# Craigflower Creek Habitat Assessment 2026

## Habitat Status Review and Restoration Planning Recommendations

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World Fisheries Trust and participating stewardship organizations

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https://www.gorge.ca/craigflower-creek-coalition

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# Executive Summary

The Craigflower Creek watershed encompasses 2,424-hectares in the central part of the Capital Regional District (CRD), including portions of View Royal, CRD parks, and the District of the Highlands. 12.3 km in length, it drains into Portage Inlet, and remains one of the most important urban salmonid-bearing watersheds within the CRD. It continues to support coho salmon, coastal cutthroat trout, amphibians, waterfowl, and a diverse range of aquatic and riparian species. Although portions of the lower watershed have been significantly altered by urbanization and infrastructure development, substantial habitat values remain throughout the system.

Key challenges for salmonid productivity and aquatic health are low water in the summer, exasperated with climate change, and contaminated stormwater in the transportation corridor. The watershed benefits from the presence of Prior Lake, Pike Lake, Thetis Lake, McKenzie Creek, extensive wetland complexes, and relatively intact upper watershed habitats that continue to provide important hydrological and ecological functions. Increasing beaver activity affords opportunities to enhance these for improved summer flow. Reach 3, in the middle of the watershed and in parkland, remains the primary spawning and juvenile production area. Reach 1, at the lower end of the watershed, is the most impacted by development, but functions as a critical migration corridor connecting freshwater and marine habitats and has substantial potential for more rearing environments. Reaches 1 and 2 may become more important as spawning reaches as winter rains are delayed with climate change and impede timely upstream migration.

Future restoration efforts should emphasize riparian recovery, stormwater management, habitat complexity enhancement, wetland protection (including making use of beaver activity), and climate resilience. Protection of existing high-quality habitats within the upper watershed should remain a priority alongside restoration of impaired lower watershed reaches.

Overall, Craigflower Creek is assessed as a **functioning but impaired urban watershed with high ecological value, significant restoration potential, and strong long-term recovery opportunities through coordinated watershed stewardship and habitat restoration initiatives.**

# Craigflower Habitat Assessment 2026

## 1. Introduction

Craigflower Creek is an ecologically significant urban watershed located within the Capital Regional District of southern Vancouver Island, British Columbia. The watershed drains a diverse network of lakes, wetlands, tributaries, forested uplands, transportation corridors, agricultural lands, and urban residential areas before discharging into Portage Inlet. Principal watershed features include Upper and Lower Thetis Lake, Prior Lake, Pike Lake, McKenzie Creek, Munn Creek, and associated tributary systems that collectively support a range of aquatic, riparian, and wetland ecosystem functions.[1]

Craigflower Creek has long been recognized as an important salmonid-bearing stream supporting populations of coho salmon (*Oncorhynchus kisutch*) and coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), including both resident and sea-run life histories. Historical fisheries investigations dating back to the 1970s and 1980s identified the creek as one of the more important urban trout and salmon systems within the Greater Victoria region and emphasized the need for coordinated watershed management to maintain fisheries productivity under increasing urban development pressure.[2] [3]

Historical habitat interpretations identified strong relationships between stream gradient, channel morphology, seasonal flow conditions, and fish habitat function within the watershed. Lower-gradient reaches downstream of Prior Lake were historically associated with coho spawning and juvenile rearing habitat, while steeper upper watershed reaches provided more suitable habitat for resident coastal cutthroat trout.[3] These earlier fisheries assessments also identified seasonal low summer flows as one of the primary long-term limiting factors affecting salmonid habitat availability and productivity throughout the watershed.[3]

Since the 1980s, progressive urbanization within the watershed has altered natural hydrologic processes, increased stormwater runoff, reduced riparian integrity, fragmented floodplain connectivity, and contributed to elevated summer water temperatures and sedimentation within portions of the creek.[4] [5] Transportation corridors, residential development, invasive species encroachment, historical channel modification, and declining large conifer recruitment have collectively reduced habitat complexity within lower watershed reaches.[6]

Despite these pressures, Craigflower Creek continues to support functioning salmonid habitat and remains the focus of extensive stewardship, restoration, fisheries monitoring, and community outreach initiatives led by organizations including World Fisheries Trust, Gorge Waterway Action Society, Esquimalt Anglers Association, Goldstream Hatchery, government agencies, consultants, and local volunteers.[7] Recent watershed initiatives have included fish fence monitoring, smolt trapping, riparian restoration, invasive species removal, water quality monitoring, flow enhancement studies, stewardship outreach, and habitat restoration planning.[7] [8]

Recent monitoring and restoration planning efforts have increasingly emphasized the importance of:

- maintaining summer low-flow resilience;
- protecting thermal refuge habitat;
- restoring riparian and floodplain ecological function;
- reducing urban runoff impacts;
- improving instream habitat complexity; and
- strengthening long-term watershed stewardship coordination.[8] [9]

The watershed also faces emerging environmental pressures associated with climate change, including increasing summer drought conditions, elevated stream temperatures, altered hydrologic timing, and cumulative urban runoff impacts. Recent water quality monitoring has documented periodic dissolved oxygen limitations and elevated summer temperatures in portions of the Prior Lake and McKenzie Creek system during low-flow periods.[8]

This report builds upon historical fisheries assessments, watershed management plans, habitat restoration studies, stewardship initiatives, and recent monitoring programs to provide an updated watershed-scale habitat assessment and restoration planning framework for Craigflower Creek. Particular emphasis is placed on:

- standardized reach delineation based on geomorphic and habitat function characteristics;
- evaluation of limiting factors affecting salmonid productivity;
- integration of historical and contemporary habitat information;
- identification of restoration opportunities and stewardship priorities; and
- development of a technically defensible framework to support future watershed restoration, monitoring, and adaptive management initiatives.

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# 2. Objectives

The objectives of this habitat assessment and restoration review are to:

1. Compile and synthesize historical and contemporary fisheries, habitat, hydrologic, riparian, and watershed management information for the Craigflower Creek watershed in order to develop an integrated understanding of current ecological conditions and restoration opportunities.
2. Develop a standardized reach-based habitat framework for Craigflower Creek using channel gradient, geomorphology, riparian condition, hydrology, development intensity, fish passage constraints, and habitat function as primary delineation criteria.
3. Characterize habitat conditions within each reach, including:
    - channel morphology;
    - substrate composition;
    - habitat complexity;

    - riparian integrity;
    - flow conditions;
    - water quality limitations; and
    - fish habitat function for salmonid life stages.
4. Evaluate the ecological functions and habitat requirements of coho salmon (*Oncorhynchus kisutch*) and coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), including:
    - spawning habitat;
    - juvenile rearing habitat;
    - overwintering habitat;
    - refuge habitat;
    - migratory connectivity; and
    - riffle-pool habitat relationships.
5. Identify key limiting factors affecting watershed productivity and aquatic ecosystem resilience, including:
    - low summer flows;
    - elevated water temperatures;
    - dissolved oxygen limitations;
    - sedimentation;
    - urban runoff;
    - riparian degradation;
    - invasive species;
    - channel confinement; and
    - hydrologic alteration.
6. Integrate historical fisheries interpretations and watershed assessments with recent monitoring and stewardship initiatives to support long-term adaptive management and restoration planning.[1] [2]
7. Identify and prioritize restoration and habitat enhancement opportunities throughout the watershed, including:
    - riparian restoration;
    - invasive species management;
    - instream habitat complexity enhancement;
    - spawning gravel rehabilitation;
    - stormwater treatment and runoff mitigation;
    - floodplain reconnection;
    - refuge habitat protection; and
    - flow and temperature resilience measures.
8. Support ongoing stewardship, monitoring, and collaborative watershed management initiatives undertaken by World Fisheries Trust, Gorge Waterway Action Society, Esquimalt Anglers Association, and other stewardship partners through development of a technically defensible watershed habitat assessment framework.[3]
9. Provide a watershed-scale restoration planning document that can assist future environmental assessments, restoration design, fisheries monitoring, stewardship funding applications, and long-term conservation planning within the Craigflower Creek watershed.

# 3. Methods

## 3.1 Study Approach

This assessment was completed through a desktop review and synthesis of historical and contemporary fisheries, habitat, hydrologic, riparian, restoration, and watershed management information related to Craigflower Creek and associated tributaries. Information reviewed included fisheries investigations, watershed management plans, riparian assessments, restoration planning documents, water quality monitoring reports, stewardship summaries, environmental assessments, and habitat restoration studies completed between approximately 1978 and 2026.[1] [2] [3]

The study was undertaken to consolidate fragmented historical habitat information into a standardized watershed-scale habitat interpretation framework capable of supporting restoration planning, stewardship prioritization, and future adaptive management initiatives. Particular emphasis was placed on identifying reach-scale differences in geomorphology, habitat function, hydrology, riparian condition, and fish habitat use throughout the watershed.

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## 3.2 Literature Review and Data Compilation

Available technical reports, fisheries correspondence, stewardship documents, and monitoring datasets were compiled and reviewed to characterize:

- channel morphology and stream gradient;
- hydrology and seasonal flow conditions;
- riparian condition;
- water quality;
- fish habitat characteristics;
- habitat restoration history;
- fish passage constraints;
- floodplain function; and
- watershed-scale ecological processes.

Primary information sources reviewed included:

- historical fisheries habitat assessments;
- watershed management plans;
- Proper Functioning Condition assessments;
- riparian restoration plans;
- water quality and temperature monitoring reports;
- fisheries enumeration and smolt trapping information;
- stewardship and restoration summaries; and
- environmental assessment reports associated with transportation and infrastructure development.

Additional upper watershed information regarding headwater habitat conditions, gradients, and resident fish habitat was incorporated from previous environmental protection planning completed within the Pike Lake and upper watershed area.[4]

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## 3.3 GIS and Spatial Interpretation

Spatial interpretation and reach delineation were completed through review of:

- aerial imagery;
- orthophotography;
- LiDAR interpretation where available;
- watershed mapping;
- riparian mapping;
- transportation corridor crossings;
- known fish passage barriers;
- floodplain morphology; and
- restoration project locations.

GIS interpretation was used to assist with identification of:

- channel confinement;
- gradient transitions;
- riparian continuity;
- development intensity;
- wetland and beaver-influenced habitat;
- tributary confluences; and
- major hydrologic transition zones.

Historical fisheries observations and restoration records were also spatially reviewed to assist in interpretation of habitat function and fish utilization patterns within individual reaches.[1] [3]

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## 3.4 Reach Delineation

Reach delineation was standardized through comparative review of historical habitat assessments, fisheries investigations, restoration planning documents, stewardship mapping, and watershed process information. Reaches were defined based on observable and recurring transitions in:

- stream gradient;
- channel morphology;
- confinement and floodplain condition;
- riparian structure and vegetation;

- development intensity;
- hydrologic characteristics;
- fish passage constraints;
- substrate composition; and
- fish habitat function.

The watershed was divided into five principal habitat reaches representing distinct geomorphic and ecological conditions within the Craigflower Creek system:

| Reach | Description |
|---|---|
| **Reach 1** | Lower Urban Corridor |
| **Reach 2** | Transitional  Glide Reach |
| **Reach 3** | Upper Riffle / Spawning Reach |
| **Reach 4** | Prior Lake / McKenzie Transitional Reach |
| **Reach 5** | Pike Lake/ Headwaters Reach |

The Headwaters Reach was differentiated from downstream reaches based on steeper gradients, reduced urban influence, seasonal flow conditions, greater riparian integrity, and dominance of resident coastal cutthroat trout habitat.[3] [4]

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## 3.5 Habitat Assessment Framework

Habitat quality and ecological function were evaluated using a qualitative habitat assessment framework informed by methodologies adapted from the Urban Salmon Habitat Program (USHP) and supplemented through review of historical fisheries habitat interpretations and contemporary restoration assessments.[1] [5]

Habitat indicators considered during the review included:

- substrate suitability;
- spawning gravel availability;
- instream cover;
- large woody debris recruitment potential;
- riffle-pool complexity;
- floodplain connectivity;
- riparian shading;
- thermal sensitivity;
- sedimentation and substrate embeddedness;
- channel stability;
- overwintering habitat;
- refuge habitat availability; and
- degree of channel alteration or urban confinement.

Particular consideration was given to historical observations regarding coho salmon and coastal cutthroat trout habitat partitioning associated with stream gradient, pool-riffle distribution, and seasonal low-flow conditions.[3]

Habitat quality was interpreted qualitatively using relative ratings of:

- Poor;
- Fair;
- Moderate; or
- Good

based on overall ecological function and relative value for salmonid life stages.

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## 3.6 Restoration Opportunity Assessment

Restoration opportunities were identified through comparative analysis of limiting habitat factors within each reach and review of previous restoration recommendations, stewardship initiatives, and habitat enhancement studies.

Potential restoration measures considered included:

- riparian restoration and conifer planting;
- invasive species management;
- instream habitat complexity enhancement;
- spawning gravel rehabilitation;
- floodplain reconnection;
- stormwater treatment and runoff mitigation;
- sediment and erosion management;
- refuge habitat protection;
- selective beaver management considerations; and
- long-term flow and temperature resilience measures.

Restoration priorities were evaluated qualitatively based on:

- ecological benefit;
- fisheries habitat value;
- restoration feasibility;
- long-term watershed resilience;
- implementation complexity; and

# consistency with previous watershed restoration objectives.

# 4. Results

## 4.1 Watershed Overview

Craigflower Creek is an approximately 9 km long urban coastal stream system located within the Capital Regional District of southern Vancouver Island, British Columbia. The watershed drains approximately 24 km² of mixed urban, forested, wetland, agricultural, lake, and parkland environments before discharging into Portage Inlet near View Royal.The watershed includes a complex hydrologic network consisting of Upper and Lower Thetis Lake, Prior Lake, Pike Lake, McKenzie Creek, Munn Creek, associated tributaries, wetlands, floodplain habitats, and seasonally connected drainage systems that collectively support hydrological and ecological connectivity throughout the basin.

Approximately 29.5–30% of the watershed remains protected within regional park systems including Thetis Lake Regional Park, Francis/King Regional Park, and Mount Work Regional Park. These protected upland and riparian areas provide important hydrologic storage, groundwater recharge, sediment retention, thermal buffering, and wildlife habitat functions within the watershed. Upper watershed areas remain comparatively less disturbed and are characterized by forested uplands, wetlands, rural residential properties, agricultural lands, groundwater-fed tributaries, and protected parkland systems.

Urban development is concentrated primarily within the lower watershed adjacent to the Highway 1 transportation corridor and the municipalities of View Royal and Saanich. Lower watershed areas are characterized by transportation infrastructure, residential and commercial development, stormwater drainage systems, floodplain encroachment, channel confinement, and fragmented riparian vegetation. Historical and contemporary watershed studies identified altered hydrology associated with urbanization, increased impervious surface area, stormwater runoff, elevated summer water temperatures, dissolved oxygen limitations, invasive species encroachment, reduced large woody debris recruitment, channel confinement, sedimentation, and floodplain disconnection as major watershed-scale stressors affecting ecological function.[2] [4] [5] Although detailed watershed-wide impervious surface mapping was not identified within the reviewed references, previous watershed management plans identified impervious surface expansion and stormwater runoff as significant long-term threats to watershed health and recommended future mapping and runoff management initiatives.[2]

Hydrology within the watershed is strongly influenced by seasonal rainfall patterns characteristic of coastal British Columbia. Elevated flows typically occur during fall and winter rainfall events, while summer conditions are characterized by reduced baseflows, increased thermal sensitivity, and localized dissolved oxygen limitations. Historical fisheries assessments identified seasonal low summer flows as one of the primary long-term limiting factors affecting salmonid habitat productivity throughout the watershed. Wetland and lake systems within the upper and middle watershed continue to provide important hydrologic storage and flow moderation functions; however, altered runoff patterns associated with urbanization have increased peak flow intensity and reduced watershed resilience in some lower watershed areas.

Craigflower Creek continues to support important fish and aquatic habitat functions for coho salmon (*Oncorhynchus kisutch*), coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), rainbow trout/steelhead, prickly sculpin, stickleback, lamprey species, and amphibian communities associated with wetland and riparian habitats. Historical fisheries assessments identified strong relationships between stream gradient, habitat morphology, and salmonid distribution within the watershed, with lower-gradient reaches functioning primarily as juvenile coho rearing habitat and steeper upper watershed reaches supporting resident coastal cutthroat trout populations.[3]

Recent stewardship and monitoring initiatives completed by Gorge Waterway Action Society, World Fisheries Trust, Esquimalt Anglers Association, and collaborating agencies have focused on fish fence monitoring, smolt trapping, riparian restoration, invasive species management, water quality monitoring, habitat enhancement planning, floodplain restoration, and watershed stewardship coordination. Recent monitoring programs have also documented elevated summer stream temperatures, low dissolved oxygen concentrations, urban runoff concerns, seasonal low-flow conditions, and emerging contaminants such as 6PPD-q associated with roadway runoff.[4]

Despite historical and ongoing urban pressures, the watershed retains substantial ecological and restoration value due to remaining habitat connectivity, functioning upper watershed habitats, extensive protected parkland, wetland and lake storage systems, active stewardship involvement, and continued salmonid utilization throughout much of the watershed.

## Key Watershed Characteristics

- Watershed area: ~24 km²
- Mainstem stream length: ~9 km
- Protected parkland: ~30% of watershed area
- Dominant lower watershed influence: Urban and transportation infrastructure
- Dominant upper watershed influence: Forested uplands, wetlands, and parkland
- Primary fish species: Coho salmon and coastal cutthroat trout
- Major limiting factors:
    - Low summer flows;
    - Urban runoff;
    - Elevated summer temperatures;
    - Riparian degradation;
    - Channel confinement;
    - Sedimentation;
    - Floodplain disconnection.

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## Reach Delineation Summary

Reach delineation was based on stream gradient, channel morphology, hydrology, floodplain connectivity, riparian condition, fish habitat function, development intensity, and infrastructure influence. Lower-gradient reaches were generally associated with coho salmon rearing and overwintering habitat, while steeper upper watershed reaches were associated with riffle-

dominated habitat and resident coastal cutthroat trout utilization patterns consistent with historical fisheries interpretations (Clough 1984).

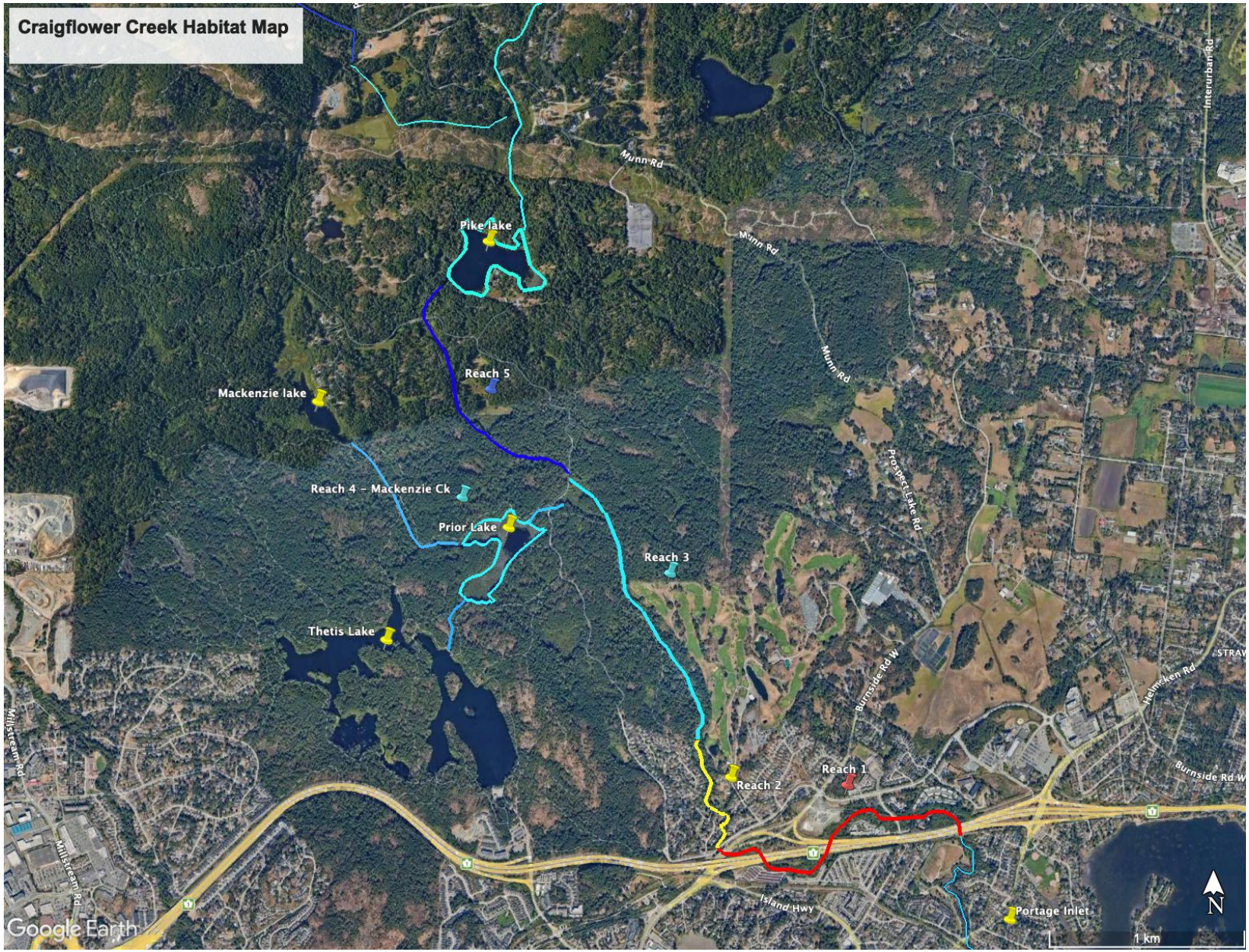
The watershed was standardized into five principal habitat reaches based on geomorphology, stream gradient, riparian condition, hydrology, fish habitat characteristics, and degree of urban development influence.

## Table 4-1. Craigflower Creek Reach Locations, Lengths, and Gradients

| Reach | Reach Name | General Location | Approx. Length | Approx. Gradient | Dominant Characteristics | Primary Habitat Function |
|---|---|---|---|---|---|---|
| **Reach 1** | Lower Urban Corridor | Lower watershed Highway 1 and Burnside Road corridor | ~1.7 km | ~1.1% | Urban confinement, stormwater influence, degraded riparian habitat, sediment accumulation, beaver influence | Adult migration, juvenile coho rearing, overwintering refuge |
| **Reach 2** | Transitional Glide Reach | Transitional floodplain sections upstream of lower urban corridor | ~0.75 km | ~2.0% | Glide habitat, taller mixed Conifer canopy, Residential properties along riparian. | Refuge habitat, spawning, juvenile rearing |
| **Reach 3** | Upper Riffle / Spawning Reach | Mid-watershed transitional riffle-pool sections below Prior Lake | ~1.5 km | ~1.1–2.0% | Riffle-pool morphology, spawning gravel, improved habitat complexity, Forested lands | Coho spawning, juvenile rearing, cutthroat habitat |
| **Reach 4** | Prior Lake / McKenzie Transitional Reach | Prior Lake outlet and McKenzie Creek wetland-associated sections | ~0.85 km | ~0.5% | Wetland influence, thermal sensitivity, fine sediment deposition, CRD Park lands | Seasonal refuge habitat, wetland connectivity, juvenile habitat |
| **Reach 5** | Pike Lake/ Headwaters Reach | Upper watershed and Pike Lake headwater tributaries | ~1.6 km | ~7.5–10% | Steeper gradients, forested riparian habitat, seasonal flow variability, Private lands | Resident coastal cutthroat habitat, cold-water refuge |

*This reach framework integrated historical fisheries habitat interpretation with recent restoration planning and stewardship monitoring initiatives.[2] [3]

## Figure 1 ; Craigflower Survey Reaches and waterbodies



## 4.2 Reach 1 – Lower Urban Corridor

### Reach Description

Reach 1 represents the lowermost section of Craigflower Creek extending from Portage Inlet upstream through the Highway 1 and Burnside Road transportation corridor to the transitional floodplain habitats of Reach 2. This reach is approximately 1.6 km in length and has an average channel gradient of approximately 1.1%, resulting in a predominantly low-gradient pool and glide channel morphology. Historical fisheries assessments identified this reach as an important migration corridor and juvenile coho salmon rearing area due to its perennial flow regime, low-gradient habitat, and direct connectivity with marine environments (Clough 1984).

Reach 1 occurs within the most heavily urbanized portion of the watershed and is strongly influenced by transportation infrastructure, residential and commercial development, stormwater drainage systems, and historical channel modifications. Watershed assessments completed over the past four decades consistently identify this reach as the most altered section of the watershed, exhibiting reduced floodplain connectivity, degraded riparian function, limited large woody debris recruitment, elevated summer temperatures, and simplified habitat complexity (Roberts and Harding 1997; Roberts et al. 1998; Aqua-Tex 2021).

### Channel Characteristics and Fisheries Habitat

Habitat inventory data collected from lower watershed assessment stations indicate an average bankfull channel width of approximately 13.6 m and an average wetted width of approximately 11.4 m. Channel morphology is dominated by pool and glide habitat with limited riffle development and reduced hydraulic diversity. Pools are present throughout the reach but are frequently shallow, elongated, and characterized by fine sediment deposition and embedded substrates. Beaver activity, which is increasing, has helped to create pools. Habitat compensation of the highway project in the 1990s also created pools, a defunct concrete shelf for juvenile refuge, and retention ponds for storm runoff of unknown effectiveness.

#### Table 4-2. Reach 1 Habitat Assessment Summary

| Parameter | Reach 1 Condition |
|---|---|
| **Reach Length** | ~1.6 km |
| **Average Gradient** | ~1.1% |
| **Average Bankfull Width** | 13.6 m |
| **Average Wetted Width** | 11.4 m |
| **Dominant Habitat Type** | Pool and Glide |
| **Pool Frequency** | Moderate |
| **Riffle Frequency** | Low |
| **Spawning Habitat** | Limited and localized |
| **Juvenile Rearing Habitat** | Extensive |
| **Overwintering Habitat** | Moderate |
| **Fish Passage** | Generally passable |

Substrates are dominated by sand, gravel, and localized cobble accumulations. Suitable spawning gravel occurs only in isolated locations associated with riffle transitions and localized hydraulic sorting zones. Historical fisheries investigations concluded that the lower watershed functions primarily as juvenile rearing habitat rather than a major spawning reach (Clough 1984). Recent habitat inventory data and stewardship monitoring continue to confirm utilization of the reach by juvenile coho salmon and coastal cutthroat trout. These may be particularly sensitive to 6 PPDq toxicity of highway runoff.

Large woody debris abundance is generally low throughout the corridor and stable key pieces capable of influencing channel morphology are uncommon. Consequently, habitat complexity is reduced relative to upstream reaches and cover is largely restricted to overhanging vegetation, undercut banks, root masses, bridge abutments, and localized debris accumulations. Off-channel habitat and floodplain refuge areas are similarly limited due to channel confinement and adjacent infrastructure.

No significant fish passage barriers were identified within Reach 1. However, transportation crossings, bridge structures, fish fence infrastructure, stormwater outfalls, localized bedrock controls, and beaver activity may create temporary hydraulic constraints during extreme low-flow conditions. Fish passage is generally considered functional throughout the reach, though delayed rains impede passage over Helmcken Falls at the mouth of the creek. Seal predation on salmon holding in the long estuarine inlet leading to the creek and otter predation on salmon holding in pools of this reach that enter with flash floods of first rains may be substantial, particularly in years with low returns. .

Localized bank erosion occurs adjacent to transportation embankments, stormwater outfalls, recreational access points, and confined channel sections. Significant anthropogenic alterations include Highway 1 crossings, Burnside Road infrastructure, stormwater discharge systems, bank armouring, floodplain encroachment, invasive species colonization, and recreational trail development.

Recent water quality monitoring has identified elevated summer water temperatures, seasonal dissolved oxygen limitations, and concerns regarding roadway-derived contaminants including 6PPD-q associated with transportation runoff. These findings reinforce historical observations that low summer flows, thermal stress, and urban runoff remain significant limiting factors affecting fisheries habitat productivity within Reach 1 (MacGregor and McConnachie 2026).

### Table 4-3. Reach 1 Instream Habitat Assessment

| Habitat Attribute | Condition | Rating |
|---|---|---|
| **Fish Passage** | Generally passable throughout reach | Good |
| **Adult Migration Habitat** | Seasonal access to upstream habitats | Good |
| **Juvenile Rearing Habitat** | Extensive but limited cover and thermal sensitivity | Fair |
| **Overwintering Habitat** | Limited off-channel and refuge habitat | Fair |
| **Pool Habitat** | Moderate frequency but low complexity | Fair |

| | | |
|---|---|---|
| **Riffle Habitat** | Sparse and localized | Poor |
| **Spawning Habitat** | Limited gravel and embedded substrates | Poor |
| **Large Woody Debris** | Low abundance and recruitment potential | Poor |
| **Instream Cover** | Limited stable cover features | Poor |
| **Habitat Complexity** | Simplified pool-glide morphology | Poor |
| **Channel Stability** | Localized erosion and confinement | Fair |
| **Water Quality Resilience** | Thermal loading and stormwater influences | Poor |
| **Floodplain Connectivity** | Limited access to floodplain habitat | Poor–Fair |

## Riparian Habitat

Riparian habitat within Reach 1 is highly fragmented and reflects extensive historical and ongoing urban disturbance. Riparian vegetation widths vary considerably depending on adjacent land use and infrastructure constraints. In highly confined sections adjacent to Highway 1, Burnside Road, and commercial developments, riparian vegetation depth may be less than 5 m on one or both banks. Wider riparian zones ranging from approximately 10–25 m occur locally within parklands, undeveloped floodplain areas, and municipal green spaces.

The dominant riparian vegetation community consists of second-growth deciduous forest and shrub communities characterized by red alder, bigleaf maple, black cottonwood, willow, salmonberry, snowberry, and red-osier dogwood. Coniferous vegetation is sparse and consists primarily of isolated second-growth Douglas-fir and western redcedar. Mature conifer recruitment potential is generally poor and old-growth riparian characteristics are absent throughout the reach.

Habitat inventory data indicate canopy cover ranging from approximately 20% to 100%, with an average canopy closure of approximately 53%. Invasive species are widespread and include English ivy, Himalayan blackberry, reed canary grass, nightshade species, and periwinkle. These species suppress native understory development and reduce riparian resilience.  In some areas, yellow flag irises and bullrushes are expanding out of retention ponds and may be problematic in the near future.

Numerous formal and informal trail crossings, maintenance access routes, stormwater utility corridors, and recreational pathways occur throughout the reach and contribute to vegetation disturbance, soil compaction, bank erosion, and invasive species spread. Recent riparian restoration assessments and stewardship initiatives have identified Reach 1 as a priority area for conifer establishment, invasive species removal, live staking, bank stabilization, and native shrub enhancement to improve channel shading, bank stability, and long-term habitat complexity.

## Table 4-4. Reach 1 Riparian Habitat Assessment

| Riparian Attribute | Condition | Rating |
|---|---|---|
| **Riparian Width** | Generally <5–25 m | Poor |
| **Vegetation Continuity** | Fragmented corridor | Poor–Fair |
| **Canopy Closure** | Approximately 53% average | Fair |
| **Conifer Representation** | Sparse second-growth conifers | Poor |
| **Future LWD Recruitment** | Limited | Poor |
| **Deciduous Component** | Moderate to abundant | Fair |
| **Shrub Layer Development** | Moderate | Fair |
| **Invasive Species Condition** | Extensive ivy and blackberry | Poor |
| **Bank Stability Function** | Reduced in disturbed areas | Fair |
| **Sediment Filtering Function** | Reduced by fragmentation | Poor–Fair |
| **Wildlife Corridor Function** | Present but fragmented | Fair |
| **Floodplain Interaction** | Restricted by development | Poor |

## Restoration Opportunity Discussion

Reach 1 presents the greatest restoration challenge within the Craigflower Creek watershed due to the degree of urbanization, infrastructure encroachment, and floodplain confinement. Despite these constraints, the reach continues to provide critical migration, juvenile rearing, and connectivity functions for coho salmon and coastal cutthroat trout. Restoration planning should therefore focus on improving ecological processes and habitat function rather than attempting large-scale channel reconstruction.

The highest priority restoration opportunity is riparian forest restoration, particularly the establishment of long-lived native conifer species such as Douglas-fir (*Pseudotsuga menziesii*), western redcedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), and grand fir (*Abies grandis*) where site conditions permit. Multiple assessments have identified the lack of mature riparian forest and limited large woody debris recruitment as primary factors affecting long-term channel resilience. Increasing conifer representation will improve shading, reduce summer water temperatures, enhance bank stability, and provide future sources of large woody debris recruitment.

Stormwater management is also considered a high priority due to the extensive transportation infrastructure and urban development within the Highway Corridor. Previous watershed studies and recent water quality monitoring have identified urban runoff, elevated temperatures, sediment inputs, and roadway-derived contaminants as significant stressors affecting aquatic habitat. Opportunities to improve stormwater treatment through municipal infrastructure upgrades, bioswales, infiltration systems, and treatment wetlands should be pursued where feasible.

Instream habitat enhancement through large woody debris placement represents the highest priority direct habitat improvement measure. Habitat inventories consistently identify low woody debris abundance and limited cover throughout Reach 1. Properly designed wood structures

could increase habitat complexity, create cover, promote pool formation, and improve juvenile rearing habitat while complementing long-term riparian restoration objectives.

Floodplain and off-channel habitat enhancement opportunities are more limited due to urban development and infrastructure constraints; however, even small flood refuge habitats may provide significant benefits to juvenile coho salmon during winter high-flow events. Bioengineered bank stabilization, invasive species management, and trail management should be implemented in conjunction with riparian restoration to maximize long-term project success.

Spawning gravel enhancement is considered a lower priority because Reach 1 functions primarily as migration and juvenile rearing habitat rather than a key spawning reach. Similarly, major channel reconstruction is not recommended due to high costs, limited feasibility, and the substantial infrastructure constraints associated with the Highway 1 corridor.

A recent (2024) restoration of a tributary feeding into Reach 1 through the HandyDART facility converted what had become a drainage ditch into a model stream, with instream and riparian features considered ideal for restoration goals. While not likely feasible for larger sections of the creek, the tributary is showing increasing fish use – both by coho and cutthroat – and may become a key resource in this reach.

Overall, restoration within Reach 1 should emphasize a **process-based restoration approach focused on riparian recovery, stormwater management, habitat complexity enhancement, and localized floodplain function restoration**. These actions are expected to provide the greatest long-term ecological benefit while remaining compatible with existing transportation infrastructure, municipal land uses, and public access requirements.

## Reach 1 Restoration Opportunities and Priority Ranking

Restoration opportunities for Reach 1 were identified through review of historical fisheries assessments (Clough 1984), the Craigflower Watershed Assessment (Roberts and Harding 1997), Craigflower Watershed Management Plan (Roberts et al. 1998), the Lower Craigflower Creek Proper Functioning Condition Assessment (Aqua-Tex 2021), recent riparian restoration planning (Scott 2024), GWAS stewardship monitoring, habitat inventory data, and the Craigflower Creek Restoration Opportunities Assessment (2019). Opportunities were ranked based on ecological benefit, feasibility, watershed influence, and ability to address identified habitat limitations.

### Table 4-5. Reach 1 Restoration Opportunities and Priority Ranking

| Priority | Restoration Opportunity | Habitat Limitation Addressed | Expected Ecological Benefit | Feasibility |
|---|---|---|---|---|
| **High** | Riparian Conifer Establishment and Native Forest Restoration | Limited shade, poor LWD recruitment, fragmented riparian corridor | Improved thermal buffering, future large woody debris recruitment, bank stability, nutrient inputs, and habitat complexity | High |
| **High** | Stormwater Treatment and Runoff Management | Urban runoff, sediment inputs, elevated temperatures, contaminants (including 6PPD-q) | Improved water quality, reduced peak flows, improved fish habitat resilience | Moderate–High |

| | | | | |
|---|---|---|---|---|
| **High** | Invasive Species Removal and Riparian Rehabilitation | Extensive ivy, blackberry, reed canary grass, reduced native recruitment | Improved native vegetation establishment and long-term riparian function | High |
| **High** | Large Woody Debris Enhancement | Low habitat complexity, limited cover, reduced pool formation | Increased habitat diversity, cover, pool development, and juvenile refuge habitat | Moderate |
| **Moderate** | Floodplain and Off-Channel Refuge Habitat Enhancement | Limited overwintering habitat and flood refuge areas | Improved juvenile salmonid survival and increased habitat resilience | Moderate |
| **Moderate** | Bioengineered Bank Stabilization | Localized erosion and sediment delivery | Improved bank stability, reduced sedimentation, improved riparian establishment | High |
| **Moderate** | Fish Passage Improvements at Localized Constraints | Seasonal low-flow migration limitations | Improved habitat connectivity and migration conditions | Moderate |
| **Moderate** | Trail and Access Management | Bank trampling, vegetation disturbance, erosion | Reduced chronic disturbance and improved riparian recovery | High |
| **Low** | Spawning Gravel Rehabilitation | Embedded substrates and limited spawning habitat | Localized improvements to spawning habitat quality | Moderate |
| **Low** | Major Channel Reconstruction | Historical channel simplification | Limited benefit relative to cost and infrastructure constraints | Low |

These priorities are consistent with recommendations contained within the Craigflower Watershed Management Plan, Proper Functioning Condition Assessment, Craigflower Creek Restoration Opportunities Assessment, recent riparian restoration planning documents, and ongoing stewardship initiatives within the watershed.

## Reach 1 Conclusion

Reach 1 (Highway Corridor) represents the most urbanized and infrastructure-constrained section of the Craigflower Creek watershed, yet continues to provide critical habitat functions for coho salmon and coastal cutthroat trout. Historical fisheries assessments, watershed studies, habitat inventories, Proper Functioning Condition assessments, restoration planning documents, and recent stewardship monitoring consistently identify this reach as an important migration corridor and juvenile rearing area linking upstream habitats with Portage Inlet and the marine environment (Clough 1984; Roberts and Harding 1997; Aqua-Tex 2021; GWAS 2024–2026).

The reach is characterized by a low-gradient pool-glide morphology, relatively wide channel dimensions, continuous fish passage, and extensive juvenile rearing habitat. However, habitat quality is constrained by limited instream complexity, low large woody debris abundance, embedded spawning substrates, elevated summer water temperatures, stormwater runoff, invasive species encroachment, and reduced floodplain connectivity. Habitat inventory data and recent monitoring indicate that while the reach retains important fisheries values, both instream and riparian habitat conditions are generally rated as **Poor–Fair** relative to reference conditions

described in Urban Salmon Habitat Program and Proper Functioning Condition assessment frameworks.

Riparian habitat condition is similarly affected by transportation infrastructure, historical clearing, invasive vegetation, and limited mature conifer recruitment. The resulting reduction in channel shading, bank stability, woody debris recruitment, and floodplain function contributes to ongoing habitat degradation and limits the reach's ecological resilience. Despite these constraints, remnant riparian corridors continue to provide important shading, sediment retention, wildlife movement, and habitat connectivity functions.

Reach 1 also presents significant opportunities for habitat restoration and ecological improvement. The highest priority restoration measures include riparian conifer establishment, invasive species management, stormwater treatment and runoff management, and instream habitat enhancement through large woody debris placement. Additional opportunities exist to improve floodplain connectivity, create off-channel refuge habitats, stabilize eroding banks using bioengineering techniques, and address localized fish passage constraints. Collectively, these measures would improve habitat complexity, thermal resilience, water quality, and long-term channel function while remaining compatible with existing urban infrastructure and land use constraints.

Overall, Reach 1 is assessed as being in **Poor–Fair habitat condition with High restoration potential**. Although heavily altered, the reach remains a critical component of the Craigflower Creek watershed and represents one of the most important opportunities for improving lower watershed fisheries habitat through targeted, process-based restoration and riparian recovery initiatives.

## 4.3 Reach 2 – Transitional Glide Reach

### Reach Description

Reach 2 extends upstream from the Lower Urban Corridor (Reach 1) through the Highland Road subdivision area and transitional floodplain sections of Craigflower Creek. This reach is approximately 0.75 km in length and has an average channel gradient of approximately 2.0%. It has Reach 2 represents a transitional section between the highly urbanized lower watershed and the more natural riffle-pool habitats of Reach 3.

The reach is characterized by low-gradient glide habitat, with localized pool areas and increased floodplain interaction compared to Reach 1. Historical watershed assessments and recent restoration planning initiatives identify this section as an important juvenile salmonid rearing and overwintering area, off-channel habitat potential, and seasonal refuge functions. This reach has perennial pools. It offers spawning habitat for Cutthroat and Coho. Although portions of the reach have been modified by residential development and historical channel alteration, habitat conditions are generally improved relative to the Highway Corridor reach downstream.

## Channel Characteristics and Fisheries Habitat

Reach 2 was surveyed in 2019 for restoration opportunities (Clough 2019). Channel morphology within Reach 2 is dominated by glides and pools. Wetted channel widths generally range between 4 and 8 m, while bankfull widths range from approximately 4.4 to 12 m

Substrates are dominated by sand, gravel, organics, and localized cobble accumulations. Spawning habitat is present and was observed being used for Cutthroat trout spawning in the 2019 survey.

Instream cover is provided by undercut banks, overhanging vegetation, small woody debris accumulations, root masses. There were limited large woody debris structures , and where found were jammed with small wood debris . Habitat complexity is greater than in Reach 1 although large stable conifer-derived woody debris remains limited throughout much of the reach. Unlike reach 1, reach 2 does not appear to have its channel re-aligned for rail and highway alignments.

Fish passage is generally functional throughout Reach 2. Historical fisheries assessments and recent stewardship monitoring indicate regular utilization of the reach by coho salmon and coastal cutthroat trout.

### Table 4-6. Reach 2 Habitat Assessment Summary

| Parameter | Reach 2 Condition |
|---|---|
| **Reach Length** | ~0.75 km |
| **Average Gradient** | ~2.0% |
| **Average Bankfull Width** | 6–12 m |
| **Average Wetted Width** | 4–8 m |
| **Dominant Habitat Type** | Glide, Pool and Ponded Habitat |
| **Pool Frequency** | High |
| **Riffle Frequency** | Moderate |
| **Spawning Habitat** | Moderate |
| **Juvenile Rearing Habitat** | Extensive |
| **Overwintering Habitat** | Extensive |
| **Fish Passage** | Generally passable |
| **Beaver Influence** | High |
| **Floodplain Connectivity** | Moderate–Good |
| **Overall Reach Condition** | Fair |

### Table 4-7. Reach 2 Instream Habitat Assessment

| Habitat Attribute | Condition | Rating |
|---|---|---|
| **Fish Passage** | Generally passable throughout reach | Good |
| **Adult Migration Habitat** | Continuous access to upstream habitats | Good |
| **Juvenile Rearing Habitat** | Extensive habitat availability | Good |
| **Overwintering Habitat** | Extensive ponded and refuge habitat | Good |
| **Pool Habitat** | Abundant and well distributed | Good |
| **Riffle Habitat** | Limited but present | Fair |
| **Spawning Habitat** | Limited by fines | Fair |

| | | |
|---|---|---|
| **Large Woody Debris** | Limited but present | Poor |
| **Instream Cover** | Good cover from vegetation and woody debris | Good |
| **Habitat Complexity** | Limited | Fair |
| **Channel Stability** | Generally stable | Good |
| **Water Quality Resilience** | Moderate thermal sensitivity | Fair |
| **Floodplain Connectivity** | Active floodplain interaction | Good |

## Instream Habitat Discussion

Reach 2 provides important spawning, juvenile rearing and overwintering habitat within the watershed. Pools do not dry in summer although connected flow may be limited. Overall fisheries habitat function is improved relative to Reach 1 due to greater habitat complexity, spawning habitat , and better water quality being above the highway runoff influence.

## Riparian Habitat

Riparian habitat within Reach 2 is generally older, taller and more continuous than in Reach 1. The vegetation community is primarily a second growth coniferous forest dominated by Douglas Fir with Red Cedar and Grand Fir. There remain clusters of deciduous trees; primarily Broadleaf Maple, Red Alder with some Willow species as well. There are also areas of riparian encroachment from the residential properties along the west bank.

Conifer recruitment remains below reference conditions in some locations but is substantially improved relative to the Highway Corridor reach. Invasive species such as Himalayan Blackberry remain present but are generally less dominant than in Reach 1. Riparian widths commonly range between 15 and 40 m and provide improved shading, bank stability, wildlife movement corridors, and future woody debris recruitment potential.

### Table 4-8. Reach 2 Riparian Habitat Assessment

| Riparian Attribute | Condition | Rating |
|---|---|---|
| **Riparian Width** | Generally 15–40 m | Good |
| **Vegetation Continuity** | Largely continuous corridor | Good |
| **Canopy Closure** | Moderate to high | Good |
| **Conifer Representation** | Moderate | Fair |
| **Future LWD Recruitment** | Moderate | Fair |
| **Deciduous Component** | Abundant | Good |
| **Shrub Layer Development** | Well developed | Good |
| **Invasive Species Condition** | Present but localized | Fair |
| **Bank Stability Function** | Generally stable | Good |
| **Sediment Filtering Function** | Effective | Good |
| **Wildlife Corridor Function** | Strong | Good |
| **Floodplain Interaction** | Active and functional | Good |

## Restoration Opportunity Discussion

Reach 2 is functioning relatively well compared to lower watershed reaches and restoration should focus on enhancement and protection rather than major reconstruction.

The highest restoration priorities include riparian planting in exposed areas near residences, invasive species management, selective large woody debris enhancement, and protection of existing floodplain and wetland functions. Additional opportunities include addressing debris jams, localized bank stabilization, and enhancement spawning habitat.

### Table 4-9. Reach 2 Restoration Opportunities and Priority Ranking

| Priority | Restoration Opportunity | Habitat Limitation Addressed | Expected Ecological Benefit | Feasibility |
|---|---|---|---|---|
| **High** | Riparian planting | Shade, Bank stability, LWD recruitment | Improved future habitat complexity and shading | High |
| **Moderate** | Invasive Species Management | Reduced native vegetation recruitment | Improved riparian function | High |
| **Moderate** | Large Woody Debris Enhancement | Localized cover limitations | Improved habitat complexity | Moderate |
| **Moderate** | Native Shrub and Wetland Planting | Habitat connectivity | Improved riparian resilience | High |
| **Moderate** | Localized Bank Stabilization | Small erosion areas | Improved channel stability | High |
| **Moderate** | Spawning Gravel Enhancement | Reduced spawning habitat | Localized spawning improvements | Moderate |

## Reach 2 Conclusion

Reach 2 functions as an important reach within the Craigflower Creek watershed. Compared to Reach 1, it offers a much older riparian condition, and more diverse pool, riffle, glide habitat. the reach is above the influence of the TransCanada highway.

Overall, Reach 2 is assessed as being in **Fair habitat condition with Moderate to High restoration potential**. Protection of existing spawning and rearing habitat function and enhancement and protection of the recovering second growth conifer forest represents the most effective strategy for improving long-term ecological resilience and fisheries habitat values within this reach.

This section will fit directly after Reach 1 and aligns with the scoring summary already shown later in your report where Reach 2 scores **Fair (Lower–Moderate)** and performs better than Reach 1 but below Reach 3.

## 4.4 Reach 3 – Upper Riffle/ Spawning Reach

### Reach Description

Reach 3 extends from the Highland Road subdivision area upstream through the golf course and parkland corridor to the outlet area of Prior Lake. This reach is approximately 1.5 km in length and exhibits gradients ranging from approximately 1.1% to 2.0%, resulting in a well-developed riffle-pool morphology. Reach 3 represents the most important spawning and juvenile rearing reach within the Craigflower Creek watershed and contains some of the highest quality salmonid habitat identified during historical and contemporary fisheries assessments.

Historical fisheries investigations identified this section as a key coho salmon spawning and juvenile rearing area due to the presence of gravel substrates, riffle habitat, groundwater influences, and improved habitat complexity relative to downstream reaches (Clough 1984). Subsequent watershed assessments, restoration planning studies, and stewardship monitoring programs have consistently identified Reach 3 as one of the highest value habitat reaches within the watershed.

### Channel Characteristics and Fisheries Habitat

Channel morphology within Reach 3 is characterized by alternating riffle, run, glide, and pool habitats. The reach exhibits greater hydraulic diversity than downstream reaches and supports a wider range of habitat functions for multiple salmonid life stages. Channel widths generally range from approximately 4–8 m wetted width and 6–12 m bankfull width depending on seasonal flows and local floodplain conditions.

Substrates are dominated by gravel, cobble, and coarse gravel riffles with localized accumulations of spawning-sized gravels. Fine sediment deposition occurs in some glide and pool habitats but is substantially lower than observed in Reaches 1 and 2. Numerous riffle-pool transitions provide suitable habitat for coho salmon spawning and juvenile rearing.

Historical fisheries assessments documented active coho salmon spawning and juvenile cutthroat trout utilization throughout this section of the watershed. More recent stewardship observations, restoration assessments, and juvenile fish surveys continue to confirm the importance of Reach 3 for spawning, rearing, and seasonal refuge habitat.

Several habitat enhancement opportunities identified during the 2019 restoration assessment occur within Reach 3. These include localized spawning gravel enhancement opportunities, riffle crest repair, live staking, selective debris management, conifer establishment, and enhancement of juvenile cover habitat. Observations documented coho fry, cutthroat trout habitat, active spawning areas, and functional riffle-pool sequences throughout the reach.

Large woody debris abundance is moderate relative to downstream reaches and contributes to pool formation, cover habitat, and channel complexity. Instream cover is provided by root masses, undercut banks, overhanging vegetation, woody debris accumulations, and pool habitats.

Fish passage is generally unrestricted throughout the reach and habitat connectivity remains good under most flow conditions with the exception of a gully and large rock in one location impedes

fish passage during low-mid flows and could be removed. Downstream transport of logs can be substantial, creating log jams in some years that impede passage but can be removed.

Table 4-10. Reach 3 Habitat Assessment Summary

| Parameter | Reach 3 Condition |
|---|---|
| **Reach Length** | ~1.5 km |
| **Average Gradient** | 1.1–2.0% |
| **Average Bankfull Width** | 6–12 m |
| **Average Wetted Width** | 4–8 m |
| **Dominant Habitat Type** | Riffle-Pool |
| **Pool Frequency** | Moderate–High |
| **Riffle Frequency** | High |
| **Spawning Habitat** | Extensive |
| **Juvenile Rearing Habitat** | Extensive |
| **Overwintering Habitat** | Moderate |
| **Fish Passage** | Seasonally Passable |
| **Large Woody Debris** | Moderate |
| **Floodplain Connectivity** | Moderate |
| **Overall Reach Condition** | Fair–Good |

Table 4-11. Reach 3 Instream Habitat Assessment

| Habitat Attribute | Condition | Rating |
|---|---|---|
| **Fish Passage** | Unrestricted | Good |
| **Adult Migration Habitat** | Excellent connectivity | Good |
| **Juvenile Rearing Habitat** | Extensive and diverse | Good |
| **Overwintering Habitat** | Moderate pool habitat availability | Fair–Good |
| **Pool Habitat** | Well distributed | Good |
| **Riffle Habitat** | Extensive and functional | Good |
| **Spawning Habitat** | High quality gravel riffles | Good |
| **Large Woody Debris** | Moderate abundance | Fair–Good |
| **Instream Cover** | Diverse cover features | Good |
| **Habitat Complexity** | Well-developed riffle-pool morphology | Good |
| **Channel Stability** | Generally stable | Good |
| **Water Quality Resilience** | Moderate thermal resilience | Fair–Good |
| **Floodplain Connectivity** | Moderate | Fair–Good |

## Instream Habitat Discussion

Reach 3 contains the highest quality spawning habitat identified within Craigflower Creek and functions as the primary production reach for coho salmon within the watershed. Gravel riffles, pool-riffle transitions, moderate gradients, and improved habitat complexity support all freshwater life stages of coho salmon and coastal cutthroat trout. Habitat quality is enhanced by greater substrate diversity, improved channel stability, and reduced urban influence relative to downstream reaches.

Although habitat conditions are generally favourable, localized limitations remain. Some riffles exhibit sediment accumulation and embeddedness, while several spawning areas identified during restoration assessments could benefit from gravel augmentation, riffle crest enhancement, or selective habitat maintenance. Overall, Reach 3 provides the highest instream habitat value within the watershed.

## Riparian Habitat

Riparian habitat within Reach 3 is generally in better condition than lower watershed reaches. The corridor consists of a mixture of parkland, golf course interfaces, second-growth mixed forest, deciduous stands, and localized conifer-dominated areas. Riparian widths commonly range between 20 and 50 m depending on adjacent land use and floodplain conditions.

Vegetation communities are dominated by red alder, black cottonwood, willow, salmonberry, red-osier dogwood, Douglas-fir, western redcedar, and scattered grand fir. Conifer representation is substantially greater than in Reaches 1 and 2 and provides improved future large woody debris recruitment potential.

Invasive species remain present but are generally localized and less extensive than in downstream urban reaches. Riparian shading, bank stability, wildlife movement, and sediment filtering functions are generally well developed throughout the corridor.

### Table 4-12. Reach 3 Riparian Habitat Assessment

| Riparian Attribute | Condition | Rating |
|---|---|---|
| **Riparian Width** | Generally 20–50 m | Good |
| **Vegetation Continuity** | Continuous corridor | Good |
| **Canopy Closure** | Moderate–High | Good |
| **Conifer Representation** | Moderate–High | Good |
| **Future LWD Recruitment** | Good potential | Good |
| **Deciduous Component** | Abundant | Good |
| **Shrub Layer Development** | Well developed | Good |
| **Invasive Species Condition** | Localized | Fair–Good |
| **Bank Stability Function** | Strong | Good |
| **Sediment Filtering Function** | Effective | Good |
| **Wildlife Corridor Function** | Strong | Good |
| **Floodplain Interaction** | Functional | Good |

## Restoration Opportunity Discussion

Reach 3 is one of the highest functioning habitat reaches within the watershed and restoration activities should focus on enhancement, maintenance, and protection rather than major rehabilitation. Existing habitat functions should be preserved through continued riparian protection, invasive species control, and stewardship monitoring.

Priority restoration opportunities include spawning gravel enhancement at selected riffles, conifer planting within gaps in the riparian corridor, localized bank stabilization, enhancement of juvenile cover habitat through woody debris placement, and protection of existing spawning

areas from future disturbance. Restoration assessments completed in 2019 identified several riffle and gravel-bar locations where relatively minor interventions could improve spawning habitat and juvenile cover.

Table 4-13. Reach 3 Restoration Opportunities and Priority Ranking

| Priority | Restoration Opportunity | Habitat Limitation Addressed | Expected Ecological Benefit | Feasibility |
|---|---|---|---|---|
| **High** | Protection of Existing Spawning Habitat | Habitat degradation risk | Maintain watershed productivity | High |
| **High** | Riparian Conifer Enhancement | Improve future LWD recruitment | Increased habitat complexity and shading | High |
| **High** | Invasive Species Management | Localized riparian impacts | Improved native vegetation resilience | High |
| **Moderate** | Spawning Gravel Enhancement | Localized gravel limitations | Increased spawning habitat capacity | High |
| **Moderate** | Juvenile Cover Enhancement | Limited cover in some riffles | Improved rearing habitat | Moderate |
| **Moderate** | Selective LWD Placement | Habitat complexity gaps | Increased pool formation and cover | Moderate |
| **Low** | Localized Bank Stabilization | Minor erosion areas | Improved channel stability | High |

## Reach 3 Conclusion

Reach 3 represents the highest quality fisheries habitat reach within the Craigflower Creek watershed and functions as the primary spawning and juvenile production reach for coho salmon and coastal cutthroat trout. The combination of moderate gradients, gravel riffles, pool-riffle morphology, improved riparian condition, and good habitat connectivity supports a wide range of salmonid life-stage requirements.

Compared to Reaches 1 and 2, Reach 3 exhibits superior spawning habitat, greater habitat complexity, improved riparian integrity, and reduced urban influence. Although localized restoration opportunities exist, the primary management objective for this reach should be protection and enhancement of existing habitat functions. Overall, Reach 3 is assessed as being in **Moderate (Upper Fair to Good) habitat condition with High conservation value and Moderate restoration potential**.

This scoring aligns with the summary table later in your report (Reach 3 = **2.1–2.5 instream score, Moderate/Upper Fair overall**) and supports the conclusion that Reach 3 is the strongest fish production reach in the watershed.

## 4.5 Reach 4 – Prior Lake/McKenzie Transitional Reach

### Reach Description

Reach 4 encompasses McKenzie Creek, the western headwater branch of the Craigflower Creek watershed. The reach originates from the outlet channels of McKenzie Lake and Thetis Lake, which converge at Prior Lake before continuing approximately 200 m downstream to the confluence with the North Fork of Craigflower Creek immediately downstream of Highland Road. This reach provides an important hydrological and ecological connection between the upper watershed lake systems and the mainstem Craigflower Creek watershed.

The McKenzie Creek channel upstream of Prior Lake is approximately 850 m in length and is characterized by low-gradient glide, pool, wetland, and beaver-influenced habitats. A natural gradient barrier to anadromous salmonids occurs approximately 600 m upstream of Prior Lake, limiting upstream access by coho salmon and defining the upper extent of accessible fish habitat within the McKenzie Creek system. Above this barrier, habitat is utilized primarily by resident coastal cutthroat trout and other aquatic organisms. While McKenzie Lake could be a valuable reservoir to maintain summer creek flows, a beaver dam at its mouth is regularly removed by local residents.

Prior Lake is the dominant habitat feature within Reach 4 and occupies approximately 7.6 ha. Historical fisheries assessments identified Prior Lake as a critical fish refuge area because portions of McKenzie Creek both upstream and downstream of the lake experience substantial reductions in wetted width during summer low-flow periods, with some channel sections becoming intermittent or completely dry during drought years (Clough 1984; Roberts and Harding 1997; Roberts et al. 1998). Consequently, Prior Lake functions as one of the most important permanent aquatic habitats within the Craigflower Creek watershed. Beaver dams at the Prior Lake outflow are regularly removed by swimmers, interfering with the potential contribution of beavers to water flow management.

### Channel Characteristics and Fisheries Habitat

Channel morphology within Reach 4 is dominated by glides, pools, wetland channels, and low-gradient transitional habitats. Wetted channel widths generally range between 2 and 5 m, while bankfull widths range from approximately 4 to 8 m depending on wetland influence and seasonal water levels.

Substrates consist primarily of gravel, sand, organic sediments, and localized cobble deposits. Due to the low gradient and wetland influence, spawning habitat is generally limited and occurs only in localized areas where suitable gravel substrates and flow conditions are present. The reach functions primarily as juvenile rearing, refuge, overwintering, and migration habitat rather than a major spawning area.

Groundwater influence is evident throughout portions of McKenzie Creek and contributes to thermal moderation and maintenance of summer baseflows. Beaver activity has historically influenced habitat complexity within portions of the reach through pond creation, flow attenuation, and sediment retention. Habitat complexity is enhanced by undercut banks, wetland vegetation, small woody debris, root masses, and seasonal floodplain inundation.

Fish passage is generally functional throughout the reach under normal flow conditions. The low-gradient channel provides important connectivity between Prior Lake, upper watershed habitats, and downstream spawning and rearing reaches. Juvenile coho salmon and coastal cutthroat trout are expected to utilize this reach for seasonal rearing and migration, while wetland habitats provide refuge during both high- and low-flow periods.

Table 4-14. Reach 4 Habitat Assessment Summary

| Parameter | Reach 4 Condition |
|---|---|
| **Reach Length** | ~0.85 km |
| **Average Gradient** | ~0.5% |
| **Average Bankfull Width** | 4–8 m |
| **Average Wetted Width** | 2–5 m |
| **Dominant Habitat Type** | Glide, Pool and Wetland Channel |
| **Pool Frequency** | Moderate–High |
| **Riffle Frequency** | Low |
| **Spawning Habitat** | Limited |
| **Juvenile Rearing Habitat** | Extensive |
| **Overwintering Habitat** | Extensive |
| **Fish Passage** | Generally passable |
| **Beaver Influence** | Moderate |
| **Floodplain Connectivity** | Good |
| **Overall Reach Condition** | Fair–Good |

Table 4-15. Reach 4 Instream Habitat Assessment

| Habitat Attribute | Condition | Rating |
|---|---|---|
| **Fish Passage** | Generally passable throughout reach | Good |
| **Adult Migration Habitat** | Continuous connectivity | Good |
| **Juvenile Rearing Habitat** | Extensive wetland and low velocity habitat | Good |
| **Overwintering Habitat** | Abundant refuge habitat | Good |
| **Pool Habitat** | Well distributed | Good |
| **Riffle Habitat** | Limited | Fair |
| **Spawning Habitat** | Localized gravel habitat | Fair |
| **Large Woody Debris** | Moderate abundance | Fair |
| **Instream Cover** | Good cover from vegetation and root structures | Good |
| **Habitat Complexity** | Enhanced by wetland and beaver influence | Good |
| **Channel Stability** | Stable | Good |
| **Water Quality Resilience** | Strong groundwater influence | Good |
| **Floodplain Connectivity** | Active floodplain interaction | Good |

## Instream Habitat Discussion

McKenzie Creek functions primarily as a wetland-connected rearing, refuge, and flow attenuation reach. Habitat quality is enhanced by groundwater inputs, low-gradient channel conditions, floodplain connectivity, and wetland influence. While spawning habitat is relatively

limited compared to Reach 3, the abundance of low-velocity habitats, seasonal refuge areas, and overwintering opportunities provide significant value for juvenile salmonids.

The reach also plays an important watershed-scale role by moderating flows, retaining sediment, supporting nutrient cycling, and contributing cool water inputs to downstream habitats. Flows from Thetis lake come through this path. This flow is regulated by the outflow dam, following a mandated curve, which is considered the prime method for guaranteeing summer flows in Craigflower Creek. Management of beaver dams with levelers at both McKenzie and Prior Lakes could contribute to guaranteeing summer flows. Consequently, habitat values within McKenzie Creek extend beyond direct fish production and include important ecological process functions that support overall watershed resilience.

## Riparian Habitat

Riparian habitat within Reach 4 is generally broad, continuous, and strongly influenced by adjacent wetlands. Riparian widths commonly range from 20 to more than 50 m and support a mixture of wetland vegetation, mixed forest communities, shrub thickets, and localized conifer stands.

Vegetation communities are dominated by red alder, black cottonwood, willow, Douglas-fir, western redcedar, salmonberry, hardhack, red-osier dogwood, skunk cabbage, and other wetland-associated species. Riparian canopy closure is generally moderate to high and provides effective shading and bank stability functions.

Conifer recruitment potential is moderate to good and substantially improved relative to lower watershed reaches. Invasive species occur locally but do not dominate the riparian corridor. Wetland vegetation communities contribute important sediment retention, nutrient uptake, flood attenuation, and wildlife habitat functions.

### Table 4-16. Reach 4 Riparian Habitat Assessment

| Riparian Attribute | Condition | Rating |
|---|---|---|
| **Riparian Width** | Generally 20–50+ m | Good |
| **Vegetation Continuity** | Continuous corridor | Good |
| **Canopy Closure** | Moderate–High | Good |
| **Conifer Representation** | Moderate | Fair–Good |
| **Future LWD Recruitment** | Moderate–Good | Fair–Good |
| **Deciduous Component** | Abundant | Good |
| **Shrub Layer Development** | Well developed | Good |
| **Wetland Vegetation Function** | Extensive | Good |
| **Invasive Species Condition** | Localized | Fair–Good |
| **Bank Stability Function** | Strong | Good |
| **Sediment Filtering Function** | Excellent | Good |
| **Wildlife Corridor Function** | Strong | Good |
| **Floodplain Interaction** | Functional | Good |

Table 4-17. Reach 4 Restoration Opportunities and Priority Ranking

| Priority | Restoration Opportunity | Habitat Limitation Addressed | Expected Ecological Benefit | Feasibility |
|---|---|---|---|---|
| **High** | Wetland Protection and Enhancement | Potential loss of hydrological function | Maintains flow regulation and habitat diversity | High |
| **High** | Riparian Conifer Enhancement | Improve future LWD recruitment | Increased long-term habitat complexity | High |
| **High** | Invasive Species Management | Localized vegetation impacts | Improved native habitat function | High |
| **Moderate** | Beaver Habitat and dam Management | Localized passage concerns & opportunity for flow management | Maintain ecological benefits and reservoirs while supporting fish passage | Moderate |
| **Moderate** | Native Shrub and Wetland Planting | Habitat enhancement opportunities | Improved riparian resilience and wildlife habitat | High |
| **Low** | Localized Bank Stabilization | Minor erosion areas | Improved channel stability | High |
| **Low** | Instream Habitat Enhancement | Limited habitat deficiencies | Minor ecological benefit | Moderate |

## Reach 4 Conclusion

McKenzie Creek represents an important transitional wetland and floodplain reach within the Craigflower Creek watershed. The reach provides substantial juvenile rearing, overwintering, refuge, and hydrological functions through its extensive wetland connectivity, groundwater influence, and low-gradient channel morphology. Compared to the lower watershed reaches, habitat complexity, floodplain interaction, and riparian condition are substantially improved.

Although spawning habitat is limited, the reach performs an important role in supporting downstream fish production through flow moderation, thermal buffering, sediment retention, and provision of high-quality rearing habitat. Protection of wetland functions, maintenance of riparian integrity, and preservation of natural hydrological processes should remain the primary management objectives for this reach.

Overall, Reach 4 is assessed as being in **Fair–Good habitat condition with High conservation value and Moderate restoration potential**, reflecting its importance as a wetland-connected ecological transition zone within the Craigflower Creek watershed.

## 4.6 Reach 5 – Pike Lake / Headwaters Reach

### Reach Description

Reach 5 encompasses the upper headwater tributaries of the Craigflower Creek watershed draining through Pike Lake. This reach represents the northeastern headwater branch of the watershed and includes Pike Lake, its outlet channel, associated wetlands, seepage-fed tributaries, and upper drainage features that contribute flow to the North Fork of Craigflower Creek.

Reach 5 is approximately 1.4 km in total length and is characterized by steep-gradient headwater channels, wetland margins, groundwater-fed tributaries, and forested riparian corridors. Channel gradients range from approximately 3% in lower sections to greater than 10% in confined upstream tributaries. Habitat conditions are strongly influenced by groundwater discharge, wetland storage, mature forest cover, and natural large woody debris recruitment.

Unlike the lower watershed reaches, Reach 5 remains relatively unaffected by urban development and retains many natural headwater characteristics. The reach plays an important watershed-scale role in groundwater recharge, summer baseflow maintenance, nutrient cycling, sediment retention, and thermal regulation. Although fisheries habitat is more limited than in downstream reaches, the ecological functions provided by the Pike Lake headwater system are critical to maintaining the hydrological and biological integrity of the Craigflower Creek watershed.

### Channel Characteristics and Fisheries Habitat

The Pike Lake outlet channels are  typically narrow and shallow, with wetted widths generally ranging from 0.5 to 2.0 m and bankfull widths ranging from approximately 1 to 4 m. Channel morphology is dominated by riffles, cascades, step-pool sequences, and localized plunge pools associated with woody debris and natural grade controls. One channel dries in the summer, whereas the second is maintained by the outflow from an adjustable beaver-dam leveller.  This has been essential in maintaining summer flows of the Craigflower when the release from Thetis Lake is insufficient.

Substrates consist primarily of gravel, cobble, boulder, organic materials, and exposed bedrock. It offers spawning habitat substrates and there are no barriers to Coho or Cutthroat in this reach. Large woody debris is abundant throughout much of the reach and provides important habitat complexity, sediment retention, bank stability, and organic matter storage. Instream cover is provided by woody debris accumulations, root wads, undercut banks, boulder clusters, overhanging vegetation, and pool habitats.

Fish habitat within Reach 5 is generally limited by seasonal flow conditions as sections near Pike Lake and downstream tributary junctions are known to dry. The primary fisheries value of Reach 5 is therefore associated with cold-water production, refuge habitat, and maintenance of watershed hydrological processes.

Groundwater discharge and wetland storage contribute significantly to maintaining summer baseflows and moderating water temperatures. During low-flow periods, these headwater systems provide important cold-water inputs to downstream habitats.

Table 4-18. Reach 5 Habitat Assessment Summary

| Parameter | Reach 5 Condition |
|---|---|
| **Reach Length** | ~1.6 km |
| **Average Gradient** | 3–10%+ |
| **Average Bankfull Width** | 4-5 m |
| **Average Wetted Width** | 0.5–4 m |
| **Dominant Habitat Type** | Cascade, Riffle, Step-Pool |
| **Pool Frequency** | Moderate |
| **Riffle Frequency** | High |
| **Spawning Habitat** | Limited and localized |
| **Juvenile Rearing Habitat** | Low |
| **Resident Trout Habitat** | Fair |
| **Fish Passage** | Generally Passable |
| **Large Woody Debris** | High |
| **Wetland Connectivity** | High |
| **Groundwater Influence** | High |
| **Overall Reach Condition** | Good |

Table 4-19. Reach 5 Instream Habitat Assessment

| Habitat Attribute | Condition | Rating |
|---|---|---|
| **Fish Passage** | Generally passable | Good |
| **Resident Trout Habitat** | Well developed | Good |
| **Juvenile Rearing Habitat** | Moderate availability | Fair–Good |
| **Refuge Habitat** | Numerous pools and cover features | Good |
| **Pool Habitat** | Moderate | Fair |
| **Riffle Habitat** | Extensive | Good |
| **Spawning Habitat** | Localized | Fair |
| **Large Woody Debris** | Abundant | Good |
| **Instream Cover** | Excellent | Good |
| **Habitat Complexity** | High | Good |
| **Channel Stability** | Stable | Good |
| **Water Quality Resilience** | Excellent | Good |
| **Groundwater Influence** | Significant | Good |
| **Thermal Refuge Function** | Strong | Good |
| **Overall Instream Habitat Rating** | **Good** | |

## Instream Habitat Discussion

Reach 5 contains some of the most natural aquatic habitats within the Craigflower Creek watershed. Habitat complexity is maintained by natural forest processes, large woody debris recruitment, groundwater discharge, wetland connectivity, and steep-gradient channel dynamics. While fisheries habitat is naturally limited by channel gradient and seasonal flow variability, the reach provides important habitat for resident coastal cutthroat trout and contributes significant ecological benefits to downstream reaches.

The abundance of woody debris, coarse substrates, and step-pool habitats creates diverse aquatic conditions that support aquatic invertebrates, amphibians, and resident fish populations. Groundwater-fed tributaries and wetland complexes provide cold-water inputs that help maintain thermal resilience throughout the watershed.

## Riparian Habitat

Riparian habitat within Reach 5 is generally intact and consists of mature second-growth conifer forest, mixed forest stands, wetland communities, and shrub-dominated riparian habitats. Riparian widths commonly exceed 30 m and frequently extend beyond 50 m adjacent to wetlands and seepage areas.

Vegetation communities are dominated by Douglas-fir (*Pseudotsuga menziesii*), western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), salmonberry (*Rubus spectabilis*), sword fern (*Polystichum munitum*), skunk cabbage (*Lysichiton americanus*), and other wetland-associated species.

Mature conifer representation is high, resulting in excellent future large woody debris recruitment potential. Human disturbance is generally limited to trails, utility corridors, and localized recreational access near Pike Lake. Invasive species occur at low levels and do not significantly influence overall riparian condition.

Riparian functions including bank stability, sediment retention, groundwater recharge, wildlife movement, nutrient cycling, and thermal buffering remain largely intact throughout the reach.

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Table 4-20. Reach 5 Riparian Habitat Assessment

| Riparian Attribute | Condition | Rating |
|---|---|---|
| **Riparian Width** | Generally >30 m | Good |
| **Vegetation Continuity** | Continuous | Good |
| **Canopy Closure** | High | Good |
| **Conifer Representation** | High | Good |
| **Future LWD Recruitment** | Excellent | Good |
| **Deciduous Component** | Moderate | Good |
| **Shrub Layer Development** | Well developed | Good |
| **Wetland Vegetation Function** | Extensive | Good |

| | | |
|---|---|---|
| **Invasive Species Condition** | Minor | Good |
| **Bank Stability Function** | Strong | Good |
| **Sediment Filtering Function** | Excellent | Good |
| **Wildlife Corridor Function** | Excellent | Good |
| **Groundwater Protection Function** | Excellent | Good |
| **Overall Riparian Habitat Rating** | **Good** | |

Table 4-21. Reach 5 Restoration Opportunities and Priority Ranking

| Priority | Restoration Opportunity | Habitat Limitation Addressed | Expected Ecological Benefit | Feasibility |
|---|---|---|---|---|
| **High** | Protection of Forested Riparian Corridor | Future habitat degradation risk | Maintains ecological integrity and hydrological function | High |
| **High** | Wetland and Groundwater Protection | Hydrological alteration risk | Maintains baseflow and thermal resilience | High |
| **High** | Invasive Species Monitoring and Control | Localized vegetation impacts | Protects native habitat communities | High |
| **Moderate** | Trail Management and Access Control | Localized disturbance and erosion | Reduced habitat impacts | High |
| **Moderate** | Protection of Large Woody Debris Recruitment Areas | Future habitat complexity | Maintains channel stability and habitat diversity | High |
| **Low** | Localized Bank Stabilization | Isolated disturbed sites | Improved channel resilience | High |
| **Low** | Instream Habitat Enhancement | Limited habitat deficiencies | Minor ecological benefit | Moderate |

## Restoration Discussion

Reach 5 exhibits the highest degree of ecological integrity within the Craigflower Creek watershed and therefore restoration efforts should focus primarily on protection rather than active habitat reconstruction. Existing forest cover, wetlands, groundwater recharge areas, and natural channel processes should be maintained wherever possible.

The highest management priorities include protection of forested riparian corridors, preservation of groundwater recharge functions, maintenance of wetland habitats, and prevention of future encroachment or hydrological alteration. Continued stewardship and monitoring will help ensure that the ecological functions of this headwater system remain intact and continue to support downstream habitat productivity.

### Reach 5 Conclusion

Reach 5 represents the uppermost headwater system associated with Pike Lake and performs critical watershed-scale ecological functions. Although fisheries habitat is naturally constrained by channel gradient and seasonal flow conditions, the reach supports resident coastal cutthroat trout, provides cold-water refuge habitat, and contributes significantly to groundwater recharge, summer baseflow maintenance, and water quality protection.

The intact forested riparian corridor, extensive wetland connectivity, abundant large woody debris, and strong groundwater influence result in high habitat quality and ecological resilience. Compared to downstream reaches, habitat limitations are primarily natural rather than anthropogenic.

Overall, Reach 5 is assessed as being in **Good habitat condition with High conservation value and Low restoration need**. Long-term management should focus on protection of riparian forests, wetlands, groundwater recharge areas, and natural hydrological processes to ensure continued support of fisheries habitat and watershed resilience throughout the Craigflower Creek system.

## 4.7 Prior Lake

### Lake Description

Prior Lake is a 7.6 ha freshwater lake located within the upper Craigflower Creek watershed and forms the hydrological connection between the McKenzie Creek system, Thetis Lake outlet channel, and the North Fork of Craigflower Creek. The lake occupies a central position within the watershed and functions as one of the most important aquatic habitat features supporting fish populations and watershed resilience.

The lake receives inflows from McKenzie Creek, Thetis Lake outlet channels, groundwater seepage, and associated wetland complexes before discharging through a short outlet channel approximately 200 m upstream of the confluence with the North Fork of Craigflower Creek. Due to its size, storage capacity, and permanent wetted habitat, Prior Lake exerts a significant influence on downstream hydrology, seasonal fish habitat availability, water temperatures, and summer flow maintenance.

Historical fisheries assessments identified Prior Lake as a critical refuge habitat for coho salmon (*Oncorhynchus kisutch*) and coastal cutthroat trout (*Oncorhynchus clarkii clarkii*) within the Craigflower Creek watershed. During summer low-flow periods, sections of McKenzie Creek both upstream and downstream of the lake experience substantial reductions in wetted width and localized channel dewatering. Under these conditions, Prior Lake provides one of the few large permanent aquatic habitats available to fish within the upper watershed (Clough 1984).

## Fisheries Habitat Function

Although Prior Lake provides limited spawning habitat, it performs several important fisheries habitat functions throughout the year and supports multiple salmonid life stages.

The lake functions primarily as:

- Summer refuge habitat;
- Juvenile coho salmon rearing habitat;
- Coastal cutthroat trout rearing habitat;
- Overwintering habitat;
- Seasonal migration habitat;
- Drought refuge habitat;
- Flow attenuation and storage habitat; and
- Thermal buffering habitat.

Historical fisheries investigations documented coho salmon and cutthroat trout utilization of the lake and outlet channels. More recent GWAS monitoring and habitat assessments continue to identify Prior Lake as a critical refuge area during drought and low-flow periods when habitat availability elsewhere in the watershed becomes restricted.

The importance of Prior Lake is amplified by the seasonal nature of many upper watershed tributaries. During extended dry periods, portions of McKenzie Creek above and below the lake may become highly constricted, fragmented, or locally dry, while Prior Lake continues to provide permanent aquatic habitat capable of supporting fish survival until fall rains restore stream connectivity.  A beaver dam at its outlet affords the opportunity to further retain the lakes reservoir function, but is regularly dismantled by swimmers.

## Hydrological Function

Prior Lake performs several important watershed-scale hydrological functions and acts as a natural storage reservoir within the upper watershed.

Key hydrological functions include:

- Summer baseflow maintenance;
- Flood attenuation;
- Seasonal flow storage;
- Sediment retention;
- Nutrient cycling;
- Groundwater interaction;
- Thermal moderation; and
- Downstream flow support.

Historical watershed management initiatives have recognized the importance of maintaining water levels and flow contributions from the Thetis Lake–McKenzie Creek system. During drought periods, supplemental releases from Thetis Lake have been utilized to support downstream fish habitat and maintain summer flows within Craigflower Creek.

The lake also contributes to attenuation of peak winter flows, reducing erosive energy and improving downstream channel stability.

## Water Quality and Thermal Conditions

Recent water quality monitoring completed by the Gorge Waterway Action Society identified summer surface water temperatures at the Prior Lake outlet reaching approximately 22°C during warm weather periods. While these temperatures may exceed preferred conditions for juvenile salmonids, Prior Lake remains an essential refuge habitat because permanent wetted habitat persists even when stream habitats contract significantly.

Water quality monitoring has identified several seasonal concerns including:

- Elevated summer water temperatures;
- Reduced dissolved oxygen concentrations during warm periods;
- Summer flow limitations;
- Increasing climate-related drought stress; and
- Potential impacts associated with watershed urbanization.

Despite these concerns, Prior Lake continues to provide one of the most resilient aquatic habitats within the watershed because of its permanent water availability and refuge function.

### Table 4-22. Prior Lake Habitat Functions

| Habitat Function | Importance |
|---|---|
| **Summer Refuge Habitat** | High |
| **Juvenile Coho Rearing** | High |
| **Coastal Cutthroat Trout Habitat** | High |
| **Overwintering Habitat** | High |
| **Migration Habitat** | High |
| **Spawning Habitat** | Low |
| **Hydrological Storage** | High |
| **Summer Flow Maintenance** | High |
| **Thermal Buffering** | Moderate–High |
| **Wetland Connectivity** | High |
| **Groundwater Interaction** | Moderate–High |
| **Watershed Resilience** | High |

### Table 4-23. Prior Lake Habitat Condition Assessment

| Habitat Attribute | Rating |
|---|---|
| **Permanent Wetted Habitat** | Excellent |
| **Juvenile Salmonid Habitat** | Good |
| **Cutthroat Trout Habitat** | Good |
| **Summer Refuge Habitat** | Excellent |
| **Overwintering Habitat** | Excellent |
| **Water Quality Resilience** | Fair–Good |

| | |
|---|---|
| **Thermal Resilience** | Fair |
| **Hydrological Storage Function** | Excellent |
| **Flow Maintenance Function** | Good |
| **Riparian Condition** | Good |
| **Wetland Connectivity** | Good |
| **Habitat Connectivity** | Good |
| **Overall Habitat Condition** | **Good** |

## Restoration Opportunities

Prior Lake remains largely functional and therefore restoration activities should focus on habitat protection, resilience enhancement, and long-term stewardship rather than intensive habitat reconstruction.

### Table 4-24. Prior Lake Restoration Opportunities and Priority Ranking

| Priority | Restoration Opportunity | Expected Benefit |
|---|---|---|
| **High** | Protect riparian vegetation and shoreline habitats | Maintain shading, bank stability, and habitat connectivity |
| **High** | Protect groundwater recharge and wetland areas | Maintain summer flows and thermal resilience |
| **High** | Continue water quality and temperature monitoring | Support adaptive watershed management |
| **High** | Maintain lake and outlet channel connectivity | Preserve refuge habitat function |
| **Moderate** | Native shoreline vegetation enhancement | Improve habitat complexity and bank stability |
| **Moderate** | Invasive species management | Improve native habitat quality |
| **Moderate** | Evaluate future climate adaptation measures | Improve drought resilience |
| **Low** | Structural habitat enhancement | Localized habitat improvements |

## Prior Lake Conclusion

Prior Lake is one of the most important fisheries and hydrological features within the Craigflower Creek watershed. Although the lake provides relatively limited spawning habitat, it performs critical refuge, rearing, overwintering, migration, and flow-maintenance functions that support salmonid populations throughout the watershed.

Historical fisheries assessments, watershed studies, and recent GWAS monitoring consistently identify Prior Lake as a key refuge habitat during summer low-flow periods when portions of McKenzie Creek experience substantial habitat contraction or localized dewatering. The lake's role in maintaining permanent aquatic habitat, moderating flows, supporting groundwater interactions, and providing seasonal fish refuge makes it disproportionately important relative to its size.

Overall, Prior Lake is assessed as being in **Good habitat condition with Very High conservation value and Moderate restoration potential**. Future management should focus on

protecting water quality, riparian vegetation, wetland connectivity, groundwater recharge functions, and summer flow resilience to ensure the lake continues to support fisheries habitat and watershed ecological function under future climate and development pressures.

## 4.8 Thetis Lake

### Lake Description

Thetis Lake is the largest and most influential waterbody within the Craigflower Creek watershed and serves as a major source of water storage, groundwater recharge, and summer flow maintenance for downstream aquatic habitats. Located within Thetis Lake Regional Park, the lake system consists of Upper and Lower Thetis Lake connected by a narrow channel and surrounded by extensive forested parkland, rocky uplands, wetlands, and seepage areas.

Thetis Lake forms the uppermost component of the western watershed and contributes flow to McKenzie Creek through managed outlet structures and natural drainage pathways. Due to its size, storage volume, and protected watershed setting, Thetis Lake exerts a significant influence on downstream hydrology, water quality, groundwater recharge, and fisheries habitat conditions throughout the Craigflower Creek system.

Historically, water releases from Thetis Lake have been used to augment summer flows within McKenzie Creek and Craigflower Creek during drought periods to maintain fish habitat and improve downstream flow conditions. As a result, the lake functions not only as a recreational resource but also as an important hydrological asset supporting watershed resilience.

### Hydrological Function

Thetis Lake performs several critical watershed-scale functions:

- Long-term water storage;
- Summer flow augmentation;
- Groundwater recharge;
- Flood attenuation;
- Water temperature moderation;
- Sediment retention;
- Nutrient processing;
- Climate resilience; and
- Downstream habitat support.

The lake captures winter precipitation and groundwater inputs and slowly releases water throughout the year. This storage capacity helps sustain downstream flows during summer low-water conditions and reduces the severity of seasonal drought impacts within McKenzie Creek and Craigflower Creek.

The extensive surrounding wetlands, seepage zones, and forested uplands further contribute to infiltration and groundwater recharge, supporting long-term hydrological stability throughout the watershed.

## Fisheries and Aquatic Habitat Function

Although Thetis Lake is located above the primary anadromous fish-bearing reaches of Craigflower Creek, it contributes significantly to downstream fisheries productivity through maintenance of water quantity and water quality. The lake supports resident fish populations and provides aquatic habitat for a variety of native species.

Key habitat functions include:

- Water storage supporting downstream fish habitat;
- Cold-water reservoir functions;
- Resident fish habitat;
- Amphibian habitat;
- Aquatic invertebrate production;
- Waterfowl habitat;
- Wildlife watering habitat; and
- Seasonal drought resilience.

The lake contributes indirectly to coho salmon and coastal cutthroat trout production by sustaining summer baseflows and improving hydrological resilience within downstream reaches, particularly McKenzie Creek and Prior Lake.

## Water Quality and Climate Resilience

Thetis Lake plays an increasingly important role under projected climate change scenarios due to its ability to store water and support summer flow maintenance. Prolonged drought periods, elevated temperatures, and increasing watershed pressures highlight the importance of preserving lake storage functions and groundwater recharge areas.

The protected nature of the surrounding parkland contributes to generally good water quality and reduced development pressures compared to lower watershed areas. However, recreational use, climate change, invasive species, and increasing summer drought conditions remain important management considerations.

### Table 4-28. Thetis Lake Habitat Functions

| Habitat Function | Importance |
|---|---|
| **Water Storage** | High |
| **Summer Flow Maintenance** | High |
| **Groundwater Recharge** | High |
| **Climate Resilience** | High |
| **Water Quality Protection** | High |
| **Flood Attenuation** | High |
| **Resident Fish Habitat** | Moderate–High |

| | |
|---|---|
| **Amphibian Habitat** | High |
| **Wildlife Habitat** | High |
| **Aquatic Productivity** | High |
| **Downstream Fisheries Support** | High |
| **Watershed Resilience** | High |

Table 4-29. Thetis Lake Habitat Condition Assessment

| Habitat Attribute | Rating |
|---|---|
| **Water Storage Function** | Excellent |
| **Summer Flow Support** | Excellent |
| **Groundwater Recharge Function** | Excellent |
| **Water Quality Function** | Good–Excellent |
| **Resident Fish Habitat** | Good |
| **Amphibian Habitat** | Excellent |
| **Wetland Connectivity** | Good |
| **Riparian Condition** | Good–Excellent |
| **Climate Resilience Function** | Excellent |
| **Watershed Connectivity** | Good |
| **Ecological Integrity** | Good–Excellent |
| **Overall Habitat Condition** | **Excellent** |

## Restoration Opportunities

Because Thetis Lake remains largely protected within a regional park setting and continues to perform critical watershed functions, management should focus on conservation, monitoring, and climate resilience rather than active habitat restoration.

Table 4-30. Thetis Lake Restoration Opportunities and Priority Ranking

| Priority | Restoration Opportunity | Expected Benefit |
|---|---|---|
| **High** | Protect lake storage and outlet management functions | Maintain downstream summer flows |
| **High** | Protect groundwater recharge areas | Maintain hydrological resilience |
| **High** | Preserve forested parkland and riparian habitats | Protect water quality and habitat integrity |
| **High** | Continue hydrological and water quality monitoring | Support adaptive watershed management |
| **Moderate** | Invasive species monitoring and management | Protect native ecological communities |
| **Moderate** | Shoreline and recreational impact management | Reduce localized habitat disturbance |
| **Moderate** | Climate adaptation planning | Improve long-term watershed resilience |
| **Low** | Habitat enhancement projects | Limited benefit due to existing condition |

### Thetis Lake Conclusion

Thetis Lake is the most significant hydrological feature within the Craigflower Creek watershed and plays a critical role in maintaining watershed resilience, summer flow conditions, groundwater recharge, and downstream fisheries habitat. Although the lake contributes relatively little direct salmonid habitat, its influence on flow regulation and water storage supports fish populations throughout McKenzie Creek, Prior Lake, and downstream reaches of Craigflower Creek.

The lake's protected setting within Thetis Lake Regional Park, combined with its extensive storage capacity and groundwater recharge functions, results in high ecological integrity and strong resilience to environmental stressors. Continued protection of water quality, forest cover, groundwater recharge areas, and outlet management functions will be essential to maintaining the ecological health of the broader watershed.

Overall, Thetis Lake is assessed as being in **Excellent habitat condition with Very High conservation value and Low restoration need**, reflecting its fundamental role in supporting hydrological function and fisheries habitat throughout the Craigflower Creek watershed.

# 4.9 Other Headwater Lakes and Wetland Complexes

## Overview

In addition to Prior Lake, Pike Lake, and Thetis Lake, several smaller lakes, ponds, wetlands, and groundwater-fed depressions contribute to the hydrology and ecological function of the Craigflower Creek watershed. These include Eagle Lake, McKenzie Lake, and numerous unnamed wetland complexes distributed throughout the upper watershed.

Although these waterbodies contribute relatively little direct fish habitat compared to Prior Lake and Thetis Lake, they perform important watershed-scale ecological functions including groundwater recharge, seasonal water storage, flood attenuation, nutrient cycling, wildlife habitat, and maintenance of downstream baseflows.  All could contribute greater reservoir and summer flow contributions with beneficial management of beaver activities.  At the moment, most dams are regularly removed

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## Eagle Lake

Eagle Lake is located within the upper watershed and functions primarily as a headwater storage and groundwater recharge feature. The lake is relatively isolated from direct fish migration corridors but contributes to downstream hydrological stability through storage of winter precipitation and gradual release of water through groundwater and surface flow pathways.

Primary ecological functions include:

- Groundwater recharge;
- Amphibian breeding habitat;
- Wildlife habitat;
- Water storage;
- Nutrient cycling; and
- Climate resilience.

Riparian habitat surrounding Eagle Lake consists primarily of mixed forest, wetland vegetation, and shrub communities with relatively limited development pressure. Beavers are present in this lake.

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## McKenzie Lake

McKenzie Lake forms part of the western headwater system contributing flow to McKenzie Creek and ultimately Prior Lake. Although fish habitat values within the lake itself have not been extensively documented, the lake contributes significantly to maintenance of summer baseflows and hydrological stability within the McKenzie Creek system. A beaver dam at its mouth, while in the park, is regularly removed by residents.

Key functions include:

- Water storage;
- Groundwater recharge;
- Flow support to McKenzie Creek;
- Wetland connectivity;
- Wildlife habitat; and
- Climate resilience.

The lake's greatest ecological importance is associated with sustaining downstream habitat functions within Prior Lake and McKenzie Creek.

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## Wetlands and Seasonal Ponds

Numerous wetlands, ephemeral ponds, seepage areas, and groundwater-fed depressions occur throughout the Craigflower watershed. Collectively these habitats provide significant ecological functions including:

- Groundwater recharge;
- Amphibian breeding habitat;
- Waterfowl habitat;
- Sediment retention;
- Nutrient uptake;
- Flood attenuation;
- Summer flow maintenance; and

- Carbon storage.

These habitats are particularly important under future climate scenarios where increased drought frequency and altered hydrological patterns may increase reliance on natural water storage systems.

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### Table 4-31. Other Headwater Lakes and Wetland Habitat Functions

| Waterbody | Water Storage | Groundwater Recharge | Fish Habitat | Amphibian Habitat | Watershed Importance |
|---|---|---|---|---|---|
| **Eagle Lake** | High | High | Low | High | High |
| **McKenzie Lake** | High | High | Moderate | High | High |
| **Wetland Complexes** | High | High | Low | High | High |
| **Seasonal Ponds** | Moderate | Moderate | Low | High | Moderate |

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## Conclusion

The numerous lakes, wetlands, and headwater storage features distributed throughout the Craigflower Creek watershed collectively contribute to the hydrological and ecological resilience of the watershed. Although many of these waterbodies provide limited direct salmonid habitat, their role in supporting groundwater recharge, water storage, summer flow maintenance, amphibian habitat, and climate resilience is substantial. Protection of these features should therefore be considered an important component of long-term watershed management and fisheries habitat conservation within the Craigflower Creek system.

# 5. Watershed Habitat Condition Assessment and Restoration Priorities

## 5.1 Watershed Habitat Condition Assessment

Craigflower Creek supports a diverse range of aquatic and riparian habitats extending from the urbanized lower watershed at Portage Inlet through the floodplain, lake, wetland, and forested headwater systems associated with Prior Lake, McKenzie Creek, Pike Lake, and Thetis Lake. Historical fisheries assessments, watershed studies, restoration planning initiatives, habitat inventories, and recent stewardship monitoring demonstrate that habitat condition generally improves with increasing distance from urban development and infrastructure influences.

The lower watershed, particularly Reach 1 (Highway Corridor), exhibits the greatest degree of habitat alteration and contains the highest concentration of limiting factors affecting fisheries habitat productivity. Habitat conditions within this reach are constrained by urban runoff, channel confinement, reduced riparian function, limited large woody debris recruitment, invasive species, elevated summer temperatures, and reduced floodplain connectivity. Despite these limitations, Reach 1 continues to function as a critical migration corridor and juvenile salmonid rearing area linking marine and freshwater habitats.

Reach 2 (Highland Road Subdivision) represents a transitional floodplain and wetland reach where habitat conditions improve substantially relative to Reach 1. Beaver influence, increased floodplain connectivity, and improved riparian condition contribute to enhanced juvenile rearing, refuge, and overwintering habitat values. Habitat complexity and ecological function within this reach remain moderately high despite localized development influences.

Reach 3 (Upper Riffle / Spawning Reach) contains the highest quality spawning and juvenile production habitat identified within the watershed. Gravel riffles, pool-riffle morphology, improved riparian condition, and reduced urban influence support coho salmon and coastal cutthroat trout production. This reach represents the primary fish production area within the watershed and should be considered a high-priority conservation reach.

Reach 4 (McKenzie Creek) and Prior Lake perform unique hydrological and ecological functions within the watershed. Although spawning habitat is limited, these habitats provide critical refuge, rearing, overwintering, migration, and flow-maintenance functions. Prior Lake, in particular, represents one of the most important permanent aquatic habitats within the watershed and provides essential refuge habitat during summer low-flow periods when sections of McKenzie Creek may experience substantial habitat contraction or localized drying. Similarly, Thetis Lake functions as the principal hydrological storage feature within the watershed and contributes significantly to downstream flow maintenance, climate resilience, and water quality protection.

Reach 5 (Pike Lake Headwaters) and associated wetland complexes represent the most intact habitats within the watershed and provide important groundwater recharge, thermal buffering, flow regulation, and resident fish habitat functions. Management of the beaver dam on Pike Lake has been essential in maintaining summer flows in Craigflower creek when flow from Thetis Lake has been inadequate.

Overall, habitat quality follows a general upstream improvement gradient, with the most altered conditions occurring in the lower watershed and the highest ecological integrity occurring within the upper watershed lakes, wetlands, and forested headwater systems.

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## Table 5-1. Watershed Reach Habitat Condition Summary

| Reach | Reach Name | Instream Habitat Rating | Riparian Habitat Rating | Overall Condition | Restoration Potential |
|---|---|---|---|---|---|
| **Reach 1** | Lower UrbanCorridor | Poor–Fair | Poor–Fair | Poor–Fair | High |
| **Reach 2** | Transitional/Glide Reach | Fair | Fair–Good | Fair | Moderate–High |
| **Reach 3** | Upper Riffle / Spawning Reach | Good | Good | Good | Moderate |
| **Reach 4** | Prior Lake/McKenzie Transitional Reach | Good | Good | Good | Moderate |
| **Prior Lake** | Lake Habitat | Good | Good | Good | Moderate |
| **Reach 5** | Pike/ Headwaters Reach | Good | Good | Good | Low |
| **Thetis Lake** | Watershed Storage System | Excellent | Good–Excellent | Excellent | Low |

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## 5.2 Key Habitat Limiting Factors

Review of historical and contemporary assessments identified several recurring habitat limitations affecting fisheries productivity within the watershed.

### Hydrological Alteration

Urban development, impervious surfaces, stormwater infrastructure, and historical channel modifications have altered natural hydrological processes within portions of the watershed. Increased runoff rates, reduced groundwater infiltration, and lower summer baseflows contribute to habitat degradation within lower watershed reaches.

### Elevated Summer Water Temperatures

Summer thermal stress remains one of the most significant watershed-wide concerns. Recent monitoring documented elevated temperatures within lower watershed reaches and at the Prior Lake outlet. Climate change, reduced riparian shading, low summer flows, and urban runoff are expected to further increase thermal stress in the future.

## Reduced Riparian Function

Riparian degradation remains a significant issue within the lower watershed. Limited conifer recruitment, invasive species encroachment, fragmented vegetation structure, and reduced corridor widths have impaired shading, bank stability, large woody debris recruitment, and sediment retention functions.

## Limited Habitat Complexity

Large woody debris abundance is below reference conditions throughout portions of the lower watershed. Reduced habitat complexity limits pool formation, juvenile cover, hydraulic diversity, and refuge habitat availability.

## Floodplain Disconnection

Transportation infrastructure, urban development, and historical channel confinement have reduced floodplain connectivity in lower watershed reaches, limiting habitat diversity and reducing natural hydrological functions.

## Climate Change

Increasing summer drought conditions, elevated water temperatures, reduced summer flows, and increased hydrological variability are expected to place additional pressure on watershed habitats. Protection of groundwater recharge areas, lakes, wetlands, and riparian corridors will be increasingly important to maintaining ecological resilience. The timing of fall rains, and associated upstream migration of adult salmon, is also changing and is exasperated by the flashiness of flows from the highways and hardened surfaces of Reach 1. This creates problems for fish that are either holding longer in Portage Inlet or attracted into the stream and holding in small ponds of Reach 1 and being predated by seals or otters. The fish may also not be able to reach the optimal spawning environments of Reach 3, and need to spawn in reaches 1 and 2. Consideration of these aspects should be included in the restoration planning of the lower creek.

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## Table 5-2. Watershed Habitat Limiting Factors

| Limiting Factor | Relative Severity | Primary Affected Reaches |
|---|---|---|
| **Urban Runoff** | High | Reach 1, Reach 2 |
| **Elevated Summer Temperatures** | High | Reach 1, Reach 4, Prior Lake |
| **Reduced Riparian Function** | High | Reach 1 |
| **Limited LWD Recruitment** | High | Reach 1, Reach 2 |
| **Floodplain Confinement** | High | Reach 1 |
| **Invasive Species** | Moderate–High | Reach 1, Reach 2 |
| **Reduced Summer Flows** | Moderate | Reach 1, Reach 4 |
| **Spawning Habitat Limitations** | Moderate | Reach 1, Reach 2, Reach 4 |
| **Fish Passage Constraints** | Low–Moderate | Localized locations only |
| **Wetland Loss Risk** | Moderate | Upper watershed |

## 5.3 Watershed Restoration Priorities

The watershed assessment indicates that restoration efforts should focus on improving ecological processes rather than intensive channel reconstruction. Restoration priorities should target the principal factors limiting habitat productivity while maintaining and protecting existing high-quality habitats.

### Priority 1 – Riparian Forest Restoration

Restoration of riparian forests, particularly establishment of long-lived conifer species, should be considered the highest watershed-wide priority. Improved riparian condition will enhance thermal buffering, future large woody debris recruitment, bank stability, habitat complexity, and climate resilience.

### Priority 2 – Stormwater Management

Improved stormwater treatment and runoff management within urbanized portions of the watershed are critical to addressing water quality degradation, contaminant loading, elevated temperatures, and altered hydrology. In particular, the recently recognized toxicity of tire wear compounds to coho makes the lower reaches of the creek particularly sensitive. A better understanding of the highway runoff dynamics is needed to enable appropriately placed mitigative measures in this area.

### Priority 3 – Habitat Complexity Enhancement

Strategic large woody debris placement and protection of natural wood recruitment processes will improve habitat complexity, pool development, juvenile cover, and hydraulic diversity.

### Priority 4 – Wetland and Floodplain Protection

Protection and enhancement of wetlands, floodplain habitats, Prior Lake, McKenzie Creek, Pike Lake, and associated groundwater recharge areas should be prioritized to maintain watershed hydrology and climate resilience. Beavers are active in this area, and appropriate management can facilitate this goal.

### Priority 5 – Invasive Species Management

Continued invasive species removal and maintenance planting will improve riparian function and increase the success of restoration efforts throughout the watershed.

## Table 5-3. Watershed Restoration Priority Ranking

| Priority Rank | Restoration Objective | Primary Target Areas |
|---|---|---|
| **1** | Riparian Forest Restoration | Reach 1, Reach 2 |
| **2** | Stormwater Treatment and Runoff Management | Reach 1 |

| | | |
|---|---|---|
| **3** | Habitat Complexity Enhancement (LWD) | Reach 1, Reach 2 |
| **4** | Wetland and Floodplain Protection | Reach 4, Prior Lake, Reach 5 |
| **5** | Invasive Species Management | Reach 1, Reach 2 |
| **6** | Refuge Habitat Enhancement | Reach 1, Reach 2 |
| **7** | Spawning Habitat Enhancement | Reach 3 |
| **8** | Fish Passage Improvements | Site-specific locations |
| **9** | Monitoring and Adaptive Management | Watershed-wide |
| **10** | Major Channel Reconstruction | Not recommended except site-specific applications |

## 5.4 Watershed Conclusion

Craigflower Creek remains one of the most important urban salmon-bearing watersheds within the Capital Regional District and continues to support coho salmon, coastal cutthroat trout, amphibians, waterfowl, and a diverse range of aquatic and riparian species. Although portions of the lower watershed have been significantly altered by urbanization and infrastructure development, substantial habitat values remain throughout the system.

The watershed benefits from the presence of Prior Lake, Pike Lake, Thetis Lake, McKenzie Creek, extensive wetland complexes, and relatively intact upper watershed habitats that continue to provide important hydrological and ecological functions. Reach 3 remains the primary spawning and juvenile production area, while Reach 1 functions as a critical migration corridor connecting freshwater and marine habitats.

Future restoration efforts should emphasize riparian recovery, stormwater management, habitat complexity enhancement, wetland protection, and climate resilience to low flow and high temperature. Protection of existing high-quality habitats within the upper watershed should remain a priority alongside restoration of impaired lower watershed reaches.

Overall, Craigflower Creek is assessed as a **functioning but impaired urban watershed with high ecological value, significant restoration potential, and strong long-term recovery opportunities through coordinated watershed stewardship and habitat restoration initiatives.**

# 6. Acknowledgements

The author sincerely thanks Dr. Yogi Carolsfeld (World Fisheries Trust) for his careful editorial review and valuable technical recommendations. Appreciation is also extended to dedicated Craigflower Creek stewards Bruce Bevan and Mick Collins, who generously shared decades of firsthand observations and historical knowledge of the watershed. Their long-term commitment to protecting and restoring Craigflower Creek has helped preserve an invaluable record of environmental change that greatly enriched this assessment.

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# Appendix A - Annotated Reference List

## Aqua-Tex Scientific Consulting Ltd. (2021)

**Lower Craigflower Creek Proper Functioning Condition Assessment**

This assessment evaluated channel function, riparian condition, floodplain connectivity, hydrological processes, and habitat condition within lower Craigflower Creek. The report identified channel confinement, reduced riparian function, invasive species, stormwater impacts, and limited large woody debris recruitment as primary ecological stressors. Findings were used extensively in Reach 1 habitat condition scoring and restoration priority development.

## Clough (1984)

**Craigflower Creek and Colquitz Creek Fisheries Habitat Assessment**

This is a fisheries habitat assessment for the watershed and reference for fish distribution, habitat utilization, migration barriers, spawning habitat, and juvenile salmonid use. The report documented coho salmon and coastal cutthroat trout utilization throughout the watershed and identified Prior Lake as a critical summer refuge habitat. Reach delineation, historical habitat interpretation, and fisheries habitat descriptions were strongly informed by this assessment.

## Finnegan, B. 1985.

**Craigflower Creek: An Update on the System with Special Reference to the Stream's Coho Salmon Population and Prospects for Their Enhancement.** Prepared for Fisheries and Oceans Canada, Victoria, BC. April 1985.

This report provides one of the earliest comprehensive fisheries assessments of the Craigflower Creek watershed and remains a foundational reference for understanding historical fish populations, watershed hydrology, migration barriers, and habitat limitations.

## Gorge Waterway Action Society (2024)

**Craigflower Creek Riparian Restoration Action Plan (RAPR)**

The RAPR report evaluated riparian condition and restoration opportunities throughout the watershed. The report identified priority restoration sites, invasive species issues, riparian deficiencies, conifer recruitment opportunities, and long-term habitat enhancement strategies. Restoration recommendations and priority rankings within each reach were derived in part from this report.

## Gorge Waterway Action Society (2024–2026)

**Craigflower Creek Habitat Assessment and Monitoring Program Database**

The habitat assessment database provided quantitative field measurements including habitat unit inventories, channel dimensions, gradients, substrate composition, canopy closure, large woody debris abundance, and habitat complexity metrics. These data were used to support reach characterization, habitat scoring, and habitat condition summaries throughout the assessment.

## Gorge Waterway Action Society (2025)

**McKenzie Creek and Prior Lake Water Quality Monitoring Summary**

This monitoring program documented seasonal temperature, dissolved oxygen, conductivity, and flow conditions within McKenzie Creek and Prior Lake. Results highlighted the importance of Prior Lake as a summer refuge habitat and identified elevated summer temperatures as a watershed management concern. These findings informed the Reach 1-4 and Prior Lake assessments.

## Gorge Waterway Action Society (2026)

**Lower McKenzie Creek Habitat Assessment**

This habitat inventory provided detailed field measurements for lower McKenzie Creek downstream of Prior Lake, including channel dimensions, habitat unit classifications, substrate composition, canopy closure, water quality measurements, and habitat complexity observations. The report was used extensively in the Reach1- 4 assessment and habitat condition scoring.

## Langford, R.W. (1978)

**Colquitz–Craigflower Urban Fisheries Rehabilitation and Watershed Management.** Aqua Science Consulting Ltd.

This report documents one of the earliest watershed restoration programs in the Colquitz–Craigflower system and identifies urbanization, channelization, loss of riparian vegetation, poor water quality, and altered streamflows as the primary causes of declining coho salmon and sea-run cutthroat trout populations. The study promoted integrated watershed management, riparian protection, floodplain preservation, stormwater retention, and habitat enhancement as essential strategies for restoring urban stream ecosystems. Many of the restoration principles and watershed management approaches recommended in 1978 remain relevant to Craigflower Creek today and form the foundation of modern watershed stewardship and habitat restoration efforts.

## MacGregor and McConnachie (2026)

**Craigflower Creek Watershed Habitat Assessment and Monitoring Program**

This report summarized recent watershed-wide monitoring activities, restoration initiatives, fish observations, water quality investigations, and stewardship efforts. Findings supported current watershed condition assessments, climate resilience considerations, and restoration recommendations.

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## Roberts and Harding (1997)

**Craigflower Watershed Assessment**

This watershed-scale assessment examined hydrology, land use, fisheries habitat, riparian condition, water quality, and watershed processes. The report provided foundational information on watershed structure, historical impacts, floodplain condition, and habitat constraints and was used extensively throughout the watershed overview and reach descriptions.

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## Roberts et al. (1998)

**Craigflower Creek Watershed Management Plan**

The watershed management plan synthesized previous studies and established management objectives, restoration priorities, and watershed protection strategies. The report was particularly useful in identifying watershed-scale limiting factors and long-term restoration priorities.

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## Scott (2024)

**Craigflower Creek Riparian Restoration Plan**

This report assessed riparian vegetation condition and developed restoration prescriptions for priority reaches throughout the watershed. Recommendations regarding invasive species control, native planting, conifer establishment, bank stabilization, and habitat enhancement were incorporated into reach-level restoration planning.

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