TELKWA COAL PROJECT

Application for a Project Approval Certificate

Submitted by: Manalta Coal Ltd.

Date: January 31, 1997

PREFACE

This Application for a Project Approval Certificate for the Telkwa Coal Project has been submitted by Manalta Coal Ltd. in accordance with Section 7 of the B.C. Environmental Assessment Act.

The Application should be read in the context that it is the basis for the first major stage of the Environmental Assessment Process as it applies to new mine developments proposed for British Columbia. The purpose of the Application is to provide an overview of the proposed Project with a focus on presenting available data, identifying issues, potential effects, and proposed mitigation measures.

The Telkwa Coal Project Application as presented herein is far more comprehensive than the typical Application submitted to the Environmental Assessment Office. In order to provide full disclosure to the public, First Nations and government agencies, Manalta Coal Ltd. has included much of the relevant baseline data and consultants' reports which have been compiled over the 18 years that the Project has been studied. These reports have been summarized into the appropriate sections of this Application.

Sections 2 and 9 of this report respectively provide the reader with a Project Description and a summary of the project's perceived impacts and the mitigative measures proposed by the company at this early stage. As such, they contain most of the information that will likely be of interest to a member of the general public. Information in the remaining section of the report is intended primarily for specialists within the relevant government review agencies or for members of the general public who have need for more detailed information regarding a specific component of the Project.

A government approved Public Consultation program will run concurrently with the Application Review stage. This will provide the public with the opportunity to better understand the Project and provide further input into the review process. Other issues and alternatives not presented in this document may also be addressed during this consultation.

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INDEX OF ABBREVIATIONS

AAC Annual Allowable Cut

ABA Acid-based Accounting

ALR Agricultural Land Reserve

AP Acid Potential

ARD Acid Rock Drainage

$CaCO_3$ Calcium Carbonate

CNRL Crows Nest Resources Ltd.

DDH Diamond Drillholes

EIA Environmental Impact Assessment

GPS Global Positioning Systems

masl Metres Above Sea Level

Manalta Manalta Coal Ltd.

MELP Ministry of Enivornment, Lands, and Parks

MOE Ministry of Environment

NNP Net Neutralizing Potential

NP Neutralizing Potential

NPR Neutralizing Potential Ratio

PIR Pacific Inland Resources

ROM Run-of-Mine

S Sulphur

ha hectare

kg kilogram

km kilometre

kV kilovolt

M million

MT million tonnes

MW megawatts

m^3 cubic metre

m metre

mg/L milligrams per litre

mm millimetre

m/s metres per second

m^3/s cubic metres per second

s second

L/s litres per second

t tonne

uS/cm microseconds per centimetre

ug/m^3 micrograms per cubic metre

o, '," degree, minute, second

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1.0 INTRODUCTION

Manalta Coal Ltd. (Manalta), a wholly owned Canadian coal mining company, proposes to build a coal mine and associated infrastructure in the Telkwa area of northwestern British Columbia (Figure 1-1). Manalta has prepared this Application for a Project Approval Certificate in support of the Telkwa Coal Project. The Project Description and preliminary Environmental Impact Assessment contained herein is designed to assist Manalta, the concerned government ministries and the public in assessing the environmental and social implications of the Telkwa Coal Project.

This Application has been prepared as outlined in Part 2, Division 2, Section 7 of the B.C. Environmental Assessment Act and addresses the requirements of the Application stage for a Project Approval Certificate for the Telkwa Coal Project. The document was prepared by Manalta with assistance from consultants, First Nations people and government agencies with expertise and responsibility in selected areas. Individual reports prepared by consultants are included in Appendices for reference. The results and conclusions of these consultants' reports have been summarized in this document.

The Project plans proposed in this application are based on the best available information at the time of submission. As more detailed design work is completed, and as information from various sources, including the Public Involvement Program, become available, modifications to the Project plans described herin may become necessary.

Project Name: Telkwa Coal Project

Description: Development and operation of a surface coal mine and associated infrastructure approximately six kilometres south west of the Village of Telkwa, British Columbia. The infrastructure consists of a coal washing facility, tailings disposal area, clean coal haul road and access road and rail loadout facility. Over a 25 year period, the mine is expected to produce approximately 25 million clean tonnes of coal primarily for the export market.

Proponent: Manalta Coal Ltd. is a privately owned Canadian company based in Calgary, Alberta. It is a member of the Loram Group of Companies. An average yearly production of 26 million tonnes makes Manalta Canada's largest producer of coal. Approximately 1750 people are employed by Manalta and

its subsidiaries at eight mines in British Columbia, Alberta, and Saskatchewan (Figure 1-2). Six of the mines produce lignite or sub-bituminous coal which is delivered to nearby electricity generating stations and two of the mines, including the Line Creek Mine in British Columbia, produce bituminous coal for export.

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2.0 PROJECT DESCRIPTION

The proposed Telkwa Coal Mine has been planned to produce up to 1.5 million tonnes of clean coal per year depending upon export market requirements. The Project plan described in this section was based on a one million tonne per year preliminary feasibility study. Ongoing feasibility study work will evaluate production levels between 1.0 to 1.5 million tonnes per year by accelerating the development plan for each pit area. There will be no increase in the disturbance area but the Project life will be reduced. The construction of the Telkwa Bridge will be required earlier.

Coal associated with the mining property is a high quality, low ash, bituminous coal suitable for use in the steel making industry or as a fuel for thermal power generation. Coal will be mined from three major mining areas that will be mined sequentially within the Project area (Figure 2-1).

The proposed coal preparation plant, mine maintenance facilities and mine service facilities will be located near the original Bulkley Valley Collieries minesite approximately six km southwest of the Village of Telkwa. Clean coal will be hauled from the coal preparation plant on an access road to a rail loadout on the CN mainline near the confluence of Hubert Creek and the Bulkley River. Coal will then be loaded onto unit trains and transported approximately 400 km by rail to the port of Prince Rupert. The location of all major Project components is shown on Figure 2-1.

A Project Boundary has been established, shown on Figure 2-1, which delineates the lands Manalta Coal Ltd. will require control of in order to restrict public access during the mine life. For safety and security reasons, Manalta Coal Ltd will maintain a no trespassing, no hunting policy on areas specified as active and where by reason of the mine infrastructure and development, public access to these areas would be restricted.

2.1 Description of the Mine Plan

Coal will be mined exclusively from open pits using conventional truck and shovel methods. Mining is planned to start in the Tenas Pit (south of Telkwa River), followed by Pit 3 with satellite pits (south of Telkwa River). The third and final mining area will include Pit 7 & 8 (north of Telkwa River). Table 2-1 summarizes the coal reserves, approximate pit life, and development area for each of the three mining areas:

Table 2-1 Mine Area Information

Mining Area	Raw Coal Reserves (MT)	Years Mined	Development Area (ha)
Tenas Pit	20	0 - 14	650
Pit 3	15	14 - 20	550
Pit 7 & 8	11	20 +	500
TOTAL	46		1 700

The primary waste moving fleet will consist of one 33.6 m^3 electric shovel loading 177-tonne haul trucks, which is a typical equipment combination for an open pit coal mine.

Pit highwalls will be developed to geotechnical design standards appropriate to the geological strata found in the Telkwa area. Engineering, geology and geotechnical assessments have been completed for all pit areas by Piteau Engineering Ltd.,which has recommended highwall configurations for each section of the pit walls. The highwall designs generally consist of 12 m double benches separated by safety berms resulting in an overall angle of 52º.

Waste rock will be blasted using a rotary blasthole drill with an ammonium nitrate/fuel oil (ANFO) explosive product.

Modern state-of-the-art mining technology (geological modelling, Global Positioning Surveying and equipment positioning) will be used to guide any selective mining of potentially acid generating rock material, so that the construction of waste rock dumps will achieve a balance of materials satisfying government Acid Rock Drainage (ARD) criteria, as discussed in Section 2.3.3.

The following is an overview description of individual pit developments.

2.1.1 Tenas Pit (Years 1 - 14)

The Tenas Pit area contains the largest coal reserves and the least complex geology in the Project area. The ultimate pit design including the potential pushback area, shown on Figure 2-2, contains 123 million m^3 of waste and 20 million raw tonnes of coal. The pit covers 300 ha and reaches a maximum depth of 120 m.

Production will be scheduled in four phases to create the maximum amount of backfill room for future waste. In-pit backfill room provides for economical waste hauls, minimization of disturbance to surrounding topography and long-term storage areas for potentially acid generating material. Approximately 45% of the total waste quantity will be backfilled into previously mined out phases as shown in Figure 2-3, the End of Mining Plan. Waste rock dumps will be developed in a series of platforms to provide a stable design and minimize the amount of uphill hauling.

Tenas Pit development will proceed through the following phases:

- Pre-Production (Year 1): This phase involves mining only overburden (also referred to as waste rock or "waste") to reduce the stripping ratio in the later years of mining. The last two months of this year will start to produce coal from the smaller Tenas West Pit.

- Tenas Phase 1-North (Years 2 - 4): Phase 1-North Pit waste rock will be dumped, or "spoiled", into the empty West Pit until full. Three external dumps, elevations 850 m, 890 m, and 938 m will be created off the northwest and northeast corners of the pit for the remainder of this phase.

- Tenas Phase 2-Middle (Years 5 - 9): The majority of waste from this phase is spoiled into the mined out Phase 1-North, dump elevation 938 m. Any excess waste is spoiled externally into the 986 m and 938 m dumps west of the pit.

- Tenas Phase 3-South (Years 10 - 14): The majority of waste from this phase is spoiled into the mined out Phase 2-Middle, dump elevations 938 m and 986 m. Any excess material is spoiled into a new external waste dump to the east, elevation 925 m.

An eight km mine haul road originating at the plant location will be constructed with pit-run waste during the pre-production year for Tenas Pit. Construction of a crossing over the Goathorn Creek is required capable of supporting the 177 tonne haul trucks. This road will be used for the raw coal haul to the preparation plant. A power line will also be installed into the Tenas area for the major equipment.

2.1.2 Pit 3 (Years 14 - 20)

When Tenas Pit is near completion, the mining operation will shift focus to the Pit 3 area including the surrounding satellite pits. The size and quantities in these satellite pits will be better defined with future exploration programs. The ultimate pit design for Pit 3, shown on Figure 2-4, contains approximately 80 million m^3 of waste and 15 million raw tonnes of coal. The pit will cover 145 ha and reach a maximum depth of 144 m.

Waste scheduling will be carried out in three phases similar to the Tenas Pit scheduling, with approximately 30% of the total waste quantity backfilled into the previously mined out phases. The end of mining plan for Pit 3 is shown in Figure 2-5. As the satellite pits are further defined, they may be mined earlier in the Pit 3 sequence to allow for more backfill room or alternate sites for storing preparation plant tailings.

2.1.3 Pit 7 & 8 (Years 20+)

The last area to be developed 20 years into the Project will be two pits north of the Telkwa River. The ultimate pit designs in this area, shown in Figure 2-6, contain approximately 58 million m^3 of waste and 11 million raw tonnes of coal. The two pits will cover roughly 160 ha. Pit 8 will have a maximum depth of 180 m and Pit 7 will have a maximum depth of 150 m. Pit 8 will be developed first in stages, providing backfill room for Pit 7 waste. Approximately 20% of the total waste quantity will be backfilled into previously mined out areas. The end of mining plan for Pit 7 & 8 is shown in Figure 2-7.

The development of Pits 7 and 8 will require the construction of a five km mine haul road with a bridge over the Telkwa River. Power lines will also be installed into the area.

2.2 Coal Preparation

The coal preparation plant will be located north of Pit 3 at the centroid of all proposed mining areas (Figure 2-1). The plantsite will consist of a run-of-mine (ROM) coal handling area, a preparation plant facility, and a clean coal storage area. The plot plan and sections for the coal preparation facilities are shown in Figures 2-8 and 2-9. The plant will wash the plus 0.6 mm coarse fraction, estimated at 82% of the feed, in a Heavy Medium Cyclone circuit and recover the 0.6 mm x 0.15 mm fraction, estimated at 8% of the feed, in a Compound Water Cyclone circuit. The minus 0.15 mm fraction, estimated at 10% of the feed, will be discarded into the tailings pond, which will be constructed at a suitable site north of Pit 3 (Figure 2-10).

Plant requirements are based on producing one million clean tonnes per year with an operating schedule of 6900 hours per year. A ROM coal feed rate of 219 tonnes per hour was selected for the process design and the material balance calculations are based on an expected yield of 67%. The process flow diagram is shown in Figure 2-11.

2.2.1 Run-of-Mine (ROM) Coal Handling

The raw coal will be hauled into the stockpile area by the mine trucks and dumped into stockpiles. Separate stockpiles are necessary to separate the various types of coal. These coals will then be fed into individual feed hoppers by a front end loader. The dump hoppers have been designed to hold 50 tonnes each. ROM coal will be blended in the correct ratio by two vibrating feeders, which will feed a single sizer/crusher. The crushed ROM blend will be conveyed to a 120 tonne surge bin, holding approximately 30 minutes of plant feed. Coal will be reclaimed by a single vibratory feeder onto the plant feed conveyor.

2.2.2 Coal Preparation Plant

The preparation plant will be a 31 m long, 16 m wide and 22 m high steel frame building with four floors. The tailings thickener will be located in a 7.5 m high, 12 m long extension to the main building.

ROM coal delivered on the plant feed conveyor will be screened on a wet screen to remove oversize coal (+38 mm) ahead of the heavy medium cyclones. The oversize will be crushed in a roll crusher and returned to the heavy medium cyclone feed. A combination of sieve bend and horizontal screen will remove the minus 0.6 mm material from the heavy medium cyclone feed. The plus 0.6 mm coal will drop down to a heavy medium sump, from where it will be pumped with heavy medium to the heavy medium cyclones. Four 500 mm diameter cyclones have been selected based on matching each cyclone with a 1 800 mm wide drain and rinse screen downstream. Each cyclone will be capable of treating 50 tonnes per hour feed.

Heavy medium cyclone product (floats) will be drained and rinsed on horizontal vibrating screens preceded by sieve bends. The drain and rinse screen overflow will be dewatered in two centrifuges before discharging onto the 750 mm wide clean coal conveyor. Heavy medium rejects will be screened in a similar manner before being pumped to the tailings sump box. Dilute medium washed off the product and rejects will be pumped to magnetic separators where most of the magnetite will be recovered and returned to the heavy medium circuit. Magnetite will be stored in the preparation plant and will be introduced into the system through a sump pump. The magnetite slurry will be pumped to the overdense magnetic separator and overdense pump box for use in the plant.

Desliming screen underflow will pass to a sump from which it will be pumped to a bank of fourteen 300 mm diameter primary compound water cyclones. Overflow from the primary cyclones will be screened on sieve bends and then dewatered through a fine coal centrifuge. Underflow will be diluted and pumped through four secondary compound water cyclones. Overflow from the secondary cyclones will be recirculated to the primary cyclones. Underflow will be sent to the thickener. Sieve bend underflow also will go directly to the thickener.

The thickener will be a high rate design with a 9.1 m diameter. The nature of the clay in the minus 0.15 mm tailings will require the addition of flocculant to ensure the settlement of the solids to the bottom and the production of the clarified water. Flocculant will be added to the thickener at a rate of 0.07 kg of flocculant per tonne of tailings. Clarified water overflow will discharge to a sump from which it will be pumped to the raw coal screen and the drain and rinse screens as spray water. The underflow will be discharged to a tailings sump box where it will be combined with the coarse tailings before being pumped to the tailings pond.

2.2.3 Clean Coal Stockpile

The clean coal conveyor will carry the coal outside the plant, discharging onto a conical stockpile at a height of 30 m above grade. The stockpile will have a capacity of 25 000 tonnes. Clean coal will be recovered from the stockpile using front end loaders, which will load smaller coal trucks for the short haul to the rail loadout facilities.

2.2.4 Laboratory

A laboratory facility will be located on the ground floor of the preparation plant next to the control room. The laboratory will be equipped to process and analyze all bulk pit coal samples and preparation plant coal samples. The selection of equipment will be based on standard laboratory practices for operating coal mines.

2.3 Waste Management Plan

2.3.1 Tailings Disposal

Tailings Impoundment Site Investigations

The tailings disposal area will be located approximately 1.4 km north of the coal preparation plant. A site investigation study of the area was conducted by Piteau Engineering Ltd. during the summer of 1996 (Appendix 8). Nine sites were drilled and the boreholes were advanced to 20 m depth or the bedrock surface to define site selection. At locations where the depth to bedrock exceeded 20 m boreholes were continued to bedrock to improve the understanding of subsurface conditions. These sites were well distributed throughout the tailings disposal area and provide good lateral site coverage.

Geotechnical samples were obtained from boreholes at selected intervals using both split spoon and Shelby tube samples. Double piezometer nests were installed at three locations.

The Piteau site investigation study concluded that the majority of the proposed tailings disposal area, which is largely underlain by more than 10 m of low permeability till, would be suitable for tailings deposition in an impoundment structure. The estimated seepage rate over the area would be in the order of 6 L/s. Potential high seepage rates through a limited sand and gravel deposit can be readily mitigated by constructing a low permeability subsurface cutoff wall. Piteau also concluded that the proposed 2 300 m of perimeter dykes are feasible from a geotechnical design standpoint, and that the till, sand, and gravel foundations will provide adequate support for the structure.

Tailings ARD Potential and Management

Both the coarse rejects and fine tailings are expected to be potentially acid generating. These wastes will be slurried at the preparation plant and deposited underwater in the tailings impoundment. Periodic temporary exposure to air of both waste types will occur due to plant operation and seasonal precipitation variations. Exposure will be limited to a few weeks and will not result in a significant effect on pond water quality due to the presence of lime added in the process and the natural carbonate alkalinity in the wastes. The tailings disposal site will be permanently flooded on closure.

The coarse rejects (plus 0.6 mm) contain variable sulphur concentrations (1.2 to 3.9%) and neutralization potentials (25 to 58 kg $CaCO_3$/t). Although some sulphur may be present in non-pyritic forms, the coarse rejects are predicted to be potentially acid generating (Neutralization Potential Ratio<0.6) but with

sufficient neutralization potential to buffer acidity for several months to a year.

Fine tailings samples (minus 0.6 mm) from pilot scale testing indicate that the fine tailings are expected to have total sulphur concentrations varying from 1.5 to 2.8% but with pyritic sulphur varying from 10 to 50% of total due to the presence of organic sulphur in coal and mudstone fines. Neutralization potentials range from 19 to 36 kg $CaCO_3$/t. Some of the samples were predicted to be acid generating while others were of uncertain acid generation potential.

Tailings Material Balance

The tailings disposal area and the initial starter dam locations are shown on Figure 2-10. The overall tailings impoundment has been sized to contain a maximum discharge from the preparation plant of 78 tonnes of solids per hour and 84 m^3/hour of water, comprised of 48% solids. Due to the ARD potential of the tailings, both the coarse rejects (plus 0.6 mm) discharged at 52 tonnes/hour dry solids, and the fine tailings at 26 tonnes/hour dry solids, will be stored under water in the tailings disposal area. During the 25 year mine life, a total of 13.2 M m^3 of tailings will be stored. This will include approximately 4.5 M tonnes of fine tailings, 9.0 M tonnes of coarse rejects and 4.7 M m^3 of entrained water.

The ultimate crest elevation of the tailings dam is estimated to be at 635 masl. This includes provisions for a reclaim clarification zone depth of 1 m and an allowance of 2 m of freeboard above the 1:20 year storm design level. This will result in a dam length of 2 300 m, with an average ultimate height of 30 m. The maximum dam height will be 35 m on the northwest corner and 40 m on the northeast corner. The total area required for tailings disposal will be 98 ha.

Storage of the initial two years of tailings without water reclaim was selected to define the initial starter dam, which is required to be built prior to the startup of the mine. The starter dam will be constructed on the north side of the pond to 612 masl and will have a length of 1 600 m and an average height of 10 m above existing grade. The majority of borrow materials excavated from within the tailings impoundment will likely be used for the construction of the starter dam. The tailings dams will be raised every five years during the life of the mine to provide sufficient storage volumes.

Tailings Pipeline

A 300 mm diameter tailings pipeline will be constructed on sleepers on the ground surface. The pipeline will run north from the preparation plant to the southwest corner of the tailings pond and then traverse the length of the dam to various spigot points. Clarified water from the tailings pond will be pumped back to the preparation plant at a rate of 60 m^3/hour. A 300 mm diameter reclaim water line will run adjacent to the tailings line from the barge pumps to the process water tank. A net loss of water will occur at the pond because evaporation, seepage, and water retained with the solids will exceed precipitation. As a result, makeup water will be pumped to the preparation plant from an infiltration gallery on the Telkwa River.

2.3.2 Waste Rock ARD Potential

Testing of waste rock materials in 1985 *(Sturm Environmental Services, 1989)* indicated that some waste rock had potential to generate acid due to oxidation of iron sulphide (pyrite) while other rock types had excess acid consuming potential. Waste management measures were proposed to mitigate acid generation.

Norecol, Dames & Moore was retained by Crows Nest Resources Limited in 1989 to provide further advice on ARD issues. After Manalta Coal Ltd.

acquired the property in 1992, the Project relationship with Norecol, Dames & Moore continued and Mr. Steven Day has provided input into the Company's understanding of the ARD potential and the required waste management plans to mitigate any impacts. A large acid generation prediction data base has been accumulated to assist with the design of waste management measures that will minimize the potential for impact due to acid generation.

In the absence of coal mines comparable to the proposed Telkwa Coal Project, or elsewhere in British Columbia, the characteristics of the coal sequence, including the acid generation potential, have been compared to the extensive Acid-Base Accounting (ABA) data bases available for coal mines in the Appalachian region of the United States.

Since the 1970s, static testing of potential waste materials from proposed coal mines has been mandatory in West Virginia and Pennsylvania. Comparison of the results to a net neutralization potential (NNP) criterion formed the basis for permitting decisions. However, since the NNP criterion was not conservative enough, acid generation occurred at some mines where the NNP was close to the criterion. The ABA data for these mines and others where acid was not generated has allowed threshold conditions to be identified for waste rock mixtures (Brady et al., 1994). Acid generation is <u>not</u> considered likely if:

- Neutralizing Potential (NP) > 15 kg $CaCO_3$/t
- NNP > 10 kg $CaCO_3$/t
- Neutralizing Potential Ratio (NPR) > 2.0.

The characteristics of the Telkwa Coal Project have been compared with the Appalachian coalfields as part of the prediction approach for the Project. These have indicated that a favourable comparison can be drawn between the Telkwa coalfield and the Appalachian coalfields.

Dr. P. Ziemkiewicz, a consultant from the Appalachian coal fields, was retained by the B.C. Government to provide comments on Telkwa ARD potential. His reports can be found in Appendix 1. The Telkwa Project mine development and ARD management plans presented in this application meet or exceed the recommendation of the Ziemkiewicz report.

Using mass balance methods, the average values for the acid-base accounting parameters have been estimated for waste rock from each pit area and summarized in Table 2-2. The Pit 3 area has the lowest potential for ARD (NPR = 2.4), followed by Tenas Creek, Pit 8 (north side of the Telkwa River), and Pit 7 (NPR = 1.4). Pit 7 has the lowest NPR because the coal-bearing sequence contains some pyritic mudstones. On the north side of the Telkwa River, acid generation potential decreases in a westerly direction.

Table 2-2 Mass-Weighted ABA Characteristics for Mining Areas

	ABA Characteristics

Area	Total S %	NP $kgCaCO_3/t$	NNP $kgCaCO_3/t$	NPR
Tenas Main Pit	0.8	50	26	2.0
Tenas Main Pit with Pushback	0.8	51	26	2.1
Pit 3	0.6	44	24	2.4
Pit 7	0.7	33	10	1.4
Pit 8	0.6	37	18	1.9

2.3.3 Waste Rock ARD Management Options

The Ministry of Employment and Investment has a stated policy of preventing the formation of ARD rather than perpetual treatment of acidity after it emerges as a discharge or seepage *(B.C. Mines ARD Guidelines Draft, September. 1996)*. The Guideline's preferred technology for management of potentially acid generating wastes is disposal beneath a permanent water cover thereby limiting oxidation rates due to the low solubility of oxygen in water. Underwater disposal can be achieved by disposal in natural lakes, artificial impoundments or abandoned mines. Manalta Coal Ltd. has adopted this approach to the extent practical for the Telkwa Coal Project. The economics of mining at Telkwa dictate that other approaches must also be considered due to the lack of suitable underwater disposal sites near the proposed pits, particularly in the early stages of mine development.

As shown in Table 2-2, waste rock from the three mining areas varies from uncertain acid generating potential (Pit 7) to non-acid generating (Pit 3). This is a result of the combination of individual geological zones classified as non-acid generating (NPR>2), uncertain acid generation potential (1<NPR<2) or potentially acid generating (NPR<1). The geology of the coal deposits therefore offers the opportunity to modify the mass-balance to produce a more favourable waste rock dump composition. In concept, the overall approach to management of waste rock is summarized as:

- segregation of waste rock to produce geochemically mixed waste rock dumps with an acceptable excess of acid neutralization capacity;
- disposal of segregated potentially acid generating waste rock in pits during operation to permit eventual flooding where possible;
- permanent on-land disposal in engineered encapsulated waste rock dumps of potentially acid generating waste rock released early in mining for which suitable in-pit or under water disposal locations are not available.

These approaches to waste rock ARD management, as described below, are incorporated into the conceptual mine plans provided in this Application. Further details of the waste management plan can be found in Appendix 2, *ARD Potential and Management, Telkwa North*, Norecol.

Geochemically-Mixed Waste Rock Dumps

Geochemically-mixed dumps will be constructed to mitigate acid generation internally by intimately mixing the potentially acid generating and non-acid generating rock types. The overall mix will be maintained on a continuous basis to produce an NPR exceeding 2.0. This value has been determined based on geochemical considerations of the pyrite oxidation and carbonate acid neutralization reactions and experience at Appalachian coal mines. In practice, mixing will be achieved by careful waste scheduling that includes:

- Pre-mining characterization of previously defined waste rock zones;
- Analysis of blast hole cuttings;
- Selective handling of waste rock of different types by using existing mining technology;
- Use of ISO Quality Management systems;
- Control and real-time monitoring of trucks using Global Positioning System (GPS) technology; and
- Post-construction monitoring of dumps.

Potentially acid generating rock placed in mixed waste rock dumps will not have oxidized sufficiently to allow initiation of localized acid generation in the dumps.

The dumps will be constructed by end-dumping. This is believed to provide the finest possible three-dimensional mixing of potentially acid generating and acid consuming rock types.

In-Pit Disposal of Segregated Potentially Acid Generating Waste Rock

In-pit disposal of waste rock will be possible because all of the mining areas will have several distinct pits that will be exhausted at different times. For example, Tenas Pit Phase 1 - North, will be mined first. This will allow potentially acid generating waste rock from Tenas Pit Phase 2 - Middle to be placed into the mined out Phase 1. This waste will eventually be saturated as the pit floods, providing a permanent disposal site. To limit oxidation prior to flooding compacted glacial till will be placed periodically over the waste rock to limit oxygen availability and infiltration.

Permanent On-Land Disposal of Segregated Potentially Acid Generating Waste Rock

In the early stages of mining, suitable locations for underwater disposal of waste rock will not be available for segregated potentially acid generating waste rock. This material will be encapsulated in thick compacted glacial till layers designed to provide optimal exclusion of oxygen and limitation of infiltration of water. As a contingency, the dumps will be located to allow collection and treatment of any acidic seepage.

In part, the design of the dumps will be based on the experience gained from the leach pads established and currently being monitored at the Tenas site.

Demonstration leach pads were constructed by Manalta Coal Ltd. to evaluate the effects of the placement of a compacted glacial till cover over a potentially acid generating sandstone material that was selectively excavated during the 1996 Tenas Bulk Sample Pit program. This project is in the early stages of monitoring.

Manalta Coal Ltd. has also initiated a program of laboratory kinetic tests to contribute to waste rock ARD management plans, and address related issues such as potential heavy metal leaching. Further discussions relating to ARD prediction are provided in Section 3.8.

2.3.4 Exposed Highwalls ARD Management

During operations, pit water is expected to be pH-neutral due to the influx of alkaline groundwater and the continuous exposure of buffering capacity in newly exposed rock. The largest area of the walls is the footwall of the lowest seam (Seam 2 in Pits 3, 7 and 8 and Seam 1 in the Tenas Creek area). These footwalls will contribute alkalinity to pit water collected in sumps.

At closure, all the pits will flood partially. Due to the influx of alkaline groundwater and the exposure of non-acid generating rock in the gently sloping footwall of the pits, the resulting pit water quality is expected to be non-acidic.

2.4 Conceptual Reclamation Plan

Reclamation will be an integral part of the Telkwa Coal Project. This section outlines a conceptual reclamation and decommissioning plan that will be implemented by Manalta Coal Ltd. The plan is designed to facilitate reclamation and decommissioning of mined land and Project facilities as closely behind mining operations as is feasible. Operational reclamation research programs will be implemented as an ongoing part of mine development and operation to ensure reclamation objectives are met.

2.4.1 Land Use Objectives

The Telkwa Coal Project is located in the Bulkley Valley in an area where historical land and resource uses have been dominated by mining and forestry. Old mine workings from the McNeil and Aveling mines are found along the Telkwa River and Goathorn Creek, while both new and old forestry cutblocks occur throughout the upland areas of Tenas Creek.

A large portion of the Telkwa Project area lies within the Agricultural Land Reserve (ALR), the extent of which is outlined in Section 10.2. Existing land uses within the Project area consist of limited forestry activity and agriculture. Agricultural activity consists of mainly forage crop production and pasturing

livestock. Land cleared for such agricultural uses occurs in major portions of the Pit 3, Pit 7 & 8, tailings disposal, haul road and loadout areas. Wildlife habitat and forestry land uses dominate the Tenas Pit area and portions of other mine development areas. Figure 4-2 illustrates the general distribution of forested and non-forested land use types in the Telkwa Coal Project area.

The objective of reclamation in the Telkwa Coal Project area will be to re-establish agriculture, forestry and wildlife uses to equivalent capabilities as existed before mining. In general,

- flat dump areas that were historically in agricultural land use areas will be reclaimed to forage pasture;
- flat dump areas that were historically in uncleared forested areas will be reclaimed to a forestry/wildlife land use based on forestry plantings, complemented with plantings of deciduous trees and shrubs as warranted based on site specific wildlife habitat design;
- dump slopes and drainage pathways will be reclaimed to a forestry/wildlife land use, and
- flooded pits will be reclaimed to wetland habit.

Manalta Coal Ltd. is confident these reclamation land use objectives can be achieved. In part, this assessment is based on the results of a series of reclamation research reports that assessed plant growth on study plots established on the Pit 3 Test Pit. These plots were monitored by independent reclamation consultants on behalf of CNRL during the years 1983 to 1987, and more recently by K.G. Gizikoff, an environmental consultant, in 1993 on behalf of Manalta Coal Ltd.

The purpose of the research plots was to examine conifer and forage productivity on various soil treatments, and identify the capability of different subsoil materials to meet the reclamation objectives of commercial forestry, agriculture, and wildlife habitat. The plot studies confirmed reconstructed soil profiles on backfilled mine spoil can support satisfactory forestry and forage crop end land uses. Manalta Coal Ltd.'s soil management program will achieve a standard of soil replacement on reclaimed dumps exceeding the conditions established on the reclaimed test pit. Manalta Coal Ltd. has also gained considerable experience locally in reclaiming exploration sites.

Some land will be permanently altered though mining such as the tailings pond area, waste dumps, and pits. Reclamation of these areas will provide diverse new habitats that can be exploited by wildlife.

Approximately 1 700 ha will be affected by development of the mine and associated facilities over the life of the Telkwa Coal Project. Using a progressive strategy of soil salvage and replacement Manalta Coal Ltd. is confident that the capability of both the agricultural and forested land will be maintained. During operation of the mine, as areas become available, they will be reclaimed and provide additional opportunities for wildlife. Use of recently reclaimed areas of minesites by wildlife is well documented throughout British Columbia, and is expected at the Telkwa Coal Project.

2.4.2 Reclamation Concepts

Specific portions of the Telkwa Coal Project will require individual reclamation and decommissioning plans to establish productive and sustainable post

closure conditions. This section outlines the proposed reclamation plans for various components of the mine. These plans are at a conceptual stage and will be refined as detailed mine engineering and operational plans develop. Figures 2-12 to 2-18 outline conceptual reclamation plans and reclamation cross sections for the three development areas: Tenas, Pit 3 and Pit 7 & 8.

Mine Pits

Reclamation of mined out pits will consist of three different options. These options include:

- Pits will be backfilled with waste rock, where economical and practical, as outlined in Section 2.1. The waste rock will be capped with till material and topsoil if available. These areas will then be reclaimed to wildlife habitat.

- Mined out pits will be left open and allowed to fill with water and become small lakes. Where possible, the shores of these lakes will be reclaimed to wetland habitat to encourage use by waterfowl.

- Some portion of the mined pit may be filled with potentially acid generating waste rock as outlined in Section 2.3. These pits will then be filled with water to cover the waste. This permanent water cover will act to limit the formation of any acid mine drainage from the potentially acid generating material. The shores of these flooded areas would be reclaimed to wetland habitat.

In all three options, portions of the highwalls and footwalls will be left as is once mining is completed. Exposed highwalls and footwalls contain both acid generating and acid consuming material. Final water levels in the pits will cover the majority of this material. Where this is not the case, such as in Pit 7, the ratio of acid consuming to acid generating material is positive and will lead to net basic conditions.

Waste Rock Dumps

Reclamation of waste rock dumps will follow as closely behind mining operations as feasible. Prior to dump construction, suitable topsoil and till material will be salvaged from the dump area in accordance with the recommendations set out in the soil survey, "Soil Suitability for Reclamation Evaluation", Section 4.6, and Appendix 13. Salvaged soil will be stockpiled until required. Topsoil and till stockpiles will be segregated and vegetated with erosion controlling vegetation until required for use.

Once the waste dump has been completed, the dump slopes will be recontoured to approximately 26^0. The designated end land uses for these dump areas will be pasture or forage land and wildlife habitat, depending on location and slope conditions.

Dumps designated as pasture or forage land will be contoured to have a gently sloping surface. This will enable farm equipment to use the area while reducing the possibility of water ponding. Dumps designated as wildlife habitat/forestry will be contoured into rolling topography to increase habitat diversity.

Reclaimed dumps will be initially capped with a total of 1 m of compacted till and topsoil material.

Dumps designated as pasture or forage land will be revegetated with a mixture of grasses, and legumes. Dumps designated as wildlife habitat/forestry will be revegetated with a mixture of grasses and legumes as well as trees and shrubs to promote use by wildlife.

All waste dumps will be ringed by a series of interceptor ditches to keep surface runoff from running onto the dumps or to catch any runoff from the dumps. The interceptor ditches from all dumps that do not contain potential acid generating material will be directed into settlement ponds to ensure that water quality meets licensed discharge limits prior to release into the receiving environment. Interceptor ditches from dumps that contain potential acid generating material will be routed through settlement ponds and treated as required to ensure that any offsite discharge meets licensed discharge limits

The interceptor ditches will be sized, constructed and maintained to become permanent drainage features at mine closure. They will promote the establishment of riparian vegetation depending on drainage characteristics.

Tailings Pond Area

The tailings pond has been designed for the subaqueous disposal of the plant site reject material. The tailings pond berm will be revegetated immediately after construction to control erosion of the berm. Upon closure of the mine the tailings area will remain as wetland/wildlife habitat. The shoreline area will be planted with suitable plant species to promote use by waterfowl.

Plantsite Area

The plantsite area consists of a coal preparation plant, office and maintenance complex and associated infrastructure. Prior to construction of the plantsite and infrastructure, available topsoil and till material will be salvaged and stockpiled. Once mining is complete, all buildings and infrastructure will be removed from the site. The area will be recontoured to topography compatible with existing conditions, the soils will be replaced, and the land returned to its equivalent agricultural capability.

2.4.3 Soil Suitability for Reclamation

Soils within the Project area have been characterized and classified in Section 4.7.2, and in Appendix 13. The soils in the Project area have been rated in terms of suitability for reclamation. In general, the upper A and B (where available) horizons, which average about 40 to 60 cm in total thickness, are rated as being of good quality for reclamation. Soils located below this level are of poorer quality and rated as fair to unsuitable for reclamation with stoniness, structure and consistence as the main limiting factors.

The soils within the Telkwa Coal Project area are quite variable and reflect the geological complexity of the area. The variation in soil type and development over very short distances suggest that soil salvage operations will need to be monitored continually to ensure that all available soil is salvaged for reclamation. A soil salvage monitoring program will be developed prior to the start of mining to ensure efficient use of the soil resources.

2.4.4 Revegetation

Naturally occurring vegetation patterns within the Telkwa Coal Project area are described in Section 4.2. Revegetation programs will be designed to promote the diversity of vegetation types currently found throughout the area. Revegetation planning at the Telkwa Coal Mine will satisfy the following objectives:

- Establish a stable land surface;

- Replace salvaged soil materials to provide a suitable growth medium;

- Initially establish vegetation that will stabilize the surface and prevent erosion; and

- Incorporate ecologically appropriate vegetation species that will create a self -sustaining cover and increase the diversity of the newly reclaimed area relative to the reclamation land use objectives.

The conceptual reclamation plans presented above have been designed to provide an overview of the reclamation activities expected to occur at the Telkwa Coal Mine. Detailed plans will be finalized when Manalta Coal Ltd applies for a Reclamation Permit as required under the *British Columbia Mines Act.*

3.0 GEOLOGY

The Skeena Group sediments of the Telkwa Coalfield are an erosional remnant of Lower Cretaceous sedimentary rock which were initially deposited within a large deltaic complex along the southern flanks of the Bowser Basin. Throughout late Jurassic and early Cretaceous time the Bowser Basin was the focus of rapid sedimentation, subsidence and increased tectonic activity, which resulted in thick accumulations of coal-bearing sedimentary rock. Today the coals associated with this deltaic complex, which intermittently extend along the length of the paleoshoreline, form an important resource of coal for British Columbia. In the scope of this text the geology of the Telkwa coalfield is discussed, with particular emphasis paid to the coal measures found within the limits of resource areas identified to date.

Historically the coal resources of the Telkwa coalfield have been exploited on a sporadic basis since the early 1900s, and since 1950 the coalfield has been actively prospected by a variety of companies. Manalta Coal Ltd. has held the coal licences of the Telkwa Coal Property since May, 1992. Since that time Manalta has completed five exploration programs in as many years. Several areas of potential economic interest have been identified to date, including the Goathorn, Bowser, Tenas, Cabinet, Whalen, Helps and Northwest resource areas. The Goathorn, Bowser and Tenas resource areas are currently identified as having the highest resource potential and are considered the main resource areas of the property.

3.1 Exploration

The current geological data base for the Telkwa coal property consists of geological information obtained from historical mine records, surface mapping, exploration drilling, surficial geology boreholes, geophysics, seam trenches, and three bulk sampling programs. The drilling information, upon which most of the data base is based, is derived from drillholes completed since 1979 when geophysical logging was utilized in conjunction with drilling as a tool to reliably and accurately portray subsurface lithologies.

Exploration has been undertaken annually on the property since 1979 with the exceptions of 1980, 1987, 1990 and 1991. Coring has been an integral part of

the exploration programs as a means of collecting rock and coal samples for subsequent acid rock drainage (ARD) and coal quality analytical work. The following discussion is based on previous years' geological assessment reports, which provide additional detail on annual geological work completed on the property.

Geological models have been generated for each of the main resource areas, utilizing Minescape, Medsystem, or Lynx mine modelling software. The Goathorn resource area has been modelled with the Medsystem software, due to the structural complexity of the deposit; the Tenas area with Minescape software; and the Bowser area with Lynx. Each has been updated to reflect the most recent exploration for the area with the exception of Tenas, pending an update to reflect 1996 exploration information. The resulting models are considered to be an accurate representation of the geological information obtained to date.

To date, 662 exploration drillholes and 28 surficial geology boreholes have been completed on the Telkwa property, most of which were concentrated within or proximal to identified resource areas. The main resource areas were the focus of the bulk of this drilling activity, as were the bulk sampling programs. All drillholes possess a complete suite of geophysical logs. Drillholes and resource areas are identified on the Regional Geology Map (Figure 3-1) as are property limits, bulk sample locations, tentative facility locations and seam subcrop positions.

3.2 Geologic Setting

Throughout Jurassic and Cretaceous time, much of western British Columbia was formed and moulded by a series of terrains that moved slowly toward and eventually collided with the North American craton. The Bowser Basin, and ultimately the Telkwa coalfield, is the product of sedimentation that occurred as one such terrane, the Stikine Terrane, pushed eastward to eventually become sutured to the North American landmass.

The Bowser Basin, a successor basin that had developed during Middle Jurassic time, formed in response to the approaching Stikine terrane and was a centre of deposition. Bounded on the north by the Stikine Arch, on the south by the Skeena Arch and on the east by the early uplifting of the Columbian Orogeny, the Bowser Basin collected sediment from all sources although it was dominated by the eastern provenance. The result in the Telkwa area is more than 500 m of coal-bearing strata referred to as the Lower Cretaceous Skeena Group.

Sedimentation continued throughout the Lower Cretaceous, during which time deposition was influenced by two regressive / transgressive episodes. As a result, the stratigraphic sequence of the Skeena Group is divisible into four lithostratigraphic units, Units l through lV. The lithologies within Units l and lll are representative of the regressive episodes and, in turn, the periods of significant peat development in the Telkwa area.

3.3 Stratigraphy

In the Telkwa coalfield, Skeena Group sediments unconformably overlie Jurassic Hazelton volcanics and, where complete, maintain a cumulative thickness of approximately 500 m throughout most of the Telkwa Coal Project study area. Porphyritic Tertiary and Cretaceous intrusive dykes and sills commonly disrupt the local stratigraphy, however, as does a large Tertiary granodiorite plug identified on the northern coal licences.

The stratigraphic sequence is dominated by marine and non-marine sandstones and siltstones, with lesser amounts of mudstone and conglomerate. Coals normally occur within the lower three lithostratigraphic units although best represented within Units l and lll. Coal units commonly occur as multiple seams. Main seams are often correlatable over long lateral distances. The coals within Unit l, collectively referred to as Coal Zone 1, are separated from the Unit lll coals by as much as 140 m of mainly marine sediment. Coal seams 2 through 11, represented in Unit lll, collectively contribute 20.5 m of coal to the unit's 85.0 m average thickness. Typical stratigraphic columns for the main resource areas (Figure 3-2) clearly illustrate unit relationships and the coal-bearing units.

Lithologies between coal seams consist predominantly of interbedded marine and non-marine sandstones, siltstones and, to a lesser degree, carbonaceous mudstones. Bentonites and bentonitic mudstones are also present, most commonly found associated with the coal zones.

Bedrock on the property is usually obscured by glacial sediments that form an irregular mantle over much of the area, with exceptions occurring sporadically or along sections of deeply eroded river and stream valleys such as Goathorn Creek. Thick accumulations of Tertiary sands and gravels also commonly occur underlying glacial tills, particularly on the south side of the Telkwa River near Cabinet Creek and near the confluence of Goathorn and Tenas Creeks. Till thicknesses are variable, normally ranging from 1.0 to 25.0 m while Tertiary sediments, where present, range up to 165.0 m in thickness.

3.3.1 Unit I

The basal unit, Unit I, was deposited in a fluvial environment and, in the Telkwa area, rests unconformably over an eroded Hazelton volcanic basement of Jurassic age. Because it was deposited over an undulating surface, the Unit l stratigraphy displays variability in thickness, often over short lateral distances. This variability is most evident in the lower sedimentary assemblage, between the basement contact and the lowermost Unit l coals. As such, Unit l can be in excess of 100 m in thickness, consisting mainly of conglomerate, sandstone, mudstone and coal.

Coals within this unit, collectively referred to as Coal Zone 1, formed in poorly drained backswamps and are characterized by lateral variation throughout the study area. Illustrated on the Typical Stratigraphic Columns for the major resource areas, Figure 3-2, the Unit l coals can consist of up to 12 individual seams which collectively contribute up to 11.9 metres of coal to the unit's overall thickness. Sands and gravels were typically deposited in braided channels and bars while mudstones accumulated in floodplains. Indications are that there was periodic marine influence during deposition of the unit Deposition of Unit I ended with a marine transgression and deposition of Unit II.

3.3.2 Unit II

Unit II was deposited within a deltaic / shallow marine environment. It consists of up to 140 m of sandstone, silty mudstone and occasional thin coaly mudstone. Sands were deposited in distributary channels and mouth-bars while mudstones and silty mudstones accumulated in interdistributary bays. Thin discontinuous peat beds, none of which are of economic significance, accumulated in local salt marshes.

3.3.3 Unit III

Unit III is indicative of the second regressive episode for the area. It represents the deposition of the main coal-bearing stratigraphic sequence. The unit averages 85 m in thickness, comprised of sandstone, siltstone, carbonaceous mudstone and thick, laterally extensive coal seams.

Restricted nearshore marine, tidal flat and coastal swamp environments persisted throughout much of the deposition of Unit III. Sandstone units were deposited within tidal channels while interbedded sandstones and siltstones were deposited nearshore within intertidal environments. Mudstones are representative of tidal flat deposits. A significant marine influence during deposition of the entire unit is indicated.

Coal zones 2 through 11, illustrated on the typical stratigraphic columns (Figure 3-2), are represented in Unit III. Unit III collectively contributes up to 17 coal seams of economic significance.

The coal zones were likely formed in freshwater peat swamps, located landward of the tidal flat, somewhat isolated from influxes of brackish water. The presence of sulphur in some of the coal seams suggests, however, that the peat was infiltrated periodically by marine water. Thus, the major coal seams are interpreted to have formed from peat accumulated in a freshwater marsh that was proximal to a brackish environment. The Snuggedy Swamp of South Carolina is considered a modern analog for the paleoenvironment in which Unit III was deposited.

Unit IV overlies the coal measures and represents a marine transgression that terminated coal deposition over the study area. The unit exceeds 150 m in thickness and consists of sandstone overlain by silty mudstone. The basal sandstone is a transgressive lag deposit while the remainder represents deposition within a near-shore, shallow marine environment.

3.4 Structural Geology

Since deposition, the Skeena Group sedimentary package has been modified by faulting and minor folding resulting from continental stresses that persisted throughout much of the Upper Cretaceous and Tertiary. The Telkwa area has undergone at least two episodes of structural significance, the first during the Upper Cretaceous, and the second during the Tertiary.

The Upper Cretaceous in the Bowser Basin reflects a time of deformation, when high angle faulting and plutonism were occurring eastward within the Omineca Crystalline Belt, and increasing uplift was occurring to the west. This was a result of the suturing of the Stikine Terrane to the North American craton and the effects of additional terrains approaching from the west. Although folding in the Telkwa area was not as significant as in other portions of the basin, high angle faulting roughly trending in a north-south direction is apparent in the Telkwa coalfield, especially on the south side of the Telkwa River. Where folding has been observed, fold geometries are typical of those found in other parts of the basin, trending northwest to southeast, with shallow dipping west limbs and steeper east limbs. Porphyritic Late Cretaceous dykes and sills also occur locally within the coal measures.

During the Tertiary, much of the area on the north side of the Telkwa River was intruded by a large granodiorite and quartz monzonite intrusion. The igneous body, which vertically intruded the Skeena sediments, complicated the structural geology of the area further. This is especially apparent at close proximities to the intrusive body on the northern coal licences. Structural repercussions in the Skeena sediments appear to be represented by high angle faulting, establishing a mosaic of structural blocks that have been rotated and tilted into a variety of orientations. Each of the resource areas identified to date are representations of such fault blocks.

No specific orientation has been observed to the faulting although faults are apparent in concentric geometries near the intrusive body and also appear to crudely radiate from the intrusive edge. Fault displacements have been observed to range from only a few metres to more than 150 m.

Although bedding orientations within the Telkwa Coal Property resource areas tend to be fault block controlled, each with independent orientations, dips normally range from 10 to 30 degrees. In the fault blocks associated with the Goathorn resource area dips are typically 20 degrees to the east, while within the blocks of Bowser East and West they average 17 degrees to the east and northeast respectively. In the Northwest Area, block orientations are to the southeast and southwest, with dips ranging from 10 to 35 degrees.

The Tenas resource area lies within a closed northwest / southeast trending synform. Orientations along the west limb are consistently northeasterly dipping, normally ranging from 9 to 22 degrees, while along the east limb dips steepen to 45 degrees in a southwesterly direction.

Within the Whalen Block orientations vary but typically range from 15 to 25 degrees to the east/southeast. Orientations in the Helps area are directionally variable due to faulting, but are typically 20 degrees to the south. The Cabinet resource area has been identified as a structurally complex area where faulting is common and orientations are extremely variable.

3.5 Detailed Geology

Seven potential resource areas have been identified on the Telkwa property to date (Figure 3-1). On the north side of the Telkwa River these include the Bowser area, the Whalen Block and Northwest area. On the river's south side, the Goathorn, Tenas, Cabinet and Helps areas have been identified. The economic coals found represented within the Goathorn, Bowser, Helps and Northwest resource areas are those of lithostratigraphic Unit III (Seams 2 - 11). In the Tenas, Cabinet and Whalen Block areas, however, the main seams of interest are those of the Seam 1 coal sequence of Unit I. Small areas identified within the Goathorn resource area also contain coal measures from the Unit l stratigraphy.

3.5.1 Tenas Resource Area

The coal measures of Tenas Resource area (Figure 3-3) are exclusive to the 1 Coal Zone of Unit I and may be correlatable, although fault displaced, to seams in the vicinity of Cabinet Creek. Exploration has been undertaken annually in the area since 1992 and to date 187 drillholes have been completed within the confines of the resource area. Of these, approximately 158 have intersected the seam sequence, providing a drillhole spacing of 150 m or less throughout

most of the field.

The coal quality data base is currently based on 37 coreholes and an 80 tonne bulk sample collected in 1996. Fourteen of the coreholes have also been utilized for ARD analytical work.

Compressional forces directed from the southwest have shaped the Tenas resource area such that the deposit lies today as an erosional remnant of Unit l/ll stratigraphy within a shallow closed synform. Its syncline axis trends northwest to southeast and plunges from opposite ends toward the centre of the resource area to create a deposit bounded by subcrop on all sides.

The stratigraphy of the syncline's west limb trends at approximately 145 degrees and dips gently east / northeastward until it culminates at the axis. Bedding orientations normally range from 9 to 22 degrees, gradually increasing towards the southern limits of the resource area. Dips along the east limb are considerably steeper, ranging up to 45 degrees in a southwest direction. Small-scale faulting is suspected along the axis of the syncline, particularly at its southern end.

The area has been modelled with Minescape mine modelling software. The model is currently being updated to reflect the additional drilling information obtained during the 1996 exploration program. The update, expected early in 1997, is not expected to vary from the current version substantially. Geological interpretations portrayed on cross-sections and the area geology map found in this text reflect work completed to the start of 1996, although 1996 drillholes are displayed on area maps.

The typical stratigraphic column for the Tenas Creek area is included on Figure 3-2. Typical cross-sections are presented as Figures 3-4, 3-5 and 3-6. Cross-section locations are referenced on the Tenas Geology Map (Figure 3-3).

Although several seams occur within the Unit l stratigraphy of Tenas, most are thin and not of economic significance. Three seams, however, currently identified as c-seam, 1-Upper seam, and 1-seam, are consistent in nature and form the mineable component of the Tenas resource. The c-seam is separated from the 1U-seam by approximately 13.0 m and averages 1.51 m in thickness. The 1U and 1-seam are separated from one another by a siltstone parting which develops midway through the field, and increases in thickness gradually to a maximum thickness of 2.50 m at the northwest end of the field. The thickness of the 1U and 1-seams, where undisturbed, average 1.93 and 3.45 m respectively.

At the field's northern limits, Tertiary sediments, presumably associated with the glacial paleochannel of the Tenas Creek drainage, overlie the local coal measures stratigraphy. These sediments become increasingly thicker in a northerly direction. Within the confines of the paleochannel the thickly interbedded sand, silt and gravel blanket is in excess of 85 m.

3.5.2 Goathorn Resource Area

The Goathorn resource area was extensively explored between 1979 and 1984, and again in 1993 and 1996, resulting in considerable accumulated information on the area's Unit lll coal measure stratigraphy. To date, 169 drillholes, 8.4 km of surface geophysics, and the removal of a 219 tonne bulk sample have been completed within the limits of the resource area.

The vast majority of the exploration activity has been conducted within potential pit areas established on the east side of Goathorn Creek (Goathorn East). The current drillhole spacing for Goathorn East ranges from 125 to 150 m. Most of the area drillholes were cored, yielding considerable seam quality information for the area. Rock units from six of the continuous coreholes were sampled and subsequently analyzed for ARD purposes. The resource area, geology, and all drillholes, including ARD hole locations, are illustrated on the Goathorn Geology Map (Figure 3-7).

Other than a few isolated occurrences of the 1-seam package, mainly on the west side of Goathorn Creek, the Goathorn seams (Unit lll, seams 2 to 11) subcrop on the east side of the Goathorn Creek, roughly paralleling the creek valley. Most of the seams deteriorate in an easterly direction, becoming thinner and poorly developed suggesting that locally, during deposition, a restricted nearshore marine environment persisted to the east.

Much of Goathorn area is characterized by an east-dipping stratigraphy, repeatedly broken by a series of north/south trending normal faults. Regional dips range from 10 to 35 degrees, averaging 20 degrees, while normal fault displacements range up to 20 m. Typical geological cross-sections (Figures 3-8 and 3-9) are identified on Figure 3-7. A geological model for the eastern component of the Goathorn resource area was generated in 1996 with Medsystem mine modelling software, upon which detailed engineering work was initiated and resources calculated.

3.5.3 Helps Resource Area

The Helps resource area was identified by exploration drilling in 1996. It has been interpreted to hold coal measures of the Unit lll stratigraphic sequence. The three drillholes intersecting the sequence indicate that the area may contain some faulting, as bedding orientations are variable. Additional work is required in the area to determine field limits and further understand the deposit geometry.

3.5.4 Bowser Resource Area

East (Pit 7) Block

To date, 19 drillholes have intersected the Unit III coal measures (Seams 2 - 11) within the Bowser - East Block area (Figure 3-6). Of the 19 drillholes, 14 represent seam quality coreholes including three which were also sampled for ARD analytical work. The drillhole spacing for the block is currently approximately 125 m. In 1989, a bulk sample was extracted from four large diameter coreholes.

The coal measures of East Block trend in a north-south direction and dip east to northeastward until they terminate against a northeast-southwest trending near vertical fault. This normal fault exhibits considerable displacement (approximately 150 m), juxtaposing thin coal seams possibly of the 1 seams against the Unit III coal seams found in East Block.

The coal measures also abruptly terminate to the north where Skeena sediments have been intruded by a large Tertiary granodiorite plug. The intrusive truncates the sediments at nearly 90 degrees to bedding and extends beyond East Block, further disrupting the coal measures of Bowser West Block and Northwest Area.

Small-scale faulting has been identified at close proximities to the intrusive contact in other areas and is suspected at East Block as well. The coal seams shown on cross-sections 7A and 7C (Figure 3-11) subcrop to the west and south.

West (Pit 8) Block

Exploration of the Bowser - West Block resource area has 66 drillholes within the area's limits, 55 of which have intersected the seam 2 - 11 coal package of Unit III. Consequently a drillhole spacing of 150 m or less is established for the block. Of the 55 drillholes, 29 are coreholes which have yielded seam quality information. ARD samples were collected from seven coreholes that intersected the Unit lll stratigraphy, and two others that intersected the Tertiary intrusive and nearby Unit l coal measures.

Drillhole data indicate that the area consists of two main parallel trending fault blocks which present a repetition of the Unit III coal-bearing sequence (Figure 3-10). Displacement on the normal fault separating the two blocks ranges from 40 m near its southeastern end to 80 m at its northwestern terminus with the Tertiary intrusive body. Additional normal faulting has also been identified at the block's southeast end.

These faults, trending approximately perpendicular to the regional strike of the area, have displacements ranging from 20 to 80 m and are known to break and juxtapose the 2 to 11 coal seam package into a series of smaller fault blocks. Several other small-scale displacement faults have also been identified, commonly occurring at close proximities to the intrusive body.

The coal seams of West Block subcrop to the southwest and are constrained on the northeast by the granodiorite intrusive. An area of intense faulting and the absence of coal-bearing sediments terminates the Bowser resource area to the northwest. Although displaced by normal faulting the coal trend continues to the southeast, and may continue as far south as the Telkwa River, where the trend is presumed fault terminated. The coals historically exploited by the Aveling Mine are likely extensions of the trend, suggesting that additional normal faulting may occur beyond the current limits of drillhole control. Additional exploration is required to further determine the trend geometry in proximity to the Telkwa River.

Bedding orientations throughout the block area are generally to the northeast, averaging 17 degrees, as indicated by area cross-sections 8B, 8D, 8F, 8H and 8J (Figures 3-12, 3-13 and 3-14). Cross-section locations are referenced on Figure 3-10.

The complete Bowser resource area has been computer modelled utilizing the Lynx Mine Modelling System. The resulting models are considered to be an accurate representation of the geological information obtained to date.

3.5.5 Whalen Block Resource Area

Within the Whalen Block, exploration activities to date include 16 drillholes, three of which have been cored. ARD samples of the Unit l stratigraphy were collected from one outcrop location along the erosional bank of the Telkwa River and from one corehole. Seam subcrops and drillhole locations are illustrated on Figure 3-10. Small-scale faulting is suspected to occur throughout the area.

Lithologies intersected by drilling on the Whalen Block indicate that the Unit l stratigraphic sequence is present along the south and west sides of the block where it directly overlies basement Hazelton volcanics. Exploration has also indicated the localized presence of structurally complex areas where small

segments of the Unit lll sequence may also exist. Additional exploration is required to fully evaluate seam geometries, particularly near the block's north-central boundary.

3.5.6 Cabinet Resource Area

Drilling and field mapping completed to date on the Cabinet resource area have indicated that coal occurrences in the area are sporadic and discontinuous. To date, field mapping and 20 drillholes have been completed within area boundaries, 3 of which were cored. Much of the area, particularly the southern half of the resource area, is capped by thick accumulations of Tertiary gravels. Where coal measures have been intersected the stratigraphy has been subjected to considerable structural stresses, as faulting and variability in structural orientation is apparent.

The Unit l stratigraphy is represented in the Cabinet resource area, and is believed to be, although fault displaced, a continuation of the stratigraphic and structural trend found at Tenas. Although additional work is required to fully evaluate the resource potential of the area, seams are thinner and not as well developed as those encountered at nearby Tenas. Like the Tenas area coal measures are underlain by volcanic rock, presumably of the Hazelton Group.

3.5.7 Northwest Resource Area

Drillhole information and surface geophysics indicate that the Unit lll coal sequence represented within Bowser West Block is re-established at mineable depths in the Northwest Area. The area is, however, characterized by north-south trending faults near the intrusive boundary and a thick till cover which ranges up to 35 m. Some thinning of seams 2 through 5 exists although the package's upper seams continue to be well-developed. The area has not been computer modelled to date, as additional drilling is considered necessary to accurately determine field limits and geometry.

The Northwest area (Figure 3-10) is divided by normal faulting into an east and west component. Bedding orientations within the area's western fault block range from 10 - 35 degrees to the south-southwest, while near the intrusive body within the east block bedding dips range up to 30 degrees to the southeast. To date, 18 drillholes have been completed within the limits of the resource area, 14 of which have been cored. Two of the cores have been utilized for ARD analytical purposes.

3.6 Coal Quality Data Base

Coal in the Telkwa Coalfield varies from High Volatile A bituminous to semi-anthracite by the ASTM classification of coal rank. The vast majority of the area coals, however, are a High Volatile A bituminous product with RoMax vitrinite values generally ranging from 0.80 to 1.00 percent. Within the coal measures of the Skeena Group sediments, coal rank generally tends to decrease slightly for coal units situated higher in the stratigraphic column. Localized occurrences of medium-volatile and semi-anthracite coals are thought to have resulted from either post-Cretaceous heat sources, deeper burial and

subsequent uplift of some coal-bearing units, or from localized higher heat flux from the pre-Cretaceous basement. Increases in coal rank have been observed in coals situated at close proximities to the Tertiary intrusive on the northern resource areas as well as some coals within the Cabinet Creek area.

The evaluation of coal quality for each of the resource areas of the Telkwa coalfield is based upon the analytical results of core obtained from diamond and rotary drillholes since 1979, and three bulk sample analytical programs (1983, 1989 and 1996). This data base has established reliable determinations of the raw and clean quality characteristics of the Telkwa coalfield. Analytical seam quality data compiled to date are summarized for each of the major resource areas on Table 3-1. Analytical work for some of the 1996 analytical program is still ongoing, and is not included within the quality summary table.

While the majority of Telkwa coals are relatively consistent with respect to raw calorific value, volatile matter and fixed carbon values, variations in raw ash and sulphur values occur between seams. Sulphur content variations between some seams are attributed to periodic infiltrations of marine water into the developing peat swamp, while inundations are thought to have terminated development of some of the coal seams.

Table 3-1 Clean Coal Quality Summary; Core Washabilities

Telkwa Evaluation

Reported on a Dry Basis

Resource Area	Seams	Seam Quality Characteristics						
		Ash (%)	Sulphur (%)	Specific Gravity (AD)	Calorific Value (kcal/kg)	Volatile Matter (%)	Fixed Carbon (%)	F.S.I. (Range; Avg)
Goathorn East (Pit 3)	2 - 10	11.02	1.13	1.38	7418	28.94	60.04	----
Bowser East (Pit 7)	2 - 6U	9.22	0.90	1.36	7567	28.96	61.94	0.5 - 6.5; 2.5
Bowser West (Pit 8)	2 - 11	12.61	0.99	1.40	7273	27.32	59.72	0.5 - 7.5; 2.1

Tenas	c, 1U, 1	9.38	1.12	1.36	7548	25.20	64.51	1.0 - 4.0; 2.0

3.7 Coal Resources

Quantities of in-situ coal have been determined from drillhole seam intersection information gathered between 1979 and 1996. Specific resource areas have been identified, each of which represents an independent coal deposit within the limits of the Telkwa Coalfield. Each possesses unique characteristics with respect to deposit geometries and all target the coal measures of either Unit I or Unit III. In the context of this report in-situ quantities reported are referred to as *resources*. The economically and technically recoverable portion of these resources are termed *reserves*.

The coal resource areas discussed in this report have been classified according to the *Standardized Coal Resource/Reserve Reporting System for Canada compiled by the Geological Survey of Canada (1989)*. Due to the nature of the Telkwa deposit, the resource areas identified thus far within the coalfield have been classified as *complex* geological deposits. The drillhole density is currently in place allows the Bowser East and much of the West coal resource to be classified as *measured* resources. The Goathorn area resource is considered *indicated* to *measured* for those resources found on the east side of Goathorn Creek, and *indicated* to *inferred* for resources identified on the west side. The Tenas prospect is considered *measured* throughout most of its extent, with small areas of *indicated* resources. The Northwest area and Whalen Block is considered an *inferred to indicated* resource, while the Helps and Cabinet resource are considered *inferred*.

Resource estimates have been prepared based upon drillhole seam intercept information established from geophysical log signatures. Resource areas for which geological computer models were generated include Goathorn (East Goathorn), both Bowser blocks and Tenas. Total in-situ resources were determined for these areas with computer modelling software. For the Northwest, Cabinet, Whalen and Helps areas, resource estimates are based upon simpler, more direct measurement methods. In-situ geological resource estimates for all Telkwa resource areas are tabulated on Table 3-2.

The criteria utilized to conduct resource estimates vary between resource areas due to such factors as the structural complexity, drillhole density and the seam stratigraphy of a particular resource area. For both Bowser blocks and Goathorn areas, resource criteria for seam selection are based primarily upon seam thickness; generally seams which exhibit thicknesses of 0.50 m or greater (1.0 m or greater for Goathorn) were included in the volume calculations. Partings with thicknesses exceeding 0.30 m (0.50 m for Goathorn) were considered separable and not included as part of the seam package.

Table 3-2 In-situ Coal Resources/Reserves

Resource Area	Geological Resource (M tonnes)	Geological Reserve (M tonnes)	Depth Cutoff (m)	Confidence Level

Telkwa North				
Bowser East (Pit 7)	4.33	4.30	150	Measured
Bowser West (Pit 8)	19.55	6.70	180	Measured
Northwest	11.06	----	----	Indicated & Inferred
Whalen Block	8.63	----	----	Indicated & Inferred
North Total	43.57	11.00		
Telkwa South				
Goathorn East Satellites	1.11	1.00	60	Indicated
Goathorn East (Pit 3)	36.96	10.00	150	Measured & Indicated
Goathorn West Satellites	4.10	4.00	150	Inferred
Tenas	27.37	20.00	100	Measured
Helps	7.31	----	----	Inferred
Cabinet	3.71	----	----	Inferred
South Total	80.56	35.00		
Grand Total	**124.13**	**46.00**		

For the Tenas resource area, reported coal quantities include all seams considered mineable (c-seam, 1U-seam and 1-seam), regardless of seam thickness or depth of burial. Similarly, resource criteria for the Northwest, Whalen Block, Cabinet and Helps areas consider only those seams that are of technically recoverable thickness (0.50 m or greater), and do not consider depth of burial.

3.8 Waste Rock ARD Quality Data Base

Since evaluation of the property began in 1985 a variety of test methods have been used by CNRL and Manalta Coal Ltd. to assess and quantify the acid generation potential of the property. Table 3-3 summarizes the prediction studies completed and ongoing, and the numbers of tests in each category. The test methodologies, static and kinetic testing, are described in more detail below.

Table 3-3 Summary of ARD Prediction Data Base

Company and Year	Location	Static Testing	Old Mine Inspection and Monitoring	Lab Kinetic Tests	Site Kinetic Tests	Outcrop Studies	Appalachian Comparison
CNRL (1985)	Pit 3	238 (5 holes)		11			
CNRL (1989, 90)	North of Telkwa River	141 (2 DDHs)					X
Manalta Coal (1992, 93, 94)	North of Telkwa River	152 (14 DDHs)	X	3 (1996)		X	X
Manalta Coal (1996)	Pit 3	86 DDHs	X	7	4		
Manalta Coal (1995, 96)	Tenas Creek	492 (14 DDHs)	X	7	2		

X = Study performed DDH = Diamond Drillholes

3.8.1 Static Testing

For the earlier studies by CNRL, sample locations for static testing were selected to provide even coverage over the pit areas. Subsequent sampling by Manalta Coal Ltd. has emphasized collection of sufficient samples to confidently estimate the potential for acid generation in identifiable zones. The adequacy of the data base has been tested using sensitivity analysis on the zones of influence of individual holes.

The approach to collection of samples from core for static testing has been consistent throughout the duration of the Project. The core was sampled on a continuous basis from the subcrop to the footwall of the lowest seam. Sampling intervals were rarely wider than 3 m to allow individual lithological units to be sampled.

Static testing has primarily been completed using the standard United States Environmental Protection Agency method for acid-base accounting (ABA)*(Sobek et al, 1978)*. The exception was the CNRL study in 1989 which used the B.C. Research Initial Test with calibration of a selection of samples to the EPA method. Although evidence suggests that NP determinations by the EPA method may be biased towards high NP values *(MEND, 1996)*, the use of this method allows comparison with ABA data bases accumulated for coal mines in the Eastern U.S.A.

Static tests have also included determination of sulphur in the form of sulphide and sulphate, total inorganic carbon (TIC), and metal concentrations for selected samples. Polished thin sections have also been described.

Refer to Appendix 3, McKinstry and Appendices 4 and 5, Manalta Coal Ltd. Internal.

To be consistent with interpretation methods at other coal mines, acid potential (AP) was calculated from total sulphur, rather than pyritic sulphur. Classification of individual samples was based on the neutralization potential ratio (NPR) which is NP/AP. If the NPR is less than 1, the rock is classified as potentially acid generating. If the NPR is greater than 1, the rock is classified as potentially non-acid generating although the classification is uncertain between NPRs of 1 and 2 .

3.8.2 Laboratory Kinetic Tests

Eleven 500 g to 1000 g samples of rock crushed to <2 mm were leached for eight weeks in 1985 *(Sturm Environmental Services, 1985)* for CNRL. Leachates were analyzed each week for pH, acidity, alkalinity, manganese, iron, sulphate, total dissolved solids and sodium. Composite leachate samples collected during the entire test period were analyzed for heavy metals. The samples were selected to indicate a range of potential waste rock composite compositions and disposal scenarios (six tests) and various types of potentially acid generating rock compositions (five tests). These tests were of limited value due to their limited duration and lack of key analytical parameters in leachates (example, Ca, Mg).

Manalta Coal Ltd. initiated 17 humidity cells in January 1997 using 1 kg rock samples crushed to minus 6 mm using a protocol described by the Ministry of Employment and Investment. The samples being tested are from the Pit 3, Pit 7 & 8 (including a granodiorite sample), and the Tenas Creek areas. One sample of fine tailings will also be tested.

To simplify sample selection, a matrix (Table 3-4) was prepared using classification based on acid-base accounting and rock "hardness". Rock hardness refers to the tendency of individual rock types to break down, which is usually an important factor in the rate of oxidation. Soft rock types are primarily shales and mudstones. Hard rock types are sandstones and some siltstones. Sample leachates are being analyzed for pH, sulphate concentrations, alkalinity, acidity, and concentrations of Ca, Mg and selected regulated elements.

The kinetic tests will be interpreted to obtain:

• the lag time before acid generation begins for potentially acid generating type materials;

• metal release rates under pH neutral and acidic conditions;

• relative weathering rates for soft and hard rock types; and

• relative rates of sulphide oxidation and acid neutralization under pH neutral conditions.

The latter calculation will be used to a infer a site specific criterion for acid generation in terms of one or several NPR values.

3.8.3 Field Kinetic Tests

In 1995 and 1996, Manalta Coal Ltd. initiated field level kinetic testing by constructing ARD leach pads. These field demonstration projects consist of small (10 to 20 tonne) test leach pads that were constructed from:

· waste rock backfilled in the location of the 1985 bulk coal sample collection in the Pit 3 area (2 pads);

· weathered waste rock from dumps at the former Forestburg open pit coal mine (3 pads); and

· potentially acid generating sandstone at the location of 1996 bulk sample collection in the Tenas Creek area (3 pads).

Table 3-4 Matrix of Sample Selection for Humidity Cells

ABA Classification	Rock Strength/Lithology	
	Strong	Weak

NPR<0.5, T_S>2%	1 cell S1, 2 cells S2-10 (Pits 3 and 8)	1 cell S1, 1 cell S2-10 (Pit 3)
1<NPR<2	1 cell S1, 1 cell S2-10 (Pit 3)	1 cell S1, 2 cells S2-10 (Pits 3 and 8)
NPR>2	1 cell S1, 1 cell S2-10 (Pit 3)	1 cell S1, 2 cells S2-10 (Pits 3 and 8)
Granodiorite	1 cell	Not applicable
Coarse Reject	Not applicable	See NPR<0.5, T_S>2% (Weak)
Tailings	1 cell	

Note: S1 = Seam 1 package (Tenas Creek)

S2-10 = Seam 2 to 10 package (Pits 3, 7 and 8).

The total number of humidity cells is 17.

The pads at the Pit 3 and Forestburg locations were constructed in the fall of 1995. Rock was excavated and placed on liners equipped with slotted leachate collection pipes. Leachates were collected from the pads on a monthly basis and analyzed for parameters comparable to the humidity cells.

The leach pads in the Tenas Creek area were constructed to evaluate the effect of placement of a compacted glacial till cover over the potentially acid generating sandstone. This project is in the early stages of monitoring.

3.8.4 Investigation of Existing Workings

Coal has historically been mined on the Telkwa property from at least three locations, the most significant of which were the open pit Forestburg Mine and the underground McNeil Mine. Several small underground openings are also present along the north bank of the Telkwa River. These workings have been inspected and any seeps sampled as part of Manalta Coal Ltd.'s evaluation of the property.

Test pits were excavated in the Forestburg Mine dumps to observe the surface weathering profile. Samples were collected for static testing including determination of metal availability using sequential extractions.

Samples of seepage from the McNeil Mine area have been collected and analysed. Seepage emerging from the area of the 1985 Pit 3 bulk coal sample area has been sampled regularly since 1994. All results of these monitoring programs indicate that the seepage emerging from old mine workings and backfilled materials are of a near-neutral or slightly basic quality.

3.8.5 Outcrop Studies

To understand the long term weathering characteristics of exposed strata, samples were collected from outcrops on the north side of the Telkwa River. The same strata were also drilled and sampled upslope from the outcrop. The samples were tested using ABA analysis and selected samples were described in polished thin sections.

3.9 Classification of ARD Potential in Waste Materials

The following sections describe the available data on the acid generation potential of each main type of waste material at the Telkwa Coal Project. The waste types are:

• Sedimentary waste rock.

• Waste coal.

• Glacial till.

• Intrusive igneous rock (north side of Telkwa River only).

3.9.1 Sedimentary waste rock

A rigorous assessment of the acid-base accounting data base for the coal-bearing stratigraphy north of the Telkwa River in 1994 (Appendix 3, McKinstry) led to the conclusion that acid generation potential could not be reliably correlated with lithological rock types (eg., mudstone, siltstone, sandstone). Instead, the NPR characteristics of interburden zones between specific seams were found to be correlatable between drillholes. This resulted in a zone-based method of quantifying acid generation potential for waste rock. Interburden zones were named according to the upper and lower seams. For example, Zone I is beneath Seam 2, Zone II is between Seams 2 and 3, Zone III is between Seams 3 and 5, and so on. The zone method was used to quantify the acid generating potential for the Tenas and Pit 3 areas based upon samples collected in 1995 and 1996. Details of this work are presented in Appendix 4, Manalta. Typical ABA characteristics of each zone are summarized in Table 3-5. Figure 3-15 shows all acid-base accounting data for each pit area.

3.9.2 Coal

Coal is potentially acid generating based on an average total sulphur concentration of 1.5% and neutralization potential of 21 kg $CaCO_3$/t. However, 35% of sulphur is present in non-pyritic form. The presence of neutralization potential indicates that acid generation would be delayed.

3.9.3 Glacial Till

Glacial till consists of clay and crushed rock originating geologically outside the Project area. It contains negligible sulphur concentrations and in places sufficient carbonate to react visibly with dilute acid. The till is therefore an acid neutralizing material.

3.9.4 Intrusive rock (north side of the Telkwa River)

Mining on the north side of the Telkwa River will result in removal of some intrusive rock of granodiorite composition. This rock contains negligible sulphur and neutralization potentials of 32 to 41 kg $CaCO_3$/t in the form of carbonate minerals (possibly calcite or dolomite). It will provide some neutralizing potential when placed in waste rock dumps.

Table 3-5 Summary of ABA Characteristics by Waste Rock Zone

Zone	Upper Seam or other unit	Lower seam or other unit	Total Sulphur (%)	NPR
Tenas Pit				
Till			0.04	17.06
1	Till Contact	TUE	0.68	3.21
2	TUE	TUD	1.54	1.83
3	TUD	TUCA	1.16	2.42
4	TUCA	TIB	0.77	2.72
5	TUB	T1A	1.09	1.55

Pit 3				
Till			0.21	6.58
10	Till Contact	10	0.41	5.73
9	10	9	0.57	1.13
8	9	8	1.34	0.75
7	8	7	0.5	3.89
6	7	6	0.6	1.70
5	6	5	0.57	5.00
4	5	4	0.96	3.34
3	4	3	0.79	2.67
2	3	2	0.73	0.58
1	2	None	0.42	15.23
Pit 7 & 8				
8	None	Marker sandstone	0.3 to 0.6	>2.0
7	Marker sandstone		1.7 to 3.1	>0.6
6	Marker sandstone	8	1.2 to 2.5	<0.8
5	8	6	0.3 to 1.1	>2.0
4	6	5	0.2 to 0.9	?
3	5	3	0.6 to 2.0	<1.0
2	3	2	0.2 to 0.4	0.3 to 1.3
1	2	None	0.3 to 0.5	>2.2

4.0 ENVIRONMENTAL BASELINE

4.1 Forest Resources

4.1.1 Forest Cover and Capability

The proposed Telkwa Mine lies within the Bulkley Forest District in an area where Pacific Inland Resources (PIR), a division of West Fraser Mills Ltd., has historically harvested timber under Forest License A-16830. The area contains lodgepole pine, white spruce, subalpine fir and aspen as the predominant tree species. Currently, Manalta Coal Ltd. has a license to harvest, Forest Licence L-4205. Since 1992, Manalta Coal Ltd. has harvested timber annually in support of ongoing exploration programs on the property. Development of the proposed mine will result in staged harvesting of forest resources within the Project boundaries.

Section 2.4, the Conceptual Reclamation Plan, outlines measures to re-establish timber production in designated forestry land use areas. Reclamation research undertaken at the Pit 3 Test Pit site has confirmed that timber values can be re-established on reclaimed mine areas in the Project area.

Tenas Pit Area

The Tenas Pit area, the first area to be mined, is the only mine area with any significant merchantable timber. The main Tenas Pit contains stands of both immature and mature lodgepole pine, spruce and subalpine fir. Stand heights are typically 19.5 m to 28.4 m with the estimated area occupied by the canopy through vertical projection ranging from 26% to 45%. The site index classification is rated as medium to good. Approximately one fifth of the pit area has been previously harvested. The remaining area has been marked for future harvesting by PIR.

The smaller Tenas West Pit contains mature stands of aspen and lodgepole pine. Cover ranges from 26 to 35%. The site classification is rated as medium. Timber within the Tenas West Pit is designated by PIR for future harvesting.

The Tenas Pit West Dump area contains mature stands of lodgepole pine and spruce. With 26 to 55% cover, the dump area site classification is rated as good. Approximately half of the west dump has been harvested and the other half is designated for future harvest by PIR.

The Tenas Pit East Dump area contains primarily mature lodgepole pine and spruce, but also contains significant numbers of mature subalpine fir and aspen. The estimated area occupied by the canopy ranges from 26 to 45%. Site classification in the dump area is rated as medium. The east dump area has not been harvested, but the area has been marked by PIR for harvest.

Pit 3 Area

Pit 3, the second area scheduled to be mined, contains mature stands of aspen, lodgepole pine and spruce with site classification rate from poor to medium. Portions of the Pit 3 area are cultivated and the remainder is non-commercial brush.

The Pit 3 Dump exhibits similar characteristics to the Tenas Pit with some stands of lodgepole pine, spruce, aspen and non-commercial brush, but the area is

dominated by cultivated land. One small area has been marked by PIR for future harvest.

Pit 7 & 8 Area

Pit 7 & 8, the last pits scheduled for mining, are predominantly located on private land, but some Crown land exists within the north and west sides of the Project boundary. The area is cultivated with some non-commercial brush. The Crown land is part of the Smithers Community Forest.

Infrastructure

Construction of mine service buildings, the preparation plant, train loadout with rail loop, and haul roads will result in clearing of some timber resources. The proposed preparation plant and shop area contains mature stands of aspen, spruce and lodgepole pine rated as medium. The area is also cultivated to some extent. The proposed train loadout, rail loop, and 7.8 km clean coal haul road are on cultivated land with some stands of poorly rated aspen and lodgepole pine intermixed. The proposed tailings disposal area location is on cultivated land. For the proposed 7.3 km haul road from the main Tenas Pit to the preparation plant, 2.5 km goes through land designated by PIR for future harvesting.

4.1.2 Forest Access Roads

Roads into and through the proposed minesite are public roads administered by the Bulkley Forest District. One road provides access to Hunter Basin, a popular hunting area south of the Project area. This same road is currently used by Manalta Coal Ltd. for access to the Project area.

4.2 Vegetation, Habitat and Wildlife

The assessment of the vegetation, wildlife and habitat resources in the Telkwa Project study area is based on previous studies conducted by Taesco Consultants Ltd. (1985) and (Hatler, 1990)(Appendix 11). The studies addressed, respectively, a mine development area south of the Telkwa River (a Pit 3 based project) and a development area north of the river (Pit 7 & 8 based project). The Taesco study provided detailed vegetation and habitat descriptions. Additional information includes resource mapping provided by the Ministry of Environment, Lands and Parks (MELP).

The Taesco studies, supervised by Dr. G. Schuerholz, date to 1983 and 1984. The study addressed provincial requirements for Stage II Environmental Impact Assessment. The Taesco study area included all of the present Project development sites north and south of the Telkwa River, the Tenas Creek drainage, and perimeter areas. The area was less developed at the time of the study than present, and perhaps more reflective of wildlife habitat potential than at present. This study established a number of habitat monitoring sites from which to assess the effects of long term land use trends.

The Hatler study, conducted in 1990, focussed on wildlife resources in the Project development area along and north of the Telkwa River. This study drew on additional aerial surveys in 1988 and 1990. It also addressed biodiversity issues.

The Hatler study indicated that the Project area included important winter range for moose. With reference to mine development in the Pit 7 & 8 areas, the study recommended maintenance and enhancement of the moose winter range as the first priority in mitigation. MOE's 1990 review of this report for the previous application for Mine Development Certificate indicated the need for enhancement of habitat adjacent to the Project area to offset loss of winter moose range during the active life of the mine.

As of March, 1994, MELP (Appendix 9) accepted the conclusions of the Hatler wildlife report, as part of the review for the Manalta Telkwa Coal Project (Pit 7 & 8) under the Mine Development Assessment Process. MELP requested that the report's recommendations be incorporated into the Project's conceptual reclamation plan.

4.2.1 Vegetation

The study area falls within the Sub-Boreal Spruce biogeoclimatic zone, represented by the (White) Spruce subzone, which occupies about three-quarters of the study area at lower elevations to approximately 750 masl, and the Subalpine Fir subzone, found above 700 masl. Lodgepole pine and trembling aspen form the climatic climax of the Spruce subzone, while subalpine fir, hybrid spruce or lodgepole pine form the climatic climax of the Subalpine Fir subzone. Trembling aspen and lodgepole pine are the main seral tree species.

Sixteen vegetated and five non-vegetated cover types occur in the study area. The lower elevations are dominated by hybrid white spruce-lodgepole pine forests in various stages of succession. Pure lodgepole pine stands occur extensively on flat, drier sites. Hybrid white spruce and subalpine fir form the climatic successional stages. Wetland communities are characterized by black spruce. The numerous brushlands are man-induced.

Cover Types

The study area contains twenty-one cover types, grouped into five categories: Coniferous Forests, Deciduous Forests, Natural Meadows, Brushlands, and Non-vegetated types. The major types in the study area were Forested types (67%) and Natural Meadows and Brushlands (together 16%). Of the forested types, Coniferous types comprise about 38% of the total area and Deciduous types about 30%.

The major forested coniferous cover types, by dominant tree species, are Pine, (White) Spruce-Balsam, Spruce-Balsam-Pine, Spruce-Pine, Spruce-Pine-Aspen, Black Spruce, and Black Spruce-Spruce. The Spruce-Pine-Aspen type is the most common type (almost 14%). The pine and black spruce types are common at the lower elevations, while the spruce-balsam types are common above 700 masl.

The major forested deciduous cover types are Aspen, Aspen-birch, Aspen-Pine, Aspen-Spruce, and Cottonwood-spruce. Trembling aspen stands are common in the Project area, primarily as part of the distinct Aspen type (7%) and the Aspen-Spruce (11%). The Cottonwood-spruce type (5%) is found primarily along watercourses and some upland terraces.

The non-forested cover types are divided between the Natural Meadows (2%) and Brushlands (15%). The Brushlands type includes cleared and logged areas that have developed shrub growth. As of 1985, urban, cultivated or cleared, logged, and other disturbed land types totalled over 15% of the study area. These types have increased in area since the Taesco study.

Plant Communities

A number of plant communities have been identified in the study area:

• Spruce Subzone

- Mesic Maturing Hybrid Spruce-Lodgepole Pine-Purple Peavine;

- Mesic Seral Trembling Aspen-Highbush Cranberry;

- Alluvial Black Cottonwood-Hybrid Spruce-Shrub;

- Black Spruce-Hybrid Spruce Swamp;

- Willow-Scrub Birch Swamp;

- Black Spruce Bog;

- Dry Lodgepole Pine-Moss;

- Scrub-Steppe-Meadow.

• Subalpine Fir Subzone

- Mesic Maturing Hybrid Spruce-Subalpine Fir-Black Huckleberry;

- Mesic Seral Trembling Aspen-Thimbleberry;

- Upland Black Cottonwood-Black Twinberry;

- Black Spruce Fen.

Detailed community descriptions are provided in the Taesco report.

Conservation Status of Plants and Communities

Out of 180 plant species identified, only two, Carex trisperma and Rubus arcticus spp. stellata, were designated rare. These were found once in wet habitats. Endangered plant species are not known to occur in the study area.

Scrub-Steppe-Meadow is the only plant community that appears to be rare, based on the Taesco study. It is restricted to a few steep south- to west-facing slopes on the north side of the Telkwa River. This community is also uncommon in the region but may be quite common in the dry southern interior of British Columbia.

4.2.2 Habitat and Wildlife

Taesco determined use of local habitats by wildlife, with emphasis on ungulates, furbearers and birds. The relative abundance of species was assessed based on winter surveys of ungulates, furbearers and small mammals, and seasonal bird surveys. Twenty-three vegetation cover types were used for the ungulate browse-pellet studies, and 28 for the bird surveys, while five major habitat types were designated for the furbearer surveys (Brushlands, Riparian Deciduous and Coniferous, Riparian Deciduous, Conifer Mix, and Mixed Forests).

Ungulates

The principal ungulate species in the study area are moose and mule deer. White-tailed deer may occasionally occur. Caribou and mountain goat are found in the Telkwa Mountains, south of the study area. Hatler identified moose as a high priority species in the local management framework.

Pellet group counts by Taesco indicated that Moose is much more common in the study area than deer. Moose generally use all habitat types throughout the year with some preference for deciduous early successional forest cover types characterized by high browse plant production. The highest use was noted in Cleared areas, followed by Logged habitat types, Scrub-Steppe-Meadow, Aspen-Birch, Spruce-Pine-Aspen stands, Hydro Transmission corridor, Brushlands and Aspen stands. Most pellet groups were located in lower elevation, level terrain areas.

Areas designated as "true winter range" for Moose showed the highest pellet group concentrations for the Spruce-Aspen-Cottonwood and Brushland types. These high use areas were associated with western and northwestern slopes and valley bottoms.

Deer are associated mostly with deciduous and open habitat types in early succession except for the Spruce-Pine-Aspen type, which in winter is used principally for thermal cover. Logged areas in early succession received the highest overall use by Deer. Deer were observed wintering on the southeast facing slopes along the Telkwa River and on the level terrain between the Telkwa and Bulkley Rivers. Pellet group densities were highest in ecotones between cleared areas and timber stands, suggesting that deer use old growth forests as thermal and escape cover and enter the clearcuts for foraging.

Habitat use was assessed by examining species, form class and utilization of shrub plant species used as forage, or browsing. Ranking the habitats in terms of the preferred browse species indicated that the highest browse production is found in the Spruce-Balsam-Pine type, followed by Aspen, Brushland, Cleared, and Spruce-Balsam habitats, which generally corresponds to the distribution of ungulates.

The most common browse species were not necessarily the most heavily used plants. The browse species generally did not show extreme degrees of browse pressure, suggesting that the range was not over-stocked. Preferred browse species were ash, fir, willow, birch, saskatoon berry, red-osier dogwood, bittercherry, aspen and squashberry. The relationships between browse plant species and ungulate habitat use will contribute to reclamation planning.

Helicopter surveys of ungulate winter range were conducted by Taesco in 1983 and 1984 to determine the winter distribution of ungulates. These surveys

concentrated generally along the Telkwa River and Goathorn Creek valleys. The Taesco surveys occurred during a mild, low snow year, which would have acted to disperse the ungulates more than in a deep snow year.

By comparison, the 1990 winter was the most severe in terms of snowpack in a decade. Based on the 1990 aerial surveys conducted by Hatler, the winter range in the study area along the Telkwa drainage (the lower benches and slopes, including Pit 7 & 8 areas, and river bottoms) is among the best available to the moose population, which concentrates there from hundreds of square kilometres of surrounding summer range. At the same time, Hatler observed a low number of cow/calf pairs, which may have indicated that the winter range in the Telkwa drainage may not be entirely adequate for present numbers, especially during "critical" winters.

The Taesco surveys showed that moose were associated with Brush, Open Deciduous Forests and Riparian vegetation. All three community types provide ample browse and shelter. High numbers of moose were observed along the Telkwa River and south of the Telkwa River east of Goathorn Creek. Highly productive brushland or early succession habitat conditions in this area were judged to offer excellent forage conditions and good cover.

Aerial survey data summarized by Hatler indicate that the study area supports a significant concentration of moose in at least some winters. Calculated densities in 1988 and 1990 surveys covering the study area ranged from 2.25 to 2.84 moose/km^2, which was considered to reflect a population at or near a peak. Considerable variability was noted in observed numbers over the period 1980 to 1990, which is likely related to snow depth, the major factor determining the dispersion of moose .

Seasonal movement patterns of moose were derived from the aerial survey observations. These indicate the importance of upland areas within the study area. Hatler noted a general pattern of movement between mid-February and mid-March away from river bottom habitats to adjoining uplands, in response to increasing snowpacks.

The distribution of mule deer is limited by snow depth primarily. Studies by Hatler indicated that the primary winter range in the area is in the thick pine along the lower Telkwa river and Tatlow Road areas. Significant occurrence of white-tailed deer is not likely in the study area.

A small population of caribou occurs in the nearby Telkwa Mountains. No regular use of the study area by caribou is known or suspected.

Other Big Game Species

The study area includes some high quality bear habitat, used by both grizzly bears and black bears. These include high, south-facing slopes and benches used in spring, and mesic sites and wetlands used during the summer and fall. Denning sites are not known. Black bears are the most commonly observed bears in the study area. Grizzly bears likely use higher elevation denning sites in the Telkwa Mountains from which they disperse in early spring throughout the study area. Black bears are associated with Telkwa floodplain habitats and other habitat types sustaining seral plant communities.

Furbearers

Furbearer track surveys confirmed the presence of a number of carnivorous furbearer species, notably marten and weasel, followed in order of relative abundance by coyote, fox, mink, fisher, lynx and wolf. Red squirrel and snowshoe hare are also common.

A number of habitat types are used by furbearers, particularly pure Conifer stands and Brush by marten and Brushlands by weasel. Distributions often reflect

predator-prey relationships, notably squirrel and marten in Conifer dominated habitats.

The streams in the study area are generally limited for beaver by unstable water levels and excessive width. The riparian habitats support mink.

Birds

Over 140 species are expected to nest in the study area. The Taesco report presents an annotated bird list for all species expected to occur in the study area, with reference to habitat and season of use.

Waterfowl use of the study area is limited by the lack and low quality of suitable habitat. Rivers and creeks support low densities of common merganser, mallard, and harlequin duck. Migratory and nesting waterfowl species use larger water bodies such as Tyhee Lake, which will be unaffected by the Project. Nesting species typically include common loon and mallard, while migrants typically include western grebe and whistling swan. Shorebirds are generally restricted by lack of suitable habitat.

The Spruce-Pine-Aspen type supports a wide range of bird species, reflecting variety in understorey and food sources. Relatively homogenous habitats such as Pine show limited species diversity and habitat use. The Alluvial Forest habitat types along Tenas and Goathorn Creeks and the major rivers support a diverse bird fauna in all seasons.

Rare and Endangered Species

Based on the Taesco report, no rare or endangered mammal species are known to occur in the study area. Birds of special conservation interest are Peregrine falcon, osprey and mountain bluebird, which may use the study area for nesting and feeding. Since wetlands supporting waterfowl are scarce in the study area, feeding habitats for peregrine falcon and osprey are of low quality. The cliffs along the Telkwa River may serve as falcon nesting sites. Suitable habitat for mountain bluebird is marginal, most commonly occurring on farmland in the lower Bulkley Valley.

Hatler reviewed the status of wildlife relative to the "Blue List", which includes species "considered sensitive and/or deserving to be 'red-flagged' for management attention because of major declines in their population". Two of the Blue-listed birds, bald eagle and gyrfalcon occur in the Bulkley River valley area, the former regularly throughout the year and the latter seasonally, usually in winter, of some years. Individuals of both species might be found hunting in the study area at least occasionally, but more significant occurrence, such as nesting, was judged to be unlikely, particularly for the gyrfalcon. Of the mammals listed, only caribou and grizzly bear are present in the study area.

Biophysical Classification for Wildlife Capability

Wildlife capability mapping prepared by the Ministry of Environment (1983) indicates primarily moderate capability (Classes 2 to 4) moose winter range areas along the major watercourses and terraces above the rivers, and the moderately sloping areas between Bulkley River and Tenas Creek. Moderate to high snow conditions limit most habitats for ungulates in the study area. A frequent limitation noted in the biophysical units covering the study area is upland forest soils that promote dense conifer forests.

The biophysical units covering the study area are also rated somewhat lower in capability class for mule deer, elk, white-tailed deer and caribou, generally of capability class 4 or lower (low capability), and rarely winter range.

Hatler noted that the observed densities and distribution of moose are greater than those expected from the habitat capability ratings. This may reflect an under-rating of the area, or the ongoing permanent loss of preferred habitats elsewhere within the Bulkley Valley due to agricultural and urban developments (Hatler, 1990).

Biodiversity

Hatler (1990) provided an estimate of local vertebrate biodiversity and productivity, as measured on a series of transect surveys in mine development areas north of the Telkwa River. The species diversity, on a species/km basis, ranged from two to 17.

"Productivity", as a measure of the extent to which an area supports wildlife, was also determined by quantifying "wildlife sign" observed on the ground transects. The findings confirmed local variability in wildlife diversity and productivity.

4.2.3 Resource Use

Forestry

Forestry is the largest resource sector in the Smithers region. Logging generally occurs in the Lodgepole Pine-Spruce forest of the intermediate mountain slopes. Most of the study area has been logged, some of which cleared for pastureland. This includes large portions of the Pit 7 & 8 areas north of the Telkwa River, and lands along Telkwa River and Bulkley River affected by the Project.

Non-Consumptive Wildlife Use

Wildlife viewing is an important aspect of outdoor recreation in the region. A small herd of caribou in the Telkwa Mountains is a regionally significant feature. The eastern limit of this herd's range extends to Hunter Basin at the headwaters of Cabinet Creek. This is outside the Telkwa Project development area; however, the road leading to Hunter Basin passes through the Tenas Pit area and is the most direct access to the alpine areas where caribou and other viewing opportunities exist.

Hunting and Trapping

In general, hunting pressure in the Telkwa valley is high. Most hunters are local residents. Hunting and trapping are also important to Aboriginal peoples in the area.

Moose is the principal big game animal hunted, followed by black bear, deer, and grizzly bear. Upland game birds are abundant and also contribute to the hunting resource.

The Pit 3 area and access corridor lie within the boundaries of a single trapline, which includes the Goathorn Creek drainage and extends east to the Bulkley River. Trapline returns show the presence of marten, beaver, fisher, weasel, wolverine, lynx, mink and otter.

4.3 Fisheries and Aquatic Habitats

4.3.1 Fisheries Data Base

A review of current fisheries information was conducted to document background information on fisheries and aquatic habitat within the Project Area boundaries. The review was conducted in 1996 by SKR Consultants Ltd. of Smithers. This section of the application was abstracted from the review conducted by SKR.

The overall knowledge of fisheries resources in the Telkwa River drainage, and two tributaries of the Bulkley River included in the Telkwa Project area, appears to be extensive. Some detailed information was available for the southern part of the Project area, but little specific information could be located for tributaries draining the northern half of the area (for example, Pine Creek). Several detailed studies have focussed on Goathorn Creek and its tributaries.

Fisheries resources in the area are valuable, and consist of several species of salmonids. The presence of pink salmon, coho salmon, chinook salmon, steelhead trout, cutthroat trout and Dolly Varden char in the Project area has been well documented in the past. A recent study also confirmed the presence of bull trout (a Blue listed species) in the Telkwa Project area. Fish habitat descriptions have been documented primarily for major drainages in the southern part of the Project area.

The fisheries information presented in this report includes the distribution of individual fish species in the Project area, trends in abundance/escapement estimates, aquatic habitat characteristics, the presence of Red- and Blue-listed species, and the use of the area by anglers and guided anglers. The Fisheries Branch at the B.C. Environment's Regional office (Skeena Region) was contacted and Fisheries data bases, including the Stream Information Summary System (SISS) and the Fisheries Information Summary Systems (FISS) were consulted for baseline information. Stream and lake files as well as reports present at B.C. Environment were also researched. The Department of Fisheries and Oceans (DFO) was contacted for further information on fish and fish habitat in the Project area, as well as information on escapement and abundance estimates. Relevant data identified in the above sources were summarized and mapped.

Some studies pertaining to the Telkwa Project area are presently underway and are not presently available for review. These include a summary of water quality data for the Skeena Watershed, funded by Green Plan, and fish inventory, funded by Forest Renewal B.C.

The Telkwa Coal Project area is located in the lower watershed of the Telkwa River (including parts of Pine Creek, the majority of Goathorn Creek and its tributaries), and the upper watershed of Hubert and Helps Creeks (Bulkley River tributaries). This section:

• compiles and summarizes information relevant to Project planning on fish populations, and aquatic habitat in the Project area;

• maps existing information on fish distribution, and aquatic habitat at 1:50 000 scale (Figure 4-1), and

• addresses the significance of the local fisheries and habitats in a regional and provincial context.

4.3.2 Fish Distribution

Fish distribution for the Telkwa River and sections of the Bulkley River near the Village of Telkwa have been mapped and summarized in the Fisheries Information Summary System (FISS), and the Stream Information Summary System (SISS). More detailed information can be found in Bustard (1985, 1984, 1983a&b,) located in Appendix 12. The following paragraphs summarize the known fish distribution for the Bulkley and Telkwa Rivers and major tributaries, which drain major portions of the Telkwa Project area, and for Hubert and Helps Creeks, which drain the haul road and loadout areas.

Fisheries resources in the Bulkley River are extensive. The presence of four of the five species of anadromous salmon (coho (*Oncorhynchus kisutch*), chinook (*O. tshawytscha*), sockeye (*O. nerka*) and pink *(O. gorbusha*)), rainbow trout and steelhead (*O. mykiss*), cutthroat trout (*O. clarki*), Dolly Varden char (*Salvelinus malma*), and bull trout (*Salvelinus confluentus*), have been documented, among several species of non-game fish (SISS).

Little fisheries information exists for the Hubert Creek area. However, FISS indicates that coho (*Oncorhynchus kisutch*) and steelhead utilize this tributary to the Bulkley River (Figure 4-1). Cutthroat trout spawning locations have been identified in Helps Creek, a tributary to Hubert Creek (FISS).

Fisheries information has been documented for the mainstem Telkwa River to a point located approximately 5 km upstream of Milk Creek. Species that have been identified in the Telkwa watershed include coho, Dolly Varden char (possibly bull trout), mountain whitefish (*Prosopium williamsoni*), cutthroat trout, pink salmon, steelhead, and peamouth chub (*Mylocheilus caurinus*) (SISS, FISS). In particular, coho, pinks and steelhead have been documented in the mainstem Telkwa River downstream of Goathorn Creek (SISS).

Steelhead, mountain whitefish, Dolly Varden char, and bull trout have been documented in Goathorn Creek, and Tenas Creek (Figure 4-1). Dolly Varden char have also been sampled in Cabinet Creek, and in the upper reaches of the Goathorn watershed (SISS, FISS). Coho have been documented in lower reaches of Goathorn and Tenas Creeks (Read Environmental & Planning Associates Ltd., 1982); although these are likely mis-identified pink salmon. The documented presence of Dolly Varden char was likely mis-identified bull trout in some cases. The presence of bull trout, a Blue-listed species (sensitive/vulnerable), in Goathorn Creek was only recently established (Bustard pers. com.).

Pink salmon, cutthroat trout, Dolly Varden char (possibly bull trout), and mountain whitefish have been identified in Pine Creek (FISS, Figure 4-1). Pink salmon spawning locations have been documented in reach 1 of Pine Creek. Coho have been identified spawning in the lower reach of Pine Creek (Read Environmental & Planning Associates Ltd., 1982). Again, these may be mis-identified pink salmon.

4.3.3 Fish Abundance

Coho salmon

Adult coho migrate from the ocean to their natal stream to spawn in the fall, after spending two to three years in the ocean. Coho spawn later in the season than other species of Pacific salmon (Sandercock, 1991). Adults destined for the Telkwa watershed generally ascend the Bulkley River in October, and spawning has been observed from late October into December (Bustard, 1982). Peak spawning for the Telkwa River generally occurs in mid to late

November (Bustard, 1982; Saimoto pers. com.). Coho generally spawn in coastal streams, and in some small tributaries to major water bodies.

Coho have been reported as one of the least particular of Pacific salmon in terms of spawning habitat characteristics. Gravel size can vary from fine gravel to cobble, and flow may be between 0.30 and 0.55 m^3/s. Females generally select a redd site at the head of a riffle area. Coho are semelparous (one time spawners). Fry emerge from the gravel between March and June, generally around April and May (depending on time of spawning and incubation temperature). It has been estimated that 15% to 27% is the average survival to emergence. Young fry prefer slower moving water, and generally congregate in side channels, quite backwaters, and small creeks with good cover and shade (Sandercock, 1991). Areas ponded by beaver activity can be of prime importance for coho rearing habitat, as are the many small tributaries to large systems (Finnegan pers. com., Saimoto pers. com.).

As fry become older, they move into progressively faster water, and become increasingly territorial. The majority of fry rear in streams, although some may migrate a considerable distance upstream to rear in the littoral areas of lakes. The abundance of coho in streams directly reflects the availability of suitable territories for fry.

More structurally complex streams (e.g. boulders, sweepers, log jams, cut banks, overhanging vegetation) support larger numbers of juvenile coho. Juvenile coho generally overwinter in deep pools, and prefer areas of high cover. Intra-specific aggression during winter months is low.

Coho smolts migrate downstream in the spring, generally at ages one to three (Sandercock, 1991). Wild coho smolt enumeration at Toboggan Creek, a tributary to the Bulkley River just south of the town of Smithers, B.C., indicates that coho smolts migrate with spring high flows in May/June. Coho smolts are two to three years old, with the majority of smolts being two years old (Saimoto, 1995, 1996a).

Of the salmonids identified in the Project area, coho salmon is the most significant species for the Telkwa watershed. Historical escapement estimates (1960's - 1989) ranged between 100 and 1200 coho annually (SISS); however, coho escapement estimates are considered to be crude due to the extended spawning season of the species, and the late timing of spawning (October to December). Coho carcasses have been reported in Howson Creek, Goathorn Creek (probably mis-identified pinks (Bustard, pers. com.)), Pine Creek and the mainstem Telkwa (Read Environmental & Planning Associates Ltd. 1982). Aerial surveys for coho spawners have been conducted from Howson Creek to upstream of Elliott Creek to a site where the elevation of the Telkwa River exceeds 780 masl. These surveys were conducted in two consecutive years (1994 and 1995)

Coho counts in the Telkwa system were conducted on three dates in 1994 and ranged between 239 and 643. Only one count was conducted in 1995, in which 178 coho were counted by helicopter (Saimoto, pers. com.). The number of coho observed during aerial reconnaissance is an underestimate of the number of spawners actually present due to the presence of cutbanks, sweepers and log jams, and ice.

Bustard (1983a) undertook an extensive study to document the use of the Telkwa River by coho salmon in 1982. The study focussed on Goathorn/Tenas Creeks and Pine Creek. No juvenile or adult coho were found in the Goathorn/Tenas systems, or in Pine Creek (Bustard, 1983a, Bustard, 1984). However, coho was the most abundant species captured in a juvenile survey conducted in Helps and Hubert Creeks (Bustard, 1984).

Pink Salmon

Overall, pink salmon is the most abundant of the five species of Pacific salmon. Unlike other species in the same genus, pink salmon exhibit a fixed two year life span, with odd and even year stocks being genetically distinct. Run strength in southern B.C. is stronger for odd years. The reverse is true for northern stocks. Pink salmon do not migrate far off shore due to their short residency in the ocean.

Adults congregate near shore between June and September, with peaks from July to September for British Columbia stocks. Spawning occurs mainly in September and October. Pink salmon select spawning beds with substrates of relatively uniform size. Spawning beds are located on riffles with clear gravel or along the transition from pool to riffle in shallow areas with fast current. Water depth is generally between 30 and 100 cm, but can be found in areas as shallow as 10 to 15 cm in dry years. Current velocities range between 30 and 100 cm^3/s directly over the redds.

The redds are located in areas of coarse gravel with ew large cobbles, some sand and a low amount of silt. Females generally guard their redds for up to eight days prior to dying. Emergence occurs five to eight months after egg deposition (depending on temperature). Egg to fry survival in productive streams has been estimated as 10% to 20%. Upon emergence and achieving neutral buoyancy, fry immediately migrate downstream. Pink salmon generally have the shortest freshwater residency of any species of pacific salmon (Heard 1991).

Escapement data on pink salmon are relatively scarce. Some of the reported coho information probably refers to pinks. This is in part inferred from the timing of reported coho sightings (Bustard pers. com; Read Environmental & Planning Associates Ltd., 1982). Pink escapements in systems upstream of Moricetown canyon appear to have increased since the installation of fish ladders at the canyon (1950) (Read Environmental & Planning Associates Ltd., 1982).

Bustard (1983b) conducted a study to document the distribution of pink spawning in the lower Telkwa watershed. Adult pink salmon were observed in the lower 600 m of Goathorn Creek, all sections of the Telkwa River examined (below Pine Creek), Pine Creek and Howson Creek. A crude estimate of between 500 and 1000 pink spawners for the lower Telkwa River and tributaries was established for 1983, one of the two largest pink runs on record up to that date.

Steelhead

Steelhead trout is the anadromous life history form of rainbow trout. Unlike pacific salmon, steelhead are repeat spawners. Steelhead ascend the rivers after spending between one to four years in the ocean (McPhail & Lindsey, 1970). Two types of steelhead are distinguished between winter run and summer run (Leider *et al*, 1986). These two types are genetically distinct (Parkinson, 1984).

Summer run steelhead enter freshwater and migrate upstream in June to August. They overwinter in freshwater, and ascend their natal stream prior to spawning in the spring (generally March to May). Winter run steelhead move into freshwater a few months to a few weeks prior to spawning, but generally begin entering freshwater in mid-winter (Leider, 1985). The Telkwa stock is a summer run steelhead stock (Spence, 1989). Steelhead spawner studies in the upper Sustut River indicate that steelhead spawning habitat consists of gravel or gravel pockets interspersed with boulders and cobbles. The timing of spawning is dependent on temperature and water conditions (Bustard, 1993). Juveniles spend from one to four years in freshwater in the south (McPhail & Lindsey, 1970) and two to five years in the north, with the peak age at smolting being two years. Smolts migrate to sea in May to June. Fry are generally found in faster, riffle habitat (Saimoto pers. com).

Estimates of steelhead abundance for the Telkwa have not been conducted. A majority of the summer-run steelhead utilizing the system appear to over winter in the Bulkley just downstream of Telkwa, although some steelhead have been observed overwintering in the mainstem Telkwa (Read Environmental & Planning Associates, 1982). In a survey of juvenile fish in Goathorn and Tenas Creeks, and the lower Telkwa River, Bustard (1984) established that juvenile steelhead were the most abundant species in Goathorn Creek and Tenas Creek, comprising about 70% and 93% of the catch respectively. Bustard (1984) acknowledges the possibility of a population of resident rainbow trout in the Goathorn and Tenas systems. Thus, the number of juvenile steelhead reported may actually be a mix of juvenile steelhead and rainbow trout.

Chinook Salmon

There are two races of chinook salmon: ocean-types and stream-types. The stream-type is generally found in Asia, and in northern portions of the species' distribution, as well as headwater tributaries in the southern portion of the species' range. The ocean-type encompasses most North American populations south of 56^{o}N.

The Telkwa River population is a stream-type. Stream-type chinook salmon spend at least one year in freshwater before migrating to sea. At sea, these chinook migrate quite far off shore, and return to their natal stream in spring or summers, several months prior to spawning (Healey, 1991). As with other species of pacific salmon, chinook salmon are semelparous. Chinook salmon spend two to three years at sea, although ocean residency can be as short as one year or as long as five years (Scott and Crossman, 1973).

Adult chinook salmon generally have one peak of migration to the mouths of their natal streams in northern systems. This peak usually occurs in June, but may range from April to August. Up to three peaks of migration have been observed regularly for the species further south. Spawning between mid August and late September has been reported for the Skeena River. Spawning beds chosen by chinook salmon show considerable variability. Water depths may range from a few centimetres to several metres. Individuals may spawn in tributaries (two to three m wide) or in mainstems of rivers. Water velocity can range between 10 and 150 cm^3/s, with stream-types generally preferring deeper and faster water. Chinook spawn in gravel substrate, but particle size is generally larger than for coho or pinks. However, provided subsurface flow is good, chinook will spawn in varying water depth, particle size and water velocity.

Egg to fry survival is variable, and is generally 30% or lower (Healey, 1991). Fry emerge in the spring (Scott and Crossman, 1973), and are displaced or migrate for some distance downstream. Fry then reside in the river for one year or longer. Chinook mainly rear in riverine habitat, and less frequently in beaver ponds or off channel habitats. Stream-type chinook delay seaward migration until the spring following emergence, or the spring thereafter (Healey, 1991).

Few juvenile chinook have been captured in the lower Telkwa River (Bustard, 1985). The presence of chinook salmon has been documented for the Bulkley River (FISS; Bustard, 1985), and a few chinook fry have also been captured in Hubert Creek (Bustard, 1984). No escapement estimates exist for chinook in the Hubert Creek system, or the Telkwa River. The lower portion of Hubert Creek is likely the only section utilized by this species. Bustard (1984) speculated that the three juvenile chinook captured in his study of juvenile salmonids entered the lower Hubert Creek area from the Bulkley River. All three fish were captured within 100 m of the Bulkley River. No juvenile chinook were captured in the upper Helps or upper Hubert creeks in 1983 (Bustard, 1984). Bustard speculated that the few chinook caught in the lower Telkwa River may originate from the Bulkley River, although the possibility exists that a few chinook move into the Telkwa River to spawn in some years (Bustard, 1985).

Dolly Varden Char and Bull Trout

Dolly Varden char and bull trout have traditionally been considered to be the same species. However, recent studies have shown that morphometric and meristic differences occur between Dolly Varden char and bull trout, and the two are now considered to be separate species (Haas and McPhail, 1991; Ford *et al*, 1995). The two species occur in sympatry in the Bulkley Valley (Haas and McPhail, 1991).

Literature on both species is scarce. Bull trout are iteroparous (Ford *et al.,* 1995), and are known to spawn in flowing waters in smaller rivers and tributaries, but avoid larger, higher order streams (McPhail and Baxter, in prep). Spawning sites tend to be characterized by relatively gentle gradient, small gravel and low water velocity. Water depth over redds varies from 10 to 50 cm. Bull trout are fall spawners, and fry emerge in the spring. Most juveniles rear in streams and utilize pool and riffle habitat, although they appear to prefer pool habitat in some systems. Adult bull trout exhibit several different life history strategies.

Bull trout may be fluvial-adfluvial (adults live in large rivers and spawn in small streams), stream resident (non-migratory) or lacustrine-adfluvial (adults live in lakes, spawn in streams, and young rear in streams) (Ford *et al*, 1995). Anadromy is suspected in southern British Columbia (McPhail and Baxter, in prep). Sexual maturity is generally reached by five years of age (Ford *et al*, 1995). Information for Dolly Varden char presented in Scott and Crossman (1973) is somewhat confusing, since the species distinction between Dolly Varden char and bull trout had not been established. Scott and Crossman (1973) consequently lumped information for bull trout and Dolly Varden char.

Dolly Varden char are iteroparous fall spawners, and spawning generally occurs between November and December. Dolly Varden char may be resident or anadromous. Dolly Varden char in the Telkwa watershed are resident. Emergence of fry occurs in the spring. Juveniles rear in streams for three to four years, and adults mature in lakes or in streams (Scott and Crossman, 1973).

An extensive distribution of Dolly Varden char has previously been documented throughout the Telkwa watershed (FISS). This is particularly true for Goathorn Creek, where the presence of Dolly Varden char has been documented into the headwaters (Bustard 1984, FISS). Some, if not all of these observations may actually be bull trout. The two species are very similar, and are often difficult to distinguish, particularly for small specimens.

A recent study conducted by Bustard and Associates (pers. com.) identified bull trout in all three sample sites established in the Goathorn system. No other sampling for bull trout was conducted in the Telkwa Watershed at this time. This cursory study indicated that the Goathorn sites presented one of the highest abundance of bull trout of all sites sampled in the Skeena watershed study. Since bull trout is currently a Blue-listed species, this area is of particular management concern for the conservation of bull trout. Bull trout are ranked as rare or uncommon on a global and provincial basis, and may be susceptible to large scale disturbances (British Columbia Conservation Data Centre, 1995).

Other species

No abundance estimates have been established for other species recorded for the Project area, or within the vicinity of the Project area. These include cutthroat trout, mountain whitefish, and peamouth chub (FISS). Mountain whitefish was the second most abundant species captured in a study of juvenile fish conducted by Bustard (1984) in the lower Telkwa River. A single mountain whitefish was captured in the lower Goathorn and Tenas Creeks in 1984 (Bustard, 1985). Resident rainbow trout may be present in the Telkwa system, although their presence has not been documented (Bustard, 1984).

Longnose suckers (*Catastomus catastomus*), longnose dace (*Rhinichthys cataractae*) and cutthroat trout have been recorded in Hubert and Helps Creeks.

4.3.4 Fish Habitat

Detailed descriptions of fish habitat in the Telkwa Project Area have been compiled by Bustard (Read Environmental and Planning Associated Ltd., 1982; Bustard, 1984, 1985). The following is a brief description of habitat characteristics documented for the Project area. Fish habitat species documented in each of the systems examined is summarized in Table 4-1.

Juvenile coho salmon have been reported in Goathorn, Pine and Howson Creeks as well as in the upper Telkwa River (upstream of Sinclair Creek), indicating that these areas have suitable rearing habitat for the species. The presence of coho in Goathorn Creek should be questioned, as pinks may have been mis-identified as coho (Bustard, pers. com.) The presence of wetlands and side channels along the mainstem Telkwa downstream of Goathorn Creek, and in the upper Telkwa, provide excellent rearing habitat, although the use of these habitats by coho has not been established (Read Environmental and

Planning Associates Ltd., 1982).

Bustard (1983a) reported that less than 1% of the substrate in the lower nine km of Goathorn Creek was suitable for coho spawners. The substrate was generally deemed too large in this area. The lower nine km of Goathorn Creek also appeared to offer little rearing habitat, due to a notable lack of side channels and off channel rearing habitat. A beaver dam located 600 m upstream of the confluence of Goathorn Creek with the Telkwa River may have been impassable to coho at the time of the spawner surveys. Coho carcasses were recorded in 1975, but the number of coho carcasses recorded, and the nature of the habitat present in the lower section of Goathorn Creek suggest that the use of this system by coho is limited (Bustard 1983a).

The benthic invertebrate community in Goathorn Creek was predominantly composed of species belonging to the orders Ephemoptera and Plecoptera (Bustard, 1984, 1985). Benthic Invertebrate samples throughout Goathorn Creek indicated that species richness was the highest in the headwater areas, and was lowest approximately 1.2 km downstream of Four Creek (Bustard, 1984, 1985). The significant difference in the mean abundance of invertebrates did not appear to affect fish biomass (Bustard, 1984). Bustard (1984) did not establish a causal relationship between the presence of the minesite and the reduced abundance in benthic invertebrates.

The lower 8.5 km of Tenas Creek were surveyed for coho spawners in the fall of 1982. Low discharge and formation of subsurface ice were noted during the study period. Bustard (1983a) speculated that spawning habitat present in Tenas Creek may be utilized by spring spawning steelhead rather than fall spawning coho due to spring high flows allowing for easier access to spawning sites. Tenas Creek had consistently higher productivity for benthic invertebrates than Goathorn Creek or the lower Telkwa in 1983 (Bustard, 1984). Tenas Creek also exhibited the highest juvenile fish density of the streams sampled by Bustard (1984).

Less than 1% of the substrate in the lower 13.5 km of Pine Creek was deemed suitable for coho spawning (Bustard 1983a). A four metre barrier located 2.5 km upstream from the Telkwa River was reported, and gradients below this barrier were higher than 2%. The substrate in the portions of Pine Creek accessible to coho was generally too large to be suitable for spawning. Bustard (1983a) indicated that the previous records of coho spawners and carcasses in September 1975 (Read Environmental and Planning Associates Ltd., 1982) were likely pinks due to the timing and number of individuals reported.

The lower three km of Howson Creek were also examined by Bustard (1983a). This section of creek appeared to offer more coho spawning habitat than Goathorn, Tenas or Pine creeks. Coho rearing habitat was also noted in the lower 1.5 km of Howson Creek. Cursory fish sampling indicated that few coho juveniles were present upstream of 0.5 km, but steelhead fry (possibly rainbow) were dipnetted from marginal areas up to two km upstream of the Telkwa mainstem. This indicates that Howson Creek may be more important for steelhead spawning and rearing than for coho (Bustard 1983a). Dolly Varden (possibly bull trout) were observed spawning in the lower sections of Howson Creek in the fall of 1982 (Bustard, 1983a).

Extensive use of coho spawning and rearing habitat in the upper Telkwa (near Elliott Creek) was observed by Bustard (1983a) and Saimoto (1994 and 1995). Bustard (1983a) attributes the higher use of this area to the lower gradient streams providing for more suitable substrate, and higher water temperatures due to higher groundwater influence in this area.

Table 4-1 Summary of Types of Habitat Present in the Different Systems Examined.

All salmonids found in each of the systems is listed. U indicates unknown, + indicates habitat is present, - indicates habitat is not present.

	Spawning	Juvenile Rearing	Overwintering/ Holding
Telkwa River			
Chinook Salmon	U	+	N/A
Coho Salmon	+	+	N/A
Pink Salmon	likely	N/A	N/A
Steelhead Trout	+	+	+
Cutthroat Trout	U	U	U
Dolly Varden or Bull Trout	U	likely	likely
Mountain Whitefish	likely	likely	likely
Peamouth Chub	likely	likely	likely
Hubert Creek			
Chinook Salmon	U	+	N/A
Coho Salmon	+	+	N/A
Steelhead Trout	likely	+	U
Cutthroat Trout	U	likely	U
Longnose Sucker	U	likely	U
Longnose Dace	U	likely	U

Helps Creek			
Chinook Salmon	-	U	N/A
Coho Salmon	+	likely	likely
Cutthroat Trout	+	likely	U
Longnose Sucker	likely	likely	likely
Longnose Dace	likely	likely	likely
Goathorn Creek			
Coho Salmon	-	+	N/A
Pink Salmon	+	N/A	N/A
Steelhead Trout	+	+	U
Dolly Varden or Bull Trout	U	likely	U
Mountain Whitefish	U	likely	U
Tenas Creek			
Coho Salmon	-	U	N/A
Steelhead Trout	+	+	U
Dolly Varden or Bull Trout	U	likely	U
Mountain Whitefish	U	U	U

Cabinet Creek			
Dolly Varden or Bull Trout	U	likely	U
Pine Creek			
Coho Salmon	-	+	N/A
Pink Salmon	+	N/A	N/A
Cutthroat Trout	likely	likely	likely
Dolly Varden or Bull Trout	likely	likely	U
Mountain Whitefish	likely	likely	likely
Howson Creek			
Coho Salmon	+	+	N/A
Pink Salmon	+	N/A	N/A
Steelhead Trout	+	+	U
Dolly Varden or Bull Trout	+	likely	U

The use of the Telkwa mainstem between 30 and 46 km upstream of the Bulkley River by coho spawners has been well documented (Bustard 1983a). Potential coho spawning habitat has also been identified in the lower Telkwa River, downstream of Goathorn Creek, although no fish were observed in this area in 1982 (Bustard 1983a). This may have been due to poor conditions, and the variable timing of coho spawning.

Steelhead holding habitat has been identified in a telemetry study conducted by B.C. Environment (Read Environmental and Planning Associates Ltd., 1982). Although the telemetry study was small scale, results indicated that steelhead generally over-wintered in the area downstream of Pine Creek. The study also indicated that spawning habitat in Tenas Creek was being utilized by steelhead. Bustard (1984) established the presence of a small number of juvenile steelhead trout (possibly rainbow trout) up to five km upstream in Goathorn Creek, suggesting that steelhead likely spawn in Goathorn Creek.

The presence of fish habitat in Hubert and Helps Creek has been documented in Bustard (1985). The lower reaches of Hubert Creek exhibit low gradient and an extensive network of ponded sections (Bustard 1985). Habitats with these characteristics are often used by rearing coho. The mid-reaches of Hubert Creek

tend to be primarily utilized by a resident population of cutthroat trout, and, to a smaller extent, a resident population of Dolly Varden char (possibly bull trout). Beaver activity was indicated as a main hindrance for coho utilizing the extensively ponded section in Hubert Creek (Bustard 1985). Coho spawning habitat is limited to a 200 m long section of poor quality spawning gravel in the lower section of Hubert Creek. Steelhead habitat is sparse in the lower section of Hubert Creek (Bustard, 1985).

A study conducted by SKR Consultants Ltd. (1996b) investigated the relative amount and severity of logging related impacts on fish, fish habitat and riparian areas in the Telkwa valley (including the Telkwa Project Area) by examining selected sites near or in cutblocks and road crossings. Fish, fish habitat and riparian areas in the Goathorn drainage did not appear to have been heavily affected by logging related activities, although some moderate and minor negative impacts related to logging roads, and some major, moderate and minor impacts related to blocks were identified. In the Pine Creek area, some moderate impacts on fish, fish habitat and riparian areas due to past logging related activities were identified. Despite the fact that the Hubert Creek/Coffin Lake area was identified as one of the most heavily logged sub-units in the study, this sub-unit did not exhibit any major impacts of logging on fish. However, a large number of moderate and minor impacts were noted in this sub-unit. Impacts recorded in the study for these systems ranged from inadequate road crossings, increased sedimentation, destabilization of slopes, and removal of riparian cover. Fish sampling was not conducted in the study.

4.3.5 Discussion

The Telkwa Coal Project has received a considerable level of attention over the last 14 years. Several studies document the presence of important fisheries resources in the Telkwa watershed as a whole. The Telkwa River is known to be a relatively important coho producer (Atagi, pers. com., Finnegan pers. com.), and provides important coho rearing and spawning habitat (Bustard 1982). Goathorn Creek, Tenas Creek and Pine Creek are not noted to be of prime importance to coho in the Telkwa watershed. Fish sampling has indicated the presence of juvenile steelhead (possibly rainbow trout) and Dolly Varden char (possibly bull trout) in these systems. In addition, pink salmon are known to spawn in the lower Goathorn (Bustard, 1983a), and are suspected to spawn in other tributaries to the Telkwa River.

The overall importance of the Telkwa River for commercial, recreational, and native fisheries is difficult to assess. This watershed is unquestionably important for fisheries resources, and it influences important fisheries resources downstream in the Bulkley River. The Telkwa River itself is not of major importance to the sport fishery due to its relatively high sediment load and turbid water conditions but fish destined for the Telkwa River are undoubtedly caught in the mixed stock sport and native fishery downstream (Atagi pers. com.). Steelhead harvest analysis statistics indicate that the Telkwa River itself is not used extensively by sport fishermen (Table 4-2), except at its confluence with the Bulkley River.

The size of Hubert and Helps creeks precludes them from being major sport fishing streams; however, the presence of important rearing habitat, and limited spawning habitat for coho has been documented by Bustard (1985). The presence of resident cutthroat trout in the upper reaches of this system is also a fisheries concern, since cutthroat trout are a game fish and since little is known about this population.

The identification of bull trout in the region has increased efforts to distinguish this species from the very similar Dolly Varden char. A recent study documenting the distribution of bull trout and Dolly Varden char in the Skeena watershed identified the presence of bull trout in Goathorn Creek. Only a few sites, near roads, were sampled to clarify if bull trout are present in the system. The documentation of the presence of this Blue listed species clearly indicates that other sites with bull trout may have been mis-identified in the Telkwa Project area and immediately downstream.

A fisheries inventory project is currently underway in the Bulkley Forest District. Triton Environmental Consultants Ltd. has been retained by Pacific Inland

Resources (PIR) to conduct fish inventory under a Forest Renewal Project. The Telkwa Watershed has been deferred for inventory until the 1997 field season. The results of this study should give additional information on fish distribution and aquatic habitat.

Table 4-2 Summary of Steelhead Harvest Analysis for Telkwa River

(B.C. Environment, Skeena Region). Data included below are estimates based on angler surveys conducted by the Ministry of Environment.

Year	# Anglers	# Days Fished	# kept/angler day	# landed/ angler day
1967	39	194	0.52	0.52
1968	29	472	0.02	0.02
1969	13	23	0.17	0.17

1970	14	78	0.00	0.00
1971	17	57	0.07	0.07
1972	17	97	0.00	0.00
1973	23	134	0.09	0.12
1974	38	80	0.05	0.26
1975	22	114	0.04	0.06
1976	23	104	0.07	0.07

1977	19	139	0.00	0.00
1978	28	69	0.09	0.09
1979	51	279	0.07	0.09
1980	42	249	0.04	0.04
1981	66	210	0.01	0.01
1982	36	152	0.02	0.06
1983	28	126	0.03	0.08

1984	45	93	0.00	0.06
1985	44	121	0.08	0.17
1986	44	86	0.05	0.40
1987	57	231	0.07	0.22
1988	43	97	0.07	0.89
1989	21	57	0.00	0.44
1990	18	69	0.00	0.07

1991	30	160	0.00	0.19
1992	13	106	0.00	0.76
1993	11	18	0.00	1.28
1994	17	17	0.00	0.24
1995	14	51	0.00	0.00

4.4 Hydrology and Water Quality

4.4.1 Hydrology

Hydrology data have been collected for the Telkwa Project area, and surrounding area through several studies. These studies include:

• Telkwa Coal Project: Stage II Geotechnical, Hydrogeological and Hydrological Design Report. Klohn Leonoff, 1985.

• Water Quality Investigation, Telkwa Coal Project. Maclaren Plansearch, 1985.

• Baseline Data: Surface Water and Groundwater. Piteau Engineering Ltd. 1994 (Appendix 6).

The boundaries of the Project area encompasses the lower reaches of the Telkwa River, parts of Pine Creek, Goathorn Creek (and tributaries), a smaller tributary to the Bulkley River (Hubert Creek), and a portion of the Bulkley River (Figure 4-1).

The Telkwa River is a major tributary to the Bulkley River, and thus forms part of the Skeena Watershed. Over a river length of 50 km, the Telkwa River drains an area of approximately 1 120 km^2 prior to draining into the Bulkley River at the village of Telkwa, B.C. The headwaters of the Telkwa River originate at an elevation in excess of 2 000 masl.

The glacial origin of much of the Telkwa River drainage, as well as many naturally unstable banks and soils found along the drainage result in a substantial amount of sediment loading to the Bulkley River. Several major tributaries account for a large part of the volume of the Telkwa River. One of the major tributaries is Goathorn Creek, which drains into the southern shore of the lower Telkwa River (Table 4-3). Another major tributary to the Telkwa River is Pine Creek, which drains into the northern shore of the Telkwa River, approximately 14 km upstream of Goathorn Creek.

The upper reaches of Hubert Creek, and its tributary (Helps Creek), are also within the Project area. Hubert Creek drains directly into the Bulkley River, and drains an area of approximately 44 km^2.

Table 4-3 Summary of flow data at Bulkley River, Telkwa River and Goathorn Creek (Water Survey of Canada, 1996)

	WSC 08EE004	WSC 08EE020	WSC 08EE008
Station Name	Bulkley R. at Quick	Telkwa R. at Tsai C.	Goathorn C.
Coordinates	54º73'05":126º53'55"	54º36'10":127º29'42"	54º38'50":127º07'20"
Years data recorded	1930-1988	1975-1988	1960-1988
Drainage area (km^2)	7360	368	132

Mean flow	134	13.9	1.75
Max. daily discharge	957 (Jun 13,1972)	156 (Nov. 1, 1978)	40.8 (May 20, 1968)
Min. daily discharge	11.38 (Feb. 25, 1980)	0.680 (Apr. 2, 1982)	0.052 (Feb 22, 1986)
Max. Instant. discharge	not available	239 (Nov. 1, 1978)	51.5 (Sep 29, 1988)

(Flow in m^3/s)

4.4.2 Water Quality

Water quality data were compiled from records located at the Environmental Protection Branch of B.C. Environment, Skeena Region. Reports located in the B.C. Environment library were researched. Knowledgeable consultants and MELP staff were contacted to ascertain if further information may be present in the SEAM data base. A very low likelihood of additional information in the SEAM data base was indicated (Rhebergen pers. com., Remington pers. com.), and the database was not consulted. Water quality data summarized in this report were compared to standards established by the Canadian Council of Resource and Environment Ministers (1987) and Pomment & Swain (1995).

Water quality sites referred to in this report are located on Figure 4-1 and Appendix 6. The Water Management Branch of B.C. Environment was contacted to document consumptive use of water in the Project area. Water rights maps and water licence information were researched.

Water Quality

The following sections summarize water quality results, and the interpretations given in several reports, particularly for chemical constituents of interest for mining development. Provincial (Nagpal, 1995) and federal (Canadian Council of Resource and Environment Ministers, 1987) water quality guidelines for drinking water and aquatic life were used to evaluate water quality data summarized in this report. The applicable water quality criteria are listed in Tables 4-4 and 4-5.

The Telkwa River is naturally turbid (Beaudry *et al.*, 1991). Some natural sediment sources were identified in a study conducted by SKR Consultants Ltd. (1996b) in the lower reaches of the Telkwa River. A large section of unstable banks just upstream of the Howson Creek confluence appeared to contribute a substantial amount of sediment, along with some smaller sections of unstable banks. The glacial nature of the system was particularly evident at the confluence of Milk Creek (SKR Consultants Ltd., 1996b).

The lower section of Goathorn Creek was found to be naturally unstable in an overview flight conducted by SKR Consultants Ltd. (1996b). The lower 12 km of Tenas Creek (a major tributary to Goathorn Creek) were also found to be naturally unstable (SKR Consultants Ltd., 1996b), and were identified as a major

sediment source to Goathorn Creek (highest concentration recorded in study = 1 177 mg/L on May 28, 1990) (Beaudry *et al.,* 1991). In addition to natural sources of sediment in both Goathorn and particularly Tenas Creeks, a few slides related to or caused by timber harvesting were identified (SKR Consultants Ltd., 1996b). Goathorn, and particularly Tenas Creek, contribute some sediment to the Telkwa River during rainfall events (Beaudry *et al.,* 1991).

In a study conducted on suspended sediment in the Telkwa watershed, Beaudry *et al*. (1991) found that Pine Creek is the most important chronic sediment source for the Telkwa watershed during spring run off. Goathorn and Tenas Creeks were also identified to be sediment sources during rainfall events. Glacial silt contributed to the "milky" colour of the Telkwa River during warmer summer temperatures, as a result of meltwater from glaciers.

Crows Nest Resources Ltd. (1983) summarized the results of water quality measurements up to and including 1983. Runoff regimes of relevant Water Survey of Canada stations were summarized in the report. The Telkwa River generally exhibits periods of high flows in the spring and fall (Beaudry and Schwab, 1991).

Surface water quality analysis conducted for the same study (June 9 -11, 1983) indicated that dissolved aluminum is within the provincial and federal water quality guidelines. Total iron levels exceed those laid out in the provincial and federal water quality guidelines for drinking water and aquatic environment at five of the 12 stations examined. These sites were at Goathorn Creek below the mine, at two sites in the Telkwa above Goathorn Creek, at Hubert Creek and at the Bulkley River below Hubert Creek. Manganese exceeded concentrations laid out in federal and provincial water quality criteria at one of the 12 sites examined (Bulkley River below Hubert Creek).

Historic water quality data (1975-76) for Goathorn Creek and the Telkwa River presented in Crows Nest Resources Ltd. (1983) indicate that mean natural levels of total iron exceed federal and provincial water quality criteria. Calcium appears to be naturally high, indicating a good buffering capacity. Goathorn Creek calcium levels exceeded 20 mg/l, indicating a good buffering ability.

Wilkes and Lloyd (1990) summarized water quality data collected for eight rivers in the Skeena watershed. Two of the eight sites may serve for background data for water quality for the Telkwa Coal Project. These are site 0920088 (Bulkley River at Quick) and site 0400187 (Telkwa River). Water quality data were collected between 1982 and 1988 at Bulkley River at Quick station, and between 1983 and 1988 for the Telkwa River.

Mean turbidity (5.9 NTU) readings at the Bulkley River at Quick site fell below the drinking water criteria set in provincial and federal water quality guidelines (Nagpal, 1995; Canadian Council of Resource and Environment Ministers, 1987); however, the maximum level (37 NTU) exceeded water quality guidelines. Maximum levels recorded for dissolved aluminum at this site (2.9 mg/L) were also higher than those stipulated in provincial water quality criteria for drinking water and aquatic life. Mean total iron concentrations (0.53 mg/L) were higher than federal and provincial water quality criteria for drinking water and aquatic life. Maximum total phosphorus concentrations (0.138 mg/L) exceeded provincial criteria for drinking water and aquatic life.

Similar results were found at the station on the Telkwa River. Maximum turbidity measurements (180 NTU) exceeded those at the Bulkley River at Quick and, in doing so, exceeded provincial and federal guidelines. Mean turbidity (12.38 NTU) was also higher than provincial and federal water quality guidelines for drinking water. Maximum dissolved aluminum (0.22 mg/L) exceeded provincial water quality criteria for drinking water and the aquatic environment, although mean measurements (0.067 mg/L) were below accepted standards. Mean and maximum total iron (0.99 mg/L) and total manganese (0.05 mg/L) were higher than provincial and federal guidelines for water quality of drinking water and for the aquatic environment. Maximum zinc (0.08 mg/L) concentrations recorded exceeded provincial criteria for the aquatic environment.

MacLaren Plansearch Services Ltd. (1985) conducted a water quality study for Crows Nest Resources Ltd. in the Telkwa Coal Project area. This report summarized water quality data obtained from 12 surface water sample locations, 24 wells and three piezometer stations**.** Surface water qualities appeared

"typical to natural conditions in a pristine aquatic environment" (MacLaren Plansearch Services Ltd., 1985), although relatively elevated amounts of nitrogen were found (from a water quality perspective). pH reflected the alkaline nature of the local soil and bedrock. Elevated levels of some parameters (pH, total dissolved phosphates, total chromium, dissolved chromium, iron, mercury, zinc, ammonia nitrogen) were found occasionally, but these levels were reportedly not widespread or persistent. Toxic levels of mercury were found at three locations on the same date, and iron concentrations were generally high in most locations. Iron was considered to be present at elevated levels due to the proximity of sampling stations to sulphide ores. Although nitrate and nitrite were present in very low concentrations, ammonia nitrogen levels were high in surface waters, exceeding acceptable levels for drinking water and fresh water aquatic life on numerous occasions.

When comparing the data summarized in MacLaren Plansearch Ltd. (1985) to provincial and federal water quality guidelines (Nagpal, 1995; Canadian Council of Resource and Environment Ministers, 1987), trends found in water quality conducted by Crows Nest Resources Ltd. (1983) and Wilkes & Lloyd (1990) are again observed. Surface water quality exceeding criteria set by provincial and federal agencies consisted of total iron, dissolved aluminum, manganese, pH, chromium, mercury and zinc. Hubert Creek was consistently high in total iron and manganese, with concentrations exceeding federal and provincial water quality criteria for drinking water and aquatic environment.

The Telkwa River had consistently high iron concentrations, but manganese was only found to exceed provincial and federal standards in two months. Other sites also had high iron and manganese concentrations, but not as frequently as Hubert Creek. These included Cabinet Creek, Tenas Creek, Goathorn Creek, Four Creek, Bulkley River (upstream and downstream of Hubert Creek), and the Telkwa River upstream and downstream of Goathorn Creek. Aluminum was also found at concentrations higher than those accepted for drinking water and aquatic habitat. Aluminum was high in April to August for several of the sites examined. pH was within the accepted range, and tended to be basic. Alkalinity and calcium concentrations tended to be high, indicating a good buffering capacity. However, pH in the Bulkley River in February 1983 was found to be slightly below accepted levels, and calcium concentrations were low at the same time (1.08 mg/L).

Further water quality sampling for groundwater and surface water in the Telkwa Project area was undertaken by Piteau Engineering Ltd. (1994) in September 1993, and April 1994 (Appendix 6). In addition to sites previously sampled by MacLaren Plansearch Ltd., Piteau sampled sites on the north side of the Telkwa River. Piteau (1994) also summarized previous water quality data.

As in studies previously summarized, the Piteau sampling found iron in surface water at concentrations exceeding federal and provincial guidelines for drinking water and the aquatic environment at most of the locations sampled. Only one location sampled by Piteau (Goathorn Creek downstream of Tenas Creek) was found to have total iron concentrations below 0.3 mg/l, but previous data for the same site indicated that iron concentrations at this location were also high. Calcium and alkalinity were found to be high, indicating a good buffering ability of the systems sampled. Aluminum, chromium , zinc, copper, manganese, nickel and silver were detected at concentrations higher than federal and provincial water quality standards on a creek sampled on the north side of the Telkwa River (Tailings Pond Creek).

The Telkwa River at Telkwa had higher iron and copper concentrations than those stipulated in federal and provincial water quality guidelines. The Bulkley River downstream of Telkwa had elevated concentrations of aluminum, chromium, iron, manganese and zinc. Aluminum, copper, iron, manganese and zinc exceeded federal and provincial guidelines in the Bulkley River downstream of Tailings Pond Creek. Iron concentrations were also elevated in Goathorn Creek, and in the Telkwa River upstream of Goathorn Creek, exceeding federal and provincial water quality guidelines.

Surface water quality sampling of the Pit 3 reclamation plot by SKR at Goathorn Creek near its confluence with Four Creek showed higher levels of ammonia nitrogen, total iron, manganese, nitrite and sulphate. Concentrations of some chemical parameters measured appeared to be higher in spring than in the fall. These parameters included aluminum, copper, chromium, iron, manganese and zinc. The source of these elements was not identified, but was

speculated to be due to a higher level of total suspended solids. Since the analysis was for total metals in some of these cases, higher amounts of suspended solids was speculated to account for some of the elevation in concentration of the parameters which showed seasonal variations.

Analysis of tissue from fish taken in 1994 as summarized in Piteau (1994), showed that none of the seven trace elements analysed (arsenic, antimony, cadmium, chromium, nickel, lead and selenium) were detected, and none exceeded provincial criteria for trace metal concentrations.

Coincident with a periphyton study conducted in 1983 and 1984 (Bustard, 1984, 1985), some water quality analysis was conducted for Goathorn Creek at 1.1 km upstream of the Telkwa River and 700 m upstream of Four Creek. Conductivity, total dissolved solids, alkalinity and nutrients (phosphorus and nitrogen) were recorded for the study sites. Periphyton consisted almost exclusively of diatoms. A low N:P ratio (below 6.7) was found for both years of the study in the lower Goathorn Creek. Goathorn Creek was found to be deficient in nitrogen (from a fisheries perspective), and exhibiting rates of nitrogen accumulation near the lowest value reported for extreme nutrient deficient streams in B.C. (Crows Nest Resources Ltd., 1985; Bustard, 1985). Water quality analysis also indicated that the system's nutrient levels indicated low productivity (MacLaren Plansearch Services Ltd., 1985).

Benthic invertebrates can be used to indicate water quality. Extensive sampling of benthic invertebrates was conducted in 1983 and 1984 (Bustard, 1984, 1985) for Goathorn and Tenas Creeks and the lower Telkwa River. Bustard (1985) summarized the tolerance of the different taxa of benthic invertebrates in the Project area and indicated the value of comparing biotic condition indices over time and space to document impacts on the aquatic environment.

Bustard (1985) conducted fish tissue analysis for sites in the Telkwa Project area. Steelhead (possibly rainbow) and Dolly Varden char (possibly bull trout) fish samples were collected along Goathorn Creek (1.2 km downstream of Four Creek), and at one site in Tenas Creek (3.6 km upstream of Goathorn Creek). These were analysed for cadmium, lead, arsenic, zinc, copper, iron, aluminum and 17 more elements. Water quality samples were also collected at the same sites.

Results of the fish tissue analyses indicated that fish of all species, at all sites had relatively similar levels of arsenic, copper, and zinc. Tenas Creek fish exhibited a higher level of cadmium than fish captured in Goathorn Creek. Fish taken below the minesite in Goathorn Creek had higher levels of lead, aluminum and iron than those taken at other sites. These slight differences were not reflected in the water quality analysis. Overall, the metals concentration in fish tissue was comparable to those for other nearby systems (Bustard, 1985).

Consumptive Use of Water

Most of the water for consumptive use in the Telkwa area is obtained from wells. These wells tap the alluvial deposits adjacent to the Telkwa River and the Bulkley River. Several residents north and east of the proposed minesite obtain their water from wells near the confluence of Goathorn Creek and the Telkwa River (Crows Nest Resources Ltd., 1983; MELP water management files). The Village of Telkwa has water rights to the water in the area. An intake in the Bulkley River at the Village of Telkwa was noted in MELP water management files.

4.4.3 Discussion

Water quality data collected for the Telkwa Project area and vicinity indicates that surface and groundwater are highly variable, and naturally high in iron, manganese and dissolved aluminum. Iron concentrations set for drinking water are determined based on aesthetic criteria. The oxidized form of ferrous iron

(Fe^{2+}) is ferric iron precipitate which may settle on the bottom of stream beds and form a cement like material, potentially rendering previously suitable spawning and rearing habitat unsuitable to fish. Loose flocs of iron hydroxides may decrease water clarity, and prevent primary production in waters. In anaerobic environments, iron may react with hydrogen sulphide to form ferrous sulphide, which yields a black mineral mud (Canadian Council of Resource and Environment Ministers, 1987).

Manganese concentrations acceptable for drinking water are also primarily based on aesthetics, although elevated concentrations of manganese can have possible health concerns.(Canadian Council of Resource and Environment Ministers, 1987).

Aluminum concentrations can be elevated by natural weathering and accelerated acidification processes. Calcium and alkalinity tended to be high in the study area, indicating a good buffering ability of the water, and pH is generally basic. At a few locations, however, lower calcium concentrations and pH levels outside recommended values indicate that pH, calcium and alkalinity should be closely monitored.

Mercury and chromium have been found at toxic levels (MacLaren Plansearch Ltd., 1985). Chromium is usually present in two forms, one of which is essential to human life (Cr III) and one of which has detrimental effects (Cr VI). The hexavalent form of chromium is more mobile than the trivalent form, and is bio-accumulated, but appears not to be bio-magnified in the food web (Canadian Council of Resource and Environment Ministers, 1987). Mercury is toxic to humans, and the acceptable level of all forms of mercury in the water is 1 mg/L (Canadian Council of Resource and Environment Ministers, 1987).

Zinc was found to exceed provincial and federal water quality standards. These standards for drinking water quality are based on aesthetics. Zinc is found to be bio-accumulated in aquatic environments (Canadian Council of Resource and Environment Ministers, 1987).

Remington (pers. com) conducted a detailed summary of water quality data in the Skeena watershed. This study was funded by Green Plan, and should be published by early 1997. The study should be consulted once available to confirm further background information.

Table 4-4 Water Quality Criteria, B.C. Environment, 1995

Parameter	Drinking water	Aquatic Environment

Alkalinity (mg/L)		< 10, highly sensitive to acid inputs 10-20, moderately sensitive >20, low sensitivity (see calcium for sensitivity to acid input; the more restrictive of calcium and alkalinity applies)
Aluminum (mg/L)	0.2	0.1 (at pH> or = 6.5)
Ammonia Nitrogen (mg/L)		
Antimony (mg/L)	6	50
Arsenic (mg/L)	50	50
Beryllium (mg/L)		5.3
Bicarbonate		
Bismuth		
Boron (mg/L)	5	5

Cadmium (mg/L)	5	0.2 at hardness 0 - 60 mg/L $CaCO_3$ 0.8 at hardness 60 - 120 mg/L $CaCO_3$ 1.3 at hardness 120 - 180 mg/L $CaCO_3$ 1.8 at hardness > 180 mg/L $CaCO_3$
Calcium (mg/L)		<4, highly sensitive to acid inputs 4 - 8, moderately sensitive >8 low sensitivity (see alkalinity)
Carbonate		
Chlorides (mg/L)	250	
Chromium (mg/L)	50	2,maximum for phyto- and zooplankton 20, maximum for fish
Cobalt (mg/L)		50
Colour (Pt-Co)	15	
Conductivity		
Copper (mg/L)	500	[0.094 (hardness) + 2] where water hardness is reported as mg/L $CaCO_3$
Ferrous Iron		

Fluoride (mg/L)	1.5	0.2, maximum where water hardness <50 mg/L $CaCO_3$ 0.3, maximum where water hardness > or = to 50 mg/L $CaCO_3$
Hardness (mg/L)	> 500	
Hydroxide		
Iron (Fe) (mg/L)	0.3	0.3
Lead (mg/L)	50	3 at hardness < or = 8 mg/L $CaCO_3$; exp(1.273 ln (hardness)- 1.460) at hardness > 8 mg/L $CaCO_3$
Magnesium (mg/L)	100, taste threshold, sensitive people 500, taste threshold, average people >700, laxative effects	
Manganese (mg/L)	50	100 - 1000
Mercury (mg/L)	1.0	0.1
Molybdenum (mg/L)	0.25	

Nickel (mg/L)	200, max. (without treatment); 250, max. (with treatment)	25, max., hardness 0 - 60 mg/L $CaCO_3$ 65, max., hardness 60 - 120 mg/L $CaCO_3$ 110, max., hardness 120 - 180 mg/L $CaCO_3$ 150, max., hardness > 180 mg/L $CaCO_3$
Nitrates (mg/L)	10	200
Nitrites (mg/L)	1	0.06
Ortho-Phosphates		
pH	6.5 - 8.5	6.5 - 9.0
Phosphorus (mg/L)	10	5 - 15 inclusive (lakes only with salmonids as predominant fish species)
Potassium		
Selenium (mg/L)	10	1
Silica		
Silicon		

Silver		0.1
Sodium (mg/L)	270	
Strontium		
Sulphates (mg/L)	500	100
Suspended Solids (mg/L)		
Tin		
Titanium (mg/L)	100	100
Total Dis. Phosphorus		
Total Dis. Solids (mg/L)	500	
Total Phenolics (mg/L)		1
Total Phosphates		
Turbidity (NTU)	5	
Vanadium (mg/L)	0.1	
Zinc (mg/L)	5	0.03

Table 4-5 Canadian Water Quality Standards, 1987

Parameter	Drinking water	Aquatic Environment
Alkalinity		
Aluminum (mg/L)		0.05 (pH<6.5; [Ca^{2+}]<4mg/L; DOC<2.0mg/L) 1 (pH 6.5, [Ca^{2+}] 4.0mg/L; DOC 2.0mg/L)
Ammonia Nitrogen (mg/L)		2.2 (pH 6.5; temp. 10^{o}C) 1.37 (pH 8.0; temp 10^{o}C)
Antimony		
Arsenic (mg/L)	0.05	0.05
Beryllium		
Bicarbonate		
Bismuth		

Boron (mg/L)	5.0	
Cadmium (mg/L)	5	0.2 (Hardness 0-60mg/L) 0.8 (Hardness 60-120 mg/L) 1.3 (Hardness 120-180 mg/L) 1.8 (Hardness > 180 mg/L)
Calcium		
Carbonate		
Chlorides (mg/L)	250	
Chromium	0.05 mg/L	2.0 mg/L
Cobalt		
Colour (TCU)	15	
Conductivity		

Copper	1.0 mg/L	2 mg/L (Hardness 0-60mg/L) 2 mg/L (Hardness 60-120 mg/L) 3 mg/L (Hardness 120-180 mg/L) 4 mg/L (Hardness > 180 mg/L)
Ferrous Iron		
Fluoride (mg/L)	1.5	
Hardness		
Hydroxide		
Iron (mg/L)	0.3	0.3
Lead	0.05 mg/L	1 mg/L (Hardness 0-60mg/L) 2 mg/L (Hardness 60-120 mg/L) 4 mg/L (Hardness 120-180 mg/L) 7 mg/L (Hardness > 180 mg/L)
Magnesium		
Manganese (mg/L)	0.05	
Mercury (mg/L)	1	

Molybdenum		
Nickel		25 mg/L (Hardness 0-60mg/L) 65 mg/L (Hardness 60-120 mg/L) 110 mg/L (Hardness 120-180 mg/L) 150 mg/L (Hardness > 180 mg/L)
Nitrates (mg/L)	10.0	
Nitrites (mg/L)	1.0	0.06
Ortho-Phosphates		
pH	6.5-8.5	6.5-9.0
Phosphorus		
Potassium		
Selenium	0.01 mg/L	1 mg/L
Silica		
Silicon		

Silver	0.05 mg/L	0.1 mg/L
Sodium		
Strontium		
Sulphates (mg/L)	500	
Suspended Solids		increase of 10mg/L if background suspended solids < or = 100 mg/L increase of 10% above background if background suspended solids > 100 mg/L
Tin		
Titanium		
Total Dis. Phosphorus		
Total Dissolved Solids	500	
Total Phenolics (mg/L)	2	1
Total Phosphates		
Turbidity (NTU)	5	

Vanadium		
Zinc (mg/L)	5.0	0.03

4.4.4 Groundwater

The following is a summary of the baseline hydrogeological investigations conducted in the areas of Pit 7 & 8 (Piteau Engineering Ltd., 1994)(Appendix 6), and Tenas Pit and Pit 3 (Piteau Engineering Ltd., 1997(Appendix 7); Klohn Leonoff,1985).

4.4.5 Pit 7 & 8

Background

Several baseline hydrogeological investigations were completed in the area of Pit 7 & 8. These include Klohn Leonoff (1985), Piteau Engineering Ltd. (1990), and Piteau Engineering Ltd. (1994). In total, eleven piezometers were installed in coal seams 1, 2 and 6.

Geology

Bedrock within the Project area consists of a coal-bearing sedimentary sequence comprising siltstone, sandstone, mudstone and shale strata of the Lower Cretaceous age Skeena Group. The sedimentary deposits are underlain by undifferentiated volcanic rocks of the Hazelton Group, which include andesite, trachyte, and basalt with associated tuffs and breccias. Both the Hazelton and Skeena Groups have been intruded by granodioritic rocks of late Cretaceous age as evidenced by the intrusion which is exposed along the northern boundary of the coal lease. The most prevalent surficial (Quaternary) deposit throughout the region is silt and clay till.

Within the area of Pit 7 & 8, two coal packages have been identified by Manalta. A lower seam 1 package is separated from the seam 2 sequence by approximately 100 m of sediments. Each of these coal packages has several layers of coal. These units generally strike north-south to northwest-southeast and dip to the east and northeast. The Project area is dominated by a series of sub-parallel, near vertical normal faults, many of which strike either from northwest/southeast to northeast/southwest. As a result of faulting, the area has been subdivided into various discrete blocks. The role of these faults on the groundwater flow regime is presently unknown.

Till thickness is highly variable and ranges from less than 1 m to greater than 43 m. The till is predominantly comprised of silty clay with trace amounts of sand.

Groundwater Flow

The distribution of groundwater surface elevations in all of the monitored coal seams (1, 2 and 6) indicates that groundwater movement appears to be controlled by topography, and thus flow is south, toward the Telkwa River. At two of the double piezometer nests, upward vertical hydraulic gradients were measured.

Hydraulic conductivity values of the coal seams were estimated to be in the range of 2.7×10^{-9} m/s - 3.5×10^{-7}m/s. Using representative average values for the factors that control groundwater flow, the average linear flow velocity was estimated to be on the order of 19 m/year. Notwithstanding this estimated velocity. it is expected that in local fault zones with open fractures and/or brecciated zones, groundwater velocities may be significantly higher. Given the geological scenario of high gradient low hydraulic conductivities (average $I \times 10^{-8}$) and fault zones, groundwater flow velocities in the range of 10 to 100 m/year may be expected.

Groundwater Quality

Groundwater temperatures were in the range of 5.0 to 10.0 ºC. Groundwater pH was in the range of 6.73 to 9.50. Electrical conductivities were in the range of 308 to 5 875 ¼S/cm. Groundwater analyses from piezometers completed in the coal seams can be characterized as sodium-bicarbonate to sodium-calcium bicarbonate hydrochemical type. The dominance of the sodium cation suggests groundwater with a relatively long residence time and/or natural softening by cation exchange. Concentrations of total dissolved solids (TDS) were in the range of 175 to 3 790 mg/L.

Canadian Drinking Water Quality Guidelines (1987) and water quality standards specified by the B.C. Ministry of Environment for freshwater aquatic life were used to assess the results of the chemical analyses for selected indicator parameters and metals respectively. In terms of Canadian Drinking Water Quality Guidelines, only TDS concentrations exceeded the recommended criteria. Total ammonia concentrations in groundwater were above the freshwater aquatic life criteria in most piezometers. A number of total metals were measured at concentrations above the recommended criteria. Metals typically in exceedance of the freshwater aquatic life criteria included chromium, copper, lead, zinc, aluminum, iron, and manganese. In general, the piezometers installed in 1993 had more chemical constituents exceeding recommended criteria than the piezometers installed in 1989. Piteau Engineering Ltd. concluded that the elevated total metal concentrations were of a temporary nature and would decline with time (Piteau Engineering Ltd., 1994).

4.4.6 Tenas Pit

Background

Hydrogeological investigations began in 1995 with the installation of four piezometers within coal seam 1. Hydraulic conductivity testing and the first round of groundwater sampling at these piezometers were completed in October, 1995 (Piteau Engineering Ltd., 1995). The second round of groundwater sampling was completed at these piezometers by SKR Consultants Ltd. of Smithers, B.C., under the guidance of Piteau Engineering Ltd. in late October, 1996.

The groundwater monitoring network in the Tenas Pit area was expanded in 1996 with the installation of five piezometers in the major coal seams at three new locations. Piezometer nests were installed at two locations to permit determination of vertical hydraulic gradients. Hydraulic conductivity testing and the first round of groundwater sampling was completed by Piteau Engineering Ltd. in September, 1996. The combined information from the above investigations was used to assess baseline hydrogeological conditions in the Tenas Pit area (Piteau Engineering Ltd., 1997).

Geology

The coal-bearing Lower Cretaceous Skeena Group can be subdivided into four upper units (Units I through 4) and a unit of undivided sediments. The economic coal seams in the Tenas Creek area are located within Unit l, an approximate 120 mm thick sequence of interbedded coal and sedimentary rocks. This unit is overlain by Unit 2 sedimentary rocks and Telkwa Formation volcanic rocks. The economic Seams in the Pit 7 and Pit 8 areas (seams 2 through 11) are located within Unit 3, which lies about 100 m stratigraphically above Unit 1.

Surficial deposits predominantly consist of glacial till, which ranges from a sandy silt to a silty clay, with minor gravel. The till is low plastic and of stiff to very stiff consistency. The till ranges in thickness from less than three m to more than 10 m. On the north side of the Tenas Pit, towards and beyond Tenas Creek, the bedrock surface forms a depression which is overlain by a thick (exceeding 100 m) deposit of highly permeable sand and gravel outwash deposits. A buried channel is present in the northwest corner of the Tenas Pit waste dump sites. Channel fill materials range from clays to sands and gravels. The sedimentary sequence in the Tenas Pit area is folded into an upright syncline in which the gently northeastward dipping (typically 10^{o} to 20^{o}) western limb of the syncline subcrops on the western side of the pit area, while the moderately southwestward dipping (40^{o} to 45^{o}) eastern limb subcrops on the eastern side of the pit.

Faulting in the region is generally near vertical, and can be subdivided into two main groups, one that strikes approximately northwest/southeast and the other that strikes approximately northeast/southwest. A few east/west striking faults have also been interpreted. While no sedimentary bedrock exposures were available in the Tenas Pit areas, a similar spatial relationship between bedding joints and cross-joints is expected to exist in these pit areas as was found in the Pit 3 area, and which has been observed in many other sedimentary rock masses.

Groundwater Flow

Groundwater surface elevations in coal seam 1 at the Tenas Pit range from between 892.55- 1 011.19 masl with groundwater flow interpreted to be in a northeasterly direction under a horizontal hydraulic gradient of 0.1. Except for three piezometers, static water levels in the piezometers completed in coal seam 1 are above the top of the PVC casing (i.e., flowing artesian conditions exist).

Hydraulic conductivities for the various coal units were in the range of 2.1×10^{-8} - 6.0×10^{-6} m/s, with a geometric mean of 3.7×10^{-7} m/s Using representative-average values for the parameters that control groundwater flow, the average linear horizontal flow velocity is calculated to be 115 m/year. This analysis does not take into account local fault or fracture zones. Groundwater flow velocities in these features could be significantly higher than estimated above. Given the range of hydraulic conductivities and potential effects of geological faults or fractures, groundwater flow velocities in the range of 10 to 250 m/year may be expected.

Taking into consideration results from the hydraulic conductivity testing conducted as part of the 1996 investigation program, potential groundwater inflows to the Tenas Pit previously estimated by Piteau Engineering Ltd. (1996) generally remain valid, but may be somewhat conservative.

Vertical hydraulic gradients between coal seam 1 and an underlying unnamed coal seam were very low. Vertical hydraulic gradients at the other piezometer nest were not possible to establish as flowing artesian conditions exist in both piezometers at that location.

Groundwater Quality

Groundwater temperatures were in the range of 3.5º to 6.5ºC. With one exception, groundwater pH was in the range of 7.20 to 9.53. Electrical conductivities were in the range of 827 to 4 910 ¼S/cm. Groundwater analyses from piezometers completed in the coal seams can be characterized as a sodium-bicarbonate hydrochemical type. The dominance of the sodium cation suggests groundwater with a relatively long residence time and/or natural softening by cation exchange. Concentrations of TDS were in the range of 536 to 1 954 mg/L.

Water quality standards as specified by the MELP for freshwater aquatic life were used to assess results for selected indicator parameters (sulphate, chloride, TDS and nitrogen species) and metals. Except for total ammonia at one piezometer, concentrations of indicator parameters in groundwater at the remaining piezometers were below the freshwater aquatic life criteria.

A number of total metals were measured at concentrations above the recommended criteria. Metals typically in exceedance of the freshwater aquatic life criteria included cadmium. chromium, copper, lead, zinc, aluminum, iron, and manganese. These chemical results may not be representative of actual groundwater conditions due to the likelihood of high levels of total suspended solids occurring within the sand pack following piezometer installation. For example, compared with the initial sampling event, metal concentrations in groundwater have decreased by as much as two orders of magnitude at the piezometers installed in the Tenas Pit area in 1995. These findings suggest the analytical results for metal concentrations from the first sampling event may be biased by suspended materials from within the immediate vicinity of the well screen. Laboratory results from a second sampling event are expected to provide a better indication of metal concentrations in groundwater at the piezometers installed in 1996.

4.4.7 Pit 3

Background

The geology and hydrogeology of the Pit 3 area were investigated by KIohn Leonoff in the early to mid-1980s. Results from those programs are presented in Klohn Leonoff (1985) and are reported herein where appropriate. In total, sixteen piezometers were installed within the minesite area. However, most of the piezometers have either been destroyed or are no longer suitable for groundwater quality sampling. Consequently, five piezometers were installed at three locations in Pit 3 during the field investigations supervised by Piteau Engineering Ltd. in 1996 (Piteau Engineering Ltd., 1997). A piezometer was completed across coal seam 2 at each of these locations. A second piezometer was installed in coal seam 4 at two locations.

Geology

The Pit 3 area is located within an outlier of the Lower Cretaceous Skeena Group (Klohn Leonoff 1985). The bedrock geology consists of an alternating sequence of siltstone, mudstone, sandstone, and coal, with sporadic volcanic tuffs disseminated throughout the sequence. The sedimentary sequence is underlain by the Hazelton Group. The Hazelton Group predominately comprises andesite trachyte and basalt (KIohn Leonoff, 1985).

The pit area is characterized by a complex series of sub-parallel north-south trending reverse faults and north-south, and to a lesser extent east-west, trending normal faults.

The bedrock is overlain by approximately 0 to 15 m of surficial deposits. Within the Pit 3 areas these deposits are interpreted to comprise a silty clay till, which may include minor coarse fragments and sand.

Groundwater Flow

Based on the piezometers installed in coal seam 2 by Piteau Engineering Ltd. in 1996, groundwater surface elevations range from between 751.12 - 796.82 masl. Groundwater flow is interpreted to be in a north to northwesterly direction under a horizontal hydraulic gradient of 0.04. These results are similar to the interpreted groundwater flow directions reported by Klohn Leonoff (1985) in the area of Pit 3. Based on the available groundwater level data, no evidence exists for the presence of a groundwater divide within the coal deposits in the central portion of Pit 3 as interpreted by Klohn Leonoff (1985).

In contrast to the Tenas Pit static groundwater elevations in all piezometers in Pit 3 in 1996 were below the top of the PVC casing. The depth to water ranged from 7.90 - 37.46 m below ground surface.

From one single well response test the hydraulic conductivity of coal seam 2 was estimated to be 4.3×10^{-10} m/s. From two single well response tests, the hydraulic conductivity of coal seam 4 was estimated to be 8.5×10^{-7} and 3.7 x l0^{-4}. These results are generally similar to the range of values (i.e., 5×10^{-9} - 5×10^{-7} m/s) determined from single well response and packer tests carried out in selected coal seams (Klohn Leonoff, 1985). Average linear horizontal groundwater flow velocities in the coal seams are thus estimated to be in the range of 20 - 100 m/year.

Groundwater level elevation data at the two double piezometer nests completed in 1996 indicated moderately strong downward vertical hydraulic gradients (0.6) exist between coal seams 4 and 2. Several areas of groundwater seepage indicative of upward vertical hydraulic gradients were noted by Klohn Leonoff (1985).

Groundwater Quality

Based on results from the 1996 groundwater sampling program, groundwater temperatures were between 4.1º - 5.8ºC. Groundwater pH was in the range of 7.67 - 8.21, with electrical conductivities between 910 - 5 l00 ¼S/cm.

Groundwater analyses from the four piezometers completed in 1996 can be characterized as sodium-bicarbonate hydrochemical type. The dominance of the sodium cation suggests groundwater with a relatively long residence time and/or natural softening by cation exchange. These results are consistent with the analyses of groundwater samples from selected coal seams in the area of Pit 3 (Klohn Leonoff, 1985). Moreover, the results are also comparable with groundwater quality analyse from coal seams 1, 2 and 6 at Pit 7 & 8 (Piteau Engineering Ltd., 1994).

Concentrations of TDS were in the range of 720 to 3 684 mg/L. These values are generally higher than values previously measured by Klohn Leonoff (1985) in the area of Pit 3 and in the Tenas Pit. Except for sulphate (126 mg/L compared to the recommended criterion of 100 mg/L) at one piezometer (1996), concentrations of all indicator parameters were below the freshwater aquatic life criteria.

A number of total metals were measured at concentrations above the recommended criteria. Metals typically in exceedance of the freshwater aquatic life criteria included cadmium, chromium, copper, lead, zinc, aluminum, iron, and manganese. As previously noted, laboratory results from a first sampling event may contain elevated metal concentrations due to high levels of total suspended solids within the sand pack. Laboratory results from a second sampling event are expected to provide a better indication of metal concentrations in groundwater.

4.5 Climate and Air Quality

The Telkwa Coal Project area, approximately 15 km from Smithers, is characterized with hilly uplands dominated by forest and, to a lesser extent, grassland. Valleys are numerous, irregular in direction and pattern, and are more open and gradual than their counterparts in southern B.C. Although the area is relatively close to the Pacific Ocean, the coastal mountain ranges form a barrier to the west giving the area a climate more typical of continent interiors. Although wind in the area is predominantly from the west, frequent irregularities in barometric pressure bring air masses from distant and diverse regions to give highly variable weather. Typically, though, winters are long and cold, and summers are cool and short. Compared to the close coastal climate, precipitation is relatively light.

Regional climatic conditions are cited from Kendrew and Kerr (1955) and corroborated with climatic normal data provided by Environment Canada for Smithers. Climatic normals collected at the Smithers airport (1942 - 1990 data) are listed in Table 4-6.

4.5.1 Temperature

Given its continental climate, the region experiences a great range of temperatures from intensely cold lows to moderately warm highs. In Smithers, the range from the mean monthly minimum to the mean monthly maximum is 34.4ºC. The range from extreme minimum to maximum is 79.7ºC. The yearly mean temperature in Smithers is 3.8ºC.

Winters in the region are long and cold lasting typically five months. January is the coldest month with a mean daily temperature of -9.0ºC and the mean daily minimum dropping down to -13.0ºC. The region may experience periods of intense cold when polar air mass incursions from the north drop temperatures for several days. The extreme minimum temperatures for Smithers, down to -43.9ºC, result from these air masses.

Temperature usually decreases with increasing elevation. However, during winter, valley inversions may form where lower temperature air is trapped within the valley giving adjacent higher elevations warmer temperatures.

Summers in the region are short and cool lasting typically three months. July is the warmest month with a daily mean temperature of 14.9ºC. Occasionally, temperatures can become hot with temperatures up to 35.8ºC. Generally, though, daily summer highs are around 21ºC. The Smithers area averages 91 frost free days annually running usually from June 6 to September 6 (Environment Canada, pers. com.).

Table 4-6 Environment Canada Climatic Data for Smithers Area - Averages for 1942-1990 Period

Smithers Airport [54º49'N; 127º11'W; 523M]

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Temperature (°C)													
Daily Maximum	-5.2	-0.1	4.8	10.3	15.3	19.0	21.4	21.0	15.7	9.0	0.6	-4.4	9.0
Daily Minimum	-13.0	-9.6	-5.7	-1.5	2.6	5.9	8.3	7.8	4.0	0.3	-5.7	-11.7	-1.5
Daily Mean	-9.0	-4.8	-0.4	4.4	9.0	12.5	14.9	14.4	9.8	4.7	-2.5	-8.0	3.8
Extreme Maximum	15.6	11.9	16.0	24.3	35.8	33.9	34.4	35.2	31.1	24.4	15.6	11.5	
Extreme Minimum	-43.9	-35.6	-33.3	-18.3	-7.2	-4.1	-1.1	-2.2	-6.7	-22.0	-32.4	-36.7	
Precipitation													
Precipitation (mm)	57.8	29.3	22.3	18.0	33.3	42.2	45.7	42.1	53.7	62.3	54.5	48.0	509.5
Rainfall (mm),	11.6	6.3	5.8	12.1	32.7	42.2	45.7	42.1	53.5	55.5	22.3	7.5	337.4
Snowfall (cm)	60.7	29.7	19.7	6.9	0.9	0.0	0.0	0.0	0.2	7.3	39.2	51.9	216.4
Extreme Daily Precipitation (mm)	61.0	18.0	22.6	24.6	52.3	42.6	40.1	30.4	46.8	42.7	59.7	29.0	
Extreme Daily Rainfall (mm)	26.7	13.2	15.5	24.6	52.3	42.6	40.1	30.4	46.6	41.7	59.7	23.6	
Extreme Daily Snowfall (cm)	61.0	22.1	21.1	15.7	6.4	0.0	0.0	0.0	2.5	15.2	43.7	36.8	
Month-end Snow Cover (cm)	39	32	12	0	0	0	0	0	0	1	12	26	

Days With:													
Maximum Temperature > 0ºC	8	16	27	30	31	30	31	31	30	31	18	9	292
Measurable Precipitation	17	13	12	8	11	12	12	12	14	17	16	17	160
Measurable Rainfall	3	3	4	6	11	12	12	12	14	15	7	3	101
Measurable Snowfall	16	11	9	4	*	0	0	0	*	3	12	16	72
Freezing Precipitation	1	*	*	0	0	0	0	0	0	*	*	*	3
Fog	3	3	2	*	*	2	3	6	12	7	5	3	46
Thunderstorms	0	0	0	*	*	1	2	1	*	*	0	0	6
Hours of Sunshine	43.8	78.6	124.4	179.5	223.9	241.4	254.8	227.7	140.1	90.6	41.3	33.3	1679.5
Barometric Pressure (kPa)	95.17	95.08	94.98	95.11	95.25	95.27	95.46	95.39	95.35	95.07	94.91	95.11	95.18
Moisture													
Vapour Pressure (kPa)	0.31	0.37	0.43	0.51	0.68	0.91	1.12	1.13	0.93	0.69	0.46	0.33	0.66
Relative Humidity - 0600L (%)	83	83	83	82	82	83	88	91	93	89	87	84	
Relative Humidity - 1500L (%)	77	68	56	45	43	47	50	52	59	67	78	81	

Wind													
Speed (km/h)	8	8	7	8	8	7	6	6	6	7	7	7	7
Most Frequent Direction	C	C	C	C	C	C	C	C	C	C	C	C	C
Maximum Hourly Speed (km/h)	66	56	55	61	51	46	50	46	56	58	64	51	
Direction	SW	SW	W	SW	NW	SE	SE	SW	SW	SE	SW	SW	
Maximum Gust Speed (km/h)	114	120	81	93	100	74	78	74	81	87	106	111	
Direction	SW	W	W	SW	SW	SW	NE	N	S	W	E	SW	

* Measurements Indeterminate

The Project area ranges in elevation from 540 m to 860 m above sea level. The lower reaches of the Pit 3 minesite and the plantsite are expected to experience conditions similar to those at Smithers. The upper reaches of the Project Area are expected to experience slightly cooler temperatures, except during winter inversions.

4.5.2 Precipitation

The Telkwa Coal Project area is located of the leeward side of the Coast Mountain and the Hazelton Mountain Ranges. These ranges form a barrier against the warm, water laden Pacific air. As the air comes into contact with the mountains, the rising warm air loses much of its water holding capacity in the form of precipitation. Because of this, the coastal ranges can get over 2 500 mm of precipitation annually, whereas the rolling country to the east receives typically 500 mm - 750 mm annually. Portions of the deeply trenched Bulkley Valley often receive less than 500 mm annually.

The Smithers region experiences approximately 510 mm of precipitation annually over 160 days: 337 mm as rain and 216 cm as snow. October and January experience the most precipitation, October's primarily as rain, and January's primarily as snow. Spring months are relatively dry. Snow falls from September to May and accumulates on the ground from October to March. Most of the snow accumulates in December and January.

Summers are relatively cloudy, but low cloud cover is remarkably uniform throughout the year. While the region has light thunderstorm activity, thunderstorms are rare in the deeply trenched and sheltered Bulkley Valley. Smithers averages six days annually in which thunderstorms occur. Freezing precipitation, other than snow, is also rare in Smithers occurring only on three days annually.

Smithers has fog typically 46 days annually. Inversion valley fog occurs with the greatest frequency, particularly in autumn and winter, leaving the valley

with low visibility while higher adjacent elevations have clear conditions.

Klohn-Leonoff, in their Stage 2 geotechnical report to Crows Nest Resources Ltd. (1985) estimated lake evaporation using a Thornwaite Climatic Water Balance Analysis based on Smithers airport temperature data. The annual distribution of lake evaporation is:

Period	Nov - Apr	May	June	July	Aug	Sept	Oct	TOTAL
Lake Evaporation (mm)	52	77	107	123	104	62	28	553

Because the top elevation of the Project area is approximately 320 m higher than the confluence of the Telkwa and Bulkley Rivers, climatic conditions are expected to vary slightly from those reported at Smithers. The snowpack for the upper elevations of the Project Area is expected to be greater than at Smithers. Inversion valley fog may affect the lower elevation portions of the Project Area, but higher elevations should be affected significantly less.

4.5.3 Wind

Wind conditions in the Smithers area are most frequently calm. Winter winds are strongest and prevail predominantly from the west. Wind speeds slightly decrease in summer as Pacific cyclonic activity is reduced and anticyclones are more numerous. The average wind speed in Smithers is 7 km/h annually. Gusts may prevail from many directions, but the stronger gusts prevail from the west up to speeds of 120 km/h.

Wind speeds and directions at the proposed Project Area may be somewhat different from those experienced at Smithers because of differences in local topography. However, wind speeds are expected to be similar because they are caused by the same weather systems.

4.5.4 Baseline Air Quality

Airborne particulate matter is a public concern in the Bulkley Valley. According to Bulkley Valley Air Quality Management Plan: Inhalable Particulate (1992) [Air Quality Plan], ambient air quality in Smithers was degraded for approximately one month over a one year period. The Air Quality Plan also reasoned that the atmosphere in the Bulkley Valley becomes polluted due to three factors: poor dispersion meteorology, poor dispersion topography and a variety of point and area sources of inhalable particulates.

Valley temperature inversions, which form primarily during winter months as a result of radiative cooling and the valley topography, are characterized by a very stable atmosphere. With little mixing, inversions do not readily disperse pollutants. Any pollutants emitted in the Bulkley Valley during an inversion

tend to remain trapped close to their source. Topography can intensify inversions as cold air resulting from radiative cooling on hillside slopes can drain into a valley bottom to augment an inversion.

The Air Quality Plan listed the sources of air pollutants by the percent of particles smaller than 10 microns (PM_{10}) they contribute to the atmosphere. In the Bulkley Valley, the breakdown is as follows:

Prescribed Burning 40%

Wildfires 28%

Point Source Burning (Beehive Burners) 17%

Road Dust 7%

Mobile Exhaust (automobile, trains,

heavy duty diesel engines) 7%

Area Burning (wood burning stoves) 2%

As a result of the air quality problems in the Bulkley Valley, the Valley's PM_{10} criteria are set at 50 ¼g/m^3 for a 24 hour period and at 20 ¼g/m^3 for a yearly average. Total suspended particulate (TSP) criteria are set at 150 ¼g/m^3 for a 24 hour period and 60 ¼g/m^3 for a yearly average.

B.C. Environment supplied TSP data for the Telkwa area were collected from March 31, 1983 to January 14, 1986. During that period, the 24 hour average TSP criteria value of 150 ¼g/m^3 was exceeded two times and the annual geometric mean TSP never exceeded the criteria of 60 ¼g/m^3.

4.6 Soils and Terrain

Soils and terrain for the Telkwa Coal Project area were mapped in 1984 by Pedology Consultants of Victoria, British Columbia in the report titled "Soil Survey and Land Capability Evaluation of the Telkwa Coal Project" (Appendix 13).

Both parameters were classified and mapped at two different scales depending on their location. Areas located in the direct vicinity of the plant site and associated mine infrastructure were classified and mapped at a scale of 1:5 000. The outer regions of the Project Area were mapped at a scale of 1:20 000. This report does not cover the Tenas Creek and Pit 7 & 8 areas of the Project.

4.6.1 Soils Baseline Information

Methodology

Soils inspections were made at 119 sites within the 1:20 000 area and 191 sites within the 1:5 000 area. At each inspection site, soils were described and classified according to criteria outlined by the *Canadian System of Soil Classification* (Canadian Soil Survey Committee, 1978).Observations of the soil profile were limited to the upper 1 metre of the surficial materials containing the A and B (solum) and C (upper parent material) horizons. The soil profile attributes described in the field included: horizon type and thickness, texture, colour, structure, internal drainage, and moist consistence. Other attributes included drainage class, slope class, parent material, landforms and surface stoniness.

Soil survey information was plotted onto 1:20,000 scale topographic maps. Map unit boundaries were delineated on this map according to observable changes in topography, drainage, and soil profile characteristics. The delineation of a given map area, is based on the extrapolation of soil information at the individual inspection sites to other areas by air photo interpretation.

Soil Sampling and Analysis

Typical soils of the area were sampled at 10 sites within the 1:20 000 area and at 10 sites within the 1:5 000 scale area. Each major soil horizon was sampled across its exposure to produce adequate sample material. Samples were analysed by Pacific Soil Analysis Inc. in Vancouver for pH, electrical conductivity, exchangeable cations, saturation %, soluble salts, organic C %, extractable metals and nitrogen.

Agricultural Capability

Soils were rated for Agricultural Capability according to the Land Capability Classification for Agriculture in British Columbia (British Columbia Ministry of Environment, 1983). This system grouped all mineral soils into seven classes according to their potential limitations for agricultural use. Classes 1 to 3 are capable of sustaining a cereal or forage crop rotation. Class 4 is considered marginal, while Class 5 is suitable for only permanent pasture of forage. Class 6 is capable of native grazing only while Class 7 has no potential for agriculture.

Each class listed above can also be described by the limitation or subclass associated with it. The subclasses are listed below and also described in more detail in Appendix 13.

a) Soil moisture deficiency (A)

b) Soil structure (D)

c) Erosion potential (E)

d) Inundation (overflow from rivers or streams) (I)

e) Stoniness (P)

f) Depth to bedrock or rockiness (R)

g) Topography (T)

h) Excessive wetness (W)

Soil Suitability For Reclamation

Soils within the Project area were also evaluated in terms of suitability for reclamation. Through the soils evaluation, soil profiles were broken down into three categories.

1. Topsoil, which was defined as the surface A horizon and the O horizon of the Organic soils,

2. Subsoil, which was defined as the B horizons, and

3. Buffer, which was defined as the parent material below the soil profile, usually to a depth of 3 m.

The physical and chemical characteristics of these categories were evaluated using the Soil Suitability for Reclamation Guidelines (Alberta Agriculture, 1981). These guidelines provide a subjective evaluation of (Good, Fair, Poor and Unsuitable) soils based on the their physical, chemical and morphological properties. A detailed description of this rating system, and the reclamation suitability map, are located in Appendix 13.

Soils Descriptions

The Telkwa Project area is dominated by both Luvisolic and Brunisolic soils typical of the continental climate of the region, which is partly influenced by coastal air masses. Other soil types encountered within the Project area include soils from the Regosolic and the Humisolic orders. These soil types have developed over several types of depositional parent material which include fluvial deposits, glaciofluvial deposits, moraine, lacustrine deposits, colluvial deposits and organic materials. In total, 52 soil units were identified over the Telkwa Project area. These units are summarized in the soils map legend contained in the report titled "Soil Survey and Land Capability Evaluation report of the Telkwa Coal Project" (Pedology Consultants, 1984) located in Appendix 13.

Luvisolic Soils

Luvisolic soils within the Project area consist of mainly Orthic Gray Luvisols, with some inclusions of gleyed Gray Luvisols and Brunisolic Gray Luvisols. Orthic Gray Luvisols within the Project area generally consist of approximately 30 - 50 cm of loamy sand or sometimes silty sand A and B horizon overlying clay loam to silty clay loam parent material These soils are generally well to imperfectly drained and found predominantly on the upper or ridge topography with slopes ranging from two to 40%.

Agricultural capability for the Luvisolic soils located within the Project area is generally low with soils being rated as Class 4 to 6. Major limitations to

agricultural capability are stoniness, topography, and erosion potential.

Reclamation suitability for these soils is high with both the A and B horizons being rated as good quality for reclamation. The parent material is generally rated as fair to poor quality for reclamation with texture and consistence being the main limiting factors, depending on its location and nature.

Brunisolic Soils

Brunisolic soils within the Project area consist of mainly Eluviated Dystric Brunisols, and Orthic Dystric Brunisols. These soils generally consist of 20 to 40 cm of yellowish brown, sandy loam textured A and B horizon which overlies a gray sandy loam to loam textured under developed Cg horizon (approximately 40 to 60 cm). The parent material varies from a silty clay loam to gravelly sand texture and goes down approximately one to three metres in depth. These soils are generally well to imperfectly drained and occur on north and east facing slopes in the wetter areas. Slopes generally range from two to 50%.

Agricultural capability for the Brunisolic soils located within the Project area is generally low with soils rated as Class 5, improvable to Class 4 and some areas rated as low as Class 6. Major limitations to agricultural capability include stoniness and moisture content.

Reclamation suitability for these soils is rated from good (A horizon) to fair to poor for the remainder of the soil profile. Careful consideration should be given when salvaging this soil material for reclamation. A horizon material represents some of the best reclamation material available in the area, while the lower soil profile is substantially lower in quality with texture, slope and stoniness as the major limitations.

Regosolic Soils

Regosolic soils within the Project area consist mainly of Orthic and Cumulic Regosols. Regosolic soils are generally very weakly developed, which may be due to recent alluvium or the instability of material on slopes which are prone to movement. Regoslic soils within the Telkwa Project area are found on both the level topography of the active flood plain areas (Cumulic), and on very steep erosional slopes (Orthic). These soils generally consist of 10 to 15 cm of loose sands over gravelly sand or cobbles. Occasionally, thin buried horizons also occur within the profile. Due to these soils being found either on flat or very steep topography, the drainage is variable. Slopes generally range from nearly flat on the floodplain areas to 50 to 100% on the erosional slopes.

Due to the locations of these soils agricultural capability is rated as either Class 7 on the floodplains or no agricultural capability on the steep slopes.

Reclamation suitability is rated as unsuitable for the Regosolic soils based on location.

Organic Soils

Organic soils are present within the Telkwa Project area in the form of Mesisols and Fibrisols. The type of organic soil present is dependant on the degree of decomposition of the organic material as well as the height of the water table. These soils generally consist of fibric or mesic layer approximately 70 cm thick overlying the water table. Organic soils are mapped in the depressional poorly drained areas within the Project boundary. Some areas are treed and referred to as swamps, and others are open referred to as bogs.

Agricultural Capability of these soils is rated as Class 4 to 5 and occasionally 6 with wetness as the major limiting factor.

Reclamation Suitability for these soils has not been rated. This requires further investigation as these soils contain an abundance of organic matter, but are generally acidic in nature.

4.6.2 Terrain Analysis

Methodology

The surficial geologic features of the Telkwa Project Area were characterized according to the British Columbia Terrain Classification System (British Columbia Ministry of Environment). This method of terrain analysis combines aerial photograph interpretation with field investigations to characterize the landscape by means of subdividing the land surface into specific terrain units according to the origin of the surface materials. Further divisions are then made on the basis of material texture, landforms (surface expression), and the effects of modern processes on the land surface .

Data on the characteristics of the geologic materials were collected from natural outcrops such as river and stream banks; from man-made outcrops such as road, railway and gravel pit cuts; and from hand-dug shovel holes. Observations were recorded for the 119 sites in the 1:20 000 map area and for 191 sites in the 1:5 000 map area during the soil survey.

The geologic materials were inspected using a backhoe and described to a depth of three metres at 10 sites (five sites were sampled at approximately 0.5 m intervals) in the 1:20 000 map-area and at 41 sites (14 sites were sampled at approximately 0.5 m intervals) in the 1:5 000-map area.

Surficial Geology

Landforms and surficial glacial materials occurring in the Telkwa Project Area are mainly the depositional and erosional products of the Fraser Glaciation, the last significant period of glaciation in British Columbia. Materials deposited during the Fraser Glaciation include till (moraine) as well as glaciofluvial and glaciolacustrine sediments that were laid down during ice advance and/or retreat. Since glacial time colluvial materials have accumulated on or at the foot of slopes and exposed bedrock has been subject to weathering processes. Fluvial, lacustrine, and organic sediments have been deposited on valley floors and in depressions. The surficial geologic features of the study area landscape are portrayed on the Terrain Maps (Appendix 13).

The various types of surficial materials and their important physical characteristics which occur in the Project area are:

Moraine: The regional basal till of the area has a dense, compact matrix of sand and silt which is slightly to moderately calcareous and contains rock and mineral fragments of various shapes and rock types. Thickness of the impervious basal till ranges from a thin veneer to greater than six metres.

Fluvial: Fluvial materials consist of gravel, sand and/or silt and are often moderately to well sorted and stratified. These sediments occur as channel and floodplain deposits, terrace deposits, alluvial fans and gravelly, sandy veneers deposited on upland surfaces.

Glaciofluvial: Glaciofluvial materials consist mainly of gravel and sand that ranges from non- to well-sorted and from massive to well bedded. These sediments occur as large gravel outwash plains, irregular terraces along main valleys, hummocks and ridges, and gravelly and sandy mantles over upland moraine.

Lacustrine: Sacustrine sediment consist of stratified fine sand, silt and clay deposited on the lake bed and of coaster-textured beach and littoral sediments.

Glaciolacustrine: Glaciolacustrine sediments such as silt and fine sand are most common but coarse sand and gravel also occur. They may range in structure from massive to finely laminated.

Organic: materials resulting from vegetative growth, decay an accumulation in and around close basins or on gently slopes where the rate of accumulation exceeds that of decay. May be classified as either bogs, fens or swamps.

Disintegrated Bedrock: mechanically weathered (eg, frost shattering) debris derived in-situ from underlying bedrock. Consists of angular to subangular blocks, rubble and boulders.

Colluvium: materials which are the products of mass wastage and have reached their present position by direct, gravity-induced movement.

Decomposed Bedrock: weathered and rotted rock derived in-situ from underlying bedrock mainly by chemical processes. Rock is altered so that it contains a high proportion of residual fines and its strength properties are significantly different from those of the equivalent unweathered bedrock.

Bedrock: bedrock outcrops and rock covered by less and 10 cm of unconsolidated material.

Anthropogenic: substrate materials constructed by man or geological materials so modified by human action that their original physical properties, such as structure, cohesion, compactness and strength have been significantly altered. Commonly applied to materials transported and redeposited, usually in conjunction with mining and waste disposal and to excavated areas where topography and/or surface materials have been extensively changed.

Mapping and characterizing the surficial deposits within an area provides the basis of terrain analysis. Interpreting this data to assess the capability of the land to support various forms of development is the next important step. Conditions and characteristics that help indicate a desirable location and potentially troublesome areas can be readily interpreted from the base terrain data and maps.

Terrain Constraints

Conditions which are of concern include natural hazards and land constraints. Natural hazards are geomorphic processes that may be impossible or unfeasible to prevent (for example, mass movement or flooding) whereas land constraints are conditions of the landscape that should be recognized but which can usually be overcome by conventional engineering methods (for example, poor drainage or compressible materials). The Terrain Constraints Maps, located in Appendix 13, identify areas that may exhibit terrain conditions that are hazardous or constraining to certain land uses. The important terrain constraints identified in the Project area are as follows:

• Frequent Flooding

• Occasional or Rare Flooding

• Potential Mass Movement and Surface Soil Erosion

• Gully and Channel Bank Erosion

• Active Mass Movement

• Organic Deposits

• Potentially Troublesome Foundation Conditions

The main areas of terrain constraints in the study are occur along the floodplains of the Telkwa River and Tenas and Goathorn Creeks are on the adjacent scarp slopes. Along the Telkwa River flood prone areas are extensive and the scarps are subject to potential mass movement and surface soil erosion. The valley floors of Tenas and Goathorn Creeks, while not as wide as that of Telkwa River, are also prone to flooding. Slopes bordering these watercourses are potentially unstable and subject to erosion, particularly within the deeply incised tributary gully systems. Significant areas of active mass movement occur along the ridge dividing Tenas and Goathorn Creeks and on the east slope bordering Goathorn toward the southern end of the Project area.

On the upland, the terrain constraints appear widespread although they are not all significant. Surface drainage channels have been designated as areas of potential channel bank erosion. Near surface seepage is common off the bedrock controlled slopes. Depressions and flat lying areas underlain by impervious moraine or lacustrine silts are usually areas of high water table and/or shallow organics. Small, isolated areas of deep organics and/or thick fine-textured materials are scattered throughout the Project area. Thick lacustrine silts border the saturated drainage depression which is infilled with organic material.

5.0 SOCIO-ECONOMIC CONDITIONS

5.1 Recreation and Tourism Resources

This section presents the tourism and recreation opportunities and facilities in the area between Moricetown and Houston. The information presented in this section has been collected from promotional literature, government records, and investigations completed by Manalta Coal Ltd.

The Project area and surrounding Bulkley Valley provide superior opportunities and facilities for outdoor and adventure recreational activities in all seasons. The main activities include hunting, fishing, hiking, walking, bird and game viewing, downhill skiing and cross country skiing. The area has all necessary services. Tourism figures substantially in the local economy. Access to the Bulkley Valley is provided by the Yellowhead Highway (Highway 16), or air service to Smithers from a number of regional centres in British Columbia. Following are profiles of selected communities in the vicinity of the Telkwa Project area, drawn from published sources.

5.1.1 Moricetown

Location: 34 km from Smithers, 45 km from Telkwa.

Access: Adjacent to Highway 16, Greyhound Bus Line in Telkwa, Smithers Airport

Recreational Activities: Community hall,

Community Facilities: Band office, fire hall, recreation centre, health station

Area Attractions:

• Telkwa High Road: scenic drive paralleling Yellowhead Highway between Telkwa and Moricetown

• Moricetown Falls: Bulkley River squeezes through this dramatic 15 m wide canyon

(B.C. Ministry of Aboriginal Affairs, 1996)

5.1.2 Smithers

Total Trading Population: 25,000

Climate: Summer averages 14.5 ^{0}C, winter averages -12 ^{0}C

Rainfall: 33.7 cm/yr

Snowfall: 106 cm/yr

Access: Smithers Airport (Canadian Regional Airlines, Air BC, Central Mountain Air), Helicopter (Canadian Helicopters, Highland Helicopters, Northern Mountain Helicopters), Highway 16, VIA Rail, Greyhound Bus Line, BC Bus Transit

Recreational Activities: horseback riding, mountaineering, fishing, hunting, mountain biking, white-water kayaking, river rafting, golfing, swimming, curling, skating, fitness trail, downhill skiing, cross-country skiing, snowmobiling, dog sledding, tennis.

Recreational Facilities: Art gallery, museum, licensed hunting and fishing guides, camp ground, downhill ski slope, groomed cross country ski trails, picnic sites, arena, two golf courses, swimming pool and fitness centre, fish hatchery, ball parks.

Area Attractions:

• Hudson Bay Mountain, Babine Mountains Recreation Area: hiking trails

• Perimeter Trail: used year round by walkers, joggers, hikers, bikers & cross-country skiers around the perimeter of Smithers

• Community Forest: interpretive nature trail through a variety of ecological habitats

• Babine Mountain Recreation area: 32 000 hectares of mountainous environment, glacier fed lakes, sub-alpine meadows; areas available for snowmobiling in winter

• Twin Falls - Glacier Gulch: canyon with two glacier fed 150 m waterfalls

• Ski Smithers: commercial ski hill with 17 runs, triple chair, 2 t-bars and beginners tow

Annual Events:

• Bulkley Valley Exhibition, various agricultural, logging and home crafts competitions, show, displays, midway, music, etc. August 22-24, 1997

• Smithers Business Trade Show, April

• Smithers Mexican Mountain Top Festival, April

• Smithers Mid-Summer Festival , Valley artists and musicians, mid-June

• Smithers Winter Festival, parade, fireworks, torchlight ski parade, snow golf

• Smithers Air Show (every other May)

Super, Natural British Columbia: North By Northwest, North by Northwest Tourism Association of BC, PO Box 1030 (NW), Smithers, BC V0J 2N0

(Smithers District Chamber of Commerce, North by Northwest Tourism Association of BC, 1996, 1997/8)

5.1.3 Telkwa

Telkwa = "where the rivers meet" in the Wet'suwet'en language, sits at the confluence of the Bulkley and Telkwa Rivers

Location: Approx. 11 km southeast of Smithers

Access: Highway 16, Greyhound Bus Line, Smithers Airport, sea plane base nearby.

Climate: Summers average 18 ^{0}C, Winters average -12 ^{0}C

Precipitation: 45.6 cm/yr

Recreational Activities: sport fishing (steelhead, salmon, trout), canoeing, hiking, bird watching, self guided historical walking tour of the village.

Recreational Facilities: restaurants, motel, RV park, pub, tennis courts, playground, baseball diamond, soccer field, community hall, skating rink, museum

Area Attractions:

• Tyhee Provincial Park: 33 ha full facility Provincial Park, 200m beach front, 55 campsites, swimming beach, boat launch, bird watching observation platform on marsh, float plane base.

• Aldermere Ridge: hiking

• Driftwood Canyon Provincial Park: fossil digging

• Telkwa High Road: scenic drive paralleling Yellowhead Highway between Telkwa and Moricetown

Annual Events:

• Telkwa Barbecue and Demolition Derby (end of summer)

(North by Northwest Tourism Association of BC, 1996, 1997/8)

5.1.4 Houston

Climate: Summer averages 21.4 ^{0}C and winter averages -7.4 ^{0}C

Rainfall: 30.5 cm/yr

Snowfall: 16.4 cm/yr

Location: Approximately 58 km east of Telkwa

Access: Greyhound, VIA Rail, Highway 16, airport (light aircraft and helicopters)

Recreational Activities: fishing (fly, steelhead, spring salmon, coho salmon, trout, char), forestry tours (summer), cross country skiing, golfing, mountain biking, hiking, snowmobiling, dog sledding, rafting, rock hounding, lumber mill tours (summer)

Recreational Facilities: motels, lodges, cabins, camping, restaurants, RV park, golf course

Annual Events:

• Pleasant Valley Days, rodeo, ball tournament, dance, May

• Discovery Days, 4x4 mud competition, East Coast Night, June

• Discover Houston Trade Show, business, home, recreation show, September

5.2 Social Considerations

Information on the existing socio-economic conditions in the vicinity of the Telkwa Coal Project was gathered from a variety of sources. The area of influence for the Project is the Bulkley Valley region from Moricetown in the north to Houston in the south. This area was chosen as it is believed that this is the area that will provide:

• the workers for the operation of the mine, and

• the local governments and businesses that will provide services for the mine.

Information was gathered by contacting federal, provincial and local government agencies, researching public documents, and reviewing surveys completed by other mining companies in the area. The census completed in 1991 has been used extensively for collecting data on population, employment, levels of education, and household incomes. Manalta Coal Ltd. representatives coordinated all of the information gathering for this section.

The impacts of the Telkwa Coal Project on the baseline existing conditions are presented in Section 9 along with mitigation measures that Manalta will incorporate into its development planning. Socio-economic profiles of the affected communities are provided below.

5.2.1 Moricetown

General

Moricetown is named after Father Adrien Morice who produced the first real map of north central British Columbia.

Social and Demographic Profile

The residents of the Moricetown band are part of the Wet'suwet'en group of First Nations people.

The latest population estimate is 1437. The 1991 census data indicate 26.9% of the total population 15 years and over have less than Grade 9 education and only 34.6% have achieved higher than Grade 13 education. This compares with the provincial averages of 8.7% and 63.6% respectively.

Main Industries

Fishing, forestry and government services are the main industries supporting the residents of Moricetown. A band owned sawmill (Kyah Industries Ltd.) Is also operated by local labour.

Labour Market and Employment

At the 1991 census, 51.2% of the population on the Reserve was in the labour force (15 years of age and over). 27% of the labour force was employed in primary industries, 20% in manufacturing and another 20% in government service industries. The remaining workforce was spread across construction and "other" areas.

The unemployment rate is 52.9% compared with the provincial average of 10.3% and the national average of 10.2%. The unemployment rate for males is higher than that for females (50.0% compared to 42.9%), which shows a reverse of the provincial figures (10.1% for males compared to 10.5% for females). The participation rate of 68.0%, however, is very near the provincial rate of 67.6%. The participation rate refers to the total labour force expressed as a percentage of the population 15 years of age and over, excluding institutional residents.

The average number of people per household is 4.1. This value is considerably higher than the provincial average of 2.6.

Housing and Accommodation

• Private - Moricetown has 166 private dwellings.

• Motels - Moricetown has no motels.

• Hotels - Moricetown has no hotels.

Community Services

• Education - Band, provincial and private schooling available.

Fire and Police Services - Volunteer fire department with pump truck, fire hall and Emergency Communications System. The RCMP detachment at Smithers provides police service to the area.

• Shopping - Limited shopping on the reserve.

• Other - Rural delivery of mail from Post Office in Smithers, two churches

Local Government

The Reserve is governed under the Indian Act with an elected chief and associated counsellors.

• Power - BC Hydro and Power Authority provides service.

• Water - Sourced from the Bulkley River with one unheated main and a water treatment plant.

• Sewage - Sanitary main with one lagoon, which is currently being expanded.

• Solid Waste - Solid waste landfill site.

5.2.2 Smithers

General

Smithers has a long history, dating back to 1913 when the Grand Trunk Pacific Railway's divisional headquarters was established here. The site was chosen due to its proximity to nearby large mineral deposits. Smithers become the first village to be incorporated in British Columbia in 1921.

Social and Demographic Profile

The population of Smithers is estimated at over 5800 at the end of 1996. The BC Ministry of Government Services[6] estimated the population to be 5689 in November, 1995 and, using the 1991 census data, a population growth rate of 9.9% was calculated for this period. This growth rate is below the provincial rate of 11.4% for the same period.

The two age categories of note are the +65 year and <4 year age brackets. These categories have a direct influence on social programs and facilities required in the town. In particular, senior citizens' care facilities, medical facilities, day care, and kindergartens must be available to suit the requirements. The 65+ age bracket and <4 year age bracket constitute 7.2% and 9.3%, respectively, of the population in Smithers. These values compare with the provincial levels of 12.9% and 6.7%.

The average number of persons per household in town is 2.8, the provincial average being 2.6. All of the above indicators show that Smithers has a younger population, which is consistent with most resource based communities. Only 7.3% of the total population 15 years and over have less than Grade 9 education and Smithers is the only town in the area of interest that has higher education levels comparable with the provincial average. The other towns vary from 41 to 49% in terms of some form of secondary education beyond Grade 13.

Main Industries

Retail trade, manufacturing (including wood processing and pulp and paper manufacturing), transportation, and government services are the main industries supported by the town. The retail trade sector includes businesses that provide goods and services to the forestry, mining and construction industries as well as to the general public.

Labour Market and Employment

56.3% of the population in Smithers was in the labour force (15 years of age and over) and 20.3% of this group was employed in trade industries, 9.9% in manufacturing and another 9.3% in transportation and storage industries. Government services and primary industries accounted for 8.6% each.

Smithers has an unemployment rate of 9.3% and a participation rate of 77.0% which is much higher than the provincial rate of 67.6%.

Housing and Accommodation

• Private - The town has 1785 private dwellings.

• Motels - The town has 8 motels in the town with over 260 units.

• Hotels - The town has 3 hotels in the town with over 160 units available for occupancy.

• Other - The town has 2 RV Parks with a total of 55 units capacity and one campground with 40 sites.

Currently few vacant lots are for sale and rental opportunities are low. Short term building plans include:

Phase 1 Willowvale - 75 lots, start summer of 1997

Phase 2 Willowvale - 30 lots, start servicing in 1997

Phase 3-8 Willowvale - total approximately 400 lots

Kathlyn Creek subdivision - 17 lots, ready July 1997

Community Services

• Education - Three elementary schools, one junior secondary school and one senior secondary school, four private schools, Community College.

• Fire and Police Services - A volunteer fire department is located in town. Police services (RCMP) are also centred in town with responsibility for Smithers and the surrounding area.

• Shopping - Various stores, services, and restaurants.

• Other - churches, six banks, Post Office

Local Government services

• Post Office, garbage pickup, street lighting, road maintenance, and animal control.

Utilities

• Power - BC Hydro and Power Authority provides 138 kV three phase power.

• Water - Three wells, upgrading pumping capacity by 40% in second quarter of 1997

• Natural Gas - Pacific Northern Gas Limited provides continuous supply.

• Sewage - No expansion required in short term.

• Solid Waste - Regional transfer plans to be reviewed with BNRD

5.2.3 Telkwa

General

The village was the main settlement in the Bulkley Valley until 1913 when the Grand Trunk Pacific Railroad chose Smithers to be its divisional point. The village was incorporated in 1952. Telkwa has always supported a sawmill, some intermittent mining and agricultural activity since its beginning in 1907.

Social and Demographic Profile

The population of Telkwa was 959 in the 1991 census and is estimated at 1200 in 1996 (BC Municipal Redbook 1996/97).

The Village's average age (1991 census) was under 35 years and the education level was above the average for the province.

The 65+ age bracket and <4 year age bracket constitute 6.8% and 8.9%, respectively, of the total population and these figures show that Telkwa has similar population distribution as Smithers. The average number of persons per household in the village is 3.1 (provincial average is 2.6). Only 7.3% of the total population 15 years and over have less than Grade 9 education but higher education levels are comparable with provincial averages.

Main Industries

The people of Telkwa are mostly employed in manufacturing industries outside the village boundaries. Forestry (logging and timber processing), mining, agriculture and tourism are the main industries that provide revenue and employment to the people of the village.

Labour Market and Employment

There was 49.5% of the population in Telkwa in the labour force, 20.0% of the labour force was employed in trade industries , 15.8% in primary industries and another 11.6% in manufacturing industries.

Telkwa has an unemployment rate of 13.7%, which is above the provincial average of 10.3%. The participation rate of 72.0%, however, is much higher than the provincial rate of 67.6%. The educational levels in the trade and non-university areas are higher than the provincial average. This condition, along combined with the low average age, makes Telkwa a prime source of employment for a variety of industries.

Housing and Accommodation

• Private - The village has 270 family dwellings located within the village boundaries.

• Motels - The village has one motel with 10 units.

• Hotels - The village has one hotel (Telkwa Pub).

• Other - A camping area is located at the Tyhee Lake Provincial campground with 55 campsites and a private RV park with 48 sites is situated within the village boundaries.

Numerous lots, varying in size, are available for building new homes but no serviced industrial is land currently available for development.

Community Services

• Education - one elementary school with classes from kindergarten to grade six.

• Fire and Police Services - A volunteer fire department is located in Telkwa. Police services (RCMP) are provided by the British Columbia government from Smithers.

• Shopping - Various stores, services, and restaurants.

• Other - three churches, library, museum, creamery, Post Office

Local Government services

• Post Office, garbage pickup, street lighting, road maintenance, and animal control.

Utilities

• Power - BC Hydro and Power Authority provides 138 kV three phase power.

• Water - Community water service

• Natural Gas - Pacific Northern Gas Limited provides continuous supply to over 200 residents.

• Sewage - Recently completed a major sewer project.

• Solid Waste - Regional transfer plans to be reviewed with BNRD

5.2.4 Houston

General

The history of the town dates back to the early 1900s when it was established as a tie-cutting centre for the Grand Trunk Pacific Railway. Forestry continues to be the major industry within the area but the town has diversified due to tourism, nearby mining developments and agriculture.

Social and Demographic Profile

The population of Houston was 3707 in 1993. The growth rate for the town, and the current population, has been effected greatly by the closing of operations at the Equity Silver Mine in 1994.

To compare available information with other major centres in the region, the 65+ age bracket and <4 year age bracket constitute 4.3% and 9.0%, respectively, of the population in Houston. Houston, therefore, has a very similar population spread with Smithers. The average number of persons per household in town is 2.9.

Main Industries

Manufacturing (including wood processing and pulp and paper manufacturing), primary industries and retail trade are the main industries supported by the town. Houston is home to the largest (Northwood Pulp and Paper) and fourth (Houston Forest Products) largest sawmills in British Columbia. The retail

trade sector includes businesses that provide goods and services to the forestry, mining and construction industries as well as to the general public.

Labour Market and Employment

At the 1991 census, 52.6% of the population of Houston were in the labour force and 25.7% of this group were employed in the manufacturing industries, 18.6% in primary industries and another 18.0% in the trade industries. The forestry and pulp and paper sectors combined have a major influence on the employment conditions in the area of Houston.

Houston has an unemployment rate of 10.5%. The participation rate of 72.4% is slightly higher than the provincial rate of 67.6%.

Housing and Accommodation

• Private - The town has 1235 private dwellings.

• Motels - The town has 2 motels with a total of 113 units.

• Hotels - The town has no hotels.

• Other - There are 3 RV Parks with a total of 106 units capacity and 1 campground with 11 sites.

Currently 11 lots (1 - 2 acre lots) of serviced industrial land are available for development. The town is encouraging new building, both private and industrial, within the town boundaries.

Community Services

• Education - Two public elementary schools, a secondary school, one private elementary school, an alternate school, and Northwest Community College.

• Fire and Police Services - A volunteer fire department is located in Houston. A RCMP detachment is located in town.

• Shopping - Various stores, services, and restaurants.

• Other - library

Local Government services

• Post Office, Social Services and Housing.

Utilities

• Power - BC Hydro and Power Authority provides 138 kV three phase power.

• Water - Four wells (three in service and another held for fire fighting purposes due to water quality) have water licence on nearby lake but not required at this time, currently reviewing capabilities

• Natural Gas - Pacific Northern Gas Limited provides continuous supply.

• Sewage - over 50% of town area has sewage service, other areas on septic systems

• Solid Waste - Currently using landfill site near Knockholt, regional transfer plans to be reviewed with BNRD

The existing municipal services are sufficient to handle a 50% increase in population growth (Houston, Room to Grow, Houston & District Chamber of Commerce).

5.2.5 Bulkley-Nechako Regional District (BNRD)

General

The Bulkley-Nechako Regional District encompasses over 73 100 km^2 of land between the northwestern corner of the province to Morice Lake and Vanderhoof in the south and east. The district has enormous wealth in raw materials including forestry, base metal and non-base metal mining, and fish and wildlife.

Social and Demographic Profile

The population of the regional district was estimated at 38,343 in the 1991 census. A population growth rate for the previous 5 years from 1986 was 2.3%. This growth rate is below the provincial rate of 13.8% for the same period.

The 65+ age bracket and <4 year age bracket constitute 6.0% and 9.1%, respectively, of the population in the district. These values compare with the provincial levels of 12.9% and 6.7%. The average number of persons per household in town is 3.0.

Main Industries

Primary industries (including forestry, mining and agriculture), manufacturing (including wood processing and pulp and paper manufacturing), and trade industries are the main industries supporting the district.

Labour Market and Employment

At the 1991 census, 51.0% of the population was in the labour force. 20.5% of the labour force was employed in primary industries, 15.9% in manufacturing

and another 14.6% in trade industries.

Bulkley-Nechako has an unemployment rate of 12.8% which is higher than the provincial average of 10.3% and the national average of 10.2%. The participation rate of 71.7% is also higher than the provincial rate of 67.6%.

Housing and Accommodation

• Private - BNRD has 12 630 private dwellings.

• Motels / Hotels/Lodges - BNRD has numerous motels, hotels, and lodges.

5.3 Cultural and Heritage Resource Assessments

The past approval processes for the Telkwa Coal Project resulted in several historical and cultural assessments that collectively covered the Project area. These reports are reproduced in Appendix 10. Manalta has also summarized the history of coal mining in the area (Section 5.3.3). Figure 5-1 indicates the sites identified by Borden numbers and some of the locations and names of historical features, particularly old coal operations.

Aboriginal use and historic and pre-contact occupation of the Project lands are also mentioned in Section 12.0

5.3.1 Historical Resources Overview

The Stage I Heritage Resources overview of the Telkwa Project area was conducted by I.R. Wilson Consultants Ltd. in 1983. The study is included in Appendix 10. This report reviewed the Native use and sustenance of the area, provides ethnographic information, provides a brief post-contact history of the area, and rates the Project area as to Heritage Potential. some the historical features mentioned in this report are indicated on Figure 5-1.

5.3.2 Stage II Application Study 1984

In 1984 Shell Canada Ltd. commissioned I. R. Wilson Consultants Ltd. to conduct a Stage II Heritage Resources Inventory and Impact Assessment for the Telkwa Coal Project in its Stage II configuration (Appendix 10). This configuration corresponded roughly to the Pit 3 Mine area, satellite pits, plantsite, and the rail loadout area.

The Wilson study identified four historic sites in the Goathorn Creek area. Several other sites identified in the Telkwa area or along the CN Railway appear

to be sites identified by other sources. Those sites of some relevance to the present Project area (Figure 5-1) are as follows:

GdSr 8. Identified in Lot 1144 just north of the original Hubert Siding. No information was given on this site.

GeSs 7. An unidentified site in the middle of Telkwa near the fairgrounds.

GeSs 1. An unidentified site near the north end of the CN Rail bridge near the middle of Telkwa.

GdS 1. A large historic site, probably the mining camp for the Number 3 Mine and possibly the Number 1 Mine.

GdS 2. The Number 1 Mine of Bulkley Valley Collieries Ltd., largely destroyed.

GdS 3. The Bulkley Valley Collieries #2 Mine opened by Asa Robinson in 1938 and operated until 1958. The mine was an underground operation. During the period 1945 to 1951, 90,500 tons of coal were mined from this operation.

GdS 4. Historic site possibly an old bridge, or a mining or logging camp.

Most of these sites can be located in the field. Manalta will confirm and map these locations in order that they are avoided during detailed mine planning.

No further work was recommended at sites GdSs1, GdSs 2 or GdSs 4 even if affected by the Project.

The mitigation recommended for site GdSs 3, if affected by mine development plans, will be to record, map and photograph the sites.

In 1985, CNRL commissioned a Heritage Resources Assessment covering a water intake structure on the Telkwa River and pits west of Goathorn Creek (the Pit 3 satellite pits), which was added as an amendment to the Stage ll Assessment. No heritage sites were found. This amendment is included in Appendix 10.

5.3.3 Stage ll Amendment 1990

In the late 1980's CNRL approached government to amend the Stage ll approval for the Telkwa mine to allow the inclusion of the North Mine (Pit 7 & 8) Area. A Historical Resource Inventory and Impact Assessment was conducted by I.R. Wilson Consultants Ltd in 1990 for the North Mine and Infrastructure area. Appendix 10. No further work was recommended on the north side of the Telkwa River. Wilson also did more work on the south side of the Telkwa River in the Pit 3 Area resulting in one additional site (GdSs 5) being recorded.

GdSs 5 This site was identified from a 1989 Cat operation. It consisted of three obsidian bifaces that are complete. They may represent either finished knives or biface platforms for smaller spears. Wilson noted that the occurence of such artifiacts in one place is highly unusual but little else was found in the area.

This site will be disturbed by the development of Pit 3. Manalta will follow the recommendations of Wilson and will have a qualified person on site when

the site is disturbed to inventory any other artifacts that may be exposed. This further work will be done in consultation with the Heritage Conservation Branch.

5.3.4 Coal Mining History

A brief review of coal mining history in the Project area indicates coal mining has been an integral part of the socio-economic landscape of the Bulkley Valley. Interests in the coal deposits along the Telkwa River appear to have started around the end of the nineteenth century. Wilson reports that a surveyor (A.L. Poudrier) noted coal outcroppings in the area as part of the justification for a road into the Bulkley Valley.

The construction of the Dominion Telegraph line in 1899 began the settlement of the Valley by Europeans. The first coal claim for coal in the Bulkley Valley region was on Goat Creek (now Goathorn). This claim produced some coal for local production.

By 1906 Cassiar Coal Company had a camp in the vicinity of the present Manalta Coal Ltd. Core shack and had drilled two rotary holes at Telkwa and near the later Aveling Mine (Figure 3-10). A second camp, established by Webster, was located several miles up Cabin (Cabinet) Creek. Two other firms were also reported to be working in the area.

Leach (1907) described the coal deposits in the area. Leach reported the edges of most of the major coal measures in the area, including the Telkwa north deposits, the Mud Creek deposit (Tenas Creek), Goat Creek (Goathorn) deposits and the deposits up Cabin Creek (Cabinet Creek).

Leach also noted the high degree of erodibility of the coal formation rock making it impossible to find resistant outcropping anywhere than in the Creek bottoms.

Leach noted that the Grand Truck Pacific Railway was coming to the area. One possible routing for the railway was through the Telkwa Pass. When he was working in the area, the only town was Aldermere.

Over the next few years, several companies explored in the area including the Grand Truck Pacific which concentrated on the Tenas area. Telkoal Ltd. explored the north bank of the Telkwa river. Exploration methods at that time appear to have consisted of driving adits into valley wall exposures, (some over 100 feet in length), or sinking shafts vertically to intercept the seams.

The first confirmed production of coal was from the McNeil Mine right at creek level on the lower portion of Goat Creek in 1918. Mining started at a rate of 14 tons per day and later up to 45 tons per day. Coal was hauled out by Sleigh to the Telkwa siding and sold in Prince Rupert. Other sources state this Mine operated during the period 1922 to 1929. Asa Robinson was a key figure in the operation of the McNeil Mine.

Between 1920 and 1925 the Aveling Mine operated in its first phase on the north bank of the Telkwa River with very small levels of production. The Mine produced again in the Second World War at which time a bridge was built across the Telkwa River to the Mine. Government geological maps indicate two locations for Aveling mine (Figure 3-10), possibly indicating two entries or two periods of mining.

The records suggest coal production in the area was fairly continuous from the early 1920s through to it ending in 1986. Production rarely exceeded 10 000

tonnes per year and probably averaged much less.

During 1926 and 1927 production reached the levels of 1,280 and 1,700 tons per year from a mine in the Goat Creek Valley south of the now closed McNeil Mine. The increased production was assisted by the Province of British Columbia building roads into the area.

The Number 1 Mine of Bulkley Collieries started operation under Mr. Dockrill in 1930 after the Bulkley Valley Collieries Number 2 Mine started operations in 1943. Production during the late 1940s and early 1950s was about 9,000 tons per year and the price was $ 8.00 per ton for run-of-mine and up to $10.47 for sized coal. The Bulkley Valley Collieries number 3 mine opened in 1950 with its major customer being Columbia Cellulose at Prince Rupert. Coal was trucked to Telkwa where coal bunkers loaded train cars.

In 1951, the Federal Government in conjunction with Bulkley Valley collieries drilled 33 diamond drillholes on both sides of the Goathorn Creek valley in an attempt to locate commercial quantities of coal.

In 1954, J.D. Chapman, a landowner north of the Telkwa River sank a shaft, presumably on his land , intersecting several coal seams.

In 1955, the industrial market disappeared and production was mainly for domestic use.

In 1962, Mr. J. D. Carnhan assumed management of the mines and built a modern screening and crushing facility.

In 1966, Luscar began stripping in the Number 2 Mine area . In that year 7,791 tons were produced from the surface and 3,070 tons underground. Luscar's involvement continued under Forestburg Collieries until 1970 when its option on the property expired.

Between 1972 and 1986, Mr. Lloyd Gething held an option agreement with Carahan and mined 15,250 tons both from underground operations and the Number 4 open pit.

The Gething Mine is identified on Figure 5-1 as the Luscar open pit. Work in this area was started by the Dockrill family some time after the closure of the McNeil mine in 1929. It seems the Docrills mined underground. Lloyd Gething operated an open pit mine at this site through to the early 1980s when Gething ceased the last mining in the area. Gething's mine apparently has erased all traces of the Dockrill operation.

In 1978 Shell Canada Ltd. became involved with the Telkwa property through its subsidiary CNRL.

5.4 Public Health

This section deals with the current level of health and community services available in the region. Existing community health facilities have been addressed briefly.

Hospitals

The Bulkley Valley District Hospital is the only facility in the region that provides surgical and hospital care. The nearest hospitals are in Hazelton to the north and Vanderhoof to the east. Complicated or specialized care requirements are handled outside the region.

Health Units

The Skeena Health unit operates offices in Smithers and Houston to provide basic medical services. Home care nurses who provide out-patient care operate from the Health units as well.

Health Canada operates a clinic in Houston under the Department of Indian Affairs.

Ambulance Service

Ambulance service is operated from Smithers and Houston only.

Volunteer fire departments have trained people in all the centres who provide first response care (spinal boards, CPR, Save the Life).

Smithers and Houston also have optometrist, physiotherapist, dental and other health services. Various social and community programs including alcohol and drug counselling, parenting and pregnancy support groups, and other health services are available in all centres.

6.0 ANCILLARY FACILITIES

6.1 Rail Loadout

The proposed rail loadout is sited immediately adjacent to the CN mainline just north of the Hubert Creek bridge (Figure 6-1). This location minimizes the length of new track construction required for the project development. The loadout area will include a truck dump, train loading station, rail loop, and stockpile area.

Clean coal will be transported to the rail loadout on a 12 hour per day, 7 day per week hauling schedule. Manalta Coal Ltd. is proposing a slow loading yard style facility where an empty car set will be dropped off to be loaded and a loaded car set will be picked up. The train loading activity will operate on the same schedule as the coal haul, 12 hours per day, 7 days per week. Unit train sets will be comprised of 50 cars rather than the standard 106 car set used for the Northeast BC coal mines. There will be 200 trains per year, an average of four per week, to move the one million tonnes of clean coal from Telkwa to the Ridley Island port facilities.

A rail loop with a minimum diameter of 500 m will be required to turn the trains around. The loop will be constructed adjacent to the CN mainline and will tie into the main line about 500 m north of the Hubert Creek bridge. Sufficient room will be provided to allow for the coal trains to be loaded without interfering with mainline traffic by parallel tracking the mainline northward. The 500 m diameter rail loop can be mostly located on the lower river flats

north of Hubert Creek; however, the south sector of the loop will cross the creek twice and encroach onto another river flat area which is currently under cultivation. Tree clearing will be minimized in the rail loop area to maintain natural visibility screens to landowners located east across the Bulkley River.

The truck dump hopper and stockpile area will be located on a small hill above the rail loop. The coal trucks will normally dump directly into the hopper; however, a ground stockpile will be maintained to provide uninterrupted train loading as a contingency in support of the coal haul. A transfer conveyor will move the coal from the truck dump to the elevated surge bin located above the tracks. Water sprays will be used to control dust on the ground stockpile.

The train loading station will be located on the lower area, and will include a surge bin, weigh bin, and chute work to provide an efficient and dust free loading facility. The rail cars will be weighed using a track scale before entering the station and the required coal payload will be achieved using the weigh bin. After loading, the cars will be sprayed with latex emulsion (or equivalent coal tar based chemical) to minimize the dust loss during transport. The complete train loading station will be enclosed in a heated and ventilated building to provide for year round operation.

A yard locomotive will be required to shunt the cars during the loading operation. A small maintenance and storage building will be provided. A control room will be located in the train loading station where a loadout operator will be continuously stationed to monitor the coal hauling, dumping and loading operation. Communication equipment will be provided to maintain communication with the minesite and the railway.

6.1.1 Alternate Loadout Locations

A number of alternatives for the location of the clean coal loadout facility and the associated railspur near the confluence of Hubert Creek have been considered. The Project Concept document located the rail loop as shown on Figure 6-1, Option 1. Comments received through the Public Consultation process suggested relocation of the loop to minimize encroachment on agricultural land. The relocated loop has been moved as far north as possible on the lower valley area, about 500 m, to minimize use of existing grazing land. However, the proposed loop still crosses Hubert Creek and requires about 10 hectares of grazing land south of the creek. The relocated loadout site selected also utilizes the natural terrain to minimize visual impact.

Another location for the loop was considered about 2.3 km south of the proposed location and is identified as option 2 on Figure 6-1. This site was also considered to reduce the effect on grazing land however this location lengthens the coal haul and requires the use of about 2 km of Lawson road by the coal haul trucks. Safety concerns could arise with the use of Lawson Road by both mine equipment and public traffic.

The alternative of using a rail siding instead of a loop was also considered and is shown as option 3 on Figure 6-1. This option minimizes the land purchase requirements. The siding was located on the old CN Hubert station right-of- way which has a length of 2 000 m. The loadout would be located in the centre of the siding near the MacDonald farmstead. The clean coal haul road would be routed across grazing land from Lawson road to the loadout site. This option is not preferred due to its effect on the existing landowners.

Other rail loadout locations will be investigated during the Project Review process.

6.2 Mine Service Complex

A heavy equipment repair and service complex will be provided at the plantsite to maintain and service all mine and plant mobile equipment. The overall complex will incorporate equipment repair and service bays, a washbay, a warehouse and tool crib, machine and welding bays, an electrical shop, and a general office area. (Figure 2-10)

6.2.1 Heavy Equipment Repair and Service

The main heavy equipment repair, service, and wash area will be devoted to mine equipment servicing and repairs, and will consist of a number of bays. The high bay section will allow for the raising of the boxes of the large off-highway waste haulers for servicing and repairs. These bays will be serviced by a travelling overhead crane.

The bulk lube and oil storage area will provide for the storage and distribution of all oil, lubricants, and anti-freeze requirements. A waste oil storage tank will also be provided in this area.

The wash bay area will feature a hot water heating, dual pressure pumps, soap storage tanks and a water recycle system that will feed to hose reels mounted on the wash bay walls. A high pressure water booster pump will be provided for spraying and rinsing. The water recycle sump and the oil interceptor system will be provided outside the wash bay pit to separate oil from water and a waste oil tank to store the residual oil. Any overflow water will be directed to the sewage treatment plant.

6.2.2 Warehouse and Storage

The warehouse will be a pre-engineered structure connected to the equipment maintenance bay. Forklift access from the warehouse to all repair bays will be provided. The warehouse will serve as the main distribution centre for the mine and preparation plant. An office area will be provided in the warehouse for receiving and shipping, together with secured areas for small parts storage and tool crib. One covered truck unloading door will be provided for receiving stores. A fenced outside warehouse storage area will be provided adjacent to the building.

6.2.3 Dry Facilities

The hourly employee dry facility will consist of dry facilities, staging and dispatch area sized for 200 operations personnel. The dry will be directly connected to the administrative and engineering offices. The dry will serve all mine and plant staff and hourly employees. The wash and shower facilities will be designed to handle the shift change total for all categories of employees using the dry.

6.2.4 Administration Facilities

The administration section will provide offices for minesite senior management, accounting, purchasing, labour relations, and facilities personnel as well as conference and meeting rooms. Space will be provided for a staff of approximately 30 people. Facilities will be provided for staff washrooms, engineering and drawing office space, supplies storage, records, vault, computer section and reference material storage room. Additional space will be provided for general office facsimile, photocopier, training, drawing storage, printroom and lunchroom.

6.3 Electrical Power Supply

Electrical power is available from the B.C. Hydro 138 kV overhead line which runs North to South along Lawson Road. The average electrical requirements for the mine and surface plant are estimated at 7.5 MW. The main 138/25 kV substation will be located near the rail loadout facilities. Power will be supplied from this main sub to the rail loadout facilities. A 8.0 km long 25 kV overhead powerline will be required from the main substation to the plantsite. It will parallel the proposed access road. A secondary 25/6.9 kV substation will be provided at the plantsite to supply power to the mine service complex , the preparation plant, and other facilities.

6.4 Natural Gas Supply

Natural gas is available from the existing 150 mm diameter Pacific Northern Natural gas pipeline located approximately 2 km north of the plantsite. A 2 300 m long buried pipeline will be provided to bring the natural gas from the existing junction building to a station near the plantsite. The pipeline will follow the existing right-of-way to Coalmine Road and will then parallel the east edge of Coalmine Road south to the plantsite.

6.5 Water Supply

The average fresh, domestic and firewater requirements for the mine and surface plant are estimated at 30 m^3 per hour. The present concept assumes that the most reliable source of fresh water supply will be from the Telkwa River.

A water supply pumphouse will be provided to supply the annual water requirements for the entire plant and mine use. The water supply pumphouse will be located downstream of Goathorn Creek in the Telkwa River as shown on Figure 2-10. The pumphouse and wet well within the river will contain three vertical turbine supply pumps and electrical controls required to convey fresh water via a 3 300 m long buried 300 mm diameter high density polyethylene

pipeline to the plantsite storage tanks. The buried pipeline will be located along the east side of Coalmine Road. The water supply line will discharge into a head tank located at the preparation plant.

6.6 Fuel Storage and Distribution

The main fuel storage compound will be located near the mine service complex. It will consist of one 265 000 L diesel fuel tank and one 32 000 L gasoline tank. The entire fuel storage facility will be surrounded with a berm area that provides a volume equal to the volume of the largest tank plus 10% of the volume of the remaining tanks. A pumping facility will be provided outside the bermed area to unload the supply trucks and transfer the fuel to the storage tanks. Diesel and gasoline pumping stations will be provided adjacent to the berm for filling mine and plant mobile equipment.

6.7 Sewage Treatment

Sewage effluent from the preparation plant and surface facilities will be collected by buried PVC gravity sewage lines and directed for treatment to a packaged sewage treatment plant. The solid effluent will be retained and treated in the plant and the liquid will overflow into an adjacent percolation tile field. The design of all the systems will be consistent with the requirements and regulations governing individual sewage disposal systems for the Province of British Columbia.

6.8 Road Access

Access to the Telkwa Coal Project site, off Highway 16, will be over an existing bridge on the Bulkley River located in the village of Telkwa and then 4 km south on Lawson Road. A new 7.8 km long private access road will be constructed from Lawson Road near the Hubert Creek crossing to the plantsite. This road will be constructed as a secondary gravel roadway with a width of 12 m to accommodate the large clean coal haul trucks. A controlled level crossing will be provided at the intersection of Lawson Road and the access road.

The Goathorn Creek portion of Coalmine Road will be maintained to the plantsite for emergency use only.

6.9 Port Facilities

The coal from the Telkwa Coal Project will be transported by rail to the Ridley Island transshipment facilities near the Port of Prince Rupert, British Columbia. The Port facility is owned and operated by Ridley Terminals Inc. and was commissioned in 1984 to service the Bullmoose and Quintette coal mines located in northeastern British Columbia.

The Port has a design capacity of 12.0 million tonnes per year. Recent discussions held with representatives of the Port facility during the Pre-application consultation period indicated that there would be sufficient capacity with existing infrastructure to handle up to 1.5 million tonnes per year from the Telkwa Coal Project.

7.0 PROJECT TIMELINE AND CONSTRUCTION PLAN

The project timeline and construction plan for the Telkwa Coal Project have been prepared using:

• the B.C. Environmental Assessment Process guidelines,

• Manalta Coal Ltd. internal planning requirements and market opportunities,

• typical engineering and procurement timetables, and

• typical construction periods based on seasonal weather conditions

Major milestones are shown in the following project timeline (Figure 7-1). A detailed description of these milestones is given below.

7.1 Overview

A Project Concept document was circulated during the pre-Application consultation phase that was undertaken between October, 1996 to January, 1997.

The Project Approval process was initiated in February, 1997 with the submission of this application for a Project Approval Certificate. This process is estimated to take eighteen months with a Project Approval Certificate anticipated in July, 1998.

Applications for the required government permits will be submitted immediately following the Project Approval stage. Initial site preparation and construction activities will commence in April, 1999 and continue until early the following year when commissioning of equipment and facilities will occur. The first coal production is expected in May, 2000.

The Environmental Assessment process is on the critical path of the project development timetable and any delays in receiving a Project Approval Certificate will delay the commencement of coal production. Key Project dates are as follows:

Event Expected Date

Submit application February, 1997

Submit Project Report March, 1998

Receive Project Approval Certificate July, 1998

Receive Government Permits July, 1998 - May, 1999

Commence On-site Construction April, 1999

Commence Overburden Removal November, 1999

Commissioning of Preparation plant March, 2000

First Coal Shipment May, 2000

Manalta's ability to meet the schedule is dependent on the successful completion of a number of specific Project components as outlined below.

7.2 ARD Kinetic Testing

The drillhole core data from the 1996 exploration program was analyzed for ABA determination in late 1996. The analyses and interpretation of the results are detailed in Appendix 4. Individual cores representative of the materials to be handled in the mining operations were also prepared for kinetic testing. Humidity cells were prepared, with input from individuals in MEI and MELP, for testing over extended periods of time. The kinetic testing will continue throughout most of 1997 to determine the potential for materials to generate acid, the time until acid generation commences, and the type and quantity of metals released after acid generation. The data will be reviewed by Manalta Coal Ltd., consultants retained by Manalta Coal Ltd., and regulatory agencies with expertise in this area. The public will be part of this process. This information will then be used in the design of materials handling plans and mitigation plans.

7.3 Environmental Assessment Process

This application initiates the B.C. Environmental Assessment process. Future work schedules are controlled by guidelines established by the Environmental Assessment Office.

Project specifications will be developed by the Project Committee outlining any government requirements and studies to address issues raised during the pre-Application and Application stage consultations. Various baseline studies, over and above those already completed for previous applications, will be required for specific areas. These areas will be identified during the Application Review stage scheduled for February to May, 1997.

A Project Report containing the results of the studies detailed in the project specifications will be prepared and submitted to the Project Committee. The time required for the preparation of this Project Report will depend on the specifications detailed at the end of the Application Review stage, but it is expected to be approximately nine months. A Project Approval Certificate would then be issued subject to the outcome of the review of the Project Report.

Sufficient times have been allowed for the review and comment of all required materials by government agencies, First Nations and the public. Manalta Coal Ltd. will also undertake an intensive public involvement program to occur during the Application and Project Report phases to ensure public understanding of the Project and the associated issues and the appropriate public input is acquired during the approval process.

7.4 Government Permits to Construct

After the Project Approval Certificate has been received, the required governmental permits will be sought. A total of 43 weeks has been allowed to obtain all relevant permits. The permits required to commence initial site clearing and construction will be targeted first.

An initial listing of the required government permits is shown below but the list will be reviewed with government agencies to ensure completeness.

• Special Use Permit (Forest Act)

for construction and use of access road,

• Industrial Road Permit (Highway (Industrial) Act)

to join access road to public road,

• Sewage Disposal Permit (Health Act)

for construction and use of a sewage disposal system,

• Energy Removal Certificate (Utilities Commission Act)

for use of energy from Public Utilities,

• Water Licence (Water Act)

for diversion and or use of surface water,

• Air Permit (Waste Management Act)

for discharge of emissions from the preparation plant and mine activities,

• Refuse Permit (Waste Management Act)

for solid waste disposal on site,

• Special Waste Permit (Waste Management Act)

for storage of hazardous waste materials prior to disposal.

7.5 Detailed Feasibility Studies

Manalta Coal Ltd. will continue to improve its understanding of the Telkwa property during 1997 by completing infill exploration drilling in the mining areas south of the Telkwa River. In particular, target areas include:

• rotary drilling to confirm coal intersects in Pit 3 and nearby satellite pits,

• rotary drilling to obtain data for foundation analyses for the preparation plant, rail loadout and office and shop facilities, and

• rotary and core drilling to confirm hydrogeological baseline information.

This drilling will be used to increase the confidence of the mine plans and subsequent financial analyses and provide data for more detailed engineering design work. This process will continue independently of the Environmental Assessment Process.

7.6 Detailed Engineering

Engineering designs for the preparation plant, rail loadout, office and shop facilities and other infrastructure will be initiated in early 1998 and are expected to take 12 months. These designs are required before tender documents can be issued for construction purposes.

The purchase commitments for equipment and facilities requiring extended manufacture and delivery times will also be made during this stage.

7.7 Construction

Tenders for the construction of the mine access road, preparation plant, rail loadout, shop and office facilities and the site clearing are expected to be completed in late 1998 and early 1999. Depending on the weather conditions and the amount of snowfall in the area, on-site construction will commence in April, 1999. The start of construction depends on:

• the date of the Project Approval Certificate, and

• the prevailing weather conditions.

If the Project Approval Certificate is received earlier than July, 1998, government permits for specific items could be obtained and some clearing and site preparation activities commenced in late 1998.

The site preparation for the facilities and construction of the mine access road will be completed first to allow access to the site for heavy equipment and construction personnel. The construction of the rail loadout, preparation plant, shop and office facilities will be completed several months later in early 2000. Construction of the preparation plant will require approximately 10 months time and will be the last facility commissioned in the second quarter of 2000.

7.7.1 Construction Manpower

The construction of the infrastructure identified in Section 7.7 will be completed by individual contractors with the required expertise in their appropriate field. The local workforce will be relied upon to supply labour, specialized equipment and services, and facilities. An estimated 170 to 200 people with varying skill levels will be required for a period of approximately 12 to 15 months commencing in late 1998 or early 1999.

The required skills of the construction workforce will vary during this phase. Initially, heavy equipment operators will be required to build the mine access road, prepare the building sites for the preparation plant and shop facilities, and construct the rail loadout area. Building construction personnel will then be required for the framework and exterior of site buildings. Tradespeople would then complete the fitting of equipment and machinery, and interior furnishings.

7.8 Preproduction

Major mining equipment will be delivered on site and assembled during favourable weather conditions in mid to late summer of 1999. Removal of till and overburden in the Tenas Pit will commence in late 1999. The material excavated from the mining areas will be used to construct a raw coal road between the Tenas Pit and the preparation plant area.

7.9 First Coal Shipment

Start up of the coal handling and preparation plant facilities is scheduled for March, 2000 and will continue for approximately 2 months. During this time, initial coal recovered from the preproduction phase will be processed to ensure the correct workings of the coal processing facilities.

The first coal shipment to the port, subject to favourable market conditions, is scheduled for May, 2000.

8.0 PUBLIC WORKS OR UNDERTAKINGS

8.1 Regional Infrastructure Requirements

During the preparation of this Application, and during previous applications for earlier layouts of this mine, Manalta Coal Ltd. was not made aware of any need for major infrastructure in the Telkwa region. Consequently, the Application and Project plans were submitted based on certain assumptions relating to the availability of existing infrastructure to support Project requirements; for example, services and accommodations for Project workers.

8.2 Local Social Infrastructure Requirements

Smithers, Telkwa and Houston have all indicated to Manalta Coal Ltd. that they have significant supplies of town lots and services in various stages of availability to handle anticipated growth. The Village of Telkwa has some immediate issues with its municipal water supply.

In Telkwa, any significant growth in population will soon trigger the need for a new elementary school. In the local area of the Project, generally the Bulkley Valley between Houston and Moricetown, some effects on local social infrastructure will be felt, such as increased numbers of school children.

8.3 Infrastructure Requirements or Upgrades

8.3.1 The Bulkley River Bridge in Telkwa

This bridge is the principal local transportation issue. The bridge has a rated GVW of 58 000 kg, is narrow and has restrictive approaches. All local traffic and resource industry traffic crossing the Bulkley River south of the Telkwa River must utilize the bridge. Presently, the bridge sustains heavy logging traffic from the Telkwa River watershed.

Traffic conveyed into the Village of Telkwa by the bridge is also an issue, particularly on Coalmine Road. The Telkwa Project will increase the utilization of this bridge. The Company estimates that about 80 percent of the traffic generated by the Project will cross the bridge in Telkwa over the Bulkley River. The traffic will utilize Highway 16, the bridge and Lawson Road by way of Birch Street. The mine related traffic will include staff and workers, suppliers and contractors during mine operations. More traffic will occur during the Telkwa Project's construction phase than during mine operations.

During the fall of 1996 the Ministry of Highways surveyed a new approach to the bridge from the west. The proposed realignment is to make the bridge approach safer. The Ministry feels that in the near term the entire bridge may have to be realigned. This realignment would consist of rotating the bridge more to the south on the west bank and to the north on the east bank of the river to improve the approaches to the bridge. The increase in traffic through Telkwa due to the development of the Telkwa Mine would probably be a contributing factor in any decision to do this work.

8.3.2 A Bridge over the Telkwa River

The Telkwa River has no bridge across it from its confluence with the Bulkley River in the middle of the Village of Telkwa and west upstream to allow north/south traffic west of the Bulkley River. Historically, two bridges crossed the Telkwa River. A highway bridge existed in the middle of Telkwa Village, parallel to and just upstream of the CN Rail bridge. The piers of this bridge still stand. It was apparently taken out by a flood during the early 1940s. This bridge connected Tatlow Road with the centre of Telkwa.

A second bridge also crossed the Telkwa River further west about 10 km from the confluence of the Telkwa and Bulkley Rivers. This was a low level bridge apparently built to provide access to the Avelling Mine. It crossed the Telkwa River at the boundary between Lots 221 and 230. This bridge apparently burned down in the early 1970s. This bridge continued to provide access, although circuitous, across the Telkwa River and on into Smithers by way of Chapman and Tatlow Roads.

In 1990, CNRL amended its Stage II application to reflect improved Project economics, which was achieved by moving the initial mine development, the preparation plant and rail loadout to the north side of the Telkwa River. Under this Project configuration, the need for a bridge across the Telkwa River became important. If mine workers had chosen to live in Telkwa they would have been unable to drive directly to work north across the Telkwa River. They would have had to drive into Smithers and then down Tatlow Road to the preparation plant.

Several years ago Pacific Inland Resources (PIR) expressed strong interest in a new bridge over the Telkwa River. This bridge could be important in terms of reducing forest industry traffic on Coalmine Road and over the Bulkley River bridge in Telkwa. The Telkwa River bridge, for Pit 7 & 8 access, proposed in Year 18 of the Project may be available for Public use after mine closure.

8.3.3 West Telkwa Realignment of Highway 16

The Telkwa Mayor and some councillors have mentioned to Manalta Coal Ltd. that the Ministry of Highways may, in the long term, consider a realignment of Highway 16 west of Telkwa. The Ministry of Highways indicated that this was a most tenuous idea as it involved two major river bridges.

8.3.4 Lawson Road and Telkwa Forest Service (FSR) Road Access

The road access to the Telkwa Coal Project from the north will follow Lawson Road from just west of the Bulkley River bridge in Telkwa. From Coalmine Road to the proposed mine access road is about four km.

Project traffic from the southern portion of the Bulkley Valley could travel to the Project by taking the East Quick Road, the Quick Bridge and Lawson Road.

All heavy or wide loads will be routed from Houston over the Morice River bridge and north on the Telkwa FSR due to load constraints on the bridge in Telkwa.

When the Project is developed, these roads may require some minor improvements as a result of increased traffic volumes and weights. These decisions would be made by the Ministry of Highways, which maintains the roads.

8.3.5 The Quick Bridge

The Quick bridge, rated at 8 000 kg GVW, requires significant repairs in the near future to its deck and piers. Occasional light Project traffic will use this bridge, but this additional traffic is not anticipated to influence the future of this bridge.

8.4 Infrastructure Contributions by the Project

In the long term a number of mine infrastructure items could be useful to the local road and bridge infrastructure. On mine closure, Manalta Coal Ltd. will have to either remove and reclaim infrastructure, such as the bridge over the Telkwa River, the crossing of Goathorn Creek and the mine access road, or find an acceptable local authority to take responsibility for such facilities.

A number of mine structures may be useful to the Ministry of Highways or other infrastructure authorities in the area.

The Telkwa River Bridge

The Telkwa River Bridge will be built approximately 18 years into the Project and will be required until mine closure. The bridge will be built as a permanent structure and will provide the equivalent width of a two-lane highway bridge with excellent approaches. If it could fit in with long term infrastructure plans, it would be suitable as a highway bridge and be available to the Ministry of Highways.

The Mine Access Road

The Mine access road could be available as a local road, possibly providing access to the upper Goathorn Creek area if this was desirable.

The Goathorn Creek Crossing

This crossing could be left after Mine closure, if useful.

Other Mine Facilities

Manalta Coal Ltd. does not anticipate that any other mine infrastructure would be useful following Mine closure. This application envisions all other facilities being dismantled and sites reclaimed.

8.5 Other Projects

Manalta Coal Ltd. is aware of two other projects in the vicinity of the Telkwa Coal Project.

The PacRim Project

The proposed alignment of the PacRim gas pipeline proposal passes through the Telkwa Project area. Manalta Coal Ltd. has been in contact with PacRim and anticipates that the joint interests of both projects will be achieved through consultation and joint planning.

The Telkwa Pass Highway

Since the days when routes were being considered for the Grand Trunk Pacific Railway, the Telkwa Pass or the Pine Creek Pass area has been considered as a route for transportation. The First Nations people used the route as the Copper Trail.

The concept of a Telkwa Pass Highway seems distant at the present time due to its expected cost. The presence or absence of the Telkwa Coal Project should not be a factor in advancing this highway concept.

9.0 POTENTIAL IMPACTS AND MITIGATION MEASURES

This section identifies the potential environmental and social impacts of the Telkwa Coal Project and addresses the mitigation measures that will be implemented by Manalta Coal Ltd. to ensure the Project is environmentally acceptable.

9.1 Air Quality

In all mining activities, dust will be generated within the Project Boundary to varying degrees and under certain atmospheric conditions. The dust can be generated from either the coal, the associated earthmoving and hauling activities, or blasting.

The coal in the Telkwa deposit is significantly different from the coal found in northeast and southeast British Columbia. Due to the depositional characteristics, the Telkwa coal is considerably harder than coal from the other mines in British Columbia. The Hardgrove index, a measure of coal hardness, for various coal properties is shown in Table 9-1.

Table 9-1 B.C. Mines Hardgrove Indices

Coal Property	Hardgrove Index
Telkwa - 1 Seam	60

Telkwa - 2 - 10 Seam	60
Bullmoose	72 - 82
Quintette	77 - 81
Line Creek	71 - 83
Fording River	69 - 100

Hardgrove Index is a indicator of the energy required to grind a coal to a desired fineness; the lower the index, the harder the coal.

As indicated in Table 9-1, the Telkwa coal is harder than all other coals and, as such, does not break down as much during the mining and processing activities. With less breakage, fewer fines are generated. The fines content of coal is the major factor determining the dusting potential.

9.1.1 Dust from Coal Stockpiles

Project development will require the temporary storage of raw coal and clean coal at the preparation plant and rail loadout. These stockpiles will be continually replenished and handled to maintain the supply of coal to the unit trains. The handling of coal can be expected to generate coal dust, requiring the implementation of dust control measures.

Mitigation Measures

Dust blowing from raw coal stockpiles will be reduced by:

• locating the stockpiles in the shelter of plantsite infrastructure,

• establishing wind barriers (trees or screens), and

• spraying water in the stockpile area on a regular basis.

Sprinkler systems will be installed at the ROM breaker station where the raw coal is transferred to the preparation plant.

The clean coal stockpiles situated at the preparation plant will have a higher moisture content than the raw coal due to the addition of water in the washing processes in the preparation plant. This clean coal will have a moisture content of approximately 10%, thus reducing the probably of dust blowing off the stockpile area under normal wind conditions. This will be supplemented by water spraying as required.

The preparation plant and associated clean coal stockpiles are located up gradient from several residences and subdivisions along the Telkwa River, some of which are within three to five km of the preparation plant. While coal dust is considered unlikely to migrate in substantive amounts to these residences under

normal conditions, several design considerations will be adopted to control the sources of coal dusting; namely, siting the stockpiles in a sheltered area, constructing the stockpiles with low profiles, spraying water and constructing wind barriers as required.

The stockpile located at the rail loadout will act as a buffer between the clean coal haulage fleet and the train loading operation. Sprinklers or some other form of dust suppression system will be installed in the transfer bins at the rail loadout facility.

Established practice in the coal industry is to spray a thin layer of latex on the top of coal loaded in rail cars. This layer of latex binds the surface of the coal and reduces the amount of fine coal blown off during transportation to the port. Another technique used to reduce coal loss due to wind is to manage the profile of the coal in the rail cars. When the top of the coal is kept below the sides of the rail cars, less surface area is subjected to high winds and thus coal loss is reduced.

The CN rail line passing through Smithers and Telkwa is currently used for transporting coal from the mines in the northeast of the province to Ridley Island Terminal near Port Rupert. The dust levels currently experienced along the rail line would not increase significantly.

9.1.2 Blasting Dust

Dust can be generated in two areas in the blasting operation:

• explosion gases prematurely venting to the atmosphere and carrying with it dirt and small rock fragments, and

• the movement of the rock mass across the pit floor.

Mitigation Measures

Dust control in the blasting operations will include:

• watering of the pit floor adjacent to the blasting area to reduce the amount of dust that could be lifted by the explosion gases.

• careful design of the amount and quality of confinement material (stemming) on top of the explosive columns before blasting. This will eliminate premature stemming ejection.

• video recording and analysis of significant blasts to identify potential problems. Explosives suppliers currently offer services to complete blast predictions and in-depth computer analyses of blasts.

9.1.3 Mine Haul Road Dust

Vehicle traffic on mine haul roads is the major contributor during the summer months to dust at mining operations. In particular, large haul trucks travelling between the pit areas, the dumps and the coal preparation plant can generate dust. Dust, if uncontrolled, can originate from the road surface and from the contents of the haul trucks.

Mitigation Measures

A water truck will be dedicated to the mine operating areas to ensure that dust generation is controlled on all active roadways. In addition to its value environmentally, this water truck is both a safety requirement and a cost control requirement. Good visibility is maintained on the haul roads by minimizing the amount of dust generated, thus making the road safe for vehicle traffic. Tire replacement and repair costs, which are a significant portion of the overall mine operating cost, can be reduced by continuous watering of roads to lower tire operating temperatures. Ongoing supervision will also ensure coal haul trucks are not overtopped, which otherwise could result in spillage and dusting.

9.1.4 Pit Operation Dust

Heavy equipment operating within the pits and dumps will create dust.

Mitigation Measures

As mentioned above, a water truck will be dedicated to the mine operating areas to ensure that dust generation is controlled.

9.1.5 Dust from Soil Stockpiles

Soil stockpiled for later reclamation use has the potential to generate dust.

Mitigation Measures

Any soil stockpiles that must be maintained for extended periods of time will be revegetated as soon as practical. The growth of grasses and legumes will provide a cover to reduce moisture loss and to reduce the surface area of the fine dirt. These stockpiles will also be located in strategic locations to reduce exposure to wind and to manage surface water flow.

9.1.6 Dust Management

The Telkwa Coal Project will monitor air quality in the vicinity of the mine and rail loadout facilities to ensure that all dustfall standards set by government regulations are met. To achieve this, high volume and dust fall sampling will be carried out at the Project boundaries to monitor the effectiveness of dust

management. Manalta Coal Ltd. currently operates eight mines in Western Canada and two of these mines are very close to populated areas. The Company has been able to operate these mines and maintain good relations with neighbours by addressing and managing dust issues to mutual satisfaction.

9.2 Noise

Noise is a very subjective issue and careful monitoring is required to ensure that noise levels are maintained within acceptable limits. Four main areas will contribute to increased noise levels from the mining areas and surface facilities.

9.2.1 Blasting Noise

The blasting of overburden to facilitate the mining of coal will generate sound (air blast) that will be heard outside the Project boundary.

Mitigation Measures

Blasting will be confined to predictable times during daylight hours (for example, 11:00 am or 2:00 pm) on weekdays. This schedule will provide sufficient blasted material to meet production requirements and minimize the effect of the blasting noise on surrounding residents. It is during these times that normal background noise levels are highest (for example, traffic noise, household appliances, farm equipment, logging trucks).

The size and geometry of the blasts will also be controlled to reduce air blast. Confined blasts will be avoided where possible to ensure that the explosives provide useful rock breaking work rather than generating wasted energy in the form of vibration, air blast, and backbreak. Industry standard blasting procedures will be adopted and training provided to government certified blasters to ensure that these conditions are maintained.

Standard blasting practices require that millisecond delays be used in all production blasts. The use of these pyrotechnic delays allows for effective ground movement (reduces confinement), reduction in vibration levels (cancellation of out-of-phase frequencies) and reduction in charge weight per delay period (reduces vibration levels).

To meet government seismic and noise standards, monitoring of blasting operations will be conducted as required.

9.2.2 Preparation Plant Noise

The equipment and machinery associated with the preparation plant will be operated continuously. Noise from these operations will be generally confined to the immediate plantsite area.

Mitigation Measures

The preparation plant will be designed to industrial standards and government regulations.

9.2.3 Rail Loadout Noise

The loadout facilities will be operated on a schedule to meet CN train loading requirements. The frequency of trains based on a 1.0 million tonne per year production case is on average four per week. Noise will be generated from the shunting of rail cars during the loading operation.

Mitigation Measures

The access road and loadout facilities will be designed and located to make use of existing topography and tree cover to provide sound protection. The loadout facilities will also be designed to industrial standards and government regulations.

9.2.4 Vehicle Noise

Mine trucks hauling coal from the pits to the preparation plant will generate noise.

Mitigation Measures

The speed of coal haul trucks will be strictly controlled to minimize noise.

Road designs will include the use of sight and sound berms, where appropriate, to limit the noise levels outside the Project boundary.

9.2.5 Noise Management

The residents of Telkwa are presently subjected to noise levels similar to those anticipated during the mining operation, with the exception of blasting. Noise modelling, however, will be completed as for the 1985 application for the Pit 3 Stage II approval. This modelling will support the detailed engineering studies scheduled for mid-1997. Design modifications to mitigate noise levels will be investigated depending on the outcome of the modelling.

9.3 Visual Impact

The construction of the preparation plant, pits and dump platforms, and the rail loadout facility will alter the viewscape for some residents in the vicinity of Telkwa. Reclaimed waste rock dumps and mine pits will become permanent features of the landscape. The effects of mining will be most pronounced during the active mining phase. As individual dumps are reclaimed, especially during early stages of reclamation, they will assume the appearance of regenerating timber cutblocks, which are common features in the regional landscape.

Mitigation Measures

A number of design criteria will be employed when constructing the mine, including:

• the use of low dump profiles to blend in with the topography,

• the continuous reclamation of dumps and pits as soon as practical to minimize the time when viewscapes will be affected,

• the use of tree barriers wherever possible to block views, and

• the selective clearing of trees.

Computer simulations will be prepared superimposing the features of the Telkwa Coal Project on the existing landscapes from selected 'points of view'. These simulations will be based on aerial photography information, building design plans, and surface disturbance plans from mine modelling software.

9.4 Groundwater, Surface Water and Fisheries

9.4.1 Groundwater Supply and Quality

Previous studies of groundwater conditions in the Pit 3 *(Klohn Leonoff, 1985)* and Pit 7 & 8 areas (Piteau Engineering Ltd., 1994. Appendix 6) indicate that groundwater inflows into the open pits will be relatively low to moderate, averaging 50 m^3/hr (Pit 3) to 108 m^3/hr (Pit 7 & 8). These values are indicative of an order of magnitude of flow, rather than a precise number. Short duration exceptional flows may occur when fault zones are intersected, which may effectively double the inflow rate. Average pumping rates, accounting for inflows due to direct precipitation, will likely average about 100 m^3/hr in Pit 3.

Water well inventories conducted in these previous studies indicate that most groundwater users within the Project area rely on water supply wells located within the alluvial plain, or generally from surficial deposits rather than bedrock. Some wells on the floodplain of the Goathorn Creek valley are installed in channel sand and gravel deposits having limited groundwater yielding potential. Residents located on a sand and gravel plain to the northeast of Pit 3 obtain water supplies from the surficial sand and gravel deposits, which comprise a productive aquifer.

Mining activity will result in groundwater inflows to the open pits, requiring dewatering of the pits. The net effect will be the formation of a groundwater drawdown cone, resulting in a general lowering of groundwater elevations. The groundwater drawdown cone will be controlled by local geology and topography. For the Pit 7 & 8 area, local factors, such as the low hydraulic conductivity intrusive rock mass and the deeply incised Telkwa River valley, will limit drawdown cone development.

Water wells in the vicinity of the pits may experience a lowering of water levels, depending on location relative to the drawdown cone. Changes in groundwater quality may also result depending on which aquifers are affected. Any wells located within the alluvial plain would be below the bottom of any of the pits, and therefore would not be adversely affected by the pit development.

Mitigation Measures

Periodic hydrogeological exploration is planned through all stages of the Project development and operations to better define Project interactions with the groundwater regime. This is essential for mine planning, safe mine operation, an understanding of potential effects on groundwater users, and assessment of groundwater conditions after Project closure.

The following factors will combine to minimize the impact of a pit development on groundwater:

• groundwater inflows to mine pits from the bedrock and surficial deposits are expected to be low;

• geological and topographic conditions will limit drawdown; and

• few or no groundwater users are located in the area adjacent to the pits, especially Tenas Pit.

As a result, the impact of mine development on groundwater resources is expected to be short to medium term (probably less than 15 years) and unlikely to affect other groundwater users.

Groundwater supply in the vicinity of the Project area will be monitored to ensure that pre-Project quantity and quality levels are maintained. While no interruption of groundwater supply is expected due to the mining operation, Manalta will formulate a water replacement policy similar to those established at Manalta's other mines, as a contingency planning measure. Any impact on existing wells attributed to mining operations will be mitigated by providing a new well or alternative supply of water.

9.4.2 Surface Water and Fisheries

The surface drainage pattern in the mining areas and around the plantsite will be altered either permanently or temporarily. Potential sources of Project effects on surface and groundwater quality may include the following:

• surface disturbance from clearing, mining and road activity resulting in surface drainage alterations and, if improperly managed, a lowering of surface

water quality in the receiving stream; the parameters of greatest concern are suspended solids, which are harmful to the fisheries.

• diversion of groundwater from inpit dewatering programs to surface waters, resulting in alteration of aquifers available to groundwater users and any potential detrimental mixing of untreated groundwater with surface water; the parameters of greatest concern are dissolved solids and other parameters that could affect the quality of the surface stream waters.

• possible acid rock drainage from acid generating rock materials excavated during mining; the parameters of greatest concern are pH and heavy metals possibly leaching out of the rock materials into either surface waters or local aquifers, which would be detrimental to fish.

• withdrawal of water from the Telkwa River to meet preparation plant makeup water requirements, as outlined in Section 6.5.

• construction of crossings for access and haul roads, some of which may require short term instream construction activity.

Potential impacts to the fisheries resource from mining could include the loss of spawning habitat through siltation of the existing watercourses, and the loss of fish due to changes in water quality. The Mine development plans, described in Section 2.0, do not involve any direct alteration or relocation of the fish bearing stream channels in the Project area. The scope of mitigative measures is therefore focussed on drainage control so that aquatic habitats and fisheries resources are protected and maintained during the life of the Project.

Mitigation Measures

The mitigation of potential offsite impacts to the receiving waters and fisheries begins with onsite management of operations. Systems will be put in place to ensure that any offsite releases of water are within the permitted discharge limits for the Telkwa Project.

These systems will consist of interceptor ditches to ensure that surface water is directed away from the mine where possible, and that any surface water affected by mining operations is directed through the onsite system of settlement ponds prior to release offsite.

Surface runoff or water originating from areas that contain potentially acid generating material will be collected and treated, as required, prior to discharge offsite. To ensure adequate capacity and contingency, all water and drainage management systems will be sized to handle major precipitation events.

Surface water within the Project area will be diverted along collector ditches to settlement ponds for treatment. The treatment may involve addition of flocculants, if necessary, to reduce the suspended solids to acceptable levels as dictated by government regulations. Final detailed design specifications for water control structures will be developed during Project Report and permitting phases.

The current preparation plant design calls for a flow of makeup water to be drawn from the Telkwa River. The maximum volumes and timing of such withdrawals from the River will be designed within limits acceptable to the protection of the fisheries resource. In the event that the required volumes cannot be fully obtained from the River, supplementary sources of makeup water, such as wells, will be developed. This makeup volume will be reduced, if practical, by maximizing the use of recycled water from the tailings pond.

All pits and dumps will be designed to minimize the effect on current drainage patterns. Reclaimed mining areas will incorporate surface drainage features designed to integrate with adjacent drainage patterns. This technology is well established in the coal mining industry.

Local groundwater quality generally falls within accepted water quality objectives and should not impair any receiving water, although this concern will be addressed in further Project planning. Out-of-pit containment structures will be built for treatment of pit water, prior to any offsite release.

ARD concerns are addressed in Section 2.0. The ARD management plans outlined in this application are believed to address possible effects on groundwater and surface water quality. These provisions include materials handling plans and water barriers designed to control inpit and out-of-pit acid generation, with provision for control and treatment options as required. Specifically, measures will be supported by:

• inpit drilling to define site-specific materials handling;

• scheduling of waste rock management to maintain proper blending of potentially acid generating and acid consuming materials in waste rock storage sites;

• incorporation of modern engineering technologies, such as GPS and computerized truck dispatching system, to achieve materials handing objectives;

• integrating all ARD management plans within an ISO 9000 quality management system, as described in Section 14.0.

Some road crossings may require short-term instream construction activity. The location of such crossings and the time of this construction will accommodate the life cycle sensitivities of the fish present in the particular stream. This planning will draw upon the fisheries data base summarized in Section 4.3.

Water quality monitoring stations will be set up on all receiving waters to ensure that any potential impacts from mining operations are minimal. Manalta will also implement a fish monitoring program to ensure that fisheries concerns are properly addressed in project planning and development. This program will draw on the experience gained from the successful fish and aquatic habitat management program at Manalta's Line Creek Mine.

9.5 Vegetation, Habitat and Wildlife

The Telkwa Coal Project will involve a number of direct and indirect effects on vegetation and wildlife populations in the Project area, including habitat alterations, direct mortality, disturbance and wildlife management considerations related to resource use.

9.5.1 Habitat Alterations

The vegetation cover types and habitats affected by development support a variety of vegetation and wildlife communities. Habitat alterations will include unavoidable habitat losses, associated with pit and infrastructure development, while ongoing reclamation will provide habitat returns, associated with interim revegetation and post-mining landscapes. Indirect impacts may include terrain or drainage modifications affecting movements of wildlife. The proposed mine development will encroach on an important and heavily used winter range for moose.

At any one time during the Telkwa Coal Project, some 400 to 500 ha of presently used habitat will be removed over the short term. The major habitats affected will be the coniferous forest vegetation types, including the logged and cleared areas, supporting moose summer and winter use.

The Telkwa River corridor, serving as moose habitat and supporting a diverse plant and animal community, will be relatively unaffected by mine development, with the exception of the haul road crossings. The Goathorn Creek, Tenas Creek, Helps Creek and Hubert Creek drainage ways will remain similarly unaltered.

In general, the removal of habitat will result in localized displacement of wildlife and loss of carrying capacity in the areas affected. The magnitude of impact will be in proportion to the relative areas of habitat types affected and their importance to the associated wildlife. These relationships have been outlined in the Taesco and Hatler reports, which will provide guidance for mitigation planning. These reports also describe the vegetation communities associated with the cover types and habitats in the Project area.

The extent of habitat losses will be either short term or long term. Mine development areas will involve relatively short term habitat losses, with individual pit or dump areas reclaimed to a stable and non-erodible state three years after completion, and full forest or wildlife capability within the timeframe of five+ years depending on site reclamation objectives. These estimates are based on a review of the Pit 3 test pit reclamation research program. As outlined in Section 2.4, this research indicates the capability of reclaimed backfilled pit or dump areas to achieve a self-sustaining state supporting either forage crop or timber plants within this timeframe.

The clearing of areas required for buildings, roads and other infrastructure will be longer term, lasting at least until Project closure when reclamation and decommissioning can start. The development of individual pits will be staged so that when new pits are developed any habitat losses will be offset by reclamation habitat returns at decommissioned pit areas and final dumps.

Mitigation Measures

Previous studies suggest that local habitats are not fully utilized, suggesting that displaced ungulates will have the opportunity to utilize habitats adjacent to mine development sites as mining progresses. This will mitigate the severity of the short term habitat losses. Mine development will be staged and after the initial pit clearing local habitat losses will be incremental and within the adaptation capabilities of local ungulates.

Additional factors minimizing impacts is the ability of ungulates to coexist with coal mining up to and within the limits of mining, based on Manalta Coal Ltd.'s experience at other mountain and foothills mines. Reclamation will provide progressive habitat returns, which are expected to be utilized quickly. As Hatler indicates, moose respond quickly to new habitat opportunities. The high use of local logged and cleared areas by moose indicates that moose will accept reclaimed areas, with proper reclamation planning.

Manalta will monitor habitat use by ungulates in areas adjacent to mining and throughout the Telkwa River corridor, following approaches to be developed in consultation with MELP. Manalta Coal Ltd. will undertake habitat improvements in selected offsite areas to the extent that compensatory measures are warranted. Mitigative options may include selective clearing of forested habitats or willow cutting to promote forage production. Habitat improvements developed in consultation with MELP will be accomplished within the context of regional wildlife management objectives. Hatler indicated that, with the implementation of suitable mitigative measures, the impacts on wildlife could be managed within acceptable limits.

Reclamation will address wildlife requirements, similar to the approach employed at Manalta Coal Ltd.'s Line Creek Mine. The Line Creek Mine has been

recognized for its progressive approaches to wildlife habitat reclamation and consideration of biodiversity issues. The plant community descriptions provided in previous studies will contribute to reclamation planning for designated wildlife habitat. The construction of waste rock dumps will provide terrain diversity that will promote the native plant reestablishment and biodiversity.

9.5.2 Disturbance of Wildlife

Mine-related activities may be disturbing to some wildlife, resulting in energy loss or avoidance of available habitat. Disturbance may also lead to increased energy expenditures when disturbance, such as noise, blasting or mine traffic, is frequent and unpredictable.

Mitigation Measures

This impact will be managed somewhat by the regularity and predictable nature of mining activities. Blasting will be scheduled for certain time periods. Habituation of wildlife to coal mining is commonly reported and observed. The ability of wildlife to habituate to predictable stimuli can be used in conjunction with a reclamation program to mitigate the effects of initial disturbance for a variety of wildlife. The Mine's Quality System procedures and Environmental Awareness Handbook will be modelled on those of other Manalta Coal Ltd.'s mines to ensure that workers are properly trained to recognize and minimize wildlife harassment situations.

The No-Shooting provision around active minesites will be a factor in promoting wildlife acceptance of habitats immediately adjacent to minesites. Mitigative effort will be directed at managing wildlife attracted to habitats and reclaimed areas within mining areas, such as traffic speed control, elimination of garbage and education of the workforce to potential wildlife harassment situations.

9.5.3 Direct Mortality of Wildlife

Forest clearing in advance of soil salvage, mining or construction activities will result in unavoidable mortality of some wildlife, particularly small wildlife species such as mice. During mine development, collisions of mine vehicles with larger wildlife may occur, especially during winter when wildlife may have difficulty in overcoming snow berms. Moose encountered on plowed roadways may run along in front of vehicles for long distances, causing stress or death.

Most of the small wildlife affected by forest clearing are common to the cover types in the study area, and able to respond to habitat returns reestablished through reclamation. The effects of clearing and development on these wildlife will be similar to those produced by fires or logging. In the context of reclamation, these habitat effects are reversible. Wildlife species such as voles will invade newly reclaimed grassland areas, while others such as squirrels will adopt areas reclaimed to forestry land use as planted seedlings ultimately mature. This pattern is a feature of local vegetation succession and cutblock regeneration.

Mitigation Measures

Mine traffic speeds will be controlled within limits to avoid harassment or collisions with wildlife. Experience at Manalta Coal Ltd.'s other mines shows that

this potential problem can be minimized with proper minesite management and worker education. Manalta Coal Ltd.'s Line Creek and Gregg River Mines maintain ungulate populations within mining limits with minimal road kill problems.

9.5.4 Wildlife Management Issues

New mine development is associated with the introduction of new residents and potentially increased access to formerly remote areas. This will likely increase recreational pressure on local wildlife, and potential disturbance to wildlife due to increased offroad activity throughout the region in general as a result of any population increases.

Mitigation Measures

Ultimately, game animal management, hunting and access controls, and provision for No-Shooting zones around mining areas are wildlife management options that can be implemented by MELP to address changes in hunting pressure or access. Manalta Coal Ltd. will be able to control traffic on all roads controlled by the Mine. Access and shooting restrictions will be strictly maintained by the Company to limit mortality of local wildlife and meet mine safety requirements.

Hatler raised the issue of the condition of local habitats for moose. In Hatler's view, as of 1990, the available habitat is probably not sufficient to support present moose numbers in a severe year. Even without mining development, Hatler identified a need for some habitat management activity in and around the Telkwa Coal Project area. This issue needs to be reexamined as part of a more detailed impact assessment, so that reclamation and mitigation plans fit with wildlife management objectives.

9.6 Agriculture

Approximately 1 500 ha of land within the Telkwa Project area lies within the Agricultural Land Reserve. The nature of impacts to agricultural land from the Project will be both permanent and temporary. Permanent impacts include areas that will become permanent features at the end of mining such as the tailings pond, portions of the waste dumps and the pit areas. Land affected by these impacts will be permanently removed from the ALR.

Temporary impacts include areas that will be disturbed for a period of time and then reclaimed once that phase of the mine is completed or at the end of mining. These temporarily affected areas include portions of the waste dumps, the plantsite, coal haul roads and associated mine infrastructure.

Mitigation Measures

In order to mitigate the effects of mining on the agricultural land within the Telkwa Coal Project area, Manalta Coal Ltd. will attempt to locate facilities such as the rail loadout and haul roads on non-agricultural land as much as possible. Mitigation of the permanently affected areas such as portions of the waste

dumps will include reclaiming these areas back to pasture or forage land, where possible, as outlined in the conceptual reclamation plan in Section 2.4.

Areas which will be permanently disturbed but cannot be reclaimed back to the agricultural land base, such as pits, and the tailings pond area, will be reclaimed as wetland/riparian habitat. Waste dump slopes which are not compatible with agricultural production will be reclaimed to a wildlife/ forestry end land use.

Areas which will be temporarily affected such as the plantsite and associated mine infrastructure will be reclaimed back to pasture or forage land and returned to the agricultural land base as outlined in the conceptual reclamation plan (Section 2.4).

9.7 Forestry

The main impact of the mine on forest production will be in the loss of Annual Allowable Cut (AAC) due to the destruction of immature and unsalvageable growing stock. This loss will be largely within the Tenas Pit area.

The loss of regenerating forest is not a permanent loss as Manalta Coal Ltd. anticipates the appropriate end land use designation for most of the Tenas Pit area will be largely forest production, where appropriate, based on site suitability within the reclaimed landscape. In these areas the stocking of regenerating seedlings shortly after the cessation of mining will limit the loss of forest growth to 15 to 18 years.

Manalta Coal Ltd. will not allow harvesting of standing wood on its private lands, other than for exploration access, prior to Project approval. During mine operations, standing timber will be retained as much as possible within the Project area. Standing timber will assist in reducing visual impacts and noise from the mine activity.

9.8 Socio-Economic Impacts

Manalta Coal Ltd. will prepare a socio-economic impact analysis of the Telkwa Coal Project. The Telkwa Coal Project will have a positive contribution to the social and economic conditions in Canada, in the province, in the nearby towns and surrounding district. These contributions are discussed below.

9.8.1 Project Economics

The following overview of Telkwa Coal Project economics is based on engineering feasibility studies completed by Manalta Coal Ltd. in early 1996. These

studies were based on the geological and mining models developed from the 1995 exploration program and on pre-feasibility studies completed by specialist consultants.

The economic studies were based on the development of the Tenas and Pit 3 reserves, which yields a fifteen year mine life. The total revenue over the life of the Project is estimated to be $750 - $1,275 million dollars.

Table 9-2 presents the capital costs for the major cost categories of the project. All costs are shown in 1996 Canadian dollars. The total capital investment over the life of the project is $105 - $135 million dollars. This total does not include the cost of constructing a haul road and bridge across the Telkwa River to develop the reserves in the Pit 7 & 8 mining area.

Table 9-2 Project Capital Costs

Description	Capital Cost (Can $ 000,000s)
Construction	40 - 50
Mining Equipment	30 - 40
Equipment Replacement	35 - 45
Total	105 - 135

Note: Equipment replacement costs are spread over the 15-year mine life.

Total operating labour cost for the Project is $120 million dollars based on an average employee salary and benefits packages of approximately $65,000 per year. The major portion of the total labour cost is a direct influx of money into the local communities.

Operations Manpower

The manpower requirements for the Project during full operation are shown in Table 9-3. These requirements are divided into four categories: mine, preparation plant, mine maintenance, and administration.

Table 9-3 Operations Manpower

Mine	Labour Requirement	Preparation plant	Labour Requirement	Mine Maintenance	Labour Requirement	Project Staff	Labour Requirement
Shovel Operator	4	Senior Plant Operator	4	Mechanic	4	Mine Manager	1
Loader Operator	2	Plant Operator	4	Welder	4	Office Manager	1

Waste Coal Hauler	14	Plant Tradesman	4	Electrician	3	Accountant	2
Dozer Operator	8	Loader Operator	4	Serviceman	2	Secretary/Clerk	2
Driller	4					Warehouse Manager	1
Grader Operator	4					Warehouseman	2
Equipment Operator	2					HR/Safety/Training	1
Blasters	1					Mine Supt./Foreman	1
Labourer	4	Labourer	4	Labourer	4	Maintenance Supt./Foreman	3
Contract Coal Haul	5					Chief Engineer	1
						Engineers	4
						Environmental Planner	1
						Plant Laboratory Technician	1
						Surveyors	2
						Plant Supt./Foreman	5
SUB TOTAL	51		20		17		32
TOTAL OF 120							

9.8.2 Financial Benefits to Governments

The financial benefits to the three levels of governments are substantial. Various taxes, levies, and fees are charged on specific items and distributed according to pre-determined schedules. The following list shows examples of these taxes.

Federal government

• Federal Income tax

• Unemployment Insurance

• Canada Pension

• Corporate Income tax

• Personal Income tax

• Federal Fuel tax

• Federal Capital tax

Provincial government

• Workers Compensation premiums

• Corporate Income tax

• BC mineral tax

• Provincial sales tax

• BC Capital tax

• BC Environment related taxes

• Water Rental Rate fees

• Coarse Coal refuse fee

• Provincial Fuel tax

• Land use tax

• Vehicle Licensing fees

• Coal leases / licences

• Personal Income tax

Municipal governments

• Property tax

Other

• Freehold royalties

These are direct taxes that can be calculated for the Telkwa Coal Project. The indirect taxes attributable to employee spending are, however, considerable and would also flow through to all levels of government.

9.8.3 Project Employment

Employment opportunities will be created during the construction period and during the operating mine life. An estimated 170 to 200 construction jobs will be provided during a 12 to 15 month period commencing late in 1998 or early in 1999. These jobs will require various skills and training and would be contract in nature.

During the operating life of the Project, an additional 120 to 140 people will be employed by Manalta. The jobs will vary from general labour positions to equipment operators, contract labour, supervisors, clerical support and management positions. Many of these positions will be filled with local people currently employed or those presently without jobs but with skills and experience from previous employers.

If local residents with the necessary trades and experience are available, the Project is expected to have a positive impact. In the Bulkley Valley many workers and trades people are employed in the forest industry. These people generally have the job skills and background that makes them good candidates for employment at a surface coal mine.

The key factor in determining the impacts on the communities of the Bulkley Valley will be whether the Project is successful in hiring local people. Manalta anticipates this is the case based on current employment levels.

9.8.4 Employee Training

Manalta will provide training to all employees to ensure that safe, efficient, and environmentally responsible operating practices are followed. This training will allow individuals to develop skills and expertise that they did not possess prior to employment with Manalta.

Training programs will be developed for all employees of the Company. In particular, extensive equipment operator manuals will be provided to ensure that drivers understand fully the capabilities of the equipment they are operating and the Company requirements with respect to safe working practices. Equivalent training programs will be developed in the preparation plant, rail loadout, and maintenance facilities.

WHMIS (Workplace Hazardous Materials Information System) training will be provided for all employees and specific training will be provided to those employees in specialized areas or handling hazardous materials.

All employees will be trained in corporate Environmental Awareness and in quality management as it relates to their work functions.

9.8.5 Project Accommodation

Available accommodation in the area surrounding Telkwa will be used by employees during construction and operation of the Project.

Mitigation Measures

Manalta does not expect a camp during the construction phase of the Project. Contractors will be able to house their workers in the motels, hotels, and apartments currently existing in Telkwa, Smithers and Houston.

Permanent accommodation for Project employees will be provided by houses, condominiums, apartments and trailer parks in the local communities. Continued discussions with local councils can take place to provide housing developments for the expected increase in population.

9.8.6 Public Health

The Project, as outlined in Section 2.0 and Section 6.0, will be essentially self-contained with modern waste and sewage treatment facilities.

Noise, dust and water releases have been addressed earlier in this section. Manalta will develop a mine-specific waste management plan similar to plans in place at other Manalta operations. The waste management plan will address potential environmental and public health concerns. Key components will be recycling, waste minimization, and emission control measures.

9.8.7 Employee Health and Safety

General employee health and safety will be addressed by existing corporate policies, provincial regulations and health and safety guidelines. Manalta Coal Ltd. considers worker safety to be extremely important as indicated by the Company Mission Statement (Section 14.1) and the excellent safety record maintained by all Manalta operations. To achieve a working environment that is safe requires extensive training, education, and commitment. This culture is in place at all Manalta Coal Ltd.'s operations and will also be developed at the Telkwa Coal Project.

All employees will undergo a general health assessment at the time of hire. These assessments will typically be completed by local medical practitioners. Followup testing will be completed periodically to ensure employee health is not being jeopardized.

The Telkwa Coal Project will develop a medical surveillance program as outlined in the *Health, Safety and Reclamation Code for Mines in British Columbia, 1992*. This program will address fitness testing, hearing conservation, and general health and safety awareness. A Health and Safety program will also be in place and will be similar to those currently in place at existing Manalta operations. One, or both of the ILCI (International Loss Control Institute) or STOP (Safety Training Observation Program) programs, or their equivalent will be used as models. Appropriate personal protective equipment will be available to workers who are subjected to hazardous conditions in their workplace.

The workers in the operations departments will be required to work shift schedules to match production requirements. To the extent possible, shift rotations will be developed to minimize the disruption to family and social life and to ensure that worker safety is maintained. Many employees in the forestry, wood processing, transportation, and mining industries in the Bulkley Valley currently work some form of shift schedules. Employment work schedules at the Telkwa Coal Project will not be a radical change from the current situations in other local industries.

All equipment and machinery will be matched to the required work activity. Ergonomic designs in mining equipment have addressed back related injuries and injuries related to repetitive strains.

9.8.8 Community Involvement

Manalta Coal Ltd. has been operating in western Canada for more than 60 years and is a major employer for many residents of the communities near its mining operations. The Company is committed to the well-being of these towns and villages, and encourages its employees to become active in their communities. Many employees volunteer in local associations, service clubs and sports organizations, while others serve on town councils and committees.

Synergistic Services

Significant time and effort is spent developing capable fire fighting, mine rescue, and emergency services that could be available for situations outside the mining operations.

Indirect employment opportunities can also be attributed to the Telkwa Coal Project. Service companies and suppliers between Moricetown and Houston

will also grow due to the business dealings with the mine. CN Railways will also spread the benefits to Terrace and Prince Rupert as a result of crew change requirements further west of Smithers.

9.9 Mine Access

The location of the mine access road will result in increased vehicle traffic through Telkwa. The mine access road connects with Lawson Road approximately four km south of Telkwa; therefore, mine traffic from the north will travel through Telkwa and cross the bridge over the Bulkley River before turning south on Lawson Road (Birch Street). Traffic from the south is expected to use Highway 16, cross the bridge at Quick to Lawson Road and then continue northwest to the mine access road.

An estimate of the increase in traffic due to the Telkwa Coal Project is based on the following assumptions:

• work force of 120 people

• some forms of car pooling by two thirds of the employees

• based on a 12-hour rotating roster

• 80% of employees from north of the mine access road

Using these assumptions, 16 vehicles from the north and four vehicles from the south are expected for every 12-hour shift. Some of the vehicles from the north will originate in Telkwa West and therefore not pass through town. This peak traffic is expected during a 30-minute duration due to the staggering of start times for specific individuals. Other traffic throughout the day will include suppliers and visitors to the mine.

This increase in vehicle traffic would result in some increase in the noise and dust levels in the Village of Telkwa.

Mitigative Measures

As much as possible, non-employee traffic will be routed from Houston along the Telkwa Forest Service Road (FSR) to avoid travel through residential areas of Telkwa.

All heavy machinery and equipment required for the mine will use the bridge at Houston, which is rated for large loads, to cross the Morice River and travel along the Telkwa FSR.

9.10 Clean Coal Haul Road

Traffic travelling on the clean coal haul road from Lawson Road to the plantsite will include haul trucks, mine vehicles, employees to and from shift change, and public vehicles. This traffic will result in wildlife, livestock, noise, and dust impact concerns.

Mitigation Measure

The clean coal haul road will be built on a right-of-way corridor between the plantsite and the rail loadout. This right-of-way will be fenced and signposted to control unauthorized entry by the general public and to limit the entry of livestock. The haul road will be constructed so that a corridor is maintained on either side of the road. This corridor will comprise:

• open area (approximately 30 m on either side of the road) to allow good visibility of any wildlife that may cross the fences,

• tree cover, where appropriate, to act as a sight and sound barrier, and

• berms adjacent to the ditches, where appropriate, to act as a sight and sound barrier.

The road surface will be prepared and maintained in such a manner to control the generation of dust. Operational studies will be completed to determine an appropriate road surface treatment.

Speed limits will be controlled on this road to minimize the possibility of accidents with wildlife and control traffic noise.

9.11 Recreational Access to Hunter Basin

When construction begins on the Project infrastructure, present access to the Hunter Basin will be discontinued at the Coalmine Road/Avelling Road intersection. This is required to avoid unauthorized public entry into construction areas where heavy equipment will be operating due to safety concerns and security issues.

Mitigation Measures

An alternative route is required to maintain recreational access to the Hunter Basin. The proposed access would follow the existing route along Coalmine Road and Avelling Road to the Hydro Hill Road intersection immediately following the Tenas Creek crossing. A new road would be constructed from Hydro Hill Road, south across Tenas Creek to reconnect with existing roads further up in the Hunter Basin (Figure 2-1).

One crossing of a haul road (Tenas Pit to preparation plant) will occur approximately five km from the Hydro Hill turnoff. This crossing will::

• provide a right angle intersection,

• provide sufficient visibility in both directions to see oncoming mine traffic, and

• be properly signposted to ensure motorists are aware of the intersection and the risks involved in crossing the road.

10.0 LAND AND RESOURCE MANAGEMENT PLANS

The Telkwa Coal Project will be developed in the Bulkley Valley in an area that could be described as a transition zone between rural agriculture lands and small acreage holdings to the east, and the Bulkley Forest District lands to the west. The Project area has a complex pattern of land ownership. This section will deal with the present status of the lands in and around the Project area, excepting aboriginal aspects which are discussed in Section 12.0

10.1 Land Ownership and Dispositions

10.1.1 The Proposed Project Area

The land base required for the Telkwa Coal Project can be subdivided into five distinct areas: three geographically and chronologically separate mining blocks or mine areas, a rail loadout area on the CN Rail line, and several rights-of-way joining the mine areas.

A Project Boundary has been established to delineate the land Manalta Coal Ltd. requires in order to ensure public and worker safety during the life of the Project (Figure 2-1). As illustrated in Figure 2-1, approximately 46% of the lands within the Project Boundary will be affected by mining or by the construction and operation of mine related facilities. Manalta Coal Ltd. will maintain a strict no trespassing and no hunting policy within the Project Boundary.

Table 10-1 summarizes the land areas within the Project Boundary for each of the three mine areas, as well as lands required for the rail loadout, and rights-of-way.

Rights-of-way will be required for roadways connecting the different mine areas and the loadout area. The road corridors are estimated to be up to 100 m in width. The wide allowance will allow the construction of roadways (up to 30 m in width), overhead powerlines and underground utilities. The rights-of-way will also provide an area to build any required cuts and fills and drainage ditches. A good portion of the rights-of-way will retain standing timber, to assist in reducing noise, dust and viewscape impacts. This will be balanced, on a site-specific basis, with the need to maintain snow storage areas and sightlines for driver safety.

Table 10-1 Telkwa Coal Project Boundary Land Area		
Project Sub-Area	Area (acres)	Area (ha)
Tenas Area	3,360	1 368
Pit 3, Plant &Tailings Area	4,800	1 943
Pit 7 & 8 Area	3,040	1 230
Rail Loadout Area	155	63
Rights-of-Way (8 500 m)	85	34
Totals	11,440	4 638

Table 10-2 provides a summary of the present land surface status within the Project Boundary. The surface areas are broken down into acres, reflecting the land survey convention meaningful to these land use dispositions.

Table 10-2 Surface Land Ownership Status within Project Boundary

	Crown				Private				
	Crown Land		Crown Land under Grazing Lease/Permit		Third Party Ownership		Surface Owned by Manalta Coal Ltd. Coal		Total Land Area
	Acres	%[1]	acres	%[1]	acres	%[1]	Acres	%[1]	Acres
Tenas Area	3360	100%	nil		nil		nil		3360
Pit 3,Plant & Tailings Area	1980	41%	nil		1620	34%	1200	25%	4800
Pit 7 & 8 Area	960	32%	160	5%	1440	47%	480	16%	3040
Loadout Area	18	12%	nil		137	88%	nil		155
Rights-of-Way	42	49%	33	39%	10	12%	nil		85

TOTALS	6360	55%	193	2%	3207	29%	1680	14%	11 440

[1] Percentages shown for each ownership class represent percentage of the Total Land Area shown in the right hand column

10.1.2 Private Land in the Project Area

Private lands held by Manalta and third parties account for approximately 43% of the land within the Project area. The Project area includes 680 ha of land presently owned by Manalta Coal Ltd.

Table 10-3 provides a list of private lands within the Project area including grazing leases and grazing permits. The lot boundaries and owner names of large lots are shown on Figure 10-1. Private land held by third parties will be purchased as required to facilitate Project development.

Table 10-3 Private Land and Crown Grazing Land In the Project Area

Tenas Area, Pit 3 Area and Rail Loadout Area

District Lot Reference	Land Area (acres)
222	640
248	640
224 Block B	6.0
224 Block D	9.2
225 Block B	160

225 Block C	7.5
225 Block D	5.5
	...Continued

District Lot Reference	Land Area (acres)
225	5.5
225 Block F	5.5
225 Block G	136
406	30
414 Lot 1	12.3
414 Lot 2	21.9
4263	11

Sect. 24 Twp 5	61
Pit 7 & 8 Area	
District Lot Reference	Land Area (acres)
221 N	320
228/229	960
410	160
	...Continued

Crown Grazing Lands	
District Lot Reference	Land Area (acres)
403	15
407	15
229	160

10.1.3 Crown Dispositions in the Project Area

Manalta Coal Ltd.'s land title search showed Crown dispositions within the Project area are limited to grazing licences and grazing permits (Figure 10-1). No third party sand and gravel, or mineral dispositions are located within the Project area. The search also indicated no other Crown dispositions registered

within the Project boundary.

The proposed access road and rail loadout area passes through Crown grazing leases. On these grazing leases held by one landowner, the haul road will run through approximately 600 m of the southern edge of L402 and then through approximately 1.8 km of the southern half of L403, dividing the lease into two distinct areas. The access road will also run through approximately 1.4 km of the half lot grazing lease held by another landowner. The northeast corner of that lot will form the southwest corner of the rail loadout area.

The Pit 7 & 8 area, scheduled for mining in year 20, has one Crown grazing lease encompassing the southwest quarter of lot L229 (160 acres, 64 ha) and 40 acres (16 ha) in the southwest corner of a grazing lease on lot L418. The proposed haul road to the preparation plant will also run through approximately 250 m of grazing lease in Lot L224. All Crown grazing leases in this area are held by one landowner.

Several registered traplines are located to the south of the Project area but not within the Project Boundary.

10.1.4 Coal Rights

Manalta Coal Ltd. controls all of the coal rights required for the life of the Project with the majority of the Project area being held under Crown Coal Licences. Some of the Coal Licences in the Project area are held by Manalta Coal Ltd. on behalf of another party who holds a royalty and option agreement with Manalta Coal Ltd. Five district lots are fee simple coal rights owned by Manalta Coal Ltd. Figure 3-1 shows coal ownership or licence rights for the Telkwa property.

To build and operate a coal mine utilizing the Crown coal rights on all Project area lands, Manalta Coal Ltd. will apply for a Coal Lease on these lands except where Manalta Coal Ltd. already owns the fee simple Coal Rights.

Due to provisions of the B.C. Coal Act with respect to areas allowed for inclusion in a Crown Coal Lease, the area of Manalta Coal Ltd.'s proposed coal leases is much larger than what is actually required for development of the property. Manalta Coal Ltd. will analyze the cost-effectiveness of surveying and registering survey plans in order to keep these leases to the minimum required for mine development and operation.

10.1.5 Land Acquisition: Policy and Timing

Manalta Coal Ltd. recognizes that private lands within the Project boundary will have to be purchased. Manalta Coal Ltd.'s objective is to ensure landowners are not unnecessarily inconvenienced by this Project. Manalta Coal Ltd. will work with private land owners within the Project area to ensure that a fair and equitable sale or relocation package is agreed upon.

Land purchases in the Pit 3 area and the rail loadout area will commence after Manalta's Final Approval to Proceed has been made. The Project schedule indicates this will be mid-summer 1998 (Figure 7-1). Land purchase options may be negotiated before this date.

Land in the Pit 7 & 8 area is not required until about 18 to 20 years after the decision to proceed with the Project. Once the mine commences operations, Manalta Coal Ltd. intends to pursue a land purchase schedule for this area.

Table 10-4 indicates lots that are adjacent to the Project Boundary. Manalta will seek mutually satisfactory agreements with individual landowners adjacent to or in proximity to the Project area who are objectively shown to be adversely affected by the Project.

Table 10-4 Private Land Adjacent to the Project Area

District Lot Reference
221
221 Lot 6
224 Block C
225 Block A
414
414 Lot 3

10.2 Land Zoning

The Project area is zoned under a number of planning authorities for specific land uses.

10.2.1 Municipal Land Zoning

The Regional District of Bulkley Nechako has zoned the Project area and vicinity into rural land use zones with the exception of those portions of the area located outside of surveyed lands and within the Bulkley Forest. Municipal District Zoning for the Project area is shown on Figure 10-3.

The Tenas Area is within the Bulkley Forest and is not zoned by the Municipal District. Small portions of the Pit 7 & 8 area and the Pit 3 area are also within the Forest district.

The remainder of Project area is zoned either as Rural Resource Zone in the Pit 3 area or Large Holdings Zone in the Pit 7 & 8 area. Portions of the loadout and the eastern half of the access road right-of-way are in an area designated Agricultural zone.

Manalta Coal Ltd. understands no present zoning restrictions exist that would limit mine development under existing municipal district zoning.

10.2.2 The Agricultural Land Reserve

Figure 10-2 indicates the location of the Agricultural Land Reserve (ALR) in the Project vicinity and ALR lands within the Project area. Table 10-5 indicates the total amount of ALR land in the Project area and in each of the five sub- areas.

Approximately 660 ha of the Pit 3 area and approximately 842 ha of the Pit 7 & 8 area are in the ALR. The access road runs approximately 4.0 km through the ALR in L402, L404 and L407. The entire rail loadout area is located on the ALR. The haul road from Pit 7 & 8 runs approximately 1.5 km through the ALR in L410 and L224.

Manalta Coal Ltd. will seek direction from the Agricultural Land Commission (ALC), Municipal, and Provincial and Regional district governments as to how to best deal with Project lands within the ALR. To date, Manalta Coal Ltd. has been advised it may be possible either to leave Project lands within the ALR or to withdraw them. Coal mining is not a permitted use under ALR regulations but it may be possible to retain the mine lands in the ALR by applying for a long term, temporary Special Use Permit on the basis of provision for approved Reclamation Plans.

The Company will reclaim areas presently within the ALR back to equivalent agricultural capability where possible. This includes portions of the Pit 7 & 8 area, about half of the Pit 3 area, the rail loadout and access rights-of-way. Other areas will be better suited for reclamation to forestry/wildlife use. Section 2.4 addresses these issues in the context of Conceptual Reclamation Plan. During the operation of the Project, agricultural lands within the Project boundary that are not required for mine related activities will remain in agricultural production.

Table 10-5 ALR Land within the Project Area.

Project Sub-Area	Surface Total Area Within Sub-Area (acres)	Area (acres)	Area (ha)	% Project Within Sub-Area
Tenas Area	3,360	nil	nil	
Pit 3 ,Plant and Tailings Area	4,800	1,630	660	34 %
Pit 7 & 8 Area	3,040	2,080	842	68%
Loadout Area	155	155	63	100%
Rights-of-Way	85	80	32	94%
Totals	11,440	3,945	1 597	35%

10.2.3 The Bulkley Valley Forest Reserve

Figure 10-3 indicates the boundary of the Bulkley Valley Forest Reserve (BVFR). The Reserve consists of both Private and Crown land. The Tenas Pit, and small portions of the Pit 3 and Pit 7 & 8 areas, are located within the BVFR.

The private land consists of deciduous standing wood lots. Some large standing balsam poplar grow on Manalta Coal Ltd.'s private land holdings along Goathorn Creek, which are located within the limits of Pit 3.

On Crown lands within the Project area, the principal standing wood areas are in the Tenas Area. The forested Crown lands are within the licence to cut of Pacific Inland Resources Ltd. (PIR).

The BVFR is subject to Ministry of Forests forestry management. Since parts of the Telkwa Project area are within the BVFR, their interests will be considered in postmining reclamation. Manalta will seek the appropriate agreements with the BVFR and PIR to cover mining development and access to their respective areas of interest.

10.2.4 The Smithers Community Forest

The Smithers Community Forest includes a small portion of the Project area. The Forest contains important recreational areas, particularly cross country ski areas in the vicinity of Hudson Bay Mountain Road.

The Pit 7 & 8 area includes approximately 130 ha of a strip along the southern edge of the Smithers Community Forest. Manalta Coal Ltd. understands that it will have to seek an access agreement with the Community Forest Steering Committee, prior to development of the Pit 7 & 8 area.

10.3 The Bulkley Land and Resource Management Plan (LRMP)

The *Bulkley Long Range Management Plan (LRMP)* provides a recently completed (May, 1996) Consensus Management Direction (CMD) for Crown land use in the Bulkley Forest District. The plan refers to principles in the CMD that will guide more detailed levels of planning.

The Bulkley LRMP is currently under review by Provincial Ministries and has not yet been approved by cabinet. At the time of this Application more accurate mapping on the Bulkley LRMP was in the final stage of preparation. The material presented in this section in Figures 10-4, 10-5, and 10-6 is from mapping that may not be the most recent. Manalta Coal Ltd. will update the projection of the Telkwa Project onto the Bulkley LRMP as soon as the new mapping is available.

The following sections summarize the Bulkley LRMP planning directions with respect to the Telkwa Project area. These aspects will be considered during Telkwa Project planning in relation to site and route selection, the formulation of Environmental Protection Plans, and site-specific reclamation planning.

10.3.1 Resource Management Zones

Figure 10-4 indicates the portions of the Project area within the Resource Management Zones of the Bulkley LRMP. The following Integrated Resource Management Zones (IRM) will be affected by the Project:

Planning Unit 11; Telkwa, Sub Unit 4; Goathorn Creek (11-4)

Planning Unit 7; Sub Unit 1; Bulkley Valley (7-1)

The following Special Resource Management Zones (SMZ) will be affected by the Project:

Planning Unit 7; Sub Unit 3; Valley Agriculture/Wildlife Zone (7-3)

Planning Unit 10; Sub Unit 4; Community Forest (10-4)

The Tenas Pit Area

The Tenas Pit area is entirely within Planning Unit 11-4 where a full range of resource values are recognized and equal consideration must be given to all

values. Planning Unit 11-4 offers specific management directions for Goathorn Creek, which are reproduced in Table 10-6.

The Pit 3, Plantsite, and Tailings Disposal Area

Approximately 60% of the Pit 3, plantsite, and tailings disposal areas are on private land, which is not subject to the Bulkley LRMP. The remainder is in Integrated Resource Management Zone (IRM) Planning Unit 11-4 and Special Management Zone (SMZ) Planning Unit 7-3, whose management directions are noted in Tables 10-6 and 10-8.

The Pit 7 & 8 Area.

The Pit 7 & 8 area is largely private land (approximately 63%). The remainder is in the following Resource Management Zones:

• IRM Planning Unit 7-1 Bulkley Valley Zone (Project area overlapping approximately 130 ha), with planning directions as noted in Table 10-7.

• SMZ Planning Unit 7-3 Agriculture/Wildlife Zone (Project area overlapping approximately 80 ha), with planning directions as noted in Table 10-8. The LRMP states that industrial activities, such as mining, in this area will be conducted with a view to enhancing the agricultural or wildlife capacity of the land. This issue will be addressed in the application to the Agricultural Land Commission as the Project review process continues.

• SMZ Planning Unit 10-4 Community Forest - Recreation and Demonstration Forest (Project area overlapping approximately 260 ha), with planning directions as noted in Table 10-9. This zoning covers a strip of land along the north border of the Pit 7 & 8 area, the only portion of the Project area in a Special Management Zone. This amounts to 10% of the Pit 7 & 8 area or 3% of the Project area. Manalta Coal Ltd. understands that activities such as mining or logging in this zone are subject to special management prescriptions. The objective for this area is for community recreation and education. The Company will meet with the Smithers Community Forest Steering Committee to ensure that the Telkwa Project development is compatible with the long range plans of the Smithers Community Forest.

The Rail Loadout Area

This portion of the Project area is on private land and is not affected by the Resource Management Zones.

Rights-of-Way

Three main rights-of-way are associated with the Telkwa Project. The right-of-way between the Tenas Pit area and the Pit 3 area is within Integrated Resource Management Zone 11-4. The right-of-way between the North Mine Area and the Pit 3 Area is within Integrated Resource Management Zone 7-1. The right-of-way connecting the Pit 3 area to the rail loadout area is within Integrated Resource Management Zones 7-1 and Special Management Zone (Agriculture/Wildlife Zone) 7-3.

Manalta Coal Ltd. will work with the appropriate agencies charged with the administrative aspects of the Bulkley LRMP to ensure that the relevant planning directions are addressed in Project planning.

Table 10-6 Bulkley Valley LRMP - Resource Management Zones, Sub-Unit 11-4: Goathorn Creek	
Management Directions	
Biodiversity	• Caribou habitat prescriptions must be better identified.
Access	• Consider caribou habitat. • The IPT is to consult with existing guide regarding a Telkwa River and Scallion Creek access control point. • Discourage circle route through Morice District.
Timber Management	• Caribou habitat prescriptions must be better identified • Follow P.U. 11 General Management Directions on erosion and sedimentation.
Water Quality	• Follow P.U. 11 General Management Directions on erosion and sedimentation.
Fish and Wildlife Habitat	• Follow General Management Directions. • The IPT is requested to develop a comprehensive plan to sustain and enhance a viable caribou population (consider: habitat, predator control, transplants, etc.)
Visual Quality	• Follow General Management Directions. • Pay special attention to views from the Highway 16 corridor.
Range Management	• Evaluate this sub-unit for range potential.
Outdoor Recreation and Tourism	• Enable access to development areas beyond the sub-unit. • Protect caribou habitat.
Subsurface Resources	• Recognize coal exploration.
Archeological and Historical Sites	• Follow General Management Directions.

Future Planning Processes	• Follow General Management Directions.

Table 10-7 Bulkley Valley LRMP - Resource Management Zones,

Sub-Unit 7-1: Bulkley Valley

Management Directions	
Biodiversity	• Note that a different approach than that taken in other planning units is required here because of the high percentage of private land. • Note that the Forest Ecosystem Network requires a high degree of cooperation between landowners and government agencies. • Biodiversity is a priority on Crown land. • Red and Blue listed plant species and ecosystems should be inventoried. • Designate Call Lake as a Goal 2 PAS area. • Significant recreation sites and areas of significant biodiversity should be retained as Crown land.
Access	• Malkow Lookout access should be non-motorized only.
Timber Management	• Must be highly sensitive to all other resources: urban, agriculture, wildlife, fisheries, water, urban/rural interface. • A high priority is placed on provincial Forest Land for integrating biodiversity and wildlife with timber management.
Water Quality	• On Bulkley River and tributaries: maintain and restore quality. • On Telkwa River and tributaries: Maintain and restore quality. • All valley bottom lakes need maintenance and restoration of water quality.

Fish and Wildlife Habitat	• Place management focus on: 1) winter habitat for ungulates 2) migratory birds 3) fisheries in the Bulkley and Telkwa Rivers • Consider encouraging wildlife and aquatic habitat in future land development. • Habitat concerns should be noted in covenant to landowners. • Toboggan and Kathlyn Creek are regionally significant spawning areas. This is a priority area for watershed assessments.
Visual Quality	• Note the following travel corridors: Highway 16, Bulkley River, Telkwa High Road. • Visual quality to be considered in community planning. • Emphasis on natural beauty.

SUB-UNIT 7-1: Bulkley Valley
Management Directions (continued)

Range Management	• Recognize existing tenures. • New tenures are to encourage biodiversity guidelines. • Foster and encourage cooperation between range users and other users and land values. • Sustain and enhance the agricultural industry in this planning unit. • Foster cooperation in agricultural land development for biodiversity and sustainability. • Notification must be given before new agricultural leases are issued (including notification to surrounding residents.)
Outdoor Recreation and Tourism	• Place management focus on rivers and lakes. • Develop a mechanism for dealing with recreation land use conflicts, including the Bulkley River. • Encourage use of this planning unit as the front country service hub for tourism and recreation in the planning area.
Subsurface Resources	• Maintain interests of coal and sand and gravel resources. • Follow General Management Directions. • Consider the coal resource development impacts on the Telkwa River at all stages of exploration and development.
Archeological and Historical Sites	• Follow General Management Directions. • Management requirements are greater in this planning unit than in some others.
Future Planning Processes	• Foster cooperation between all levels of government and the community.

Table 10-8 Bulkley Valley LRMP - Resource Management Zones,

Sub-Unit 7-3: Valley Agriculture/Wildlife Zone

Objective: Crown land with good agricultural capabilities is identified and marginal agricultural land that has better wildlife forage capacity is excluded. Industrial activities in this area will be conducted with a view to enhancing the agricultural or wildlife capacity of the land.

Management Directions	
Biodiversity	• Forest Ecosystem Networks approved by this LRMP should not be alienated unless suitable replacement can be found. • Apply appropriate conservation management measures to protect rare and endangered, sensitive and vulnerable, and regionally significant species and plant communities. • BC Environment will track percentage and distribution of Crown land plant communities to guide referral comment on development proposals.
Access	• Retain public access corridors to Crown land to allow emergency response to control fires, beetle and disease outbreaks. • Ensure that existing access to Crown land is maintained through the establishment of public rights-of-way prior to land alienation.
Timber Management	• Control infestations of insects, disease and noxious weeds to prevent their spread. • Manage for natural regeneration; basic silviculture. No incremental silviculture. Encourage use of domestic livestock for brushing and weeding. Designate cottonwood and aspen as acceptable species.

Water Quality	• See Range and Agriculture Management Directions (listed later in this section) for management regarding water quality.
Fish and Wildlife Habitat	• Agencies are to carefully review referrals of land development proposals. • Strive for integration of Crown land resources; where agriculture development is considered, protect high wildlife habitat.
Visual Quality	• Protect visual quality by encouraging partial cutting systems and minimizing the size of clearcut openings.

SUB-UNIT 7-3: Valley Agriculture/Wildlife Zone	
Management Directions (continued)	
Range and Agriculture Management	• Support the purpose and intent of the Agriculture Land Reserve (ALR) through the Agriculture Land Commission Act. • Support the purpose and intent of the Soil Conservation Act, which is, to preserve and maintain the quality of soil within the ALR. Allow suitable Crown lands to be alienated for agriculture uses via the current Crown Agriculture Lease Policy (1990) in accordance with wildlife habitat objectives. • Minimize conflicts between wildlife and recreation enhancement uses with private agricultural operations and Crown grazing. • Control noxious weeds by implementing Noxious Weed Control Plans prepared by the Northwest Weed Committee and enforcing the Weed Control Act. • Develop target Animal Unit Month levels for the plan area. • As required, develop mechanisms to minimize impacts between

	domestic livestock and wildlife uses of grazing resource (land, water, vegetation, access) based on enhancement and sustainability of the resource. • Improve local public participation role in wildlife enhancement and recreational plans in livestock grazing and agricultural areas. • Maintain or enhance the access and use of Crown land and water resources by livestock within the context of the Forest Practices Code (FPC), Protected Areas Strategy (PAS), and Community Watershed guidelines. • Encourage the use of domestic livestock for silvicultural vegetation control. • Maintain or enhance the access and use of Crown water resources for agricultural uses. (Refer to the Department of Fisheries and Oceans and the BC Environment Water Management Branch for comment.) • Apply the Forest Practices Code. • Apply the code of Agricultural Practices for Waste Management, Waste Management Act. • Refer agricultural pollution problems via Agricultural Protection Council through the British Columbia Cattleman's Association (BCCA) or the British Columbia Federation of Agriculture (BCFA). • Promote Agricultural land and water stewardship through public education. • Control infestations of insects, diseases and noxious weeds to prevent their spread. • Encourage range tenures. Include in range tenures requirements to protect silviculture investments.

SUB-UNIT 7-3: Valley Agriculture/Wildlife Zone	
Management Directions (continued)	
Outdoor Recreation and Tourism	• Maintain existing recreation trails and where possible, provide opportunity to establish new trails that link the Settlement zone, and the Agriculture/Wildlife zone, to the IRM zone.
Subsurface Resources	• Follow General Management Directions.
Archeological and Historical Sites	• Follow General Management Directions.
Future Planning Processes	• Agencies will support community expansion within designate community growth boundaries. • Agencies will consult with the local government before issuing new long term tenures or proceeding with development plans, and when reviewing Crown land resource management proposals. The regional District and municipalities will consult with Resource agencies when changing Official Community Plans.

Table 10-9 Bulkley Valley LRMP - Special Management 2 Zone, **Sub-Unit 10-4: Community Forest**	
Objective: This area is intended for community recreation and education in a demonstration forest. All activities must recognize this, and plans for this area must endorse the Smithers Community Forest Steering Committee Plan.	
Management Directions	
Biodiversity	• Incorporate and maintain a desired mix of habitats into the long-term plan.
Access	• Develop a road and trail network compatible with other uses.
Timber Management	• Provide small scale demonstration harvesting and silviculture activities.

Water Quality	• Follow General Management Directions ensuring protection of local community watersheds.
Fish and Wildlife Habitat	• No hunting or commercial activities; maintain diversity and abundance.
Visual Quality	• Plan activities to minimize visual impacts on other uses.
Range and Agriculture Management	• No range in this area.
Outdoor Recreation and Tourism	• Create and improve opportunities recognizing a diversity of compatible interests.
Subsurface Resources	• Recognize the coal licenses in this area.
Archeological and Historical Sites	• Follow General Management Directions.
Future Planning Processes	• Maintain contact with the *Smithers Community Forest Steering Committee.*

10.3.2 Enhanced Timber Areas (ETD)

Portions of the Tenas Pit area have been designated as ETD areas. Although difficult to scale from the maps of the Bulkley LRMP, the ETD within the Project area may total approximately 770 ha.

The Consensus Management Direction (CMD) states that, within ETD, timber takes priority over other uses but it also states that the ETD are not single use sites. The CMD is a consideration for designating a forestry/wildlife land use as a objective of reclamation in the Tenas Pit area (Section 2.4).

10.3.3 Core Ecosystems

The core ecosystems of the Bulkley LRMP are part of an "ecosystem network of core ecosystems and landscape corridors which will extend throughout the district in order to provide a representative cross-section of ecosystems and maintain connectivity." Large scale disturbance is not considered compatible with the maintenance of core ecosystems. If disturbance must occur, it should involve small areas, longer rotation cycles and modified harvest practices to maintain old growth structure.

The best information available to date indicates the southwest corner of the Tenas Pit area is close to, but does not encroach into, one of the Core Ecosystem Areas identified in the Bulkley LRMP. This core ecosystem can be described as the relatively small area lying southeast of Tenas Creek and straddling the lower reaches of the largest southeast tributary of Tenas Creek (Figure 10-6). No other part of the Project area appears to be in a Core Ecosystem under the

Bulkley LRMP, including the probable extensions onto private lands in the Project area.

10.3.4 Landscape Corridors

Landscape Corridors are designed for the following purposes according to the Bulkley LRMP.

• to maintain connectivity within the landscape;

• to reduce habitat fragmentation;

• to permit movement and dispersal of plant and animal species; and,

• to maintain, within a managed forest setting, forests dominated by mature tree cover and containing most of the structure, function, microclimate conditions and biota associated with old forest.

The LRMP also provides some broad guidelines to help meet and define the objectives of management in Landscape Corridors. Figure 10-6 shows the landscape corridors within and in the vicinity of the Project area.

The Tenas area includes segments of the Tenas Creek Landscape Corridor. The mining activity in this area will not encroach into the Creek Valley but will occur above the Valley. Activity within the Valley in this part of the Project area will be limited to water diversion, water treatment and discharge facilities and monitoring facilities.

In the Pit 3 area, Landscape Corridors follow the lowest reach of Tenas Creek and lower Goathorn Creek. In ecological terms the corridor extends south up Goathorn Creek through five km of private land. Manalta Coal Ltd. will protect the corridor as much as possible by minimizing any mine-related activity within these Landscape Corridors. Disturbance within the valleys will be limited to a small area near the south portion of Pit 3, water management facilities and a haul road crossing of Goathorn Creek.

The loadout area is within what would have been the landscape corridor along the Bulkley River and the confluence of the Bulkley with Hubert Creek although the area is private land. Some of the corridor values in this area may be altered due to the construction of the rail loadout facility.

The Pit 7 & 8 area is located outside the Landscape Corridors.

The mine access and clean coal haul road; and the bridge to the Pit 7 & 8 mining area will cross the Hubert Creek and the Telkwa River Landscape Corridors, respectively. Some loss of habitat through this disturbance will occur due to the road crossing .

11.0 PUBLIC CONSULTATION

This section provides a summary of the previous and present public consultation programs associated with the Telkwa Coal Project. These programs

contributed to Manalta's present Application for a Project Approval Certificate under the Environmental Assessment Act of British Columbia.

11.1 Company Approach to Public Consultation

Manalta Coal Ltd. has purposely chosen to conduct its public consultation programs using its own staff. This was done to provide consistency and more direct input into the Project.

Manalta Coal Ltd. has drawn on its in-house staff in different technical aspects of the Project as public contacts for their areas of expertise. These include engineering and environmental professionals directly involved in Project planning.

Manalta Coal Ltd. has viewed public consultation and public involvement as a continuous process since the Project was first being developed by Crows Nest Resources Limited (CNRL). Manalta has reviewed the public issues documented for earlier project applications and has addressed these during Project planning where possible. Manalta Coal Ltd. anticipates that, once the Application has been reviewed by the Environmental Assessment Office, the Office will define the subsequent public involvement required. The Company will maintain public involvement as a part of Project development through the mine operation and closure stages.

11.2 Public Consultations By Crows Nest Resources Limited

Public consultation for the Telkwa Coal Project started in the early 1980s when the concept of a new coal mine in the Telkwa coalfields was developed by Crows Nest Resources Limited (CNRL), a wholly owned subsidiary of Shell Canada Ltd. This consultation continued through to a Stage II Mine Approval for the Pit 3 area in 1986. Further public consultation was undertaken when CNRL submitted an application in 1990 to expand the approved Project to include pits north of the Telkwa River.

Manalta Coal Ltd. acquired the records of this work with the acquisition of the Telkwa coal properties in early 1992. Manalta maintained continuity with previous public consultation programs as it developed its own mining development plan concurrent with yearly exploration activity to better define the Telkwa coal resource. This effort was coordinated with extensive ARD investigations and discussions with government experts to establish achievable ARD management criteria. These programs involved considerable interaction with MEI and MELP staff.

Manalta kept local stakeholders and government representatives informed of the Company's progress in these matters. Manalta was careful to emphasize that the decision to proceed with a Telkwa Coal Project would not be made until an economically and environmentally feasible project could be established.

11.3 Public Consultations by Manalta Coal Ltd. 1992-1996

From 1992 through to October, 1996, Manalta Coal Ltd. continued the Project review under the Mine Development Review Process originally started by CNRL.

The present configurations of the Project, the lands to be mined, and the sequence of mining are different than those under the previous approval processes. Manalta Coal Ltd. has observed, however, that the environmental and public issues and concerns have remained quite consistent during the more recent consultations undertaken by the Company, particularly with respect to issues that deal with the general concept of a mine west of the Village of Telkwa.

Since 1992, Manalta Coal Ltd. held regular (annual) meetings with the Smithers and Telkwa mayors and Council members. The Company held discussions with a number of people within and outside of government in the Bulkley Valley to become familiar with issues associated with the development of a mine at Telkwa.

These consultations were to inform people of the progress of exploration programs, Project planning and approval issues as the Telkwa Coal Project evolved. Manalta Coal Ltd. dedicated substantial annual expenditures to exploration programs to better define the coal resource and address ARD issues. These programs resulted in the present mining sequence and inclusion of the Tenas Pit.

In October, 1996, Manalta Coal Ltd. chose to withdraw from the previous approval process and to start from the beginning under the new B.C. Environmental Assessment Act. This allowed the new Tenas mining area to be included in the Project.

11.4 Pre-Application Stage Public Consultations

11.4.1 Pre-Application Public Consultations

Prior to the submission of an Application for a Project Approval Certificate, the Environmental Assessment Office recommends a pre-Application stage of public consultation along with data collection. This consultation is the initial phase in a public participation process that is required at each stage of the British Columbia Environmental Assessment Review Process.

Manalta formally began its pre-Application consultations with the public and First Nations in October, 1996. A listing of the people contacted is included in Appendix 15. Public consultation will continue with subsequent programs that will be triggered by the submission of this Application. Manalta Coal Ltd. will seek the advice and direction of the Environmental Assessment Office for the subsequent public participation programs.

11.4.2 Project Concept

The basis of pre-Application Public consultation was a document titled "Telkwa Coal Mine, Project Concept." This was generated by Manalta Coal Ltd. to describe a reconfigured Project that included the Tenas pit. This document is provided in Appendix 14.

The Project Concept document was designed to meet the requirements of the Environmental Assessment Process with an initial concept or prospectus to form the basis of initial public consultation. More than 250 copies of this document were distributed by January 20, 1997. The Project Concept document also contains a comment sheet and two colour maps indicating Project location and overall Project layout.

11.4.3 Meetings with Landowners

Manalta staff have met with all major landowners and most small lot owners in the Project area as defined by the Project Concept document. The Project Concept document was explained and left with these people. While these personal contacts elicited cautious support for the Project, in general, specific concerns were raised about individual circumstances in relation to the locations of mine infrastructure. The main comments and areas of concern expressed by landowners directly affected by the Project are as follows:

• Concerns about the impact of the Project on land values, and how existing landowners will be compensated;

• Concerns with continued uncertainty relative to the timing of the Project;

• Concerns related to the siting of mine infrastructure on land already cleared and developed for agricultural purposes;

• Concerns related to optional land purchase and lease arrangements that will have to be resolved prior to and following mining; and

• Concerns that the loss of agricultural land may make farming of adjacent or remaining parcels of agricultural land uneconomic.

11.4.4 Meetings with Governments

*Senior Government Leve*l

In addition to ongoing meetings between Manalta and regulatory officials, Manalta has also met with the following representatives whose constituencies or mandate encompass all or part of the Telkwa Project area:

• Mr. Mike Scott, Member of Parliament for Skeena;

• Mr. Dick Harris, Member of Parliament for Prince George-Bulkley Valley;

• Mr. Bill Goodacre, MLA for Bulkley Valley; and

• Mr. Dan Miller, Minister of Employment and Investment, Province of British Columbia;

Manalta has briefed these individuals about the Telkwa Coal Project and the status of programs leading to a Project Approval Certificate. These individuals have confirmed their interest in the Project, and their desire to be kept informed of progress in this matter. They reinforced the importance of addressing the environmental and social issues associated with the Telkwa Coal Project.

Municipal Level

Manalta has met regularly with the Councils, elected officials and managers of the following municipal governments:

• The Village of Telkwa;

• The Town of Smithers;

• The Town of Houston; and

• The Regional District of Bulkley-Nechako.

These groups and officials have identified their interests relative to the Telkwa Coal Project with regard to long term planning objectives, and available resources and infrastructure that would support the Project.

Manalta has been encouraged by their input and support and will continue to consult with these municipalities to ensure that the Telkwa Coal Project is compatible with their long term planning objectives.

11.4.5 Public Presentations

Manalta Coal Ltd. has made several presentations to non-governmental groups to introduce the Project Concept during the pre-Application period. These presentations are summarized in Table 11-1. Consultations with First Nations are discussed separately in Section 12.0.

Table 11-1 Public Presentations on the Telkwa Coal Project

Location and Group	Date	Subject	Attendance

Smithers Exploration Group	December 8, 1996	Project Concept and Project Geology	Approximately 30 to 35 persons
Smithers Chamber of Commerce General Meeting	January 15, 1997	Project Concept	Approximately 65 persons
Rotary Club of Smithers	January 15, 1997	Project Concept and Economic role of the Coal Industry in BC	Approximately 30 persons

11.4.6 Media Coverage for the Telkwa Coal Project

Since the completion of the Project Concept document, Manalta has endeavoured to inform the local news media of its progress toward a Project Approval Certificate. On October 30, 1996, Manalta prepared a Press Release for the Interior News newspaper and the two local radio stations. This Press Release, provided in Appendix 15, announced the submittal of the Project Concept document in compliance with the B.C. Environmental Assessment Act. Manalta also placed an advertisement in the Interior News (Appendix 15) to share information on the Project and to facilitate additional Public input. In Manalta's view, these efforts resulted in suitable media coverage of the proposed Project throughout the region.

A toll-free telephone number (1-888-8TELKWA) was also placed in the newspaper advertisement. This number can be reached from anywhere in British Columbia, and is answered directly during office hours by a Manalta Coal Ltd. person who is knowledgeable about the Project. After hours, or when the line is in use, callers are greeted with a voicemail message requesting a telephone number for a return call.

Manalta intends to maintain the toll-free number until the Company establishes a Project office in Telkwa. Table 11-2 summarizes the nature of telephone calls received to mid-January, 1997.

11.4.7 Other Meetings

In November, 1996, Manalta Coal Ltd. held a meeting with persons actively involved in Bulkley Valley environmental issues. The objective was to introduce Manalta Coal Ltd. personnel and the Project Concept.

Some of their initial concerns, comments or advice are summarized below:

• They expressed concern that the Environmental Assessment Process does not allow the public on the Project Committee, raising concerns that the review process is not transparent.

• They suggested that the Company could address the latter concern by suggesting and setting up a Public Advisory Committee that would receive information concurrently with the Project Committee.

Table 11-2 Summary of Calls on the Telkwa Project Toll Free Number

(November 4, 1996 to January 17, 1997)

Call Categories	Number of calls	Comments made
Request Concept document	27	
Interested in employment	3	First Aid Attendant Heavy Equipment Operator Aquatic Biologist
Services/contractors	3	Provide Buildings for Construction phase and mine. Office space for rent. Warehouse/office space for rent or sale.
Comments	2	Sought information on Project history to write a letter to newspaper. Has reviewed Concept Report and approves of Project.

• They expressed the view that the public involvement programs suggested by governments are not balanced. Company meetings and open houses were perceived as discouraging the input of persons who hold alternative views on a project or who are opposed to a project.

• They expressed concerns about Manalta Coal Ltd. including all of the mine pits in this new Project. Some persons felt that the Pit 7 & 8 area should be left out as it may be controversial. Alternatively, others felt that it would be more honest to show all potential mine areas.

• They considered the concept of dry capped dumps containing potentially acid generating materials as unacceptable, as is the concept of trying to blend

potentially acid generating material with non-acid generating material.

• Some persons expressed interest in touring the Telkwa property during the coming summer.

• They stressed the importance of Manalta being open and providing sufficient information. They described the Bulkley Valley not as a community of environmental activists on one hand and a pro-development group on the other. Rather, they considered the valley to consist largely of people who value their environment and who are capable of deciding whether this Project is environmentally acceptable or not.

• They advised Manalta to talk to the conservation people involved in the Community Resources Plan as the Project will encroach on core ecosystems.

• They expressed concern about why the previous Approval Review, which had been underway up to October, 1996, was suddenly withdrawn by Manalta. They expressed interest in reviewing the Company's data on ARD, which are not provided in the Project Concept document.

In part, some of the comments raised at this meeting indicated dissatisfaction with the process for reviewing new projects under the B.C. Environmental Assessment Act. Manalta will continue to solicit and evaluate input from persons or groups with environmental or social concerns related to the Telkwa Coal Project and incorporate their input into Project planning, where warranted and feasible.

11.5 Modifications to the Application due to Public Input

11.5.1 Public Input to the Project Concept

The Project Concept document reflects input from a number of sources from public consultation programs in the past. Some notable Project design alterations that can be attributed to public input to Manalta include the following:

• The choice of a new access road as far south and away from residential areas as possible;

• The avoidance of the use of Coalmine Road and Silkhorn Roads as possible mine access routes; and

• The provision of alternate public access to the Hunter Basin and logging areas west of the current access road.

11.5.2 Public Input to the Application

This Application reflects further modifications in Project planning based on recent public input; namely,

• Manalta will discuss with the Environmental Assessment Office the possibility of establishing a Public Advisory Committee to address ARD issues. This will allow members of the public access to the type of deliberations that will occur at the Project Review Committee level.

• The preferred loadout location has been moved further north to reduce the loss of high quality agricultural land on the Wittwer farm. This new location includes several small lots along Lawson Road. It may involve more disturbance of the Hubert Creek area, but greatly reduces the visibility of the loadout from Lawson Road and from the east bank of the Bulkley River.

• The access road will be fenced to prevent potential conflict between livestock and mine vehicles.

• A tree buffer will be provided between the access road and open agricultural lands to the north.

11.6 Public Consultation at the Application Stage

Public Consultation is a key component of the project review process as defined by the Environmental Assessment Act. Specific requirements for future public involvement will be provided by the Environmental Assessment Office.

Manalta Coal Ltd. acknowledges the necessity and value of carrying out an effective public consultation program with all stakeholders. This is evident from the pre-Application consultation undertaken by Manalta following the submission of the Project Concept document.

Future consultation proposed by Manalta will include:

• Project Office - Manalta will establish a project office where all information relevant to the Project will be available. The office will be staffed by a Manalta representative knowledgeable about the Project.

• Information Sessions - Manalta proposes to hold public information sessions at the invitation of interested parties. Company representatives will provide an overview of the project, and will be available to respond to any questions.

• Public Advisory Committee - Under the direction of the Environmental Assessment Office, Manalta will participate in the formation of a Public Advisory Committee on Acid Rock Drainage. The purpose of this group would be to provide input to the Project Review Committee on all aspects of the ARD management plans proposed by Manalta.

• Press Releases - Manalta will publish press releases in the local newspapers to highlight Project milestones achieved, as well as general information on Project development.

The Company expects to receive further direction from the Environmental Assessment Office on the public consultation program.

11.7 Preparation For Public Notice

Copies of Manalta Coal Ltd.'s Telkwa Coal Project will be made available to the general public at convenient locations in the Bulkley Valley.

To provide notice to the Public that the Application is available for review, the Company will place a notice in two separate editions of the local weekly newspapers.

Appendix 15 contains a copy of the proposed notice.

The Environmental Assessment Office will provide direction as to the locations where this Application will be available for review and into which local newspapers the proposed notice shall be placed.

12.0 FIRST NATIONS CONSULTATION

The lands included in the Telkwa Project area have a long record of human occupation and use dating back millennia. Although little of this world is recorded in the standard histories of the region, it is still in the memory of the people who live in the communities of the Bulkley Valley, at Moricetown and in the Burns Lake district.

Manalta Coal Ltd. wants to understand and respect the different perspectives the First Nations peoples of the region have of the Project lands.

The Company wants to ensure that the Telkwa Coal Project is developed with the advice and involvement of the people who were descendants of the original Bulkley Valley residents.

12.1 The Wet'suwet'en Territories and Traditions

The Wet'suwet'en are the main original inhabitants of the Bulkley Valley. Although their language has been identified with the interior Carrier linguistic group, many of their traditions are similar to the people of the coastal region, particularly of the Gitksan who lived closely adjacent and generally to the north and west of the Wet'suwet'en.

The Wet'suwet'en have been divided up by the reserve and administration systems of post-contact history. Until quite recently, the Wet'suwet'en lived within their traditional territories before being relocated to reserves.

The Wet'suwet'en have explained some of their traditions to Manalta Coal Ltd. through our meetings with them. Significantly, they have also provided an indication of their complex social organization, which is based on a matrilineal inherited Clan and House system. The Wet'suwet'en have produced a map of their traditional lands, which indicates something of the pre-contact world of their place names, significant places, and villages. At least two communities were located near the Project area, a village at Telkwa and a trading village called *Kiil Winiits* on the shore of McDonnell Lake.

A portion of the Wet'suwet'en map covering the Project area identifies five Wet'suwet'en Clans: *Gitumden* (wolf), *Gihsehyu* (Big Frog), the *Laksilyu* (Small Frog), *Laksamisyu* (Fireweed), and *Tsayu* (Beaver). Each Clan consists of sub-units called Houses and the Wet'suwet'en names take place through each House.

Manalta Coal Ltd. has reproduced a portion of the Wet'suwet'en territorial map as Figure 12-1 to indicate where the proximity of the Telkwa Coal Project is in relation to the Wet'suwet'en traditional territories. The Project is almost entirely located in the Woos or Wolf House territory.

The Woos House is part of the Gitumden Clan (the wolf/bear). The Project Area straddles the *Dee'el Kwe* (Telkwa River). *Dee'el Kwe* formed part of a major trade route and trail system which ran from the *Wedzen Kwe* (Bulkley River) to the coast and over the pass between *Cenduuyeez Kwe* (Pine Creek) and Zymoetz River. This trade route provided a vital cultural link between the Wet'suwet'en and the Coastal tribes. On the west shore of *Sde Keen T'aat* (McDonnell Lake) was the Kiil Winiits Village, which the Wet'suwet'en say was their largest and most active village and open to other peoples as a trade centre.

The proposed Tenas Pit area is located along *Centeel Kwe* (Tenas Creek) and *Tsaynnii Kwe* (Goathorn Creek). The access road to the rail loadout follows present day Hubert Creek, which is *Ghonteel Kwe* to the Wet'suwet'en. This creek was the boundary between Woos and WahTahKwets House Chiefs. As the proposed alignment of the access road is actually south of Helps Creek, this portion of the Project area is in the territory of Chief WahTahKwets territory, which is land of the Laksilyu Clan.

At this preliminary stage, the Company understands the Clan/House Chief is responsible for these specific territorial divisions. The present day Wet'suwet'en people want this system to be respected, and mine issues dealing with Aboriginal people to be dealt with by the appropriate hereditary Chief. Manalta understands that the Telkwa Coal Project area falls in the territories of the Woos and Wahtahkwets. The Clan and chiefs of these territories will determine which Wet'suwet'en in the traditional territories will benefit from and participate in the Project.

12.2 The Inclusion of the Wet'suwet'en in the Project

The Government of British Columbia has a number of policies that ensure the inclusion of Aboriginal involvement in the Environmental Assessment Review Process. These policies also direct the proponent to consult and seek the input and involvement of Aboriginal communities in the vicinity of a proposed project.

Manalta's objective, in addition to meeting government policy objectives, is to have a project that is accepted and supported by a broad base of people in the Bulkley Valley. The Wet'suwet'en people are a major component of this population. Manalta recognizes the Wet'suwet'en have claims to historic rights stemming from centuries of life on these lands.

In developing the Telkwa Coal Project, the Company has come to understand and appreciate to a degree the aspirations of the Wet'suwet'en. They want to be recognized as the first and longest inhabitants of the Valley. They also want recognition of their claims and use of the Valley lands, and recognition of ill treatment during historic times.

The Company's objective is to reach an understanding with the Wet'suwet'en people that will define what they want and expect out of the Telkwa Coal Project. In turn, the Company will strive to achieve an agreement setting out mutual expectations and understandings.

12.3 Consultations with the Wet'suwet'en to January 1997

Manalta Coal Ltd. was introduced to representatives of the Wet'suwet'en hereditary chiefs shortly after acquiring the property from Crows Nest Resources Ltd. in 1992. The Company has subsequently held a number of meetings and functions with the Wet'suwet'en over the last five years which have given the Company an understanding of what they may expect of the Telkwa Coal Project.

The Company has received several clear messages from the Traditional Chiefs. Environmental issues are foremost. The Wet'suwet'en derive a portion of their food supply from the rivers and streams in the Bulkley Valley. The rivers are their source of life and must therefore be protected.

Manalta's understanding of the Wet'suwet'en view point is that the Wet'suwet'en are not opposed to mining in their territories. They are not opposed to economic development. What they want out of economic development is inclusion in the decision-making process and inclusion in the benefits of economic development. The Wet'suwet'en have a number of economic ventures underway such as those by the Kyah Weget society.

In discussions with Manalta, the Wet'suwet'en have indicated they will identify suitable candidates available to work in the proposed mine. They want Manalta Coal Ltd. to identify and participate in training programs necessary to bring workers who do not have adequate training up to a level sufficient to be eligible to work in mine jobs.

The Wet'suwet'en have a number of business ventures in development or underway. These will be studied to determine opportunities for contract work with the mine Project.

Manalta Coal Ltd. will be requested to do evaluations of the Telkwa coal property in terms of defining the traditional use components of the traditional lands in the Project area, including:

• Cultural and historical review

• Ceremonial and sustenance inventory

• Impact assessment and management recommendations for traditional use and resource findings.

Most of this information is presently available from the Wet'suwet'en and Manalta Coal will continue to work with the Wet'suwet'en to clarify these considerations for the Telkwa Project.

12.4 Consultation Recommended by the Environmental Assessment Office

The Environmental Assessment Office has confirmed that the Telkwa Coal Project is located within the Wet'suwet'en Nations Traditional Territories. The Office has also indicated that the Project is within the Carrier - Sekani Tribal Council's (CSTC) Traditional territories. Within the CSTC, Manalta Coal Ltd. has been advised to consult with the Broman Lake Band and the Burns Lake Band. Manalta will initiate this consultation during the Project Review.

12.5 Summary of Bands in the Region of the Telkwa Project

Table 12-1 summarizes information supplied by the Provincial Ministry of Aboriginal Affairs. This provides another perspective of regional Aboriginal interests overlapping at least part of the Telkwa Project area and surrounding lands.

Table 12-1 Native Bands or Groups in Project Region

Band	Affiliation	Historical Grouping by Language	Main Location	Recent Population
Nee-Thai-Buhn	Wet'suwet'en	Carrier	South shore Francois Lake	192
Burns Lake	Carrier-Sekani Tribal Council	Carrier	Burns Lake	73
Broman lake	Carrier-Sekani Tribal Council	Carrier	Decker Lake	144
Moricetown	Wet'suwet'en	Carrier	Moricetown	1,437

Hagwilget	Wet'suwet'en	Carrier	Hagwilget (near the Hazeltons)	575
Skin Tyee	(Band breaking from Nee-Tahai-Buhn)	Carrier	N/A	N/A

12.6 Future First Nations Consultations

This section has outlined Manalta Coal Ltd.'s current consultations with the Wet'suwet'en, and the Company's understanding of First Nations concerns regarding the Project. Manalta will continue to consult with the individual clan and house leaders who have a direct interest in the Project to ensure that all concerns are addressed.

Future First Nations consultation proposed by Manalta will include:

• Manalta will, upon invitation, meet with the Hereditary Chiefs council of the Wet'suwet'en to discuss the Project.

• Manalta will meet with the Broman Lake and Burns Lake Bands, as was recommended by the Environmental Assessment Office, to discuss details of the Project.

• Manalta proposes to hold information sessions, when requested, to provide information to all First Nations people in the vicinity of the Project area. Company representatives will provide an overview of the Project, and be available to respond to any questions.

• Manalta will continue to offer employment to the Wet'suwet'en on ongoing Project exploration programs until longer term opportunities are available upon Project Approval.

13.0 GOVERNMENT CONSULTATIONS

13.1 Pit 3 Stage ll Approval

The Telkwa Coal Project was initially started by Crows Nest Resources Ltd. (CNRL), which purchased coal licenses for the property in 1978. In 1985, CNRL submitted a development application for the Pit 3 coal reserves south of the Telkwa River.

CNRL then obtained a Stage II Approval-in-principle (currently a Project Approval Certificate) in November, 1986. The Project was placed on hold due to depressed world coal markets, but coal exploration continued during this time.

13.2 Pits 3, 7 and 8 Revisions to Stage II Approval

The addition of coal reserves north of the Telkwa River (Pit 7 & 8), improved the economics of the Project enough to justify the development of a conceptual mine plan. In March, 1990, CNRL submitted an application for a Stage II Approval under the Mine Development Review Process, covering an expanded Project plan, which included Pits 3, 7 and 8 reserves.

The major changes in the 1990 Project plan relative to the existing 1986 Stage II Approval-in-Principle were:

• Mining would start north of the Telkwa River in Pit 7 & 8, followed by Pit 3 on the south side.

• Plant infrastructure including tailings pond would be moved from the south side to the north side of the Telkwa River.

• Road access and rail spur would be located on the north side of the Telkwa River.

CNRL held open-house meetings in 1990 to present the expanded Telkwa Coal Project. Specific issues expressed during these meetings were addressed in the January, 1991 Stage II Addendum.

Manalta Coal Ltd. purchased the Telkwa coal property in May, 1992. The Company met with the review agencies to identify the outstanding issues and activities required to resolve them for approval.

13.3 Key Outstanding Issues Identified

Key outstanding issues identified in 1992 included:

• completion of additional ARD studies, and

• Conceptual Reclamation Plan

Manalta subsequently provided all information requested, excluding the finalization of additional studies related to acid rock drainage potential and reclamation planning, to a level consistent with the issuance of a Mine Development Certificate. Manalta has held ongoing discussions with the review agencies since purchasing the property, which were focused on developing an acceptable ARD materials handling plan.

The following is a brief status of the key issues as understood by Manalta Coal Ltd in March, 1994:

• Fisheries, Aquatic Resources and Surface Water Quality: The review agency required a more detailed investigation of the tailings pond discharge and receiving location, and an assessment of the potential impacts on spawning salmon due to the Pit 3 access bridge.

All technical information requested by the review agencies was provided by Manalta Coal Ltd. to a level consistent with the issuance of a Mine Development Certificate.

• Tailings Pond Management: Tailings pond management options were provided to ensure that acidic rock drainage was not produced in the long term. Other issues related to tailings pond management were considered resolvable at the permitting stage.

• Groundwater: Manalta Coal Ltd. confirmed a commitment to monitor groundwater during the operation of the mine through wells located near waste rock dumps, backfilled pits and the tailings pond.

• Wildlife Management: The Ministry of Environment, Lands and Parks accepted the conclusions and recommendations of the wildlife report, and requested that the recommendations for offsite habitat enhancement be incorporated into the conceptual reclamation plan.

• Aboriginal Issues: An ethnographic study was required to identify cultural and sustenance resources on the proposed minesite. The Company and the MEMPR would contribute toward hiring a Natural Resources Coordinator.

• Socio-Economic Concerns: An upgraded 1990 socio-economic study is required.

• Visual and Noise Impacts: Company policy keeps reclamation current with development by reclaiming disturbed areas as they become abandoned and available for revegetation.

Measures outlined in the revised socio-economic study will be taken to address noise produced at the site.

The present Application is the outcome of ongoing discussions with MEI and MELP, continuing exploration programs, and further ARD studies. Programs and commitments addressing these outstanding issues are summarized in this Application.

14.0 CORPORATE POLICIES

A number of Manalta Coal Ltd. internal policies are listed in this section. These policies outline the major principles which guide the planning and operation of the Company business. The Telkwa Coal Project will use these policies and also develop site-specific procedures in accordance with regulatory and minesite requirements.

14.1 Mission Statement

Relevant sections of the Company's Mission statement are as follows:

• *To profitably conduct the Company's operations in a safe, efficient and environmentally responsible manner.*

• *To provide superior service and products to meet the needs of our customers.*

14.2 Environmental Policy

The Company's Environmental Policy is as follows:

Manalta Coal Ltd. is committed to conducting its business affairs in an environmentally responsible manner.

To fulfil this commitment, the Company shall strive to:

• *Conduct all activities and operations, and plan development projects, in a manner that addresses environmental implications in compliance with government policy and legislation.*

• *Act appropriately to avoid and, when needed, take timely action to mitigate undesirable environmental effects arising from its activities.*

• *Encourage its employees, suppliers and contractors to increase their awareness of environmental issues and take responsibility for environmental protection.*

• *Assess and maintain environmental performance through the use of appropriate monitoring, evaluation and training programs.*

• *Implement conservation and efficiency initiatives for all resources under its control.*

• *Communicate and consult with local communities and relevant government agencies regarding the environmental implications of its activities.*

• *Encourage and support appropriate research to improve its ability to protect the environment.*

Manalta is currently building on this corporate-wide Policy to incorporate the new ISO 14000 Environmental Management System standards, reflecting each mine's environmental conditions.

ISO 14001 provides organizations with the elements of an effective environmental management system that can be integrated with other management requirements to achieve environmental and economic goals (ISO/DIS 14001, EMS - Specification with Guidance for Use, International Organization for Standardization). Two of Manalta's mines are pursuing ISO 14000 Environmental Management System (EMS) certification. Manalta will adapt the present corporate EMS elements into an ISO 14000 certified system.

14.3 Safety/Loss Policy

The Company's Safety/Loss Control Policy is as follows:

Manalta Coal Ltd. is committed to the health and safety of all its employees. We fulfil this commitment by implementing, at all our worksites, a comprehensive safety program, the objectives of which include the training of personnel in the control of:

- *accidental injury to people,*
- *damage to property, and*
- *loss to production.*

Our safety management system places emphasis on occupational health, an effective security program, and the prevention of loss due to fire and other causes.

We feel safety can be achieved through good management combined with active employee participation.

All levels of management and every employee shall follow company safety rules and regulations, as well as those legislated by government.

It is the policy of our company to perform work in a safe manner, consistent with good mining practices.

14.4 Purchasing Policy

The Company's Purchasing Policy includes the following:

The Company, in order to support the community and/or province in which a mine operation is located, shall give preference to local suppliers which provide competitive prices and quantities and which meet the Company's delivery and service requirements.

14.5 Quality Management

Manalta Coal Ltd. has a long and positive history in dealing with its customers. Relationships established with customers have been built on trust, commitment to quality and an understanding of requirements. Manalta continues to develop improved operating practices and apply sound management principles to ensure product quality is maintained at contractual specifications. The ISO series of standards has been chosen as the model the company will adopt for the development of management systems.

14.5.1 Manalta History with Quality

Quality systems, in various forms, have been in place at all Manalta coal operations since the 1980s. These systems have contributed to achieving the company internal goals of improving safety performance, reducing costs and increasing efficiency of operations.

In 1992, the Line Creek Mine became the first coal mine in the world registered under the International Organization for Standardization, ISO 9003-87. Since that time, all Manalta operations have embarked on achieving ISO certification for their particular requirements. Table 14-1 below details the current status of this initiative.

Manalta Coal Ltd. is a leader in its commitment to quality within the coal mining industry and will continue to improve its existing operating systems and procedures to ensure it remains a leader.

14.5.2 ISO 9001

ISO 9001 is a model for quality assurance when conformance to specified requirements is to be assured by the supplier during design, development, production, installation and servicing. ISO 9002 is like ISO 9001 but does not cover the design component of a product or service. ISO 9003 is only for use

Table 14-1 ISO Certification Status of Manalta Coal Ltd. Mines

Coal Mine	ISO Level	Certification Date	Description
Line Creek, BC	9003-87	Sept '92	Laboratory
	9001-87	June '94	Coal flow
	9001-94	May '95	Coal flow
Gregg River, AB	9001-94	Mar '96	Site wide
Highvale, AB	9002-94	Dec '95	Coal flow
ISO Certification in Progress			
Vesta, AB	9000-94	Dec '97	Site wide
Montgomery, AB	9000-94	Dec '97	Site wide
Utility, SK	9002-94	Dec '98	Coal flow & maintenance
Poplar River, SK	9001-94	Nov '97	Site wide
Head Office Technical Services	9001-94	Jun '97	Engineering Exploration Environmental Services Information Technology

for final inspection and testing of a product or service (ISO/DIS 9001.2, Quality Systems - Model for quality assurance in design, development, production, installation and servicing, International Organization for Standardization).

The requirements specified are aimed primarily at achieving improved quality control by preventing non-conformity at all stages from design through to servicing. A series of policies are developed to cover 20 required elements of business operations. These policies are then supported by a host of procedures that detail the actual steps taken to complete tasks and processes.

Procedures will be developed for all key operational functions (for example, waste rock dump management, water quality management). These procedures will be incorporated into the Telkwa Coal Mine to develop and continuously improve minesite work practices.

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