Morice Watershed-based Fish Sustainability Planning

A Plan to Conserve and Protect Morice Watershed Fish Populations and their Habitat – Stage II

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

The Morice Watershed-based Fish Sustainability Plan is a work in progress. This report is the culmination of efforts over 18 months toward developing a plan to conserve and protect the fish and fish habitat of the Morice River watershed. This document will act as a starting point when watershed planning resumes for the area. Significant work is required to complete the process as described in the Watershed-based Fish Sustainability Planning Guidebook (MELP & DFO 2001) and to develop a thorough and effective plan.

The Ministry of Sustainable Resource Management is currently funding a review of Watershed-based Fish Sustainability Planning (WFSP). The purpose of the review is to clarify the nature of federal and provincial government involvement in WFSP and to determine how to implement the process effectively throughout the province given recent widespread reorganization and new policy direction.

1.0 INTRODUCTION

1.1 What is Watershed-based Fish Sustainability Planning?

Watershed-based Fish Sustainability Planning (WFSP) is a planning process focused on fish populations and aquatic habitat. "Its overall goal is to ensure effective long-term conservation of fish and fish habitat" (MELP & DFO 2001). The process, introduced in 2001, is described in a guidebook developed by provincial and federal government agencies responsible for managing fish in British Columbia. This guidebook outlines a four stage planning sequence that can be used by interested First Nations, community groups, industries and government agencies to identify and protect those fish populations and fish habitats that most urgently require attention:

Stage I: Establishes regional priorities for conservation of significant fish populations and habitats based on a broad profile of a large watershed or sub-basin. The stage concludes with the selection of one or more candidate watershed planning units for more detailed planning.

Stage II: Establishes priorities and an action plan framework for key planning units identified in Stage I based on a detailed watershed profile and social, economic and political considerations. In this stage, strategic direction (goals), management objectives and strategies are established.

Stage III: Develops an action plan detailing how the plan will be implemented and monitored, and by whom.

Stage IV: Implements, monitors and modifies the plan.

1.2 Rationale for adopting a WFSP approach

Watershed-based Fish Sustainability Planning was adopted for the Bulkley watershed with the goal of completing strategic watershed planning begun by the Bulkley-Morice Salmonid Preservation Group (BMSPG). The BMSPG, formed as the delivery group for Fisheries Renewal BC in the Bulkley watershed, consisted of representatives from First Nations and community organizations concerned about fish stocks and the health of the watershed. The group was chaired and administered by Community Futures Development Corporation of Nadina (Nadina Community Futures).

The BMSPG completed its first stage of watershed planning in mid-2001. The resulting document entitled *Healthy Watersheds, Healthy Communities: Bulkley-Morice Salmonid Preservation Group Draft Strategic Plan – Phase 1* (Tamblyn and Donas 2001) identified eight priority watershed issues and listed draft goals, objectives and strategies to address each issue. To maximize the plan's effectiveness as a direction-setting document, further planning was required to determine priority sub-watersheds, and to develop an implementation and monitoring strategy. The BMSPG felt that integrating the existing draft plan into a government endorsed WFSP process would achieve these goals within guidelines designed to create consistency among watershed plans throughout the province.

1.3 The Morice Watershed-based Fish Sustainability Plan

1.3.1 Guiding Principles and Process Goals

Nine guiding principles and several process goals provide the framework for the Morice WFSP:

a) The Project will be undertaken with a focus on the sustainability of wild fish stocks, and with attention to both anadromous and non-anadromous species, genetic diversity, and commercial and non-commercial species;

b) The Project will maintain a focus on watersheds, including their processes and their interconnections, both instream and upland;

c) The Project will be carried out using a "fish first" approach; that is, with an emphasis on the needs of fish;

d) The Project will identify priorities for the protection and restoration of fish stocks and habitat;

e) The Project will build on existing initiatives;

f) The Project will use the best information currently available, including scientific data, traditional ecological knowledge, land and resource development trends, and community values;

g) The Project will identify data gaps and will provide recommendations on priorities and means of filling those gaps;

h) The Project will use "adaptive management"; that is, an approach that incorporates ongoing monitoring and assessment to create a living plan that has no defined completion point; and

i) The Project will be carried out using an inclusive and consensus-based process that openly involves members of the community, including residents, responsible agencies, and commercial and non-commercial users of the watershed.

Additional process goals are:

- To integrate WFSP with concurrent land use planning processes, including the Morice Land and Resource Management Plan (LRMP) and the Morice-Lakes Innovative Forest Practices Agreement (IFPA), to ensure coordination and to minimize overlap;
- To articulate the connection between managing for sustainable fish populations and managing for sustainable land use; and
- To develop a modular plan for the benefit of implementing industry and agencies.

1.3.2 Stage I – The Bulkley WFSP

Nadina Community Futures and Fisheries and Oceans Canada initiated WFSP for the Bulkley watershed soon after the completion of Phase I of the BMSPG plan. Stage 1 of the WFSP was launched in late 2001 with the establishment of a planning committee (see Appendix A). As an initial step, the planning committee divided the Bulkley watershed into four planning units: the Morice watershed, and the upper, middle and lower Bulkley watersheds (Figure 1). Following consultation with the public, First Nations, and government via questionnaires, the committee selected the Morice River watershed as the priority planning unit for continued planning (Figure 2).

Around the same time, an independent Skeena stage I WFSP process, led by the Skeena Fisheries Commission, selected the Morice watershed as one of the three most important watersheds in the Skeena from a salmon production perspective (Gottesfeld et al. 2002).

1.3.3 Stage II – The Morice WFSP

Stage II began in January 2002 with the formation of the Morice WFSP technical committee (see Appendix A). The planning and technical committees mapped out Stage II of the planning process with the help of the WFSP guidebook. The technical committee's first task was to guide the creation of the Morice biophysical watershed profile (Bustard and Schell 2002). This document summarized the fish stocks in the watershed including life histories, population status and trends, distributions and key habitats, probable limiting factors to fish productivity, and information gaps. To aid the WFSP process further, Croft and Bahr (2002) developed a problem analysis to attempt to link fish and fish habitat trends with resource management practices. In addition, Croft conducted a GIS-based land use analysis using Watersheds BC data[1] to provide a baseline for future analysis and monitoring (see Section 4.2 and Appendix B).

The technical committee then categorized issues and concerns identified by the public and Bustard and Schell (2002). General aquatic ecosystem / watershed issues are summarized in Appendix C1. Species-specific issues are listed in Appendix C2. When the Morice WFSP process continues, the criteria suggested in Appendix D may help rank the issues into a priority list.

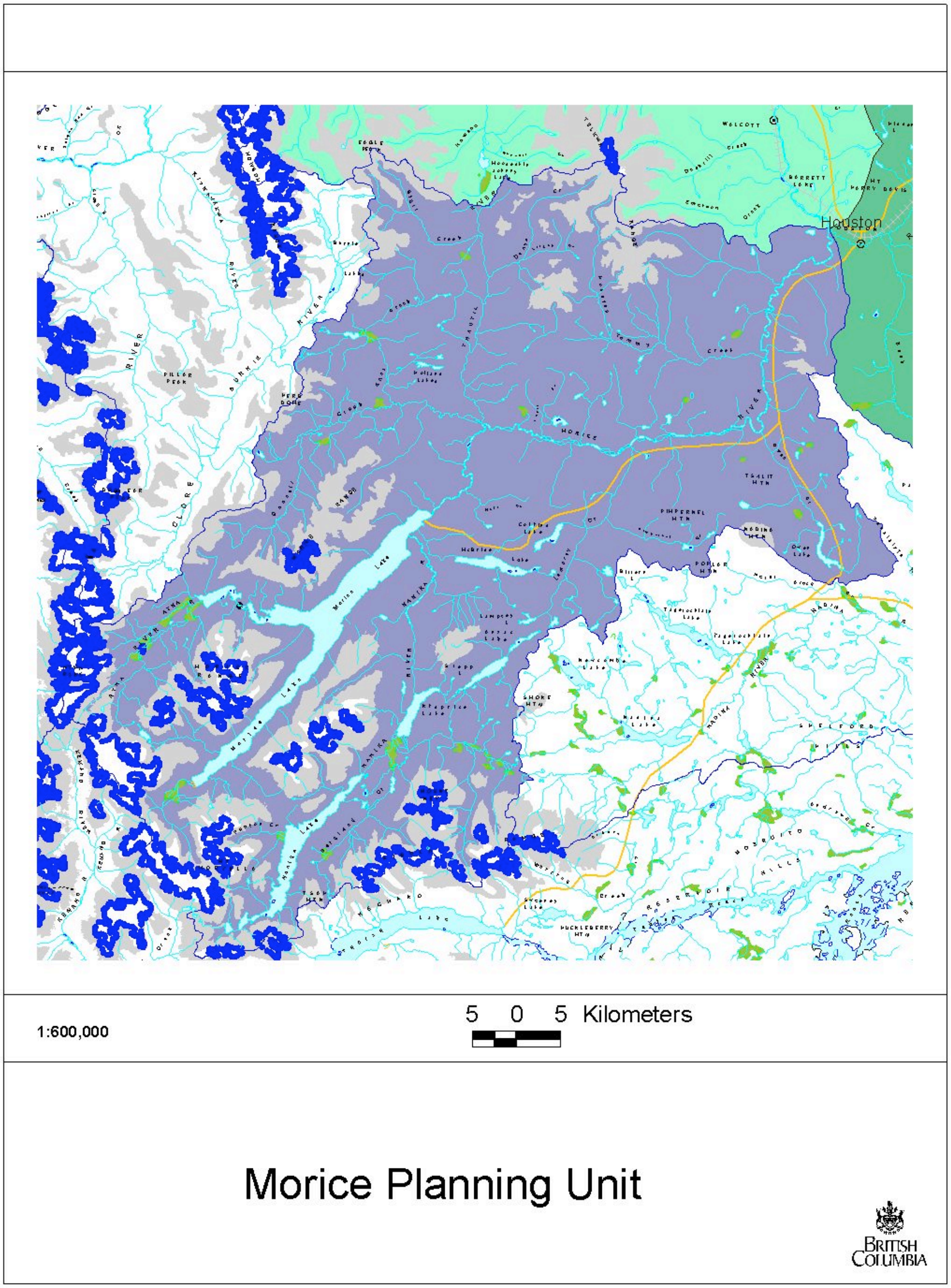
For this current draft of the plan, key issues were extracted from the conclusions and recommendation sections of Bustard and Schell (2002). Draft objectives, example strategies and possible indicators were identified for selected priority issues (Section 6).

Lower Bulkley

[1] A detailed land use analysis expected from the IFPA did not materialize prior to drafting this report.


S K E E N A
HAZELTON
B U L K L E Y
MORICETOWN
Babine
SMITHERS
GRANISLE
TELKWA
QUICK
R I V E R
Lake
WALCOTT
HOUSTON
Morice
Lake
Francois
Ootsa
Lake
Tahtsa
L
Takla
N
W
E
S
(at map centre)

Figure 2: The Morice watershed.



1.3.4 Public Participation

Burnout associated with multiple ongoing planning processes, combined with increasing demands on volunteers, resulted in limited direct public participation at planning and technical committee meetings. Nonetheless, we made attempts to ensure the incorporation of public concerns into the Morice WFSP through:

- Regular review of the BMSPG draft strategic plan (which was a public process);
- Review of compiled lists of issues and concerns from the Morice LRMP Fish and Fish Habitat Sector;
- Presence of one of the authors at Morice LRMP Fish and Fish Habitat Sector meetings; and
- A presentation on WFSP and distribution of meeting summaries to Morice LRMP Fish and Fish Habitat Sector members.

1.3.5 Strategic Direction

The aquatic ecosystems and most fish populations in the Morice River watershed appear to be relatively healthy. Unlike many watersheds identified as priorities for watershed planning in British Columbia, tremendous opportunities exist to protect existing habitats and fish stocks in the Morice. While rehabilitating damaged habitat is required in some areas, proactive, preventative actions are preferred where possible. The overall strategic directions for the Morice WFSP are:

- To maintain natural aquatic ecosystem functions and processes; and
- To maintain or increase populations of endemic wild fish populations to levels equal to the productive capacity of the Morice watershed.

More detailed goals are:

Biological goals:

- To protect existing habitat and rehabilitate impacted habitat where identified as a priority;
- To ensure that aquatic species do not decline below sustainable levels (limit reference points where established); and
- To allow adequate escapements of anadromous fish to fully seed the available habitat, while maintaining a natural species mix and balance.

Socio-economic goals:

- To maintain or improve quality of life for communities in the Bulkley and Skeena watersheds through ensuring clean water supplies and providing world class recreational angling opportunities; and
- To provide long-term economic opportunities for commercial and First Nation fishers and the local tourism industry by maintaining or increasing fish populations and fish habitat.

1.3.6 Time frame for the Morice WFSP

We expect the completion of Stage II and Stage III of the Morice WFSP to take another year. Implementation will require several additional years, depending on opportunities to implement some of the plan's objectives through the Morice LRMP, the Morice-Lakes Innovative Forest Practices Agreement and Sustainable Resource Management Plans.

The Morice WFSP is a living plan meant to be altered based on implementation and effectiveness monitoring and society's changing priorities. We envision significant updating and revision to occur every 5-10 years.

1.3.7 Linkages to other Planning Processes

The Morice WFSP is facing unique challenges and opportunities resulting from concurrent planning processes in the area. The ongoing Morice Land and Resource Management Plan and the Morice-Lakes Innovative Forest Practices Agreement (IFPA) both encompass the WFSP planning area. Stage I of the Skeena WFSP process also incorporated the Morice watershed. With so many competing processes, the main challenges lie in 1) avoiding duplication and in 2) attracting participants from industry, government and the general public to the WFSP. Nevertheless, opportunities abound for synergism due to the niches of each planning process. Figure 3 outlines the connections among ongoing related planning processes.

WFSP and LRMP

The fish sector of the Morice LRMP is providing input into the Morice WFSP. In return, the fish sector and the Government Technical Team use technical products from the WFSP for the LRMP. Should the Morice WFSP be completed promptly, we hope that some of the strategic goals and objectives for the WFSP will be incorporated into the Morice LRMP.

WFSP and IFPA

Members of the IFPA and WFSP are working collaboratively to the benefit of both processes. The IFPA and subsequent Sustainable Forest Management Plans may provide avenues for monitoring and implementing part of the WFSP. As the Morice WFSP continues, the technical committee can utilize modelling and land use analyses conducted by the IFPA, while the WFSP can help fill aquatic management and monitoring gaps in the IFPA. Together, these processes will link sustainable fish habitat and populations to sustainable land use management.

Morice and Skeena WFSP

The Morice WFSP planning committee has endeavored to work collaboratively with other WFSPs in the region, including the Skeena Stage I process. The other two recommended Stage II processes in the Skeena watershed - the Kispiox and Lakelse - have been postponed due to funding shortages. However, in the future, we hope to achieve some consistency among plans and streamline requests for help and information from government agencies by working together.

Morice LRMP
Fish Sector

Morice LRMP

Morice
Sustainable Resource
Management Plan

Sustainabl
Manageme

Figure 3: Links among land use planning processes related to the Morice WFSP.

2.0 WATERSHED PROFILE

2.1 Physiography

The Morice watershed, located southwest of Houston, B.C. (Figure 2), is the largest tributary to the Bulkley River, with a catchment area of 4,349 km^2. This basin drains both the interior plateau south of Houston, and the Coast Mountains to the west. The Morice River, headed by Morice Lake, flows northeast for approximately 80 km before entering the Bulkley River four kilometers west of Houston. The Bulkley then proceeds approximately 150 km northwest to join the Skeena River at Hazelton.

The predominant biogeoclimatic zone covering most of the lowland coniferous forests in the watershed is the Sub-Boreal Spruce (SBS) zone with dry cool (dk), moist cold (mc), and wet cool (wk) sub-zones. The SBS zone meets the Englemann Spruce-Subalpine Fir (ESSF) zone at upper elevations ranging from 900 to 1300 m. The ESSF is dominated by continuous forests stretching into sub alpine meadows at upper elevations and is characterised by moist cold (mc), moist cool (mk) and moist, very cold (mv) sub-zones. Additional biogeoclimatic zones and sub-zones include the Alpine Tundra (AT) at the highest elevations, Coastal Western Hemlock, wet submaritime (CWHws), flanking the shores of the large lakes in the southwestern portion of the watershed, and Mountain Hemlock, moist maritime (MHmm), in the southern-most headwaters.

2.2 Hydrology

The Morice River hydrograph is primarily influenced by snowmelt, with peak flows occurring from late May through July. Historically, June experiences the highest average monthly flows, which can approach 500 m^3 /second. In some years, rain on snow events produce peak flows in October and early November (Bustard and Schell 2002).

Two of the largest tributaries within the Morice River watershed are the Nanika (895 km^2) and Atna (300 km^2) rivers, which empty into Morice Lake. The Thautil River and Gosnell Creek combine to form the largest tributary (535 km^2) downstream of Morice Lake. Hydrologically, this is one of the most important systems in the Morice watershed as it influences peak flows and contributes significant bedload and sediment to the Morice River mainstem (Bustard and Schell 2002).

Due to slow glacier melt, abundant lake storage and fall rains, the mainstem Morice and Nanika rivers, as well as the larger tributaries such as the Thautil, Gosnell and Houston Tommy, maintain relatively high flows throughout the year until freeze up, typically in November. The lowest stream flows in both the mainstem rivers and smaller tributaries occur during the late winter usually from March to the middle of April at the higher elevations. Smaller, lower elevation streams draining the Interior Plateau, such as McBride, Lamprey, and Owen creeks often experience low summer flows (Bustard and Schell 2002).

2.3 Water Quality

Although the overall nutrient level is low, Morice River water quality is considered excellent, with a typically clear water column, a near neutral pH level, a mean alkalinity of 23 mg/l and a mean conductivity of 53 μohms/cm (Remington 1996; Gottesfeld et al. 2002; Bustard and Schell 2002).

Impacts to water quality in the Morice have been linked to both forestry and mining land use activities. Bustard (1996) considered increased suspended sediments associated with road construction and inadequate road maintenance to be the greatest logging related impact on Morice watershed streams. Remington (1996) identified the Silver Queen Mine on the eastern shore of Owen Lake as a source of elevated zinc (Zn) and copper (Cu) levels in the Owen watershed.

2.4 Land and Water Use

Industrial land use in the Morice watershed is dominated by forest management activities, an expansive road network, and past mineral exploration. Other land use activities include recreation, tourism, trapping, guide outfitting, cattle grazing and utility corridors.

2.4.1 Forest Management

Forest management activities in the Morice watershed have historically involved progressive road development and well distributed timber harvesting, typically characterized by clearcut silviculture systems.

The current mountain pine beetle infestation in the Morice has resulted in a shift in forest management strategies. Recent forest development activities have focused on small scale harvesting of infested stands with a greater reliance on temporary roads. However, should the infestation reach epidemic proportions, extensive harvesting control strategies present a risk to the integrity of the aquatic ecosystems of the watershed.

2.4.2 Mineral Resource Development

The mining industry has a long history in the area, as evidenced by extensive mineral exploration. However, of five developed prospects, only one mine has operated within the watershed. The Silver Queen Mine, located on the eastern shore of Owen Lake, produced silver, gold, cadmium, copper, lead, and zinc in 1972 and 1973 (Horn and Tamblyn 2000).

2.4.3 Transportation and Utilities

Progressive construction by the forest industry has resulted in a network of roads throughout most of the valley bottoms and onto the majority of the upland plateaus. This road network is primarily utilized by the forest industry, recreationalists, trappers, guide-outfitters and the mining industry. Since 1996, Huckleberry Mine, located 120 km southwest of Houston, has used the Morice-Owen Road to haul ore. A BC hydro line servicing Huckleberry Mine closely follows the road right of way (Gottesfeld et al. 2002).

2.4.4 Other Land Use

The Morice watershed is used extensively for recreational activities such as hunting, fishing, hiking, camping, canoeing and snowmobiling. Small capital ventures such as guide outfitting, trapping and tourism also utilize the watershed. Cattle range tenures exist near Houston, to the east of Owen Lake, and to the east of Tagetochlain Lake (Horn and Tamblyn 2000).

2.4.5 Water Use

Water use in the Morice watershed is restricted to 14 water licences that authorize the use of water from Morice River tributaries for domestic, stock watering, waterworks and enterprise as defined by Land and Water BC. The total allowable consumption authorized under the fourteen water licences is 35,200 gallons per day (GD) with 7000 GD for domestic, 10,700 GD for stock watering, 10,500 GD for enterprise and 7,000 GD for waterworks (Land and Water BC Inc. 2003).

2.4.6 Settlements

The entire Morice watershed is located within the Wet'suwet'en traditional territory. Wet'suwet'en people resided at various village sites throughout the watershed until the early 1950's. Currently, less than 20 people reside permanently within the watershed (Gottesfeld et al. 2002).

The District of Houston, located four kilometres east of the Morice and Bulkley River confluence, is the primary settlement and is home to approximately 3600 people (2001 statistics). Houston is experiencing a decline in population and lost 9.1% of its population between 1996 and 2001 (Stats. Can 2003). Neighbouring communities utilizing the Morice watershed for work or recreation include Smithers, Telkwa, and Topley.

2.4.7 Employment and Income

The District of Houston and neighbouring communities rely heavily on natural resources for employment. In 1996, half the jobs in the Morice Timber Supply Area (includes Houston, Granisle and Topley) were with the forest industry (Table 1). Other important employers were the public sector, tourism, construction, agriculture and mining. These statistics are aging and under estimate current numbers for the mining industry, and over estimate the size of the public sector. Significant cutbacks in 2002 and 2003 drastically reduced the provincial government work force. Average wages for employees in the District of Houston are summarized in Table 2.

Table 1. Basic sector employment estimates as a percentage of total jobs for the Morice Timber Supply Area (including Indian Reserves), 1996.

Sector	**% Basic Employment**
Forestry	50%
Mining[2]	3%
Public sector	22%
Tourism	9%
Agriculture	6%
Construction	7%
Other[b]	2.1%

a. Note, the percentages shown above reflect each sector's share of an area's total employment, including direct and indirect employment.
b. The "other" category includes several sectors, including transportation, fishing, trapping, and high technology
c. Basic income flows into the community from outside of the area. Non-basic employment refers to local income that occurs due to the spending of basic income in the local area (e.g., local goods and services)

(Source: Horn and Tamblyn 2000)

Table 2. Number of people employed in Houston and average earnings based on 2001 statistics.

Characteristics	Numbers and earnings
# persons with earnings	2090
Average earnings	$34,338
# persons working full time	980
Average earnings for full time workers	$48,862

(Stats. Can. 2003).

3.0 FISHERIES RESOURCES

The Morice watershed is well known for its high fisheries values and is a major producer of all Pacific salmon species except chum (*Oncorhynchus keta*). The watershed forms an integral part of the salmon production in the Skeena drainage, and is therefore important to First Nations groups, as well as commercial and recreational fisheries. The Morice is also famous for its summer steelhead (*O. mykiss*) run.

In addition to producing Pacific salmon, the Morice watershed is utilized by rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), kokanee (*O. nerka*), bull trout (*Salvelinus confluentus*), Dolly Varden (*S. malma*) and lake trout (*S. namaycush*). Numerous other resident fish species including mountain whitefish (*Prosopium williamsoni*), burbot (*Lota lota*), lake (*Conesius plumbeus*) and peamouth (*Mylocheilus caurinus*) chub, longnose (*Catostomus catostomus*) and

[2] The figures for basic mining employment and after-tax income related to mining do not include the Huckleberry mine, which opened in 1997, a year after these statistics were derived.

largescale (*C. macrocheilus*) suckers, redside shiners (*Richardsonius balteatus*), longnose dace (*Rhinichthys cataractae*), prickly sculpins (*Cottus asper*) and pacific lamprey (*Lampetra tridentata*) can also be found in the watershed.

3.1 Sockeye Salmon

3.1.1 Population Status and Trends

Morice-Nanika sockeye is the only significant sockeye run in the Morice watershed. As part of the Skeena watershed escapement, the Morice-Nanika sockeye stock comprises 1-2 % on average, while the Babine stock makes up 91%. The overwhelming difference in size of the two stocks, in conjunction with commercial fishing methods and management, makes the Morice-Nanika stock vulnerable to over harvesting by commercial fishing operations targeting the larger Babine stock (Bustard and Schell 2002).

The Morice-Nanika sockeye run has generally been in decline since the mid-1950's. Returns in the early 1950's averaged 50,000 fish; however, by 1955 escapement levels dropped to 4,000, and remained less than 6,000 fish until the early 1990's. From 1991 to1997 the stock appeared to rebound with returns of 22,000 – 41,000 fish; however, by 1998, numbers dropped again and remained low through to 2001 (Bustard and Schell 2002).

The drop in numbers is a particular concern for the Office of the Wet'suwet'en and the Moricetown Band who rely on Nanika sockeye at Moricetown Canyon for a First Nation's food fishery.

3.1.2 Limiting Factors to Production

The factors influencing production and possibly contributing to the sharp decline and continued low abundance of Morice-Nanika sockeye since the 1950's are thought to be the low nutrient levels within Morice Lake, low spawner recruitment, climatic conditions causing flooding, redd dewatering and freezing, predation and possibly the availability of quality spawning habitat during high escapement years (Bustard and Schell 2002).

3.1.3 Habitat Condition and Protection

Critical sockeye habitat in the Morice is limited to a few key locations in the upper portion of the watershed. The only significant spawning area for Morice-Nanika Sockeye is located in the upper Nanika River. This area is relatively deep and subject to stable warm water flows from Kidprice Lake. Egg survival is expected to be good in these spawning sites due to a lack of ice, flooding and sediment inputs. Secondary spawning locations downstream of Glacier Creek may be subject to changing hydrological flows, increase sediment inputs and severe ice conditions during some years (Bustard and Schell 2002). These conditions can be greatly exacerbated with increased forest development in the area. As such development plans need to take into account the significance and fragile nature of these critical habitats.

3.2 Chinook Salmon

3.2.1 Population Status and Trends

Within the Skeena watershed, the Morice is one of the most important rivers for chinook. The Morice River has produced on average 25% of the Skeena River escapements since 1950. From the early 1950's to 1985, chinook escapements were generally less than 5,000 spawners; however, since the mid-1980's, numbers have reached near record levels, with returns up to 15,000 fish. This rebound in escapement levels was reflected in the Skeena as a whole where escapements were low through the sixties to early eighties, followed by increased numbers in the last sixteen years (Bustard and Schell 2002).

Morice river chinook runs form an integral part of the in-river sport fishery and the Moricetown food fishery. Wet'suwet'en catch records originating from 1930 indicate an average annual chinook catch at Moricetown of 2,000 to 5,000 fish (Bustard and Schell 2002).

3.2.2 Limiting Factors to Production

Chinook production in the Morice system is probably limited by factors associated with spawning and rearing (Bustard and Schell 2002). Spawning and rearing limitations may include the effects associated with major floods, low winter flows, dewatering, extreme cold, redd superimposition and spawning gravel quality and quantity.

Low winter flows, extreme cold periods and freezing of redds in the upper Morice during some years can be significant factor in chinook survival. A combination of high fall flows that push spawners to the river edge and low late winter incubation flows is expected to lead to poorer chinook egg-to-fry survival in the upper Morice River (Bustard and Schell 2002).

Because spawning occurs over a period of roughly one month and chinook spawners tend to concentrate at sites offering the best spawning, the potential for chinook redd superimposition in the Morice is high (Bustard and Schell 2002). Reduced survival is clearly linked with chinook spawner abundance (Groot and Margolis 1991).

3.2.3 Habitat Condition and Protection

Prime chinook habitat within the watershed is found in the mainstem (spawning) and side channels (rearing) of the Morice River. Of critical importance is the four kilometer stretch of river downstream of the mouth of Morice Lake, with additional key areas downstream to the Lamprey Creek confluence. These habitats provide 97% of chinook spawning habitat in the Morice (Bustard and Schell 2002). Suitable gravel recruitment into these primary chinook spawning areas is probably limited, effectively determining how much spawning habitat is available. Generally, spawning site exposure to sediment events is expected to be rare because the Morice River is lake headed. However, forest management practices in the small watersheds flowing directly into key chinook spawning areas have the potential to introduce sediments and reduce the suitability of these sites (Bustard and Schell 2002).

3.3 Coho Salmon

3.3.1 Population Status and Trends

Since 1950, the Morice coho stock has accounted for an average of 6% of the Skeena watershed run. Morice coho returns have been volatile from the 1950's through to the 1990's with numbers dropping from as high as 15,000 fish in 1956 to 725 fish in 1991. Due to these extremely low escapements, the Department of Fisheries and Oceans declared a "coho crisis" during the late 1990's, initiating strong conservation measures to protect upper Skeena River coho stocks. Through restricting sport and Canadian commercial fisheries (responsible for approximately 65% of the harvest), escapements improved dramatically with estimated coho returns of 6500 fish in 1997 and 19,907 in 2000 (Bustard and Schell 2002). The sport fishery has recently been reopened, as populations appear to be increasing (Bustard and Schell 2002).

Wet'suwet'en fisheries also participated in coho conservation. Records indicate a drop in average catch from approximately 1500 fish per year prior to 1997 to less than 100 coho annually since then for the dip-net-fishery at Moricetown.

3.3.2 Limiting Factors of Production

Adequate spawner recruitment in the past has limited coho production. Poor ocean survival combined with high exploitation rates led to severely depressed populations for 30 years. The recent increased escapements indicate the high capability of the Morice watershed to support juvenile coho. Efforts to sustain coho populations in the Morice are dependent on ensuring strong escapements through fisheries management decision (Bustard and Schell 2002).

In late October and early November, floods due to rain on snow events help coho navigate beaver dams to reach spawning sites. However, fall freshets may also result in the scouring of redds (Bustard and Schell 2002).

Of the salmon species, coho rely on small tributaries for rearing the most. Weather conditions in both early and late summer determine coho distribution in non-spawning streams, with late summer flows and temperatures directly affecting the suitability of many coho rearing habitats (Bustard and Schell 2002).

Overwinter rearing mortalities in side channels and small tributaries are a result of poor water quality due to low flows, dewatering as flows decline during late winter, and predation as ice cover on the channels melts during the spring.

3.3.3 Habitat Condition and Protection

Coho are widespread throughout the Morice watershed, primarily using small streams. Therefore, habitat protection is an important issue for this species.

Habitat protection begins with accurate identification of coho habitat. During the decades of depressed coho abundance, many coho rearing streams may not have been identified by stream inventories conducted throughout the Morice watershed due to low stock densities. As such, known coho distribution may not be accurate.

The redistribution of newly emerged coho fry and yearlings into non-spawning streams and off-channel ponds is greatly influenced by road stream crossing structures. For instance, juvenile coho have limited ability to move upstream through road culverts (Bustard and Schell 2002).

The reliance of coho on smaller tributaries and off-channel ponds makes riparian management in and around these areas crucial. The maintenance of suitable water temperatures and flows as well as the reliable recruitment of debris for cover are important factors for coho rearing.

3.4 Pink Salmon

3.4.1 Population Status and Trends

Numbers of pink salmon returning to the Morice River have increased from approximately 5,000 in the early 1950's to 800,000 in 1991. Through the mid-eighties and early nineties, returns were consistently over 50,000 fish, but since 1993, annual pink spawner numbers in the Morice have fluctuated from 5,000 to 175,000. Morice pinks make up 9% of the Skeena River pink stock (Bustard and Schell 2002).

The Wet'suwet'en food fishery at Moricetown does not target pink salmon. However, the large escapements in the last 15 years have resulted in an average harvest of 3000-4000 pinks per year by the first nation. The sport fishery angling regulations have allowed the retention of two pink salmon per day in the Bulkley River and the lower two kilometers of the Morice River since the mid-1990's (Bustard and Schell 2002).

3.4.2 Limiting Factors on Production

Freshwater survival of pink salmon from egg to alevin, even in highly productive streams, commonly only reaches 10-20% (Groot and Margolis 1991). Primary factors affecting freshwater survival of pinks in the Morice are dissolved oxygen concentrations, stability of spawning beds, and freezing of redds (Bustard and Schell 2002). Redd sites with no surface flows tend to have low dissolved oxygen levels. In mid-winter, discharge levels decline in the Morice, resulting in reduced subsurface dissolved oxygen levels, as groundwater inputs comprise a larger portion of the discharge (Bustard and Schell 2002).

Climatic conditions such as winter severity and discharge levels can greatly influence pink salmon survival in the Morice River. Low discharge during the early winter can lead to direct freezing of redds in some key spawning habitats in Morice side channels in years with very cold temperatures and low snow cover. At the other extreme, rain on snow events can lead to extreme freshets after the pink spawning period, which can cause gravel shifting resulting in poor survival (Bustard and Schell 2002).

Predation of emerging pink fry by birds, coho smolts and resident char can be a significant factor in pink survival in the Morice watershed (Bustard and Schell 2002).

3.4.3 Habitat Condition and Protection

Increased forest development within the Thautil and Gosnell watersheds which empty into the main pink salmon spawning area of the Morice mainstem could lead to increased sediment loading and reduced egg survival. As such, limited harvest rates and appropriate riparian management strategies in these areas are essential in order to protect critical downstream habitat.

3.5 Steelhead

3.5.1 Population Status and Trends

The Morice River is one of the most important steelhead systems in the Skeena drainage. The Morice watershed was estimated to have a capacity of just over 6,000 adults, or approximately 8% of the Skeena's potential of 80,000 steelhead. Mark-recapture surveys have estimated recent Morice steelhead escapements to be between 3300 (Lough 1995) and 6750 fish (Mitchell 2001).

A catch and release regulation has been imposed on the steelhead sport fishery in the Morice since the early 1990's. The Wet'suwet'en food fishery records at Moricetown indicate an annual catch of about 500 fish per year since the early 1980's (Bustard and Schell 2002).

3.5.2 Limiting Factors for Production

Adequate spawner recruitment into the Morice watershed has been greatly impacted by both the Alaskan and Canadian mixed stock fishery, the native fishery and hooking mortalities associated with the sport fishery catch and release regulation. These factors account for a 60% exploitation rate during some years (Ward et al. 1995). Recent observations also suggest that changes in ocean habitats have affected survival rates of steelhead (Bustard and Schell 2002).

Given adequate spawner recruitment, the limiting factor for steelhead production in the Morice is juvenile rearing habitat. Steelhead populations in the Morice are influenced by density control factors in some tributaries, as well as environmental extremes such as severe ice, low winter flows and freshets (Bustard and Schell 2002). The availability of steelhead rearing areas is restricted by low summer flows in Lamprey and Owen creeks, which may have a large influence on potential production of fry and parr. Water temperature in these systems is critical as well. Small increases in water temperature are expected to favour species other than steelhead, resulting in increased competition for similar habitats in these streams (Bustard and Schell, 2002). Rearing steelhead can be significantly impacted during severe winter conditions. As flows decline during the winter and the wetted area of the channels is reduced, standing water is created, water quality deteriorates, and predation by birds results in poor survival of steelhead parr. During the spring and fall, steelhead are subjected to high flows in the Morice watershed during the snowmelt freshet. These conditions are thought to result in the displacement of steelhead fry and small yearlings unable to find suitable refuge (Bustard and Schell 2002).

3.5.3 Habitat Condition and Protection

Some of the key steelhead habitats in the Morice watershed are subject to low summer flows, potentially high temperatures and high erosion potential. These conditions make steelhead habitats sensitive to forest development activities. Poor logging and road building practices in the Owen and Lamprey watersheds has resulted in significant sediment inputs into these systems including the headwater areas of core steelhead-producing tributaries such as Pimpernel Creek. Protecting the riparian areas and maintaining water temperatures in these systems is critical as well. A minor increase in water temperatures in both Lamprey and Owen could make these systems unsuitable for juvenile steelhead (Bustard and Schell 2002).

3.6 Rainbow Trout

3.6.1 Population Status and Trends

The status of both the Morice Lake and Nanika-Kidprice lakes rainbow trout stocks are largely unknown. Creel survey data from October 1979 indicated rainbow trout were the most common sport fish captured in Morice Lake (Envirocon 1984), comprising 58% of the catch. Based on an additional tagging study, Envirocon (1984) estimated the rainbow trout population (individuals larger than 25cm fork length) in Morice Lake to be 4000-7000 fish. However, this estimate is expected to be high since it assumed no spawning moralities. No reliable estimates of the rainbow populations in Nanika-Kidprice lakes are available (Bustard and Schell 2002).

3.6.2 Limiting Factors of Production

Competition between steelhead and rainbow may be quite high since habitat requirements of juveniles are so similar. Resident rainbow are rarely noted at locations where significant steelhead populations occur (Bustard and Schell 2002).

Low nutrient levels in Morice Lake may be responsible for the slow-growing and late maturing nature of Morice Lake rainbow trout. As well the absence of lakes at the headwaters of Houston Tommy and Fenton Creek is suspected to be responsible for the small size (approximately 20cm) of the rainbow in those systems (Bustard and Schell 2002).

3.6.3 Habitat Condition and Protection

Rainbow trout populations in the Morice are primarily found in smaller streams as opposed to the mainstem Morice. The most important rainbow rearing habitats are found in the Nanika River. Environmental extremes such as dewatering and freezing of habitat, as well as displacement caused by flooding, may impact juvenile recruitment into Morice Lake and ultimately influence the rainbow population (Bustard and Schell 2002).

3.7 Cutthroat Trout

3.7.1 Population Status and Trends

Stock status of Morice River Cutthroat is unknown.

3.7.2 Habitat Condition and Protection

Cutthroat trout utilize small streams throughout the Morice watershed, and as such, are particularly susceptible to the impacts of forest development. Habitat issues for Morice River cutthroat trout stock are primarily linked to poorly installed road stream crossing structures that prevent upstream movements by juveniles and poor riparian management practices which lead to changes in hydrological flow and increased stream temperatures (Bustard and Schell 2002). Road development and access management of smaller lakes, streams and ponds should be an important factor in forest development planning in the Morice watershed.

3.8 Bull Trout

3.8.1 Population Status and Trends

British Columbia bull trout are designated as a blue-listed species, meaning populations are considered vulnerable or at risk. The current stock status of Morice River bull trout populations is largely unknown. Due to the difficulty associated with conducting bull trout counts, many studies have resorted to creel surveys or redd counts to provide estimates of bull trout populations. Such studies have estimated that the Morice River bull trout population may be limited to less than 1000 spawners (Bustard and Schell 2002).

3.8.2 Limiting Factors for Production

Bull trout prefer cold streams. Distribution of Morice River bull trout populations is strongly correlated with the coldest streams in the watershed. Temperatures rarely exceed 10 degrees Celsius in spawning sites and 12 degrees Celsius in juvenile rearing areas (Bahr 2002). Because bull trout are better adapted to cold water, they have a competitive advantage against other species in these areas. Conversely, bull trout are less effective competitors in warmer stream reaches.

The stability of redd sites is an issue in systems which are naturally dynamic (e.g. Crystal and Glacier creeks). Late fall freshets in bull trout spawning areas can lead to poor fry survival.

Fry displacement as a result of late freshets could be a concern. Side channel locations buffered from the full freshet flows are expected to be important refuge areas for bull trout fry (Bustard and Schell 2002).

Morice bull trout adults spend a significant amount of their time in areas easily accessed by anglers. Studies in other rivers with good angler access indicate that sport fishing can have a major influence on bull trout populations (Bustard and Schell 2002). In the Morice watershed, the Thautil-Gosnell confluence and the Nanika falls are thought to be particularly vulnerable to increased angler pressure (Bahr 2002; Bustard and Schell 2002).

3.8.3 Habitat Condition and Protection

Bull trout habitat protection issues are primarily linked to the impacts associated with forest development activities in the Morice watershed. Riparian management associated with small non-fish bearing streams flowing into bull trout spawning areas is important in terms of maintaining cold stream temperatures. The interception of groundwater and small seepage flows by roads can potentially affect bull trout spawning areas. In addition, channel stability in bull trout spawning streams can be greatly influenced by road stream crossings and the introduction of debris and course sediments. Finally, legal and illegal angler harvest of bull trout is greatly aided by increased access to key bull trout habitats (Bustard and Schell 2002).

3.9 Dolly Varden

3.9.1 Population Status and Trends

The current stock status of Morice River Dolly Varden is unknown. There have been no direct studies on Dolly Varden populations in the Morice system. It is expected that Dolly Varden achieve relatively low densities in most stream systems, and that stocks are not threatened or declining in the Morice watershed (Bustard and Schell 2002).

3.9.2 Habitat Condition and Protection

Dolly Varden abundance, distribution and habitat preference throughout the Morice watershed, in conjunction with their small size, can lead to habitat protection issues that are linked to forest development activities. Dolly Varden are present in high gradient streams with marginal habitat. As such, careful attention to riparian management strategies aimed at protecting upstream sites from sediment, hydrological changes leading to low flow and peak flow impacts, and increased water temperatures is important. Although difficult, the proper installation of road stream crossing structures on these streams is important in order to allow fish passage. Drainage changes due to road construction and timber harvesting can also lead to impacts to key seepage habitats (Bustard and Schell 2002).

3.10 Lake Trout

Lake trout are known to be present in four lakes within the Morice watershed: Morice, Owen, McBride and Atna lakes (Envirocon 1984; Bustard and Schell 2002). The current stock status of Morice watershed lake trout is unknown.

3.11 Kokanee

The presence of kokanee in the Morice watershed has only been recorded in two lakes: Morice and Shea lakes. Based on a 1979 creel survey, Kokanee numbers are low in Morice Lake and only make up 1% of the total angler catch (Envirocon 1984).

3.12 Whitefish

According to the FISS database, three species of whitefish are present in the Morice watershed (Applied Ecosystem Management Ltd. 2001). Pygmy whitefish are reported in Owen and Morice lakes, and lake whitefish have been sampled in McBride and Morice lakes. Mountain whitefish is the most widely distributed and abundant whitefish species in the Morice watershed. Stock status of all three species is unknown (Bustard and Schell 2002).

3.13 Other species

3.13.1 Burbot

Burbot have been recorded in McBride, Morice and Owen lakes. However, no life history, stock status or distribution information is available (Applied Ecosystem Management Ltd. 2001).

3.13.2 Lake Chub

Within the Morice Timber Supply Area (TSA), this species has been identified as regionally important by the Ministry of Water Land and Air Protection (WLAP). Lake chub have been recorded in the Gosnell, Thautil, Lamprey and Owen creeks, and in Morice and Owen lakes (Applied Ecosystem Management Ltd. 2001).

3.13.3 Longnose Sucker

Longnose suckers inhabit McBride, Tagit, Owen and Lamprey creeks and their associated lakes. They are also present throughout the Nanika-Kidprice lakes system (Bustard and Schell 2002).

3.13.4 Largescale Suckers

This species is common throughout the mainstem of both the Bulkley and Morice rivers. In the early 1980's, largescale suckers made up 6% of snorkel observations of resident fish in the upper Morice River (Envirocon 1984). The Morice River between Gosnell and Owen creeks provides overwintering habitat for approximately 800 largescale suckers as counted during an aerial survey in late November 1979 (Bustard and Schell 2002). Largescale suckers have also been found in Collins, McBride, Morice and Owen lakes (Applied Ecosystem Management Ltd. 2001).

3.13.5 Redside Shiners

Redside shiners have been identified in Tagit creek and Owen, Collins, McBride and Morice lakes (Applied Ecosystem Management Ltd. 2001).

3.13.6 Longnose Dace

This species is abundant throughout the mainstem Morice River and Lamprey, Owen and McBride creeks. In 1979, longnose dace comprised 9% of the mainstem Morice River sample; however in subsequent years, this percentage decreased (Envirocon 1984). Dace are also found in the Nanika watershed.

3.13.7 Prickly Sculpin

This species is present in Morice and Nanika rivers and lower McBride and Lamprey creeks. They are also found in Owen and Gosnell creeks (Bustard and Schell 2002).

3.13.8 Pacific Lamprey

Pacific lamprey are abundant and widespread in the Morice watershed. Large numbers of pacific lamprey have been observed spawning in Owen and Lamprey creeks during June and July, and in the Morice River mainstem during late July (Bustard and Schell 2002).

The FISS database summarizes reports of peamouth chub and white suckers. Triton (2000) reports the presence of coast range sculpins and northern pike minnows in a reconnaissance level inventory (Bustard and Schell 2002).

4.0 FACTORS AFFECTING MORICE FISH POPULATIONS

In the opinion of Bustard and Schell (2002), the primary factors influencing the health of Morice River fish populations are high commercial and sport fishery exploitation levels. In general, the integrity of fish habitat within the Morice watershed is sound; however, the cumulative effects associated with progressive forest road building and timber harvesting activities could have significant future impacts on Morice watershed fish habitat and its productive capacity.

4.1 Commercial and In-river Fishing

Based on existing information and population trends for Morice fish stocks, it is clear that commercial interceptions, and in some years, the in-river-fisheries, have had a severe impact on salmon and steelhead populations in the Morice (Bustard and Schell 2002). Management strategies aimed at curtailing the commercial fishery over the past decade have allowed increased spawner recruitment and provided evidence of the impressive habitat capabilities of the Morice watershed to produce native fish stocks. Recent escapement numbers for Morice coho chinook and steelhead provide a clear insight into these potential production levels (Bustard and Schell 2002).

4.2 Land Use Activities

Present land use in the Morice watershed is dominated by forest management activities, with minor amounts of grazing and mineral exploration and development. Forest management activities in most valleys have included progressive road development and timber harvesting utilizing the clearcut silviculture system.

According to the results of a baseline land use analysis for the Morice drainage, the most heavily developed sub-watersheds, as of the mid- to late 1990's, are located in the mid- and lower parts of the watershed (Figure 4). Owen, McBride, Lamprey watersheds and an unnamed watershed (Unnamed 26), showed the highest relative forestry impacts (Appendix B). The Morice mainstem (including first and second order tributaries) and Gold and Knapper watersheds scored moderately high in terms of relative land use.

Unfortunately the best available data for use in the analysis was dated 1995-1998. Therefore, the intention of this land use analysis is to provide a baseline data set in which to compare current land use data when it becomes available. This will allow for the identification of trends and possibly geographic areas, in which specific management objectives and strategies can be developed, implemented and monitored.

4.3 Fish Farms

Recent initiatives to establish fish farms on the north coast need to be closely examined in terms of the potential impacts to Morice native fish stocks. As outlined in Gottesfeld et al. (2002), the introduction of foreign species such as Atlantic salmon into the Skeena watershed could threaten the integrity of Morice steelhead and other native salmon stocks.

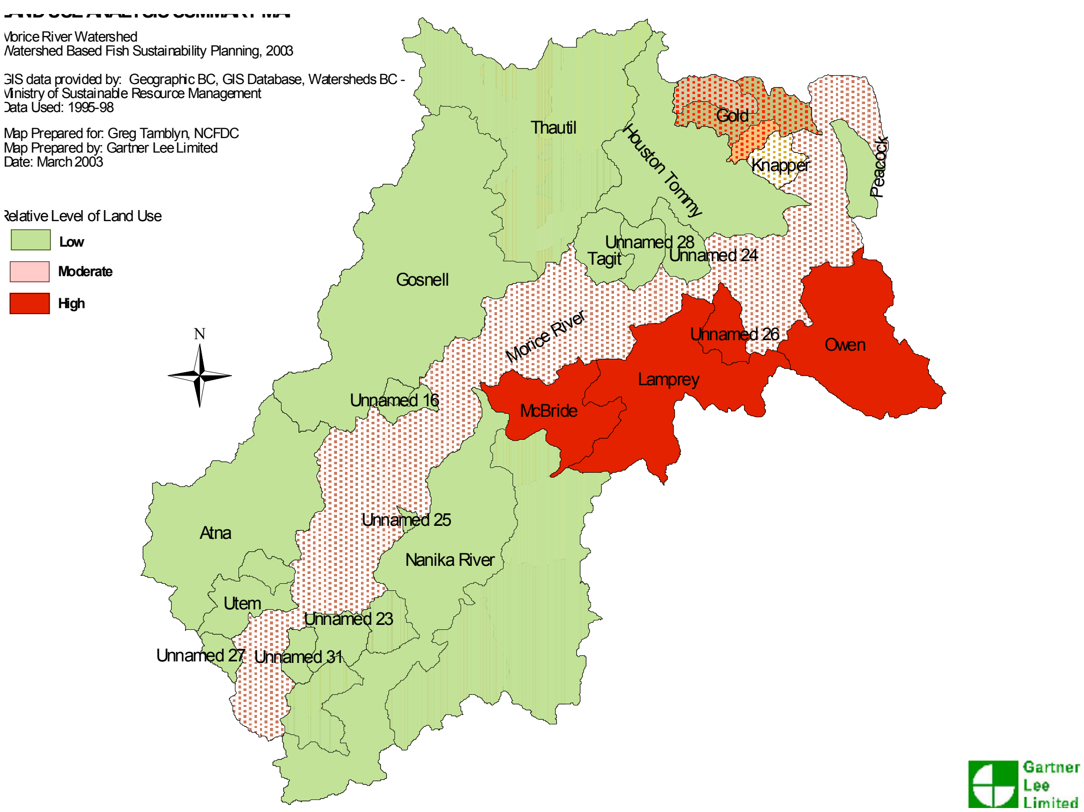


Figure 4: Relative impacts of land use within the Morice River watershed.

5.0 PRIORITY ISSUES

5.1 Morice Watershed Issues

Issues can be defined as problems, concerns or opportunities. Prior to determining objectives for any plan, the issues need to be identified. For the purpose of the Morice WFSP, issues were collated from a number of sources:

1. Summary reports produced for WFSP
   - *Conserving Morice Watershed Fish Populations and Their Habitat* (Bustard and Schell 2002);
   - *Conserving Skeena Fish Populations and Their Habitat* (Gottesfeld et al. 2002); and
   - *Phase II Watershed-based Fish Sustainability Planning: Synopsis of key fisheries resource issues* (Croft and Bahr 2002).
2. A previous watershed plan
   - *Healthy Watersheds, Healthy Communities: Bulkley Morice Salmonid Preservation Group Draft Strategic Plan – Phase 1* (Tamblyn and Donas 2001)
3. The WFSP technical committee
4. The public via the Morice LRMP Fish Sector

Issues were organized into three categories:
- Fisheries management;
- Habitat (includes instream, riparian, upland and hydrological issues), and
- Data gaps.

General or broad issues affecting many fish species or the aquatic ecosystem as a whole are listed in Appendix C1. Issues identified specifically for (a) species of fish are compiled in Appendix C2.

5.2 Selection of Priority Issues

Due to time limitations, the technical committee was unable to meet to prioritize issues. Instead, the authors have summarized the key issues as noted by Bustard and Schell (2002) in their conclusion and recommendation sections. There will be opportunities to further assess priority issues when the Morice WFSP resumes. A possible scoring matrix to help rank issues is in Appendix D.

Priority fish species as determined by Bustard and Schell are listed in Table 3.

Table 3. Priority fish species and stocks of interest

Species / Stock	Reason for Priority Status
Nanika Sockeye	Unexplained population fluctuations dominated by low escapements since the 1950s.
Bull Trout	Blue listed species particularly sensitive to habitat degradation.
Steelhead	Vulnerable to fisheries management decisions and habitat impacts.
Coho	Vulnerable to fisheries management decisions and habitat impacts.

5.2.1 Priority Fisheries Management Issues

The issues in this and the following sections were identified as significant in Bustard and Schell (2002) but have not yet been ranked.

Significant fisheries management issues include:
- Lack of adequate coho spawner recruitment to the Morice watershed:
  - High Canadian commercial fishery bycatch in mixed stock fishery– sockeye, coho, steelhead, chinook; and
  - Heavy Alaskan commercial fishery harvest / bycatch – steelhead, coho;
- Generous angling regulations for rainbow trout, lake trout and bull trout given lack of stock status information and oligotrophic nature of the system; and
- Past high First Nation in-river harvest rates for sockeye and steelhead during some years.

5.2.2 Priority Habitat Issues

Significant freshwater habitat issues include:

- Increased water temperatures, especially for bull trout and steelhead (Owen and Lamprey creeks);
- Road stream crossing barriers to fish migration, especially for Dolly Varden, cutthroat trout and coho;
- Loss of riparian integrity and function on small creeks (especially for Dolly Varden, cutthroat trout);
- Increased sedimentation and debris loading (particularly from the Thautil watershed) as a result of industrial development in all key habitats in the Morice watershed:
    - Upper Nanika River
    - Upper Morice River (Morice Lake to Gosnell Creek)
    - Mid-Reach Morice River (Gosnell to Owen Creek floodplain)
    - Key Steelhead Tributaries
        - Owen Creek
        - Lamprey Creek
        - Shea Creek up to falls
        - Upper Thautil River above Starr Creek
    - Key Coho Tributaries
        - Gosnell Creek floodplain and tributaries upstream from Shea Creek
        - McBride and Owen creeks
        - Lower accessible ends of smaller tributaries along the mainstem Morice and Nanika rivers
    - Key Bull Trout Tributaries
        - Upper reaches of Gosnell Creek
        - Denys, Loljuh and upper Starr creeks in the Thautil watershed
        - Glacier Creek
        - Houston Tommy and Gold creeks
    - Nanika-Kidprice Lakes
    - Des Creek and Lake.

6.0 OBJECTIVES AND STRATEGIES FOR SELECTED PRIORITY ISSUES

We have chosen two fisheries management issues and two habitat issues for which to write draft objectives and strategies. Draft targets are imbedded in some objectives as examples. Determination of final targets will require extensive efforts by the technical committee and are not possible at this time.

Please note that the WFSP technical committee and management agencies have not agreed to the following draft objectives, strategies and indicators. Their purpose is to promote dialogue once the Morice WFSP process resumes.

Issue 1: Lack of adequate coho spawner recruitment to the Morice watershed.

Lack of adequate coho spawner recruitment to the Morice watershed has been a major limitation to coho production in the system (Bustard and Schell 2002). Poor ocean survival combined with high exploitation rates by both the Canadian and Alaskan commercial fisheries have led to low escapements for much of the past 30 years. Since 1998, Fisheries and Oceans Canada has taken dramatic steps to protect Skeena River coho stocks by limiting recreational, First Nation and commercial coho fisheries.

The authors of this plan acknowledge that Fisheries and Oceans fish management biologists need to contribute to future iterations of these objectives and strategies.

Draft Objective

1.1 Increase average escapements of coho to the Morice watershed to *(a target #)* by *(year)* in order to fully reach productive capacity of the watershed.

Draft Indicator for Objective 1.1

Number of coho reaching the Morice watershed annually.

Possible Strategies / Management options

Fisheries Management

- Encourage terminal fisheries[3] for sockeye in key locations in the Skeena watershed.
- Continue to adjust timing of commercial fisheries to allow maximum escapement of Morice coho.
- Encourage the use of selective fishing gear in the commercial and First Nations fisheries.
- Negotiate with the Alaskan commercial fishery to reduce catches of Bulkley bound coho.
- Restrict retention of coho salmon by recreational anglers should populations dip below *(a number)*.

Research to fill data gaps

- Determine the carrying capacity and seeding requirements for the Morice watershed so that target escapements can be determined.
- Continue operation of the Toboggan Creek hatchery to provide an indicator stock for commercial fishery harvest levels.
- Develop improved in-season stock estimates for coho.
- Continue refining the mark-recapture program conducted at Moricetown Canyon.

Issue 2: Generous angling regulations for bull trout are putting bull trout stocks at risk given lack of stock status information and oligotrophic nature of the system.

The authors of this document acknowledge that Ministry of Water, Land and Air Protection biologists need to contribute to future iterations of these objectives and strategies.

[3] A terminal fishery is the harvesting of adult fish at a location near, or at the end, of a stock's spawning migration.

Draft Objective

2.1 Reduce number of bull trout removed from the Morice River by anglers by an average of 50% from 2004 to 2013 or until population estimates and stock status are determined.

Draft Indicator for Objective 2.1

Average number of bull trout caught annually by anglers

Possible Strategies / Management options

Regulations

- Work with the Ministry of Water, Land and Air Protection to modify sport fishing regulations to reflect uncertainty in the bull trout populations in the Morice watershed.
  - Establish restrictions on angling at staging and holding areas for bull trout.
  - Reduce daily catch quotas and review size limits for bull trout.
  - Educate sport fishers about identifying bull trout vs. Dolly Varden by including information in regulations (synopsis).

Road access

- Restrict the construction of roads within 500 m of major staging and holding areas for bull trout.

Research to fill data gaps

- Monitor both adults and juveniles to assess bull trout populations over time by establishing long-term index sites for juveniles and redd counts on key spawning reaches in the upper Gosnell, Denys, upper Starr, and Glacier creeks.
- Conduct a multi-year creel survey at fishing locations along the Morice River to determine numbers of bull trout caught and if they are targeted or bycatch.
- Monitor impacts of angling on adult bull trout numbers in the Morice River.

Education

- Place signs at major fishing locations on the Morice River indicating what bull trout look like and identifying concerns about bull trout.
- Place the same information in the Freshwater Fishing Regulations for the Morice River.
- Promote release of fish caught in the Morice River that look like Dolly Varden.

Issue 3: High in-stream temperatures leading to lower fecundity, stress or mortality in salmonids, and improved ability to compete by minnow species.

Bull trout and steelhead are two species particularly susceptible to increased temperatures.

Draft Objectives

3.1 Maintain water temperatures in streams utilized by salmonids at temperatures below 12°C for bull trout and below 15°C for other salmonid species. (This objective could be modified to incorporate water temperature tolerance ranges for various life stages for each fish species of concern. Also important to consider is the temperatures at which non-salmonids start to out compete salmonids).

Draft Indicator for Objective 3.1
Peak temperatures (or mean daily temperatures) in streams utilized by bull trout and / or other species.

Possible Strategies / Management options

Industrial development

- During industrial development activities, ensure adequate riparian vegetation is left along S2-S6 streams and wetlands in watersheds sensitive to temperature increases including Owen and Lamprey creeks.
- Minimize modification of groundwater hydrology including springs and seepage areas when building roads and determining maximum allowable equivalent clearcut area to ensure adequate cool groundwater recharge to streams in low flow periods.
- Design and build roads to minimize temperature impacts on water (i.e. ditches collecting ground water and runoff are exposed to higher levels of solar radiation than buffered streams or groundwater).
- Minimize sediment run-off into waterways from roads and stream crossings, thus minimizing the water's ability to absorb solar radiation.
- Re-establish riparian zones where deemed appropriate alongside Owen and Lamprey creeks.

Research

- Continue with small stream temperature research to determine appropriate riparian zone widths for streams of various aspects as to avoid increasing in-stream temperatures.
- Monitor water temperatures annually in Owen and Lamprey creeks and other streams in which relatively small increases in temperature could change the relative composition of fish species.

Issue 4: Poorly installed road stream crossing structures impede juvenile and/or adult movements and migration.

Culverts can act as barriers to fish migration. Fish utilizing small streams including Dolly Varden, cutthroat trout and coho salmon are especially susceptible. Steep culverts act as velocity barriers, particularly for juveniles trying to access rearing habitat. Perched culverts can be barriers to adults migrating to spawning grounds and/or juveniles moving throughout a system.

Draft Objectives:

4.1 Ensure fish passage in fish bearing streams for juvenile and adult resident and anadromous fish species in 100% of new stream crossings.

Draft Indicator for Objective 4.1

Number of new stream crossing structures that inhibit upstream passage of fish based on best available determinants of fish passage.

Possible Strategies / Management options

4.1.1 Minimize number of stream crossings for roads.
4.1.2 Use options and technologies for road crossings that will ensure fish passage.

4.2 By 2008, restore uninhibited fish access to 20% of historically available habitat that is inaccessible in 2003 due to poor stream crossing structures.

Draft Indicator for Objective 4.2

Area (m^2 or km^2) of fish habitat to which full access has been restored compared with the area of historically available habitat.

Possible Strategies / Management options

Road Development

4.2.1 Replace existing structures that prevent upstream fish movement or those that impede access to certain habitats associated with specific life stages of fish present in the system.
4.2.2 Where access is not a priority for user groups, remove existing structures, permanently deactivate roads, and prevent motorized access.

Research

4.2.3 Complete a full inventory of road crossings in fish bearing streams to determine which crossing structures currently restrict fish passage or could possibly impede fish movement in the future.
4.2.4 Calculate net habitat "loss" by determining the quantity and quality of potential spawning, rearing and overwintering habitat, for all fish species, upstream of barriers caused by road stream crossing structures.

7.0 MONITORING FRAMEWORK

Because the Morice WFSP is still underway, developing a monitoring plan is not feasible at this point. The final monitoring strategy will be directed by the final objectives and indicators of the watershed plan. Below are some monitoring concepts and the key components of a monitoring plan.

7.1 What is Monitoring?

Monitoring is regular or ongoing systematic testing, sampling or tracking of specific parameters in order to collect information or to determine trends. A number of monitoring approached can be implemented through a strategic plan including baseline, implementation, effectiveness, project and compliance monitoring.

7.2 Why is Monitoring Important?

Monitoring is a vital component of any plan or project. It is required to determine the effectiveness of strategies and actions in meeting the objectives of the plan. In the case of the Morice WFSP, monitoring will be used to determine the progress made toward mitigating impacts on fish populations, fish habitat and the aquatic ecosystem as a whole.

Monitoring is also integral to improving a plan through adaptive management. Adaptive management uses well-designed monitoring programs to inform management decisions and allow adjustments as circumstances change or knowledge is gained.

7.3 Monitoring for the Morice WFSP

We recommend two main types of monitoring for the Morice WFSP:

1) Implementation monitoring: Determine the status of the actions laid out in the implementation plan. We envision this monitoring to be done by the Implementation Committee who will actually put the plan into action. Their role would be to monitor the status of plan implementation and to address challenges and barriers to implementation.

2) Effectiveness monitoring: Determines to what extent objectives in the plan are being met. Effectiveness monitoring will help determine if the implemented management options or strategies have been successful, or perhaps whether or not objectives are feasible. Effectiveness monitoring is based on the indicators developed in the plan.

   Effectiveness monitoring has three main stages according to Mackay (1998):

   a) Baseline evaluation: Collating existing information for areas of concern, identifying data gaps and determining what potential impacts may arise from different land use and fisheries management decisions. This has been done to a large extent by Bustard and Schell (2002) and work completed by the Watershed Restoration Program (Ecofor 2001).

   b) Site Design: Selection of control and monitoring sites considering indicators and the types of information that will be required to determine if objectives are being met. Careful site selection to consider control or reference sites is vital to adaptive management.

   c) Measurements:

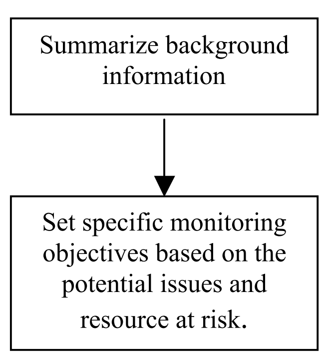
- Precedence measurements: Measurements to fill data gaps or measurements prior to land use development or prior to the implementation of a strategy outlined in the plan.
- Condition measurements: Measurements taken following land use or strategy implementation (i.e. results monitoring).

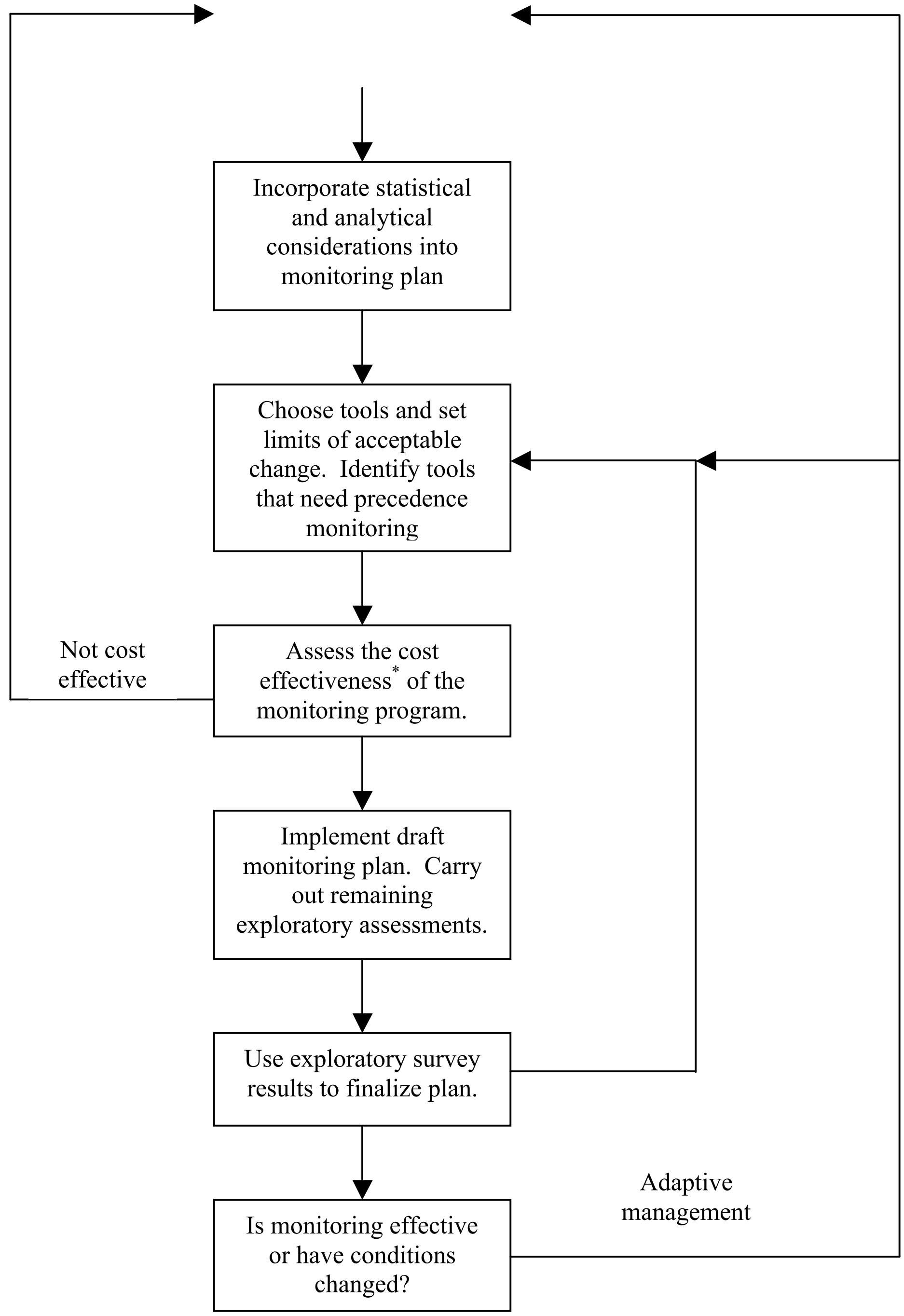
Much of the monitoring detailed in the final Morice WFSP is expected to be long-term. Long-term monitoring is required to track trends and to determine cumulative effects of land use on aquatic ecosystem integrity. In addition, some aspects of streams fluctuate naturally throughout a year or from year to year. To control for this natural variation, we recommend 1) monitoring over a range of geographic areas and 2) monitoring benchmark sites in an attempt to separate naturally occurring events from human induced impacts (e.g. temperature increases due to climate change as opposed to clearing of riparian vegetation).

A well-designed effectiveness monitoring plan should include (Mackay 1998):

- The monitoring objectives;
- Statistical considerations;
- What parameters to measure and the limits of acceptable change for each parameter;
- The benefits and advantages of monitoring selected parameters;
- Where monitoring will occur and why;
- How this plan can complement current monitoring activities;
- How frequently measurements are made;
- How the introduction of error and bias can be minimized (quality assurance and control);
- How the program's cost effectiveness can be maximized;
- How results are to be analyzed; interpreted and reported; and
- How long monitoring should continue in the absence of any exceeded limit of acceptable change.

Figure 5 shows a set of steps that could be taken to develop a monitoring plan.





*Defined by the trade-off between cost, requirements to meet objectives and the need for statistical confidence

Figure 5: Possible steps to develop a monitoring plan. Source Mackay (1998) with minor modifications.

7.4 The Monitoring Toolbox

In monitoring, as in a mechanic's shop, there is no magic tool. A number of tools or indicators is required to evaluate the integrity of an aquatic ecosystem and the impacts of various resource management developments and decisions. The challenge is to find the most cost-effective set of tools to fill data gaps while gaining maximum feedback.

Mackay (1998) provides a number of options for monitoring the potential impacts of forest development on aquatic ecosystem integrity (Table 4).

Table 4. Possible tools for monitoring forest development (adapted from Mackay 1998)

Impact issue	Tools	Reconnaissance assessment tool?	Detailed assessment tool?
Sedimentation	turbidity	X	X
	Total suspended sediments	X	X
	Substrate cores		X
	Sediment traps		X
	Conductivity	X	
	Cobble embeddedness	X	
Channel Morphology	Pebble count	X	X
	Bank stability	X	
	Large woody debris	X	
	% pools	X	X
	Degree of channel aggradation / degradation	X	
	Bankfull width and depth	X	
Water Quality	Temperature	X	X
	Fecal pathogens	X	
	Sulphate		X
	Dissolved oxygen	X	X
	Pesticides / Herbicides		X
Water Quantity and Timing	Bankfull width and depth	X	
	Peak flows		X
	Low flows		X
	Timing to peak flows		X
	General discharge curves	X	
	Groundwater flows		X
Stream productivity	Nutrients	X	
	Alkalinity	X	
	Chlorophyll a	X	
	Algae biomass	X	
	Periphyton	X	
	Benthic invertebrates	X	X
	Fish	X	X

Monitoring the effects of fisheries management decisions is another component of the plan. Historically, stock assessment (numbers of fish, combined, in some cases, with weight, size and age measurements) has been the dominant tool:

- Adult counting fences;

- Redd counts;
- Juvenile index sites – trapping / electroshocking;
- Catch per unit effort;
- Aerial, in-stream, stream shore counts for spawning adults;
- Mark / recapture;
- Inter and intraspecific competition studies; and
- Creel surveys.

However, additional measurements providing greater insight into the health of fish could also be tracked:

- Fecundity;
- Genetic diversity;
- Disease proneness; and
- Toxin levels.

Finally, an assessment of the social and economic value associated with fisheries management decisions could be used as an index (i.e. does an increase in escapement equal greater economic stability?).

7.5 Data Management

An effective monitoring program requires that collected data and results be accessible to the organizations responsible for implementing and reviewing the plan. On option is to utilize the Upper Skeena Atlas website as a depository for summarized information – reports, implementation committee meeting summaries, etc. The GIS portion of the website could be used to display monitoring locations, collected data and information about each sampling site. This website is part of the Community Mapping Network and the Sensitive Habitat Inventory Mapping project (http://www.shim.bc.ca/), run with the help of Brad Mason of Fisheries and Oceans Canada. The site integrates data from many sources including major government fisheries and watershed databases and makes it accessible through a user-friendly mapping system that everyone can access with minimal training.

8.0 IMPLEMENTATION FRAMEWORK

An implementation program specifies who will do what and when to put the plan into action. In other words:

- What agencies, organizations or companies are responsible for carrying out the various "actions" of the plan and when;
- Who is responsible for funding the various "actions" outlined in the plan and
- How the Morice WFSP will be integrated with related planning processes.

The implementation plan will also outline:

- The sequence and timeline for implementing activities;
- The creation of a data management system to monitor progress and maintain records; and
- A contingency plan to identify options should an organization be unable or unwilling to meet its designated responsibilities.

Potential groups involved in implementing aspects of the Morice WFSP include:

- Forest licencees: HFP, Canfor, BC Timber Sales branch of the Ministry of Forests;
- Ministry of Water, Land and Air Protection: Ecosystems Section, Fish and Wildlife Science and Allocation Section, Environmental Quality Section;
- Ministry of Sustainable Resource Management: Planning Section; Information Section;
- Fisheries and Oceans Canada – various branches;
- First Nations;
- Tourism operators;
- Community groups; and
- New industrial developers to the area.

Plans through which parts of the Morice WFSP could be implemented:

- Morice LRMP;
- Morice-Lakes Innovative Forest Practices Agreement;
- Sustainable Forest Management Plans; and
- Morice Sustainable Resource Management Plan

9.0 NEXT STEPS

The WFSP process, as outlined in MELP & DFO (2001) envisioned four stages. Stage II involves developing strategic direction (i.e. goals), management objectives and strategies. Stage III establishes an implementation and monitoring plan. The final stage, Stage IV, puts the plan into action, allowing opportunities to modify the plan through feedback derived from monitoring.

This document summarizes progress in Stage II of the process. Completing Stage II of the Morice WFSP will require:

1. Obtaining sufficient funding;
2. Confirming government, public and forest industry interest and support, and identifying available expertise to participate in and implement the Morice WFSP;
3. Completing a Local Strategic Overview that considers social, cultural, economic, political and ecological issues. The Morice WFSP process is in a unique position because the concurrent Morice Land and Resource Management Planning process has summarized most of this information;
4. Reviewing and ranking issues;
5. Developing objectives, indicators, targets, and strategies for key management issues; and
6. Assessing the advantages and disadvantages of each strategy / management option.

Steps in Stage III include:

1. Developing a monitoring and assessment program to evaluate performance of the plan and
2. Developing an implementation strategy required to achieve objectives, including projects, activities, manpower, and funding.

Given the current provincial government land use planning system, evolving government legislation and policy, and reduced government staffing levels, implementing the Morice WFSP is reliant on its integration into other planning processes. For a short time, opportunities exist to have portions of the Morice WFSP implemented through the Morice Land and Resource Management Plan. However, the Morice LRMP is scheduled to be finished by March 2004. If the Morice WFSP is delayed much longer, a tremendous opportunity to have WFSP recognized in a higher level plan will be missed.

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Appendix A Members of the Morice WFSP planning and technical committees.

Project Coordinator: Mary Swendson - CFDC Nadina / Greg Tamblyn (final month)

Planning Team
- Dana Atagi, WLAP (initial participation)
- Brenda Donas, DFO
- Martin Forbes / Dale Gueret, Fisheries and Oceans Canada (DFO)

- Allen Gottesfeld, Skeena Fisheries Commission
- Walter Joseph, Wet'suwet'en Fisheries
- Sharon Roberson, BC Federation of Fly Fishers / CFDC Nadina
- Greg Tamblyn, CFDC Nadina
- Gord Wadley, Bulkley Morice Salmonid Preservation Group (not active member)

Technical Team

- Gary Baptiste, Wet'suwet'en Fisheries
- Matt Jessop, Ministry of Sustainable Resource Management (early 2002)/ Ministry of Water, Land and Air Protection (2002 - March 2003)
- Vesna Konic, DFO (2002)
- Allen Gottesfeld, Skeena Fisheries Commission
- Tom Pendray, DFO
- Stefan Schug, Wet'suwet'en Fisheries
- Jim Schwab, Ministry of Forests (not active member)
- Greg Tamblyn, CFDC Nadina
- Melissa Todd, Houston Forest Products / IPFA
- Laurence Turney, IFPA (part of 2002)
- Carl Vandermark, Canfor / IFPA (part of 2002 / 2003)

"Land use analysis

APPENDIX B LAND USE ANALYSIS TABLE

This table needs to be printed on an 11x17 sheet.

APPENDIX C1 GENERAL ISSUES TABLE

FISHERIES MANAGEMENT	HABITAT

• Genetic diversity of native fish species by sub-species and by watershed (Public)
• High angling pressure (Public)
• Aquaculture/Farming of Atlantic Salmon potentially impacting wild fish populations (Public; Gottesfeld et al. 2002)
• Over harvesting of anadromous species (Gottesfeld et al. 2002; Bustard and
	• Loss of critical spawning areas in lakes, rivers and streams for all fi
	• Increased water temperatures (Bustard and Schell 2002).
	• Barriers to fish migration
	  • Road crossings
	  • Beaver dams
	• Increased sedimentation affecting water quality, spawning, rearing habitats (Bustard and Schell 2002).
	• Reduced riparian function and integrity, especially along small tribu associated with forestry and range practices (Bustard and Schell 20

Schell 2002).
• Shifts in natural native fish species composition in watershed (Public).
• Population declines due to over harvesting and habitat degradation (public).
	• Loss of channel stability associated with road stream crossings (Bu 2002).
	• Water contamination associated with mining activities (Gottesfeld e
	• Timber harvest rates and road building impacts on the hydrological watersheds (i.e.: groundwater and small stream flow interception, s and melt, "flashy water flows" Gottesfeld et al. 2002; Bustard and S
	  • Floods can lead to redd scour, substrate movement that crushes of juveniles, stranding of juveniles, or forcing some species to s habitats.
	  • High flows during migration can, however, improve access to s
	  • Low flows in winter can result in dewatering of redds, freezing
	  • Low flows in summer and fall can lead to migration barriers an fecundity and survival.
	• Altered wetland integrity and function due to adjacent forest harves
	• Large volume water utilization associated with proposed industrial
	• Changes in stream and river morphology (public)
	• Increased angler access to sensitive fish habitats (public)
	• Global warming / climate change warming water and reducing sum water flows (public)
	• Changes in ocean conditions affecting survival rates of anadromous

APPENDIX C2 SPECIES SPECIFIC ISSUES

		Issues	
Species	Stock Status	Fisheries Management	Habitat
Sockeye	• Spawner recruitment generally low since the 1950's (Bustard and Schell 2002). • Hatchery built (pilot project) to increase stocks – unsuccessful.	• First Nations in-river harvest rate (Bustard and Schell 2002) • Mixed fishery bycatch (Public).	• Naturally low productivity i Lake (Bustard and Schell 20 Gottesfeld et al. 2002). • Sediment inputs to spawning grounds from Glacier Creek and Schell 2002).
Chinook	• No enhancement on Morice stocks • Stock escapement is stable (Bustard and Schell 2002).	• First Nations, Commercial and Recreational harvest rates (Bustard and Schell 2002).	• Sediment inputs and debris l within direct tributaries to th mainstem Morice River espe between Gosnell/Thautil cor and Owen Creek (Bustard a 2002). • Redd superimposition (a key factor).
Coho	• Conservation management strategies implemented in 1998 • Strategic stock enhancement conducted 1998-1999 • Morice populations recovering since 1998 • Decreasing coho composition in juvenile	• Mixed fishery bycatch (public and technical committee) • High Alaskan fishery harvest rate (Bustard and Schell 2002)	• Sediment inputs and debris l within direct tributaries to th mainstem Morice River espe between Gosnell/Thautil cor and Owen Creek (Bustard a 2002). • Poor ocean survival (Bustar Schell 2002) • Access to spawning sites du

		Issues	
Species	Stock Status	Fisheries Management	Habitat
	samples (Bustard and Schell 2002).		fall flows and beaver dams e in Owen, Lamprey and McB creeks (Bustard and Schell 2 • High instream temperatures dissolved oxygen in small re streams (Bustard and Schell • Dewatering of rearing and overwintering habitats (Bust Schell 2002). • Fish passage associated with stream crossings (Public).
Pink	• Moricetown fishway installed to aid fish migration in 1950. • Escapement numbers quite volatile since 1950s • Morice Pinks make up an average of 9% of the Skeena pink escapements since 1985 (Bustard and Schell 2002).	• No species specific issues identified in summary material or public input.	• Sediment inputs and debris l within direct tributaries to th mainstem Morice River betv Gosnell/Thautil confluence a Owen Creek (Bustard and Sc 2002). • Rain on snow events and fal may influence pink spawnin locations and winter egg sur partly due to freezing.
Steelhead	• Bulkley-Morice sub-unit is the most important steelhead system in the Skeena drainage • 1999-2000 mark-recapture estimates indicate 4000 to 6750 steelhead in the Morice. • Catch and release only regulation in effect for sport fishery in the Morice since the 1990's • Wet'suwet'en food fishery records at Moricetown indicate approximately 500 fish caught annually since the 1980's (Bustard and Schell 2002).	• High Alaskan and Canadian commercial bycatch (Bustard and Schell 2002) • Recreational catch and release (minor hooking mortalities (Hooton) in Bustard and Schell 2002) • Native fishery rates (Bustard and Schell 2002) • Introduction of escaped Atlantic salmon to the Skeena may threaten Morice Steelhead (Gottesfeld et al. 2002, public)	• Sediment inputs and debris l within direct tributaries to th mainstem Morice River betv Gosnell/Thautil confluence a Owen Creek. • Sediment inputs into Owen, Peacock and Lamprey water • High instream temperatures particularly in Lamprey and creeks (Bustard and Schell 2 • Low summer flows restrictir availability of rearing habita especially in Lamprey and C creeks (Bustard and Schell 2
Rainbow Trout Rainbow Trout Continued	• Several isolated populations throughout the Morice watershed (Morice, Owen, Lamprey, Phipps and Bill Nye lakes, Nanika-Kidprice lakes system, Houston Tommy, Fenton, and Gosnell creeks and Nanika River.) • Adults occur in low numbers throughout the Morice Watershed.	• Sport fishery harvest rates - liberal angling regulations considering the unproductive stocks.	• Increased angler access to ke habitat areas (Bustard and Sc 2002). • Dewatering prior to fall eme in inlet tributaries to Owen I (Bustard and Schell 2002)

		Issues	
Species	Stock Status	Fisheries Management	Habitat
	• Regulations closing the upper Morice River sport fishery during Chinook spawning period imposed in 1980 to present (Bustard and Schell 2002).		
Cutthroat Trout	• Uncommon in the mainstem Morice River, Morice Lake and Nanika River • Widespread distribution in the Gosnell watershed. • Present in larger lakes associated with tributaries within watershed (McBride, Collins, Chisholm, Julian Holland and many smaller lakes and ponds (Bustard and Schell 2002).	• No species specific issues identified in summary material or public input.	• Fish passage associated with stream crossings. • Increased angler access to k habitats (Bustard and Schell
Bull Trout	• Stock status is currently unknown. • Possible spawning population < 1000 individuals (Bustard and Schell 2002). • Provincially blue-listed species.	• Sport fishery harvest rates - liberal angling regulations considering the unproductive stocks and angler access.	• High water temperatures are concern because bull trout r low water temperatures. • Interception of ground wate small seepage flows by adja forest roads (Bustard and Sc 2002). • Improved angler access to st areas and other key habitats including below Nanika fall (Bustard and Schell 2002; p
Dolly Varden Dolly Varden Continued	• Most widely distributed species in the Morice watershed and dominate the catches in many smaller streams • Relatively low densities in most stream systems • Stocks not threatened or declining in Morice watershed (Bustard and Schell 2002).	• No species specific issues identified in summary material or public input.	• Riparian management and i temperatures. • Interception of ground wate small seepage flows by adja forest roads • Road stream crossings in ste gradient streams (Bustard a 2002).
Lake Trout	• Present in four lakes (Morice, Owen, McBride and Atna) (WLAP Lake Surveys; Bustard and Schell 2002).	• Sport fishery harvest rates - liberal angling regulations considering the unproductive stocks.	• No species specific issues id in summary information.
Kokanee	• Only reported in two lakes (Morice and Shea) (Bustard and Schell 2002).	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.
Whitefish	• Three species of whitefish reported in Morice watershed (Applied Ecosystem Management	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.

		Issues	
Species	Stock Status	Fisheries Management	Habitat
	2001). • Pygmy whitefish in Owen and Morice lakes, lake whitefish in McBride and Morice lakes and mountain whitefish spread throughout the watershed • Mountain whitefish are the most abundant species throughout mainstem rivers (Bustard and Schell 2002).		
Burbot	• Present in McBride, Morice and Owen lakes (Applied Ecosystem Management 2001).	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.
Lake Chub Lake Chub Continued	• Present in Gosnell, Thautil, Lamprey and Owen creeks as well as Morice and Owen lakes (Applied Ecosystem Management 2001). • Regionally important status due to presence in upper Pimpernel Creek above a barrier (P. Giroux, WLAP, in AEM 2001).	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.
Longnose Suckers	• Present in McBride, Tagit, Owen and Lamprey creeks and associated lakes as well as Nanika-Kidprice lake system (Bustard and Schell 2002).	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.
Largescale Suckers	• Common throughout mainstem Morice River (Bustard and Schell 2002). • Present in Collins, McBride, Morice and Owen lakes (Applied Ecosystem Management 2001).	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.
Redside Shiners	• Present in Owen, Collins, McBride and Morice lakes and Tagit Creek (Applied Ecosystem Management 2001).	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.
Prickly Sculpins	• Common in Morice and Nanika rivers and in lower McBride Creek. • Also present in Owen and lower Gosnell creeks (Bustard and Schell 2002).	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.
Pacific Lamprey	• Abundant and widely distributed throughout Morice watershed.	• No species specific issues identified in summary material or public input.	• No species specific issues id in summary information.

		Issues	
Species	Stock Status	Fisheries Management	Habitat
	• Large numbers have been observed spawning in Owen and Lamprey creeks as well as the Morice River (Bustard and Schell 2002).		

APPENDIX D POSSIBLE SCORING MATRIX TO RANK ISSUES

Potential Impact of Issue	Rating				
	VH	H	M	L	Score
Risk (multiply a x b)					
a) probability of occurrence					
b) magnitude of impact					
Real or perceived risk(4 = real; 1 = perceived)					
Seriousness					
a) Direct impact to a stock at risk					

b) Number of species directly benefiting by addressing issue					
Urgency					
Subtotal					

Ability to Plan to Address Issue	Rating				
	VH	H	M	L	Score
Feasibility / implementer's ability to influence change					
Willingness of impacter to change					
Time needed to deal with issue (long = Low, short = VH)					
Complexity of issue					
Subtotal					
TOTAL for issue					

Directions

Place scores in shaded boxes

VH =	Very High	4 points
H =	High	3 points
M =	Moderate	2 points
L =	Low	1 point

Definitions:

Risk: the probability of occurrence X magnitude of impact of an issue

Real or Perceived Risk: perceived risk is risk for which there is only intuitive or anecdotal evidence. Real Risk is based on empirical or scientific evidence.

Seriousness: Is the issue acute or dangerously chronic? Is the issue widespread or highly localized?

Urgency: How quickly does action need to be taken?

Feasibility / ability to influence change: What is the implementer's ability to influence changes needed or to overcome challenges associated with the issue.

Willingness of impacter to change: are those responsible for management willing to change their practices?

Time needed to deal with issue (long = Low, short = VH): Amount of time and resources needed to deal with the issues relative to other issues.

Complexity of issue: How multifaceted is the issue? Do we understand the issue – the cause and effect? Does the issue deal with a large number of stakeholders?