Morice Land and Resource Management Plan

A Brief Overview of Fish, Fisheries and Aquatic Habitat Resources in the Morice TSA

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BRITISH COLUMBIA

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This project was undertaken with a limited amount of resources in light of the extensive and diverse aquatic systems in the Morice TSA. While far from exhaustive, it is the hope of the author that this document will serve to inform the LRMP table of the location, condition, and importance of the major aquatic resource values in the Morice TSA.

Numerous people aided in this project by suggesting and providing resources, collecting information from databases I did not have access to, reviewing very rough drafts of this report, and/or providing the benefit of their experience in the Morice TSA. These include, in no particular order: Tom Pendray, Brenda Donas, Gary Cardinal, Len Seefried, Barry Huber and Barb Spencer (Fisheries and Oceans Canada), Dana Atagi, Matt Jessop, Marc Beere, and Paul Giroux (Ministry of Water, Land, and Air Protection), Greg Tamblyn, Regina Saimoto, Elmar Plate, Joe DeGisi, Dave Bustard, Jason Harris, Shawna Hartman, Patrick Hudson, and Shauna Bennett.

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1 Introduction

In October 2002, Chris Schell Consulting was retained by Ministry of Sustainable Resources Management to collect and compile fisheries information to present to the Land and Resources Management Planning (LRMP) process for the Morice Timber Supply Area (TSA), the LRMP plan area.

The objective of this report is to present a concise distillation and elaboration where necessary, of the existing knowledge, studies and reports related to fish, fish habitat, other aquatic resources, riparian management, and generally factors related to management of water and water quality as it relates to these resources. Where information is available, this document will describe where the resources exist, the relative value of the resources (qualitatively and quantitatively where appropriate), both within the study area and within the provincial context. This document is meant to highlight resource and habitat issues that are appropriate to be addressed at a strategic planning level (1:250, 000 scale).

1.1 Summary of Fish Species Life History, Biology, and Human Use

This document is intended for LRMP table participants, and the general public who may not have a familiarity with fish or aquatic biology. While a degree of familiarity with the affects of sediments, nutrients, etc. on aquatic habitat has been assumed, knowledge of fish species life history and habitat requirements has not. As a primer for this document, I have included a short description of some of the major sport fish species' life history and habitat requirements. Background information relevant to the water quality issues will be presented throughout the report as these issues arise.

1.1.1 Sockeye Salmon

Mature sockeye (*Oncorhynchus nerka*) migrate into their spawning systems from July to August, after 1-4 years in the ocean. They will spawn in rivers and streams in the vicinity of lakes, and less frequently on gravel beaches in the lakes themselves, from August to September. The fry emerge from the redds ("nests") in the spring and migrate into a "nursery lake", where they will rear, feeding on zooplankton for 1-2 years. Sockeye juveniles "smolt" (turn silver in colour and migrate downstream to the ocean) in the spring.

Sockeye is a much prized food fish, and the primary target of commercial ocean net fishers. First Nations groups and sport-fishers also take sockeye.

1.1.2 Chinook Salmon

Chinook (*O. tshawytscha*, a.k.a.: spring, king, tyee) are the first salmon to migrate into spawning systems, usually from May to July, thus the alias "spring salmon". They spawn from July to October. Due to their large size, these fish usually spawn in deeper water and over larger substrates than other salmon. The juveniles emerge in early spring and most rear in freshwater for 1-2 years before smolting in the spring. Juvenile chinook rear in the mainstem of larger creeks and rivers.

After steelhead, this is the most prized sport fish in the Skeena drainage, due mostly to its large size. Chinook are the largest of the Pacific salmon. Individuals over 45 kg have been captured, though most are less than 20 kg. Skeena chinook draw trophy anglers from around the world.

1.1.3 Coho Salmon

Coho (*O. kisutch*) are the latest salmon to migrate during the summer, often not entering spawning systems until late July or August. Spawning is also late, from October to November. Coho spawn in a diverse range of habitats, but are known to use small creeks further up the watershed than other salmon. The fry emerge the following spring and rear in freshwater for 1-2 years. Rearing juvenile coho show a strong habitat preference for the slack water habitat found in side and off channels, beaver ponds, wetlands, and oxbows.

Coho are taken by the commercial, first nation, and sport fisheries. This fish is a popular food fish and sport fish.

1.1.4 Pink Salmon

Pinks (*O. gorbuscha*) migrate during July and August, and spawn in September. They are not known for long migrations upstream and rarely migrate through lakes to spawn (though some Babine pink stocks migrating far up the Babine River and through the lake to spawn in tributaries). The fry emerge in the spring and move immediately downstream to rear in the ocean. There is no freshwater rearing. Pinks have a strict adherence to a 2 year ocean residency. As a result there is no mixing between years, creating two entirely separate stocks that spawn in the same location but in either odd or even years. This results in strong odd year / even year patterns in return numbers.

Pinks are taken in the commercial fishery. They are not a popular sport fish compared with other species of salmon, but are taken in the First Nations fisheries at Moricetown and in Babine Lake.

1.1.5 Steelhead

Steelhead (*O. mykiss*) are not taxonomically separate from resident rainbow trout, but they have an anadromous (migrating from the ocean to freshwater for reproduction) life history, and will be discussed separately.

There are two types of steelhead; summer and winter. Summer run steelhead migrate into freshwater from July to September, overwinter in large rivers, and resume migration to their spawning stream the following spring (April or May). The winter run steelhead migrate into freshwater during the late fall or early winter, and move to the spawning areas in the spring. Steelhead use a diverse range of habitat for spawning, from rivers to small creeks. Spawning takes place in May and June. The fry emerge from the redds in July and early August. Juvenile steelhead rear in freshwater for 1-4 years, usually moving downstream as they grow, and often occupying similar habitat to chinook (mainstem habitat). Steelhead juveniles smolt in the spring, and usually spend 1-3 years in the ocean before returning to spawn in freshwater. In contrast with salmon, steelhead do not necessarily die after spawning, though many do due to the high energy expenditure associated with spawning.

Steelhead may be the single most popular sport fish in British Columbia - prized for its energetic fight and size. The Morice TSA contains steelhead rivers that draw anglers from around the world. It is summer run steelhead that are fished, as this is the only type available during the summer/fall fishing season. There is a catch and release only regulation in place for the Skeena Watershed. This is a contentious issue with many anglers who feel there are sufficient stocks to support a retention fishery. This fish is taken as a bycatch in the commercial fishery, and by the native fisheries in the Skeena.

1.1.6 Resident Rainbow trout

Rainbow trout (*O. mykiss*) demonstrate a wide array of life history and growth patterns, including that of ocean going steelhead, above. Stream resident populations can mature at very small size (~15 cm, age 3) and spawn and rear in streams as small as 1-2 meters. Lake resident populations can grow up to several pounds before reaching maturity at age 5-6 (35-50 cm). These populations spawn in rivers and streams, usually near their lake if suitable habitat is present. Other populations will move between lake and river habitats throughout the year, to take advantage of different food resources. Most rainbow trout feed on invertebrates (plankton, gastropods, terrestrial and aquatic insects). Fish of this type will grow to 2-3 kg. Rainbow populations that feed on fish (piscivorous) can grow much larger, but populations like this are rare. There are three lakes in the Morice TSA with piscivorous rainbow trout populations: the Nechako Reservoir, Babine Lake, and Nadina Lake (DeGisi, in press).

Rainbow trout spawn in the spring, from May through June and the fry emerge in the late summer, usually from July to mid-August. Fry may rear in the stream where they emerged for several years, or they may move out of this stream almost immediately. Fry of lake and river rainbow will often rear in a "nursery" stream for 1-2 years before moving into the lake or larger river.

Rainbow trout is one of the most popular resident sport fish in North America. Popular amongst river and lake fishers, this fish is well known for its vigorous fight on a hook.

1.1.7 Cutthroat trout

Cutthroat trout (*O. clarki*) tend to be more common in coastal systems, while rainbow trout are dominant in interior drainages. In the Morice TSA, cutthroat are found in Skeena but not Fraser drainages. Spawning takes place, like rainbow trout, during the spring, from April to May in small creeks and rivers. The fry emerge in June-July and may leave the nursery system immediately or remain there for several years before moving into their adult habitat in a lake or river. Piscivory is common in mature cutthroat trout. Like rainbow trout, cutthroat are common and abundant in small systems as stream resident populations, and are frequently the dominant sport fish in trout bearing lakes.

Cutthroat trout are blue listed (vulnerable, BC Conservation Data Centre) in British Columbia.

Resident cutthroat trout, like rainbow, are very popular amongst sport fishers for both lake and river fishing.

1.1.8 Bull trout

Bull trout (*Salvelinus confluentus*) are a member of the char family of salmonids. Chars (bull trout, Dolly Varden, lake trout, and Arctic char) are more adapted to cold water than salmon or trout (Haas, 2001). Bull trout and Dolly Varden were only recognized as separate species in the past 10 years, and are known to hybridize in watersheds where they occur together.

Bull trout are blue listed (vulnerable, BC Conservation Data Centre) in British Columbia. This vulnerability is due largely to the adfluvial form of this fish, which migrates between larger rivers (and/or lakes) and small streams. Bull trout of this type can grow relatively large, and require large intact watersheds to fill the different habitat requirements over their life cycle. While migrating, populations can become quite spatially concentrated in small holding pools. If one of these holding pools was heavily fished, a spawning population of bull trout could easily be fished out in a single season.

Adfluvial bull trout spawn in small creeks high up in a watershed, from mid-September to mid-October. The spawning habitat is often located only in very specific locations associated with cover and upwelling groundwater. The juveniles emerge in the spring, and rear in the small system, moving progressively further downstream as they mature.

In the Morice TSA, bull trout are only targeted as sport fish in the Nanika River (D. Atagi, pers. comm.). In other watersheds, larger bull trout will frequently be taken when caught, but they are not specifically targeted. River fishers who are targeting other species such as coho, chinook, and steelhead can capture bull trout.

1.1.9 Dolly Varden

Dolly Varden (*S. malma*) are common stream resident fish in the Morice TSA. They are fall spawners (September – November) and the fry emerge in the spring. Dolly Varden are widespread, occupying river, lake and stream habitat. They are common in cold water systems (ie: glacial melt streams) not used by other species, but are also known to occupy warm wetland habitats. Dolly Varden do not grow to a large size (<300 mm) in the Morice TSA, and tend to occur at low densities.

Due to their small size, and lack-luster fight, Dolly Varden are not a popular sport fish. Dolly Varden are a blue listed species (BC Conservation Data Center). This designation appears to apply largely to the coastal anadromous form of Dolly Varden.

1.1.10 Lake trout

As the name implies, lake trout (*S. namaycush*) are found primarily in lakes. Spawning occurs in the fall and can take place in streams near the lake or on the near-shore lake bottom. When the fry emerge in the spring, they usually migrate immediately to the lake, and rear in deep water. Adult fish are piscivorous, long lived, and can grow to a large size. As with other char, lake trout prefer cool water, and occupy the deeper portions of the lake, below the warmer surface waters.

This is a species of regional concern due to its slow growth rate and late age of maturity. This species can live more than 40 years and reproductive maturity may only be reached by age 10. Lakes can be fished out of their spawning population of large, old individuals, and still have fish of harvestable size available to maintain angler interest and fishing pressure. In lake trout populations that have been over harvested, the collapses can be sudden, and can require decades to recover.

This species is a popular trophy fish for lake fishers due to its large size.

1.1.11 Kokanee

Kokanee are a form of sockeye salmon that do not migrate to the ocean. These fish rear in lakes as sockeye would, but remain there until reaching maturity. Size at maturity is much smaller than sockeye due to the lower productivity of lakes compared to oceans, and mature kokanee are rarely over 30 cm long. Spawning takes place during the fall in stream channels near the lake or on gravel beaches in the lake. The fry emerge in the spring and migrate almost immediately to the lake.

Kokanee can be captured by angling, but are not a popular sport fish due to their small size. Lake resident predators such as lake trout, cutthroat trout, and piscivorous rainbow trout will predate heavily on Kokanee.

2 Information Summary

The Morice TSA encompasses portions of both the Skeena and Fraser River drainages. There are fisheries information summary system (FISS) records for over 220 lakes in the Morice. Some rivers are heavily utilized by anadromous salmon while other have no anadromous fish access at all. Some watersheds have been extremely impacted by development while others are in pristine wilderness settings. In order to discuss these diverse aquatic systems and fisheries resources, the BC Watershed Atlas coverage was used to delineate 6th and 7th order watershed boundaries in the Morice. These areas are listed below and will be discussed separately.

In addition to the review of fish and aquatic resources in each watershed, areas with high fisheries values will be listed, as will any habitat concerns. Also, information on fisheries (native and sport) based on these resources will be presented in brief.

Table 1. List of major watersheds in the Morice River with comments pertaining to the major fish / fisheries resources in each.

Watershed	Comments
Morice River Watershed (Skeena Watershed)	High value river supporting many large anadromous fish runs as well as many important and sensitive resident fish populations. Relatively un-impacted but forestry development is progressing in the upper watershed.
Babine Lake and Tributaries (Skeena Watershed)	Babine Lake supports a high value lake fishery for rainbow trout and lake trout, and is the largest sockeye rearing lake in Canada. Tributaries support runs of coho, un-enhanced sockeye, and rainbow trout. This area also includes several rainbow/lake trout lakes that are popular with local anglers.
Upper Bulkley River (Skeena Watershed)	Supports many anadromous fish runs as well as resident populations. Habitat has been heavily impacted and there is concern for several fish populations, specifically sockeye and coho.
Nadina River Watershed (Fraser Watershed)	Some anadromous fish use (sockeye and chinook), as well as rainbow trout and bull trout. Nadina river is used for spawning and rearing habitat. There is concern for water temperature in the Nadina River.
Natowite Lake and Tributaries (Fraser Watershed)	No anadromous fish use. Lake resident rainbow trout and lake trout populations are fished. Important spawning and rearing habitat in the tributaries.
Tahtsa / Whitesail Lakes (Fraser Watershed)	No anadromous fish use of the Nechako Reservoir Lake resident rainbow trout are fished. Important spawning and rearing habitat in the tributaries.
Clore/Burnie Rivers (Skeena Watershed)	No anadromous fish use. Burnie lakes support cutthroat trout. Steelhead are suspected to access this area. Spectacular wilderness setting, not a heavily used angling resource.

2.1 Morice River

The Morice River watershed is located entirely within the Morice TSA and drains over 4,349 km^2 of the Interior Plateau and Coast Mountains into the Bulkley River at Houston. This system supports runs of sockeye, chinook, coho, and pink salmon as well as steelhead trout. Resident sport fish populations include rainbow trout, cutthroat trout, bull trout, Dolly Varden, lake trout, lake and mountain whitefish, and burbot. Non-sport fish populations include lamprey, suckers, dace, shiners and sculpin. Much of the fisheries information for the Morice Watershed was reciently reviewed by Bustard and Schell (2002), and the information presented here follows that report.

Most of the habitat used by spawning salmon is located downstream of large lakes. Morice and Nanika lakes are the largest in the watershed and moderate temperatures, flows, and sediments in both Morice and Nanika rivers. The areas immediately downstream of these lakes often remain ice-free during winter, improving egg overwinter survival of the chinook and sockeye populations that spawn here. The effect of the lakes also provides clear water fishing conditions when other systems are "blown-out" by high flows.

Morice River water quality has been characterized as excellent due to the neutral pH, low alkalinity, conductivity, and clear water (Remington 1996). Nutrient levels are usually below detection limits. Morice Lake's low productivity has caused it to be identified as a target for nutrient additions to improve rearing for juvenile sockeye (Shortreed *et al.* 2001).

Nanika falls, located immediately downstream of Kidprice Lake, is a barrier to upstream fish passage and marks the upstream limit of anadromous fish use.

The Morice River watershed contains some of the most heavily used and highest quality un-enhanced fish spawning and rearing habitat in the Morice TSA. This river is one of the most important chinook rivers in the Skeena, producing ~25% of the Skeena total. It is also estimated to produce, on average, 6% of Skeena coho, 9% of Skeena pinks, 6-8% of Skeena steelhead, and supports the only significant run of sockeye in the Bulkley/Morice.

Besides this river's anadromous fish stocks, it also supports important resident populations of bull trout (blue listed), Dolly Varden (blue listed), rainbow trout, cutthroat trout (blue listed), and lake trout (regional concern).

The Morice River is the most popular sports angling destination in the Morice, with a world-class reputation for chinook and steelhead fishing. It is also very highly regarded by local anglers. The Nanika sockeye run is targeted by the First-Nations fishery at Moricetown.

Table 2. List of fish species known to occur in the Morice River Watershed and comments on each.

Fish Species	Comments
Sockeye Salmon	Spawns primarily (96%) in Nanika River, and secondarily in the beaches of Morice Lake and in the Atna River. Juveniles rear in Morice Lake. Escapements of 22,000 to 41,000 since 1991, but lower (<5,000) since 1998. Minor component (1-2%) of Skeena escapement compared to Babine Lake, but important food fishery for Wet'suwet'en in Moricetown.
Chinook Salmon	Spawns primarily (84%) in the Morice River gravel dunes between Morice Lake and the Thautil River confluence. Some other spawning and rearing in Nanika River, lower Gosnell and Lamprey creeks, and remainder of Morice River. ~10,000 fish average annual escapement, accounts for 25% of the Skeena chinook run.
Coho Salmon	Spawn primarily (80%) in Morice mainstem from Thautil to Lamprey, additional spawning and rearing habitat is dispersed widely throughout the Morice watershed. Extremely depressed returns during 80's and 90's, (725 fish max count) rebounded after commercial fishery was cut back. 2001 run was second largest on record at ~17,000 spawners.
Pink Salmon	Spawns primarily (93%) in Morice mainstem between Thautil and Fenton Creek. First gained access to the Morice after installation of fishway at Moricetown in 1950, since grown to an annual run of ~75,000 spawners on average.
Steelhead Trout	Widespread spawning and rearing throughout the Morice watershed. Owen Creek is a particularly productive tributary for juveniles. Morice returns estimated at 1,834 – 6,751 spawners, or ~20% of Bulkley/Morice returns.
Bull Trout	Blue listed species. Spawn in upper reaches of Gosnell, Glacier, Denys, and the East fork of Starr Creek. Juvenile rear downstream of spawning sites. Size of population unknown.
Resident Rainbow Trout	Associated with many of the larger lakes: Morice, Owen, Nanika, Kidprice, Stepp, Anzac, Lamprey, Phipps and Bill Nye Lakes. A single population of large fish appears to move between Morice Lake, Morice River, and Nanika River. Populations of small fish are found in some of the smaller tributaries.
Resident Cutthroat Trout	Blue listed species. Found in McBride, Collins, Chisholm, Shea, Julian Holland lakes as well as many other smaller lakes and ponds. Uncommon in Morice River and Lake and Nanika River. Present in many smaller creeks with accessible lake habitat.
Lake Trout	Present in Morice, Owen, McBride, and Atna Lakes. A species of concern regionally due to slow growth rates and late maturity.
Dolly Varden	Blue listed. Found in many small creeks throughout the Morice.
Kokanee	Present in McBride and Shea Lake.
Whitefish	Mountain whitefish has been found to be the most abundant fish species in Morice River and likely many of the other large river systems. Lake whitefish present in Morice and McBride lakes. Pigmy whitefish present in Morice and Owen Lakes.
Suckers and other non-sport fish.	Tsalpin Lake is a longnose sucker monoculture. White suckers and lake chub were the only species found above a barrier in Pimpernel Creek. Lake chub monoculture was also found above a barrier in Houston Tommy Creek. Populations of non-sport fish above barriers are rare and these lake chub populations have been identified as "regionally significant".

2.1.1 Key Areas with High Fisheries Values

2.1.1.1 Upper Morice River – Morice Lake to Gosnell Creek

This portion of the river is where roughly 20% of *Skeena* River chinook spawn, making it the highest value spawning habitat in the watershed. The 4 km immediately downstream of the lake is the most heavily used. Near the lake, the main chinook spawning area is characterized by a series of large gravel dunes. The formation of dunes in gravel rivers is rare, and is suspected to be caused by heavy spawning activity combined with the hydraulic conditions. The dunes improve water circulation through the redds. This combined with the effects of Morice Lake on winter flow and temperature levels create excellent conditions for egg incubation. Small numbers of coho and summer-run steelhead also spawn in this area.

This area and the upper Nanika River provide core year-round holding and feeding areas for Morice bull trout. A population of large resident rainbow trout that moves between Morice Lake, Morice River, and Nanika River also uses this area for adult rearing.

2.1.1.2 Mid Morice River – Gosnell Creek to Owen Creek

This length of river provides much of the spawning for Morice runs of coho, pink and steelhead. It is relatively unconfined, has a significant floodplain and extensive side channel development (see section 2.1.2.1). Coho and steelhead have a wide spawning distribution in the Morice watershed, but most (50-80%) spawn in this section of the Morice River, and primarily in the side channels. Morice pinks have a more restricted spawning distribution, with almost all spawning taking place in the side channels of this reach. Ponds and back channels of the floodplain also provide key rearing and overwintering habitat for coho.

2.1.1.3 Upper Nanika River – downstream of Kidprice falls

This length of river below Kidprice Lake is where 96% of Morice sockeye spawn. As this is the only significant sockeye run in the Morice and Bulkley rivers, this area is key to the Moricetown aboriginal fishery. This area also sees some use by chinook, coho, and small numbers of steelhead in some years.

The upper Nanika, along with the upper Morice, is a core holding area for Morice bull trout. It is also the only known spawning area for a population of large rainbow trout that move between Morice Lake, Morice River, and Nanika River.

2.1.1.4 Other key spawning and rearing areas

?? The accessible sections of **small tributaries to Morice and Nanika Rivers** are used by coho for rearing.

?? **Houston Tommy Creek** – is used by bull trout for spawning.

?? **Owen Creek** – including lower Puport Creek, contains some of the most productive steelhead habitat in the watershed. It also has high potential for coho, but multiple beaver dams limit access to these fall spawners during most years.

?? **Lamprey Creek** - including lower Pimpernel is used by steelhead for spawning and rearing.

?? **Thautil River** - above Starr Creek is a key spawning area for Thautil steelhead. Thautil tributaries Dany's, Loljuh, and upper Starr Creeks contain key spawning habitat for bull trout.

?? **Gosnell Creek** – the mainstem floodplain, especially upstream of the confluence with Shea Creek contains key coho spawning. The upstream reaches contain what is to date known to be the most heavily used bull trout spawning habitat in the watershed.

?? **Shea Creek to falls** – is a key spawning area for Gosnell steelhead.

?? **McBride Creek** - has high potential for coho, but beaver dams limit spawner access most years.

?? **Glacier Creek** – is the primary spawning and rearing area for Nanika bull trout.

?? **Nanika River** – upstream of the falls this river contains key spawning habitat used by Nanika Lake rainbow trout.

?? **Des Creek** – immediately downstream of the lake contains spawning habitat used by Des Lake rainbow trout.

2.1.2 Habitat Issues and Vulnerable Areas

2.1.2.1 Morice River Floodplain

The length of the Morice from Gosnell to Owen creeks is one of the most heavily used spawning areas in the Morice TSA. The nature of this reach of river, with its broad, forested, gravel floodplain and extensive side channel development, is somewhat rare and creates abundant spawning and rearing habitat. There is evidence that this floodplain is active and highly sensitive to changes in sediment and large woody debris (LWD) loading, and water levels (Weiland and Schwab 1992). The lack of extensive development on this floodplain has largely preserved natural channel processes (i.e.: meandering, large woody debris inputs, side-channel development, etc).

2.1.2.2 Sediment Control

98% of the bedload in the mainstem Morice River is derived from the Thautil watershed, mostly from Starr Creek. Bank erosion of the Thautil River mainstem appears to be responsible for much of the suspended sediment in the Morice downstream of the confluence with the Thautil. This underlines the importance of erosion control and terrain stability when undertaking resource development in these high gradient watersheds. In the Gosnell and Thautil systems, any mobilized sediments or substrates will be transported into the highly utilized spawning and rearing habitat in the Morice mainstem. Bedload inputs to the Morice floodplain could affect channel stability, increasing erosion of the channel banks in the Morice (Weiland and Schwab 1992). While Morice and Kidprice lakes buffer the Upper Morice and Nanika rivers from sediment and bedload inputs, special consideration should be given to the small systems draining directly into these areas.

2.1.2.3 Smaller Streams

Small creeks are often those most heavily impacted by land use activities. Dolly Varden and cutthroat trout have a widespread distribution in the watershed and are found primarily in small creeks. While both these species are blue listed, it is not generally felt that the populations in the Morice are endangered. With good road construction practices and careful riparian management, impacts to small creeks can be minimized. Poor stream crossings and riparian management can result in significant impacts on these populations.

2.1.2.4 Water Temperature

In the Morice, there is concern for increasing water temperatures due to climate change and the removal of riparian vegetation. These increases may not kill fish directly, but could shift fish and invertebrate species composition in some systems. As an example, research suggests that juvenile bull trout are competitively excluded by rainbow trout in streams where the maximum summer temperatures are over 12?C, (Haas 2001). Increased water temperatures in the mainstem Thautil and Gosnell could have significant impacts on this blue listed species.

Bustard and Schell (2002) have also highlighted Owen and Lamprey creeks as two systems with temperature issues. Increases in these very productive steelhead systems could shift the community towards longnose dace.

In addition to these larger systems issues, there is also concern for the many slow moving, smaller creeks supporting populations of small cutthroat, Dolly Varden and rainbow trout. Removal of riparian vegetation could cause temperature increases in these systems sufficient to exclude salmonids. In addition, the cumulative impacts on small tributary systems, that may or not contain fish, can have significant impacts on fish bearing mainstems downstream.

2.1.3 Fishery Issues

Though other species are taken, the Nadina River sockeye run is the focus of the Moricetown First Nation fishery. Historically, sockeye catches at Moricetown have been estimated at ~25% of the in-river stock most years. Recently, in light of low returns, the Moricetown fishery has not harvested sockeye. The health of this stock is a key interest of the Wet'suwet'en First Nation.

The Morice River is one of the highest quality fishing destinations in the Morice TSA. With an international reputation for high quality river fishing for steelhead and chinook salmon, this water draws non-resident fishers from the United States, Europe, and Asia. The Morice is also heavily used by local anglers and many are actively and passionately interested in the state of this river, its fish, and its watershed.

Angling guides are required to report the proportion of their angler days used, numbers and species caught, released, and taken. BC Fisheries maintains an Angling Guide Management System (AGMS) database that compiles this information. Data extracted from AGMS for the Morice watershed are summarized Table 3, below. The Morice River is the most heavily used waterbody, followed by the Nanika River. Steelhead and chinook salmon are the target species in these waterbodies. Morice and Nanika lakes are the next most popular destinations, with rainbow trout and lake trout included amongst the target species here. The remaining lakes receive much less effort with rainbow, cutthroat trout and lake trout the target species. Guide/outfitter camps are located on Atna Lake, Nanika Lake, Kidprice Lake, Collins Lake, and at the mouth of Gosnell Creek (WLAP files, Matt Jessop, pers. comm.).

The Steelhead Harvest Analysis is based on data collected from annual questionnaires mailed to a random sample of steelhead angling license holders. This data is used to provide a relative index of local angler use of a waterbody. Angler use from the Steelhead Harvest data shows ~4,000 angler days of effort per year on average since 1968. The Nanika River shows and average of 12 angler days per year. To put these numbers in perspective, the Bulkley River, which is twice the length of the Morice and much easier to access shows an average of 7,700 angler days per year during the same period.

Table 3. Guided angler activity in the Morice Watershed expressed as average rod day per year of guided activity, number of years used (from 1990-2002), and the average of each species captured during years when the waterbody was used. Data are from the Ministry of WLAP, AGMS database. The record for chinook captured in Nanika Lake is obviously erroneous as this is upstream of Nanika Falls, but I have included it as it is in the database. Perhaps this is the catch from the Morice River.

Waterbody	Years Used	Rod Days Fished/Year	Number of Guides	Average numbers of each species captured							
				CH	CO	PK	ST	RB	CT	BT	LT
Atna L	3	10.3	1					17			8
Chisholm L	1	3	1						11		
Kidprice L	6	4.7	1					12			
McBride L	3	5	2						9		2
Morice L	10	35.5	3	32	8		36	72.8	4	1	24
Morice R	12	294.6	4	2.3	12	3	414				
Nanika L	6	26.2	-	51		6		59.8			1.5
Nanika R	5	56.6	-	30	11.5		48			10	18
Owen L	1	6	-					3			2
Shea L	1	13	2						57		

Note: CH = chinook, CO = coho, PK = pink, ST = steelhead, RB = rainbow trout, CT = cutthroat trout, BT = bull trout, LT = lake trout.

2.2 Babine Lake and Tributaries

Babine Lake is the largest, non-impounded lake contained entirely in BC. Much of the northern half of the lake is located in the Morice TSA, as are all the tributary systems on the northern half of the east shore. On the west side of the lake the Morice TSA includes all the watersheds (with the exception of upstream half of the Fulton River) to just south of Smithers Landing. Nilkitkwa Lake (including "Rainbow Alley") is in the Bulkley TSA. The south end of Babine Lake is in the Lakes TSA.

The Babine River, which drains the lake, is the largest tributary to the Skeena River and supports a large run of sockeye, as well as chinook, coho, pink and steelhead salmon and a small run of chum. Babine Lake moderates the flows, sediment levels and temperatures in the river, creating excellent spawning and incubation conditions. The vast majority of the spawning habitat used by Babine sockeye is located in the Fulton and Pinkut rivers spawning channels (see below) and the Babine River, downstream of the lake. Many smaller tributaries are also used and there is suspected to be some shore spawning in the lake, but little is known about this.

Babine Lake is the nursery lake to the largest run of sockeye salmon in Canada and the Babine run accounts for ~91% of the Skeena total (SEDS data). This high productivity is due partially to the Babine Lake Development Program (BLDP), which constructed spawning channels on the Fulton River and Pinkut Creek from 1965 to 1971. The construction on the Fulton River included impounding the lake with a dam that is used to regulate flows in the Fulton, and an intake pipe in the lake which provides water to the spawning channels. Before dam construction , a falls immediately downstream of Fulton Lake prevented upstream migration of anadromous fish.

Pre-enhancement sockeye escapements for Babine Lake averaged ~400,000 fish. Run sizes in the 1990's averaged ~1,400,000 spawners. This large increase in enhanced fish has created problems with harvest. Many non-enhanced Skeena fish stocks have been taken by the commercial mixed-stock fishery at higher rates due the to presence of the enhanced Babine run. Changes in harvesting have greatly improved this situation in recent years.

While most of the heavily used spawning habitat is contained in the Babine and Fulton rivers, there is still a great deal of key fish habitat in the smaller tributaries to the lake. Species that use tributaries of Babine Lake to spawn and/or rear include sockeye, coho, chinook, pinks, Babine Lake rainbow trout, cutthroat trout and Dolly Varden.

In addition to anadromous salmon, Babine Lake also contains resident populations of piscivorous rainbow trout, lake trout, cutthroat trout, bull trout, Dolly Varden, kokanee, lake, mountain, and pygmy whitefish, burbot, northern pikeminnow, suckers, shiners, chub, and sculpin.

The piscivorous rainbow trout and lake trout are the target of an active sport fishery on Babine Lake that attracts some guided foreign use but is mostly comprised of local anglers. Other lakes with easy road access such as Chapman, Fulton, Doris, Tanglechain, and Pine Tree lakes are also popular amongst local anglers.

The Babine Lake First Nation has a community fishing license for sockeye, coho, pinks, and chinook salmon to be used for food, social and ceremonial purposes. In addition, there is often a first nation "Excess Salmon to Spawning Requirements" (ESSR) fishery for sockeye in Babine Lake.

Table 4. List of known fish species occurring in Babine and its tributaries in the Morice TSA.

Fish Species	Comments
Sockeye Salmon	Largest sockeye run in Canada (~1,400,000 fish annually during 1990s). Accounts for ~91% of the Skeena sockeye run on average. Construction of spawning channels on Fulton River and Pinkut Creek from 1965-1971 has lead to a 3-fold increase in run sizes. In the Morice TSA, non-enhanced sockeye spawn in Morrison, Tachek, and Tahlo creeks, and suspected to spawn on beaches in Babine Lake. The Upper Tahlo stock has been identified as being at high risk of extinction (Morrell 2000). Juveniles rear in Babine and Morrison lakes.
Chinook Salmon	Vast majority of Babine chinook spawning is in the Babine River, outside the Morice TSA. Some spawning takes place in Fulton Creek (max 30 fish since 1975 (FOC 2001)). Average escapement for the whole Babine watershed was 1,577 during the 1990s. This represents ~3% of the Skeena chinook run.
Coho Salmon	Babine coho accounted for 11% of the Skeena run during the 1990s. Spawning in the Morice TSA is known in Fulton, Morrison, Tachek, Sockeye, Tahlo, Hazelwood creeks, as well as many smaller unnamed systems (most identified in Bustard 1990). Decreasing escapements since the early 1970's has raised concern for coho conservation.
Pink Salmon	Babine pinks account for roughly 4% of the total Skeena run. Average annual escapement has increased from 17,000 in the 1950s to 151,000 in the 1990s. The vast majority of spawning is in the Babine River, outside the Morice TSA. Creeks in the Morice TSA used for spawning in high escapement years include Morrison Creek and Fulton River.
Steelhead Trout	Babine River steelhead are large, drawing sport fishers from around the world. Steelhead spawning occurs in the Babine River, outside of the Morice TSA.
Bull Trout	Bull trout are known from the Babine River, and are thought to occur in Nilkitkwa Lake and Babine Lake (D. Atagi, in SKR and Oikos 1999a).
Resident Rainbow Trout	Babine Lake contains a population of large, piscivorous rainbow trout that supports a popular lake sport fishery. Spawning habitat for Babine rainbow trout is widespread throughout tributaries, but key habitat in the Morice is found in an unnamed Morrison Creek tributary, Wilkinson, and Tachek creeks (Bustard 1989). Juvenile rainbow rear in streams for 2-3 years before moving to the lake. Rainbow are also present in Morrison, Fulton, Chapman, Haul, Big Loon, Tahlo, Doris, Tanglechain, and Pine Tree lakes, amongst other unnamed lakes (FISS).
Resident Cutthroat Trout	Present in Babine, Morrison, Fulton, Chapman, Tahlo, Doris, Tanglechain, Pine Tree, Boomerang, Fission, and Guess lakes, as well as most of the other unnamed lakes in Guess Creek (FISS).
Lake Trout	Known to occur in Babine, Morrison, Fulton, Chapman, Doris and Tanglechain Lakes (FISS). Chapman and Doris are popular fishing destinations for lake trout. The population at Chapman appears to be healthy while recent sampling at Doris lake captured no lake trout, raising concerns for this population (Paul Giroux pers. comm.)
Dolly Varden	Known to occur in many of the small creeks throughout the Babine.
Kokanee	Present in Babine, Morrison, and Talho lakes (FISS).
Whitefish	Lake whitefish known from Babine, Morrison, Fulton, Chapman, Haul, Doris, Big Loon, and Tahlo lakes. Mountain whitefish present in Babine, Morrison, Doris, Tahlo, and Tanglechain lakes (FISS).
Suckers and other non-sport fish.	Baboon Creek has been found to contain a population of lake chub isolated upstream of a barrier.

2.2.1 Key Areas with High Fishery Values

While the outlet of Babine Lake contains the most non-enhanced fish habitat in the Babine Watershed, many tributaries to Babine Lake contain important fish values. These are listed below.

?? **Fulton River**– An annual average of 420,000 sockeye spawned in this system, during the 1990s, 70% in the river and 30% in the spawning channels. The success of these spawning channels depends on high water quality in Fulton Lake.

The Fulton River also receives light use by chinook (max 30 fish since 1975); moderate use by coho (average 331 fish during 1990s), and use by pink during high escapement years (average 64 fish during 1990s) (FOC 2001). Upstream of Fulton Lake, this river contains spawning and rearing habitat used by fish populations in Fulton, Chapman, Pine Tree, Boomerang, Doris, and Tanglechain lakes.

?? **Morrison Creek** – The flows, temperatures, and turbidities in Morrison Creek are moderated by Morrison Lake, creating excellent spawning and rearing habitat. This creek is used by a significant run of non-enhanced Babine sockeye, with an average of 8,900 annual escapement during the 1990's. This stream is also used by coho (263 average during 1990's), and pink (<100 fish) during high escapement years. Babine rainbow trout do not appear to spawn in Morrison Creek itself, but do use unnamed tributaries to Morrison Creek for spawning, as do coho.

?? **Talho Creek** – This system is the largest tributary to Morrison Lake. A significant population of non-enhanced sockeye spawn here (average run 4,400 during the 1990's). The Upper Tahlo stock has been identified as being at high risk of extinction (Morrell 2000). It also receives some use by coho (FOC 2001).

?? **Tachek Creek** – This creek flows into Babine Lake ~4 km south of the Fulton River. It contains spawning habitat used by non-enhanced sockeye, with an average run size of 1,800 fish during the 1990s (FOC 2001). It is also used by coho, though recent survey numbers are not available. This system is also a key producer of Babine Lake rainbow trout in the Morice.

?? **Sockeye Creek** – This creek is used by a small run of non-enhanced sockeye (average run 2,200 during the 1990s), as well as coho and Babine Lake rainbow trout (Bustard 1990; FOC 2001).

?? **Wilkinson Creek** – This system contains high quality rearing habitat that is heavily used by Babine Lake rainbow trout. It also appears to receive some use by coho (Bustard 1990).

2.2.2 Habitat Issues and Vulnerable Areas

A significant portion of the Babine drainage area within the Morice TSA underwent an overview fish and fish habitat assessment under the WRP program (SKR and Oikos 1999a). The tributaries to the north side of Fulton Lake and the streams between the north arm of Babine Lake and Morrison Arm/Lake were not included in the assessments. Several impacted riparian areas were identified, but the overall assessment found that impact levels were low to moderate. Areas with the highest impacts were the Hawthorn and Guess subunits.

2.2.2.1 Hydrology

Problems with low flows in Babine Lake tributaries have been recorded by FOC for many years. The issues are typically with the mouth of the creeks dewatering, or with low flows and high water temperatures during late summer spawning (Hancock 1983).

With forest development proceeding in many of these watersheds, impacts on stream hydrology can be expected. Higher peak flows and lower summer flows are predicted for watersheds as forest cover is removed. The impacts of climate change and decreased forest cover present a significant fisheries issue in the Babine for small spawning streams.

2.2.2.2 Temperature Sensitivity

There is some concern that many of the small streams used by non-enhanced sockeye may be temperature sensitive (Tom Pendray, pers. comm.). FOC stream summary catalogues for the Babine (Hancock 1983) often make mention of high water temperatures during late summer in many of the channels used by non-enhanced sockeye. Special management should be considered for these watersheds to limit changes in water temperatures.

2.2.2.3 Small Streams

Small creeks in the Babine watershed often contain resident populations of rainbow trout, cutthroat trout, Dolly Varden, and perhaps coho. Due to their small size, these streams tend to bear the brunt of the impact of poor forest practices. The cumulative impacts on smaller creeks can also be transported downstream to large systems, which may contain non-enhanced sockeye.

2.2.3 Fishery Issues

Babine Lake supports a popular boat based sport fishery that targets the lake's populations of rainbow trout and lake trout from mid-May through September. This recreational boat-based fishery is serviced by several fishing lodges, marina's and boat launches on the southwest shore of the lake. Data from a 1985 creel survey estimated 20,906 angler days were spent on the lake that summer (Bustard 1987). The portion of the lake in the Lakes Forest District received the heaviest use (40%), followed by the area near Topley Landing and Granisle (32% of total effort). Most (~45-65%) of the anglers are "local" coming from between Smithers and Burns Lake, ~20% were from Prince George, and a significant portion of the anglers were non-Canadian (~10%). It was estimated that 10,000-20,000 rainbow trout (42 cm fork length average) and ~3,300 lake trout (57 cm fork length average) were taken annually in this sport fishery. It should be noted that these numbers are now 15 years old

and no recent efforts have been made to assess the Babine Lake fishery, and no attempts made to evaluate the condition of resident fish stocks in Babine Lake.

There is some ice fishing as well in Babine Lake, primarily for burbot. During years of high sockeye returns, a sport fishing opening for Fulton sockeye also occurs.

BC Fisheries AGMS database contains data on seven waterbodies in the Babine drainage in the Morice TSA (Table 5). As would be expected, Babine Lake is the most heavily used waterbody with rainbow trout and lake trout the target species. Resident rainbow is the most common species captured in other waterbodies fished. Fishing lodges catering to Babine Lake fishers are located in Smithers Landing and Granisle.

Table 5. Guided angler activity in the Babine Lake drainage expressed as average rod day per year of guided activity, number of years used (from 1990-2002), and the average of each species captured during years that the waterbody was used. Data from the Ministry of Fisheries AGMS database.

Waterbody	Rod Days Used/Year	Years Used	Number of Guides	Numbers of each species captured							
				CH	SK	CO	PK	ST	RB	CT	LT
Babine L	243.9	12	9	1	30.5	11	71	11	442	65	81
Chapman	3.7	3	3						2.5	30	
Fulton L	2.5	1	2						9		1
Fulton R	12.4	9	2		20				40	30.8	
Morrison C	20.5	12	1						79.6		12
Morrison L	32.7	11	1						99		20.5
Pine Tree	1	1	1							6	

Note: CH = chinook, SK = sockeye, CO = coho, PK = pink, ST = steelhead, RB = rainbow trout, CT = cutthroat trout, BT = bull trout, LT = lake trout.

In addition to the sport fishery on Babine Lake, the Babine Lake First Nation has an allocation for 35,000 sockeye, 100 coho, 1,000 pink, and 100 chinook salmon. This fishery is conducted by gillnet, beach seine, and seine boat. These fish are for food, social, and ceremonial purposes. In some years there is also an ESSR fishery and the first nation is permitted to catch fish for sale. The license for this fishery depends on run size, but licensed catches of 200,000 fish are not uncommon (Gary Cardinal, pers. comm.).

2.3 Upper Bulkley River

The Morice TSA includes the Bulkley River from roughly 28 km downstream of the confluence with the Morice River, up to ~10 km from the settlement of Topley. The "Upper Bulkley" or the "Little Bulkley" as it is also known, has its downstream limit at the Morice confluence. I will use the name Upper Bulkley even though a portion of the Bulkley River downstream of the Morice confluence will be included in the discussion. However, escapement records are from upstream of the Morice confluence only, as this is how FOC records them.

The Upper Bulkley supports runs of chinook, coho, and pink salmon, and steelhead. Pinks appear to only be present in the Upper Bulkley to 9 km past the Morice confluence. Buck Creek, a tributary that flows into the Bulkley near its mouth, is the largest tributary and is thought to contain some of the most productive juvenile rearing habitat in the watershed.

There is concern for the Upper Bulkley coho stock. Exploitation levels during the 1980s and 1990s were very high, resulting in low escapement estimates during this period. While curtailing of the commercial fishery over the past few years has allowed other Skeena coho stocks to recover, Upper Bulkley stocks have not. There is concern that changes in habitat and flow regimes have reduced this system's capacity for coho production (Saimoto and Saimoto 2001). This stock has been identified as being at moderate risk of extinction (Morrell 2000).

The Upper Bulkley has different and more pressing habitat issues than other watersheds in the Morice TSA. Remington (1996), in her review of water quality in the Skeena drainage, identified the Upper Bulkley as perhaps the watershed most impacted by humans in the Skeena drainage. Overview and detailed fish and fish habitat assessments were conducted in the Upper Bulkley and found widespread and significant channel and riparian impacts (BCCF 1998).

The development of the railroad (1913) and highway (1944) along the Upper Bulkley has cut off access to a large amount of side channel habitat that is usually heavily used by rearing juvenile coho (Saimoto and Saimoto 2001). Forest road crossings also continue to be a problem in the Upper Bulkley, limiting fish access to potentially productive spawning and rearing habitat (T. Pendray, pers. comm.).

Agricultural development is another significant limiting factor for Upper Bulkley fish stocks. Land clearing, including the removal of riparian vegetation, livestock trampling of channel banks, irrigation, fertilization and manure inputs all have impacts on aquatic habitat. Farms and ranches are located on the valley bottom along the Bulkley River, on the alluvial fans of tributaries, and Buck Flats. Loss of channel stability and large woody debris inputs, increases in water temperature and sediment loading, changes in hydrology, and nutrient loading are some of the main impacts on aquatic habitat by agriculture in the Upper Bulkley (Remington 1996, Remington and Donas 2000, Saimoto and Saimoto 2001).

Urbanization has also impacted the Upper Bulkley. Consumptive water use has impacted hydrology while the discharge of secondary treated sewage into the Bulkley River and private septic systems have increased biological oxygen demand and elevated periphyton levels (Remington 1996, Remington and Donas 2000). Channels have also been restricted and complexity reduced by dykes or rip-rap and removal of riparian forest cover. While the impacts of urban development are localized, their impacts on the aquatic environment can be cumulative and significant.

The Equity Mine located between the headwaters of Bessmer Creek, a tributary to Buck Creek, and Foxy Creek, has continued to have impacts on the water quality of the Upper Bulkley watershed after its closure in 1994. Problems with acid rock drainage continue at the mine site, and wastewater must be collected and treated before discharge into Bessemer and Foxy creeks. The discharge, when treated, contains elevated levels of nitrogenous compounds, which contribute to nutrient loading.

Spills of untreated wastewater do occur, releasing acidic water containing elevated levels of cyanide and dissolved metals.

Table 6. Fish species known in the Upper Bulkley watershed and comments on each.

Fish Species	Comments
Sockeye Salmon	Maxan and Bulkley lakes have been historically identified as sockeye nursery lakes. These are located outside the Morice TSA but sockeye would hold and migrate through the Bulkley mainstem to reach the spawning habitat associated with these lakes in August. The status of these populations is currently unknown, and the Upper Bulkley sockeye run may be extinct (Tom Pendray, pers.comm.). These stocks have been identified as having a high risk of extinction (Morrell 2000).
Chinook Salmon	Chinook spawn in the Bulkley mainstem, Buck, Barren, McQuarrie Creeks. Dungate Byman, Johnny David, Richfield, and Emerson creeks are suspected spawning systems, due to the presence of juveniles. The Upper Bulkley saw runs of 100-1,400 (615 average) from 1980-1999, but runs since then have been larger (2,560 in 2000). This system accounts for <2% of the total Skeena run. Buck Creek has received some chinook stocking historically.
Coho Salmon	Coho spawn in the Bulkley mainstem, Buck, Richfield, and McQuarrie creeks. Juveniles are known and spawning suspected in Aiken, Barrer, Byman, Johnny David, Emmerson, and Dungate creeks. Runs of ~3,500 during the 1950s (5% of the Skeena total) have dropped to an average of ~ 850 during the 1990s (1% of the Skeena total). Habitat alteration and loss are thought to be a key factors in this decline. This stock is considered to be at moderate risk of extinction (Morrell 2000). There has been some stocking of coho in Buck Creek and the Upper Bulkley River.
Pink Salmon	Only gained access to the Upper Bulkley after the construction of the Moricetown fishway in 1953. Spawn only in the Upper Bulkley, from the Morice confluence upstream ~9 km, and in the mouth of Buck Creek. Escapement was 46,000 (even year) / 5,000 (odd year) on average during the 1990s. Less than 2% of the total Skeena escapement.
Steelhead Trout	Steelhead do not use the Upper Bulkley mainstem for spawning, but do use the tributaries. Buck Creek is the most significant tributary for steelhead spawning and rearing. Barren, McQuarrie, Johnny David, Richfield Creek are also used. Spawning in Dungate Creek, the lower reaches of Aitken Creek, Emerson and Byman Creek, is suspected.
Bull Trout	Bull trout are known to use the Upper Bulkley mainstem and Buck Creek. Little else is known about bull trout in the Upper Bulkley.
Resident Rainbow Trout	Resident rainbow trout are widely distributed throughout the Upper Bulkley system. Lakes known to contain rainbow trout include: Fishpan, Sunset, Gilmour, Helen, Vallee, Dunalter, Barrett, Elwin, Watson, Swans, Lars, and Goosley lakes. Some of these are stocked by Ministry of WLAP.
Resident Cutthroat Trout	Known from the Bulkley mainstem, Aitken, Johnny David, and Richfield Creeks. Lakes known to contain cutthroat trout include: Helen, Vallee, "Barren Creek Lake", and Dunalter lakes. Some of these are stocked by Ministry of WLAP.
Lake Trout	Only known record for lake trout in the Upper Bulkley is from Maxan Lake, outside the Morice TSA.
Dolly Varden	Known in Buck, Johnny David, Richfield and Emerson creeks. There is a record for Dolly Varden in Fishpan Lake.
Kokanee	Known in Goosly Lake.
Whitefish	Mountain whitefish are likely widely distributed throughout the Upper Bulkley system. Lake records were noted from Sunset, Elwin, and Goosley Lake.
Suckers and other non-sport fish.	The Upper Bulkley supports a diverse array of non-sport fish including lake chub, lamprey, longnose and largescale sucker, longnose dace, and prickly sculpin.

2.3.1 Key Areas with High Fishery Values

?? **Upper Bulkley Mainstem** – This area contains the only pink salmon spawning habitat in the Upper Bulkley watershed. It is also used by chinook salmon for spawning and rearing, and by steelhead and coho for rearing. It is a critical migration corridor and holding area for Upper Bulkley coho, chinook and steelhead. A series of beaver dams near Topley and a cascade ("Bulkley Falls") near Forestdale can be impassable during low flows, limiting access to late migrating fish such as coho (T. Pendray, pers. comm.).

?? **Buck Creek** – This system is the largest tributary to the Upper Bulkley. Spawning and rearing habitat are abundant, and this stream is generally considered to be the most important fish producer in the Upper Bulkley. It has been found to support a relatively high density of juvenile chinook and has been estimated to produce more age 1 juvenile steelhead than any other water in the Upper Bulkley (Tredger 1984). A cascade ~10 km from the mouth of Buck Creek can become impassible at low flows and prevent coho from accessing a large amount of available habitat in Buck Creek. This cascade likely blocks pink at most flows. A falls ~36 km from the mouth is barrier to anadromous fish.

?? **Dungate Creek** – This tributary to Buck Creek contains important habitat for chinook and steelhead (Tredger 1982).

?? **Barren Creek** – Juvenile chinook, coho and rainbow are known to use this creek up to the Highway 16 culvert, which is a barrier to upstream fish passage. Adult spawning and use by steelhead and cutthroat is suspected.

?? **McQuarrie Creek** – Chinook, coho, steelhead, and rainbow trout spawn and rear in this stream.

?? **Byman Creek** – This system is used by coho, chinook, steelhead and rainbow trout for juvenile rearing, and perhaps spawning.

?? **Richfield Creek** – This tributary contains key habitat for coho, steelhead (Tredger 1982) and chinook. The stable, cool flows provided by the large wetland at the mouth of Robert Hatch Creek are considered important contributors to the rearing habitat in this system.

?? **Johnny David –** This system may be used by chinook, coho, and steelhead.

?? **Aitken Creek** – This system is used by coho, chinook, steelhead for rearing, and spawning is suspected.

?? **Emerson Creek** – This tributary to the Bulkley, downstream of the Morice confluence, is known to support chinook salmon, coho (Triton 2003), steelhead, Dolly Varden and bull trout.

2.3.2 Habitat Issues and Vulnerable Areas

Highway, railway, agriculture, urbanization and forestry activities have changed a range of characteristics of the aquatic habitat in the Upper Bulkley. In contrast with other watersheds in the Morice TSA, many of the habitat issues for the Upper Bulkley require rehabilitation and changes in current habitat management.

Habitat degradation in the Upper Bulkley has been shown to impact benthic invertebrates. Bennet and Ohland (2002) found that impacted sites had a decreased percentage of mayflies, and increased percentage of diptera (flies) and non-insect organisms. In addition, impacted sites had a decreased taxonomic richness (diversity) of stoneflies and caddisflies.

2.3.2.1 Hydrology

Hydrology in the Upper Bulkley has been undergoing long-term change. Freshets are shorter in duration and more intense, while low flow periods are becoming longer and the flow levels lower (Saimoto and Saimoto 2001). This is presumed to be due to the impacts of agriculture and forestry on the watershed's ability to store water, and water use for consumption and/or irrigation. Remington (1996) estimated that water licenses (largely irrigation) may account for up to 46% of the Upper Bulkley during a 10 year low summer flow. Changes in climate are another factor. Winter precipitation levels and summer flow levels have been declining over the past 10-20 years and research have suggested that climate change will reduce summer and early autumn flows in the Interior Plateau (Remington 1996, Remington and Donas 2000).

The effects of these changes in hydrology on the aquatic ecosystem are many. Decreased water velocity and groundwater inputs will elevate water temperatures. Barriers become more difficult or impossible for fish to pass as flow levels decrease. This affects fish species that migrate during the late summer and fall the most (ie: coho), preventing access to potentially large amounts of spawning and rearing habitat used historically. Small spawning and/or rearing streams are more likely to dry up completely, or do so earlier in the year. Beaver dams become easier to build and more established – removing more spawning and stream rearing habitat, creating more barriers, and further warming water.

Maintaining and restoring forest cover is necessary in order to limit further changes to hydrology in the Upper Bulkley. In addition, water use permits should be reviewed with respect to their impacts on fish habitat. Given that climate change models predict lower summer flows for the Upper Bulkley, significant changes in watershed and water management may be required just to maintain current flow levels.

2.3.2.2 Channel Integrity and Stability, Sediments and Bedload

Removal of riparian vegetation, livestock trampling, and increased freshet intensity will lead to increased rates of bank erosion. Higher inputs of fine sediments will fill gravel interstices and reduce egg to fry survival. Increased coarse sediment (bedload) will reduce pools, decrease the amount of wetted channel, increase the likelihood of dewatering, and reduce the function of large woody debris. All these reduce juvenile and adult rearing habitat. Channels carrying large amounts of bedload are referred to as aggraded. In their assessment of 24 reaches in the Upper Bulkley, BCCF (1998) found 19 to be aggraded, and either moderately or severely impacted. High amounts of sediments in spawning substrates was also a common observation.

Rehabilitation of riparian habitat will be required in order to address these impacts on fish habitat. In many cases this would require working with private land owners to install fencing, create alternative livestock watering options, and re-planting.

2.3.2.3 Access to Habitat

The construction of the railroad and highway through the Upper Bulkley Valley resulted in the loss of fish access to a large amount of off-channel habitat. This has been identified as a key factor for Upper Bulkley coho (Saimoto and Saimoto 2001). Drainage structures through these transportation corridors are either lacking or consist of culverts that do not allow fish passage. Forest road culverts also remain a problem in the Upper Bulkley (T. Pendray, pers. comm.). These losses, combined with the losses due to barriers becoming impassable at low flows, eliminate access to a large amount of spawning and rearing habitat in the Upper Bulkley. This represents a substantial impairment of this system's productive capacity.

There has been a focus in recent years on rehabilitating stream crossings on forest roads to allow fish passage. Though much more expensive to rehabilitate on a per structure basis, a similar focus should be applied to highways and railroads in the Upper Bulkley.

2.3.2.4 Nutrient Loading

Foxy and Buck creeks have higher levels of naturally occurring phosphorus due to their geology. This results in naturally elevated phosphate levels in these streams (Remington and Donas 2000). Nitrogen inputs from the Equity Mine site add to this enrichment, increasing primary productivity in the Upper Bulkley and Buck drainages. In the lower ends of the watershed, inputs from agriculture and septic and sewage combine with already elevated nutrient levels to have a large effect on periphyton standing crop. Periphyton levels well above the BC Water Quality Guidelines have been measured over several years at two sites in the lower Bulkley in the town of Houston (Remington and Donas 2000). Large algal mats impact the visual and aesthetic values of a channel, affect the taste and smell of the water, clog intake lines, reduce oxygen levels, impacting the benthic invertebrate community, and reduce inter-cobble habitat available for fish fry.

2.3.2.5 Temperature Sensitivity

Removal of riparian vegetation and a slowing of water velocity during low flow periods have both resulted in a warming of Upper Bulkley stream water during the late summer. BCCF (1998) and Remington and Donas (2000) have both documented maximum temperatures above BC guidelines for spawning or rearing salmonids, and well above temperatures that would exclude bull trout. Riparian management and rehabilitation is needed to increase shading of Upper Bulkley channels.

2.3.3 Fisheries Issues

Due to concern for Upper Bulkley fish stocks, the Bulkley River is closed to sport fishing above the Bulkley/Morice confluence. Lake fishing is permitted.

Downstream of the Bulkley/Morice confluence, the Bulkley River is one of the premiere steelhead sport fishing destinations in the world. The reach immediately below the Bulkley/Morice confluence is particularly heavily used (Dana Atagi, pers. comm.) Reviewing the fishing resource issues of the Bulkley River is beyond the scope of this report, but it is worth emphasizing that the spawning and juvenile rearing habitat for the fish that support this fishery is located throughout the Morice and Upper Bulkley.

2.4 Nadina River / Parrot Creek Watersheds

The Nadina River and Parrot Creek watersheds are contained entirely in the Morice Forest District and drain into Francois Lake. Included in this group are a few small, unnamed systems also draining into the west end of Francois Lake. The Francois Lake watershed is known to contain runs of chinook and sockeye salmon, resident kokanee, rainbow trout, bull trout, Dolly Varden, lake trout, lake whitefish, mountain whitefish, burbot, longnose and largescale suckers, northern pikeminnows, longnose dace, lake chub, redside shiner and prickly sculpin (FISS, Fielden 1995). Nadina sockeye and chinook are the only Fraser River sea-run fish stocks in the Morice TSA.

The Nadina River supported a run of early sockeye that entered the river in early August and spawned in late August ~10-20 km from Francois Lake. In the 1950s the early run sockeye escapement averaged 6,068 fish per year. Returns of this run declined steadily and a distinct early run has not been recorded by FOC since 1989. Early run sockeye in the Nadina are now suspected to be extinct (Fielden 1995).

A late run of sockeye salmon enters the Nadina in early September and spawns immediately below Nadina Lake in mid-September. A spawning channel was constructed just downstream of Nadina Falls in 1974 to enhance productivity of this run. This facility is now operated by FOC and has a capacity of 30,000 spawning sockeye. Average escapement during the 1990s was 13,600 fish. Sockeye do pass Nadina Falls some years and spawn in the lake tributaries above. The Nadina also supports a very small run of chinook.

The spawning habitat immediately downstream of Nadina Lake are also used by a run of Francois Lake rainbow trout (Hatlevik 1990, Bustard 1988).

Parrot Creek drains the Parrot Lakes chain. A 4 m falls located ~2.5 km downstream of the lakes is an impassible barrier to fish. Upstream of this falls, the only species found are rainbow trout and lake chub (FISS, Triton 2000). The lakes support a population of numerous rainbow trout up to ~35 cm (MoE 1974).

Other large lakes in this area include Nadina Lake, which contains a population of piscivorous rainbow trout that form the basis of a popular fishery; Tagetochlain Lake (aka: Poplar Lake), which produces lake trout up to 90 cm (10.5 kg), and a less abundant population of rainbow; and Newcombe Lake which contains abundant small rainbow trout.

Table 7. Fish species known in the Nadina and Parrot watersheds and comments on each.

Fish Species	Comments
Sockeye Salmon	Spawn in the Nadina River. An early run of sockeye used to spawn in the lower Nadina but now may be extinct. A late run spawns near Nadina Lake in the river and in a spawning channel constructed near Nadina Lake in 1974. Average escapement since 1980 is 13,900 (range = 2,000-56,000), representing 8.8% of Nechako River sockeye. Sockeye also occasionally pass the Nadina Falls and spawn in tributaries to Nadina Lake.
Chinook Salmon	A very small run of chinook salmon spawn in the Nadina River. Escapement estimates average ~10 fish per year but FOC admits that their data for Nadina chinook are poor (Barry Huber, pers.comm.). Exact spawning locations are unknown but they are often observed near the artificial spawning channel and it is suspected that these fish may be using tributaries to Nadina Lake. Juveniles are known to rear in Nadina River (Fielden 1995).
Bull Trout	Bull trout are known to occur in the Nadina River (Fielden 1995) and Francois Lake (BC Fisheries files).
Resident Rainbow Trout	Rainbow trout from Francois Lake and perhaps Tangetochlain Lake spawn in the Nadina River near the artificial spawning channels (Hatlevik 1990). Stream resident rainbow trout populations are common in small streams in this drainage (SKR 2001). Also known from Nadina Lake, the Parrot Lakes, Bittern, Dawson, Newcombe, Stanton, Shelford, and Planaria lakes (FISS). The Nadina Lake resident rainbow trout population is piscivorous (DeGisi, in press)
Lake Trout	Lake trout are known from Francois Lake, Tagetochlain Lake, and Hill Tout lakes (FISS). Lake trout from Tagetochlain (alias: Poplar) Lake have been reported up to 90 cm (10.5 kg, BC Fisheries files).
Dolly Varden	Dolly Varden have not been captured in the Nadina (Feilden 1995) but are known from many smaller creeks in this watershed (SKR 2001a)
Kokanee	Known in Francois Lake, Nadina Lake and Newcombe lakes. The Francois Lake kokanee are the only known population in the Fraser to have been observed spawning in the spring. One of the beaches used for spawning is located north shore ~ 3 km from the west end of the lake (SKR 2001).
Whitefish	Mountain whitefish are known throughout the Nadina River, Nadina Newcombe and Tagetochlain lakes, (FISS).
Suckers and other non-sport fish.	Rainbow trout and lake chub are the only two species above the barrier on Parrot Creek.

2.4.1 Key Areas with High Fisheries Values

Nadina River– Nadina Lake moderates the temperatures, flows, and sediments in the Nadina River, creating good spawning conditions. This river supports a run of sockeye, and is used by rainbow trout (660-1,229 fish) from Francois and perhaps Tangetochlain lakes for spawning. DFO spawning channels have created more spawning habitat for sockeye near Nadina Lake, and gravel was added to the channel in this area to aid resident spawning fish (Barry Huber, FOC, pers. comm.). The full length of the river contains important spawning and rearing habitat for many fish species including chinook salmon, rainbow trout, and bull trout (Fielden 1995). Bustard (1988) estimated that Nadina provided rearing for 31% of the rainbow trout parr that move into Francois Lake. Upstream of the Lake, the river provides spawning and

rearing for Nadina Lake rainbow trout and kokanee, and perhaps for Nadina chinook and sockeye in some years.

Parrot Creek – This system has been estimated to contribute 13% of the rainbow trout parr that move into Francois Lake (Bustard 1988). This creek also provides spawning and rearing habitat to the rainbow trout in the Parrot Lakes chain.

Chinook Spawning – The chinook run into the Nadina is small and therefore vulnerable to over fishing and habitat damage. The location of the chinook spawning habitat is currently unknown. It is recommended that studies be conducted to locate spawning areas used by this run.

2.4.2 Habitat Issues

2.4.2.1 Temperature sensitivity

With Newcombe Lake and Nadina Lake already warming Nadina River water, there has been some concern for high summer temperatures. Temperatures of 22.6?C have been measured in the Nadina mainstem (Fieldon 1995) – well above BC guidelines for spawning and rearing salmonids and well in excess of temperatures sufficient to exclude juvenile bull trout. Studies have demonstrated that the cool water tributaries draining the Shelford Hills south of the river significantly influence Nadina River water temperatures (Nadina Local Resource Use Plan 1993, Appendix 12), and that streamside harvesting warms these tributary systems (Dixon-Warren *et al.* 1996).

Due to this concern the lower Nadina River watershed was declared temperature sensitive by the Nadina River Interior Watershed Assessment Proceedure (IWAP 1998). The IWAP was never formalized, but the District Manager and Licensees agreed to the IWAP's recommendation of 30 m buffers on all Nadina south shore tributaries, pending further research into how to manage these temperature sensitive watersheds. There is currently an initiative underway to develop best management practices that would maintain streamside shading and allow harvesting within this 30 m buffer (Freshwater Resources 2000, no date).

2.4.2.2 Sediments

The Nadina River channel and banks are relatively stable, even where the channel is not confined. This is due largely to the low amount of bedload, which is the result of Nadina Lake preventing coarse sediment inputs from upstream (Weiland 1995). This high degree of stability is common downstream of lakes and further minimizes sediment inputs from bank erosion. The low sediment levels and the moderating influence of the lake create excellent spawning conditions throughout the Nadina River.

Due to concern for the high quality spawning and rearing habitat in the Nadina, the Nadina LRUP (1993) recommended a windfirm buffer along the Nadina Corridor to maintain the high water quality and large wood debris inputs, and to limit bank erosion and sediment inputs. The Nadina IWAP round table (1998) recommended Watershed Restoration Program (WRP) assessments in many of the Nadina tributary watersheds to identify erosion problems and make corrective prescriptions.

An Overview Habitat Assessment based on air photo interpretation was conducted on the Nadina and Parrot Watersheds (SKR 1998). Of 570 harvested areas assessed, only 1 major, 3 moderate and 11 minor impacts were found. These impacts were primarily composed of streams logged to bank, and road crossing issues. Ground surveys to further assess these impacts in the Lower Nadina were

conducted in 1998 (SKR and Oikos 1999). Five sites were observed that required channel stabilization and / or habitat rehabilitation.

2.4.2.3 Small streams

Small creeks in the Nadina and Parrott watersheds often contain resident populations of rainbow trout or Dolly Varden. Poor riparian management or road construction can severely impact these small streams. During their ground survey of the Lower Nadina, SKR and Oikos (1999) identified 5 culverts that were blocking fish passage. As always in low gradient terrain, due diligence paid to road construction, stream crossings, riparian management, replanting, and erosion control can minimize these impacts on small systems and the cumulative impacts on larger systems.

2.4.3 Fisheries Issues

BC Fisheries Angling Guide Management System show only one lake in the Nadina/Parrott area with guided angler days. Tagetochlain Lake was used for two years in the early 1990s. The lake received less than ten rod days each year and the catch was 10 lake trout one year, and 22 the next. The Parrots lake chain, Nadina, and Tagetochlain lakes are popular with local anglers. The rainbow trout in Newcombe Lake are generally too small to attract the attention of anglers.

Nadina sockeye migrate up the length of the Fraser River and are taken by many First Nations fisheries along this route. A fish fence is run on the Sellako River, the outlet to Francois Lake, and Nadina sockeye are taken here by the Stellat'en First Nation under a stock harvest management plan negotiated with FOC. Fishing for sockeye is also permitted at the west end of Francois Lake by persons designated by the Stellat'en First Nation under a communal fishing license.

2.5 Natowite Lake Watershed

Natowite Lake and all its tributaries are located entirely within the Morice TSA. The lake's outlet, the Sakeniche River, is in the Fort St. James Forest District.

There are no anadromous fish in the Natowite watershed. A chute on the Sakeniche River appears to prevent upstream migration. The sport fish populations are mostly associated with the large lakes (Natowite, Tochcha, Nakinilerak) and the spawning and rearing habitat contained in Hautete and Gloyazikut creeks. The terrain here is comprised of low rolling hills and many of the mainstem rivers (Hautete and Gloyazikut) flow through wetlands for a portion of their length.

Natowite Lake is one of the largest in the watershed and the central waterbody. It is known to contain rainbow trout, lake trout, Dolly Varden, kokanee, mountain whitefish, northern pikeminnow, coarse scale suckers, peamouth chub, redside shiners and prickly sculpin. These same species are found in the Hautete chain of lakes up to Friday Lake, and Tochcha Lake (FISS). Nizik Lake has been found to contain only rainbow trout (FISS).

Road access to Natowite and Tochcha lakes requires using the barge to cross Babine Lake from Topley Landing. As a result, these lakes are not as heavily exploited as lakes closer major settlements such as Smithers or Houston. The fishing for rainbow trout and lake trout at these two lakes is excellent (P. Giroux, pers. comm). Ice fishing may also be significant in these lakes (Dana Atagi, pers. comm.).

Table 8. Fish species known in the Natowite Lake watershed and comments on each.

Fish Species	Comments
Resident Rainbow Trout	Present and abundant throughout most of the accessible fish habitat in this watershed. Lake populations in Natowite, Tochcha, Nakenelerak, Friday, Hautete, East Hautete, and Nizik lakes. Trout up to 1.1 kg are known from these lakes (Caw 1976). Hautete Creek and Gloyazikut Creek contain abundant spawning and rearing habitat and provide some good fishing opportunities for smaller fish.
Lake Trout	Lake trout known from Natowite, Tochcha, Nakinerak, Friday, Hautete, East Hautete. Lake trout up to 4.3 kg are known from these lakes.
Bull Trout	Not known from this area. Juveniles have not been captured in any inventory, but this species is known from Takla Lake.
Dolly Varden	Reported from Natowite and Tochcha Lakes.
Kokanee	Present in Natowite, Tochcha, and Hautete Lake and nearby unnamed lakes along the Hautete Creek corridor. Known to spawn in many of the tributaries to these lakes.
Whitefish	Mountain whitefish are known from many of the larger lakes: Natowite, Tochcha, Hautete (and nearby unnamed lakes) and Nakinilerak Lakes.
Suckers and other non-sport fish.	This area supports a diverse non-sport fish population including coarse scale and longnose suckers, northern pikeminnow, peamouth chub, redside shiner, longnose dace, and prickly sculpin.

2.5.1 Key Areas with High Fisheries Values

Hautete Creek – This river system connects a chain of lakes draining into Natowite Lake. It contains important spawning habitat and rearing habitat used by fish in all of the lakes (Caw 1976). Associated with this system are many wetlands, back channels and sloughs that contain significant fish habitat (i.e.: fisheries sensitive zones, Triton 1998)

Gloyazikut Creek – Between Tochcha Lake and Natowite Lake this channel provides good, unobstructed fish spawning and rearing habitat, and some opportunities for good angling (Caw 1976). Upstream of Tochcha Lake, Gloyazikut Creek is used by kokanee for spawning (Remington and Amos 1974).

Lake Tributaries – Many of the smaller tributaries to Natowite, Tochcha, and the Hautete Creek chain of lakes are used by kokanee for spawning. Kokanee are typically foraged on heavily by larger lake trout, an important sport fish in these lakes.

2.5.2 Habitat Issues

2.5.2.1 Temperature Sensitivity

Due to the number of large lakes in this system, many of the major creeks flowing out of them are warm (Gloyazikut Creek = 19°C, Hautete = 18°C, Caw 1976), while the non-lake headed tributary systems are significantly cooler (11.5°C to 14.5°C). Though not cold water systems (<10°C), these tributaries may be critical for rainbow trout that require cooler water for egg incubation. Special protection should be considered for cool water tributaries (i.e.: not lake headed) with significant fisheries potential.

2.5.2.2 Channel Integrity and Sediments

An overview fish and fish habitat assessment in this Natowite area was conducted by SKR and Oikos (1999). They found significant impacts in the Hautete sub-unit, which had been logged more extensively than other sub-units in this area. Logging to stream banks and road crossing problems characterized the impacts. The loss of riparian habitat was leading to channel instability, increased bedload, loss of LWD inputs and decreased channel complexity.

2.5.2.3 Small Streams

Small creeks in the Natowite watershed may be used by rainbow trout and also kokanee if they are associated with a lake. Poor riparian management or road construction can severely impact these small streams: blocking fish passage, warming waters, and reducing available spawning and rearing habitat. As always in low gradient terrain, due diligence paid to road construction, stream crossings, riparian management, replanting, and erosion control can minimize these impacts on small systems and the cumulative impacts on larger systems.

2.5.3 Fisheries Issues

The Skeena AGMS database shows guided angling activity for the Natowite drainage Table 9. Besides guided activity, the lakes in this area are well known to local anglers as high quality lake trout and rainbow trout fisheries. There is a guide/outfitters camp at Tochcha Lake.

Table 9. Guided angler activity in the Natowite drainage expressed as average rod day per year of guided activity, number of years used (from 1990-2002), and the average of each species captured during years that the waterbody was used. Data from the Ministry of Fisheries AGMS database.

Waterbody	Rod Days Fished /Year	Years Used	RB	LT
Nakinilerak L	3.7	3	13	7.5
Natowite L	21.2	6	79.2	25.5
Tochcha L	1	1		3

2.6 Tahtsa / Whitesail Watershed

The Nechako Reservoir was created in 1954 after the construction of the Kenny Dam, impounding the Nechako River. The portions of the reservoir watershed located in the Morice TSA includes all of Tahtsa Lake and Reach and their tributaries, and all tributaries on the north side of Whitesail and Ootsa lakes to the TSA boundary near the settlement of Wisteria.

The Kenny Dam blocks anadromous fish passage. Lake and river resident populations characterize the fish values in the drainage. Whitesail, Ootsa and Tahtsa lakes are known to contain rainbow trout, Dolly Varden, kokanee, mountain whitefish, burbot, northern pikeminnow, longnose and coarse scale suckers, lake chub, and sculpin (FISS).

Fisheries information collection in this area began in the 1970s with surveys of many of the larger lakes (FISS). The FRBC funded Fish and Fish Habitat Inventory program in the late 1990s has been responsible for much of our current data concerning the streams (Hatfield 1997, 1997a, 1997b, 1998, SKR 2000, 2000a, 2000b, 2000c, 2003).

Sport fishing opportunities in this area is mostly confined to lake fishing for rainbow trout. The Nechako reservoir population is piscivorous and individuals up to ~6 kg are known (DeGisi, in press). Stream habitat important to maintaining this fishery are the inlet streams that support rainbow and kokanee spawning habitat.

Table 10. Fish species known in the Tahtsa / Whitesail watershed and comments on each.

Fish Species	Comments
Resident Rainbow Trout	The most widely distributed fish in this area. Known in most fish bearing lakes and streams. The dominant species in small channels. Piscivorous rainbow trout are known to grow to ~6 kg in Ootsa Lake (DeGisi, in press).
Lake Trout	Not known from this watershed.
Bull Trout	Not known from this watershed.
Dolly Varden	Known in Ootsa Lake and the headwaters of Andrews Creek.
Kokanee	Known in Ootsa, Horseshoe, Skinny, Needle, and Fish lakes (FISS). Known to spawn in Andrews Creek (Hatfield 1997a), Kasalka, and Rhine Creek.
Whitefish	Known in Ootsa, Horseshoe, Skinny, Twinkle, Needle, Short Portage, and Fish lakes (FISS). Also known from the lower reaches of Whiting Creek (Hatfield 1998).
Suckers and other non-sport fish.	This area supports a diverse coarse fish population including coarse scale and longnose suckers, northern pikeminnow, lake chub, and prickly sculpin. A population of lake chub are known upstream of a 4.5 m falls (SKR 2003).

2.6.1 Key Areas with High Fisheries Values

The following list of waterbodies was compiled from information contained in Hatfield (1997, 1997a, 1997b, 1998) and SKR (2003) during their inventories of major tributaries to Tahtsa Reach and Lake, Whitesail Reach and Lake, and Ootsa Lake.

Andrews Creek – This tributary to Whitesail Reach links together a chain of lakes including Fish, Horseshoe, Needle and Twinkle lakes. Many of these lakes support populations of rainbow, kokanee, and mountain whitefish that would be using Andrews Creek for spawning and rearing, as well as Ootsa Lake populations.

Kasalka Creek – This tributary to Tahtsa Reach contains large amount of accessible fish habitat. Rainbow trout are widespread and kokanee and burbot have been documented in the lower reach. Drains Troitsa Lake, the largest lake on the Whitesail peninsula.

Outlet of Little Lake Superior – This unnamed drainage contains the most abundant, accessible and highest quality fish habitat in the Tahtsa Reach. Rainbow trout were the only sport fish captured in this drainage, but they were abundant.

Otter Creek – This small drainage contains spawning and rearing habitat, of which most is available to Tahtsa Reach rainbow trout. No other species are known.

Hammer Creek – This drainage contains a diverse fish community, and contains spawning and rearing habitat for Whitesail Lake rainbow trout and kokanee. The lakes in this drainage all support rainbow trout.

Storm Creek – More than half of this drainage is unavailable to Whitesail Lake fish populations due to barriers, but in the accessible reaches, both rainbow and kokanee are known to occur.

Hatfield Consultants compiled lists of streams that they felt contained the "…greatest amount of spawning and rearing habitat for reservoir fish populations based on a subjective appraisal of stream lengths accessible to fish from the reservoir and habitat quality."

- Wells Creek
- McIvor Creek
- Sibola Creek
- Sweeny Creek
- Unnamed Creek (180-841600)
- Unnamed Creek (180-852600)
- Unnamed Creek (180-853200)
- Unnamed Creek (180-866000-45200-02000)
- Unnamed Creek (180-180-866000-37500-1030-0560)
- Unnamed Creek (180-866000-37500-04900)
- Unnamed Creek (180-866000-58200-13400)

2.6.2 Habitat Issues

Little is known regarding habitat issues in the streams in the Tahtsa / Whitesail drainage (Len Seefried, pers. comm.). SKR's review of inventory data in this area (SKR 2003) noted no barriers due to road crossings. Any severe impacts are likely located on the north shore of Tahtsa/Ootsa Lake. Most development south of Tahtsa Lake was undertaken after the introduction of the Forest Practices Code, and impacts on fish streams were minimized.

In the late 1990s, salvage of water-bound standing timber was undertaken in the Nechako Reservoir. The impacts on lake water quality and fisheries were evaluated in a series of impact assessment studies (Winsby *et al.* 1997c, Perrin *et al.* 1997).

The Nechako Reservoir was found to be an oligotrophic system with high levels of dissolved oxygen and no thermal stratification in Tahtsa and Whitesail reaches. Methyl-mercury, a toxin capable of bio-concentration produced in reservoirs by microbial processes after flooding of soil, was found in low levels in the reservoir's rainbow trout. The trout were deemed suitable for occasional consumption (Perrin *et al.* 1997).

The effects of the underwater harvesting were found to be relatively light. Perrin *et al.* (1997) found only localized sediment production that settled within minutes. Worse sediment plumes were found to occur naturally due to wave action on the shoreline.

The effects of harvesting on fish were also determined to be minimal. Areas subjected to underwater timber harvesting were found to support slightly more northern pikeminnow, and there was no effect on other species (Winsby *et al.* 1997).

2.6.3 Fisheries Issues

Guided rod days in the Tahtsa/Whitesail area are shown in Table 11. The data for Coles Lake appears to be in error, and reflects 3 successive years of recorded catches of over 1000 fish per year. Guide outfitter cabins are located on Needle Lake, Troitsa Lake, Seel Lake, and Coles Lake (WALP database, Matt Jessop, pers. comm.).

Table 11. Guided angler activity in the Tahtsa/Whitesail drainage expressed as average rod day per year of guided activity, number of years used (from 1990-2002), and the average of each species captured during years that the waterbody was used. Data from the Ministry of Fisheries AGMS database.

Waterbody	Rod Days Used/Year	Years Used	RB
Blanket L	5.3	3	0
Coles C	2.0	1	24
Coles L	178.3	10	568
Ootsa L	23.4	12	45.2
Seel L	7.3	3	3
Troitsa L	164.7	11	186
Whitesail L	16.6	9	25.2

2.7 Burnie River and upper Clore River

The entire Burnie River drainage and a small portion of the Clore headwaters are contained in the Morice TSA. The Burnie River is a tributary to the Clore River, which is a tributary to the Zymoetz (alais: Copper) River. The Copper supports runs of chinook, pink, chum, sockeye, and coho, but it is most famous for steelhead. Most Copper steelhead spawn in the upper 20 km of the Copper River, near the outlet of McDonell Lake. The Clore is also known to support a run of steelhead, though little is known about it (Gottesfeld *et al.* 2002).

There is a 20 m high falls on the Clore River, preventing anadromous fish for accessing the Clore headwaters and the Burnie River (Fish Wizard, 2002). The only fisheries information for the Burnie River and the Clore in the Morice TSA comes from inventories conducted by then Fish and Wildlife staff in 1975 (Osmond-Jones and Bonner 1975, 1975a, Osmond-Jones *et al.* 1975). The area has high recreational possibilities and these inventories were conducted in support of a park proposal for the area (Osmond-Jones *et al.* 1975).

The lakes and many of the tributaries were surveyed. Cutthroat trout, rainbow trout, kokanee, Dolly Varden, mountain whitefish, redside shiner, and longnose sucker were captured in this watershed. The rainbow trout captured were juveniles, and as no adults were captured they were assumed to be steelhead. This is noteworthy considering the lake's location upstream of 20 m falls. Steelhead are powerful fish, and migrate to their spawning grounds in the spring when flows are high. As a result, they are known to be able to pass significant barriers. The falls may be passable to steelhead in some years, though it is also possible that the identification of the fish is in error. There are also references to rainbow trout (assumed to be steelhead) and Dolly Varden capture in unnamed tributaries to the Clore River, but the locations of the tributaries are not recorded.

Burnie Lakes and River are the dominant aquatic resources in this watershed. The lakes are in a spectacular setting with glaciers of the rugged Howson Range coming within a few kilometers of the lakeshore. The lakes and river are coloured with glacial silt, reducing visibility to less than 1 m and filling the interstities of spawning gravels in Burnie River. Many of the streams that could be used for spawning carry a high silt load and are cold.

There has been some guided angling activity on Burnie Lakes, but the difficulty in access prevents these lakes from seeing much sport fishing use.

Table 12. Fish species known in the Burnie River and upper Clore River watersheds and comments on each.

Fish Species	Comments
Steelhead	Two juvenile fish identified as rainbow trout were captured in North Burnie Lake and presumed to be steelhead. Other data shows the upstream limit of anadromous fish to be at a 20 m waterfall on the Clore River. BC Fisheries staff know of no corroborating reports of steelhead, or any other salmon above this barrier (M. Beere, pers. comm.).
Cutthroat Trout	Dominant sport fish in Burnie River watershed. No age information is available, but the trout are known to grow up to 48 cm (1kg). The fish were observed to be very slender, suggesting food limitation and slow growth. Mice and fish were reported to be common stomach contents of both lake and river fish. They also took prunes tossed into the water by survey staff.
Dolly Varden	One individual reported from North Burnie Lake, up to 11 cm. Present in the headwaters of the Clore River.
Kokanee	Present in both North and South Burnie Lake.
Whitefish	Mountain whitefish present in both North and South Burnie Lake, up to 26 cm.
Suckers and other non-sport fish.	Longnose sucker and redside shiner were also captured in these lakes.

2.7.1 Key Areas with High Fisheries Values

Burnie Lakes and River– This system supports populations of what appear to be slow growing fish. Spawning habitat is limited and marginal, visibility minimal, and the water throughout this system is quite cold. This population should be considered potentially vulnerable to over-fishing due to presumed slow growth rates and late maturity.

2.7.2 Habitat Issues

There is currently no forestry or roads in the Burnie River watershed or the Clore headwater area. Forestry seems unlikely given the steep terrain dominated by high elevation forest and alpine. If development proceeds in this area, consideration should be given to access management to the lakes and rivers to protect what appears to be a population of slow growing fish.

2.7.3 Fisheries Issues

BC Fisheries Angling Guide Management System shows use of Burnie Lakes and River over the past nine years. Statistics are contained in Table 13. Burnie Lake is accessible by air or by long hike. As a result, angling use of Burnie Lake is likely to remain light, which is advisable in view of its alpine setting and presumed low productivity.

Table 13. Guided angler activity in the Burnie Creek/Lakes area expressed as average rod day per year of guided activity, number of years used (from 1990-2002), and the average of each species captured during years that the waterbody was used. Data from the Ministry of Fisheries AGMS database.

Waterbody	Rod Days Fished /Year	Years Used	Number of Guides	Average Numbers of Cutthroat Captured per Year
Burnie L	15.3	9	1	23
Burnie R	6.3	4	1	7.3

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