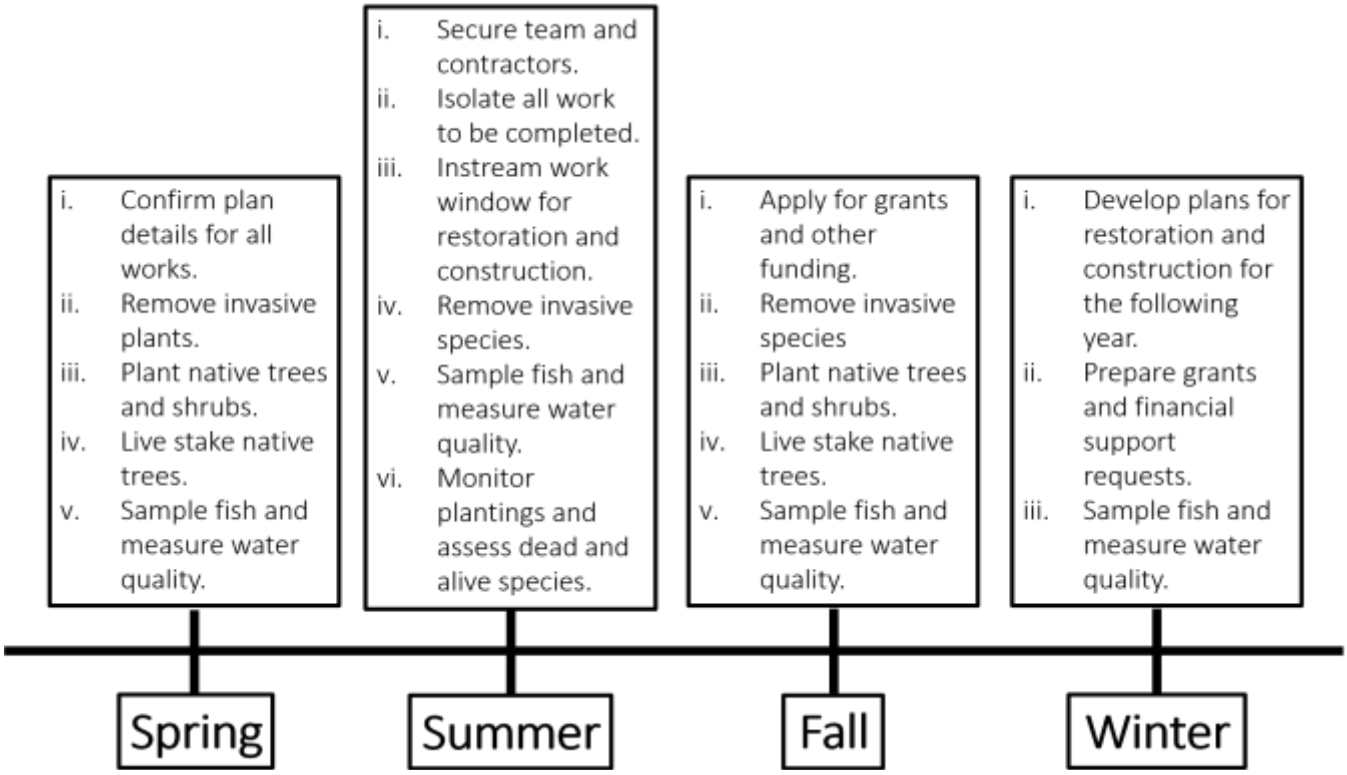

Figure 9. Timeline of restoration outlining which seasons are the most ideal months for completing different restoration and enhancement activities.

6a. Assessment and Control of Sedimentation

The rate of sedimentation can be assessed by installing a staff gauge at the recreated sedimentation pond to measure the rate of deposition in the pond. A staff gauge will allow sedimentation to be recorded empirically to understand the rate of sedimentation and to determine the depth at which the pond should be cleaned. Future cleaning of the stream will be required because sedimentation from mass wasting of the hillside will continue to infill the system and create flood conditions and reduce salmon habitat. When sediment removal is necessary an excavator can access the pond from the south end at the grade control weir and remove the sediment bar without needing to isolate the pond and take it offline. This method will require more frequent cleaning but will reduce the salvage efforts to protect the water and fish in the system.

6b. Invasive Species Control

Invasive species such as Himalayan blackberry (*Rubus armeniacus*) and Japanese knotweed outcompete native trees and shrubs resulting in reduced habitat complexity. Removing and managing the regrowth of invasive species is an important part of restoration and enhancement work to ensure that native plants have a chance to grow and reduce to colonization of invasive species in the future. Most invasive plants can be removed by clipping them or digging out roots over multiple years. However, Japanese knotweed spreads by fragmentation meaning that even a dropped clipping of the plant can regrow as a new plant and spread. This makes the removal and management of knotweed species difficult and the most effective method of removal is herbicide application which requires a special license. To report and request the removal of knotweed it is best to contact the Fraser Valley Invasive Species Society (FVISS) and/or their subcontractors such as Morrow Bioscience. It must be noted that one treatment of herbicide for knotweed is likely not enough for complete removal. Follow-up treatment is highly likely because the underground root system of the plant is so large. If a follow-up treatment is not applied in a timely manner, there is a risk of the plant becoming resistant to the herbicide resulting in the failure of future treatments. For species such as Himalayan blackberry invasive species pulls make great volunteer opportunities for the community and association members to get involved and late spring through early fall is the best window for removal as the plants are easily recognizable. More information on common invasive species and removal methods can be found at https://fviss.ca/.

6c. Native Planting

Enhancing and rebuilding the riparian area of a stream is an important part of restoration because it adds stabilization to the stream bank to reduce erosion, provides overhanging vegetation to increase food and shelter for salmon, and it reduces flood risk through root uptake of flood water and slowing the velocity of flood flows. Ideally, the riparian area of a bank should span at least 30 metres from the stream, but that is not always possible due to land use and infrastructure so the riparian area should

be as expansive as possible wherever possible along the stream. Consider planting species such as hardhack (*Spirea douglasii*), red-osier dogwood, willow, and salmonberry (*Rubus spectabilis*) as these species are tolerant of wet soils typical of a riparian ecosystem. Other species to consider can be found in the Pacific Streamkeepers Handbook in Module 7 (http://www.pskf.ca/publications/Module07.pdf.) Funding for purchasing potted native plants can be applied for through grants, and volunteer planting events are a great way to involve the community in restoration.

In addition to planting potted native species, live stakes such as willow, cottonwood (*Populus trichocarpa*), and red-osier dogwood branches can also be collected from nearby areas and staked into the ground. Branches can be collected using loppers and pruning shears and the branches should be as straight as possible and pruned of all leaves. When cutting branches, cut at an angle to be able to identify the end that goes in the ground and to more easily push the branch in to the ground. This is a form of bioengineering called live staking where the staked branches will regrow into new trees and is a good method to stabilize the stream bank quickly while waiting for possible plant funding. Planting and live staking are best done in the spring and fall when the weather is mild, and conditions are wet to promote plant growth. For more information about live staking and other bioengineering techniques for erosion control see http://chapter.ser.org/westerncanada/files/2015/01/2002-polster.pdf.

6d. Stream Complexing

It is also important to enhance the instream habitat by adding large boulders and large woody debris. This increases the habitat complexity in the stream by providing a varied stream velocity which creates more diverse habitat types for salmon. Woody debris and boulders also provide refuge for salmon during extreme weather conditions and from predators. If large machinery is required to add boulders and woody debris, then the work must have a permit and be done during the fish work window in the summer months. Boulder and woody debris size and placement alter the water behaviour in a stream. Boulder and woody debris size and placement need to consider the desired maximum velocity of the stream to ensure the enhancements made are suitable for the channel constraints.

Other future projects should include altering the existing stream to a more meandering channel with scalloped bank edges. Meandering streams create more varied habitat such as pools and spawning areas for salmon. They also vary the stream velocity to recreate a more natural and stable sediment erosion and deposition pattern and reduce downstream erosion and flooding.

6e. Monitoring and Maintenance

Monitoring a site before and after restoration or enhancement is an important step to assess if the project was successful in meeting its goal(s). For example, if an off-channel pond was created as a sediment catch then monitoring for sediment accumulation in the pond and sediment reduction in the stream is a crucial step in determining if the restoration effort was worth it. If the same off-channel

pond was built to also create salmon habitat then monitoring for fish by setting traps and measuring water quality to monitor habitat conditions is important to determine if the pond is functioning as good habitat. Monitoring at Ryder creek will likely include sampling for fish using Gee minnow traps, measuring for water quality using a water quality metre, measuring water depth, measuring sediment accumulation over time, assessing the health of plants and live stakes planted and installed at the site, and measuring the extent of invasive species over time. Water quality measurements such as temperature and dissolved oxygen do not require a permit. However, setting fish traps will require a Provincial permit and a Federal Fisheries Permit, and will need to be reported on annually. For more information see:
http://www.frontcounterbc.gov.bc.ca/guides/fish-wildlife/scientific-fish-collection/overview/
https://www.pac.dfo-mpo.gc.ca/fm-gp/licence-permis/scientific-scientifique-eng.html

Maintenance is any work that needs to be done after a project is complete to ensure that the site continues to meet the project goal(s) and monitoring will determine if maintenance is required. For example, if invasive species are observed re-growing, then maintenance will be required to remove the re-growth. Likely it will take several years of monitoring and maintenance to help Ryder creek reach its full potential to bear healthy salmon and mitigate flooding and erosion.

6f. Future Enhancement and Habitat Creation

Future projects should aim to create more off-channel ponds to act as sediment catches and to create additional off-channel salmon habitat. The more sediment catches created the greater the reduction in sedimentation impact to Ryder creek from the eroding hillside, and the greater the reduction in flooding. Off-channel habitat is also required for salmon to rest and grow during certain times of the year so building more off-channel ponds along Ryder creek creates more space for salmon to utilize. Additionally, if space allows on Chilliwack Fish and Game Protective Association property, then building a wetland is also a great option for reducing flood risk as it acts as a sink for overflowing stream water or surface water run-off during high rain or snow events. Wetlands take in flood water and slowly release it back into the stream system at a rate that will reduce the severity of downstream flooding and erosion.

7. Key Contacts

There are many resources available to help further the enhancement work at Ryder creek by the Chilliwack Fish and Game Protective Association.

7a. Overall Project Management Technical and Financial Support

The Fraser Valley Watersheds Coalition – available for help with writing grants and overall project support and planning. Contact Natashia Cox at Natashia@fvwc.ca; info@fvwc.ca or call 604-855-8274 and/or 604-791-2235.

7b. Invasive Species Management

Fraser Valley Invasive Species Society – available for help with identifying and managing invasive species especially with herbicide application for removing Japanese knotweed. Contact Kathy Ma at info@fviss.ca.

The Fraser Valley Watersheds Coalition – available for help with the removal of invasive plants that do not require herbicide treatment and for overall support and information. Contact Natashia Cox at Natashia@fvwc.ca; info@fvwc.ca or call 604-855-8274 and/or 604-791-2235.

7c. Technical Fisheries Support

The Fraser Valley Watersheds Coalition – available for help fisheries related questions and permitting, and overall project support and planning. Contact Natashia Cox at Natashia@fvwc.ca; info@fvwc.ca or call 604-855-8274 and/or 604-791-2235.

Department of Fisheries and Oceans Canada Resource Restoration Unit – available for project support and support with fisheries related questions, concerns, and permitting. Contact Robert Schaefer by email at Robert.Schaefer@dfo-mpo.gc.ca, or call 604-837-3325.

7d. Species at Risk and Biodiversity

The Fraser Valley Watersheds Coalition – available for help with writing grants and overall project support and planning. Contact Natashia Cox at Natashia@fvwc.ca; info@fvwc.ca or call 604-855-8274 and/or 604-791-2235.

The Fraser Valley Conservancy – available for help with species at risk related questions, permitting, and monitoring. Contact Joanne Neilson at 604-625-0066 or email info@fraservalleyconservancy.ca.

South Coast Conservation Program – available for any questions related to species at risk, how to investigate potential project impacts to species at risk and required permits. Visit http://www.sccp.ca/contact-us for more information.

7e. Permits

Department of Fisheries and Oceans Canada Resource Restoration Unit – available for project support, funding, and overall project engineering and construction. Contact Robert Schaefer by email at Robert.Schaefer@dfo-mpo.gc.ca, or call 604-837-3325.

FrontCounterBC – an online resource available to help understand project stipulations and project permitting. Specifically, an online application is available to apply for a scientific fish sampling permit to allow for monitoring fish in Ryder creek (http://www.frontcounterbc.gov.bc.ca/guides/fish-wildlife/scientific-fish-collection/what-you-need-to-apply/). To contact FrontCounter BC visit their Chilliwack location at 46360 Airport Road or call 604-702-5700.

Species at Risk Act in B.C. – Permits may be required if work or monitoring is being done in a stream that could potentially have any species at risk. For permitting information and contact information visit https://wildlife-species.canada.ca/species-risk-registry/sar/permit/permits_e.cfm.

Stó:lō Research and Resource Management Centre – support with information regarding and obtaining required work permits under the Cultural Heritage Act of BC (http://www.bclaws.ca/civix/document/id/complete/statreg/96187_01). Contact 604-824-8420 or visit http://www.srrmcentre.com/index.php?pageId=1.

7f. Archaeology and Culture

Stó:lō Research and Resource Management Centre – available for archaeological and cultural support. Contact 604-824-8420 or visit http://www.srrmcentre.com/index.php?pageId=1.

7g. Revenues Support and Grants

The Fraser Valley Watersheds Coalition – available for help with writing grants and overall project support and planning. Contact Natashia Cox at Natashia@fvwc.ca; info@fvwc.ca or call 604-855-8274 and/or 604-791-2235.

Pacific Salmon Foundation – available for funding opportunities. Contact 604-664-7664 or salmon@psf.ca or visit https://www.psf.ca/what-we-do/grantmaking.

TD Friends of the Environment Foundation – available for funding opportunities. Visit https://www.td.com/ca/en/about-td/ready-commitment/funding/fef-grant/.

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