Chilako River Watershed Recovery Strategy

SOCIETY FOR ECOSYSTEM RESTORATION IN NORTHERN BRITISH COLUMBIA

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The Society for Ecosystem Restoration in Northern British Columbia (SERNbc) was established in 2013 in support of ecosystem restoration efforts in the Omineca Region. Since that time, the activities of SERNbc have expanded across northern BC to include the Skeena, Omineca and Northeast (Peace) Regions. Members of SERNbc represent governmental agencies, academic institutions, organizations such as the BC Trappers Association and the Guide Outfitters Association, as well as private citizens. The mission of SERNbc is to manage the structure and function of vulnerable and degraded ecosystems to achieve a desired future condition that will sustain ecological services and human socio-economic needs. SERNbc achieves this mission by coordinating ecosystem restoration activities in northern BC and by fostering collaboration amongst stakeholders.

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This project also involved contributions and input from a range of stakeholders and resource professionals through engagement during the project.

Executive Summary

Watershed recovery as a project concept was initiated in 2018 as a result of local MLA's inviting government (FLNRORD, Regional Districts, Fisheries and Oceans Canada), First Nations Representatives and various non-governmental organizations (NGO) to come together and requesting a strategy be developed to recover some of the values that appear to be compromised in the Chilako River watershed. The Society for Ecosystem Restoration in Northern British Columbia (SERNbc) was asked to facilitate the process of creating a Watershed Recovery Strategy that identifies a set of recovery strategies for the Chilako River watershed.

Watershed recovery in the context of this project is defined as understanding the threatening conditions that push watershed ecosystems beyond their capacity to self-regulate, and through the implementation of strategic activities, focus on restoring the watershed to a condition that increases resiliency. Strategies for watershed recovery were developed with input from local stakeholders and subject matter experts in an effort to create a holistic and comprehensive approach to watershed recovery that addresses current issues in the watershed and aims to mitigate further impacts from occurring.

This project was designed as an open and flexible approach to restoration planning, looking to combine a general understanding of the impacted landscape with input from consulting specialists, government specialists, stakeholders and First Nations. The project could be seen as a "pilot" that reflects an innovative, collaborative and integrated approach to watershed recovery that goes beyond site specific treatments of disturbance to consider the resiliency of the watershed as a whole.

Through collaboration with subject matter experts and governing agencies, one key value was identified that would allow for support of all other values present in the watershed: **resiliency of the watershed to disturbance**. If the overall function of the watershed is improved, the ecosystems within will become more resilient with a greater ability to recover from disturbances, subsequently resulting in the recovery and protection of other values within the watershed (i.e. private property, wildlife habitat, water quality). With this understanding, eight (8) strategies were developed as recommended key steps in the recovery of the Chilako River watershed:

<table>
<tr><th colspan="4">Recovery Strategy</th></tr>
<tr><td rowspan="2">Short-term
↕
Long-term</td><td>Strategy 1 – Management Zonation</td><td>Strategy 2 – Basin Specific Guidance</td><td>Strategy 3 – Watershed Stewardship Group / Officer
Strategy 4 – First Nations and Stakeholders
Strategy 5 – Private Landowners
Strategy 6 – Secure Buy-in and Funding</td><td rowspan="2">Strategy 7 – Information Gaps</td></tr>
<tr><td colspan="3">Strategy 8 – Watershed Management Plan</td></tr>
</table>

These recovery strategies are intended to be flexible in their implementation to allow for maximum efficiency with time and available funding. They are listed in a recommended order of implementation as many strategies are contingent upon each other. Cost estimates and potential collaborators have been provided to support securing of additional funding and general buy-in for the process.

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List of Acronyms

BEC	Bogeoclimatic Zone
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ECA	Equivalent Clearcut Area
ESSF	Engelmann Spruce Subalpine Fir
FESBC	Forest Enhancement Society of BC
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FREP	Forest and Range Evaluation Program
FSW	Fisheries Sensitive Watershed
MLA	Member of Legislative Assembly
NDT	Natural Disturbance Type
NEWSS	Nechako Environment and Water Stewardship Society
NGO	Non-Government Organization
NRD	Natural Resource District
OGMA	Old Growth Management Area
SBS	Sub-Boreal Spruce
SERNbc	Society for Ecosystem Restoration in Northern British Columbia
SME	Subject Matter Expert
UWR	Ungulate Winter Range
VRI	Vegetation Resources Inventory
WHPOR	Watershed Health Tool Omineca Region
WRS	Watershed Recovery Strategy
WSA	Water Sustainability Act

1 Introduction

The state of the Chilako River and its watershed has been of concern for many residents, First Nations and government representatives for close to a decade. This watershed recovery initiative for the Chilako River was prompted in 2018 as a result of local MLA's inviting government (Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), Regional Districts, Fisheries and Oceans Canada), First Nations, forest licensees, and various non-governmental organizations (NGOs) to develop a strategy to recover some of the values that appear to be compromised in the Chilako River watershed. The Chilako River watershed was selected for this process due to the concerns regarding the cumulative effects of forestry, agriculture, private land activities, wildfire and forest health disturbances, as well as climate change.

The Society for Ecosystem Restoration in Northern British Columbia (SERNbc) was asked to facilitate the development of a Watershed Recovery Strategy (the Chilako WRS) that documents the historical and current conditions in the watershed, values of importance that are at risk or considered compromised, and identifies strategies for the recovery of these values. Further to this, the Chilako WRS identifies opportunities for coordination of resources, identification of partnerships, and recommended steps to facilitate recovery of the watershed in ways that may be applied to other watershed recovery efforts across the province. Strategies for watershed recovery were developed with input from local stakeholders (collected through previous engagement sessions) and subject matter experts (SMEs) in an effort to create a holistic and comprehensive approach to watershed recovery that addresses current issues in the watershed and works to mitigate further impacts.

1.1 DEFINITIONS

For the purposes of the Chilako WRS, the following definitions apply:

- **Disturbance –** Any relatively discrete event in time that disrupts or alters ecosystem, community, or population structure and changes resources or the physical environment[1]. This includes both environmental fluctuations and destructive events, either natural or human induced, and precludes whether or not an event is 'normal'. It is important to consider all sources as disturbances rarely act in isolation or independent of human activities. Disturbance regimes characterize the temporal and spatial pattern of a disturbance on a given landscape over time. The frequency, size, and severity of disturbance varies with disturbance agent and ecosystem[2].
- **Integrity** – Watershed integrity is the capacity of a landscape (that contributes surface water to a single location) to support and maintain the full range of ecological processes and functions essential to the long-term stability of biodiversity, watershed resources and services provided to society[3]. While this definition focuses on surface water, because of how a watershed is defined, the effects of groundwater in contributing to watershed integrity are acknowledged.
- **Resiliency** – The ability to plan for, withstand and recover from severe events, without suffering permanent loss of functions, devastating damage, diminished productivity or decreased quality

[1] United States Department of Agriculture (USDA) Forest Service. (1995). Disturbance Processes and Ecosystem Management. https://www.fs.fed.us/rm/pubs_journals/1994/rmrs_1994_averill_r002.pdf

[2] BC Ministry of Environment. (N.D.). Natural Disturbance. https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nrs-climate-change/applied-science/2c_va_disturbance-aug30-final.pdf

[3] Flotemersch, J. E., et al. (2015). A Watershed Integrity Definition and Assessment Approach to Support Strategic Management of Watersheds. River Research and Applications. 32(7), 1654–1671.

of life[4]. The objective is to increase or promote the natural ability of a watershed to reduce and mitigate the intensity, magnitude, duration and effects of disturbances through watershed mitigation measures, such as restoration of degraded areas[5]. Resilient watersheds are better able to response to and recover from extreme weather and disturbance events.

- **Restoration** – The process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed through active human intervention[6]. Restoration is bringing back to a former or original condition (i.e. pre-logging state), and often includes rehabilitation (returning to a state of health and useful activity by producing more favourable conditions to particular groups of organisms)[7].
- **Watershed Recovery** – Understanding the threatening conditions that push watershed ecosystems beyond their capacity to self-regulate, and through the implementation of strategic activities, focus on restoring the watershed to a condition that increases resiliency[8].

1.2 OBJECTIVES

The objectives of the Chilako River Watershed Recovery Strategy (the Chilako WRS) are to:

1. Carry out an **assessment of the area** impacted by cumulative disturbance;
2. Identify **key values** and evaluate their current **status**;
3. Recommend **watershed recovery strategies** on degraded or vulnerable ecosystems; and
4. Provide **direction for management planning** and future treatment activities.

It is anticipated that this project will contribute to the broader knowledge of strategic watershed level planning and recovery. To ensure a holistic approach to watershed recovery and support for SERNbc's mission to manage for multiple ecological services, a wide range of resource values were considered.

1.3 DISCLAIMER

There are several values and stakeholders that are not represented at this phase of the overall recovery strategy. This project represents an initial effort by the provincial government (FLNRORD) at developing a strategy to account for watershed, ecosystem, wildlife and aquatic life values or components of the overall watershed. The initial focus will be on the ecosystem and aquatic values within the purview of FLNRORD's management scope, and therefore is not inclusive of all stakeholders at this phase. It is understood that any actions and priorities recommended will be part of a larger sequence of events that considers additional values and stakeholders and demonstrates how they are integrated.

[4] Cornell Cooperative Extension, Cornell University. "Watershed Resiliency". Accessed September 24, 2019. http://ccecolumbiagreene.org/woods-water/watershed-resiliency

[5] Province of Alberta. "Watershed Resiliency and Restoration Program". Accessed September 24, 2019. https://www.alberta.ca/watershed-resiliency-and-restoration-program.aspx#toc-2

[6] Society for Ecological Restoration (SER) International Science and Policy Working Group. 2004a. The SER International Primer on Ecological Restoration. Society for Ecological Restoration International, Tucson, Arizona, USA.

[7] "Guidelines for Planning Watershed Restoration Projects" Technical Circular released by the Watershed Restoration Program, under Forest Renewal BC (MOF, 1995).

[8] Watershed recovery was defined in concert with the "Guidelines for Planning Watershed Restoration Projects" Technical Circular released by the Watershed Restoration Program, under Forest Renewal BC (MOF, 1995).

1.4 PLAN AREA

The Chilako River watershed is approximately 3,650 km^2, located southwest of Prince George, BC and upstream of the Chilako River's confluence with the Nechako River (Figure 1). The Chilako River's headwaters are near Finger-Tatuk Provincial Park, with its tributaries and influencing landbase extending from Prince George to the southwest towards Finger-Tatuk and Kluskoil Lake Provincial Parks. The watershed is within the Prince George and Stuart Nechako Natural Resource Districts (NRDs) with minor overlap in the Quesnel NRD.

This project focuses on the watershed's land base and includes Crown, agricultural, and private lands, as well as Dahl Lake, Bobtail Mountain, West Lake, and Finger-Tatuk Provincial Parks. The watershed has two dominant ecosystems, Sub-Boreal Spruce (SBS) dw2 and dw3, with lesser occurrence of SBS mw, SBS mc2, and Engelmann Spruce-Subalpine Fir (ESSF) mv1.[9,10] The dominant climate is dry and warm relative to other biogeoclimatic (BEC) subzones in the region, with predominately southern exposures and low elevations. Winter precipitation is low for the region, with an average total snowfall of 2.0 metres for the season[11].

Human land use in the watershed includes First Nations traditional use prior to European settler contact, agricultural development along the river's main stem and some of its tributaries, forest development throughout, and rural residential development near lakes and the Highway 16 corridor. Most recent major disturbance events include forest cover loss associated with the Mountain Pine Beetle epidemic (2005 to present) and subsequent salvage logging efforts, as well as periodic large forest fires (most recently the 2015 Little Bobtail wildfire that impacted 8,636 ha or 2.4% of the watershed).

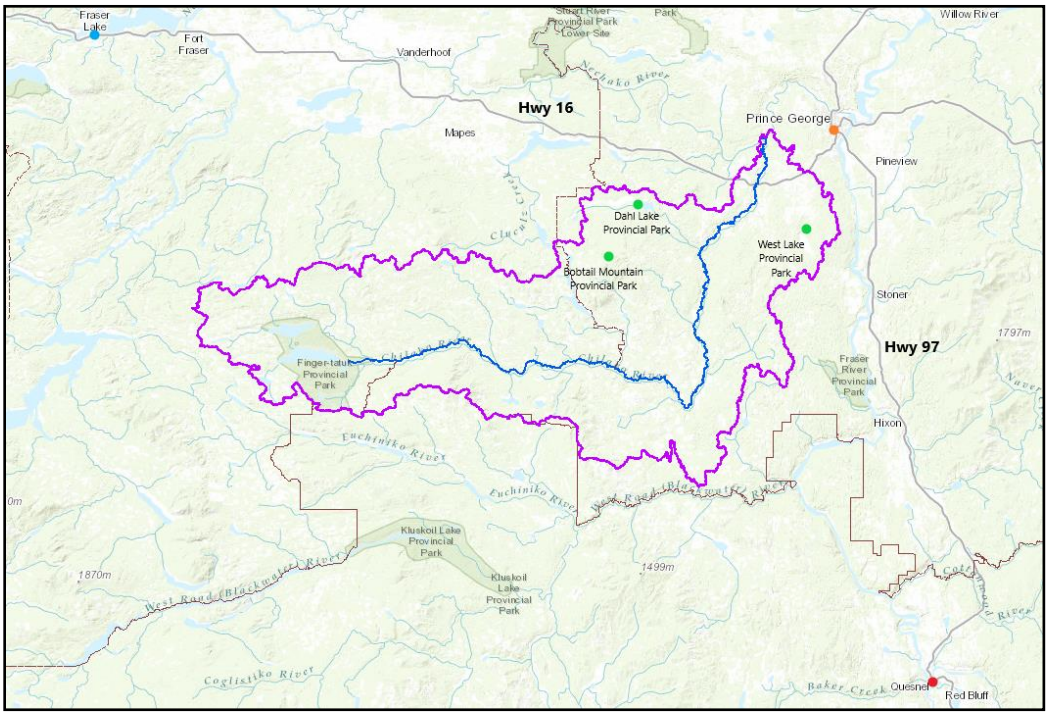

Figure 1: Location of the Chilako River (blue) watershed (purple) in relation to Prince George (orange), Quesnel (red), Fraser Lake (blue), and Provincial Parks (green).

[9] BEC units in BC: https://cfcg.forestry.ubc.ca/resources/cataloguing-in-situ-genetic-resources/about-bec-and-bgc-units/

[10] Land Management Handbook 2: https://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh24.pdf

[11] BEC Subzone Reports. https://www.for.gov.bc.ca/hre/becweb/Downloads/Downloads_SubzoneReports/SBSdw3.pdf

1.5 BACKGROUND

From the perspective of FLNRORD, the following discussion is intended to provide a rough background and timeline of the activities related to the Chilako River watershed since 2010 that formed the rationale for this recovery planning initiative. The dates provided below are approximate.

2010 – 2012

- Concerns from residents regarding forest harvesting led to a resident meeting with local MLA's at the Beaverly Fire Hall. Forest licensees where asked when they will have an overview watershed assessment and Equivalent Clearcut Area (ECA) calculations completed.
- Flooding concerns voiced by residents in the Punchaw River sub-basin that, in their opinion, was linked to extensive forest harvesting in the area.
- FLNRORD completed a site visit to the upper region of the Punchaw River sub-basin with a First Nations Fisheries Manager post-flooding to observe river conditions, habitat condition, and erosion levels. Key observations were of extensive areas of river banks absent of riparian vegetation and areas with eroding pasture into the river.
- Follow-up meeting at the Beaverly Fire Hall hosted by Fraser Basin Council where ECA calculations were presented to residents. Mike Miles and Associates Ltd. was retained by Nechako Environment and Water Stewardship Society (NEWSS) to compile information and assessments completed to date, review five (5) sites along the river's main stem, and complete a historic air-photo compilation.[12] General messages from this review were:
  - Harvested area exceeded any recommendation in the literature for the conservation of aquatic values; and
  - Independent of forest harvesting, areas where riparian loss has occurred appear to be a dominant driver in lateral instability of the main stem of the river.

2013 – 2014

- Various field trips to reaches of the Chilako River along Upper and Lower Mud River roads. Toured past Environmental Farm Plan funded initiatives to rehabilitate riparian areas where lateral channel instability was threatening bridge infrastructure on farms; considered natural sediment sources relative to anthropogenic sources (i.e. eroding pasture land).

2015 – 2017

- Several restoration demonstration projects led collaboratively by NEWSS, Upper Fraser Fisheries Conservation Alliance, private land owners, Fisheries and Oceans Canada, and SERNbc. Biological engineering approaches were implemented to reduce lateral instability of the channel in key locations, learn how to promote rapid development of riparian vegetation, and foster the development of improved fish habitat.
- Partnerships between FLNRORD and the University of Northern BC as well as the College of New Caledonia to monitor the results of ecological restoration efforts and capture a broad array of learnings about the ecology of the Chilako aquatic ecosystem.
- The FLNRORD's Forest and Range Evaluation Program (FREP) Routine Effectiveness Evaluation suggested the lower reaches of the Chilako River are "not in functioning condition".

[12] M. Miles, M.Sc., P.Geo. & S. Allegretto, B.Sc. (2019). Chilako River Data Report - Compilation of Historical Air photos (Tech.).

2018 – PRESENT

- Local MLA's, government (FLNRORD, Regional Districts, Fisheries and Oceans Canada), First Nations representatives, and various NGO stakeholders agreed that a recovery strategy should be developed focusing on the key values that appear to be currently at risk or compromised in the Chilako River watershed.
    - Key values: eroding pastures, infrastructure, remnant Chinook salmon populations, ECA levels above what would be considered "conservative" of aquatic resources, and the functioning condition of the watershed as a whole.
- This Chilako River Watershed Recovery Strategy project was initiated in the spring of 2019.

2 Approach

This project was designed as an open and flexible approach to restoration planning looking to combine a general understanding of the impacted landscape with input from consulting specialists, government specialists, and local stakeholders. The project was implemented as a "pilot" that reflects an innovative, collaborative and integrated approach to watershed recovery that goes beyond site specific treatments of disturbance to consider the resiliency of the watershed as a whole.

The following approach was used in the development of the Chilako WRS:

- Consultation with known subject matter experts (SMEs) who have personal experience in the watershed; ask them to express opinions and speak on behalf of the value they are representing/being consulted on.
- Learn where independent perspectives align and where they do not, and understand the rationale for where perspectives did not align.
- Identify if and where values represented by the SMEs are or are not compromised by land use practices, and understand if values are at risk in the short or long term.
- Consider opportunities for restoration and identify where barriers, including knowledge gaps, exist to the recovery of compromised values.

To complete this, the following steps were taken:

1) **Initial Consultation** – Initial engagement with SMEs to identify information needs (i.e. statistics, maps) required for them to form an up-to-date opinion on the risk to values in the watershed. A temporary web-map tool was used to facilitate communication and information sharing with SMEs to solicit their knowledge, experience and feedback into the process.
2) **SME Interviews** – A structured interview was carried out with each SME. Results from these conversations were used to support development of the "Current State of Values" summary, as well as support the structure of the workshop and development of recovery strategies.
3) **Workshop** – A workshop was used to engage with the SME group, where the ideas and recovery opportunities expressed in Step 2 were explored further in a collaborative environment. Outcomes from the workshop formed the direction for the Chilako WRS.
4) **Reporting** – A strategy report was developed that documented the historical context and key values, SME and workshop discussions, and identified key strategies for recovery.

3 Current State of Values

The values present in the watershed, such as agriculture, forestry, and wildlife, are numerous and variable in relation to the level and severity of disturbances. In an effort to create meaningful discussion and practical strategies for recovery, values have been grouped into four broad categories: (1) hydrology and watershed management, (2) fish and aquatic habitat, (3) landscape ecology, and (4) wildlife biology. The following summary represents the result of the SME interview and workshop input, where specialists provided their assessment of the current state of the watershed value they represented.

3.1 HYDROLOGY AND WATERSHED MANAGEMENT

Overall, riparian health is a key issue for all watersheds as the riparian area is considered the heart of a watershed, thus a "sick" or not fully functioning riparian area would mean a "sick" or not fully functioning watershed. The health of the riparian area is complex and intertwined with many watershed processes, such as streamflow regime (floods and low flows), adjacent forest cover disturbances, road crossing constructions and maintenance, and management of unstable terrain. This complexity means that it is essential to consider each process and how they interact when considering watershed health and how certain levels of disturbance may impact the landscape integrity of watershed health.

The cumulative effects of land use decisions and management practices in the watershed for cattle grazing, forage production, timber harvesting, and roads over time have contributed to the removal of vegetation, bank destabilization, and sediment loading along the river. Helicopter surveys indicate that active sediment movement, channel migration, and erosion are present and may constrain recovery efforts. In terms of level of disturbance, the watershed can be categorized by the upper and lower reaches (Figure 2). While there are no strict boundaries for where these are delineated[13], the upper reaches start at the headwaters of the Chilako River and the lower reaches end where the Chilako River flows into the Nechako River. The delineation of where the upper reaches transition to the lower reaches is depicted in Figure 2; this was defined in collaboration with the SMEs as this delineation is not formally designated. The lower reaches are considered the most heavily impacted as noted in the FREP evaluation as "non-functioning" condition, and continued riparian disturbances through logging of riparian areas and agricultural activities, such as cattle grazing, play a key role in impacting watershed function. The upper reaches of the watershed have less observable impacts to the stream channel and are generally in better condition.

Areas where road construction has altered the river channel by straightening or narrowing the channel has also altered natural flow patterns and resulted in further degradation of the channel, overall channel stability, and associated riparian ecosystems. Depending on road and stream crossing quality, function, and density, increased sedimentation and sediment loading within streams is a concern. In addition, timber harvesting has caused significant forest cover changes that have influenced the peak and low flow hazards as well as overall watershed function.

Experts anticipate that summer low flow levels may become more problematic over time, particularly with second growth stands and increased growth and transpiration of adjacent reforested clearcuts and increased delivery of sediment to the stream channels, possibly causing infilling of the channel. Extensive forage and grazing can have the same impact as riparian vegetation and forest cover removal. This type of disturbance within a riparian zone can also render the riparian ecosystems incapable of withstanding variable peak flows. Issues with forest and land management practices persist in the watershed and there are significant concerns with the coordination of forest and land management activities across the

[13] Rivers: https://www.explainthatstuff.com/rivers.html

watershed over time. Where one land use activity may have regulations regarding disturbance in riparian ecosystems, another may not, and the cumulative impact of all activities are not considered before new disturbances take place.

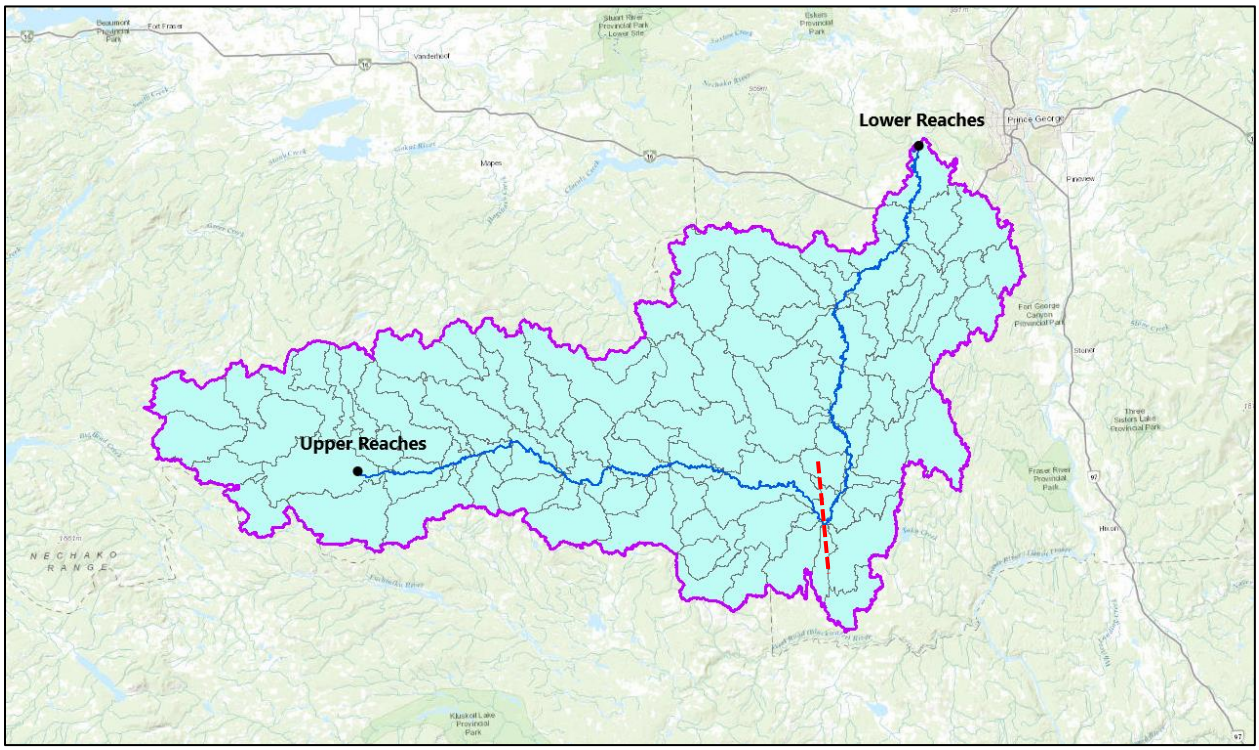

Figure 2: The Chilako River watershed delineated into sub-basins (blue) as well as the upper and lower reaches (separated by the dotted red line).

In general, there has been a limited understanding of aquatic health, invertebrates, and water quality and quantity monitoring due to reduced prioritization of these assessments by governing agencies. As a result, there are significant information gaps and a lack of baseline data needed to indicate historic conditions of the watershed. Variable or non-existent riparian disturbance limits, lack of government guidance, and the lack of requirements and consistency amongst requirements are the key contributors to the current state of the watershed. As a result, SMEs suggest, although more information and data collection are required to form a conclusive interpretation, that current disturbances in the watershed have surpassed hazard levels that are generally considered reasonable to maintain a tolerable risk level to aquatic values.

3.2 FISH AND AQUATIC HABITAT

The Chilako River watershed is home to important and distinct fish populations in central British Columbia. Experts speculate that Chinook salmon populations in the watershed may be genetically distinct due to their behaviour and life history when compared to other Chinook salmon populations in the province. Assessments completed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) have shown diminished fish populations and low annual escapement rates. Chinook in this watershed are part of the Upper Fraser stock, and the entire Chinook stock has been designated as “endangered”. In addition, First Nations are responding to the locally observed reduction of fish populations by not exercising fishing rights in the watershed to avoid further pressure on annual escapement rates.

Just as disturbance levels vary between the upper and lower reaches of the watershed, so do the impacts on fish and aquatic habitat values. Fish habitat in the lower reaches has been diminished in the river’s

main stem and it is anticipated that populations in the lower portions of its tributaries are also impacted. Experts suggest that the integrity of aquatic habitat is likely better in the upper reaches of the watershed, although more information is required to confirm this. Aerial photo interpretation shows that riffle pools historically present in the middle of the watershed have shifted and now occur in the upper reaches. Concurrently, the majority of spawning has also shifted and takes place in the upper reaches of the watershed as well. SMEs indicated that it is necessary for adult populations to stabilize and increase before implementation of broader recovery strategies, such as in stream habitat work, can be effective.

Significant information gaps exist and there is a lack of baseline data needed to indicate historical fish populations and aquatic habitat quality (discussed in greater detail in Section 3.6). Heavy riparian disturbances, a lack of landscape level disturbance thresholds, and a lack of government guidance and structured monitoring for cumulative impacts are the key contributors to the current state of fish populations and aquatic habitat in the Chilako River and its tributaries.

3.3 LANDSCAPE ECOLOGY

Historically, the Chilako River watershed contained a variety of stand compositions and ages as a result of naturally occurring wildfires. The majority of the watershed (95%) is within the Natural Disturbance Type 3 (NDT3) characterized as forest ecosystems that historically experienced frequent stand-initiating wildfires with a mean fire return interval of 125 years[14], which resulted in a mosaic of even-aged regenerating stands that ranged in size and contained patches of unburned mature forest. The remaining portion of the watershed (5%) is within NDT2 (in the ESSFmv1 BEC subzone) characterized as forest ecosystems that historically experienced infrequent stand-initiating events with a mean fire return interval of 200 years. However, as a result of forest and land management, approximately 17% of the current watershed landbase contains forests 140 years and older (VRI, 2019). The current age class distribution across the watershed is provided in Table 1 and shown in Figure 3.

These historically unmanaged forests had very different characteristics compared to managed forests, such as increased structural complexity, more and larger snags, and more intact and well distributed coarse woody debris. Currently, the presence of large tracks of contiguous unmanaged forest, including some larger patches of old growth forests (120 years and older[15]) in the watershed, have been greatly reduced as a result of timber harvesting, clearing for agricultural land use, wildfires, and forest health issues such as Mountain Pine Beetle (Figure 3). These disturbances in the watershed have left a significant portion of the natural origin forested land fragmented which has greatly altered the landscape ecology. It is important to maintain natural forested areas within the mosaic of forest types as many of these areas contain secondary structure and other stand attributes not present (or not to the same influence on ecological processes) in managed forests, making them valuable ecosystems within the broader system that can also assist in mitigating fragmentation and losses in connectivity.

[14] Biodiversity Guidebook, 1995. https://www.for.gov.bc.ca/hfd/library/documents/bib19715.pdf

[15] Order Establishing Landscape Biodiversity Objectives for the Prince George Timber Supply Area, October 20, 2004. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/omineca-region/princegeorge-biodiversity-order/biodiversity_order.pdf

Table 1: Current age class distribution across the Chilako River watershed.

Age Class	Years	Total Area (ha)	Age Class	Years	Total Area (ha)
0	0 / no age	31,541	**5**	81 – 100	41,116
1	1 – 20	82,671	**6**	101 – 120	26,102
2	21 – 40	55,608	**7**	121 – 140	40,392
3	41 – 60	15,502	**8**	141 – 250	60,569
4	61 – 80	9,902	**9**	> 250	72

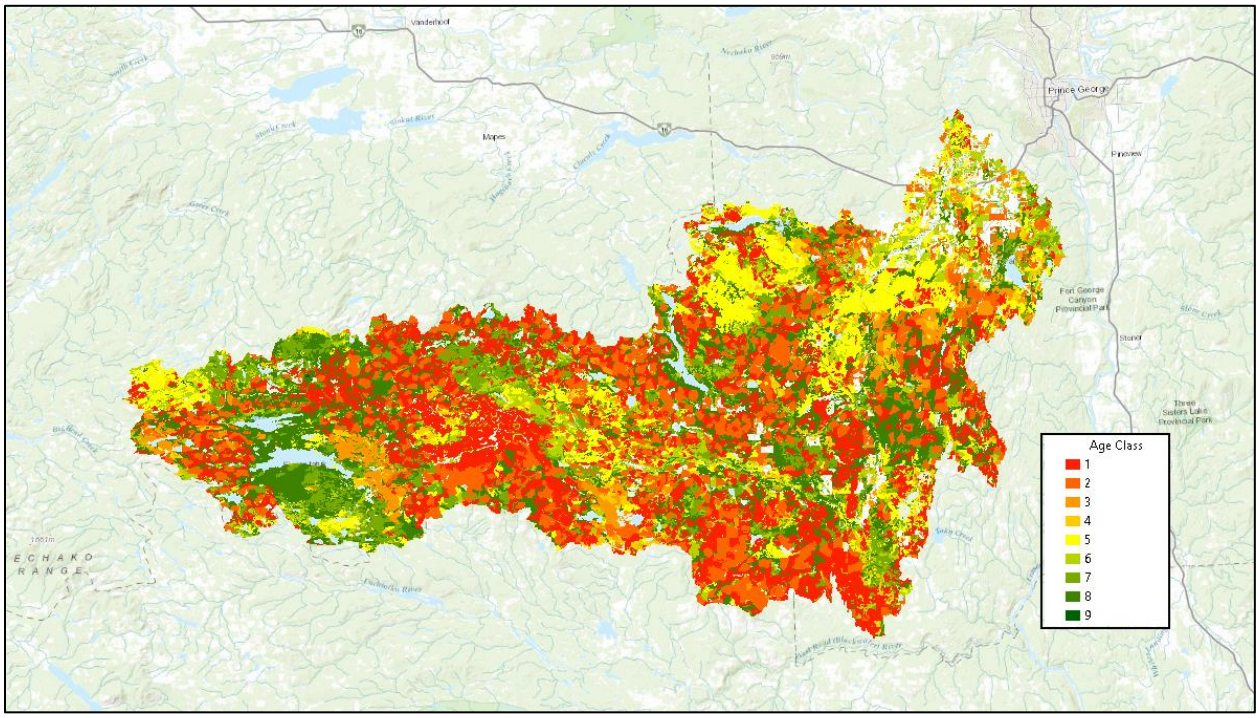

Figure 3: Current age class distribution across the Chilako River watershed.

One indicator for the level of landbase disturbance is through the determination of equivalent clear-cut area (ECA). ECA is defined as the area that has been deforested within a watershed and includes a reduction factor to account for the hydrological recovery due to forest regeneration and subsequent growth[16]. ECA can be an effective indicator of the level of forest cover loss and how it may effect streamflow, but it does not inherently assess the impacts of those disturbances as positive or negative, or indicate overall watershed health. In addition, ECA calculations fail to directly address other important watershed health issues such as erosion, slope instability, and sediment production and transport. As a result, ECA does not equate to overall health of the watershed, rather ECA values in combination with known disturbance factors, such as agriculture land use and riparian deforestation, contribute to the

[16] https://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/iwap/iwapp8.htm

conclusion that riparian function has been compromised as a result of landscape level disturbances on the watershed's land base.

Overall riparian health may be impacted by deforestation depending on where the disturbance is located, how much disturbance has occurred, how the disturbance took place, and resulting silviculture activities (if any). Poorly planned and implemented deforestation near riparian areas could have a direct negative impacts on the riparian ecosystem. While more study is needed, the initial impression of several SMEs is that the high ECA in the watershed (Figure 4) combined with known levels of riparian disturbance on private land in the lower reaches (primarily due to agriculture) have negatively impacted overall function of aquatic and floodplain ecosystems, particularly with regards to watershed resiliency.

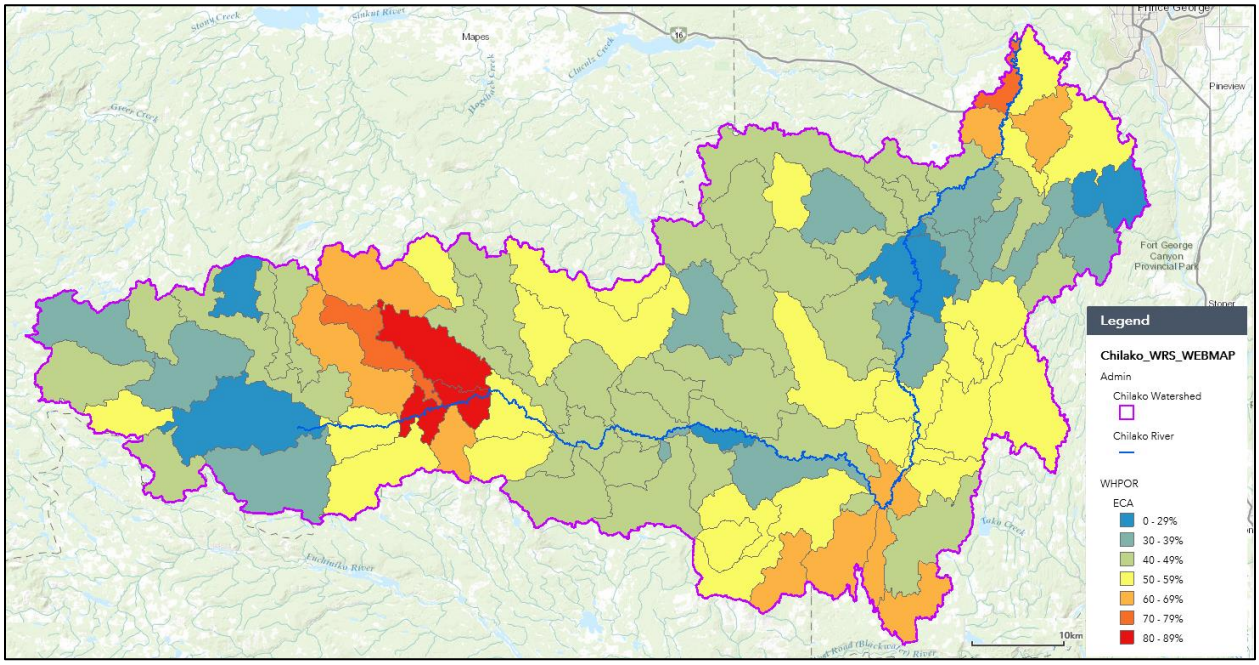

Figure 4: Equivalent Clear-cut Areas (ECA) in the Chilako River watershed as calculated by the Watershed Health Tool Omineca Region (WHPOR).

In addition to forest fragmentation, overall landscape level ecology is impacted by changes in both subterranean and surface level hydrology and irrigation along the Chilako River's route. Aerial photo interpretation comparing historical images to present day conditions show changes in wetland ecosystems associated with features such as oxbows and low gradient meanders, increased sedimentation, and erosion in the lower reaches of the watershed (Figure 5). Examples of blue-listed ecosystems (provincially recognized species or ecosystems at risk) affected by changes in subsurface flow are the FL05 Drummond's Willow-Bluejoint flood community, and the Fm02 Cottonwood-Spruce-Red Osier Dogwood mid bench ecosystem which is important to wildlife for browse and berry forage.

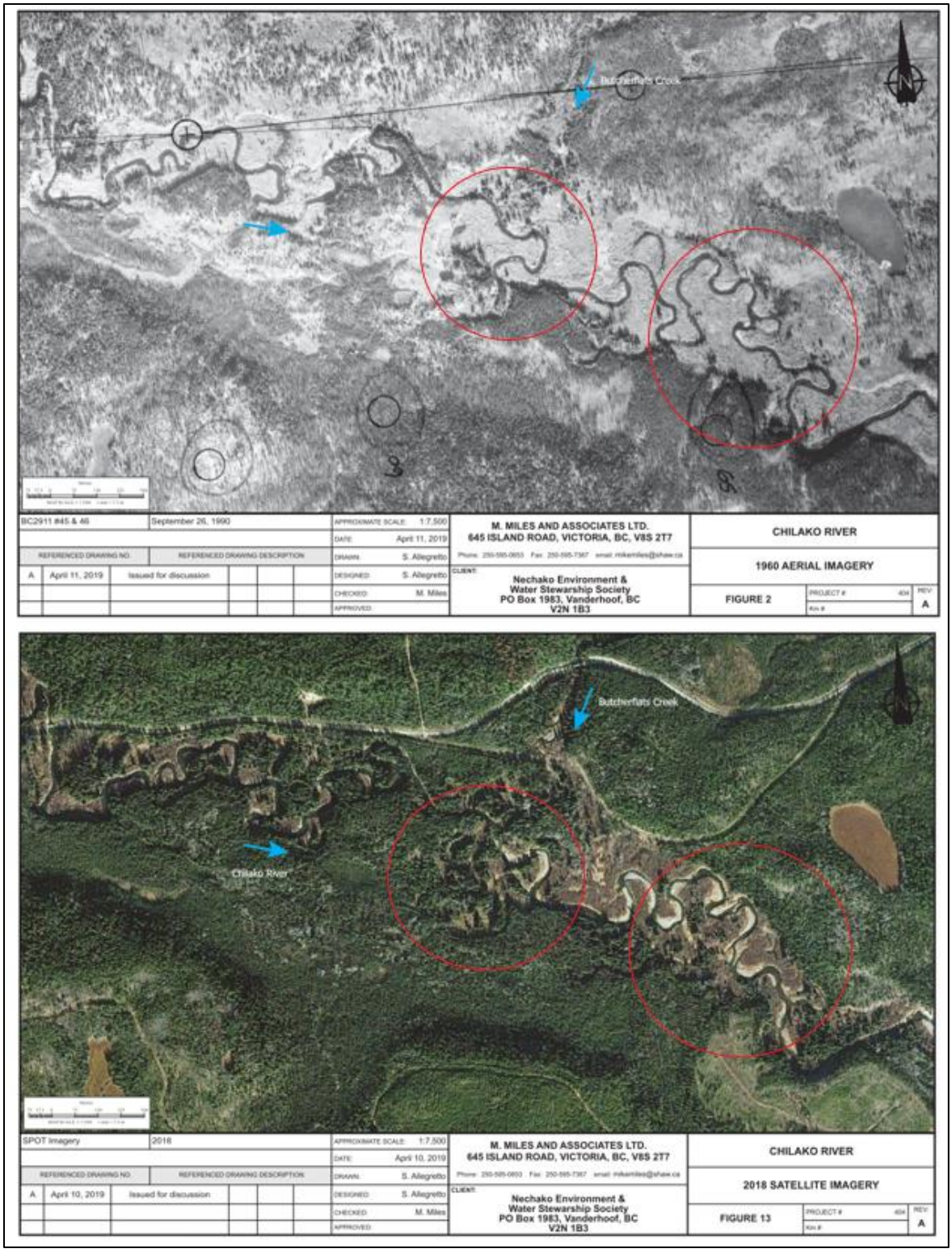

Figure 5: Aerial photo comparison of the Chilako River where Butcherflats Creek meets the river from 1960 (top) and 2018 (bottom). Blue arrows indicate direction of water flow and red circles indicate areas of most significant riparian channel changes such as sedimentation, stream channel changes, increased presence of wetland areas, and stream bank erosion.

Disturbances like cattle grazing and water use have altered growing conditions for plant communities, contributed to increased turbidity in the water and stream bank destabilization, as well as impacted habitat and food availability for wildlife. Many threatened plant communities are important to wildlife for browse and berry forage, and soil stabilization in riparian areas (i.e. Fm02 Cottonwood-Spruce-Red Osier Dogwood mid bench ecosystem). Forest harvesting has led to a large decrease in the amount of large live trees, snags, and dead wood across the landscape. Since these provide habitat, cover, foraging and nesting sites for a large variety of wildlife, SMEs suggest there has been some impact even though data is sparse on the exact number and distribution required to support healthy populations. Control of undesirable vegetation (i.e. willow, trembling aspen) through herbicide or manual treatments has also altered habitat distribution across the landscape and has negatively impacted some wildlife species that rely on these as forage (i.e. moose) or for nesting locations (i.e. bats).

The provincial parks in the watershed play an important role in maintaining contiguous forests. West Lake, Dahl Lake, Bobtail Mountain, and Finger-Tatuk Provincial Parks are present within the watershed. The most influential park in terms of old growth contiguous forest is Finger-Tatuk Provincial Park because it contains the largest track of remaining contiguous old growth forest and un-salvaged burns in the watershed. This park is also the location of the headwaters of the Chilako River and provides valuable habitat for wildlife requiring old forest or young natural forests containing large live trees, snags, and woody debris.

Ungulate Winter Ranges (UWRs) for mule deer have been established in the watershed to support conservation of valuable habitat important for winter ungulate survival. The intent of these designated areas is to maintain winter range by providing high suitability snow interception cover and foraging opportunities at landscape and stand-levels; this is achieved by implementing specific management objectives within these areas. The Chilako River watershed contains 22 established UWRs (u-7-011 and u-7-013) totaling 2,494 ha (or 0.7% of the watershed landbase) where harvesting is conditional to habitat quality present in those areas (Figure 6). The presence of UWRs in the watershed overall has influenced the continuity of forest cover as well as age classes, tree species, and forest stand structure within those areas.

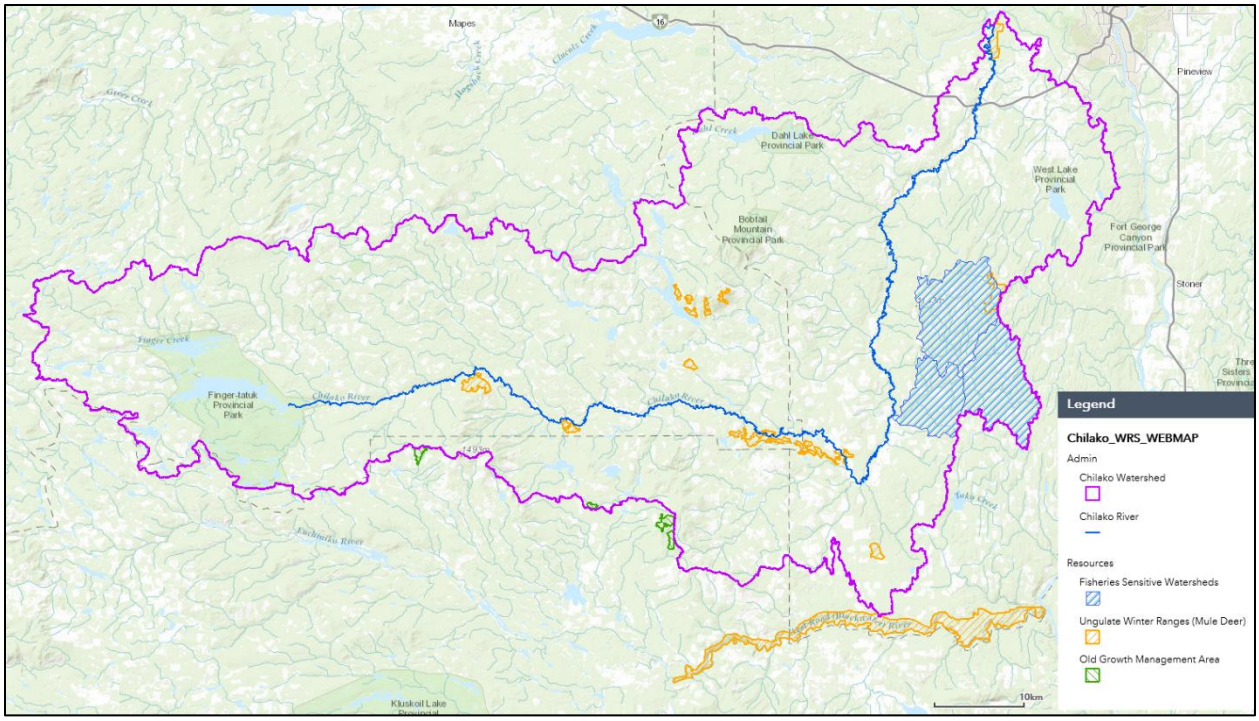

Figure 6: Established Ungulate Winter Ranges, Old Growth Management Areas, and Fisheries Sensitive Watersheds in the Chilako River watershed.

Fisheries Sensitive Watershed (FSW) designations are targeted at watersheds that have significant fisheries values and watershed sensitivity[17], and are generally used to limit disturbance and improve watershed management practices within these sensitive drainages. There is one (1) FSW in the Chilako River watershed, Chehischic Creek, which is further delineated into three (3) sub-basins (Lower, North and East) to provide detailed management direction specific to each sub-basin (Figure 6). This area has significant historic disturbance with an ECA between 50-59%.[18] The intent of the FSWs is in part to mitigate further disturbance to the sub-basins, help prevent degradation of the system, and support the recovery of fisheries values. Due to the high level of disturbance in riparian areas within the watershed, it could take several decades to measure improvements in riparian and stream channel conditions resulting from the establishment of FSWs.

Old Growth Management Areas (OGMAs) are legally designated areas of old growth forest that are established during landscape level planning processes for old growth forest retention as well as to achieve biodiversity objectives for a given area. To reflect the dynamic and changing nature of old growth forests, rotational OGMAs are utilized so they can be moved around the landscape as forest conditions change or succession occurs naturally over time. Within the Chilako River watershed, there is currently 46 ha reserved as rotational OGMAs, with an additional 418 ha of OGMA adjacent to the watershed boundary to the south.

Currently, provincial parks, UWRs, FSWs, and OGMAs within the Chilako River watershed help alleviate anthropogenic disturbance impacts across 42,671 ha (or 12%) of the watershed's land base. The level of direct disturbance to the riparian areas in unprotected portions of the watershed (primarily the lower reaches) are difficult to mitigate due to the amount of private land. Limited regulatory oversight of

[17] http://www.env.gov.bc.ca/wld/frpa/fsw/index.html

[18] As identified in the Watershed Health Project Omineca Region (MFLNRORD, 2018).

disturbances on private land for agricultural purposes coupled with regulated disturbance on Crown land have impacted the overall integrity of the channel and riparian system along the main stem of the Chilako River. There are also some relatively large contiguous areas of 80 to 120 year old forest throughout the watershed that provides an excellent opportunity for potential replacement old forest if the existing old forest is damaged by fire or pests (Figure 7). For this reason, some of the remaining larger contiguous areas should be protected from harvest while allowing harvesting to take place in scattered, smaller fragmented old forests, especially as these are impacted by blowdown and pest outbreaks. Increasing the designation of UWRs, OGMAs, FSWs, and provincial parks can also be tools to plan for and maintain these larger tracks of contiguous old and aging forests across the watershed.

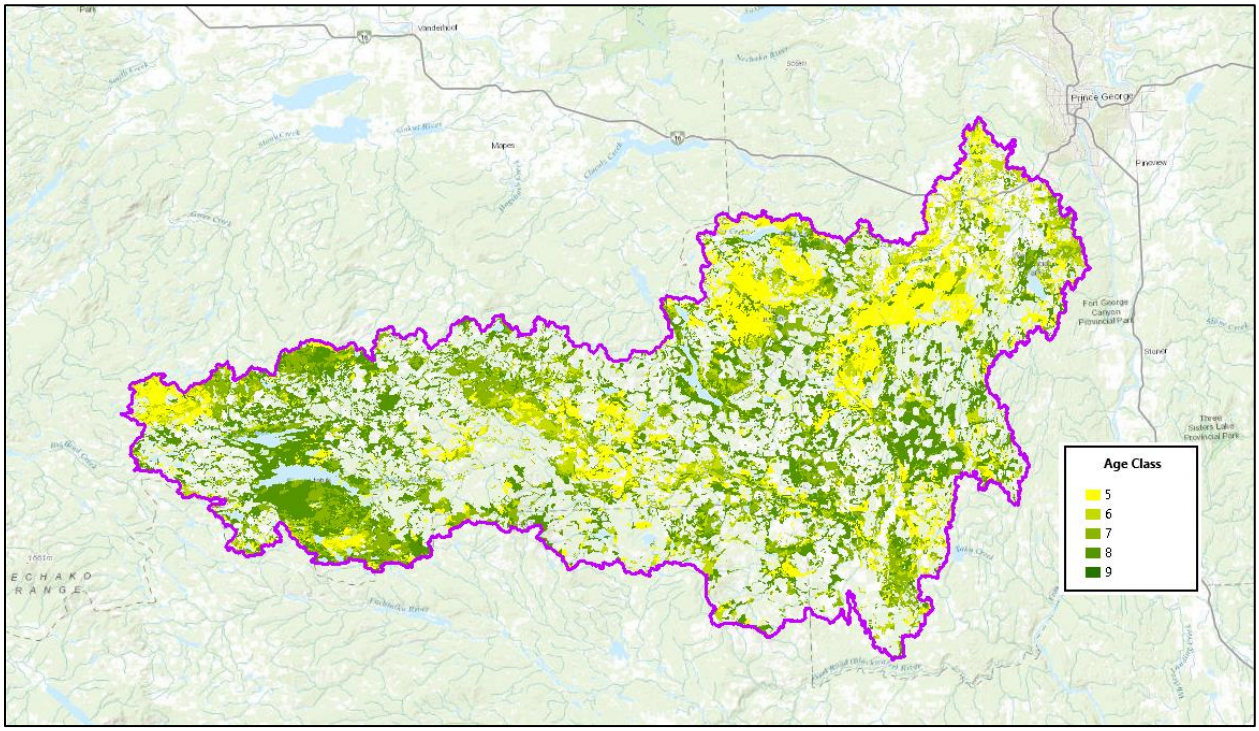

Figure 7: Age classes 5-9 (> 80 years old) in the Chilako River watershed indicating where large contiguous old forests and scattered fragmented old forest are present in the watershed.

3.4 WILDLIFE AND WILDLIFE HABITAT

The dominant land use impacts effecting wildlife in the watershed are forestry (including roads and silviculture) and agriculture. Agriculture is essentially a permanent change; any old growth forest removed for agriculture is lost forever. However, the effects of agricultural activities on riparian vegetation are reversible. Forestry affects the landscape by reducing the amount of old growth forests and creating more early seral conditions, in larger more regular patches with less edge, than would be present under a natural disturbance regime. As cutblocks age and conditions change they eventually have the potential to become old growth forests again. Forestry also creates roads which may or may not persist through time.

Different forest ages provide different features for wildlife needs. Some wildlife will benefit (i.e. have higher density and broader occupancy) from early seral conditions (e.g. moose, mule deer, white-tailed deer, elk, lynx, snowshoe hare, cougar, wolf, fox, coyote, black bear, grizzly bear, ruffled grouse), while the opposite is true for species that do better in landscapes with more old growth (e.g. marten wolverine, red squirrels, fisher, ermine, spruce grouse, cavity nesting birds). Large harvested areas, as are common

in the watershed, may not provide as much early seral benefits to wildlife as smaller cutblocks that have more edge effects. Wildlife that do better in intact riparian ecosystems include beaver, muskrat, otter, mink and many songbirds, and therefore will benefit from management activities that increase and/or restore riparian conditions. With respect to the projects overall objective to promote resiliency, the likelihood that regenerating cutblocks will follow a natural successional path to old forest conditions will be dependent on biodiversity at multiple scales (i.e. by retaining old growth forests and ensuring silvicultural activities plant tree species mixtures rather than monocultures).

Large mammal diversity in the watershed is higher than most other areas in the Omineca Region, however Regional Biologists suggest that wildlife no longer have the habitat characteristics they require to survive in the long-term. Grizzly bears in the watershed rely on resources present in the provincial parks, such as the kokanee salmon present in Finger-Tatuk Provincial Park, during the fall season however they require regular forage on the landscape for their entire active season including when they are actively fishing. As with other large mammals, management of grizzly bears generally occurs at a larger scale than a watershed (i.e. Omineca Region), however they are important to consider in developing watershed recovery strategies despite this variance in scale because they are utilizing the land base and vegetation throughout the season.

Prior to 2005, moose populations around Prince George were high and fairly stable, however recent data has shown a continuous decline (approximately 70%) since then to densities similar to moose populations elsewhere in the province. The cause of this decline are unknown but are likely the same in the Chilako as elsewhere in the surrounding areas. One potential cause is poor nutrition as a result of lower quality of food plants that grow in very large cutblocks (as identified through a provincial moose research project[19]). In general, cow moose survival is better in landscapes with a higher prevalence of young cutblocks (less than 25 years). Impacts to moose populations may be influenced by changes occurring to other species in the region. Biologists have noted more deer and elk than in past decades, although at lower population sizes compared to moose, which may be contributing to declining moose populations (i.e. influencing predator-prey dynamics) however this has not been confirmed. At the watershed scale, moose movements are generally neither constrained nor enhanced by landscape features such as wildlife corridors or forest fragmentation, however collared moose studies are showing consistent annual travel routes that may be influenced by fragmentation. Work with moose, ungulates and their predators (i.e. wolves) in the region are ongoing and will support recovery strategies as new information and data becomes available.

The impact of disturbance on small mammals and birds in riparian areas will vary since these species are heavily site specific. Although more information is required, SMEs suggest that populations of smaller mammals appear to be in decline as a result of land use pressures across the watershed. For example, SMEs suggested lynx population densities are lower than anticipated compared to other areas north of Prince George, likely due to increased access (roads) resulting in increased pressures associated with hunting and trapping, as well as an altered forest cover and a lack of remaining old forests.

Beavers are generally common in riparian areas and have contrasting effects on ecosystems. In small systems they can regulate water flow with dams that reduce flooding, regulate erosion potential and can prevent fish passage. However, where they are abundant beavers can drastically reduce the amount of riparian vegetation through consumption and dam building. Bank beavers, those that don't build dams but burrow into streambanks, contribute significantly to instream woody debris and organic carbon. Although more information is needed, SMEs believe that beaver populations are decreasing in the

[19] Werner, Jeffery & Parker, Kathrine. (2019). Where should a hungry moose eat? Habitat-specific protein limitation in managed landscapes. 10.13140/RG.2.2.22099.02084.

watershed and their lack of dams inside stream channels is changing organic content, stream flow, and the overall ability for beavers to moderate the system.

When considering watershed recovery strategies that manage disturbance impacts on wildlife, the reality that different attributes of the landscape are occupied by different species at different times and regional scales needs to be considered. Experts suggest that small mammals and birds can be managed within watershed spatial scales. In contrast, large mammals need to be managed within the Chilako watershed as well as at a larger scale (i.e. the Wildlife Management Zones) because the watershed itself and the wildlife habitat and food resource contained within it are part of a larger system. SMEs suggested that identifying and implementing limits or thresholds to forest cover disturbances would be beneficial for all wildlife in the watershed.

3.5 SUMMARY OF KEY CONDITIONS

Throughout the information gathering phase and engagement with SMEs several key challenges and issues were raised that influenced priorities and direction for recovery:

- The extent of existing and continued riparian disturbances – the **removal of riparian vegetation** has resulted in bank destabilization, eroding pastures, sediment loading, alteration of stream channels, and reduced ability to withstand variable peak flows and low flow hazards.
- High levels of **forest cover disturbances** (i.e. forest health, forest harvesting including salvage, agriculture, roads) beyond what is generally considered acceptable for the conservation of aquatic resources, resulting in a high watershed level hazard and surpassing what may be considered a "tolerable" risk.[20] This includes the lack of large, unfragmented forested stands, including older age classes, due to harvesting, salvage and insufficient stand level retention.
- **Limited understanding or data** available for some values (i.e. aquatic health, fish populations), as well as a lack of ongoing monitoring programs to track individual values, interactions between values, and success of treatment activities.
- A **lack of overall direction** (a cohesive plan) and limited regulatory oversight when addressing cumulative impacts.
- The **functioning condition of the watershed** as a whole.

Overall, it was agreed upon that the Chilako watershed has been significantly impacted by cumulative disturbance events, land use decisions and management practices.

3.6 INFORMATION GAPS

Changing government objectives and the reduced prioritization of data collection and resource monitoring in the watershed has led to significant information gaps required for effective recovery planning. Information about current and historical watershed conditions is important for establishing a baseline perspective about the impacts of disturbances in order to identify key areas and strategies for recovery. More information is needed to facilitate monitoring and assessment of the success of recovery strategies and treatments implemented in the watershed.

Key information gaps identified by SMEs include:

[20] Although "tolerable" is not defined by any government agency or stakeholder, this highlights the importance and need for defining this term to provide clarity for future management.

Hydrology and Watershed Management

- Water quality metrics, such as groundwater influences, stream temperature conditions, turbidity, and sediment loading.
- Aerial surveys need to include the entire watershed, not just the lower reaches.
- Sensitivity analysis at the sub-basin level to determine risk levels to aquatic values caused by cumulative effects of impacts.
- Hydrological modelling (or assessments) to understand the influence of watershed disturbances on peak flows and the effect of range use and related impacts on sediment production.
- Influences of climate change on current and future conditions of the watershed as it pertains to landscape ecology, aquatic health, and wildlife.

Fish and Aquatic Habitat

- Monitoring of fish populations, number of species present, and overall quality of fish habitat is needed to gain a better understanding of aquatic health.
- Analysis of genetics and spatial distribution of Chinook salmon in the watershed.
- A better understanding of the life history of fish species in the watershed (i.e. migration timing).
- Clarity around the importance of water quantity vs. quality as they pertain to impacts to fish within the Chilako system.

Landscape Ecology

- Ongoing support for dynamics of transpiration and evaporation at different forest stand ages, and its influence on discharge rates (discrepancy between precipitation and discharge) expanded to include this watershed.
- Confirm the significance and potential impact of roads across the watershed on erosion and sediment transport, wildlife, and other values, and confirm key sediment sources across the watershed, including locations of erodible soils.
- Perspective on downstream impacts of disturbances to assess current capability of the riparian systems to self-regulate, including measuring existing conditions and identifying data trends.

Wildlife Biology

- Current status, trends and habitat needs of small mammals, such as furbearers, and bird species within the watershed.

4 Watershed Recovery Strategies

The systems-based approach focusing on the overall resilience of the watershed was identified as the key direction for watershed recovery in the Chilako River watershed.

Within this context, a series of strategies were developed to improve watershed resiliency with the goal of the watershed becoming more capable of handling disturbances (both natural and anthropogenic) and, as a result, values are recovered and/or protected and overall conditions in the watershed improve over time. With this understanding, the following strategies were identified to support recovery in the watershed (Table 2). Further detail regarding each strategy is provided in the subsections below.

Table 2: Summary of recommended recovery strategies for the Chilako River watershed.

<table>
<tr><th colspan="5">Recovery Strategy</th></tr>
<tr><td rowspan="2">Short-term
↕
Long-term</td><td>Strategy 1 – Management Zonation</td><td>Strategy 2 – Basin Specific Guidance</td><td>Strategy 3 – Watershed Stewardship Group / Officer
Strategy 4 – First Nations and Stakeholders
Strategy 5 – Private Landowners
Strategy 6 – Secure Buy-in and Funding</td><td rowspan="2">Strategy 7 – Information Gaps</td></tr>
<tr><td colspan="3">Strategy 8 – Watershed Management Plan</td></tr>
</table>

These watershed recovery strategies are intended to be flexible in their implementation to allow for maximum efficiency with time and available funding. They are listed in an ideal order of implementation, with many of the strategies ideally completed before or contingent on others. For example, establishment of management zones will need to be integrated with basin specific guidance for future management. Simultaneously, the watershed stewardship officer or group could be established who would then be responsible for implementing the engagement and collaboration strategies, allowing for one focused point of contact. All strategies can occur in conjunction with the efforts to resolve information and data gaps. Although the development of the Watershed Management Plan would ideally be supported by previously completed strategies (as outlined in Table 2), it could be used in concert with many of the strategies to support recovery.

The key to focusing recovery treatments and efforts is the establishment of management zones *(Strategy 1*) across the watershed that will then guide subsequent communications, priorities and actions. In addition, there is a need for basin specific guidance (*Strategy 2*) on management, restoration and conservation efforts, including but not limited to limitations on forest cover loss (temporary and permanent). These strategies provide for spatial designations to focus efforts and allow for broader decisions to be made regarding harvesting practices, reforestation, and the implementation of other recovery activities. Watershed zonation will also give guidance for engagement with private land owners and stakeholders to provide focus for priority zones (i.e. prioritized based on benefit of treatments supporting overall watershed recovery, such as the ability to positively influence recovery efforts).

The initial scope of the project was to identify processes to prioritize recovery strategies for operational implementation, such as spatially identifying areas for on-the-ground efforts, further studies or analysis, and where policy remedies may need consideration. The process, however, focused on overall strategic direction that was not currently in place, in order to guide future planning around site-specific recommendations. Given this, operational direction and priorities for site level activities did not result from this project.

The strategies provide specific steps to be taken in order to further recovery in the watershed. Cost estimates and potential collaborators have been provided to support securing of additional funding and general buy-in for the process.

- **RESPONSIBILITY**: the Watershed Management Group / Watershed Stewardship Officer could lead the process and implement all recommended strategies.

- **COLLABORATORS**: SERNbc and FLNRORD for all strategies, forest licensees (tenure holders) to implement *Strategies 1* and *2*, and NEWSS to implement *Strategy 6*. First Nations and stakeholder engagement is strongly recommended, especially with *Strategy 8*.
- **FUNDING**: could be through FLNRORD or other NGO funding agencies.

In the US, the National Marine Fisheries Service (NMFS, 1996)[21] identified three key components of a successful recovery strategy for fish and aquatic values to be considered:

1. Inclusion of protective and conservation elements;
2. A high level of certainty that strategies will be properly implemented, including the necessary authorities, commitments, funding, resources including people, and enforcement measures; and
3. A comprehensive monitoring program.

STRATEGY 1 – MANAGEMENT ZONATION OF THE WATERSHED

DISCUSSION: The concept of watershed zonation is intended to acknowledge the varying levels of ecological resources and values, land use, disturbance and negative impacts throughout the watershed, and allow for recovery efforts to focus on specific conditions and areas. Different conditions, including levels of disturbance in the upper and lower reaches of the watershed, will require different recovery and management strategies which may include objectives for conservation of certain values. The concept of zonation supports:

- Clear messaging to First Nations, governments and stakeholders on the focus in different areas of the watershed to support a clear path forward for recovery; and
- Specific approaches to treatments that are based on conditions within designated areas.

Zonation is intended to guide implementation of recovery efforts in areas where disturbance has negatively influenced the ecosystem and requires some level of remediation. In other words, zones are identified where management guidelines would be developed, which would include considerations for development/industrial activities and conservation efforts in support of maintaining the ecological diversity and hydrological integrity required to maintain a functional watershed.

The definitions for zonation are non-exclusive, meaning an area can be identified as multiple zone types. For example, areas identified within Zone 3 (Key Chilako Basins) that have specific goals or limitations to restoration may overlap some areas also identified as Zone 1 (Channel Resiliency) or Zone 2 (Variable Vegetation). The following preliminary direction for zonation was developed through the SME workshop:

1. *Zone 1 – Channel Resiliency Zone* – Buffer zone three (3) times the width of the active river channel (main stem) on either side of the river to specifically manage for channel and riparian ecosystem resilience and/or recovery. This is the zone within which the river moves naturally. Understanding and discussions around an "Active Fluvial Unit" concept could also support the delineation of this zone.
2. *Zone 2 – Variable Vegetation Zone* – Recovery zone in the watershed to specifically manage for riparian forest values and variable vegetation types and cover that does not fit into current industrial forestry stocking standards. This zone is meant to focus on alternative stocking standards that are specific to riparian forests and allow for variable deciduous tree and shrub retention.

[21] https://www.mvihes.bc.ca/images/stories/Projects/ERWRP/englishmanrecovery.pdf

3. *Zone 3 – Key Chilako Basins* – Identification of the key basins within the watershed that represent the significant units that have relatively consistent land use, designation and conditions to guide future communications, and management and recovery reporting. The units used to support analysis and understanding of watershed conditions could be used as a starting point. Build on these to create a series (est. 10-15) of clear tributary basins (drainages) to support future guidance and/or decisions regarding disturbance and recovery.
    a. Note the linkage to *Strategy 2* and that key basins could be generated through/in conjunction with the development of basin specific guidance.

Other recovery zones that are more localized or smaller in size could also be used to highlight areas of sensitive soils, valuable forest cover and structure, sites with significant but specific damage to ecosystems that require treatment, and specific policy requirements to address primary land uses in the area. Recovery zones also have the flexibility to address specific landscape ecology, wildlife, and aquatic health issues across the watershed.

RECOVERY GOAL	Clear understanding and efficient delivery of recovery efforts within the watershed.

ACTIONS:

1. Develop the three management zones as discussed above. Consider collaboration with the SMEs involved in the recovery strategy discussions.
2. Develop specific descriptions, current status, goals and direction for recovery strategies within each of the three zones.
    a. Consider how every watershed recovery strategy relates to each of the zones.
    b. Collate and analyse current data on the defined basins and their particular sensitivities to disturbance as a part of the delineation and definition of Zone 3.
3. Use the zone definitions to guide communications throughout the engagement process (*Strategy 4* and *Strategy 5*) and ongoing recovery planning and implementation.

POTENTIAL COSTS: Estimate $5,000 to $10,000 depending on complexity of the supporting analysis.

STRATEGY 2 – DEVELOPMENT OF BASIN SPECIFIC DISTURBANCE THRESHOLDS AND GUIDANCE FOR HARVESTING

DISCUSSION: Commercial timber harvesting operations in response to forest health and wildfire (salvage) as well as through normal harvesting operations has had a significant influence on overall impacts within the watershed. For recovery efforts to be effective and sustainable over the long term, it will be important to collaborate and work with forest licensees to ensure that forest harvesting activities recognize current watershed conditions and watershed recovery efforts in the Chilako. A clear understanding and overall agreement of timber availability in response to watershed recovery is necessary to support meaningful engagement.

Following the delineation of the key drainages (*Zone 3 – Strategy 1*), an assessment of basin conditions and sensitivity along with coordinated development planning is required to ensure that additional Crown land forest harvesting is structured. Strategic development planning using timber supply analysis after harvesting thresholds are proposed can be used to assess future fibre availability within the watershed. It is critical that harvesting thresholds and resulting management strategies are mutually agreed to by all parties, otherwise recovery efforts may not be as effective or sustainable in the long-term. Discussions

around rotating old growth management areas, rotating harvesting zones, road deactivation and rehabilitation (i.e. revegetating), and increased retention of understory trees within riparian areas are suggested. Licensees should also be encouraged to consider alternative harvesting practices, such as partial cutting and alternative stocking, to support watershed recovery efforts.

In addition to the development of guidance for harvesting, including ecologically acceptable disturbance thresholds, is the concept of age class distribution across the watershed over time as forests continue to grow and recover since disturbance. An assessment of age class distribution across the watershed as well as within key drainages can be used to provide guidance to where harvesting should be concentrated or avoided to support the long term restoration of landscape level patterns of stand age and composition.

A system or approach for improved management, policy and/or regulatory influence over cumulative impacts in the watershed is needed to support overall watershed recovery. Policy tools are needed to provide a structure for recovery efforts and provide parameters for monitoring and enforcement into the future. The *Water Sustainability Act* (WSA) provides tools and updates the provincial strategy for protecting, managing and using water efficiently throughout the province. Many of the new tools allow for area-based management, such as management of an entire watershed. The province should be engaged early on in this process as they can help facilitate policy changes in support of watershed recovery. In addition, the provincial government and other stakeholders need to play a role in determining acceptable risks and cumulative impacts of disturbance in the watershed. This institutional framework is required to support recovery objectives, funding acquisition, adaptive management approaches, as well as provide focus on the long-term view for the watershed.

RECOVERY GOAL	Establish a harvest threshold and/or management direction to guide future disturbances in each of the Chilako key basins and the watershed overall.

ACTIONS:

1. Engage with BC Timber Sales and the major forest companies with harvest rights (based on delineated operating areas) in the Chilako to discuss the Chilako WRS and its recommendations, and solicit comments and input to support its implementation.
2. Analyse the key basins (*Zone 3 – Strategy 1*) to confirm disturbance levels, sensitivity of the individual sub-basins, overall role in the resilience of the Chilako system and current trajectory for forest cover renewal to inform discussions regarding disturbance thresholds. Consider the current age class distribution across the watershed and methods/approaches to recovering natural disturbance patterns over time.
    a. Interpretation of current datasets and analysis can be used to facilitate some of this action. Additional analysis is likely needed as it pertains to the defined basins.
    b. Involve forest sector partners in the design and implementation of this action.
3. Develop disturbance thresholds and management guidance within each of the key basins (*Zone 3 – Strategy 1*) and communicate the direction to those considering additional activity within the watershed. Include guidance on short and long term harvest priorities to support recovery of landscape level patterns of stand age and composition.
4. Review the avenues that can be used to implement greater management, policy and/or regulatory oversight to cumulative impact levels in the Chilako River watershed to support watershed recovery over time.
5. Implement thresholds and guidance to influence the levels of impacts in the watershed.

POTENTIAL COSTS: This level of analysis could cost between $50,000 and $100,000, depending on:

- The level of engagement and collaboration with FLNRORD and forest licensees.
- The level of analysis of current watershed conditions, including field confirmations if necessary.
- Whether or not impact analysis, including future fibre availability/modeling, is carried out.

STRATEGY 3 – CREATE A FORMAL WATERSHED MANAGEMENT GROUP / WATER STEWARDSHIP OFFICER POSITION

DISCUSSION: A formal watershed management group for the Chilako River and/or a water stewardship officer position is needed to bring sustained focus and facilitate long-term watershed recovery efforts and management of impacts. This group/individual would be responsible for coordinating future recovery efforts including education, engagement and collaboration, procurement of funding and resources to implement projects on both Crown and private land, and monitor the implementation of recovery strategies over time. The *Cows and Fish – Alberta Riparian Habitat Management Society* is an example of such an organization that operates with a focus on clear and enforceable guidelines for working with cattle in riparian areas, although the proposed group/individual would have a broader scope or mandate.

RECOVERY GOAL	Develop a long-term sustained focus for watershed recovery in the Chilako River watershed through a formal watershed stewardship group or officer position.

ACTIONS:

1. Initiate a series of meetings involving the province, First Nations and NGOs (i.e. SERNbc, NEWSS) to discuss the establishment of a group or individual to support a long-term sustained focus on watershed recovery in the Chilako.
    a. Consider utilizing current NGOs to support or facilitate this initiative.
    b. Include the development of a preliminary Terms of Reference or mandate for the group/position to support a common understanding and efficient implementation.
2. Secure First Nations and provincial government buy-in for the position.
3. Secure funding as needed to support the group/individual.
4. Implement the proposed structure or position.

POTENTIAL COSTS: Initial costs and establishment of a part time position may cost between $50,000 and $100,000 (including a part time salary/competitive wage and additional support/expenses). Annual costs in subsequent years will be less and could be between $25,000 and $50,000 depending if the position is independent or within an NGO, such as SERNbc. The success of the position, scope of influence and ultimately success of watershed recovery will be influenced by the focus (and funds) brought to this role.

STRATEGY 4 – SUSTAINED COLLABORATION WITH FIRST NATIONS AND STAKEHOLDERS

DISCUSSION: Strategies for watershed recovery will require the involvement of a spectrum of individuals, groups and governments. Cooperation and collective partnerships between forest industry, government, First Nations, private land owners, hunters, and other members of the public are necessary in the implementation of all of the strategies outlined here. Engagement with First Nations and the broader stakeholder community will also help further clarify watershed values of importance and feasibility/effectiveness of treatment activities. Involvement of a broader group of engaged partners will

also mitigate, to some degree, any impacts related to changes in government objectives over time. Further to this, collaboration with First Nations can help provide an understanding of historical watershed conditions where current data collection is lacking, and contribute to a vision for the future of the watershed based on both their traditional values and knowledge as well as in recognition of their rights and title.

RECOVERY GOAL	Create an engaged, supporting and collaborative community focused on improved resilience and recovery in the watershed.

ACTIONS:

1. Identify the relevant First Nations and current planning or engagement processes, engage in specific communication regarding the Chilako WRS, and request input on its recommendations and implementation. Subsequent actions and additions to the overall strategy will be guided by these conversations.
2. Confirm the key stakeholders and private land owners in the watershed and develop an *Engagement Plan* to both communicate the strategy recommendations as well as ensure regular (possibly annual) updates on recovery in the watershed. The *Engagement Plan* should consider the use of existing NGOs, including SERNbc, as possible implementation mechanisms, as well as specific strategies to meet the engagement objectives, such as forums, workshops, open houses, information package mail outs, online updates, community meetings, etc.
    a. Note the linkages to *Strategy 3* and the role of the Watershed Management Group / Stewardship Officer as the possible conduit for this initial and ongoing engagement.
3. Create a series of tools and resources to support education and communication of watershed recovery in the Chilako.
    a. Note the linkages to *Strategy 5* with regards to private land ownership.

POTENTIAL COSTS: Initially, in year 1, this could cost between $20,000 and $25,000, followed by annual costs of $10,000 to $15,000 depending on the level of engagement and collaboration. Costs are also contingent on creation of a Watershed Management Group / Stewardship Officer; if established, this would reduce costs if ongoing engagement and collaboration is included in their role.

STRATEGY 5 – PRIVATE LAND OWNER COLLABORATION AND INCENTIVES

DISCUSSION: The collaboration with private land owners in the Chilako River watershed has the potential to be a major influence on riparian recovery efforts, especially in the lower reaches where historic riparian impacts are most significant and the ability of the channel to adequately react to changes in flows and sediment has been compromised. To facilitate cooperation and collaboration with land owners in the recovery effort, incentives will be key. One option is to focus on some "quick wins" that include:

- Landowners that have bought into the need for riparian and channel recovery efforts; and
- Working on Crown land with Range Tenure Holders and in areas with some range related impacts to demonstrate recovery efforts.

Within *Zone 1 – Channel Resiliency Zone* (*Strategy 1*) and with support from funding partners and private land owners, treatments in areas with reduced riparian vegetation and/or channel instability will be easier to facilitate. With help from the Watershed Management Group / Stewardship Officer (*Strategy 3*), private land owners can gain access to the information and available funding sources to support the implementation of treatments on private land. Other possible strategies for private land owner engagement and buy-in include:

- Provisions for land owners to design their properties to better withstand flooding events;
- Education for locals about current and historic conditions of the watershed; and
- Signage around private land communicating the recovery treatments/efforts that is planned or currently underway.

See linkage to *Strategy 1* as a mechanism to support private land owner engagement and buy-in.

In addition to specific riparian and channel restoration treatments discussed above, engagement with land owners and ranchers regarding soil augmentation, alternatives to herbicide and fertilizer usage, and fencing and cattle management will be key steps in the implementation of strategies pertaining to development of recovery zones, disturbance thresholds, and site specific treatments. These operational practices along with channel and riparian restoration treatments should be all considered to the extent possible.

RECOVERY GOAL	Facilitate cooperative relationships with private land owners in order to implement channel and riparian restoration treatments that support overall watershed recovery.

ACTIONS:

1. Identify private land owners that have demonstrated engagement and buy-in to recovery efforts in the *Channel Resiliency Zone* (*Strategy 1*). Communicate the recovery strategy, the concept of the *Channel Resiliency Zone*, and confirm their ongoing interest to engage in recovery efforts. Develop action plans for their property within the context of the recovery strategy, and support overall implementation.
2. Develop a list of additional private land owners within the *Channel Resiliency Zone* and classify/prioritize their land for recovery efforts, including rationale[22]. Engage with priority land owners (one-on-one or in group settings) to discuss watershed recovery further.
3. Investigate the opportunity to utilize current or additional funding partners to support activities that both support channel/riparian recovery as well as home-owner protection goals as a mechanism to incentivize engagement. Develop decision processes through which these integrated projects could be facilitated.

POTENTIAL COSTS: Collaboration efforts could cost between $10,000 and $15,000 annually, less if a Watershed Management Group / Stewardship Officer is in place. Costs for incentives are more complex to estimate; significant investments could be made, however are reliant on available funding sources and willing private land owners.

STRATEGY 6 – SECURE BUY-IN AND FUNDING FOR WATERSHED RECOVERY

DISCUSSION: Political and social buy-in for the overall direction for recovery will be key to moving the Chilako WRS forward. In addition, funding for the implementation of each strategy and the associated actions will be key. Attention should be given to securing support from environmental/stewardship organizations as well as commercial/industrial partners that may have environmental regulatory requirements. The province should be engaged early on in this process as they can help facilitate buy-in

[22] Property and private land owners will be prioritized based on the potential benefit of treatments supporting overall watershed recovery, such as the ability to positively influence recovery efforts.

of policy changes and management plans using the tools provided in the WSA for the recovery of the Chilako River watershed.

Note there are linkages to many of the strategies above, with specific reference to *Strategy 4* and *Strategy 5* regarding engagement and collaboration.

RECOVERY GOAL	Secure the political buy-in and funding needed to implement the recovery strategies.

ACTIONS:

1. Initiate a series of meetings involving the province, First Nations, and NGOs (i.e. SERNbc and NEWSS) to discuss recovery strategies and specific avenues for political and social buy-in as well as funding sources.
    a. Secure formal support for this initiative and recommended recovery strategies from the provincial government and First Nations.
    b. Collaborate with existing funding agencies to determine what sources are available and what constraints exist for project implementation across the watershed.
    c. Consider innovative or alternative approaches to funding such as partnerships with First Nations, industrial partners or others.

POTENTIAL COSTS: Annual costs are estimated at $10,000 to $15,000 to support funding applications and proposal development to implement recovery activities. Some costs can be incurred through the Watershed Management Group / Stewardship Officer (*Strategy 3*).

STRATEGY 7 – ADDRESS INFORMATION GAPS

DISCUSSION: A series of information gaps were identified through the development of the strategy. The key information gaps are generally related to 1) understanding of fisheries values, such as the location of values, significance of these locations, genetic uniqueness, etc., and 2) understanding of processes that control water quality and quantity over space and time across the watershed.

Information and data gaps have been specifically categorized and identified as:

Hydrology and Watershed Management (in order of priority)

- Watershed sub-basin delineation to support sensitivity analyses to understand cumulative effects of impacts and provide direction for management (see *Strategy 2*).
- Hydrological measurements and/or modelling to understand influence of land use changes on peak flows (and possibly low-flows) and the effect of range use on sediment production.
- Water quality metrics, such as groundwater influences, stream temperature conditions, turbidity, and sediment loading.
- Influences of possible climate change projections on current and future conditions of the watershed.
- Dynamics of transpiration/evaporation at different forest stand ages and its influence on discharge rates (discrepancy between precipitation and discharge).

Fish and Aquatic Habitat (in order of priority)

- A better understanding of the life history of fish species in the watershed (migration timing, location, etc.).
- Clarity around the importance of water quantity vs. quality as they pertain to impacts to fish within the Chilako system.
- Monitoring of fish populations, number of species present, and overall quality of fish habitat.
- Analysis of genetics and spatial distribution of Chinook salmon in the watershed.

RECOVERY GOAL	Fill information gaps and provide baseline data to compare against changing watershed conditions, as well as to facilitate assessment of the success of watershed recovery strategies and treatments in the future.

ACTIONS:

1. Confirm information gap priorities with provincial and federal governments, First Nations, NGOs, academia and SMEs. See linkage to *Strategy 3*.
2. Identify programs, funding options, or alternative approaches to addressing each of the information gaps.
3. Take action as identified to secure data or establish monitoring to resolve information gaps.

POTENTIAL COSTS: Cost are dependent on identified priorities, data collection methods, partnerships or collaborations, as well as available funding sources.

STRATEGY 8 – DEVELOP A WATERSHED MANAGEMENT PLAN FOR THE CHILAKO

DISCUSSION: The strategies developed above (i.e. *Strategy 1* to *7*) represent immediate action that can be taken in support of Chilako River watershed recovery. A structured management plan with specific targets related to the overall function of the watershed is needed over the long-term. The plan should include targets that are linked back to the values and watershed recovery strategies to be most effective. The plan should also focus on maintaining a broad scope of recovery strategies so that all watershed values are supported. The objective of the plan is to take the efforts of collaboration and planning (i.e. *Strategy 1* to *7*), and move towards implementation of recovery strategies through on the ground treatments and activities.

The plan would be an initiative to be undertaken after other strategies and actions outlined in this report have been initiated. An ongoing focus, interest in and investment in recovery will have started, which can provide a base for further detailed planning. This step should also include engagement with the province for plan development in accordance with tools provided within the WSA.

RECOVERY GOAL	Provide guidance to long-term recovery and management of the Chilako River watershed.

ACTIONS:

1. Convene a *Planning Team* involving the province, First Nations, NGOs and stakeholders to develop a *Terms of Reference* for the development of a *Watershed Management Plan*.
2. Secure buy-in and funding for the planning process.

3. Implement the planning process to support long-term recovery and management of the Chilako River watershed, including spatial delineation of recovery treatments.

POTENTIAL COSTS: Assuming the identified information and data gaps are filled, basins are delineated, basin specific guidance is in place, and engagement and collaboration has begun with First Nations and stakeholders, the development of a Watershed Management Plan could cost between $50,000 and $100,000. The level of engagement in the planning process could have a significant influence on the overall cost of plan development.

5 Next Steps

Each of the recommended watershed recovery strategies are linked. Recovery in the watershed and improving resilience in the system will require a multi-facetted approach, with action being taken at multiple levels and at different time and spatial scales. This need for a broad, multi-pronged approach is reflected in the diversity of stakeholders, values, challenges, recovery strategies and associated actions. Available information may be used to initiate several strategies simultaneously while information gaps are filled and stakeholder engagement takes place. While funding for further development and implementation of recovery strategies is secured, initial zonation of the watershed can be created, engagement with province can be initiated, and the beginnings of a structured management plan can be formed. As new information is available from data collection and engagement with stakeholders and First Nations, watershed zonation and a structured management plan may be finalized as well as the development of private land owner incentives and information packages. The process of assembling a Watershed Management Group and/or a Watershed Stewardship Officer can also be completed in conjunction with other strategies. These are significant steps in facilitating treatments on the ground and may be initiated in varying order depending on the availability of information and resources.

6 Appendices

The following Appendices have been provided under separate cover:

1. Appendix A – Subject Matter Expert Interview Transcripts
2. Appendix B – Chapter of Values Summary