The
Chilko River Watershed
A Synopsis of
Reports
And A View to Sustainability

Prepared For:

Chilko Resorts
And
Community Association

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Abstract:

"Sustainable development is about ensuring that some measure of human well-being is sustained over time. Fundamental to this approach to economic development is the requirement that any actions now which are likely significantly to impair the well-being of the future must be associated with actual compensation of the future. Otherwise the future is worse off than the present" (Pearce, 1993).

The effects of accelerated world population growth are now touching the lives of the residents of the Chilko River watershed. The world's population is expected to increase by 3 billion people in the next 50 years (State of the World, 2001). As a result, increasing demands on the natural resources of the Chilko River area are being felt. Commercial harvesting of salmon originating from the Chilko River spawning grounds, the harvesting of timber, First Nations traditional use, and back country tourism and recreation are all competing for limited resources.

A long-term sustainable vision of land use in the Chilko River watershed that satisfies all stakeholders is required. The vision must be equitable to all, including First Nations, local residents and businesses, industry and government. The vision must recognize that the three equal pillars of sustainability include a healthy economy, a healthy environment, and a healthy social structure. It is imperative that we leave the world a better place for the next generation; otherwise we have not lived up to the definitions of sustainable development.

Acknowledgements

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A special thank you also goes out to the following individuals who assisted in providing research materials: Rob Dolighan, Tom Wilkinson, Jack Leggett, Nancy Oppermann, Sue Hemphill, Ken Morton, Don MacKinley, Teri Tarita, Trevor Andrews, and Al Cass. My apologies and thanks also goes out to those I may have forgotten.

Richard Holmes

Definition of Acronyms

AMP = Access Management Plan
CAPP = Channel Assessment and Prescriptions Procedure
CRCA = Chilko Resorts and Community Association
FHAP = Fish and Fish Habitat Assessment Procedure
FRBC = Forest Renewal British Columbia
FsRBC = Fisheries Renewal British Columbia
IWRP = Integrated Watershed Restoration Plan
RAPP = Riparian Assessment and Prescriptions Procedure
SB = Sub-basin
SSS = Sediment Source Survey
TEM = Terrain Ecosystem Mapping
WSC = Watershed Code

Definitions

Anadromous: Fish that breed in freshwater but live their adult life in the sea. On the Pacific coast, anadromus fish include all of the Pacific salmon, steelhead trout, some coastal cutthroat trout and Dolly Varden char, lampreys and eulachons.

Bank Erosion:A loosening and wearing away of soil and rock by water from the edge of a body of water, usually resulting in an enlargement of the body of water.

Erosion: A process or group of processes whereby surface soil and rock is loosened, dissolved or worn away, and moved from one place to another by natural processes. Erosion usually involes relatively small amounts of material at a time, but over a long time can involve very large volumes of material.

Fisheries Sensitive Zones: Side and bank channels, ponds, swamps, seasonally flooded depressions, lake littoral zones and estuaries that are seasonally occupied by overwintering anadromous fishes.

Fish Habitat: spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes. Habitat can be located instream (main river or stream system) or off-channel (small tributaries or wet areas; includes off-channel and instream habitat).

Fluvial: Of or belonging to rivers.

Freshet: A rapid rise in river discharge and level caused by heavy rains or melting snow.

Rehabilitation: Returning to a state of ecological productivity and useful structure, using techniques similar or homologous in concept (e.g. boulders replacing root masses): producing conditions more favorable to a group of organisms or species complex, especially that economically and aesthetically desired of native flora and fauna, without achieving the undisturbed condition.

Restoration: Bringing back to a former or original condition (e.g. the pre-logging state). Can be understood to include rehabilitation.

Riparian Area: The land adjacent to the normal high waterline in a stream or lake whose soils and vegetation are influenced by the presence of the ponded or channelized water. Riparian management areas are administratively designed strips of land adjacent to certain stream channels.

Salmonid: Refers to member of the fish family classed as Salmonidae, including the salmons, trout, char, whitefishes and grayling.

Sedimentation: The process of subsidence and deposition of suspended matter carried in water by gravity; usually the result of the reduction of water velocity below the point at which it can transport the material in suspended form.

Smolt: A seaward migrating juvenile salmonid, which is silvery in color, has become thinner in body form and is physiologically prepared for the transition from fresh to saltwater. The term is normally applied to the migrants of species such as coho, sockeye, Chinook, and steelhead that rear in freshwater for a period before migrating to sea.

Stream: the watercourse formed when water flows between continuous definable channel boundaries. Flow in the stream channel may be perennial or intermittent.

Stream Magnitude: The total number of streams or tributaries upstream in a watershed.

Stream Order: A scale dependent property of drainage networks that describes the position and approximate size of a stream segment in the network. First order streams are headwater streams that have no tributaries. A second order stream is formed where two first order streams join, a third order stream is formed where two second order streams join, etc. Note that the confluence of a second order stream with a first order stream remains a second order stream.

Stream Reach: A homogenous segment of a drainage network, characterized by uniform channel pattern, gradient, substrate, and channel confinement.

Watershed: An area of land (the catchment or drainage basin), bounded peripherally by a topographic height of land, that delivers water along a stream channel to a common outlet. Watersheds are the natural landscape units from which hierarchical drainage networks are formed.

Watershed Code: a hierarchical numbering system used to identify rivers and streams.
For example: Chilcotin River = 150
Chilko River = 150-335700
Taseko River = 150-335700-13400
Elkin Creek = 150-335700-13400-28700
and Chaunigan Creek which flows into Elkin Creek
= 150-335700-13400-28700-1700

1.0 Introduction

The Chilko River watershed is situated in the Chilcotin region of British Columbia and is renown for its pristine beauty and diverse ecosystems. The headwaters of the Chilko River originate in the Pacific Coast Mountains that surround Chilko Lake, and peaks as high as 11,000 feet in elevation add to the local beauty and enhance the scenery that is renown throughout the world. The most famous of these mountains is Mount Waddington which is only a short 60 mile flight to the west of the lake. Numerous glaciers replenish the lake which is utilized by sockeye salmon as a nursery lake for one year after emerging from the gravel of the Chilko River, and prior to beginning their long journey to the Pacific Ocean. Access to the area is by air or by well maintained gravel road.

The river drains in a northerly direction through the foothills of the Coast Range Mountains into the southern portion of the Chilcotin Plateau. It joins the Chilcotin River just west of the town of Alexis Creek and from here flows downstream to the confluence with the Fraser River south of the city of Williams Lake.

The Tsilhqot'in People of Xeni, governed by the Xeni Gwet'in First Nations Government, are the First Nations people who call this area their home. They are one of six Tsilhqot'in Nations who form the Tsilhqot'in National Government and on August 23, 1989 they declared their traditional area the Nemiah Aboriginal Wilderness Preserve (Xeni).

The area surrounding Chilko Lake formed part of Ts'yl-os (pronounced "sigh-loss") Provincial Park in 1994. The park is 233,240 hectares in size and was set aside to protect vegetation, wildlife and fish habitats, cultural values and special features. The park is managed through a cooperative relationship between BC Parks, the Tsilhqot'in People of Xeni, a Local Advisory Group, and the Ts'yl-os Advisory Group. Activities present in the area prior to the Park's creation such as hunting, trapping, and cattle grazing are still permitted today (Ts'yl-os Provincial Park).

2.0 Background on the Chilko Resorts and Community Association

The Chilko Resorts and Community Association (CRCA) is a non-profit organization formed in 1998 and registered under the British Columbia Societies Act Number S42055. The (CRCA) is a group of local stakeholders made up of year-round residents and tourism business operators located at Chilko Lake. Members work together to support, and advocate and promote backcountry tourism and increase employment within the local area and economy while maintaining this natural and wild environment.

The objectives of the group are as follows:

- Sustain and protect the primary product feature of backcountry tourism, the pristine, natural wilderness environment
- Promote community development that addresses existing environmental, traditional, heritage, commercial and community place-based values

- Improve the quality of information available regarding both the economy and local labour market of the area
- Developing a long-term vision of the Chilko area and how the area would be managed in the future

Tourism has historically been the majority use of the area. Given the remoteness, it is not surprising that as a group, the Chilko operators accommodate a large number of visitors. To ensure business continuance, the sustainability of the wilderness experience is first and foremost. Remoteness, the difficulty of access to the area, appears to be a key characteristic defining the quality and profitability of the tourism product offering. (Chilko Resorts and Community Association, 2001)

3.0 Project Objectives

The Chilko Resorts and Community Association (CRCA) requested that Cariboo Envirotech Ltd. of Likely, BC conduct research and provide a list of Chilko Lake and River fishery and watershed related reports that could provide information to both stakeholders and residents. The Chilko area is one of the most diverse ecosystems in the world, including some of North America's largest ice-fields, towering mountain peaks, alpine lakes, semi-arid grasslands, and extensive timber expanse including old-growth, a very healthy migratory fish spawning habitat, and untouched wildlife inventory. Due to the wealth of natural resources in the watershed, residents, local business, industry and government are feeling increasing pressure on the future use of these natural values.

It is hoped that the resulting information summarized in this report could be utilized to broaden the reader's perspective on the watershed, and help facilitate informed choices to be made on its future, while recognizing the overall values of this near pristine area. This report does not attempt to analyze the specific data, and is intended to be solely an information source. Recommendations will be provided to address local concerns, and to suggest future direction with respect to fishery and watershed issues.

Local residents who have a day-to-day feel for the health of their natural surroundings can compliment the management of the Chilko River watershed. They could be likened to the "canary in the mine" and are often the first to feel the influences on their surroundings. Local knowledge and involvement can assist policy makers in developing decisions that allow sustainable development to continue in this area while maintaining three key components of sustainability that include healthy economic, social and environmental values.

The research included the following efforts and locations:

- Internet searches including:
  - BC's Watershed Restoration Program web site
  - Royal Roads University Library web site
  - Canada's National Research Council web site
- The Fisheries and Oceans Library in Vancouver

- Cultus Lake Salmon Research Lab
- Pacific Salmon Commission Library in Vancouver
- BC Ministry of Sustainable Resource - Williams Lake
- BC Ministry of Water, Air and Land Protection

3.1 Watershed Seminar

Part of this project also included a Chilko River Watershed seminar provided by Richard Holmes of Cariboo Envirotech Ltd., Hazel Massier, and Robert Mills of Quesnel River Environmental Restoration Services (Appendix 1). The seminar was held at the Chilko Lake Resort on September 23rd and 24th and was intended to inform local residents of the fishery values of the Chilko River watershed, the importance of maintaining a healthy fishery resource, and techniques employed in watershed restoration in areas where habitat degradation has occurred. A Fish Habitat Awareness manual written by Ms. Massier was also distributed to seminar participants.

Part of the seminar included a field visit to the Chilko River, the sockeye spawning channel, and Lingfield Creek where onsite discussions were held on relevant fishery topics and restoration possibilities. A brief summary of the seminar contents follows below.

3.1.1 Sustainable Development and the Chilko River Watershed: By Richard Holmes

The definition of sustainable development as presented by Mr. Holmes was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their needs"(Norgaard, 1994). His presentation also discussed the balance of the three most important factors affecting sustainability which are an equally healthy economic, environmental and social base.

His seminar discussion provided the audience with background information on fisheries and watershed issues related to the Chilko River watershed. This topic included discussion on the physical characteristics of the lake and river, fish species present, salmon escapement numbers (Appendix 5), lake fertilization and zooplankton importance to sockeye (Appendix 6), and report research conducted to date.

3.1.2 Fish Habitat Requirements: By Hazel Massier

Ms. Massier's presentation was based on habitat requirements for fish, the importance of healthy riparian zones and the value of maintaining a functional and healthy aquatic environment. Her discussion included the four basic habitat requirements for fish which included cool, clear water, ample nutrition, cover from predators and high flows, and clear passageway for migration.

The importance of healthy riparian zones adjacent to streams, lakes and wetlands was also presented. Plant and animal diversity is abundant in riparian zones and these

transition areas unite aquatic and terrestrial life and impacts to these riparian areas will affect the aquatic ecosystem.

Her discussion also focused on the human values related to a functional and healthy aquatic environment that include aesthetics, recreation, education and a sustainable economy. The relationship of healthy fish populations and the state of our environment was presented explaining that a healthy environment for fish also means a healthy environment for people. In summary, her seminar presentation stated that we are part of this environment – our activities can have negative and positive impacts for future generations - what is left for them tomorrow is determined by us today.

3.1.3 Watershed Restoration Techniques: By Robert Mills

This presentation included a slide show and discussion, which outlined a range of fish habitat rehabilitation and riparian restoration projects completed in the Cariboo/ Chilcotin Region.

Fish habitat rehabilitation techniques such as methods of improving fish access, stream bank stabilization, riffle construction, large woody debris complexing, and enhancing off-channel habitats, were discussed.

Riparian restoration focused on assorted bioengineering techniques which have been successfully used to enhance riparian structure and function. Live staking, brush layering, wattle fencing and the construction of live fascines, were all covered in the discussion. A variety of different methods that have been utilized to exclude cattle from heavily impacted riparian areas were also introduced. These include electric fencing and whole tree placements to deter cattle movement in sensitive areas.

Emphasis was placed on the importance of community involvement at both the planning and implementation phase of any restoration project.

3.2 Review of the Five Year Forest Development Plan

At the request and specific recommendation of the Chilko Resorts and Community Association in consultation with the Xeni Gwet'in First Nations Government and The Friends of the Nemaiah Valley, registered professional forester Herb Hammond was hired to review the five - year forest development plans for the Chilko River Watershed. His findings and comments can be found in Appendix 7.

3.3 Request for Input from Residents and Stakeholders

In an effort to solicit input from the residents of the Chilko River watershed, a letter requesting comments on what they envision a healthy watershed to be, based on social, economic and environmental needs of the stakeholders was mailed out to approximately 20 residents. The letter and mailing list can be reviewed in Appendix 1.

A similar letter was mailed to approximately 15 stakeholders in the watershed requesting an overview of their organization's current strategy in the area, as well as identifying any reports they may have that could be utilized for information sources and listed in Section 7 of this report. A copy of this letter and associated mailing list can also be found in Appendix 1.

4.0 Watershed Characteristics

4.1 Chilko Lake

Chilko Lake (Watershed Code 150-335700) is situated at an elevation of 1172 metres, has a surface area of 16,900 hectares and has a perimeter of approximately 170 kilometres. Its maximum depth is 366 metres and has an average depth of 137 metres. The lake is the largest, natural high-elevation freshwater lake in Canada (Ts'yl-os Provincial Park). The following species are known to be located within the lake and their Latin names are included with their common names (FishWizard):

- Bull Trout *(Salvelinus confluentus)*
- Chinook Salmon *(Oncorhynchus tshawytscha)*
- Dolly Varden *(Salvelinus malma)*
- Minnow (general) *(many, all cyprinids)*
- Mountain Whitefish *(Prosopium williamsoni)*
- Rainbow Trout *(Oncorhynchus mykiss)*
- Sockeye Salmon *(Oncorhynchus nerka)*
- Steelhead *(Oncorhynchus mykiss)*
- Sucker (general) *(Catostomus sp.)*
- Whitefish (general) *(Prosopium spp.,Coregonus spp., Stenodussp.)*

4.2 Chilko River

The Chilko River (Watershed Code 150-335700) flows in a northerly direction to meet the Chilcotin River and is approximately 89 kilometres in length. From this confluence the rivers are called the Chilcotin River and it flows in an easterly direction until it meets the Fraser River. The Chilko River has a stream order of 7 and a stream magnitude of 1,864. The following species are known to be found in the river and their Latin names are included with their common names (FishWizard):

- Bull Trout *(Salvelinus confluentus)*
- Chinook Salmon *(Oncorhynchus tshawytscha)*
- Coho Salmon *(Oncorhynchus kisutch)*
- Dolly Varden *(Salvelinus malma)*
- Longnose Dace *(Rhinichthys cataractae)*
- Mountain Whitefish *(Prosopium williamsoni)*

- Pacific Lamprey *(Lampetra tridentata)*
- Rainbow Trout *(Oncorhynchus mykiss)*
- Sockeye Salmon *(Oncorhynchus nerka)*
- Steelhead *(Oncorhynchus mykiss)*
- Whitefish (general) *(Prosopium spp.,Coregonus spp., Stenodussp.)*

4.3 Major Tributaries of Chilko Lake and River
See Appendix 2 (FishWizard)

4.3.1 Bidwell Creek

Watershed Code: 150-335700-23800

Length: 36.67 km

Known Fish Species Present: Rainbow Trout, White Sucker

Named Tributaries: none

4.3.2 Brittany Creek

Watershed Code: 150-335700-40200

Length: 48.43 km

Known Fish Species Present: none

Named Tributaries: Casselman Creek

4.3.3 Deschamps Creek

Watershed Code: 150-335700-85800

Length: 16.6 km

Known Fish Species Present: Bull Trout

Named Tributaries: Nine Mile Creek

4.3.4 Edmond Creek

Watershed Code: 150-335700-99400

Length: 22.92 km

Known Fish Species Present: Bull Trout, Mountain Whitefish

Named Tributaries: Cyr Creek, Ramose Creek

4.3.5 Farrow Creek

Watershed Code: 150-335700-94600

Length: 10.23 km

Known Fish Species Present: none

Named Tributaries: none

4.3.6 Girdwood Creek

Watershed Code: 150-335700-77500

Length: 11.44 km

Known Fish Species Present: Bull Trout, Rainbow Trout

Named Tributaries: none

4.3.7 Glasgow Creek

Watershed Code: 150-335700-86000

Length: 5.04 km

Known Fish Species Present: none

Named Tributaries: none

4.3.8 Good Hope Creek

Watershed Code: 150-335700-85900

Length: 5.46 km

Known Fish Species Present: none

Named Tributaries: none

4.3.9 Lingfield Creek

Watershed Code: 150-335700-50700

Length: 29.0 km

Known Fish Species Present: Bull Trout, Chinook Salmon, Coho Salmon, Rainbow Trout, Steelhead

Named Tributaries: none

4.3.10 Nemiah Creek

Watershed Code: 150-335700-73600

Length: 24.74 km

Known Fish Species Present: none

Named Tributaries: Klokon Creek, Robertson Creek

4.3.11 Norrington Creek

Watershed Code: 150-335700-98700

Length: 8.46 km

Known Fish Species Present: none

Named Tributaries: none

4.3.12 Rainbow Creek

Watershed Code: 150-335700-91000

Length: 12.5 km

Known Fish Species Present: none

Named Tributaries: none

4.3.13 Rubagub Creek

Watershed Code: 150-335700-85400

Length: 3.9 km

Known Fish Species Present: none

Named Tributaries: none

4.3.14 Taseko River

Watershed Code: 150-335700-13400

Length: 131.72 km

Known Fish Species Present: Bull Trout, Chinook Salmon, Dolly Varden, Longnose Sucker, Mountain Whitefish, Rainbow Trout, Sockeye Salmon, Steelhead

Named Tributaries: Amazon Creek, Battlement Creek, Beece Creek, Chita Creek, Denain Creek, Elkin Creek, Granite Creek, Griswold Creek, Honduras Creek, Lord River, McClure Creek, Nuntsi Creek, Powell Creek, Rae Creek, Tchaikazan River, Tete Angela Creek, Vick Creek

4.3.15 Tredcroft Creek (Alias: Gold Creek)

Watershed Code: 150-335700-79600

Length: 16.54 km

Known Fish Species Present: Bull Trout

Named Tributaries: Gulliby Creek

4.3.16 Tsuniah Creek

Watershed Code: 150-335700-65100

Length: 13.13 km

Known Fish Species Present: Rainbow Trout

Named Tributaries: North Tsuniah Creek

4.4 Major Lakes in the Chilko River Drainage
See Appendix 3 (FishWizard)

4.4.1 Augers Lake

Elevation: 1448 m.

Surface Area: 75.177 ha.

Maximum Depth: 10 m.

Known Fish Species Present: unknown

4.4.2 Bidwell Lakes

Elevation: 1100 m.

Surface Area: 29.7 ha.

Maximum Depth: 9 m.

Known Fish Species Present: Rainbow Trout, Longnose sucker, White Sucker

4.4.3 Big Lake

Elevation: 1326 m.

Surface Area: 90.25 ha.

Maximum Depth: 13.1 m.

Known Fish Species Present: Rainbow Trout

4.4.4 Big Onion Lake (Alias: Onion Lake)

Elevation: 1311 m.

Surface Area: 58.862 ha.

Maximum Depth: unavailable

Known Fish Species Present: Dolly Varden, Rainbow Trout

4.4.5 Brittany Lake

Elevation: 1326 m.

Surface Area: 149.33 ha.

Maximum Depth: 3 m.

Known Fish Species Present: Rainbow Trout, Longnose Sucker, Sucker (General), Redside Shiner, Whitefish (General)

4.4.6 Chaunigan Lake

Elevation: 1494 m.

Surface Area: 460.91 ha.

Maximum Depth: 51.2 m.

Known Fish Species Present: Rainbow Trout, Redside Shiner

4.4.7 Chilko Lake

Elevation: 1172 m.

Surface Area: 16,900 ha.

Maximum Depth: 366 m.

Known Fish Species Present: Bull Trout, Chinook Salmon, Dolly Varden, Minnow (general), Mountain Whitefish, Rainbow Trout, Sockeye Salmon, Steelhead, Sucker (general), Whitefish (general), Coho Salmon

4.4.8 Choelquoit Lake

Elevation: unavailable

Surface Area: 1433.429 ha.

Maximum Depth: unavailable

Known Fish Species Present: Kokanee, Largescale Sucker, Northern Pikeminnow (formerly N. Squawfish), Northern Redbelly Dace, Peamouth Chub, Rainbow Trout, Redside Shiner, Sucker (General), Whitefish (General)

4.4.9 Dorothy Lake

Elevation: 1387 m.

Surface Area: 156.107 ha.

Maximum Depth: 21.4 m.

Known Fish Species Present: Rainbow Trout

4.4.10 Ducharme Lake

Elevation: 1478 m.

Surface Area: 28.566 ha.

Maximum Depth: 10 m.

Known Fish Species Present: unknown

4.4.11 Elkin Lake (Alias: Twin Lake)

Elevation: 1216 m.

Surface Area: 241.7 ha.

Maximum Depth: 30.8 m.

Known Fish Species Present: Bull Trout, Dolly Varden, Kokanee, Largescale Sucker, Mountain Whitefish, Northern Pikeminnow (formerly N. Squawfish), Rainbow Trout

4.4.12 Fish Lake

Elevation: 1433 m.

Surface Area: 112 ha.

Maximum Depth: 14 m.

Known Fish Species Present: Rainbow Trout

4.4.13 Fishem Lake

Elevation: 1356 m.

Surface Area: 141ha.

Maximum Depth: 12 m.

Known Fish Species Present: Bull Trout, Dolly Varden, Mountain Whitefish, rainbow Trout, Sucker (General)

4.4.14 Glasgow Lakes

Elevation: 1704 m.

Surface Area: 42.043 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.15 Kloakut Lake

Elevation: 1554 m.

Surface Area: 110.319 ha.

Maximum Depth: unknown

Known Fish Species Present: Rainbow Trout

4.4.16 Kondor Lake

Elevation: 1608 m.

Surface Area: 11.166 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.17 Konni Lake

Elevation: 1213 m.

Surface Area: 565 ha.

Maximum Depth: 29.9 m.

Known Fish Species Present: Bull Trout, Dolly Varden, Kokanee, Largescale Sucker, Longnose Dace, Longnose Sucker, Mountain Whitefish, Rainbow Trout, Redside Shiner

4.4.18 Lastman Lake

Elevation: 1356 m.

Surface Area: 54.5 ha.

Maximum Depth: 7.3 m.

Known Fish Species Present: Longnose Sucker, Rainbow Trout, Redside Shiner

4.4.19 Mainguy Lake

Elevation: 1508 m.

Surface Area: 209.654 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.20 Marian Lake

Elevation: 1978 m.

Surface Area: 7.243 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.21 Marsh Lake

Elevation: 1122 m.

Surface Area: 19.528 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.22 Murray Taylor Lake

Elevation: 1295 m.

Surface Area: 94.7 ha.

Maximum Depth: 7.6 m.

Known Fish Species Present: Longnose Sucker, Northern Pikeminnow (formerly N. Squawfish), Northern Redbelly Dace, Peamouth Chub, Rainbow Trout, Redside Shiner, Whitefish (General)

4.4.23 Nemaia Lake

Elevation: 1210 m.

Surface Area: 88.95 ha.

Maximum Depth: 1.5 m.

Known Fish Species Present: Longnose Sucker, Mountain Whitefish

4.4.24 Rosse Lake

Elevation: not available

Surface Area: 49.764 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.25 Summit Lakes

Elevation: 1608 m.

Surface Area: 7.234 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.26 Tarn Lake

Elevation: 1547 m.

Surface Area: 1.796 ha.

Maximum Depth: unknown

Known Fish Species Present: unknown

4.4.27 Taseko Lakes

Elevation: 1325 m.

Surface Area: 2123.923 ha. and 945.04

Maximum Depth: unknown

Known Fish Species Present: Bull Trout, Dolly Varden, Longnose Sucker, Mountain Whitefish

4.4.28 Tsuniah Lake

Elevation: 1222 m.

Surface Area: 1079.74 ha.

Maximum Depth: 39.6 m.

Known Fish Species Present: Longnose Sucker, Northern Redbelly Dace, Rainbow Trout, Redside Shiner

4.4.29 Tuzcha Lake

Elevation: unknown

Surface Area: 158.774 ha.

Maximum Depth: unknown

Known Fish Species Present: Bull Trout, Dolly Varden, Kokanee, Mountain Whitefish, Rainbow Trout, Whitefish (General)

4.4.30 Vedan Lake (Alias: Twin Lake)

Elevation: 1219 m.

Surface Area: 307.17 ha.

Maximum Depth: 22.2 m.

Known Fish Species Present: Bull Trout, Dolly Varden, Longnose Sucker, Mountain Whitefish, Northern Pikeminnow (formerly N. Squawfish), Whitefish (General)

4.4.31 Vick Lake

Elevation: 1341 m.

Surface Area: 12 ha.

Maximum Depth: 4.3 m.

Known Fish Species Present: Rainbow Trout

4.4.32 Yohetta Lake

Elevation: unknown

Surface Area: 118.235 ha.

Maximum Depth: unknown

Known Fish Species Present: Rainbow Trout

5.0 The Fishery Resource And The Cariboo Chilcotin Land Use Plan

On October 24, 1994, the British Columbia Government announced the Cariboo-Chilcotin Land Use Plan (CCLUP). The Cariboo-Chilcotin Land Use Plan resulted from the direct input of residents of the region. It fulfills the need for a regional plan to provide certainty and sustainability for the range of land and resource uses and values.

The implementation of the Land Use Plan is, in fact, a long term endeavour as the general elements of the Plan are applied to regional management and to sub-regional and local land use planning. Implementation of the Land Use Plan must continue to be "Made in the Cariboo", with Provincial legislation and regulations applied in a manner that is suited to the resources, the environment and the people of the region. This approach ensures:

- access to resources
- sustainable resource utilization
- maintenance of environmental qualities and values
- integration of resource uses and values

(Cariboo Chilcotin Land Use Plan.1994)

A key component of the CCLUP was addressing concerns arising from land use and its impacts on the fishery resource. Input and direction was received from both the Ministry of Environment, Lands and Parks, and Fisheries and Oceans Canada.

Large river systems such as the Taseko and Chilko Rivers are an important upstream component of the sockeye salmon cycle. These two systems provide spawning and lake rearing opportunities for sockeye and also benefit other salmonid species such as chinook, coho, rainbow trout, dolly varden and bull trout. Chinook habitat includes the natal streams and many smaller tributary streams that are used for rearing. Sidechannel habitat of the mainstem rivers is particularly important for rearing chinook (CCLUP 1994).

The goal of the Fish Habitat Policy of the Department of Fisheries and Oceans (DFO) is a "net gain" in the productive capacity of Canada's fish habitat. An essential component in the application of this policy is the objective of "no net loss" of productive capacity in relation to proposed development activity. The three supporting goals of the policy are fish habitat conservation, fish habitat restoration and fish habitat development. In the context of resource management zones within the Cariboo-Chilcotin, it is important to consider the requirements of the Fisheries resource at each level of planning and operations. (CCLUP 1994).

On August 15, 1996 a Fisheries Target Risk Assessment was prepared for the CCLUP Integration Process by the Fisheries Target Committee. The committee's role was to contribute to the short term timber availability assessment (STTAA). While the Land Use Plan determines where timber harvesting will occur on a very broad scale and within established targets, the STTAA will identify more specifically the location of the planned harvest and the short term impact of the planned timber harvest on meeting the targets in the CCLUP. The Fisheries Committee is responsible for assessing the initial proposal for timber harvest to determine the impact of proposed harvesting on fisheries resource targets and strategies in the CCLUP. The committee considers "fisheries targets" to mean no net loss to fish habitat (Fisheries Target Committee, 1996).

Assumptions were used to estimate potential cumulative impacts for biodiversity units that are watersheds and also for groups of biodiversity units that make up larger watersheds. The committee's assumptions are as follows:

- Negative impacts to fish habitat tend to increase in proportion with the percent of watershed area that is in a disturbed condition at any given time.
- The major disturbances that are of concern for this report and which can be estimated at the landscape level are timber harvesting on crown land and deforestation of private land.
- Cumulative impacts on fish habitat are mainly caused by sediment deposition in channels, channel instability, the destabilization of streambanks, and changes in water flow, temperature, and quality. These can result from road building, logging unstable slopes, disturbance of riparian areas, and increased peak streamflows resulting from timber removal (eg. IWAP Guidebook 1995 Appendices 8 and 9, Rood and Hamilton 1995). These disturbances occur on both crown land and private land.
- Cumulative impacts due to the above factors can be approximated from equivalent clearcut area and terrain characteristics.

(Fisheries Target Committee, 1996)

In comparing Fisheries Risk Estimates and Level 1 Watershed Assessments (IWAP) the committee stated that Level 1 watershed assessment results are not an absolute measure of fish habitat impact, and should be used as a screening tool to assist a stakeholder committee in deciding whether more detailed studies should occur.

The CCLUP management objectives identified for the Chilko and Taseko River watersheds were riparian protection and controlled rate of harvest. A copy of the Fisheries target Risk Assessment prepared for the CCLUP Integration Process can be found in Appendix 4 of this report.

6.0 Chronology of Major Reports (Summaries)

The following table commencing on page 29 attempts to provide the reader with samples of relevant current and historical reports of interest and importance. The number of reports that have been written on the Chilko River Watershed are far too numerous to list in this report and come from a variety of sources. The reader is encouraged to compliment this list by conducting his/her own research through the Internet and by contacting the following:

- Fisheries and Oceans Canada
- Ministry of Sustainable Resource Management
- Ministry of Air, Land and Water Protection
- Pacific Salmon Commission
- Ministry of Forests
- BC Parks
- Tsilhquot'in National Government
- The Xeni Gwet'in First Nations Government
- The Chilko Resorts and Community Association
- Lignum Ltd
- Riverside Forest Products Ltd
- Yun Ka Whu'ten Holdings Ltd

An "Interesting Internet Sites" list of watershed and fishery addresses provided by local area stewardship coordinator Sue Hemphill has also been attached in Appendix 8.

7.0 Summary Recommendations for Each Sub-Basin

Aside from the Bidwell Creek IWAP which was completed by Summit Environmental of Vernon, BC, the following recommendations have been provided by the Chilcotin Overview Watershed Assessment Report – Priority Area No. 6 written in 1997 for the Tsilhqot'in National Government by Klohn-Crippen Consultants Ltd. of Richmond, BC. The objectives of the assessment were:

- To evaluate the health of the watersheds:
  - Through procedures outlined in the Interior Watershed Assessment Procedure (IWAP);
  - Through assessment of riparian impacts and biodiversity concerns; and
  - Through discussions with concerned Tsilhqot'in communities.
- Recommend appropriate follow-up work programs and projects which would emphasize sustainable forestry uses and local community involvement.

(Klohn-Crippen, 1997)

7.1 Lower Taseko River

The Lower Taseko River sub-basin was further divided into 5 smaller sub-basins for the IWAP. Mass wasting impacts are not a concern in this watershed as the terrain is relatively flat with little or no potential for landslides. There are no direct impacts as identified by the Interior Watershed Assessment Procedure (IWAP) for the Lower Taseko River watershed.

The Tsilhqot'in people have noted wild game and fish harvested from this area has declined in the last two decades. According to forest cover information used for these assessments, roughly 16% of the Lower Taseko River watershed has been logged mostly since the late 1980s. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems. (Klohn-Crippen, 1997)

Lower Taseko Polygon No. 139a		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
461	252.4	0.19	0.13	0.19	0.68	19.0	75.9	33	44	9.5	0.056
462	21.1	0.05	0.05	0.00	0.72	0.7	5.9	0	4	0.00	0.000
463	7.8	0.00	0.00	0.00	0.00	0.0	0.0	0	0	0.00	0.000
464	7.1	0.20	0.04	0.00	0.00	0.6	1.6	0	0	0.00	0.000
465	145.1	0.23	0.08	0.00	0.89	15.9	67.4	0	42	0.00	0.000

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An assessment of both the impacts of sediment loading on the spawning habitat available to chinook salmon and potential temperature related habitat problems
- An in-depth review of all existing information and consultation to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat with a focus on bull trout and its habitat
- A sediment source survey (SSS) for the unnamed tributary in the southeast area of the polygon and adjacent to the Upper Haines watershed
- An Access Management Plan (AMP) be developed in consultation with all stakeholders
- An Integrated Watershed Restoration Plan (IWRP) be developed as part of a larger Haines Creek watershed restoration project
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.2 Middle Taseko River

The Middle Taseko River sub-basin was further divided into 6 smaller sub-basins for the IWAP. Mass wasting impacts are also not a concern in this watershed as the terrain is relatively flat with little or no potential for landslides. Direct impacts identified by the IWAP for the Middle Taseko River Watershed include 1) peak flows in sub basin 504 due to high density of roads, and 2) high surface erosion potential for sub-basin 505 due to proximity of roads to stream channels, the number of stream crossings and road density.

As with the lower Taseko River watershed, the Tsilhqot'in people have noted wild game and fish harvested from this area has declined in the last two decades. According to forest cover information used for these assessments, roughly 8% of the Middle Taseko River watershed has been logged mostly since the mid -1980s. Remaining mature and old growth forest cover is less than 20% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems. (Klohn-Crippen, 1997)

Middle Taseko Polygon No.139b		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
501	14.1	0.20	0.33	0.01	1.00	0.9	7.2	5	10	1.3	0.17
502	14.1	0.25	0.37	0.00	0.95	1.5	5.9	6	5	1.3	0.14
503	33.2	0.21	0.39	0.00	0.15	0.412	24.3	9	1	5.8	0.24

504	**36.8**	**0.49**	**0.44**	**0.18**	**0.90**	**7.6**	**38.0**	**15**	**11**	**5.5**	**0.34**
505	**15.3**	**0.42**	**0.72**	**0.17**	**0.00**	**2.8**	**20.9**	**12**	**0**	**3.4**	**0.46**
506	**168.8**	**0.16**	**0.17**	**0.00**	**1.00**	**9.2**	**67.3**	**23**	**72**	**11.2**	**0.13**

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An assessment of both the impacts of sediment loading on the spawning habitat available to chinook salmon and potential temperature related habitat problems
- An in-depth review of all existing information and consultation to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat with a focus on bull trout and its habitat
- A sediment source survey (SSS) for sub-basins 504 and 505 to identify and evaluate risks of sediment contributions to fish habitat. The SSS could be part of a larger SSS for the entire Haines Creek watershed
- An Access Management Plan (AMP) be developed in consultation with all stakeholders
- An Integrated Watershed Restoration Plan (IWRP) be developed as part of a larger Haines Creek watershed restoration project
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.3 Upper Chilko River

The Upper Chilko River sub-basin was further divided into 5 smaller sub-basins for the IWAP. Mass wasting impacts are also not a concern in this watershed since there are no forest harvesting related activities. Several non-forestry related riparian impacts were identified in this sub-basin and include recreational and agricultural activities.

The number of wild game and fish harvested from this area has declined in the past two decades according to the Tsilhqot'in people. This watershed supports one of the largest sockeye salmon runs on the Fraser River system. According to forest cover information used for these assessments, there has been no forest harvesting activity in the Upper Chilko River watershed. Remaining mature and old growth forest cover is less than 15% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems (Klohn-Crippen, 1997).

Upper Chilko River Polygon No.141d		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length Km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
521	13.1	0.15	0.00	0.00	0.39	0.8	0.0	0	1	0	0.00
522	2.2	0.00	0.00	0.00	0.00	0.0	0.0	0	0	0	0.00
523	12.2	0.27	0.00	0.00	0.41	1.3	0.0	0	1	0	0.00
524	4.8	0.57	0.00	0.00	0.00	1.1	0.0	0	0	0	0.00
525	173.2	0.21	0.40	0.01	0.83	5.2	135.1	51	45	30.2	0.780

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat on streams other than the Chilko River mainstem
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.4 Elkin Creek

The Elkin Creek sub-basin was further divided into 4 smaller sub-basins for the IWAP. Mass wasting impacts are also not a concern in this watershed since there are no forest harvesting related activities. The sub-basin is home to a small Chinook salmon population and the area has been studied by Tredger for possible steelhead enhancement. Access to many potential angling sites may produce pressure on sensitive bull trout populations and as a result strict fisheries resource management measures should be implemented to conserve this resource. Riparian impacts related to recreational activities have been identified in this sub-basin.

The Tsilhqot'in people have noted wild game and fish harvested from this area has declined in the last two decades. According to forest cover information used for these assessments, there has been no forest harvesting activity in the Elkin Creek watershed. Roughly 4% of the area has been burned. Remaining mature and old growth forest cover is less than 15% of the watershed. Further assessments could include the following:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems (Klohn-Crippen, 1997).

Elkin Creek Polygon No.154		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length Km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
481	16.0	0.00	0.00	0.00	1.00	0.0	0.0	0	14	0.0	0.000
482	34.9	0.00	0.00	0.00	0.87	0.0	0.0	0	10	0.0	0.000
483	34.8	0.05	0.05	0.00	1.00	0.7	1.8	1	33	0.9	0.053
484	140.2	0.13	0.39	0.00	1.00	7.3	93.0	46	73	20.4	0.420

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard*

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat on all fish bearing streams in the watershed
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.5 Tete Angela Creek

The Tete Angela Creek sub-basin was further divided into 3 smaller sub-basins for the IWAP. Mass wasting impacts are not a concern in this watershed as the terrain is relatively flat with little or no potential for landslides. Areas of direct impact include 1) peak flows sub-basin 492 due to high density of roads; and 2) high surface erosion potential for sub-basin 492 due to the number of stream crossings and road density.

The number of wild game and fish harvested from this area has declined in the past two decades according to the Tsilhqot'in people. According to forest cover information used for these assessments, roughly 5% of the Tete Angela Creek watershed has been logged mostly since the early1970s. Remaining mature and old growth forest cover is less than 25% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems. (Klohn-Crippen, 1997)

Tete Angela Creek Polygon No.159		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
491	109.8	0.12	0.19	0.00	0.09	0.0	28.3	19	2	6.8	0.258
492	46.7	0.42	0.59	0.15	0.00	2.3	39.6	28	0	9.0	0.848
493	157.0	0.18	0.41	0.07	0.63	14.1	106.0	50	25	25.6	0.675

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to update FC and TRIM files and to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat focusing mainly on sub-basins 492 and 493 where there are forest harvesting activities
- A sediment source survey (SSS) for sub-basins 492 and 493 (where there are forest harvesting activities) to identify and evaluate risks of sediment contributions to fish habitat
- Access Management Plan (AMP) in consultation with all stakeholders to obtain agreement which roads require de-activation in areas where there is logging activity (namely sub-basins 492 and 493)
- An Integrated Watershed Restoration Plan (IWRP) as part of a larger Haines Creek watershed restoration project which addresses the concerns of all stakeholders and prescriptive measures
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.6 Tsuniah Lake

The Tsuniah Lake sub-basin was further divided into 7 smaller sub-basins for the IWAP. Mass wasting impacts are not a concern in this watershed as there are there are no forest harvesting related activities. There are no direct impacts as identified by the IWAP for the Tsuniah Lake watershed. Some direct riparian impacts have been identified and are related to recreational activities.

The number of wild game and fish harvested from this area has declined in the past two decades according to the Tsilhqot'in people. According to forest cover information used for these assessments, there has been no forest harvesting activity in the Tsuniah Lake watershed. Roughly 4% of the area has been burned. Remaining mature and old growth forest cover is less than 10% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems. (Klohn-Crippen, 1997)

Tsuniah Lake Polygon No.160		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
511	12.2	0.05	0.00	0.00	0.79	0.2	0.0	0	3	0.0	0.000

512	**4.6**	**0.03**	**0.00**	**0.00**	**0.73**	**0.0**	**0.0**	**0**	**1**	**0.0**	**0.000**
513	**3.6**	**0.12**	**0.00**	**0.00**	**0.00**	**0.2**	**0.0**	**0**	**0**	**0.0**	**0.000**
514	**4.6**	**0.97**	**0.00**	**0.00**	**0.00**	**1.9**	**0.0**	**0**	**0**	**0.0**	**0.000**
515	**7.7**	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.1**	**0**	**0**	**0.0**	**0.013**
516	**16.0**	**0.27**	**0.57**	**0.00**	**1.00**	**1.0**	**10.9**	**5**	**14**	**5.2**	**0.683**
517	**116.8**	**0.14**	**0.41**	**0.00**	**0.26**	**3.9**	**78.7**	**45**	**6**	**15.6**	**0.673**

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to update FC and TRIM files and to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat on all fish bearing streams in the watershed
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.7 Lingfield Creek

The Lingfield Creek sub-basin was further divided into 3 smaller sub-basins for the IWAP. Mass wasting impacts are not a concern in this watershed as there are there are no forest harvesting related activities. There are no direct impacts as identified by the IWAP for the Lingfield Creek watershed. A rare and spectacular landscape results from four Biogeoclimatic Zones being present in this one small watershed. This fact, together with an exceptionally high traditional use value focusing on the Potatoe range, results in very high sensitivity.

The number of wild game and fish harvested from this area has declined in the past two decades according to the Tsilhqot'in people. According to forest cover information used for these assessments, there has been no forest harvesting activity in the Lingfield Creek watershed. Remaining mature and old growth forest cover is less than 10% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems (Klohn-Crippen, 1997).

Lingfield Creek Polygon No.163		**Hazard Indices***				**Additional Information**					
Sub basin	**Area Sq. km.**	**Peak Flow**	**Surface Erosion**	**Riparian Buffer**	**Mass Wasting**	**ECA (equivalent clearcut area) Sq. km**	**Road Length km**	**Number of Stream Crossings**	**Number of Land-slides**	**Roads 100m to creek (km)**	**Road Dens. km/km²**
531	**66.5**	**0.11**	**0.29**	**0.00**	**0.80**	**2.4**	**11.2**	**20**	**16**	**5.1**	**0.168**
532	**21.0**	**0.01**	**0.00**	**0.00**	**1.00**	**0.0**	**0.0**	**0**	**17**	**0.0**	**0.000**
533	**19.9**	**0.17**	**0.95**	**0.00**	**1.00**	**0.2**	**30.0**	**16**	**22**	**9.4**	**1.506**

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to update FC and TRIM files and to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat on all fish bearing streams in the qatershed
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.8 Nuntsi Creek

The Nuntsi Creek sub-basin was further divided into 4 smaller sub-basins for the IWAP. Mass wasting impacts are also not a concern in this watershed as the terrain is flat and there is no forest harvesting related activities. There are no direct impacts as identified by the IWAP for the Nuntsi Creek watershed.

The number of wild game and fish harvested from this area has declined in the past two decades according to the Tsilhqot'in people. According to forest cover information used for these assessments, there has been no forest harvesting activity in the Nuntsi Creek watershed. Remaining mature and old growth forest cover is less than 5% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems (Klohn-Crippen, 1997).

Nuntsi Creek Polygon No.167		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km^2
471	20.4	0.08	0.34	0.00	0.00	0.0	3.4	8	0	1.4	0.169
472	14.3	0.23	0.31	0.00	0.00	1.1	5.2	3	0	2.0	0.365
473	55.2	0.10	0.04	0.00	0.00	2.2	6.0	2	0	0.6	0.110
474	44.2	0.01	0.03	0.00	0.22	0.0	3.9	1	2	0.4	0.089

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard*

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to update FC and TRIM files and to minimize overlap of proposed Level 2 studies
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.9 Choelquoit Lake

The Choelquoit Lake sub-basin was further divided into 5 smaller sub-basins for the IWAP. Mass wasting impacts are not a concern in this watershed since the terrain is flat. Direct impacts as identified by the IWAP for the Choelquoit Lake watershed include 1) peak flows for sub-basin 542 due to high density of roads; and 2) high surface erosion potential for sub-basin 542 due to proximity of roads to stream channels, the number of crossings and road density.

The number of wild game and fish harvested from this area has declined in the past two decades according to the Tsilhqot'in people. According to forest cover information used for these assessments, 9% of the Choelquoit Lake watershed has been logged since the early 1990s. Remaining mature and old growth forest cover is less than 20% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems. (Klohn-Crippen, 1997)

Choelquoit Lake Polygon No.172		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
541	37.9	0.57	0.40	0.40	0.26	8.3	32.4	15	2	4.5	0.854
542	19.0	0.73	1.00	0.10	0.00	4.5	35.1	21	0	8.6	1.843
543	9.5	0.20	0.20	0.00	0.00	0.142	5.2	0	0	0.8	0.547
544	7.1	0.18	0.16	0.00	0.00	0.0	4.1	0	0	0.4	0.575
545	122.9	0.13	0.23	0.00	0.91	3.5	77.1	28	3	8.1	0.627

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat
- A sediment source survey (SSS) for sub-basins 541 and 542 (where there are forest harvesting activities) to identify and evaluate risks of sediment contributions to fish habitat
- Access Management Plan (AMP) in consultation with all stakeholders to obtain agreement which roads require de-activation in areas located in the northern areas of the watershed
- An Integrated Watershed Restoration Plan (IWRP) as part of a larger Haines Creek watershed restoration project which addresses the concerns of all stakeholders and prescriptive measures

- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

7.10 Bidwell Creek

The Bidwell Creek sub-basin was further divided into 3 smaller sub-basins for the IWAP. Concerns in this sub-basin based on the findings by Summit Environmental include 1) Lower Bidwell sub-basin Peak Flow index, 2) the North Bidwell Sub-basin riparian buffer index, and 3) the Upper Bidwell sub-basin Peak Flow and Riparian Buffer index. These results indicated that a Level 2 channel assessment was required. Tsilhqot'in government leaders and staff who initiated this project expressed grave concerns regarding the past, present and potential future impact of road access to high value habitats for large mammals. The numbers of moose, deer, and bears are all believed to be declining and road access to riparian and wetland areas, especially those more exposed by clearcut logging, is viewed to be the primary cause. (Summit Environmental)

As indicated above, the Level 1 IWAP analysis indicated that changes in peak flow are a potential area of concern for the Lower Bidwell and Upper Bidwell sub-basins. Anecdotal evidence of increased water levels in the watershed has been provided from local residents. Increased water levels in the watershed are consistent with a large number of studies done on watersheds from around the world which show increases following forest harvest in both water yield (total volume of water flowing out of a watershed) and in peak flow. The threshold ECA for these changes to be detected is about 20%. Changes in peak flow do not appear to have had an impact on stream channel morphology or bank stability, but have reportedly impacted land use in the basin by raising the water table in a number of hay fields, thus reducing crop yields. These changes are a function of the watershed ECA, and are watershed scale phenomena. As such, the only mitigation is ECA reduction. Adherence to the *Forest Practices Code of B.C. Act* in any current or future forest harvest operation should be adequate to minimize future direct impacts on the stream channel network (Summit Environmental).

Bidwell Creek Polygon		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km^2
Lower	48.0	.49	.10	.11	.16	n/a	n/a	n/a	n/a	n/a	n/a
North	85.0	.27	.19	.73	.00	n/a	n/a	n/a	n/a	n/a	n/a
Upper	131.0	.52	.25	.54	.00	n/a	n/a	n/a	n/a	n/a	n/a

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Summit Environmental 1996))

The following recommendations are based on the results of the assessment program:

- The culvert at Site #11 should be re-installed to lie flush with the channel bed.
- Sediment sources at Sites #9, 12 and 4 should be reclaimed
- Discharge (flow) in the Bidwell Creek watershed should continue to be monitored to evaluate the effects of changing ECA. The Bidwell basin is one of the few streams in the area with a streamflow data base, and additional data will be useful for examining ECA-discharge relationships in the region. In addition to the flow gauge near the mouth, an additional station should be installed in Upper Bidwell.
- Water quality monitoring should also continue. As a minimum, samples should be obtained quarterly for a two year period at some of the same sites covered in this report. This will provide information covering a range of flows and seasonal conditions. As is the case with discharge, longer term monitoring presents an opportunity to evaluate the influence of ECA on water quality.
- It is suggested that because of its relatively remote location, semi-permanent deactivation should be the minimum deactivation level applied in the watershed. (Note that this is presented as a suggestion only, since the choice of deactivation level falls within the mandate of the Chilcotin Forest District.)
- Level 2 road prescriptions should be done on the following roads: E1, E3, E6, L2, L2.2, L2.3, and North Main. The highest priorities are E3 and E6. In addition, during the level 2 work, it is recommended to confirm the status of the following roads: E1.3, E1.4, E1.5, E3.2, E10, and L1.5.
- If a semi-permanent deactivation standard is adopted for the watershed, the roads accessed by North Main should be upgraded from a temporary to a semi-permanent deactivation level.
- Riparian/wetland corridors at the nine impact areas should be considered for revegetation prescription work, focussing on creation of wildlife tree patches of local poplar trees and other desirable wildlife habitat enhancing species, especially forage shrubs.
- Further consultation with local resource managers is needed to determine specific needs and preferred restoration techniques.
- Riparian prescription work should be tied in with level 2 road prescription work.

7.11 Lower Chilko River

The Lower Chilko River sub-basin was further divided into 3 smaller sub-basins for the IWAP. Mass wasting impacts are not a concern in this watershed since the terrain is relatively flat with little or no potential for landslides. There are no direct impacts as identified by the IWAP for the Lower Chilko River watershed although it is important to note that several cut blocks are concentrated along the eastern boundaries of sub-basin 452 and 453.

The number of wild game and fish harvested from this area has declined in the past two decades according to the Tsilhqot'in people. According to forest cover information used for these assessments, 5% of the Lower Chilko River watershed has been logged since the mid 1980s. Remaining mature and old growth forest cover is less than 15% of the watershed. Restoration activities need to address development of an ecosystem management approach to:

- Provide suitable habitat conditions for all native species
- Maintain integrity of forest ecosystem network (FEN) corridors; and
- Minimize impacts of future forest and range use on diversity, productivity and sustainability of aquatic and terrestrial ecosystems. (Klohn-Crippen, 1997)

Lower Chilko River Polygon No.177		Hazard Indices*				Additional Information					
Sub basin	Area Sq. km.	Peak Flow	Surface Erosion	Riparian Buffer	Mass Wasting	ECA (equivalent clearcut area) Sq. km	Road Length km	Number of Stream Crossings	Number of Land-slides	Roads 100m to creek (km)	Road Dens. km/km²
451	184.7	0.07	0.10	0.00	0.72	0.4	47.1	10	36	8.1	47.1
452	34.0	0.60	0.24	0.09	0.00	8.2	35.1	7	0	1.6	35.1
453	40.5	0.29	0.47	0.09	0.60	4.2	57.9	11	6	7.3	57.9

**Note: Hazard indices* <0.5=low hazard, 0.5-0.7=medium hazard, >0.7= high hazard

Recommendations for Additional Assessments: (Klohn-Crippen, 1997)

- An in-depth review of all existing information and consultation to minimize overlap of proposed Level 2 studies
- Fish and Fish Habitat Assessments (FHAPs) to obtain a current inventory of fish and fish habitat with a focus on bull trout and its habitat
- A sediment source survey (SSS) for for the unnamed tributary in the southeast area of the polygon and adjacent to the Upper haines watershed, to identify and evaluate risks of sediment contributions to fish habitat
- Access Management Plan (AMP) in consultation with all stakeholders to obtain agreement which roads require de-activation in for logged areas located east of the Taseko River
- An Integrated Watershed Restoration Plan (IWRP) as part of a larger Haines Creek watershed restoration project which addresses the concerns of all stakeholders and prescriptive measures
- Terrestrial Ecosystem Mapping (TEM) be conducted with special emphasis on establishing Forest Ecosystems Networks (FENs)

8.0 Local Issues and Concerns

The following watershed and fishery related issues and concerns have been brought forth by the residents of the Chilko River watershed:

- The residents would like to play a more active role in the decision-making processes that affect their watershed. At times, they feel their concerns are ignored by the regulatory agencies whose role is to represent all interests in their capacity to serve as civil servants. The residents are interested in working with all stakeholders in the watershed, including First Nations people, government and industry in reaching consensus on how development should proceed in the area.

- The Fisheries and Oceans Canada Chilko River Sockeye Spawning Channel located approximately one kilometer downstream of the Chilko Lake outlet has been operationally unsuccessful since its construction a decade ago. As a result of its construction, it is suspected that the locally known Blue Pool has been affected by altered river flows, and is possibly shrinking in size. The local residents would like to see the channel decommissioned, and the surrounding area restored to its natural state as it was prior to channel construction.

- The local residents are concerned about the short term and long term effects of forest harvesting on their watershed. They find the public consultation process on individual cutblocks proposed for harvesting too time consuming, and would like to see a “blanket” or watershed approach in addressing the development of the area.

- Fisheries and Oceans Canada maintains a seasonal base of operations on the west side of the Chilko River just downstream of the Chilko Lake outlet. The local residents and business owners would like to see the site maintained in a better fashion to compliment the beauty of the surrounding area.

- The local residents would like to be kept better informed on local fishery research and operations conducted by both Fisheries and Oceans Canada and their First Nations partners, the Ministry of Sustainable Resource Development, and the Ministry of Water, Land and Air Protection.

- Long term concerns over water quality of the Chilko River due to sedimentation from development, and of Chilko Lake as a result of airborne pollutants from the lower mainland and Washington State bio-accumulating on local glaciers and ice fields.

- The local residents and lodge owners are very concerned that all fish species populations, including Pacific salmon and non-anadromous salmonids such as rainbow trout, Dolly Varden and bull trout, are maintained or increased through sound fishery management. This issue is of prime importance to the local fishing lodges.

- Local ranchers have expressed concerns about free access to the availability of water for their stock on the streams in the area and would like to see that access maintained.

- Residents have also expressed concerns about the population levels of furbearing animals that reside in the Chilko River watershed. They have stated that the current levels must be maintained or enhanced.

9.0 Discussion

A Global to Watershed View of Sustainability

"Sustainable development is about ensuring that some measure of human well-being is sustained over time. Fundamental to this approach to economic development is the requirement that any actions now which are likely significantly to impair the well-being of the future must be associated with actual compensation of the future. Otherwise the future is worse off than the present" (Pearce, 1993).

A century ago, the Chilko River watershed was a much different place than it is today, and the pressures on the utilization and impact of its natural resources was minimal. The same can be said about most areas of the world. Today, we are faced with the challenges of dealing with a population explosion, and the resulting demands on the world's natural resources. It has been said that if all the people of the world were to live the privileged western lifestyle that we have grown accustomed to, it would take the equivalent of three worlds to provide the required natural resources. There is just not enough to go around at our current rate of consumption.

The world's population is projected to increase by three billion people in the next 50 years. Within the next two decades the challenge of expanding food production to feed an additional 80 million is becoming more difficult (State of the World. 2001). As population increases, so does the demand for the world's natural resources including fish, timber and minerals.

The famed fisheries from all over the globe are now in jeopardy of collapse. Canada has not been exempt from this fishing pressure as is evidenced by the closure of the east coast cod fishery. "The growth in the oceanic fish catch exceeded even that of beef and mutton, increasing from 19 million tons in 1950 to 86 million tons in 1998, the last year for which data are available. This fourfold growth, too, was concentrated in the period from 1950 to 1990, a time during which the annual growth in the oceanic catch – at 3.8 percent – was easily double that of world population. As a result, seafood consumption per person worldwide roughly doubled" (State of the World. 2001). The oceans of the world have produced as much protein as possible and are now being overharvested.

People are now arguing that fish farms can help alleviate the pressure on oceanic fisheries to feed the population growth. This concept is only possible when fish farms find the

sustainable means to feed the farmed fish without impacting on fish in the ocean. It does not make sense to harvest so called "coarse fish" in the ocean to provide fish food to farmed fish when the food conversion rate is not sustainable far into the future. Quite often the catch utilized for farmed fish at a conversion rate of two or three to one (two – three kilograms of fish food to grow one kilogram of farmed fish) is a species that is quite acceptable to be eaten, as is, in most countries of the world. Salmon farms on the west coast of Canada are also impacting on the natural environment through pollution, disease and escapes into the wild. Fortunately, the world's largest aquaculture producer is China where the leading farmed fish is carp that feeds primarily on vegetation, and the farms are land based.

As a result of population growth throughout the world, a resulting ripple effect will influence natural resource management decisions in the Chilko River watershed. Increasing pressure to harvest timber in the area is a result of global demand for lumber for housing and other development. The Fraser River sockeye fishery, which includes the sockeye escapement into the Chilko River, is also under continuous pressure from a variety of sources. The current sockeye runs into the Fraser River system pale in comparison to the famed sockeye runs of a century ago. In 1913 the commercial catch of sockeye in the Fraser River was 32,000,000 (Roos, 1985). The Fraser River commercial catch of sockeye in 2001 was 24,011 (Fisheries and Oceans Canada, 2001. Appendix 5) If further declines continue, there will be no future commercial, sport or native fishery, and all available salmon will be allowed access to the spawning grounds. We are very near that point at present, and any detrimental impacts to the sockeye resource will impact further on its numbers and ability to sustain itself, even in the absence of a commercial, sport or native catch.

Environmental impacts on our fishery resource in the Upper Fraser River area is not presently a unique problem as is evidenced by the impact of a mining dam constructed on the Quesnel River in the late 1800s. "Prior to 1909 the Quesnel District summer-run sockeye began to suffer depletion as a result of a dam constructed on the Quesnel River in 1896-1897. The dam, placed just below the outlet of Quesnel Lake to impound water for the Golden River Quesnel Company mining operation, was 763 feet long and 18 feet wide. The gates were closed on September 11, 1898, and in that year, and in 1899, no fish got through. Following protests, a fishway of sorts was installed in 1900 by the mining company in the middle of the dam, but where the river was often dry. The mining company was subsequently closed down in 1900. This ineffective fishway had an opening for fish passage only 11 inches high and 10 inches wide" (Roos, 1985).

The sport fishery in the Chilko River watershed is an integral component of the local economy. Sport fishermen from around the world fish the local waters in search of rainbow trout, bull trout and Dolly Varden. It is anticipated that this type of recreation will increase substantially as the "baby boomer" generation reaches retirement and spends more time seeking recreational activities that are active rather than sedentary. To alleviate the increasing pressure on the sport fishery in the Chilko River, a catch and release regulation is in effect to sustain the fish populations.

The forests of the Chilko River watershed are also of importance to the local economy. Timber harvested in the area by several companies is milled in the Chilcotin region and in the town of Williams Lake. B.C.'s Forest Practices Code came into effect on June 15, 1995. Carrying the force of law, the code ensures that what happens in our forests is well planned and takes all values into account. It provides certainty in our forests, as government, industry and the public know what standards of management are expected, and that the penalties for breaching those standards are strong, fair and effective (Forest Practices Code. 1995).

In the Fish Lake area of the Taseko River watershed, Taseko Mines Ltd. has made application to the Environmental Assessment Office to develop an open pit copper gold mine. Their proposal suggests the mine would create 400-700 fulltime positions and that its life expectancy would be 21-24 years. The Environmental Assessment Office is currently awaiting a stage 2 proposal. Fish Creek, Beece Creek, Vick Creek, Taseko River and Tete Angela Creek are the watersheds that could be affected by the mine development plan options; the transmission corridor crosses a much wider area and therefore has the potential to affect other watersheds. (Environmental Assessment Office)

It is becoming evident that competing interests in the Chilko River watershed are chasing a limited resource base. The question needing to be answered is which developmental direction is for the better good of future generations if the word “sustainability” is to have any meaning. In contemplating this, we must also recognize that the three pillars of sustainable development include a healthy environment, a healthy society, and a healthy economic base.

Traditional neo-classical economic circular flow models don’t recognize the importance of placing a value on the very things that are necessary to sustain life on earth. Our world is not sustainable until the environment is recognized within the equation and not as an externality. The first law of thermodynamics is very simple and states that matter and energy cannot be either destroyed or created. There is a fixed total, which is always conserved in some way or another. Taking this observation a bit farther, we can then assume that if we reap something good from the environment, we should by right replace it with something of equal or greater value, otherwise we really aren’t taking care of things in a positive fashion for future generations.

The lives of the Xeni people in the Chilko Lake area a century ago was one tied very closely to the land. Their demands on the natural environment were sustainable, and they lived as a part of the environmental cycle. We cannot return to the past, but as individuals we really must endeavor to make less of a footprint in our time on earth. On a watershed scale, all living organisms are delicately linked and for every action, there is a corresponding reaction. Much can be learned from the old ways of the Xeni people of the Chilko River watershed.

10.0 Suggestions and Recommendations

The following suggestions and recommendations are intended to guide residents, stakeholders, regulators and developers in the Chilko River watershed. Through implementation it is hoped the results will enable them to make sound informed decisions on sustainable development in the watershed.

- A Chilko Lake Study Team came together from 1991 to 1993 to develop a series of land use recommendations for the area. The team was comprised of local residents, First Nations, industry and government agencies. One of the recommendations that came out of this process was to establish a Local Advisory Group to address ongoing land use issues. The group was intended to work by consensus and include a mechanism to resolve disputes. Also discussed during this process was the lack of specific management plans for the peripheral areas of the Chilko Lake area and the recognition of the need for the decision making process to continue to address these areas. It is recommended that the Chilko Lake Study Team, or a group similar be reestablished and maintained on a continuing basis to address all land use issues in the Chilko River watershed. There is a noted frustration on the part of residents and local business owners in the Chilko River watershed that their voices are not heard by the regulatory agencies.

- A review of the Interior Watershed Assessment Procedures (IWAPs) conducted by Summit Environmental and Klohn Crippen should be undertaken to determine if their findings and recommendations could assist in the restoration of impacted areas of the Chilko River watershed. Much time, effort and money was spent in having these professionals analyze the watershed and it would seem prudent to accept their findings and act on their recommendations. Watersheds can heal themselves in certain situations, but several outstanding problems found in their review should be revisited to determine their status.

  In particular, the Lingfield Creek sub-basin was identified as an area of very high sensitivity due to high traditional use values and the fact that it represents 4 Biogeoclimatic Zones. Also, the Bidwell Creek sub-basin was prescribed a Level 2 channel assessment and report findings indicate concern for the amount of roads in the sub-basin and that changes in peak flow are a potential for future concern. The Choelquoit Lake sub-basin 542 areas of concern include peak flows due to high density of roads, and the high surface erosion potential as a result of proximity of roads to streams, and the number of road crossings and density.

- A dedicated effort by the provincial government's Ministry of Sustainable Resource Management should be undertaken to address gaps in their fish and lake inventory program. The ability to make sound resource decisions hinges on known information. Much inventory information is available, but the database for the entire Chilko River watershed is incomplete. The process should also not be a onetime effort, but ongoing as fish populations and their habitats are continually

changing as anthropogenic factors influence their habitat. Once a fish stock comes close to extinction it is extremely difficult for it to recover and sustain itself.

- It is recommended that Fisheries and Oceans Canada decommission the Chilko River Sockeye Spawning Channel and restore the historical integrity of the Blue Pool located just upstream of the channel intake. The channel has never lived up to its production potential and is currently a drain on tax dollars. The channel area should be restored to its original natural state, and the money committed by Ottawa and the Pacific Region for its future operation should be utilized in the Chilko River watershed for ongoing fishery research on the sustainability of Pacific salmon.

- It is recommended that a joint effort by Fisheries and Oceans Canada and the provincial Ministry of Sustainable Resource Management be undertaken to research all fish species in the Chilko River watershed. Currently very little time, effort or money is dedicated to species other than sockeye salmon due to their value in the commercial fishery. Very little knowledge exists on several other species residing in the watershed.

- A sediment source monitoring program should be undertaken on impacted areas in the sub basins of the Chilko River watershed. These tributaries provide the much needed rearing areas for fry as they seek food and refuge from larger predators residing in the main stem rivers. Relatively inexpensive sampling equipment is now available that can be programmed to sample on their own or an individual can be employed to take samples for analyses. Sedimentation is detrimental to salmonids during most stages of their life cycle.

- It is recommended that the provincial Ministry of Sustainable Resource Management conduct more ongoing research on the delicate steelhead trout populations in the Chilcotin, Taseko and Chilko River systems. Due to currently limited budgets, and an anticipated further reduction in provincial budgets, it is feared that this stock will be studied less than is required to make sound management decisions that may affect its very existence.

- It is recommended that the implementation of a water quality testing program on Chilko Lake be undertaken and be continuous to determine the airborne effects of pollution from industrial sites in Washington State and southern BC as a result of southerly prevailing winds. This recommendation is based on review of the findings in the Canadian Arctic Contaminants Report which states that organochlorines (OCs) which include pesticides such as toxaphene, chlordane, and DDT and industrial chemical PCBs are polluting the arctic. The pollutants do not originate in the arctic - their source is from Europe and North America. Condensation in colder regions brings the pollutants to earth and due to colder temperatures, there is less evaporation and they can accumulate instead of evaporating and being transported away (Indian and Northern Affairs Canada).

- It is recommended that Fisheries and Oceans Canada continue to implement their zooplankton sampling program on Chilko Lake. The program determines the level of sockeye food in the lake for rearing fry and is critical information in determining the carrying capacity and resulting sockeye production numbers from the lake.

- Although there is currently a Rainshadow Grizzly Project funded through the Friends of the Nemaiah, very little research occurs in the watershed studying the intricate linkages between mammals and fish. There is a concern in the valley that due to limited research funding available to nongovernmental organizations, the research that is conducted is industry driven, and governmental agencies often do not represent a balance of all the interests in the area. It is recommended that any government research funds available for the area be utilized to conduct research addressing all points of view, and that government regulators find a balance in addressing concerns from all stakeholders in the Chilko River watershed.

- It is recommended that funds be allocated by both the federal and provincial government to assist local ranchers in providing localized watering areas for free range cattle in the small fish bearing tributaries of the Chilko River. This should include installation of natural structures to discourage cattle from accessing these small tributaries near critical fish habitat such as spawning areas.

- It is recommended that new innovative logging practices be applied to any future forest harvesting in the Chilko River drainage. These practices may help alleviate fears of potential fish and fish habitat damage in the watershed. Commercially harvested sockeye salmon numbers for the Fraser River (which includes the Chilko River) for 2001 totaled 24,011 compared to 1,320,140 in 1997 (Appendix 5). The status of wild Pacific salmon populations on the west coast is reaching a perilous state and Chilko River stocks must be provided with protection that goes beyond guidelines provided within the Forest Practices Code of British Columbia.

  A review of the consolidated five year forest development plan conducted by Herb Hammond of Silva Ecosystems Consultants Ltd is attached in Appendix 7 and discusses alternative ecosystem based development including balanced timber and non-timber forest uses.

- It is recommended that a regional fisheries library funded by the provincial and federal governments be located in Williams Lake. There is no need for anything elaborate and existing offices could fill this need. During the research of this project it became evident that much has been written on the Chilko River watershed and much more is available on a regional basis. Unfortunately, the information is stored in numerous locations within the region and within the province and little knowledge of reports from other agencies, or between departments within agencies was evident. Access to information and data is key in making informed resource based decisions.

- A final recommendation is the development of a monitoring strategy for resource development in the Chilko River watershed. Numerous recommendations from previous reports have gone unheeded. Watershed development is an ongoing issue, and as a result monitoring strategies can assist in evaluating the ever-changing biophysical conditions within the watershed, and provide guidance in planning a sustainable future for the Chilko River watershed.

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12.0 Appendices

Appendix 1. Letters to Stakeholders and Residents

Appendix 2. Fish Wizard Stream Reports

Appendix 3. FishWizard Lake Reports

Appendix 4. Five Year Forest Development Plan Review

Appendix 5. Chilko River Salmon Escapements 1938-2000

Appendix 6. Lake Enrichment Program-Chilko Lake

Appendix 7. A Review of the Five Year Consolidated Forest Development Plan

Appendix 8. A Pacific Salmon Commission Search List on the word "Chilko"