

REVIEW OF CATTLE-COMMUNITY WATERSHED
CONFLICTS IN THE SKEENA REGION

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MINISTRY OF ENVIRONMENT

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EXECUTIVE SUMMARY

Pottinger Gaherty Environmental Consultants Ltd. (PGL) and Terra-Silva Environmental Services Ltd. (Terra-Silva) were retained to review cattle-community watershed conflicts in the Skeena Region and to recommend a water quality monitoring program. Our approach included reviewing farming practices and identifying areas of concern; reviewing information on specific water quality parameters affected by cattle farming, gathering information from other jurisdictions on surface water monitoring related to cattle impacts; compiling information for the Skeena region on community watersheds, water uses, and public concerns about cattle farming; and providing an outline for a water quality monitoring program.

Several aspects of cattle farming have the potential to cause water quality impacts, including manure handling and storage, yard runoff, improper cattle watering facilities with direct access to watercourses, and handling and storage of feed, silage, and sawdust. These activities can elevate surface and ground water concentrations of nutrients, organic matter, salts, pathogens, pesticides, and metals, and can also raise water temperatures and cause riparian degradation. Some constituents are potentially harmful to fish and affect drinking water quality.

Based on our review of cattle farming activities, projects in other jurisdictions, and applicable water quality criteria in B.C. we identified a list of pertinent parameters and working criteria for monitoring the effects of cattle farming on water quality in the Skeena region. We then compiled information on the 35 community and non-community watersheds in the Skeena region, particularly regarding the extent of cattle farming within each of these watersheds, and any potential cattle/watershed conflicts associated with cattle farming activities. We selected 13 sites (including 3 control sites) for monitoring the effects of 14 water quality parameters.

Waterhed
Bulkley
Project

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1.0 INTRODUCTION

Pottinger Gaherty Environmental Consultants Ltd. (PGL) and Terra-Silva Environmental Services Ltd. (Terra-Silva) are pleased to submit this report reviewing Cattle-Community Watershed Conflicts in the Skeena Region. Our report provides the B.C. Ministry of Environment, Lands & Parks (BCE) with a review of cattle farming in the Skeena Region, and a recommendation for monitoring the impact of cattle and other livestock operations on community watersheds, including background information from other jurisdictions in western Canada.

We have provided recommendations for water quality monitoring parameters, background information from other jurisdictions in western Canada, and objectives to be implemented by BCE. This report also provides sufficient information to farmers and farm operators with information to protect water quality. With this information and the site documentation BCE can, in conjunction with the B.C. Ministry of Agriculture, Fisheries and Food (MAFF) and the Ministry of Forests (MOF), provide information to farmers to protect community watersheds.

2.0 SCOPE

Cattle ranching is an important agricultural practice in the Skeena Region, in terms of income generation and its potential to cause environmental effects. To address complaints received regarding water quality in community watersheds from beef cattle operations, BCE wishes to investigate the contribution of cattle ranching to watershed impact, and, if any, what type of monitoring would be needed to review the problem and help farmers take appropriate measures to prevent problems from recurring.

The objectives of this study were to:

- review farming practices and identify areas of concern;
- review information on specific water quality parameters affected by cattle farming;
- gather information from other jurisdictions on surface water monitoring related to cattle impacts;
- compile information on community watersheds, grazing licenses and permits, and public concerns in the Skeena Region as related to grazing and cattle farming; and
- provide an outline for a monitoring program, including parameters and sites.

Through our knowledge of the farming industry and its effect on water quality, our contacts in the industry and our contacts and knowledge of the Skeena Region, we were able to gather sufficient information to satisfy BCE's requirements. This study is based on these contacts and on a brief literature review. No actual field work or farm visits have been conducted for this study.

3.0 METHODS

PGL and Terra-Silva used several methods to obtain the information outlined in the project scope. We surveyed existing literature on the environmental effects of cattle farming and

identified specific chemical, physical, and biological impacts on water quality which could be attributed to cattle operations. Further, we contacted researchers knowledgeable on the effects of agriculture on surface water quality. We then retrieved community watershed information from the BCE Water Management Branch, the Wildlife Branch and/or the Fisheries Branch, and the MOF. From these sources, we reviewed maps and paper records to determine location, size, and number of water licenses, estimated number of water users, flow data, and fisheries and wildlife resources. We reviewed BCE water quality data for watersheds of interest. We also assessed B.C. Lands agriculture tenure files and MOF forest grazing tenure files, and documented water quality concerns attributable to cattle operations in the Skeena Region.

All information gathered was used to identify high concentrations of cattle ranching and over-wintering sites within the Skeena Region, and how these operations would affect surface water and ground water in community watersheds. We located appropriate sites to install water quality monitoring equipment, and identified appropriate monitoring parameters and relevant quality assessment criteria. We have provided references which can be used to help cattle farmers manage their operations to protect community watersheds.

4.0 RESULTS

For this study, we identified key water quality parameters associated with cattle grazing and farming, and then identified key issues specific to the Skeena Region. Section 4.1 discusses our review of relevant data and water quality parameters, and Section 4.2 discusses issues in the Skeena Region.

4.1 REVIEW OF RELEVANT DATA

For our data review, we evaluated each aspect of cattle operations to identify the environmental risks they pose. From this information, we identified relevant physical and chemical parameters for monitoring these risks, reviewed water quality monitoring activities in other jurisdictions in western Canada, and identified some key considerations in devising a water quality assessment program for the Skeena region.

4.1.1 Review of Cattle Operations

A typical cattle operation consists of range or grazing areas, confined feedlot areas, and feed storage areas. Cattle are kept on free-range grazing areas and confined feedlot areas, or in barns for part of the year. Most beef farms use wood waste or straw as bedding material in the barn. Forage crops may be grown to support the cattle. High density grazing areas and confined feedlots may have accumulated manure, as soiled bedding is removed from the barn and stored outside on a regular basis.

Several concerns regarding these practices have been documented. The Ministry of Agriculture, Fisheries, and Food (MAFF), through the Best Agricultural Waste Management Plan (BAWMP), has audited beef operations across the province. These audits identified several aspects of cattle farming that directly affect surface water or ground water, including improper burial of dead animals (27% of 34 operations surveyed); release of silage effluent and wasted feed (27%); improper manure handling or storage (36%); yard runoff from outdoor

cattle pens in proximity to water courses (91%); improper cattle watering facilities with direct access to water courses (50%); and leachate production from sawdust storage (25%)¹. From this we conclude that beef cattle operations affect mainly water resources, with some effects on soil. We believe that air pollution, associated with burning from land clearing and brush maintenance, is a minor environmental risk from cattle operations and will not be detailed in this section. In this review, we did not address disposal of dead animals as this is not likely to occur in or near waterways.

2/3 runoff
to water
in stream

A beef cattle operation includes seasonal feeding and grazing areas, each with different environmental concerns. In seasonal feeding areas (including over-wintering sites, cow-calf operations and feedlots) manure build-up due to high cattle densities poses an environmental risk to community watersheds and other water bodies through manure run-off. In regions like Skeena, with high snow melt runoff or high rainfall, these operations pose a medium to high pollution risk to both surface and ground water.

overwinter
cow-calf
feedlots
High Risk

Grazing lands do not contribute significantly to water quality problems due to low cattle density, except as discussed below. Grazing commonly takes place both on range land and in pastures.

Grazing is
low risk

Range lands contain native vegetation such as grasses, forbs, and shrubs, which are suitable for grazing. Cattle densities on range lands are very low, often with numerous hectares per animal. These lands may be under Crown or private ownership, and are commonly grazed from spring to fall with very limited winter use. The environmental concerns relate to the use of natural waters for watering. Cattle watering may cause extreme bank erosion and pollution of the stream or lake by manure. Other environmental concerns may be related to decrease in biodiversity from selective grazing of range species.

Range → water
in stream

Pastures contain only a few cultivated species of forage. Here, animal densities can be higher than on range land. However, densities will not reach levels at which manure will impact surface or ground water. Environmental effects of pasture grazing is related to cattle watering, where they have unlimited access to streams or lakes. The effect on surface water from watering is discussed below.

Several other operations on cattle farms may affect water quality in community watersheds. These include feed storage (particularly silage) and sawdust storage. Both feed storage and silage storage may release leachate and run-off. Silage runoff, because of its high biochemical oxygen demand (BOD) and nutrient content is a more potent contaminant than manure, and so is especially important.

4.1.2 Impacts on Water Quality

The previous section identified manure entering surface water through run-off and direct deposit, silage runoff, wood waste runoff and leachate, as the main factors that may affect water quality. Several constituents are contained in run-off and leachate. These constituents include ammonia (NH₃), nitrate (NO₃), other nutrients such as phosphorous, organic matter loading (measured as BOD), salts, and pathogens. Other risks from beef farming operations

¹Best Agricultural Waste Management Plan Workshop documentation. June 11, 1993. B.C. Ministry of Agriculture, Fisheries and Food, Resource Management Branch

include pesticides, petroleum hydrocarbons, sand and silt, and wood waste breakdown byproducts. We will describe each of these parameters and their potential effects on water quality. This information is then used to develop a water quality monitoring program.

Ammonia

Ammonia comes from manure or fertilizer and is highly toxic to fish in the NH_3 form. It is normally transported in open water through runoff from uncovered manure piles and barnyards. In fields and in water, ammonia is quickly transformed into nitrate through biological nitrification processes. A recent study in the Fraser Valley found high ammonia "spikes" shortly after the first major storm or period of rainy weather. Ammonia in surface water is then quickly converted into nitrate (Schreier personal communication).

Nitrate

Nitrogen applied to land can convert to nitrate. Nitrate is water soluble and is easily transported in surface water and leached into soil and ground water. High nitrate levels not only cause eutrophication (the process by which dissolved oxygen in water is depleted by the decomposition of excessive organic matter, particularly plant and algae growth) in surface water but also pose a health risk to infants. Allowable nitrate levels in drinking water are below 10mg/L. As much as 40mg/L may be safe for cattle, provided that nitrate content in cattle feed is low.

Phosphorous

Phosphorous is a major factor in lake eutrophication, because it is a major plant nutrient that is normally in limited supply in natural waters. Phosphorous is transported through surface runoff, adsorbing onto particles of silt, sand, and clay.

Organic Loading

Organic waste entering a water body requires oxygen to decompose, removing oxygen which would otherwise be available for fish and other aquatic life. The potential for this to occur is measured as biochemical oxygen demand (BOD). When waste with high levels of BOD enters a water body, fish may die from oxygen deprivation. High BOD levels are generated by leachate from waste feed and silage, and by runoff from barnyard manure piles. Excessive organic loading can contribute to eutrophication of water bodies through release of the nutrients contained in organic matter.

While BOD is a measure of potential oxygen depletion in water, dissolved oxygen (D.O.) is a measure of the actual depletion. In a recent study in the Fraser Valley on the effects of nitrogen loading from manure and fertilizer, D.O. was one of the parameters assessed. Preliminary results showed that D.O. in surface water was lower in areas with high nitrogen loading and high ammonia levels in water. These results most likely relate to the breakdown of organic matter transported through runoff and leachate (Carolyn Bereck, personal communication).

Salts

Salts from manure and human sewage can affect water quality. While salts are essential nutrients, excessive salt levels in water and soil will compromise fish and plant life by hindering vital ion exchange processes. The more abundant salts include sodium, potassium, calcium, and magnesium ions. While all of these are highly soluble, potassium -- like phosphorus -- tends to be transported by adsorption to particulate matter in runoff. The composition of cattle feed appears to contribute to salt loading from manure. Although the Alberta water monitoring found that sodium and chloride ions in water indicated manure discharge, salt content is not an effective indicator for manure. Discharge from sewage treatment plants and industrial complexes, and ground water movement through saline soils can also contribute to the salt (particularly sodium) loading of stream water.

Pathogens

Because water is often a pathway for disease transmittal to animals and humans, monitoring and controlling pathogen loading to surface water is especially important. All animal and human waste contains micro-organisms, which may include bacteria, viruses and parasites. Some of these may be pathogenic (disease-causing) to other animals, either of the same or different species.

Water pathogens can be monitored using several indicator organisms. These indicator organisms include total coliform, fecal coliform (FC) and fecal streptococci (FS). While they are not necessarily pathogenic themselves, these indicator organisms are commonly found with waterborne pathogens such as Salmonella. As environmental conditions may affect indicator species survival differently than pathogens, their sole use for determining water quality is not recommended.

Human pathogens are only expected when sewage directly enters surface water. Effluent from septic systems is not thought to contribute to indicator species levels in water because microorganisms are effectively screened by the soil before reaching ground or surface water, provided that the septic systems are in good working order.

Total and fecal coliforms are indicators human sewage or animal manure contamination in water. Warrington² indicates that the ratio of FC to FS can indicate the origin of contamination (a ratio over 4 would indicate human sources, while a ratio of less than 0.7 would indicate animal sources) but more recent experience indicates that this approach is not reliable. For example, as discussed by Whitman et al., (1995)³, the indicator species are differentially affected by time, suspended solids, and amount of storm water runoff (which made the FC/FS ratio irreproducible).

²Warrington P.D., 1990. Microbiological indicators, a discussion of the relevance of counts and ratios. B.C. Ministry of Environment and Parks, Resource Quantity Section.

³Whitman, R.L., A.V. Gochee, W.A. Dustman and K.J. Kennedy, 1995. Use of Coliform Bacteria in Assessing Human Sewage Contamination. *Natural Areas Journal* 15: 227-233.

Other indicator methodologies to differentiate between human and animal sources of fecal contamination include the identification of enteric viruses using F-specific RNA coliphage serotypes, which indicate exclusively human fecal contamination (Sobsey (1993)⁴). Although the serotypes were found to be significantly associated with human enteric viruses in samples from some sites, and were linked to fecal indicator bacteria, their levels were often below detection level unless there were nearby sources of fecal contamination or sewage. A gene frequency test for distinguishing animal from human fecal contamination has been tested by the University of California. This test uses an indol-based "colitag" technique (Chang, 1996⁵). To date, test work is not yet complete and results are unavailable.

Another source of coliforms in surface waters is bird wastes. While we are not aware of any screening methods for differentiating between cattle manure and bird wastes, we assume that coliform loading from birds will be effectively consistent between various water bodies within one region, and would therefore not require specific attention while monitoring for risk parameters from cattle operations.

Other techniques are available to differentiate between sources of fecal contamination. One method uses an indicator specific to human sewage. Whitman et.al. suggest using optical brighteners as a indicator parameter for human sewage. Optical brighteners are only present in human sewage because they are components of most laundry detergents.

Temperature

Surface water temperatures should not exceed 23°C for fish to survive, and water temperatures are affected by water use. Water temperatures tend to be higher in areas where water withdrawn for irrigation trickles back into surface water, or if vegetation overhanging water courses is removed by human or animal activity. The effect of irrigation returns on water temperature was observed in a current study in the Fraser Valley (Schreier, personal communication).

Pesticides

Pesticides may affect water quality through overspraying and sediment runoff. Pesticides are mainly transported via soil particles and organic matter which are carried by overland flow. Pesticide use at cattle farms is minimal because their main crop is for fodder. Silage and hay do not require large quantities of pesticides, so we believe that there is low risk of pesticide pollution in the Skeena region. Only incidental herbicide spraying (to control knapweed, Canadian thistle, and other weeds) may occur in small areas.

Metals

Metals may enter the environment through fertilizers, manure, etc. In particular, chicken and pig manure may contain significant concentrations of copper, zinc, manganese and other metals that have been added to feed as micronutrients. Since metals are not normally added

⁴Sobsey, M.D., et.al.: Distinguishing animal and human fecal contamination of water using enteric viruses. University of North Carolina. Project outline - CSRS:#NCW9201076

⁵Chang, G.W., 1996. Microbial indicators of food and water quality. University of California. Project outline - CSRS: #CA-B*-NTS-5675-H

to beef and dairy cattle feed, metals from manure are not considered an environmental risk from cattle operations.

Some metals, particularly zinc, can enter surface water through runoff from farm buildings which commonly have galvanized roofs. When directed into a ditch or stream, this runoff may create an environmental risk to the community watershed. Zinc is toxic to aquatic life; levels of 0.03 mg/L are considered acceptable, although 0.014mg/L has been found to affect phytoplankton. Concentrations of 1-10mg/L zinc are not unusual in runoff from galvanized roofs.

4.1.3 Activities in Other Jurisdictions

Pottinger Gaherty contacted regulators in other Western Canada jurisdictions to obtain their views on which parameters are important in monitoring the effects of beef farming on water quality. Organizations contacted included Manitoba Agriculture, Manitoba Environment, Alberta Agriculture and Fisheries, and Saskatchewan Agriculture. We collected data on their stream water management and riparian restoration programs. Manitoba has a large federal-provincial program to rehabilitate riparian zones along streams in grazing areas, and Alberta is managing water quality in their province. These two provinces cooperate in the program and have published several reports on how to manage stream water quality in grazing areas.

Alberta

Alberta is conducting several projects on the effect of grazing on the riparian vegetation. The study is concerned with large scale parameters such as vegetation effects, cross section profile changes of rivers, effects of vegetation on the "green line", the boundary between water and land, and presence of birds. The objectives of the work are to give ranchers tools for measuring the effects of grazing in riparian areas, and to change their attitudes. In these studies, actual water quality is not monitored.

Last year was the first year of Alberta Environment's multi-year program to link water quality to agricultural practices. Several rivers and lakes were carefully monitored for water quality and surrounding land use. Preliminary results showed that cattle operations affected the nutrient loading of lakes and rivers, and that levels of FC were related to livestock operations. Because animal effects were dominant, no distinction was made between animal and human inputs into stream and lake water. Tracers for animal effects included suspended solids, ammonia, and sodium and chloride ions. Flow was also measured in all streams because some contaminant levels were known to be stream flow dependent (Anderson, personal communication).

Saskatchewan

Many areas are under extensive grazing in Saskatchewan. The government has developed standards for run-off from intensive feedlots, but no programs are in place to perform routine monitoring of water quality. No information is available on parameters to be used for measuring the effects on surface water from grazing operations (Murphey).

Manitoba

Manitoba has embarked on a large project to restore riparian zones of rivers and streams, in order to reduce sediment and nutrient loading from cattle ranging. Cattle over-winter near streams, and graze in native grass lands in the summer. Watering sites, and runoff and seepage from feeding sites, are contributing factors to water quality deterioration. In the restoration program, the fish population is monitored and a baseline is set for sediment and nutrient loading. Based on this information, riparian zones are stabilized with rip rap and rock beds, and spot fencing is installed to restrict cattle access to streams. Alternative watering sources are being installed. Not only are streams studied and rehabilitated, but uplands areas are investigated. Through relocation of feedlots and grazing areas, runoff and seepage is controlled, and management plans are established.

Manitoba Environment is conducting water quality studies in several agricultural areas in the province. Water quality parameters are monitored in dug-outs, lakes and rivers to assess algae levels. The study includes a land use survey, and monitoring of water quality parameters. These parameters include FC, total coliform, dissolved and total phosphorus, total Kjeldal nitrogen (TKN), nitrate-N, ammonia-N, total suspended solids (TSS), and metals. Manitoba Environment found that FC, phosphates, TKN, ammonia -N and solids are related to manure use or to runoff from intensive livestock operations, including cattle and pigs. FC, ammonia-N and sediment loading (TSS) peaked shortly after major storms (Gurney, personal communication).

4.1.4 Water Quality Assessment

Water quality assessment is an important tool in preserving the quality of community watersheds. Before parameters can be established for the water quality, a community watershed should be defined and objectives should be established. From the established objectives, criteria can be identified and selected. This section will address these steps.

Definition

We define a community watershed as:

"a collection of streams and lakes fed from an enclosed catch basin (watershed), on which inhabitants of that catch basin depend for drinking water, irrigation, livestock watering and recreation, and that has intrinsic value for aquatic life including spawning grounds for game fish, habitat for fish, birds, aquatic animals, terrestrial animals, plants and microorganisms."

A "Community Watershed" under Section 41(8) of the B.C. *Forest Practices Code* (FPC) is defined as:

"the drainage area above the most downstream point of diversion on a stream for a water use data is for human consumption and that is licensed under the Water Act for a water works purpose, or a domestic purpose if the license is held by or is subject to the control of a water users' community incorporated under the Water Act if the drainage area is not more than 500km² and the water license was issued before June 15, 1995, or an area that is designated as a community watershed under subsection (10)"

Our definition of a community watershed accounts for the criteria under the FPC which emphasizes domestic water use. However, we have purposely broadened our definition in order to include other values within watersheds that can conflict with cattle grazing activities.

Objective

The objective for managing water quality in a community watershed is:

"To allow all water uses within the watershed, while protecting the environment and wildlife habitat."

Parameters and Criteria

To meet the objective for water quality management, criteria must be established as a basis for monitoring water quality and, where necessary, enforcement of good agricultural and environmental practice. Although many more parameters can be selected, enforcing a limited number of key parameters may be more effective than including all possible criteria in a monitoring program.

Through our literature review and our discussions with researchers and regulators in B.C. and other jurisdictions, we devised a list of parameters for measuring and evaluating the effects of beef cattle farming on water quality. Included parameters are indicators of grazing pressure, access to water, and run-off from farm yards, feedlots and overwintering sites. These include the silt loading of river and lake water caused by cattle eroding stream beds and riparian zones. Where cattle have access to streams, manure and urine will affect water quality. Suitable parameters for monitoring these effects include FC, ammonia-N, and sodium and chloride levels. Phosphate and total phosphorus levels may also be affected. Runoff from barn yards, feedlots, and overwintering sites may increase ammonia-N levels and organic loading of streams, affecting the colour, D.O., and BOD levels. Additional information is required on the pH and salt content (TDS). Stream or river flow should also be monitored.

Distinguishing between human sewage and animal sources of contamination is difficult. Several tests using ratios of numbers of microorganisms have been used but the variability of the values as they are affected by stream parameters render these tests unreliable. Other tests are still under development and tend to be expensive. As discussed under "Pathogens" in Section 4.1.2., one easy, inexpensive test is using cotton swabs to detect optical brighteners associated with laundry detergents. Although we did not review its biodegradability or other breakdown mechanisms in natural streams, we find that this cost effective test could be used to screen for human sewage input.

For the parameters discussed above, we have compiled a list of values and criteria that are enforced or are used as guidelines in B.C. These approved criteria and working guidelines include:

Approved and working criteria for water quality, 1994, BCE - Water Quality Branch (WQ)
Interim Canadian Environmental Quality Criteria for Contaminated Sites, 1991. CCME
EPS-CS34 (CCME)

- Criteria for Managing Contaminated Sites in B.C., 1995. BCE - Environmental Protection Department (CMCS)
- Special Waste Regulation - Discharge Limits (SWR).

We have used all available criteria and guidelines to generate a working list of pertinent criteria covering all usage categories (e.g., aquatic life, drinking water quality, irrigation water, and animal watering), since no one set of criteria or guidelines addressed every usage. In generating our list, we adopted the value for the most sensitive usage; if no such value was given, we adopted the value for the next most sensitive usage. Table 1 (Page 10A) contains all data from the approved criteria. From this table, we have selected the following values as fair criteria:

Table 2: Working List of Water Quality Criteria

D.O.	11-6	mg/L
BOD	20	mg/L
Temperature	<23	°C
Total Phosphorus	5-10	ug/L
NO ₃ -N	10	mg/L
NO ₂	0.06	mg/L
NH ₄	0.13-1.87	mg/L
TSS	20	mg/L
Zn	0.03	mg/L
pH	>6.5, <9.0	mg/L
FC	10	MPN/100mL
Optical Brightener	Negative	
TDS	500	mg/L

TABLE 1
 Comparison of Water Quality Criteria
 BCE - Review of Cattle-Community Watershed Conflicts in the Skeena Region
 File #043-02.01

	BC Water Quality Criteria*			CCME**		CMCS***		SWR**** Discharge Limit
	Aquatic Life	Drinking Water	Recreational	Aquatic Life	Drinking Water	Aquatic Life	Drinking Water	
D.O. (mg/L)								
Spawning Streams	11-6	-		5-9.5	-			
Others	8-3	-						
BOD								
TP								
NO3 (mg/L)	5-15 (lakes)	10 (lakes)	10 (lakes)	-	-	-	-	-
NO2 (mg/L)	200	10 (a)	10	-	45	40	10 (a)	-
NH4 (mg/L)	0.06	1	1	0.06	4.5	0.020-0.060	3.2	-
TSS (mg/L)	0.13-1.86	-	-	1.37-2.2	-	0.4-1.8	-	-
Zn (mg/L)	<10 (as NTU: 5)	-	10 (as NTU: 5)	-	-	-	-	20
pH	0.03	5 (as NTU: 1-5)	5	0.03	</= 5	0.03	5	0.2
TDS (mg/L)	<6.5	6.5-8.5	5.0-9.0	6.5-9.0	6.5-8.5	-	-	6.5-8.5
Fecal Coliform	</= 14	500 (disinfection only)	</= 200	-	500	-	-	-
Total Resin Acids	9-60	-	-	-	-	-	-	-

* Approved and Working Criteria for Water Quality, 1994 (BCE)
 ** Interim Canadian Environmental Quality Criteria for Contaminated Sites, 1991 (CCME EPC-CS34)
 *** Criteria for Managing Contaminated Sites in B.C., 1995
 **** B.C. Waste Management Act, Special Waste Regulations (BC Reg - 63/88 updated)

- criteria not given
 (a) criteria applies to total NO3 and NO2 if both are present
 Shading denotes most stringent criteria.

4.2 SPECIFIC ISSUES FOR THE SKEENA REGION

The specific effect of cattle grazing on community watersheds in the Skeena Region must be taken into account to ensure site specific applicability of a monitoring program. To provide a basis for a monitoring program and site locations, we have reviewed information about community watersheds in the Skeena region, including: their locations; grazing leases, licenses, and permits (to indicate which community watersheds are affected by cattle grazing); and water quality concerns that are attributable to cattle grazing in the specified areas.

4.2.1 Watersheds in Skeena Region

Watersheds in the Skeena Region that are used for water supply, and are potentially affected by cattle farming, can be separated in community watersheds, and non-community watersheds with potential cattle impacts. There are 35 community watersheds in the Skeena Region that meet the criteria of Section 41(8) of the B.C. *Forest Practices Code*. Detailed information for all of the community watersheds is provided in Appendix 1, including their locations, size, estimated number of water users, number of water licenses (including the license holders, license number and file number), water use allocation, fish and wildlife resources, and available water quality data. Maps showing community watershed locations are also provided in Appendix 1.

From the information in Appendix 1 we derived an overview of Community Watersheds in the Skeena Region. The overview is given in Table 3 below:

Table 3: Skeena Region Community Watershed Overview

Number of watersheds	35
Average size (range)	2,661 ha (6 - 26,000 ha)
Total area covered	93, 131 ha
Average use gallons/day/ha (range) ¹	815 (1 - 9,140)
Average # of licenses/watershed (range)	5 (1 - 32)
Average ha/user (range) ²	32 (0.05 - 433)
Cattle/watershed ³	0 - 500

¹ Based solely on water allocated for domestic and/or community water supplies (excludes water allocated for other purposes such as irrigation, stock watering, etc.)

² User estimates are given as households, assuming an average daily water consumption of 500 gallons/day/household.

³ Based on cattle grazing information attached in Appendix 2

The Skeena Region has 35 community watersheds with a wide range of water extraction for domestic use. Consequently, some of these watersheds may be sensitive to the influence of cattle, human sewage, or other animals. Cattle operations are concentrated primarily in the southeastern part of the Skeena region, within the catchments of the Upper Skeena and Bulkley River systems between Hazelton and Topley, and within the headwaters of the Fraser River drainage around Francois Lake. The number of cattle on crown tenures at any time

varies due to rotation of cattle between privately owned and crown land throughout the year. In general, cattle are overwintered on privately owned land near to the facilities of the home farm. Crown land is utilized from late spring until early fall for grazing. There are no prominent feedlots or overwintering sites for cattle on crown land in the Skeena region. Of the community watersheds identified, only the Canyon Creek and Tyhee Lake watersheds in the Smithers/Telkwa area have both significant numbers of water users and substantial cattle grazing activity. Most of the other community watersheds are towards the coast where agricultural activity is minimal. The northern most community watershed – Telegraph Creek – may have horse grazing activity within its boundaries but no cattle. The Seymour Lake watershed near Smithers has one farm near the lake that used to have cattle, but the property has recently been sold and there are no longer any cattle.

In addition to community watersheds, the southeast corner of the Skeena Region has a number of watersheds that have not been designated as "community watersheds" under the *Forest Practices Code*, but that do have a high concentration of both water users and cattle grazing operations. Appendix 2 lists several streams and lakes, and details information for waterbodies that have the greatest potential for water use/ cattle grazing conflicts. These watersheds are near Smithers, Telkwa, Quick, Perow and Francois Lake. Some 136 water licenses are located here, as well as creeks with high fisheries values.

Although our terms of reference deal with community watersheds only, we have included these non-community watersheds in our survey because of potential cattle/ water user conflicts.

4.2.2 Cattle Grazing Leases, Licenses, Permits and Overwintering Sites in Skeena Region

Crown grazing tenures and overwintering sites indicate where potential effects on water quality may occur and what the range of the effects could be. Grazing permits and licenses are the most common types of tenures allocated to farmers and ranchers in the region. Permits are granted for periods of 1-5 years whereas licenses are granted for up to 10 years. These tenures are administered by range officers in the MOF district offices and have reasonably up-to-date information available through a central MOF database. Grazing leases make up the remainder of the grazing tenures. Leases are older tenures that were granted for terms of 21 years and are still administered by the Lands Branch. There is general information on file for grazing leases but the information is not up-to-date and is unreliable in terms of the number of animals expected on the lease areas. The estimated numbers of animals on leases was provided by G. Johnstone, who has an intimate knowledge of ranching in the Region. It should be noted that a number of ranchers have multiple tenures and animals are cycled between the various areas throughout the grazing season.

Of the seven Forest Districts encompassed by the Skeena Region – Bulkley, Cassiar, Kispiox, Kalum, Lakes, Morice, and the Queen Charlottes – only the Bulkley, Morice and Lakes Districts support significant numbers of cattle grazing operations. These operations are concentrated within the catchments of the Upper Skeena and Bulkley River systems between Hazelton and Burns Lake. According to the Prince Rupert Forest Region grazing tenure summary (February, 1996) and G. Johnstone's estimated numbers of animals on grazing leases, the Bulkley District crown tenures support 2,631 cattle, the Lakes Forest District tenures support 4,326 cattle, and the Morice Forest District tenures support 3,281 cattle. Cattle grazing in the other four districts is negligible, with an estimated total of 174 head.

Cattle are also grazed on deeded land either exclusively (the exception) or in combination with Crown grazing tenures. In total, about 12,000 beef cattle and 1,020 dairy cattle graze on Crown and deeded land in the region.

Table 4 below lists the total number of active grazing tenures (leases, licenses and permits) in the Skeena Region pertaining specifically to cattle. This list is sorted by Forest District from east to west. A detailed listing of grazing tenures in the region is provided in Appendix 2 as well as specific information on crown and deeded cattle operations within community watersheds, including approximate locations of cattle grazing operations, number of cattle, water sources for livestock watering, and areas of cattle concentration (i.e.: overwintering sites, holding yards).

Table 4: Grazing Tenures in the Skeena Region (cattle grazing only)

Forest District	Number of Grazing Permits/Licenses	Number of Grazing Leases	Number of Cattle
Lakes	51	39	4,326
Morice	46	16	3,281
Bulkley	31	16	2,631
Kispiox	3	2	105
Kalum	0	0	0
Cassiar	2	0	10
Queen	1	2	59
Charlottes			

Three forest districts appear to have potential cattle/ community watershed conflicts because they support a substantial number of cattle. Any water quality monitoring should be focused on streams and lakes in these regions.

4.2.3 Documented Water Quality Concerns Attributable to Cattle Operations in the Skeena Region

Water quality concerns and related issues attributable to cattle operations have been received and dealt with by the provincial Ministries of Agriculture, Environment, and Forests, and by the federal Department of Fisheries and Oceans (DFO). The Ministry of Agriculture has historically taken the lead role in communicating environmental concerns to local ranchers and farmers and has worked with them to mitigate problems in consultation with the other agencies. On occasion, when problems have been perceived to be deliberate, persistent, chronic, or acutely deleterious to the environment or human health, the Ministry of Environment has taken the lead role in monitoring effects of cattle operations and enforcing compliance with its environmental legislation, as have the DFO when fish bearing waters are perceived to be impacted. The Ministry of Forests range officers occasionally confront water quality issues associated with crown grazing tenures, which have generally been dealt with either directly with the farmers or in association with the Ministry of Agriculture. Documented cases and anecdotal reports of water quality issues arising from cattle operations are provided in Appendix 3.

Concerns are related to:

- the run-off of cattle waste into a creek, affecting a fish hatchery;
- a manure spill in a lake;
- free access to lakes and creeks;
- visual contamination from free access to creeks;
- spring run-off from accumulated animal waste; and
- riparian degradation from free access to creeks.

These documented cases show incidents of detrimental effects of cattle on surface water. They only represent cases where regulators were involved to solve complaints. Many other cases may exist, but have not been reported because they did not trigger a complaint or substantial damage.

4.2.4 Evaluation of Cattle Ranching and Farming Practices

Skeena Region Overview

The approximately 200 beef cattle operations in the Skeena Region fall into two categories -- cow/calf and cow/yearling -- with cow/calf operations accounting for 95%. Cow/calf operations in the region have an average of 56 cows, with 32 ranches in the region carrying over 100. The annual cycle for these operations entails calving in the early spring (January - April), turning cows and calves out onto grazing lands (pasture or range) from late May until late September (with some variation across the region), bringing cattle into the home ranch at the end of the grazing season, sending the calves and cull cows to market, and overwintering the breeding herd at the home ranch. Overwintering cattle are usually kept either on winter pasture or within contained feeding areas. They are provided with forage and, to a lesser extent, grain and other processed feeds as required. Cow/yearling operations differ only in that calves are overwintered for spring sale. Both types of beef operations rely heavily on Crown range for summer grazing.

Cattle ranching and farming practices in the Skeena Region are mainly influenced by factors, local topography, large land base requirements to sustain both grazing and forage production, proximity to range land, and the climate. Topography has strongly influenced the siting of cattle ranching activities in the region, with the majority of the farms strategically located along tracts of low lying productive lands along the Bulkley River and its tributaries in the Smithers and Houston area, and throughout the gently rolling landscape around Francois Lake south of the town of Burns Lake. Grazing is intensified in these areas due to the abundance of natural browse and availability of water. Due to climatic and topographic constraints, a large land area per head of cattle is required to support ranching activities in the region.

Individual beef operations in the region are either small in scale or, in the case of larger ranches, spread over very large areas. Small operations typically consist of deeded land with relatively few cattle, and either include production of forage, or require feed supply with off-site forage. Many large operations have a substantial deeded land base for grazing and forage production, with adjoining Crown tenures that are used for grazing. Very few operations in the region have tenures that are significantly distant from the home ranch. Cold winters in the region necessitate overwintering of animals near the home ranch for easy provision of

supplemental feed and water, and proximity of assistance during the calving season. Crown tenures are not used during the winter.

The region also supports other intensive livestock operations. There are 17 dairy farm operations in the region. These dairy operations depend much less on Crown range than the beef operations. The dairy operations are more intensively managed and typically concentrate all farming activities -- pasturing, forage production, and animal holding -- on a deeded land base near the home farm throughout the year. A few dairy operations in the region have Crown tenures which are utilized to graze either replacement heifers or background steers for market. The dairy farms are concentrated in the Bulkley Valley near Smithers, due in part to the European settlement pattern of the area, and for the obvious agricultural capability of the valley.

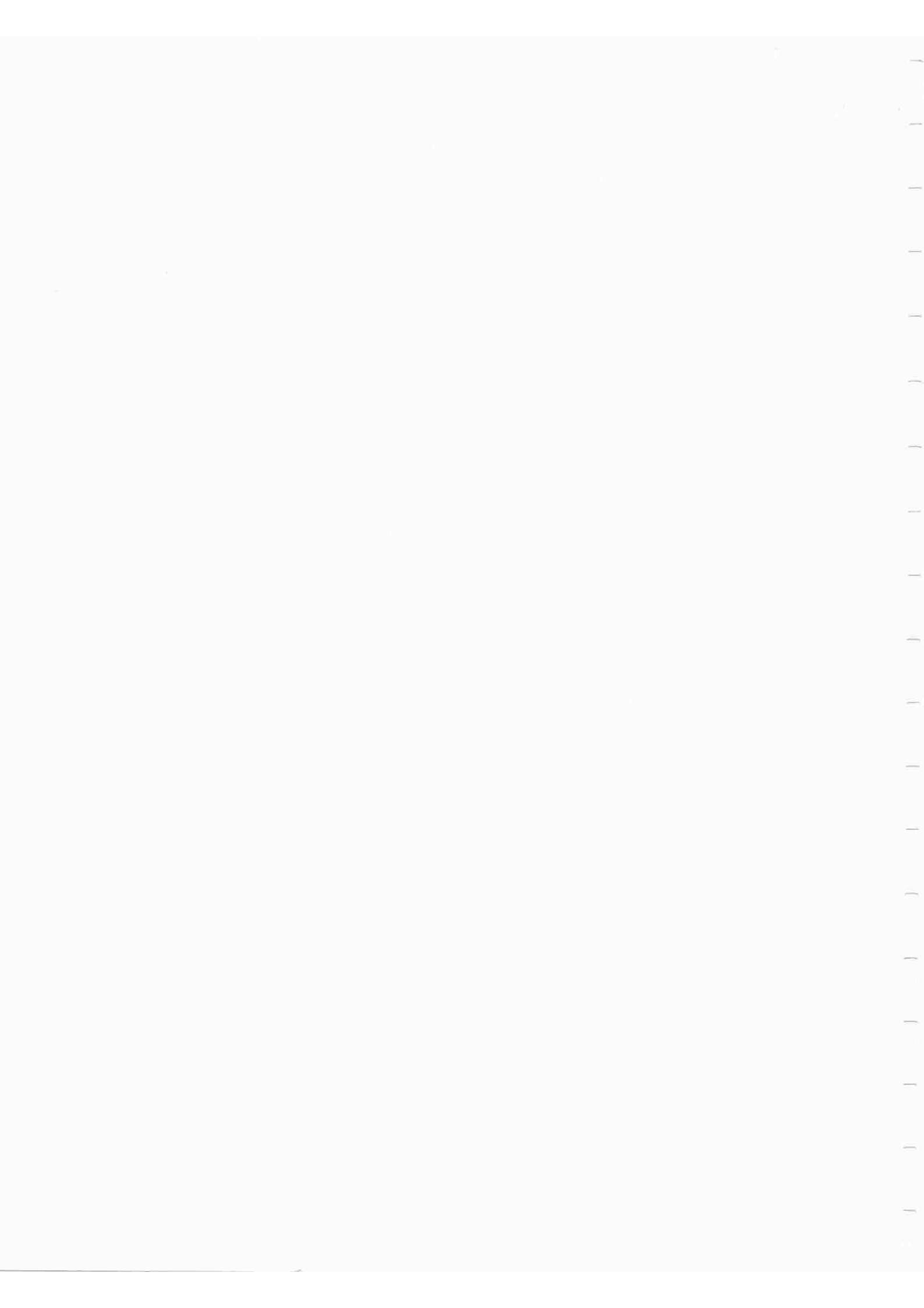
5.0 DISCUSSION

Our review of the location of the cattle operations, complaints and water courses suggests that conflict potential exists in only a few areas of the Skeena Region -- some in community watersheds, and some in non-community watersheds. Some of these conflicts have been documented. Cattle have intermittent and localized impacts on the water quality of a number of watersheds in the south eastern corner of the Skeena Region, primarily in two official community watersheds -- Canyon Creek and Tyhee Lake. Each were found to have both a significant number of water users and substantial cattle farming activity (beef and dairy). Larger cattle operations within these watersheds have been sensitized to water quality concern through public scrutiny and past dealings with local government agencies. Some have been required to mitigate conditions that were negatively impacting water quality in their watershed. Non-community watersheds near Smithers, Telkwa, Quick, Perow and Francois Lake also have potential for conflicts in water use. Several water licenses are held in areas with large numbers of cattle. These areas also contain sensitive fisheries streams.

Although it is difficult to compare Skeena against other regions due to topographical differences, climate, number and magnitude of cattle operations and farmers' attitudes, some comparisons can be made. In the Fraser Valley, large intensive livestock operations, including dairy, pig and poultry operations, produce quantities of animal waste close to the carrying capacity of the region. Locally surplus manure is produced, which need to be transported out of the region. Problems are related to overproduction and logistics. The Fraser Valley is blessed with a favourable climate and all nutrients could be used in other agricultural practices, if handled correctly. Due to increased inspections and public pressure, the effects of the manure use on the environment can be limited. Incorrect storage causes concerns for run-off and leaching of nutrients to the ground water. In fact, in some areas the level of nitrate in ground water reaches the allowable level for drinking water.

Large beef operations in the B.C. interior cause similar concerns. The scale is magnified because large numbers of cattle are held on a limited land base.

Although the potential for conflicts exist in the Skeena Region, its scale may limit them to localized effects. However, even localized effects can cause harm to fish and human health, as has been recorded in the past. Therefore we recommend monitoring water quality at



specific locations. Monitoring should include water parameters and also levels of silt, as some riparian damage has been reported.

Water quality can be affected by cattle farming, but also by human sewage, and natural wildlife. Effluent from sewage treatment facilities such as lagoons and septic tanks may elevate nutrient loading of streams and lakes, and raw or partially treated sewage may increase the levels of coliforms and other fecal bacteria. High levels of fecal bacteria may also be caused by large populations of birds and other animals using lakes and streams as habitat or resting and feeding sites. Therefore, when fecal contamination is included in a monitoring package, the source should be investigated by either following creeks upstream to detect sources or by monitoring specific parameters for each source of contamination. The optic brightener discussed earlier could be considered to monitor sources of sewage.

6.0 POTENTIAL WATER QUALITY STUDY LOCATIONS

Monitoring water quality is expensive and therefore, site locations and monitoring programs should be carefully selected and designed. The following criteria were used to delineate potential water quality study locations on each watercourse in question:

- the site is located in an "at-risk" watershed
- the site is substantially accessible by road and can be accessed by field staff for monitoring
- a significant number of cattle have direct access to the upstream portion of the watercourse or have the potential to cause indirect impacts on the watercourse (i.e.: via waste runoff)
- a substantial number of water licensees rely on the watercourse for domestic water use or there are other sensitive commodities in the watercourse requiring protection (i.e.: fisheries) downstream of monitoring site
- the site exemplifies water use/ cattle conflicts in an official community watershed (optional)
- concerns have been documented regarding potential water use/ cattle conflicts (optional)
- site has been used in the past to evaluate water use/ cattle conflicts (optional)

Potential study locations are identified in Appendix 4, which also provides a rationale for the choice of each site. We recommend the following sites:

- Canyon Creek at Flint Waterhole
- Canyon Creek at Old Babine Lake Road Bridge
- Toboggan Creek below Hopps Farm
- North Side of Francois Lake
- Tyhee Lake, North East Tributaries
- Lacroix Creek at Round Lake
- Deep Creek near Quick
- Robin Creek above Quick
- Creeks above at Perow, and
- Takysie Creek at Takysie Lake

These sites are all potentially affected by beef cattle operations, and have water licenses or sensitive fisheries streams downstream.

Including a control site to the study provides a good basis for evaluating the actual environmental impact of cattle operations, independent of other factors such as human and wildlife activity. A control site could be a true "background" site at an isolated upstream location in the watershed, or it could be a site that is similar to the study sites, but without cattle activity. We have selected the following control sites:

- Seymour Lake
- John Brown Creek
- Corya Creek

The Seymour Lake site monitors a community watershed without cattle grazing, which contains several water licenses. Seymour Lake is valued for water fowl and is close to a moose enhancement area. Water quality in this area would therefore reflect all other environmental effects on water quality. This site is reflecting the Canyon Creek sites in habitation and wildlife values. Both John Brown Creek and Corya Creek are in rugged community watersheds without cattle impacts.

7.0 CONCLUSIONS

From our review we have extracted the following conclusions:

- Cattle have intermittent and localized impacts on the water quality of a number of watersheds in the south eastern corner of the Skeena Region. The potential for cattle/watershed conflicts exists in two official community watersheds -- Canyon Creek and Tyhee Lake. Each were found to have both a significant number of water users and substantial cattle farming activity (beef and dairy).
- Several non-community watershed areas were identified as having cattle/watershed conflicts. These include watersheds in the Smithers, Telkwa, Quick, Perow and Francois Lake areas.
- Recorded conflicts dealt with manure run-off into creeks and lakes, manure spills, free access to lakes and creeks, spring run-off from high density areas, and riparian degradation.
- Ten monitoring sites were identified as well as three control sites.
- Fourteen water quality parameters were identified as representative for contamination from cattle operations. These parameters include: D.O., BOD, Temperature, Total Phosphorous, Nitrate-N, Nitrite-N, Ammonia-N, Total Suspended Solids, Zinc, pH, Fecal Coliforms, Total Dissolved Solids Optic Brightener, and Silt (probably best measured by Total Suspended Solids (TSS)).

8.0 RECOMMENDATIONS

We recommend a monitoring program for water quality in community watersheds. Further we have reviewed some documents that could be used to improve water quality. Improvements to cattle grazing and intensive livestock management practices will positively affect water quality

in community and non-community watersheds. Improvements can be made in several areas. These include the stream bed and riparian areas of the streams and rivers, and the prevention of run-off from intensively used areas such as feed lots and overwintering areas.

The protection of stream beds and riparian areas is geared towards the revegetation of the banks and partially excluding cattle from entering streams or foraging on natural vegetation. When bank vegetation is restored, run-off from the surrounding lands will not enter streams and lakes, as it is intercepted by the vegetation. Also, banks will not be eroded. This will reduce the sediment loading in streams. When cattle are excluded from the stream and stream banks for at least part of the grazing season, the vegetation can then recover and reestablish. Re-established vegetation will shade the water which will lower its temperature and provide a more suitable environment for fish. Exclusion of cattle from the stream itself, through fencing and providing alternative watering facilities, will prevent erosion, changes in the stream bed, and manure loading in water. Changes in grazing management have been studied by Alberta Agriculture and their findings are published in a manual for farmers: "Caring for the Green Zone"⁶. This publication outlines how farmers can benefit from changes in grazing management. Changes include rotation grazing of riparian zones, excluding cattle from streams, and providing protected stream crossings. A copy of this publication is provided in Appendix 6.

In British Columbia, the effects of run-off from intensive livestock operations have been given priority. Farms can ask request an inspection under the BAWMP, and will be evaluated on their pollution pressures and environmental risks. Further, farmers can use the booklet 'Environmental Guidelines for Beef Producers'⁷ to assess their operations. This publication, provided in Appendix 7, provides the legal (Code of Agricultural Practice) and environmental requirements for intensive livestock operations, and covers required setbacks to waterways, manure handling, stocking densities, feed handling, required structures, and composting.

⁶Adams, B., and Lorne Fitch, 1995. Caring for the Green Zone: Riparian Areas and Grazing Management. Pub. No. 1-581, Alberta Agriculture: Funded by Canada-Alberta Environmentally Sustainable Agriculture Agreement. 36pp. See Appendix 6

⁷B.C. Ministry of Agriculture, Fisheries and Food, 1992. Environmental Guidelines for Beef Producers in British Columbia. 81pp. See Appendix 7

9.0 STANDARD LIMITATIONS

This report has been prepared for the B.C. Ministry of Environment, Lands, and Parks. It describes our understanding of cattle farming operations and associated environmental issues risk parameters, particularly relating to the Skeena Region. The content of this report is based on the results of a literature search and review, and from information from personal conversations with knowledgeable contacts. No field testing has been conducted to obtain information or verify anecdotal or literature data. As such, potential remains for unknown, unidentified, or unforeseen environmental risks. PGL accepts no responsibility for any damages that may be suffered by third parties as a result of decisions or actions based on this report.

The findings and conclusions have been developed in a manner consistent with that level of care and skill normally exercised by environmental professionals currently practicing under similar conditions.

This project has been conducted using the terms of reference and conditions set forth in our work program. No warranty, express or implied, is made. This report neither supports nor condemns cattle farming operations in the Skeena Region.

Community Watersheds in the Skeena Region

This appendix provides specific information on the 35 defined "community watersheds" in the Skeena region, and reports key values which can be impacted by cattle farming activities. The watersheds are presented in their approximate order of location from east to west. A location map for these watersheds is attached at the end of this Appendix.

All of these watersheds meet the FPC definition of "community watershed" under the B.C. *Forest Practices Code* (FPC), as discussed in Section 4.1.4 of the report. This definition pertains to water systems serving a defined community of users, such as a municipal water supply or a rural waterworks used in common by multiple households. All activities within a designated community watershed such as agriculture, resource extraction, commercial/ residential development, and recreation must be strictly managed to protect the quality and quantity of surface water being withdrawn for domestic uses.

Many watersheds in the Skeena region contain multiple individual water licences but no communal systems. Because they are not defined as community watersheds under the FPC, they do not receive the same level of protection as designated community watersheds. To be designated as a community watershed, individual licencees can form "water user communities" (defined in the *Water Act*) and petition the regional forestry manager for community watershed status under the FPC.

We have also documented licencees slightly downstream of community watershed boundaries, because they are at least as susceptible to water quality impact from cattle farming as licencees within the boundaries. Under the FPC definition, the downstream boundary of a watershed is the last point of diversion from a community waterworks or user community. In Canyon Creek near Smithers, 18 individual water licencees at the lower end of Canyon Creek (along Snake Road) fall beyond the community watershed boundary, but should still be considered from the perspective of water quality impact from cattle farming.

1. Bulkley River - Mathews Lake

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
5 km north of Houston	127.0	2	2	D.of Houston J. Himech	1. C059596/ 6000006 2. C062041/ 0270361
WR MAP 93.L 047					
Water Use Allocations	Domestic 30,500 gal/day Stock Watering 2,000 gal/day Irrigation 1.35×10^7 gal/year <i>***Licence not currently being used by District of Houston</i>				
Fisheries and Wildlife Resources:					
- Low wildlife diversity (lowered capability) due to cattle grazing intensity. Moderate ungulates values around Grouse Mountain. Low predator population due to agricultural development.					
Water Quality Data	N/A				

2. Bulkley River - Canyon Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
20 km west of Smithers	26000.0	60	32	NWC Society Davidson Milne Davidson Boyko Hooker Emmelot Emmelot Olafsson Lorette Barratt George Hall Jackson Seinen DeGelder H&S Farms Peterson Pedersen Goble Goble Potsepp Wilford Flint Monroe Young Adzich DeJong Dunn Kendall Bianco NWC Society	Canyon Ck. 1. Z105955/ 6000782 2. C105126/ 6000768 3. C105121/ 6000767 4. F042174/ 0285309 5. F045528/ 0316487 6. F045530/ 0316440 7. C104944/ 6000757 8. F045532/ 0316486 9. C047000/ 0316485 10. C047096/ 0317671 11. C047001/ 0317674 12. C062026/ 0316464 13. C062027/ 0316452 14. F042175/ 0285556 15. F042173/ 0290669 16. F042176/ 0310078 17. C037738/ 0296353 18. C069473/ 0285561 19. C069474/ 6000127 20. C047204/ 0316049 21. F042590/ 0300686 22. C046254/ 0316463 23. C047523/ 0330938 24. C030212/ 0260624 25. Z110634/ 6000907 26. C033261/ 0273311 Ganokwa Ck. 27. C104941/ 6000755 Tamara Brook, Badley Ck., April Ck., 28. C101208/ 6000554 Lyon Ck. 29. C047526/ 0330978 ZZ Ck (R of Ganokwa) 30. Z106247/ 6000796 Auber Ck. 31. C105913/ 0328477 Astlais Ck. 32. C102544/ 6000661
WR MAP 93.L.085					

Water Use Allocations	Domestic 30,000 gal/day Stock Watering 3,850 gal/day Irrigation 1.4×10^8 gal/year
------------------------------	--

Fisheries and Wildlife Resources:

- Wildlife: North facing slopes and swampy lowlands in north east corner of watershed provides high capability summer range for ungulates--deer in pine ridges and along water courses; moose throughout watershed
- Slopes with south and south east aspects in northern half of the watershed provide early wintering habitat at high elevations for ungulates--moose, deer, goats. Excellent goat range in alpine behind Astlais mountain (north west corner of watershed).
- Reisetter Pass, a significant wildlife movement corridor, fringes the western side of the watershed. Important mineral licks for moose and goats near Dome road (near northern boundary of watershed)
- Moderate carnivore values--wolves, coyotes, foxes, lynx, grizzlies--near good ungulates habitat. Berry production on upper slopes provides good bear habitat.
- Coniferous forest in northern portion of watershed support high fur bearer values-- martin, weasels, mink & otter along water courses, lynx (where snowshoe hare are present), beaver in water courses, wolverine
- Fisheries: Lower Canyon Creek supports range of anadromous fish--steelhead, coho, juvenile chinook, pink salmon. Upper Canyon Creek and tributaries have resident rainbow trout and dolly varden.

Pressure on Habitat

- Wildlife habitat removal in watershed--agricultural fields, logging/ harvesting. Cattle grazing in some areas has depleted mid-range shrubs important for ungulate range. Logging reverts areas back to early seral stage which impacts fur bearers and ungulates.
- Fisheries: Lower end of Canyon Creek has high gradient with cobbly creek bed and banks, making it resilient to physical degradation by cattle. Much of the mid-run of the Creek (i.e.: 5-15km upstream of confluence with Bulkley River) is gorged and inaccessible to cattle, thereby protecting fisheries values. The upper ends of Canyon Creek and tributaries are flat and meandering, finer textured along banks and in the stream beds, and fed by numerous swamps and beaver ponds. The creeks at the top end are easily accessed by grazing animals, which could have impacts on fish spawning and holding areas by physical degradation of stream channels, grazing pressure in riparian areas, and contamination from animal waste.

Water Quality Data

Midstream grab sample; low flow period; 5 consecutive weeks; Aug/95	Sample Week	MPN/100ml			Ratio of Biological Indicators	
		Coli-T	E-Coli	Coli-F	TC/FC	FC/EC
	1	10	1	13	0.77	13.00
	2	2	1	11	0.18	11.00
	3	41	6	31	1.32	5.17
	4	4	2	6	0.67	3.00
	5	13	5	8	1.63	1.60

3. Bulkley River - Tyhee Lake

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
4 km north of Telkwa	3818.8	32	21	Sandberg Barclay Bakker Koopmans Burger Currie Lowe Tayler et al Beaubien Balckburn Campbell Lovatt Hidber Dykens Skjelbred Bradley Skjelbred Skjelbred Pearse Pearse Tye Farms	Tyhee Lake 1. C054595/ 0355425 2. C057742/ 0368816 3. C072079/ 6000605 4. C072046/ 6000521 5. C053281/ 0364478 6. C043095/ 0322136 7. C039855/ 0309849 8. C060201/ 6000087 9. C062308/ 0310495 10. C060202/ 6000088 11. C057743/ 0368529 12. C045178/ 0323365 13. C051653/ 0310043 14. C062004/ 6000260 Chalmers Ck. 15. C105274/ 0368161 16. C050317/ 0340688 Bede Ck. 17. C047524/ 0340092 18. C058269/ 0368162 Victor Ck. 19. C057175/ 0341193 20. C057176/ 0341193 21. C104551/ 6000247
WR MAP 93.L.065.4.4					
Water Use Allocations	Domestic 16,000 gal/day Stock Watering 5,000 gal/day Irrigation 2.7×10^6 gal/year Enterprise 6,000 gal/day Storage - Non-Power 2.7×10^6 gal/year				
Fisheries and Wildlife Resources:					
<ul style="list-style-type: none"> - Wildlife: Values similar to Canyon Creek Watershed. - Good winter range for ungulates on northern slopes. Good summer range for moose on cooler, north facing slopes and in lowland swamps around lake. - Early spring greenup provides early season bear habitat - Closed canopy coniferous stands along northern boundary of watershed provides good fur bearers habitat. - Fisheries: Tyhee Lake has resident trout, pigmy whitefish (endangered species), burbot, stocked rainbow, and stocked coho, a range of coarse fish (suckers, chub, etc.) - Water fowl: loons, ducks 					

Water Quality Data								
See attached spreadsheet A:\LAKEDAT.TXT (disk at end of Appendix)								
Tyhee Lake data: SEAM Sites 1131009, E207559, E207560, E207561								
Tyhee Lake Tributaries								
	Site Number	Date	Time	N.Kjel:T	NO ₂ NO ₃ :D	Nitrit:D	Phos ph:D	Phos ph:T
		Grab Sample		mg/L	mg/L	mg/L	mg/L	mg/L
Horse Farm Ck	E219763	95/03/17	11:21	1.03	0.03	0.009		0.78
	E219763	95/03/17	11:24	1.03	0.02	0.01		0.786
Howard's Ck	E219764	95/04/25	10:53	0.51	0.03	0.005	<	0.016
	E219764	95/04/07	12:27	0.56	0.09	0.005	<	0.024
	E219764	95/03/17	12:00	1.69	0.07	0.011	0.441	0.49
	E219764	95/03/17	12:02	1.48	0.05	0.009	0.393	0.482
Fisher Rd, Junction Ck	E219765	95/04/07	12:40	0.64	0.09	0.005	<	0.033
	E219765	95/03/17	12:43	1.58	0.06	0.037	0.866	1.03
Hoek's Ck	E219766	95/04/25	11:04	0.56	0.02	< 0.005	<	0.047
	E219766	95/04/07	12:46	0.73	0.02	0.005	<	0.076
	E219766	95/04/07	12:48	0.69	0.02	< 0.005	<	0.076
	E219766	95/03/17	12:55	1.4	0.17	0.024		0.414
Koopman's North Ck	E219768	95/03/17	13:10	5.25	0.22	0.19		2.52
	E219768	95/03/17	13:12	5.36	0.19	0.187		2.55
Koopman's South Ck	E219769	95/04/07	13:35	0.58	0.26	0.005	<	0.114
	E219769	95/03/17	14:35	1.95	0.16	0.026		1.81
	E219769	95/03/17	14:39	1.85	0.16	0.021		1.86
Victor Ck	E219770	95/04/25	14:15	0.52	0.31	0.005	<	0.008
	E219770	95/04/25	14:16	0.57	0.3	0.005	<	0.003
	E219770	95/04/07	14:15	0.62	2.04	0.005	<	0.024
Hislop Rd. Ck	E219771	95/04/25	15:00	0.58	0.02	< 0.005	<	0.019
	E219771	95/04/08	10:57	0.41	0.14	0.005	<	0.035
	E219771	95/03/18	16:00	0.53	0.02	< 0.005	<	0.343
	E219771	95/03/18	16:45	0.53	0.02	< 0.015		0.426

4. Bulkley River - Kirby Lake

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
2.5 km north west of Telkwa	38.6	24	24	Reding	1. C068096/ 6000552
				Hislop Farms	2. C068097/ 6000166
				Haggett	3. C068098/ 6000167
				Reid	4. C068099/ 6000168
				Kopfle	5. C072040/ 6000578
				Hislop Farms	6. C106681/ 6000803
				Clark	7. C109880/ 6000876
				Muzzell	8. C109881/ 6000877
				Lear	9. C109882/ 6000878
				Braun	10. C109883/ 6000879
				Hudson	11. C109884/ 6000880
				Aasland, N.	12. C109885/ 6000881
				Assland, D.	13. C109886/ 6000882
				Ryder	14. C109887/ 6000883
				Lund	15. C109888/ 6000884
				Cobb	16. C109889/ 6000885
				Stewart	17. C109890/ 6000886
				McCosker	18. C109891/ 6000887
				Hislop Farms	19. C109892/ 6000888
				Hidber	20. C109893/ 6000889
				Sparks	21. C109894/ 6000890
				Glover	22. C106002/ 6000788
				Burger	23. C108749/ 6000850
				Fulton	24. C109055/ 6000857
WR MAP 93.L.066					
Water Use Allocations	Domestic 12,000 gal/day				
Fisheries and Wildlife Resources: - Relatively similar to Tyhee Lake watershed					
Water Quality Data	N/A				

5. Bulkley River - Seymour Lake

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
5 km east of Smithers	1526.7	27	25	Fisheries Br. Van Delden Manton Poulin Budden Herchmer Phillips Hearnden Johnson Fuhr Michael Doombos Pearson Moore Paczinsky Coates Visentin Robertson Beebe Groot Kilback Whitecotton Mounsey Drummond Gleason McLean	1. C060217/ 6000110 2. C101230/ 6000611 3. C058548/ 0369188 4. C061960/ 6000238 5. C048822/ 0329402 6. C048680/ 0329403 7. C037769/ 0290576 8. C040455/ 0310335 9. C044687/ 0258641 10. C047686/ 0330679 11. C068093/ 6000541 12. F020865/ 0258635 13. F020866/ 0258636 14. F020869/ 0258642 15. F020870/ 0258643 16. F020871/ 0273894 17. F020872/ 0273643 18. F021531/ 0258639 19. F021612/ 0277499 20. F021613/ 0305062 21. F038577/ 0300598 22. F040386/ 0300601 23. F042180/ 0296674 24. F042181/ 0273665 25. F104915/ 0258637 26. C055152/ 0366002
WR MAP 93.L.075.1.3.4					
Water Use Allocations	Domestic 13,000 gal/day Constructed Conservation Works 0.51 cubic feet/sec				
Fisheries and Wildlife Resources:					
<ul style="list-style-type: none"> - Wildlife: lower slopes provide moderate value winter range for ungulates (moose enhancement project ongoing in lowlands-MOE Wildlife Branch); early winter range at higher elevations. Low density of ungulates in watershed. - Range of fur bearers and ungulate associated predators similar to Canyon Creek watershed - Good early spring bear and deer habitat on dry, juniper covered slopes - Fisheries: Seymour Lake stocked with rainbow trout; resident cutthroats and numerous species of coarse fish. - Water fowl: loons, ducks 					
Water Quality Data	See attached spreadsheet A:\LAKEDAT.TXT (disk at end of Appendix) Seymour Lake data: SEAM Sites 1131010, E207553, E207554				

6. Bulkley River - John Brown Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
10 km west of Moricetown	7918.1	40	1	Moricetown Indian Band	C031777/ 0269414
WR MAP 93.M.004					
Water Use Allocations	Community Waterworks 20,000 gal/day				
Fisheries and Wildlife Resources:					
- Wildlife: Ungulates present (low densities due to absence of appropriate browse); goats at higher elevations					
- Bears present (low density)					
- Wide range of fur bearers in closed canopy coniferous forest					
- Fisheries: Anadromous steelhead, coho; resident trout (dollies, cutthroat, rainbows)					
Water Quality Data	N/A				

7. Bulkley River - Corya Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
10 km north west of Moricetown	6386.7	531	3	Moricetown Indian Band Moricetown Indian Band Von Seydlitz	Corya Ck 1. C055359/ 0364674 2. C101226/ 6000455 Graphite Ck 3. C068057/ 6000453
WR MAP 93.M.004					
Water Use Allocations	Community Waterworks 265,000 gal/day Domestic 500 gal/day Irrigation 1.1×10^7 gal/year				
Fisheries and Wildlife Resources:					
- Wildlife: Similar to John Brown Creek					
- Fisheries: Similar to John Brown but gorged and high gradient upstream - low fish values					
Water Quality Data	N/A				

8. Kitsegucla River - Juniper Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
12.5 km north east of Kitsegucla	8848.7	300	1	Gitsegukla Indian Band	C108696/ 6000849
WR MAP 93.M.012					
Water Use Allocations	Community Waterworks 150,000 gal/day				
Fisheries and Wildlife Resources: Similar as John Brown and Corya Creeks					
Water Quality Data	N/A				

9. Bulkley River - Station Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
3.5 km south of New Hazelton	1014.7	486	5	District of N. Hazelton	1. C056425/ 0208849 2. C056426/ 0208849 3. C056427/ 0255649 4. C056428/ 0255649 5. C070975/ 6000123
WR MAP 93.M.022					
Water Use Allocations	Community Waterworks 243,151 gal/day Storage - Non-Power 3.8×10^6 gal/year				
Fisheries and Wildlife Resources:					
- Wildlife: high values for fur bearers due to prevalence of coniferous forest. Moderate ungulates values in lowlands along streams and swamps. Moderate carnivore populations at higher elevations.					
- Fisheries: Similar to John Brown and Corya					
Water Quality Data	N/A				

10. Bulkley River - Two Mile Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
10 km north east of Hazelton	2704.7	1500	2	Benson Village of Hazelton	1. C051825/ 0162823 2. C046255/ 0316438
WR MAP 93.M.022					
Water Use Allocations	Community Waterworks 750,000 gal/day Domestic 1,000 gal/day Irrigation 813,977 gal/year				
Fisheries and Wildlife Resources: Similar to Canyon Creek values					
Water Quality Data	N/A				

11. Kispiox River - Quinmas Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
2.5 km south west of Kispiox	78.2	70	1	Kispiox Indian Band	C030543/ 0260124
WR MAP 93.M.032					
Water Use Allocations	Community Waterworks 35,000 gal/day				
Fisheries and Wildlife Resources:	Similar to Canyon Creek values				
Water Quality Data	N/A				

12. Kispiox River - Dale Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
2.5 km west of Kispiox	962.3	80	1	Kispiox Indian Band	C054512/ 0270204
WR MAP 93.M.032					
Water Use Allocations	Community Waterworks 40,000 gal/day				
Fisheries and Wildlife Resources:	Similar to Canyon Creek values				
Water Quality Data	N/A				

13. Skeena River - Sikedakh Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
10 km north west of Glen Vowell	1290.7	60	2	Glen Vowell Indian Band	1. C034945/ 0277211 2. C049457/ 0340755
WR MAP 93.M.032					
Water Use Allocations	Community Waterworks 30,000 gal/day				
Fisheries and Wildlife Resources:	Similar to Canyon Creek values				
Water Quality Data	N/A				

14. Skeena River - Chicago Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
6.5 km south east of South Hazelton	625.1	280	3	Dist. of S. Hazelton Lemky	Chicago Ck 1. C027503/ 0218808 2. C050320/ 0342113 Flagg Ck 3. C070636/ 0365964
WR MAP 93.M.022					
Water Use Allocations	Community Waterworks 140,000 gal/day Industrial Ponds 65,000 gal/day				
Water Quality Data	N/A				

15. Skeena River - Ten Link Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
2.5 km east of Kitwancool	455.0	100	1	Gitanyow Indian Band	C046694/ 0317669
WR MAP 103P/SE(8-a)					
Water Use Allocations	Community Waterworks 50,000 gal/day				
Water Quality Data	N/A				

16. Kitsequecla River - Kits Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
1.5 km south of Kitsequecla	43.2	100	1	Gitsegukla Indian Band	C058654/ 0140176
WR MAP 93.M.001					
Water Use Allocations	Community Waterworks 50,000 gal/day				
Water Quality Data	N/A				

17. Lakelse River - Drake Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
10 km east of Terrace	126.6	139	1	Woodlands Utilities Ltd.	C068078/ 6000332
WR MAP 103.I.058					
Water Use Allocations	Community Waterworks 69,500 gal/day				
Water Quality Data	N/A				

18. Skeena River - Eneeksagilaguaw Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
5 km west of Terrace	77.0	50	1	Kitsumkalum Indian Band	C041644/ 0296963
WR MAP 103.I.057					
Water Use Allocations	Community Waterworks 25,000 gal/day				
Water Quality Data	N/A				

19. Skeena River - Virginia Brook

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
3.5 km east of Terrace	6.4	30	1	Timberland Trailer Park	C0317715/ 0261250
WR MAP 6618A					
Water Use Allocations	Community Waterworks 15,000 gal/day				
Water Quality Data	N/A				

20. Kitsumkalum River - Deep Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
8.5 km north east of Terrace	1226.2	5500	7	McCullough DFO Haugland Mohr DFO D. of Terrace D. of Terrace	1. C055006/ 0355075 2. C062007/ 6000242 3. C054119/ 0364553 4. C060212/ 6000116 5. C060206/ 6000066 6. C022517/ 0189873 7. C027977/ 0239567
WR MAP 103.1.057					
Water Use Allocations	Community Waterworks 2.75 x 10 ⁶ gal/day Domestic 2,000 gal/day Conservation - Use of Water 4.0 cubic feet/sec				
Water Quality Data	On SEAM: 2 sampling locations (E207384, E207385), 1 sampling date. See attached spreadsheet (disk at end of Appendix) A:\CREEKDAT.TXT				

21. Kitsumkalum River - Spring Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
7 km north east of Terrace	301.4	5511	12	Jordan Price Paogue Strachan Rempel Lynch Benoit Folleau Smaha D. of Terrace D. of Terrace Riding	1. C051342/ 0364092 2. C053359/ 0365700 3. C054803/ 0355229 4. C041100/ 0310811 5. C058109/ 0367245 6. C0581100/ 037246 7. C058111/ 0367247 8. C058112/ 0367248 9. C054084/ 0346764 10. C022517/ 0189873 11. C027977/ 0239567 12. C054083/ 0305212
WR MAP 6650D					
Water Use Allocations	Community Waterworks 2.75 x 10 ⁶ gal/day Domestic 5,500 gal/day				
Water Quality Data	N/A				

22. Stikine River - Telegraph Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
2.5 km east of Telegraph Creek	4466.3	124	1	Tahltn Indian Band	C065470/ 6000313
WR MAP 104.G.095					
Water Use Allocations	Community Waterworks 62,000 gal/day				
Water Quality Data	N/A				

23. North Coast Rivers - Wathl Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
10 km east of Kitamaat Village	12200.0	120	1	Kitamaat Indian Band	C025955/ 0227946
WR MAP 103H/NE(15-g)					
Water Use Allocations	Community Waterworks 60,000 gal/day				
Water Quality Data	N/A				

24. Nass River - Gitzyon Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
5 km east of New Aiyansh	2132.2	211	3	Spencer Gitlakdamix New Aiyansh Holdings Ltd	1. Z110426/ 6000903 2. C028169/ 0247213 3. C072058/ 6000571
WR MAP 103.P.025					
Water Use Allocations	Community Waterworks 105,000 gal/day Domestic 500 gal/day Enterprise 27,500 gal/day				
Water Quality Data	N/A				

25. Nass River - Ksa Miintl Am Hawak Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
10 km west of New Aiyansh	230.6	133	1	Gitwinksihlkw Indian Band	C101268/ 6000529
WR MAP 103.P.014					
Water Use Allocations	Community Waterworks 66,500 gal/day Storage - Non-Power 815,000 gal/year				
Water Quality Data	N/A				

26. Nass River - Ksa Tsim Psa Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
12.5 km west of New Aiyansh	141.9	133	1	Gitwinksihlkw Indian Band	C101268/ 6000529
WR MAP 103P/Stock Watering(3-g)					
Water Use Allocations	Community Waterworks 66,500 gal/day Storage - Non-Power 815,000 gal/year				
Water Quality Data	N/A				

27. Nass River - Axe Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
2.5 km north west of Greenville	157.4	120	1	Lakalzap Indian Band	C042016/ 0296841
WR MAP 103.P.003					
Water Use Allocations	Community Waterworks 60,000 gal/day				
Water Quality Data	N/A				

28. North Coast Rivers - Shawatlan River

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
12 km north east of Prince Rupert	2532.8	14,100	1	C. of Prince Rupert	C109676/ 0265049
WR MAP 6704					
Water Use Allocations	Community Waterworks 7.05 x 10 ⁶ gal/day Storage - Non-Power 1.08 x 10 ⁹ gal/year				
Water Quality Data	N/A				

29. North Coast Rivers - Shawatlan Lake

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
7.5 km north east of Prince Rupert	2103.5	14,100	1	C. of Prince Rupert	C109676/ 0265049
WR MAP 6704					
Water Use Allocations	Community Waterworks 7.05 x 10 ⁶ gal/day Storage - Non-Power 1.08 x 10 ⁹ gal/year				
Water Quality Data	N/A				

30. North Coast Rivers - Stumaun Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
4 km south east of Port Simpson	670.9	750	3	Lax-Kw-Alaams Indian Band	1. C048683/ 0305586 2. C048684/ 0305586 3. C065481/ 6000343
WR MAP 103.J.059					
Water Use Allocations	Community Waterworks 375,000 gal/day Storage - Non-Power 3.78 x 10 ⁷ gal/year				
Water Quality Data	N/A				

31. Digby Island - Dodge Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
5 km west of Prince Rupert	17.1	27	2	Dodge Cove Improvement District	1. C061909/ 0368981 2. C061910/ 0368981
WR MAP 103.J.029					
Water Use Allocations	Community Waterworks 13,333 gal/day Storage - Non-Power 813,977 gal/year				
Water Quality Data	N/A				

32. North Coast Rivers - Wolf Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
1 km east of Port Edward	1408.3	4,000	5	V. of Port Edward	1. C063008/ 0059722 2. C068075/ 6000342 3. C068076/ 6000341 4. C068077/ 6000306 5. C063009/ 0149734
WR MAP 6702A					
Water Use Allocations	Community Waterworks 2×10^6 gal/day Storage - Non-Power 1.80×10^8 gal/year Hatchery 11.50 cubic feet/sec				
Water Quality Data	N/A				

33. North Coast Rivers - Gabion River

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
2.5 km west of Hartley Bay	1845.5	200	1	Hartley Bay Indian Band	C061858/ 0366062
WR MAP 103.H.044					
Water Use Allocations	Community Waterworks 100,000 gal/day				
Water Quality Data	N/A				

34. Graham Island - Slarkedus Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
5 km east of Skidegate	583.0	200	2	Skidegate Indian Band	1. C041154/ 0310610 2. C041155/ 0310610 3. F009985/ 0265354 4. C072059/ 6000588
WR MAP 103F/SE(G/5-)					
Water Use Allocations	Community Waterworks 100,000 gal/day Domestic 10,000 gal/day Storage - Non-Power 2.74 x 10 ⁷ gal/year				
Water Quality Data	N/A				

35. Graham Island - Tarundi Creek

Location	Size (ha)	# of Water Users	# of Water Licences	Water Licence Holders	Water Licence #/ File #
7 km west of Queen Charlotte City	1065.9	836	1	Skeena-Queen Charlotte R.D	C106810/ 6000805
WR MAP 103.F.030.1.4					
Water Use Allocations	Community Waterworks 306,740 gal/day				
Water Quality Data	N/A				

Cattle Grazing Operations

This Appendix is arranged in three sections. Section 1 summarizes all Crown grazing tenures (leases, licences, and permits) in the Skeena region. Section 2 identifies and describes cattle grazing operations and overwintering sites that fall within the boundaries of official community watersheds. Finally, Section 3 identifies areas where intensive cattle grazing occurs in watersheds that have significant domestic water use but are not designated as "community watersheds" under the *Forest Practices Code*.

Cattle grazing operations include beef and dairy farms that graze animals both on deeded land and on Crown range tenures.

1.0 Grazing Tenures in Skeena Region

Cattle operations are concentrated primarily in the southeastern part of the Skeena region, within the drainages of the Upper Skeena and Bulkley River systems between Hazelton and Topley, and within the headwaters of the Fraser River drainage around Francois Lake. The number of cattle on Crown tenures varies due to rotation of cattle between privately-owned and Crown land throughout the year. In general, cattle are overwintered on privately-owned land near to home farm facilities, and are grazed from late spring until early fall on Crown land. There are no prominent feedlots or overwintering sites for cattle on Crown land in the Skeena region.

Tables 1 to 5 below list grazing tenure holders in all Forest Districts in Skeena region where the tenured areas entirely or partly for cattle grazing. The tables include the name of the tenure holder, the tenure number and type (i.e.: lease, licence or permit), and the number of cattle within the tenure licence or permit areas (accurate cattle numbers are not available for grazing leases). Tenure locations and boundaries for the Lakes District are shown on Mapsheet 1 at the end of this Appendix. Digitized maps were not available for the Morice and Bulkley Districts, so for these two districts only approximate locations of tenure areas are given. The "reference #" field in Tables 2 & 3 correspond to Mapsheets 2 & 3 (attached). Accurate tenure location maps are available to view at the Morice and Bulkley District offices in Houston and Smithers.

Table 1: Lakes District Active Grazing Tenures

Tenure Holder (Lakes District)	Tenure Number/Type	# of Cattle
Addison	070901 - Licence 0086372 - Lease	50
Amendt	071961 - Licence	156
Baker	071966 - Licence 0104762 - Lease	160
Bennett	071964 - Licence 0216459 - Lease	49

Bickle	LA1154 - Licence	55
Bickle	LA1164 - Licence 0179182 - Lease	42
Bigler	071874 - Licence 0030281 - Lease 0246838 - Lease	156
Bishop	070809 - Licence 0012626 - Lease	93
Blackwell	LA1153 - Licence	53
Block	072869 - Licence	26
Bomberger	LA1165 - Licence	53
Burt	072602 - Licence	15
Corthell	0214575 - Lease 0324585 - Lease	0
Cowan	0208550 - Lease	0
Cox	0150068 - Lease	0
Critchlow	072254 - Permit 072864 - Permit LA1166 - Licence 0104761 - Lease 0145911 - Lease 0254297 - Lease 6402816 - Lease	216
Diamond X Ranch Ltd. (Robertson)	071786 - Licence 0101603 - Lease	76
Feldmann	072662 - Licence	19
Fisher	071590 - Licence	13
Forest Meadows Holdings	072031 - Licence	12
Grant	0255352 - Lease	65
Gruen	070859 - Permit 0204923 - Lease	21
Hiatt	071870 - Licence	35
Hummel	LA1168 - Licence 0267358 - Lease	160
Ingram	LA1151 - Licence	10
Kalaman	070810 - Licence	23
Laass	0146881 - Lease	0
Lambert	0308585 - Lease	100
Larson	0194075 - Lease	0
Lepoidevin	0159260 - Lease	0
Litke	LA1157 - Licence	62
Litke	LA1158 - Licence	22
McEntire	070996 - Licence	73
McFee	071965 - Licence 0034648 - Lease 0089973 - Lease	141
McGinnes	6401146 - Lease	0
McLarry	072148 - Licence	26

Menear	0089544 - Lease	0
Meutzner	072600 - Licence	10
Miller	0248490 - Lease	0
Moore	LA1171 - Licence	78
Nealis	LA1169 - Licence	38
Nicholas Little Bear Ranch	LA1159 - Licence 0146943 - Lease	101
Palmer	071580 - Licence	340
Payne	LA1160 - Licence 0063398 - Lease	36
Peebles	180860 - Lease 0231766 - Lease	104
Petkau	LA1161 - Licence	83
Posselt	070894 - Licence	71
Priest	072888 - Licence 0244929 - Lease	219
Reedy	LA1152 - Licence 0134393 - Lease	125
Shelford	072120 - Permit 0204635 - Lease	31
Short	LA1170 - Licence 0107278 - Lease	412
Siegner	071960 - Licence	98
Skolos	LA1147 - Licence	15
Staudt	LA1163 - Licence	10
Stewart	LA1148 - Licence 0213447 - Lease	55
Strimbold, E.A.	070981 - Licence	285
Thatcher	072567 - Permit	21
Vanzanten	LA1149 - Licence	85
Weeks	072566 - Licence	2
Whitney	LA1172 - Licence	73
Wiebe	0185990 - Lease	0
Wiseman	0250699 - Lease	0
Zemenchik	071628 - Licence	52

Table 2: Morice District Active Grazing Tenures

Tenure Holder (Morice District)	Reference # Mapsheet 2	Tenure Number/Type	# of Cattle
Anaka	M1 M2	M01201 - Licence 0248538 - Lease	29
Anderson/Maxine Bell Vallee Creek Ranch	M3 M4	0135119 - Lease M01198 - Licence	344
Aslin Logging Ltd.	M5	071490 - Licence	30
Bell	M6 M7	M01185 - Licence 0236737 - Lease	30
Brienen	M8 M9	070784 - Licence 0110476 - Lease	72
Buerge	M10	071512 - Licence	4
Dykens	M11	072198 - Permit	50
Engelhart	M12	070266 - Licence	266
Groot Bros. Contracting Ltd.	M13	M01180 - Licence	380
H & A Vandenburg Logging	M14	070273 - Licence	296
Hamblin Farms Ltd.	M15 M16	072757 - Licence 0238645 - Lease	75
Hietala	M17 M18	071451 - Licence 0282955 - Lease	50
Himech	M19	M01166 - Licence	36
Jaarsma	M20	M01199 - Licence	80
Jellett	M21	M01188 - Licence	9
Johnson Services Ltd.	M22	M01178 - Licence	44
Keegstra	M23 M24	072253 - Licence 0233512 - Lease	50
Koon	M25	072238 - Permit	53
Langevin	M26	072196 - Licence	44
Lecleir Bros. Contracting	M27	M01063 - Licence	212
Lundquist Logging Ltd.	M28	M01210 - Licence	201
McKilligan	M29	070275 - Licence	26
McKilligan	M30 M31	070600 - Permit 0246802 - Lease	17
Monkman	M32	070255 - Licence	12
Murphy	M33	071510 - Permit	20
Newgard	M34 M35	070267 - Licence 0261760 - Lease	56
Olesen	M36	M01231 - Licence	70
Palmer	M37	M01175 - Licence	63
Peebles	M38 M39	070269 - Licence 0233513 - Lease	Same animals that are counted in Lakes District Summary under Peebles
Prins	M40 M41	070605 - Licence 072508 - Licence	221

Proctor	M42	071513 - Licence	12
Riley	M43	071651 - Licence	5
Rodrigues	M44	070601 - Licence	16
Rose	M45	070256 - Licence	5
Schmidt	M46	070271 - Licence	52
Seinen	M47	072726 - Licence	12
Seinen Sr.	M49	M01195 - Licence	40
Stevens	M49	071507 - Permit	4
Strimbold, F.	M50	M01196 - Licence	31
	M51	0113391 - Lease	
Strimbold, E.A.	M52	0124771 - Lease	Same animals that are counted in Lakes District Summary under E.A. Strimbold
Szydluk	M53	M01010 - Licence	68
Topley Contracting Ltd.	M54	072767 - Licence	2
Toth	M55	072186 - Licence	14
Tuchlinski	M56	M01105 - Licence	37
West Bound Holdings Ltd.	M57	0169643 - Lease	0
Wilson Bros. Enterprises	M58	072693 - Licence	143
	M59	0243703 - Lease	
	M60	0038109 - Lease	
	M61	M01167 - Licence	
	M62	0251438 - Lease	

Table 3: Bulkley District Active Grazing Tenures

Tenure Holder (Bulkley District)	Reference # Mapsheet 3	Tenure Number/Type	# of Cattle
Bulkley Valley Brush Control	B1	072744 - Non-Replaceable Permit	90
Coyote Cattle Co. Ltd. (Bob Storey)	B2	071415 - Licence	50
	B3	0074935 - Lease	
Dieleman Ranch	B4	071536 - Licence	320
	B5	072632 - Licence	
Evelyn Farmers Institute	B6	BU1080 - Licence	78
Evelyn Mountain View Farms	B7	BU1073 - Licence	45
Flint	B29	BU1061 - Lease	70
Gammenthaler	B8	070665 - Licence	70
Hagen	B9	BU1141 - Licence	78
Helps	B10	0217770 - Lease	45
Hidber	B11	0248029 - Lease	0
Hillrise Farm Ltd.	B12	072012 - Permit	150
Hobenshield	B13	BU1144 - Licence	51
	B14	0112673 - Lease	
Hopps	B15	BU1139 - Licence	93
	B16	0104777 - Lease	

Hutchinson	B17	072224 - Licence	200
Jaarsma	B18	BU1142 - Permit	23
Jahn	B19	072302 - Licence	86
Jansen	B20	072091 - Licence	30
Kerr Cattle Co. Ltd.	B21	BU1143 - Licence	325
	B22	0314009 - Lease	
	B23	0195291 - Lease	
Klassen	B24	072011 - Permit	12
Kloeckner	B25	0258616 - Lease	0
Knoerr	B26	BU1115 - Licence	120
	B27	0258560 - Lease	
Koldyk	B28	072256 - Licence	35
Meeuwissen	B30	072477 - Permit	37
	B31	0294044 - Lease	
	B32	0331706 - Lease	
Reitsma	B33	072017 - Licence	26
Robin Creek Dairy	B34	0227111 - Lease	70
Rouw	B35	072740 - Licence	26
Sbrocchi	B37	072258 - Permit	6
Schippers	B38	071567 - Licence	20
Schmidt	B39	BU1076 - Licence	56
	B40	0259074 - Lease	
Storey's Ranch Ltd.	B41	070592 - Licence	133
Sturzenegger	B42	0282070 - Lease	90
Thomas	B43	072013 - Permit	9
Trobak	B44	0111104 - Lease	0
Von Seydlitz	B45	072255 - Licence	35
	B46	072805 - Permit	
Walton	B47	BU1079 - Licence	102
Wittwer	B49	072223 - Licence	50

Table 4: Kispiox District Active Grazing Tenures (no location map provided)

Tenure Holder (Kispiox District)	Tenure Number/Type	# of Cattle
Allen	072062 - Licence	75
	0224931 - Lease	
Castle	KI1044 - Licence	0
Nash	072065 - Licence	30
Wittwer	0276680 - Lease	0

Table 5: Cassiar District Active Grazing Tenures (no location map provided)

Tenure Holder (Cassiar District)	Tenure Number/Type	# of Cattle
Ackerman	071602 - Permit	8
Brumbach	CA1124 - Licence	2

Table 6: Queen Charlotte Islands Active Grazing Tenures (no location map provided)

Tenure Holder (Q.C.I.)	Tenure Number/Type	# of Cattle
Abbott	0331593 - Lease	25
Abfam Enterprises Ltd.	RANOC1001 - Licence	29
Leach	6401551 - Lease	5

2.0 Cattle Operations within (or near) Community Watersheds

Of the community watersheds identified, only the Canyon Creek and Tyhee Lake watersheds in the Smithers/Telkwa area have both significant numbers of water users and substantial cattle grazing activity. Most other community watersheds are located towards the coast where agricultural activity is minimal. The northern most community watershed -- Telegraph Creek -- may have horse grazing activity within its boundaries but no cattle. The Seymour Lake watershed near Smithers has one farm near the lake that no longer has cattle since the property was recently sold.

Specific identification and description of grazing operations within the Canyon Creek and Tyhee Lake community watersheds are presented below. Mapsheet 4 at the end of this Appendix shows the location of grazing areas and water licences.

2.1 Canyon Creek (Smithers/Telkwa)

2.1.1 Taylor Farm

The Taylor Farm is located approximately 20km (by road) north of Smithers, on Snake Road. The farm is downstream of the watershed boundary. The lower end of Canyon Creek flows in a northwest direction through the southern fringe of the farm, with the farm boundary encompassing the confluence of Canyon Creek and Bulkley River. There are no downstream water users beyond the farm. The farm supports a 100-head beef cow/yearling operation on a landbase of 502 deeded hectares and no Crown land. Approximately 300ha of the total landbase is used predominantly for cattle grazing, with the remainder used for a combination of cultivation and grazing. Canyon Creek may run through a portion of the farm's grazing area but is not used for cattle watering.

2.1.2 Davidson Farm

The Davidson Farm is located approximately 10km (by road) north of Smithers, on Snake Road. The farm is downstream of the watershed boundary. Canyon Creek flows in a northwest direction through the western portion of the farm. Cattle are overwintered within 50 to 100m of the creek. The only downstream water user is Taylor Farm. The farm supports a 60-head dairy cow operation and 99-head beef cow/calf operation on a landbase of 343 deeded hectares and no Crown land. Approximately 220ha of the total landbase is used predominantly for cattle grazing, with the remainder used for a combination of cultivation and grazing. Canyon Creek is used by the Davidson's for both domestic and irrigation water under two water licences (Licence #'s C105126, F042174). The Davidson's have no direct cattle watering in the creek.

2.1.3 M. Vander Meulen Farm (a.k.a H&S Farms Ltd.)

The M. Vander Meulen Farm is located approximately 10km (by road) northeast of Smithers, on Old Babine Lake Road. Canyon Creek flows west along the northern boundary of the farm. The farm is downstream of the watershed boundary. There are 18 downstream users of the creek beyond this farm. The farm supports a 50-head dairy cow operation on a landbase of 200 deeded hectares and no Crown land. Approximately 38ha of the total landbase is used predominantly for cattle grazing, with the remainder used for a combination of cultivation and grazing. Canyon Creek is used by the M. Vander Meulen Farm for irrigation water under water licence #C037738.

2.1.4 Walton Ranch

The Walton Ranch is located approximately 20km (by road) east of Smithers, on Billeter Road, within the watershed boundary. Canyon Creek flows west through the northern portion of the farm's deeded property. At this point, the creek is gorged and not readily accessible to grazing animals. The farm supports a 60-head beef cow/yearling operation on a landbase of 168 deeded hectares, a 25ha agricultural lease, and a grazing licence (tenure #: BU1079). Approximately 113ha of the total landbase is used predominantly for cattle grazing, with the remainder used for a combination of cultivation and grazing. Canyon Creek is not used by Walton Ranch.

2.1.5 Flint Ranch

The Flint Ranch is located approximately 25km (by road) east of Smithers, on the Telkwa High Road, within the watershed boundary. Canyon Creek flows west through the northern portion of the farm, through both deeded and tenured land. The creek is accessible and used by cattle for watering in a few spots within the grazing tenure area. One of these locations was sampled in August, 1995 for biological indicators of contamination caused by the cattle during low flow. The results are attached to Table 2 of Appendix 1. The portion of the creek that flows through deeded land (to the east) is mostly gorged and not readily accessible to grazing animals. The farm supports a 70-head beef cow/calf operation on a landbase of 131 deeded hectares, a 204ha private lease, a 55ha grazing lease, and a grazing licence (tenure #: BU1061 - Inactive). Approximately 153ha of the total landbase is used predominantly for cattle grazing, with the remainder used for a combination of cultivation and grazing. Canyon Creek is used for domestic water by Flint Ranch under water licence #C030212.

2.1.6 Potsepp Farm

The Potsepp Farm is located approximately 20km (by road) north east of Smithers, on the Telkwa High Road. Canyon Creek flows west within the south western portion of the farm. Canyon Creek is fenced out to prevent direct access to animals. Overwintering of animals takes place within 100m of the creek. The farm has only a few cattle on the landbase of 131 deeded hectares. Canyon Creek is used for domestic water by Potsepp Farm under water licence #C030212.

2.1.7 JPN Ranch

The JPN Ranch is located approximately 25km (by road) north east of Smithers, on the Telkwa High Road. There are no significant streams near cattle grazing or feeding areas on the ranch. The ranch supports a 125-head beef cow/calf operation on a deeded landbase of 441ha. Approximately 327ha is used for forage production.

2.1.8 Bekar Ranch

The Bekar Ranch is located approximately 25km (by road) north east of Smithers, off of the Telkwa High Road. Canyon Creek flows west along the northern border of the farm and a few small tributaries run through the farm. The farm currently has no cattle on a landbase of 588 deeded hectares. Approximately 400ha of the total landbase was used in the recent past to support a 20-head beef cow/calf operation. Bekar Ranch has no water licences.

2.1.9 Crosbie Farm

The Crosbie Farm is located approximately 25km (by road) north east of Smithers on the Telkwa High Road. The farm has no significant streams running through its 33ha deeded landbase and supports a 10-head beef cow/calf operation. Crosbie Farm has no water licences.

2.1.10 Kendall Ranch

The Kendall Ranch is located approximately 30km (by road) east of Smithers, on Old Babine Lake Road. Ganokwa Creek (a tributary of Canyon Creek), flows southwest within the central portion of the ranch. The creek is accessible to grazing animals at a number of points. The ranch supports a 40-head beef cow/calf operation on a landbase of 155 deeded hectares and no Crown land. Approximately 55ha of the total landbase is used predominantly for cattle grazing, with the remainder used for a combination of cultivation and grazing. ZZ Creek (a tributary of Ganokwa Creek) is used for irrigation water by Kendall Ranch under water licence #Z106247.

2.1.11 Ellis Ranch

The Ellis Ranch is located approximately 30km (by road) east of Smithers, on Old Babine Lake Road. Ganokwa Creek (a tributary of Canyon Creek) flows west along the southern border of the ranch. At this point, the creek may be accessible to grazing animals and a few points. The ranch supports a 24-head beef cow/calf operation on a landbase of 65 deeded hectares, and an agricultural lease with 65ha cleared. Approximately 100ha of the total landbase is used predominantly for cattle grazing, with the remainder used for a combination of cultivation and grazing. Ellis ranch has no water licences on Ganokwa Creek or its tributaries.

2.1.12 Bianco Farm

The Bianco Farm is located approximately 25km (by road) north east of Smithers, on the Burnt Cabin Road. Auber Creek, a small tributary of Canyon Creek, flows south near the western border of the farm. The creek is not accessible to grazing animals. The farm supports a 20-head beef cow/calf operation. Bianco Farm holds water licence C105913 on Auber Creek.

2.1.13 Astlais Mountain Ranch

The Astlais Mountain Ranch is located approximately 30km (by road) north east of Smithers, on Burnt Cabin Road. The farm supports approximately 10 cattle on a completely deeded landbase (size unknown). Astlais Creek (a tributary of Canyon Creek) is used for domestic water by the Coast Northwest Christian Society (owners of Astlais Mountain Ranch) under water licence #C102544.

2.1.14 Heal Farm

The Heal Farm is located approximately 30km north east of Smithers on Burnt Cabin Road. Astlais Creek runs through the farm and is likely accessible to cattle at numerous points. The farm supports a 50-head beef cow/calf operation on 267ha of deeded land, a 215ha Ag. Lease, and a grazing permit (BU1138). Heal farm has no water licences.

2.2 Tyhee Lake (Smithers/Telkwa)

2.2.1 Koopmans Dairy Farm

The Koopmans Dairy Farm is located approximately 10km (by road) from Telkwa on Tyhee Lake Road. The farm has a number of small creeks running along its north western border and Victor Creek through the southern portion. The lower edge of the farm comes within 500m of Tyhee Lake. Surface runoff into the adjacent creeks and subsequently the lake have been ongoing concerns for the farm. Approximately \$60,000 has been spent to date to divert and trap waste runoff into the streams. The farm supports a 70-head dairy operation on a 409ha deeded landbase. The farm holds one water licence on Victor Creek (#C104551) and one on Tyhee Lake (C072046).

2.2.2 Jaarsma Dairy Farm

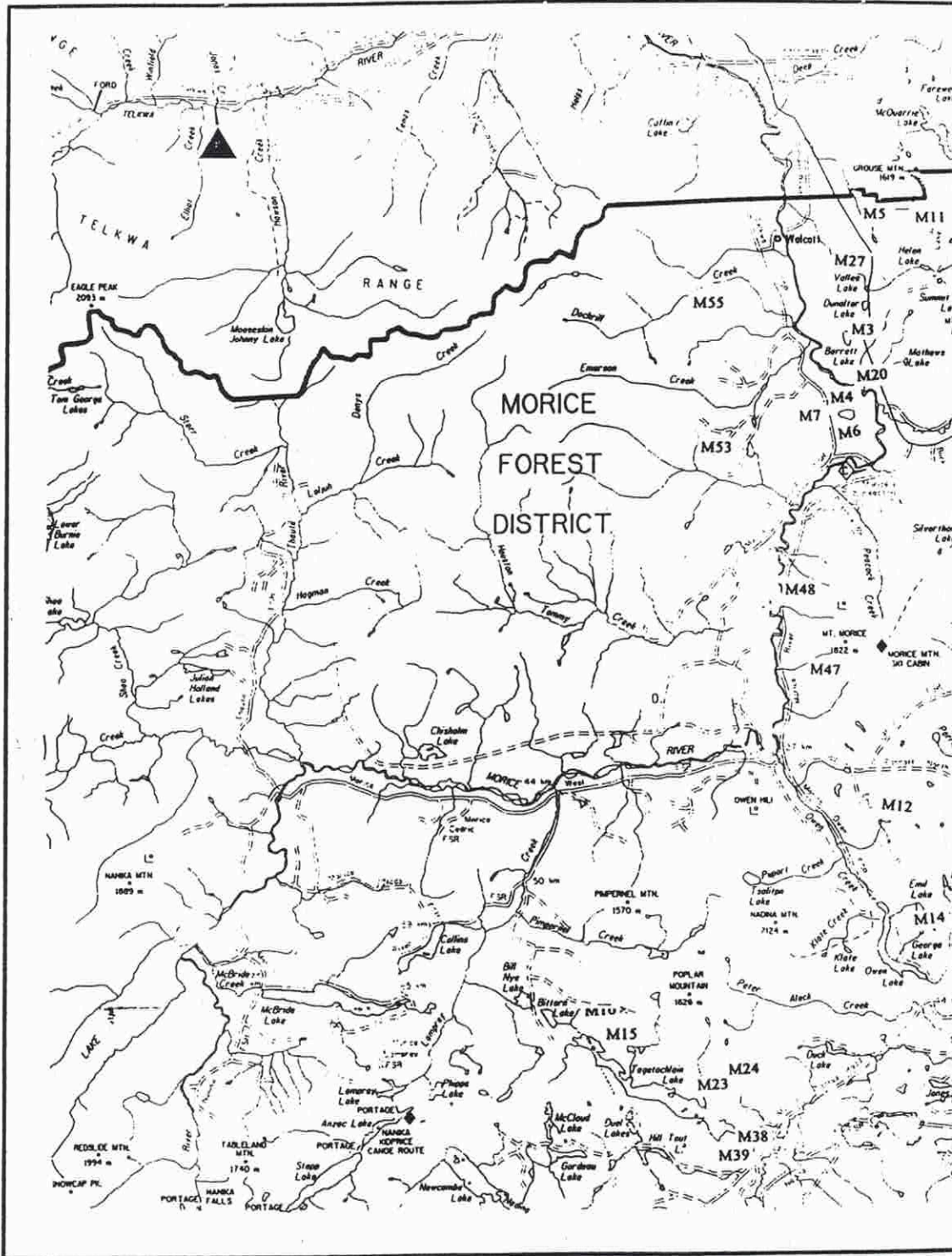
The Jaarsma dairy farm is located approximately 12km south east of Smithers on Eckman Road. Koopman's North Creek runs through the southern portion of the farm and is accessible by grazing animals. The farm supports a 65-head dairy operation on a 229ha deeded landbase and a grazing permit (BU1142) which is outside the watershed. Jaarsma farm has no water licences.

3.0 Non-Community Watersheds with Potential Cattle Impacts

As previously discussed, few official community watersheds have significant cattle operations within their boundaries. However, a number of areas (identified in the following table) exhibit a combination of high to moderate cattle grazing pressure and sensitive water resource values such as domestic water use and/or high fisheries values.

Waterbody Name	Location	Potential Cattle/ Water Quality Conflict
Toboggan Lake on Toboggan Creek	12 km north west of Smithers	Cattle grazing along the Toboggan lake and creek (cattle from J. Storey, B. Miles, B. Storey, J. Reitsma, and L. Hopps) as well as along small tributaries to the south of the creek. Toboggan Creek is important fish bearing stream (hatchery on creek); there are also 38 water licences on the creek and its tributaries.
Round Lake on Lacroix Creek Lacroix Creek and tributaries	9 km south east of Telkwa	Two large dairy farm operations and a mid-size beef operation beside Round Lake (150 animals total); 6 water licences drawing from lake. Four or five beef operations above Round lake to the north. Lacroix Creek (and tributaries) pass through or down gradient of grazing lands and overwintering site, carrying runoff into Round Lake.
Deep Creek	Within 5 km radius of Quick	Deep Creek runs through much of the Crown grazing range of Kerr Cattle Co. (325 cattle). There are 17 water licences on Deep Creek and its tributaries.

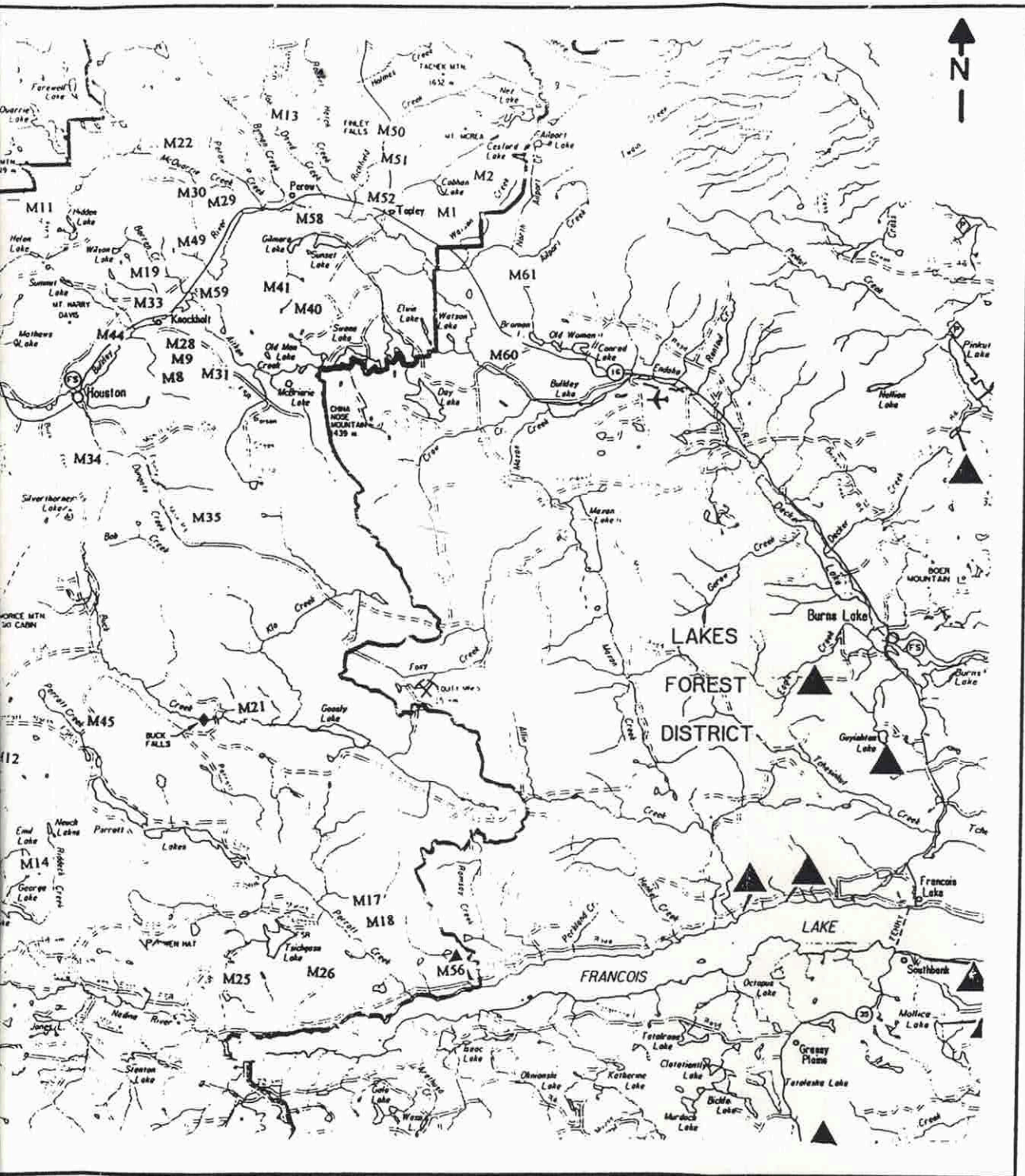
Waterbody Name	Location	Potential Cattle/ Water Quality Conflict
Perow Creek Byman Creek Johnny David Creek Robert Hatch Creek McQuarrie Creek	Within 10 km radius of Perow	Cattle from Wilson (143), McKilligan (43), Groot (380), F. Strimbald (31), Himech (36), and Murphy (20) potentially access these 5 creeks. Water users in Perow and fisheries value potentially effected.
Bulkley River (headwaters) Bulkley Lake & Tributaries Maxan Lake Maxan Creek	28 km north west of Burns Lake	Approximately 280-300 cattle graze around these lakes and creeks each year; all animals belong to E.A.Strimbald. No water users but high fisheries values. Sign of cattle in creeks has been observed by range officers.
Takysie Lake & Tributaries	39 km south of Burns Lake	There are 6 water licences on Takysie Lake and 6 licences on creeks draining into the lake. Cattle from Whitney (73), Gruen (21), and Baker (160) graze around the lake.
North Side of Francois Lake between Ferry Terminal and Ramsey Creek	22 km south of Burns Lake	There are 52 water licences on Francois Lake itself and a total of 137 licences in the watershed around the lake (including the aforementioned Takysie licences). There is a high intensity of cattle grazing operations all around the lake. There are approximately 1,113 cattle on the north side alone, west of the ferry terminal to Ramsey Creek. There are numerous creeks along the north side of the lake that flow through range areas and into Francois Lake. Ramsey Creek and Henkel Creeks are two of the larger creek flowing through rangeland and accessed cattle.



Excerpt: Morice Forest District Rec. Map
 Produced by B.C. Ministry of Forests

LEGEND

Notation on map (M with number)
 corresponds to tenures listed in
 Table 2 of Appendix 2



SCALE

Grazing Tenure Locations in Morice District

Prepared by Terra-Silva Environmental Services

APP2/MS #2

Water Quality Concerns

This Appendix summarizes some documented and anecdotal concerns that have been received by the Ministries of Environment, Agriculture and Forestry, regarding water quality deterioration or physical disturbance of streams attributable to cattle farming in the Skeena region.

1. *Overwintering of cattle near Toboggan Lake and Toboggan Creek (west of Smithers)*
 - Several farms in the area -- Storey, Reitsma, Hopps -- have in the past and continue to overwinter their cattle along the lake and creek.
 - There is generally no direct access for animals to the creek, but animal waste runoff into the creek has been frequently observed.
 - DFO is concerned with incidents of fish disease downstream of Toboggan Creek fish hatchery, believed to be caused in part by animal waste in the creek.

2. *Manure Spill from Dairy Farm on Round Lake in 1988 (east of Telkwa)*
 - Prins Dairy Farm
 - Manure holding pit discharged manure and allowed it to flow downhill and into Round Lake; the Ministry of Environment attended.
 - Cattle on the same farm had free access to a small creek that flowed directly into Round Lake.
 - Consultation between the Ministries of Agriculture and Environment led to an upgrading of the facility. The previous owner has since sold the farm.

3. *Overwintering dairy cows close to Canyon Creek*
 - Davidson Dairy Farm - 10km north of Smithers
 - Cattle are overwintered on a thin strip of land between Canyon Creek and Snake Road. Davidson's farm site is directly across the road.
 - There is a concern that the substantial waste accumulation in the overwintering area will flush into Canyon Creek which is only 25 to 50m away in places.

4. *Overwintering and pasturing dairy cows close to Driftwood Creek*
 - Nageli Dairy Farm - 15km north of Smithers
 - The farm lies at the junction of two creeks--Cygnet and Driftwood; Cattle have direct access to Driftwood Creek. Animal waste contamination in the creek has been noted based on both visual and olfactory observations.

5. *Runoff from dairy farms on hillside on northeast side of Tyhee Lake*
 - Tyhee Lake supports a large domestic water user community as well as high recreation values. Eutrophication and drinking water quality are the two major concerns for the lake

- Runoff of surface water laden with animal waste is a long-standing issue with the Koopmans Dairy Farm and, somewhat indirectly, the Jaarsma Dairy Farm above Koopmans. The issue has been dealt with by both the Ministries of Agriculture and Environment.
- A number of small creeks flow through the farms and out into Tyhee Lake. Spring flush in the past would yield noticeable plumes at the confluences of these creeks with the lake. Sampling determined that the plumes were, at least in part, attributable to the dairy operations.
- Koopmans undertook substantial containment and diversion measures to minimize the runoff.

6. *Cattle Grazing in and around the Nithi River*

- The Nithi River drains into the east end of Francois Lake and is the second most important rainbow trout recruiter to Francois Lake.
- The river has experienced low flow problems for the past decade.
- A 3 km stretch of river dewateres in late summer/early fall, stranding juvenile rainbow trout in isolated pools. Many pools dry out, resulting in the loss of thousands of juvenile rainbow trout annually.
- There is a problem with cattle accessing the Nithi during these low flow periods, causing contamination and physical degradation of the river channel. Cattle use the riverbed as a travel corridor and selectively browse the riparian area around Nithi in late summer.

7. *Cattle waste flushing into eastern end of Francois Lake*

- Clayton Vellieux, a local resident, is concerned with poor animal waste management at the farm adjoining his property.
- The site is immediately south of the Endako mine, on north side of Francois Lake. Mr. Vellieux claims that Banquarrell Creek is being heavily contaminated with animal waste.
- The site was visited by an Environmental Protection Technician two years ago and samples were taken (could not find the results).

Potential Water Monitoring Locations

This section identifies 10 potential water quality study locations. These sites were selected using the criteria outlined in Section 6.0 of the report and are ranked in order of greatest suitability to meet the water quality monitoring study objectives.

The identification of potential study sites is based solely on a review of government records and personal interviews with local professionals working privately or employed by the Ministries of Environment, Forestry and Agriculture. Site visits have not been made to assess suitable monitoring locations.

1. *Canyon Creek at Flint Watering Hole (within grazing licence #BU1079) near junction of Billeter Road and Telkwa High Road. See Mapsheet #1 in this Appendix.*

Rationale: The site is within the Canyon Creek community watershed and within an existing Crown grazing licence area. The site is a watering hole for a 60-head herd of beef cattle and is downstream of approximately 140 cattle along a 7km stretch of creek. The site is upstream of a community water supply, which serves a small subdivision and a number of individual residential water licences. The site was previously sampled in August, 1995 for biological indicators of animal waste contamination.

The site is 15 minutes from Smithers by road and sampling locations along the creek are readily accessible. The main advantage of the site is that it is within a community watershed and animals actually access the creek at the proposed sampling point during the summer. The disadvantage, in terms of assessing negative impacts of cattle operations, is that the cattle density at this point and upstream is relatively low and the browse around the creek in the area is limited so animals do not congregate around creek for long.

2. *Canyon Creek at Old Babine Lake Road bridge (just before turnoff onto Snake Road). See Mapsheet #1 in the Appendix.*

Rationale: The site is just outside of the Canyon Creek community watershed and immediately downstream (50m) of a 50-head dairy farm. The site is downstream of a number of small beef hobby farms and three mid-sized beef operations, with a total of approximately 190-head along 15km of the creek (when farms are in full production). The site is approximately 500m upstream of the first of 12 residential water intakes which draw from shallow wells beside the creek. The site is 10 minutes from Smithers by road. The main advantage of the site is its proximity to Smithers and its location just outside of a community watershed. The disadvantage of the site, in terms of assessing negative impacts of cattle operations, is the lack of actual cattle access to the creek for more than 5km upstream, reportedly good housekeeping at the Vandermeulen dairy farm, and absence of crown grazing tenures nearby.

3. *Toboggan Creek below Hopps Farm.* See Mapsheet #1 in this Appendix.

Rationale: There is substantial overwintering beside Toboggan Lake and along Toboggan Creek through the farming community of Evelyn. Cattle from at least 5 farms are overwintered next to or within close proximity to the lake or creek, and a number of tributary streams from the south also run through areas with overwintering and grazing activities. Toboggan Creek is an important source of domestic surface water (38 water licences on the creek and its tributaries) and is a valued fish-bearing stream with an established hatchery on the creek approximately 15km west of Smithers. The sampling site at Hopps Farm has been chosen because Hopps is the last point along the creek where significant numbers of cattle congregate close to the creek before the creek's confluence with the Bulkley River. The proposed site is 20km west of Smithers and only about 15m off of Highway 16, making it readily accessible for sampling and easy to make qualitative observations of the creek throughout the year. The main advantages to this site are its proximity to Smithers and established impacts attributable to cattle operations along the watercourse. A disadvantage of the site is that it will assess primarily impacts of cattle grazed on deeded land versus Crown tenures.

4. *North Side of Francois Lake between Ferry Terminal and Ramsey Creek.* See Mapsheet #2 in this Appendix.

Rationale: There are 52 water licences on Francois Lake itself and a total of 137 licences in the watershed around the lake. The entire Francois Lake basin has a high intensity of cattle grazing operations, with numerous creeks flowing through them into Francois Lake. The north side of Francois Lake between the ferry terminal (to the east) and Ramsey Creek (to the west) has approximately 1,100 cattle ranging on tenures held by Peebles, McFee, Van Zanten, Shelford, Palmer, and Short. Though no specific monitoring sites are recommended here, there are a host of streams that flow into Francois Lake which pass through these range tenures and could be potentially impacted by cattle. The advantages to the area are a large number of potential sites within close proximity and the ability to assess impacts of cattle grazed primarily on Crown grazing tenures. The disadvantage of the area is the distance from Smithers, ranging in driving time of between 2.5-3 hours, and possibly the inaccessibility of monitoring sites due to the limited road network in the area.

5. *Tyhee Lake North East Tributaries (Koopman's North Ck, Koopman's South Ck, Victor Ck).* See Mapsheet #1 in this Appendix.

Rationale: These creeks are within the Tyhee Lake community watershed. Two hillside dairy farms overwinter on and above the Koopman's North Creek, with a combined total of 130 animals. A number of other small hobby farms are located near the creek or on small tributaries of the creek. The Koopmans farm also pastures near the Koopman's South Creek and Victor Creek. All of the

creeks ultimately flow into Tyhee Lake, which has 31 licencees drawing domestic water from it. All creeks are within a 20 minutes drive from Smithers and specific monitoring locations should be readily accessible by foot. The advantages of these creeks is their proximity to Smithers, their inclusion in a community watershed, and their established cattle impacts. The disadvantages of these creeks as monitoring sites are the absence of Crown range close-by and substantial work already completed by the Koopmans farm to restrict surface run-off into the creeks.

6. *Lacroix Creek at confluence with Round Lake.* See Mapsheet #1 in this Appendix.

Rationale: Grazing in the Round Lake watershed consists of 2 dairy farms right on Round Lake (Vandemeulen and Oesterhoff, 120 animals), one beef operation on the lake (Mortenson, 30 animals), and three beef operations above the lake (B. Bree: 175 animals; Goheen: 10 animals; Sowa: 20 animals). These upland operations have either direct access to Lacroix Creek or indirect impacts via surface runoff into the creek. Round Lake has 7 water licencees and has moderate recreational value. The proposed sampling location at the confluence of Lacroix Creek with Round Lake is a 15 minute drive from Smithers and is readily accessible. The advantage to the site is its proximity to Smithers. The disadvantage is that the area does not meet the study objectives of assessing cattle impacts on Crown grazing tenures (there are none close by) in community watersheds (Round Lake is not an official community watershed).

7. *Deep Creek to the east of Kerr Rd.* See Mapsheet #1 in this Appendix.

Rationale: Deep Creek runs through the grazing area of three ranches: Kerr Cattle Co. (325 animals), Jackson (150 animals) and T. Vandenberg (30 animals). There are 17 water licencees on Deep Creek and its tributaries. The creek is 20 km south east of Telkwa, a 25 minute drive from Smithers. Appropriate sampling locations would be downstream of the cattle operations close to where Deep Creek flows under Highway 16. The advantages of this site are its proximity to Smithers and the potential to assess the impacts on local streams from a high density of animals on Crown grazing tenures. The disadvantage of the site is that the streams only have moderate value for either domestic water use or fisheries.

8. *Robin Creek above Quick (east of Telkwa).* See Mapsheet #1 in this Appendix.

Rationale: Robin Creek and its tributaries (Vanderven Creek, Lemieux Creek, and de Jong Creek) run through numerous beef cattle operations, with potential exposure to over 500 head. There are 17 licencees on these streams. The proposed monitoring site on Robin Creek is at a point approximately 2 km

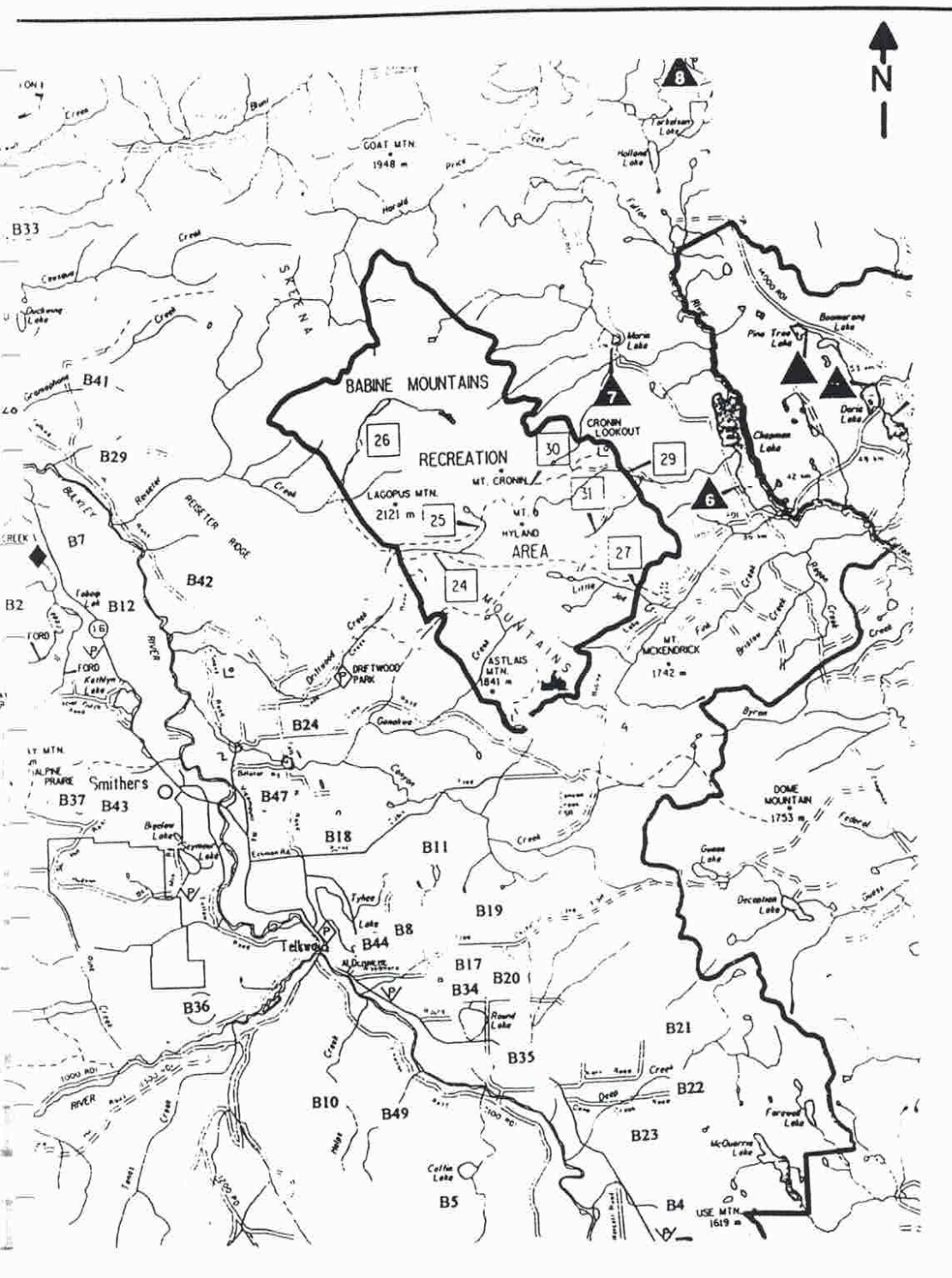
upstream from where the creek flows under Highway 16 in Quick. This site is a 20-minute drive from Smithers and should have relatively easy road and foot access. The advantages and disadvantages for this site are the same as for Deep Creek.

9. *Creeks near the community of Perow (east of Houston)*. See Mapsheet #3 in this Appendix.

Rationale: Five creeks -- Perow Creek, Byman Creek, Johnny David Creek, Robert Hatch Creek, and McQuarrie Creek -- flow through an area of intensive grazing in the Perow area. Approximately 650 cattle access these creeks. Water users in Perow and fisheries values are potentially effected. No specific monitoring sites are recommended here, though appropriate sites likely exist (sites investigation required). Drawbacks to any sites chosen in this area are travel time and site access. Perow is approximately a 1-hour drive from Smithers and much of the cattle concentration around the above noted streams is away from developed roads. With the exception of the distance from Smithers and limited site access, the advantages and disadvantages of this area are the same as for Deep Creek.

10. *Takysie Creek at confluence with Takysie Lake*. See Mapsheet #2 in this Appendix.

Rationale: There are 6 water licences on Takysie Lake and 6 licences on creeks draining into the lake. Cattle from Whitney (73), Gruen (21), and Baker (160) graze around the lake, and animal grazing and congregating at the lower end of the creek has been observed by Conservation Officers during low flow periods, with significant waste entering the stream and streambed deterioration. The disadvantage of the site is its location. Takysie Lake is approximately 15km south of the ferry crossing of Francois Lake. Travel time from Smithers to the proposed site would be approximately 3 hours (including the ferry crossing). The advantages of this site are the documented impacts of Crown grazed cattle on a lake and stream with high fisheries values and moderate water use values.

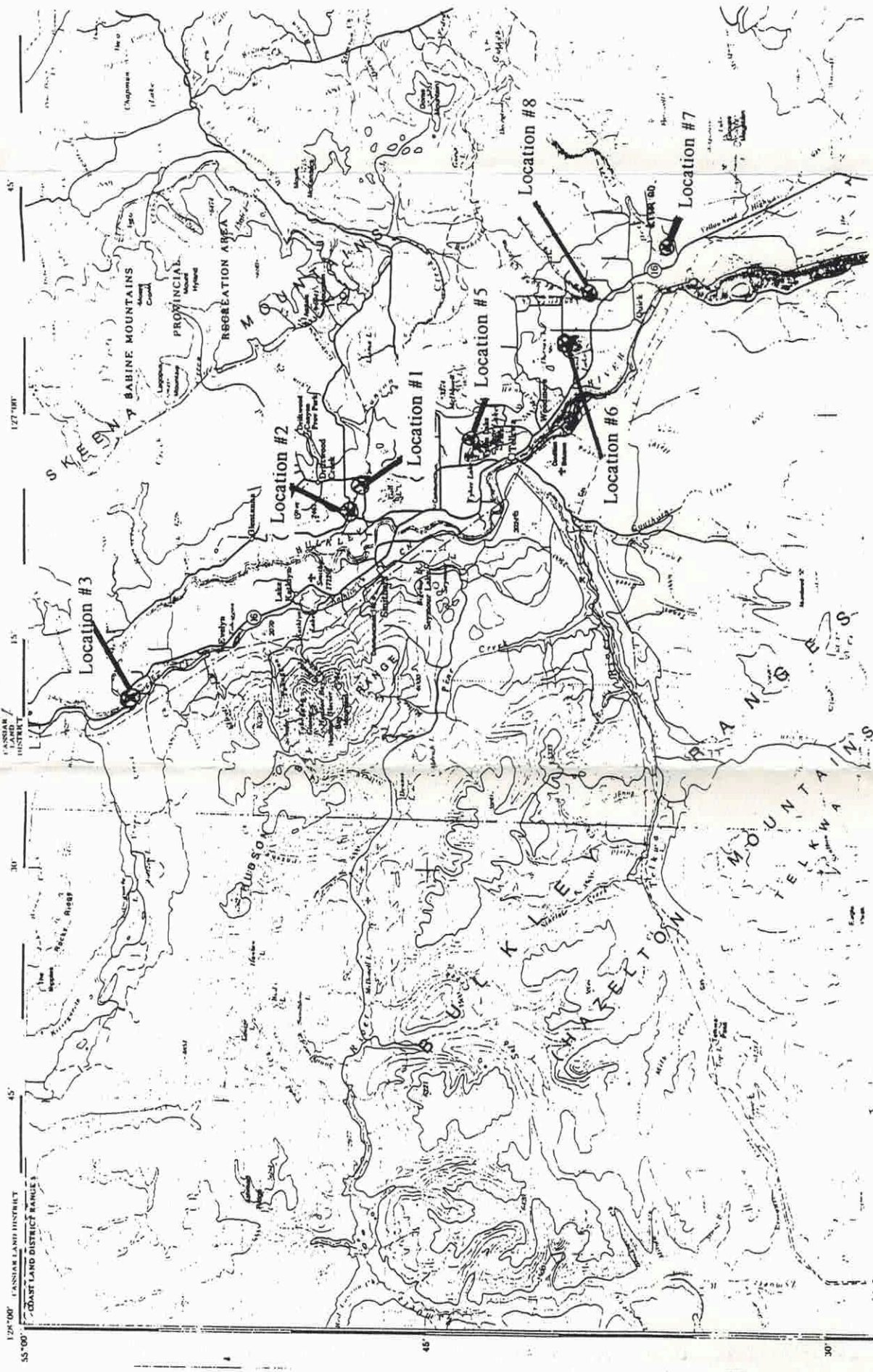


SCALE

Grazing Tenure Locations in Bulkley District

Prepared by Terra-Silva Environmental Services

APP2/MS #3

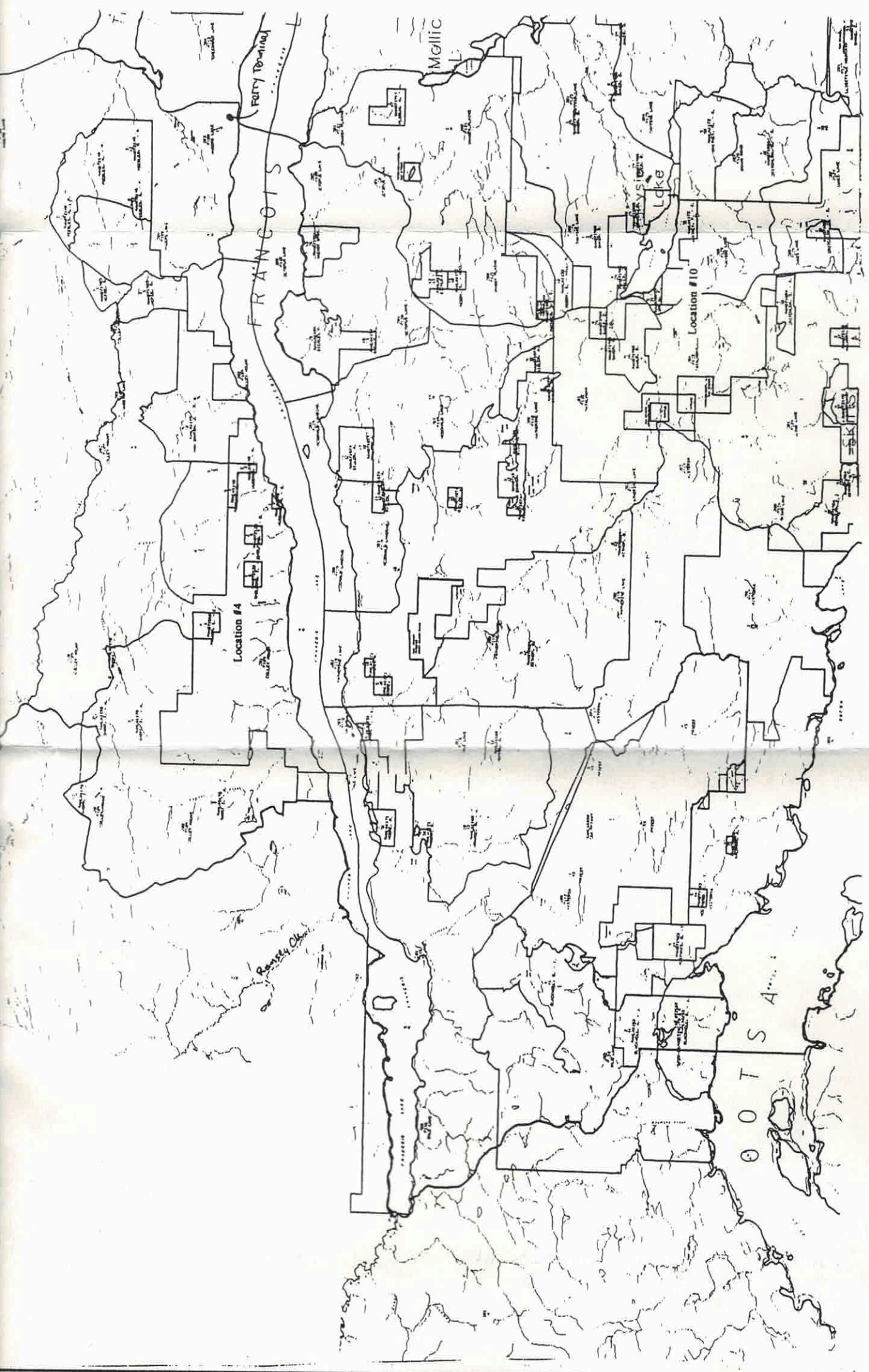


Potential Water Monitoring Locations

SCALE

LEGEND
 Circled X marks potential water quality monitoring site to assess impacts from cattle grazing activity

Excerpt from Mapsheet 83L
 Produced by Surveys and Mapping Branch
 Department of Energy, Mines and Resources
 Canada (Published 1988)



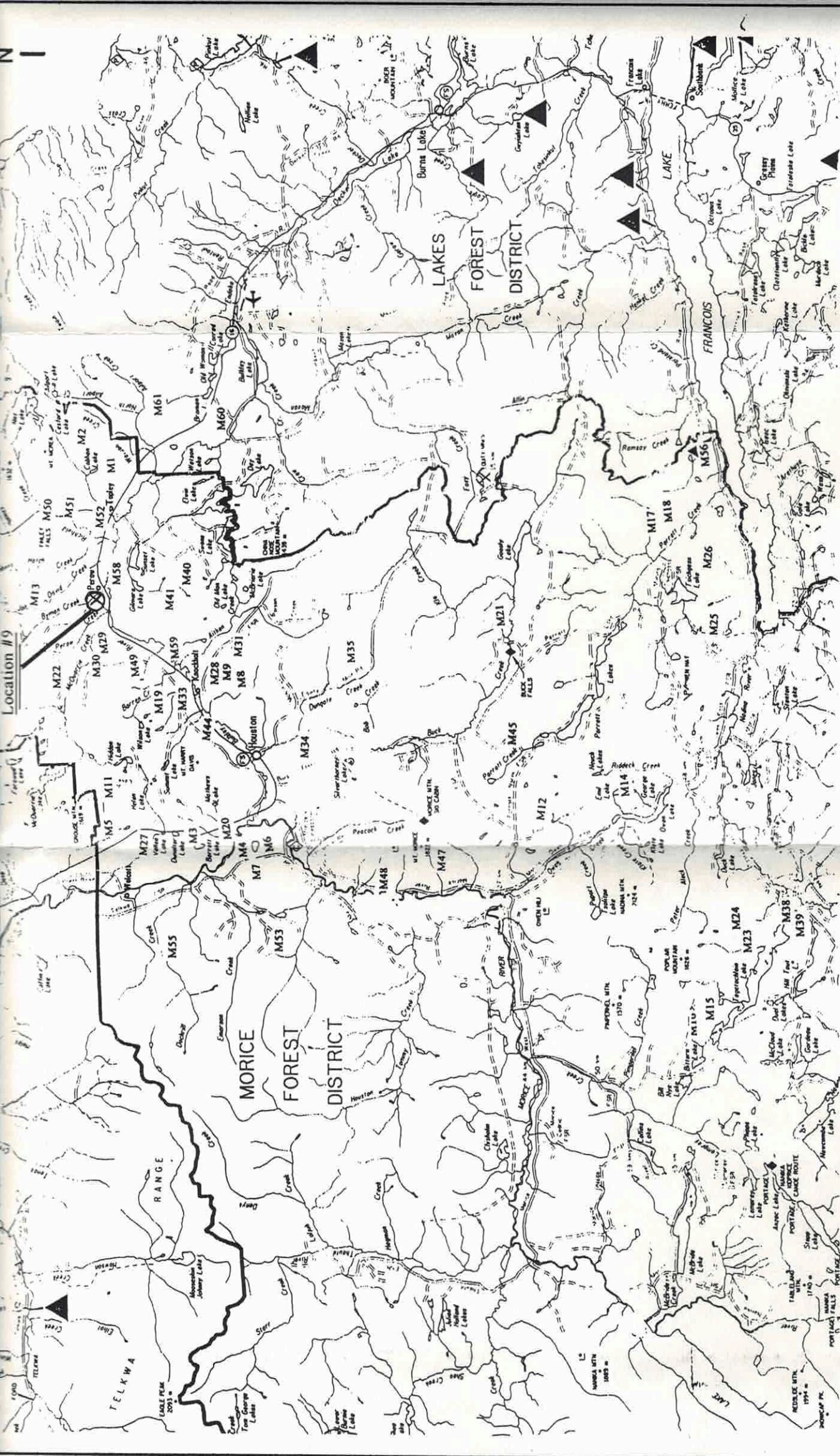
Potential Water Monitoring Locations

SCALE

LEGEND

Circled X marks potential water quality monitoring site to assess impacts from cattle grazing activity

Excerpt Lakes Forest District Digitized Map depicting Crown Range Tenure boundaries.



Location #9

Potential Water Monitoring Locations

SCALE

LEGEND

Circled X marks potential water quality monitoring site to assess impacts from cattle grazing activity

Excerpt, Morice Forest District Rec. Map
Produced by B.C. Ministry of Forests

Prepared by Terra-Silva Environmental Services

MAPSHEET 3